FINAL
REPORT

# Moffat Collection System Project
# Request for Clean Water Act
# Section 401 Water Quality Certification

*Prepared for:*

**Colorado Water Quality Control Division**

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# Acronyms

| | |
|---|---|
| µg/L | micrograms per liter |
| 401 Certification | 401 Water Quality Certification |
| AD | antidegradation |
| AF | acre-feet |
| AFY | acre-feet per year |
| APEN | Air Pollution Emission Notice |
| AWTP | Advanced Water Treatment Plant |
| BAI | baseline available increment |
| BMP | Best Management Practice |
| BWQ | baseline water quality |
| CDOT | Colorado Department of Transportation |
| CDPHE | Colorado Department of Public Health and Environment |
| cfs | cubic feet per second |
| CPW | Colorado Parks and Wildlife |
| CRCA | Colorado River Cooperative Agreement |
| CWA | Clean Water Act |
| CWC | Colorado Wildlife Commission |
| CWCB | Colorado Water Conservation Board |
| Diss | dissolved |
| Division | Colorado Water Quality Control Division |
| DLs | detection limits |
| DM | daily maximum |
| DO | dissolved oxygen |
| FEIS | Final Environmental Impact Statement |
| FERC | Federal Energy Regulatory Commission |
| FWMP | Fish and Wildlife Mitigation Plan |
| GCSMP | Grand County Stream Management Plan |
| GCWIN | Grand County Water Information Network |
| HBI | Hilsenhoff Biotic Index |
| IGA | intergovernmental agreement |
| LBD | Learn by Doing |
| ln | natural log |
| M&E | Monitoring and Evaluation |
| M&I | municipal and industrial |
| MECP | Mitigation and Enhancement Coordination Plan |
| MeHg | methylmercury |
| mg/L | milligrams per liter |
| mgd | million gallons per day |
| MMI | multi-metric index |
| Moffat Project | Moffat Collection System Project |
| MWAT | maximum weekly average temperature |
| NISP | Northern Integrated Supply Project |
| NPDES | National Pollutant Discharge Elimination System |
| PACSM | Platte and Colorado Simulation Model |
| ppm | parts per million |

| | |
|---|---|
| QA/QC | quality assurance/quality control |
| RFFAs | Reasonable Foreseeable Future Actions |
| SCT | significant concentration threshold |
| SH | State Highway |
| STORET | Storage and Retrieval |
| SWMP | Stormwater Management Plan |
| TOC | total organic carbon |
| Trec | Total Recoverable |
| TSS | total suspended solids |
| TVS | Table Value Standards |
| USACE | U.S. Army Corps of Engineers |
| USEPA | U.S. Environmental Protection Agency |
| USFS | U.S. Forest Service |
| USFWS | U.S. Fish and Wildlife Service |
| USGS | U.S. Geological Survey |
| WAT | weekly average temperature |
| WGFP | Windy Gap Firming Project |
| WISE | Water Infrastructure and Supply Efficiency |
| WQCC | Water Quality Control Commission |
| WQS | water quality standard |
| WTP | Water Treatment Plant |
| WWTP | Wastewater Treatment Plant |

# Section 1
# Introduction

The City and County of Denver, acting by and through its Board of Water Commissioners (Denver Water) is applying to the Colorado Water Quality Control Division (Division) for a Clean Water Act (CWA) 401 Water Quality Certification (401 Certification) for the Moffat Collection System Project (Moffat Project). This application is submitted in conjunction with Denver Water's applications for a CWA Section 404 Permit to be issued by the U.S. Army Corps of Engineers (USACE) and a hydropower license amendment to be issued by the Federal Energy Regulatory Commission (FERC) for the Gross Reservoir hydroelectric project (FERC Project No. 2035). This document provides the data and information required to support the 401 Certification application. This report section includes an overall Moffat Project summary, an overview of the regulatory framework associated with the 401 Certification process, and a roadmap that details the contents of the remainder of this document.

## 1.1 Project Summary

The purpose of the Moffat Project is to develop 18,000 acre-feet per year (AFY) of new, annual firm yield to the Moffat Water Treatment Plant (WTP) and raw water customers upstream of the Moffat WTP pursuant to Denver Water's commitment to its customers. Denver Water's need for the proposed Moffat Project is to address two major issues: 1) the overall near-term water supply shortage, and 2) the imbalance in water storage and supply between the North and South systems.

A Final Environmental Impact Statement (FEIS) detailing the impacts of the proposed project as well as the potential impacts of five project alternatives was filed with the U. S. Environmental Protection Agency (USEPA) on April 18, 2014. The preferred alternative, Alternative 1a (Proposed Action), is the basis of the 401 Certification application and of this report.

Denver Water's Proposed Action (Alternative 1a) is to enlarge its existing 41,811-acre foot (AF) Gross Reservoir located in Boulder County, Colorado, to 118,811 AF, increasing the reservoir's storage capacity by 77,000 AF. The additional 77,000 AF includes 72,000 AF necessary to provide the 18,000 AFY of new firm yield as well as an additional 5,000 AF of storage for use in environmental flow releases (Environmental Pool). The increased storage would be accomplished by raising the existing concrete gravity arch dam by 131 feet, from 340 to 471 feet high. The surface area of the reservoir would be expanded from approximately 418 to 842 acres, which would inundate approximately 424 acres of the surrounding shoreline.

Using existing collection infrastructure, water from the Fraser River and Williams Fork River basins would be diverted and delivered during average and wet years to Gross Reservoir via the Moffat Tunnel and South Boulder Creek. There would be no additional diversions in dry years because Denver Water can already divert the maximum amount physically and legally available under existing water rights. Existing infrastructure – including the South Boulder Diversion Canal, Ralston Reservoir, and Conduits 16 and 22 – would be used to deliver water from the expanded Gross Reservoir to the Moffat WTP and raw water customers. In most years, Denver Water would continue to rely on supplies from the North and South collection systems to meet future demands. In a drought or emergency, Denver Water would rely on the additional water it would have previously stored in the Moffat Collection System to provide the additional 18,000 AF of yield.

The Proposed Action has the potential to impact surface waters in seven major watersheds in the region as a result of changes to the timing and/or volume of water diverted into or out of each watershed (**Figure 1-1**). In general, the four impacted watersheds on the west side of the Continental Divide (Fraser River, Williams Fork, Blue River, and Upper Colorado River watersheds) will see an overall increase in water being diverted out of the basin, with flows in the Fraser River and Williams Fork watersheds being the most impacted by the project. The three impacted watersheds on the east side of the Continental Divide (South Boulder Creek, the North Fork South Platte, and the South Platte River watersheds) will receive additional diverted water and/or changes to the timing and location of the diverted water entering the watershed as a result of the Moffat Project. The most impacted watersheds on the East Slope will be the South Boulder Creek and the North Fork South Platte River watersheds.

## 1.2 Regulatory Framework

Implementation of the Proposed Action requires a CWA Section 404 Permit from USACE for the discharge of dredge and fill material and an amendment to the existing hydropower license for the Gross Reservoir hydroelectric project (FERC Project No. 2035). As part of both federal permitting processes, Denver Water must apply for and receive a 401 Certification. The Division administers the Colorado 401 Certification program, which is subject to the provisions of the Water Quality Control Commission's (WQCC) Regulation #82 (401 Certification Regulation [5 Code of Colorado Regulations (CCR) 1002-82]). This report provides the required supporting documentation to facilitate the review and approval of the application for 401 Certification submitted to the Division for the Proposed Action.

The application for 401 Certification for the Proposed Action must include the following required submittals, per Section 82.4 of the 401 Certification Regulation:

1. A signed copy of the CWA Section 404 Permit application delivered to USACE.
2. A map of the project location and a site plan.
3. A listing of the selected Best Management Practices (BMPs) chosen for the project.

Following application submission, the Division will review the proposed project and make a determination to certify, conditionally certify, or deny certification of the project. In determining whether to issue certification, the Division will consider the application as well as the following, as appropriate (Section 82.5 of the 401 Certification Regulation):

*A. Antidegradation review pursuant to the procedures in the Procedural Rules, Regulation No. 21, (5 CCR 1002-21), section 21.16.*

*B. The Basic Standards and Methodologies for Surface Water Regulation No. 31 (5 CCR 1002-31), and the Basic Standards for Ground Water Regulation No. 41 (5 CCR 1002-41).*

*C. Classifications and water quality standards assigned to the waters affected by the project for which a federal license or permit is required.*

*D. Any applicable effluent limitations or control regulations.*

*E. BMPs required by this regulation in subsection 82.6(B).*

F. *The stormwater discharge provisions of the Colorado Discharge Permit System, Regulation No. 61 (5 CCR 1002-61).*

G. *Comments and other information raised during the public comment period outlined in subsection 82.5(B).*

H. *Any project specific conditions proposed by the applicant and agreed to by the Division, including any condition beyond the authority of the Division to require.*

This report provides project-relevant supporting documentation for the Division's use during consideration of the above factors; in particular, the required antidegradation (AD) review, review of applicable water quality standards and regulations, and review of BMPs required in Regulation 82 subsection 82.6(B).

The AD and water quality standards review materials included in this report provide an analysis of all potential impacts to water quality that may result from the full extent of the projected hydrologic effects of the Proposed Action and all Reasonable Foreseeable Future Actions (RFFAs), as described in Section 2. Also provided in this report is a detailed discussion of the proposed Moffat Project mitigation and enhancement projects as well as discussion of the net environmental benefits expected to result from project implementation. Section 1.3 provides a complete summary of the information contained herein to support the Moffat Project 401 Certification application.

## 1.3 Document Roadmap

The remaining sections of this report contain the following information:

- **Section 2 – Summary of Hydrological Effects:** The anticipated hydrological effects of the Proposed Action plus RFFAs form the basis of the AD review and are described on a watershed-by-watershed basis in this section. Subsections include:
  - **2.1 – Proposed Action:** Describes the Proposed Action.
  - **2.2 – Study Area:** Describes each of the watersheds included in the project Study Area.
  - **2.3 – Cumulative Effects:** Summarizes the hydrologic effects of the Proposed Action, combined with the potential effects of all RFFAs on a watershed-by-watershed basis. This section includes details from the FEIS regarding the expected changes in the volume and timing of diversions to or from each basin that are expected when the Moffat Project is fully utilized.
  - **2.4 – Discussion:** Describes the hydrologic effects discussed previously with a link to the FEIS for a more complete description of the total project effects.
- **Section 3 – Moffat Project Antidegradation Review Methodology:** The methodology employed for the water quality and AD review process is discussed in this section of the report. This section also includes detailed information regarding the regulatory framework for the AD review process, specifically in regards to the AD provisions for Colorado surface waters (Section 31.8 of The Basic Standards and Methodologies for Surface Waters [Regulation No. 31, 5 CCR 1002-31]). Subsections include.

- **3.1 – Parameters of Concern Identification:** Describes the process to identify the parameters of concern to be assessed in the Moffat Project water quality review.
- **3.2 – Colorado Water Quality Standards:** Presents the applicable water quality standards for each parameter of concern in each waterbody.
- **3.3 – Baseline Conditions:** Establishes the basis for determining baseline conditions for the AD review for the Proposed Action. This subsection includes the methodology to determine the baseline low-flow pollutant concentration for use in AD review calculations (taking into account data limitations) and identifies representative sites for AD review.
- **3.4 – Baseline Available Increment:** Defines the baseline available increment (BAI) and the mathematical formula for calculating BAI.
- **3.5 – Future Conditions:** Explains the water quality modeling process used to project future conditions at representative water quality sites. This subsection includes discussion of the primary source of future flow projections, the Platte and Colorado Simulation Model (PACSM), as well as the mathematical basis of the mass-balance calculations used to estimate future conditions for the water quality review process.
- **3.6 – Significance Determination:** Provides the methodology for completing the significance determination evaluation in each watershed.

- **Section 4 – Moffat Project Water Quality and Antidegradation Review Results:** Provides basin-by-basin results of the outcome of the methodologies and analyses described in Section 3. This section includes a subsection for each of the seven watersheds potentially impacted by the Proposed Action.
- **Section 5 – Mitigation and Environmental Enhancement Commitments:** Provides a basin-by-basin summary of Denver Water's current commitments for mitigation and environmental enhancements related to the Proposed Action. This section also includes a summary of the BMPs that will be implemented during and following construction of the Proposed Action to reduce erosion, protect water quality, manage invasive species, suppress dust and noise, re-vegetate disturbed areas, and protect or avoid important wildlife habitat.
- **Section 6 – Conclusions:** Provides the document conclusion and a summary of the overall net environmental impacts of the Proposed Action.
- **Section 7 – Necessity of Determination Analysis:** Provides a discussion of the important social and economic benefits of the Proposed Action.
- **Section 8 – References**

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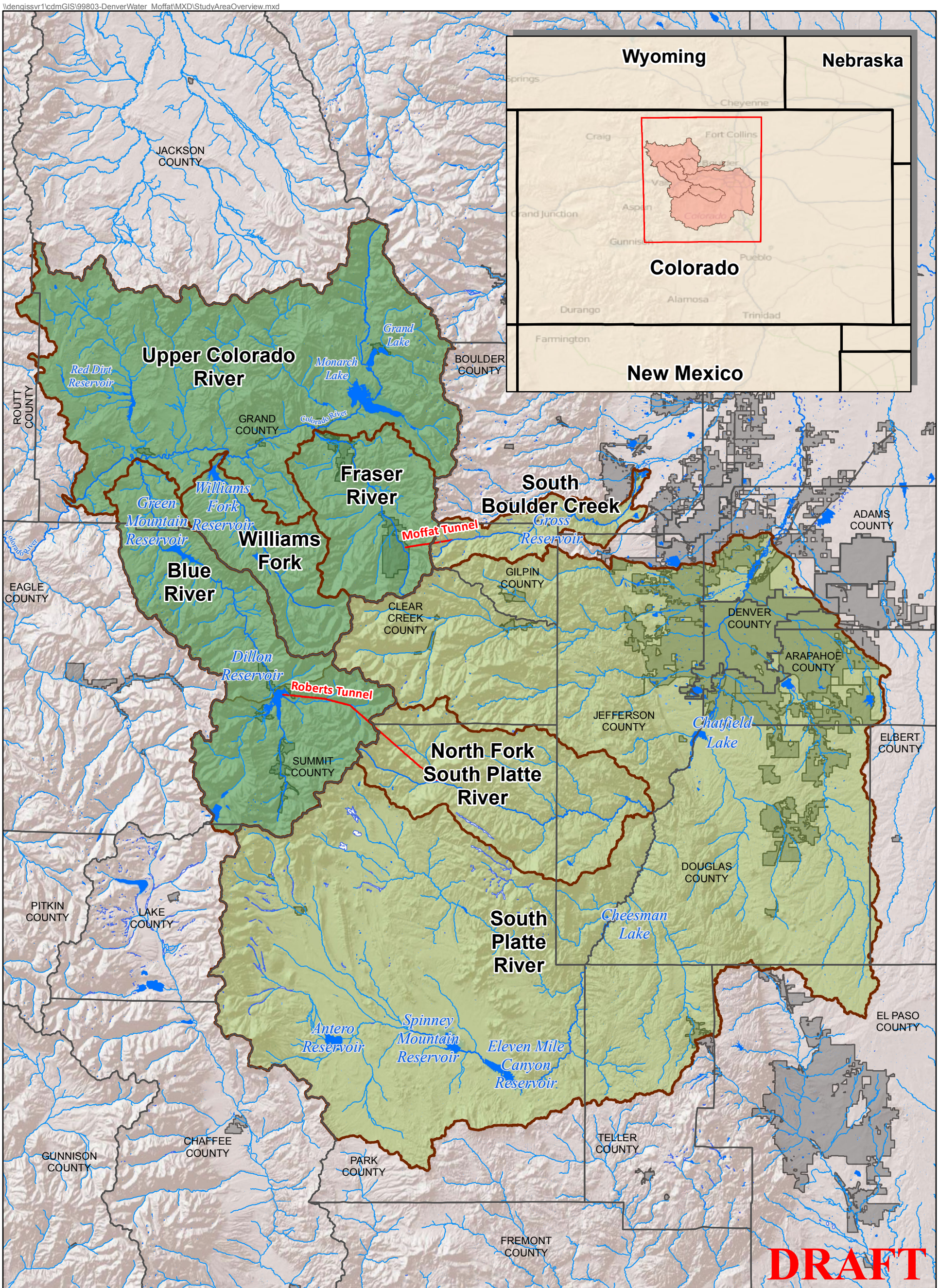


**Figure 1-1**
**Moffat Project**
**Study Area Overview**
(March 2015)

# Section 2

# Summary of Hydrological Effects

The purpose of the Moffat Project is to develop 18,000 AFY of new, annual firm yield to the Moffat WTP and raw water customers upstream of the Moffat WTP pursuant to Denver Water's commitment to its customers. Denver Water's need for the proposed Moffat Project is to address two major issues: 1) the overall near-term water supply shortage, and 2) the imbalance in water storage and supply between the North and South systems.

The FEIS analyzed in detail six alternatives for the Moffat Project. **Table 2-1** provides a summary of each of the alternatives; listed below (refer to Chapter 2 of the FEIS for detailed descriptions of each alternative).

1. Alternative 1a (referred to throughout this document as the Proposed Action) – Gross Reservoir Expansion (additional 72,000 AF).
2. Alternative 1c – Gross Reservoir Expansion (additional 40,700 AF)/New Leyden Gulch Reservoir (31,300 AF).
3. Alternative 8a – Gross Reservoir Expansion (additional 52,000 AF)/Reusable Return Flows/Gravel Pit Storage (5,000 AF).
4. Alternative 10a – Gross Reservoir Expansion (additional 52,000 AF)/Reusable Return Flows/ Denver Basin Aquifer Storage (20,000 AF).
5. Alternative 13a – Gross Reservoir Expansion (additional 60,000 AF)/Transfer of Agricultural Water Rights/Gravel Pit Storage (3,625 AF).
6. No Action Alternative, which assumes that Denver Water would not receive approval from USACE to implement the Moffat Project.

**Table 2-1. Summary of Alternatives Analyzed in the Moffat Collection System Project FEIS**

| Alternatives | Description |
|---|---|
| **Proposed Action (Alternative 1a)** | **Major Components:** Expansion of existing Gross Reservoir.<br>**Water Supply:** 18,000 AFY of new firm yield would be developed, in part, by storing additional water in Gross Reservoir diverted from the Fraser and Williams Fork rivers (using the Moffat Tunnel) and South Boulder Creek in wet and average years.<br>**Water Storage:** Expanded Gross Reservoir with an Environmental Pool for mitigation: dam raise of 131 feet (including 6 feet for the Environmental Pool), and additional storage capacity of 77,000 AF (including the 5,000 AF for the Environmental Pool). |

**Table 2-1. Summary of Alternatives Analyzed in the Moffat Collection System Project FEIS**

| Alternatives | Description |
|---|---|
| **Alternative 1c** | **Major Components:** Expansion of existing Gross Reservoir; construction of new Leyden Gulch Reservoir.<br>**Water Supply:** 18,000 AFY of new firm yield would be developed, in part, by storing additional water in Gross and Leyden Gulch reservoirs diverted from the Fraser and Williams Fork rivers (using the Moffat Tunnel) and South Boulder Creek in wet and average years.<br>**Water Storage:** Expanded Gross Reservoir: dam raise of 85 feet; additional storage capacity of 40,700 AF.<br>New Leyden Gulch Reservoir: new 177-foot high earth-filled dam; new storage volume of 31,000 AF.<br>**General:** Construction of a new Leyden Gulch Reservoir would require a 1-mile relocation of the existing South Boulder Diversion Canal, and relocation of approximately 4,000 feet of State Highway (SH) 93. |
| **Alternative 8a** | **Major Components:** Expansion of existing Gross Reservoir; new diversion structure and gravel pit storage facilities along the South Platte River. New Advanced Water Treatment Plant (AWTP) and new conduit from the AWTP to the Moffat Collection System.<br>**Water Supply:** 13,000 AFY of new firm yield would be developed, in part, by storing additional water in Gross Reservoir diverted from the Fraser and Williams Fork rivers (using the Moffat Tunnel) and South Boulder Creek in wet and average years.<br>Approximately 5,000 AFY of new firm yield from reusable return flows in the South Platte River.<br>**Water Storage:** Expanded Gross Reservoir: dam raise of 101 feet; additional storage capacity of 52,000 AF.<br>Gravel pit storage facilities along the South Platte River with a storage volume of approximately 5,000 AF.<br>**General:** Alternative 8a would require construction of a new major diversion in the South Platte River; the 36-inch pipeline from the AWTP to the Moffat Collection System would be approximately 26 miles long. |
| **Alternative 10a** | **Major Components:** Expansion of existing Gross Reservoir; new AWTP, pipelines, and approximately 81 new injection/recovery wells located at 27 separate sites to be used for deep aquifer storage and recovery of reusable return flow.<br>**Water Supply:** 13,000 AFY of new firm yield would be developed, in part, by storing additional water in Gross Reservoir diverted from the Fraser and Williams Fork rivers (using the Moffat Tunnel) and South Boulder Creek in wet and average years.<br>Approximately 5,000 AFY of new firm yield of reusable return flow from the existing Denver Recycling Plant.<br>**Water Storage:** Expanded Gross Reservoir: dam raise of 101 feet; additional storage capacity of 52,000 AF.<br>Deep aquifer storage and recovery of approximately 20,000 AF (5,000 AF of firm yield) of reusable return flows.<br>**General:** Construction of injection/recovery wells at 27 separate sites would require approximately 36 miles of new pipelines and a new 18 mile long, 36-inch pipeline from the AWTP to the Moffat Collection System. |

**Table 2-1. Summary of Alternatives Analyzed in the Moffat Collection System Project FEIS**

| Alternatives | Description |
|---|---|
| **Alternative 13a** | **Major Components:** Expansion of existing Gross Reservoir; purchase and transfer of existing South Platte River agricultural water rights stored in gravel pit storage facilities; new AWTP and new conduit from the AWTP to the Moffat Collection System.<br>**Water Supply:** 15,000 AFY of new firm yield would be developed, in part, by storing additional water in Gross Reservoir diverted from the Fraser and Williams Fork rivers (using the Moffat Tunnel) and South Boulder Creek in wet and average years.<br>Purchase and transfer of South Platte River existing agricultural water rights to supply 3,000 AFY of new firm yield.<br>**Water Storage:** Expanded Gross Reservoir: dam raise of 110 feet; additional storage capacity of 60,000 AF.<br>Gravel pit storage facilities along the South Platte River with a storage volume of approximately 3,625 AF (to produce 3,000 AFY of firm yield).<br>**General:** Alternative 13a would require construction of a new major diversion in the South Platte River; the 30-inch diameter pipeline from the AWTP to the Moffat Collection System would be approximately 25 miles long. |
| **No Action Alternative** | In the event a Section 404 Permit is not issued for the Moffat Project, Denver Water would continue to develop and implement its conservation, non-potable recycling, system refinements, and cooperative action projects as described in the 2002 IRP. It is assumed that even with these measures, demand would exceed supply in the near future (currently estimated to be around 2022).<br>Denver Water would use a variety of strategies to meet the need for additional supply, including using a portion of the Strategic Water Reserve and imposing more frequent and severe mandatory water restrictions. |

A separate alternatives analysis was not performed for the purposes of the 401 Certification and instead relies upon the alternative screening process conducted by USACE for the FEIS and Section 404 Permit application. The screening process was conducted by the Corps, with review and input from USEPA and FERC as cooperating agencies and from Grand County as a Consulting Agency. A summary of the overall process is provided here. Refer to Chapter 2 of the FEIS for a detailed discussion. The alternatives screening approach was conducted in two phases – Screen 1 and Screen 2. Screen 1 progressed from a broad range of 303 potential water supply and infrastructure components to 34 well-defined project alternatives using numerous evaluation criteria related to Purpose and Need, existing technology, logistics, costs, and environmental consequences.

Screen 2 involved a more in-depth analysis of the alternatives using criteria focused on environmental impacts to the aquatic environment and other natural ecosystems. The results of Screen 2 were a set of five action alternatives, and the No Action Alternative, carried forward for further analysis in the EIS. The five action alternatives represent a reasonable range of practicable alternatives that encompass a variety of potential water supplies and storage sites, and increase the firm yield of Denver Water's system by 18,000 AFY, consistent with the Purpose and Need. This 401 Certification application focuses on water quality assessments for the Proposed Action (Alternative 1a).

Beyond the direct impacts of each project alternative, the FEIS also includes an assessment of impacts caused by all RFFAs taken by other federal and non-federal agencies. RFFAs include, but are not limited to, foreseeable changes to local municipal water use, all additional water supply projects impacting the area, and changes to water rights. The time scale for cumulative effects of project alternatives and all RFFAs that are discussed in the FEIS reflect hydrologic conditions when the Proposed Action is completed and in full use in 2032.

The water-based RFFAs on the East and West Slopes that were considered in the evaluation of cumulative hydrologic effects include the following (refer to Chapter 4 of the FEIS for a discussion of each RFFA).

*East Slope*

- Halligan-Seaman Water Supply Project
- Northern Integrated Supply Project (NISP)
- Denver Water Reuse Project
- City of Aurora Prairie Waters Project
- Rueter-Hess Reservoir
- Dry Creek Reservoir Project
- Chatfield Reservoir Storage Reallocation Project
- Augmentation of Lower South Platte Wells
- East Cherry Creek Valley Project
- Cache la Poudre Flood Reduction and Ecosystem Restoration Project
- Water Infrastructure and Supply Efficiency (WISE)

*West Slope*

- Windy Gap Firming Project (WGFP)
- Urban Growth in Grand and Summit Counties
- Reduction of Xcel Energy's Shoshone Power Plant Call
- Changes in Releases from Williams Fork and Wolford Mountain Reservoirs to Meet U.S. Fish and Wildlife Service (USFWS) Flow Recommendations for Endangered Fish in the 15-Mile Reach
- Wolford Mountain Reservoir Contract Demand
- Expiration of Denver Water's Contract with Big Lake Ditch in 2013
- Colorado Springs Utilities' Substitution and Power Interference Agreements at Green Mountain Reservoir
- 10,825 Water Supply Alternatives
- Colorado River Cooperative Agreement (CRCA)
- Fish and Wildlife Enhancement Plan

## 2.1 Proposed Action

Denver Water's Proposed Action (Alternative 1a) is to enlarge its existing 41,811-AF Gross Reservoir, which is located in Boulder County, Colorado approximately 35 miles northwest of Denver and 6 miles southwest of the City of Boulder. The Proposed Action is to expand the existing reservoir by 72,000 AF. In addition, for environmental mitigation purposes, Denver Water is proposing to raise the dam an additional 6 feet, for a total dam height of 471 feet, in order to store an additional 5,000 AF of water in Gross Reservoir for use in environmental flow releases for enhancement of aquatic habitat downstream in South Boulder Creek. This additional storage is identified in the FEIS as the "Environmental Pool," and would be filled with water provided by the cities of Boulder and Lafayette, and release of this water would be managed under an intergovernmental agreement (IGA) between Denver Water and the two cities.

The total storage capacity of the expanded Gross Reservoir would be 118,811 AF. The surface area of the reservoir would be expanded from approximately 418 to 842 acres (refer to **Appendix D** of this application for figures displaying the components of the Proposed Action, and the conceptual plan and profile of the enlarged dam).

Using existing collection infrastructure, water from the Fraser and Williams Fork River basins would be diverted and delivered during average to wet years via the Moffat Tunnel and South Boulder Creek to Gross Reservoir. In order to firm this water supply and provide 18,000 AFY of new firm yield, an additional 72,000 AF of storage capacity is necessary. Existing infrastructure – including the South Boulder Diversion Canal, Ralston Reservoir, and Conduits 16 and 22 – would be used to deliver water from the enlarged Gross Reservoir to the Moffat WTP and raw water customers. In most years, Denver Water would continue to rely on supplies from the North and South collection systems to meet future demands. In a drought or emergency, Denver Water would rely on the additional water it would have previously stored in the Moffat Collection System to provide the additional 18,000 AF of yield. Under Current Conditions, Denver Water's average annual demand is 285,000 AF. Under the Proposed Action (full use of Denver Water's existing system plus the Moffat Project), Denver Water would have capacity to meet a future annual average demand of 363,000 AF.

## 2.2 Study Area

Although Denver Water's raw water system is not interconnected, the treated water system is. Thus, Denver Water's North and South systems operate in an integrated manner. The operational changes associated with the Proposed Action would result in operational changes in the following basins (see Figure 1-1):

- **Fraser River** – The Fraser River basin covers an area of roughly 300 square miles in Grand County, Colorado. The watershed is bounded by the Continental Divide to the south and east and elevations within the basin vary from approximately 7,900 to over 13,000 feet. Some development exists within the watershed, particularly along the mainstem of the Fraser River in the towns of Winter Park, Fraser, and Granby. A large number of diversions exist in the basin, including those that transfer water into and out of the watershed. Denver Water currently diverts water year-round from the upper Fraser River and its tributaries, including Vasquez Creek, Ranch Creek, Jim Creek, and St. Louis Creek to the east side of the Continental Divide via the Moffat Tunnel. Detailed descriptions of the watershed and the current water diversion operations within the Fraser River basin are provided in **Section 3.1.5.1** of the FEIS.

- **Williams Fork River** – The Williams Fork River flows northwest from the Continental Divide into the Colorado River. The basin is relatively long and narrow and covers a total of approximately 230 square miles. The basin is largely undeveloped and consists almost entirely of National Forest land. Water is diverted from the upper Williams Fork and its upper tributaries (Steelman Creek, Jones Creek, Bobtail Creek, and McQueary Creek) into the Fraser River basin via the Gumlick and Vasquez tunnels. Changes in quantities of diverted water impact flows in the mainstem of the Williams Fork as well as the inflow and storage within Williams Fork Reservoir. Due to the presence of a power plant located at Williams Fork Reservoir, Denver Water is required to bypass 15 cubic feet per second (cfs) or an amount equivalent to the current total reservoir inflow, whichever is less, at all times. A detailed description of the current water diversion operations within the Williams Fork River basin is provided in **Section 3.1.5.2** of the FEIS.

- **Colorado River** (from Fraser River to Kremmling) – The affected section of the Colorado River begins at the confluence with the Fraser River and continues approximately 27 miles downstream to just below the Kremmling gage. The area around the affected reach of the Colorado River is sparsely populated and minimally developed. Changes in quantities of water diverted from the Fraser, Williams Fork, and Blue River basins will alter flows in the Colorado River below the confluence with the Fraser River. Diversions operated by other entities and unrelated to the Proposed Action currently exist within the affected reach of the Colorado River and are described along with all other RFFAs in **Section 3.1.5.3** of the FEIS.

- **Blue River** – The Blue River originates on the west side of the Continental Divide near Hoosier Pass, roughly 9 miles south of Breckenridge, Colorado. The Blue River flows generally northwest, toward Dillon Reservoir and Green Mountain Reservoir, then into the Colorado River near the Town of Kremmling. The total drainage area of the basin is approximately 680 square miles and includes several municipalities (Dillon, Breckenridge, and Silverthorne) and ski areas (Copper Mountain, Keystone, Arapaho Basin, and Breckenridge) in Summit County. Water is diverted from Dillon Reservoir under the Continental Divide and into the North Fork South Platte River via the Roberts Tunnel. Water usage in the Blue River basin is complex and a number of diversions exist within the basin that are not operated by Denver Water and are not directly related to the Proposed Action. Descriptions of the current water diversion operations within the Blue River basin are provided in **Section 3.1.5.4** of the FEIS.

- **South Boulder Creek** – South Boulder Creek flows east through a relatively undeveloped area on the east side of the Continental Divide within the larger St. Vrain River watershed. The study area of the creek for this document is the reach between the East Portal of the Moffat Tunnel and the South Boulder Diversion Canal, located approximately 3 miles west of Eldorado Springs. Gross Reservoir is included within this affected reach. A detailed description of the current conditions within the affected areas of the South Boulder Creek basin is provided in **Section 3.1.5.5** of the FEIS. For purposes of the 401 Certification for the FERC-license project, as defined by FERC in the existing hydropower license, South Boulder Creek and Gross Reservoir are the waterbodies relevant to the narrower scope of the FERC's action to amend the license.

- **North Fork South Platte River** – The North Fork South Platte River originates along the east side of the Continental Divide near Kenosha Pass. It flows generally southeast through a narrow and forested river valley to its confluence with the South Platte River. The affected reach of the

North Fork South Platte begins approximately 12 miles downstream from the Continental Divide at the East Portal of Roberts Tunnel, which delivers water from Dillon Reservoir in the Blue River basin. The drainage area at the confluence with the mainstem South Platte is approximately 479 square miles. Flows within the river are generally managed by Denver Water as a result of the Roberts Tunnel discharge. There are no exports out of the North Fork South Platte River basin, and relatively little local use. A description of the current conditions within the affected areas of the North Fork South Platte basin is provided in **Section 3.1.5.6** of the FEIS.

- **South Platte River** (to Henderson) – The overall study area of the mainstem South Platte River basin extends from Antero Reservoir to Big Dry Creek near the Henderson gage. This river segment contains six mainstem reservoirs – Antero, Spinney Mountain, Eleven Mile Canyon, Cheesman, Strontia Springs, and Chatfield. The drainage area of the South Platte River at the Henderson gage is over 4,750 square miles and includes both undeveloped and highly developed lands along the base of the Front Range. A large number of water users and diversions exist within the basin, which includes the North Fork South Platte subbasin described above. A detailed description of the current conditions within the affected areas of the South Platte River basin is provided in **Section 3.1.5.7** of the FEIS.

## 2.3 Cumulative Effects

The FEIS describes, in detail, both the total environmental effects (Section 4 of the FEIS) that represent all potential cumulative effects that would result from the Moffat Collection System Project in combination with other RFFAs, as well as the specific project effects (Section 5 of the FEIS) expected as a result of the Moffat Project. The FEIS analysis includes information regarding direct and indirect impacts expected to occur as a result of implementing each of the project alternatives. Analysis of the environmental effects in the FEIS includes a wide range of social and environmental sectors:

- Surface Water/Hydrology
- Water Quality
- Channel Morphology
- Groundwater
- Geology
- Soils
- Vegetation
- Riparian and Wetland Areas
- Wildlife
- Special Status Species
- Aquatic Biological Resources
- Transportation
- Air Quality
- Noise
- Recreation
- Land Use
- Visual Resources
- Cultural/Historical/Paleontological Resources
- Socioeconomics
- Hazardous Materials

As part of the water quality review process, analysis of the future cumulative effects discussed here are limited to the hydrological and water quality impacts to surface waters as a result of implementation of the Proposed Action including all RFFAs. AD review includes the cumulative impacts of the Proposed Action and all RFFAs as a basis for comparison to baseline conditions. Descriptions of the project effects are provided on a watershed-by-watershed basis in the sections below. Project effects discussed here are limited to the hydrological impacts to surface water as these form the basis of the projected water quality impacts discussed in Sections 3 and 4 of this document. The primary source of projected hydrological effects are the outputs from the PACSM developed prior to completion of the FEIS (see **Section 4.6.1** of the FEIS). PACSM outputs include independent dry year, wet year, and average projections based on input flow values derived from historically dry years

(1954, 1955, 1963, 1977, and 1981 for the West Slope basins and 1950, 1954, 1963, 1977, and 1981 for basins on the East Slope of the Continental Divide), wet years (1952, 1962, 1983, 1984, and 1986 for the West Slope and 1949, 1970, 1973, 1983, and 1984 for the East Slope), and average runoff conditions for the entire period of record for PACSM. Summary tables of monthly changes in stream flow for select nodes were pulled from the FEIS and are available for reference in **Appendix A** of this document.

## 2.3.1 West Slope Basins

Hydrological impacts of the Proposed Action plus RFFAs to the affected watersheds on the West Slope of the Continental Divide typically consist of reduced flows under certain conditions as increases in consumed and diverted water are projected to occur. Specific impacts for each basin, as provided in the FEIS, are summarized below.

### 2.3.1.1 Fraser River

Denver Water operates 32 diversion points in the Fraser River basin, primarily diverting water from the upper reaches of the Fraser River mainstem, Jim Creek, Vasquez Creek, St. Louis Creek, and Ranch Creek. Increased storage capacity in Gross Reservoir will allow Denver Water to divert additional water from the Fraser River basin that they cannot currently capture without the additional storage capacity. Additional water demand associated with other RFFAs within the basin is expected to occur due to population growth and development, particularly in areas served by the Grand County Water and Sanitation District, the Town of Fraser, and Silver Creek Resort. As a result, decreased stream flow is expected to occur in the Fraser River and its tributaries during average and wet years. A summary of the monthly flow and changes in flow between current use and under the Proposed Action for select PACSM node locations in the Fraser River basin are provided in **Appendix A (Table A-1)**.

Additional diversions from the Fraser River basin into the Moffat Tunnel under the Proposed Action will be highly concentrated during the runoff months of May, June, and July and will be greatest during wet years following dry years. Additional reductions in flow in dry years would occur due to reductions in minimum bypass flows currently in place in some tributaries on the Fraser River basin. Under the terms of the minimum bypass flow agreement, Denver Water may reduce bypass flows when water-use restrictions are in place for its customers. An increased frequency of reductions in minimum bypass flows are predicted and incorporated into PACSM due to an anticipated increase in future water-use restrictions based on the current conditions. The increase in future water-use restrictions projected in PACSM are not related to the Moffat Project, which will likely help to mitigate the frequency and duration of future water-use restrictions. Additional diversions in late summer through early spring will be minimal except in very wet years. In most years, monthly diversions through the Moffat Tunnel will actually decrease during winter months as increased demands for snowmaking are projected.

In general, additional diversions and reductions in stream flow will increase further downstream in the mainstem Fraser River as impacts from Denver Water's diversions from Vasquez, Elk, St. Louis, and Ranch creeks combine with additional diversions to meet increased in-basin demands in the Fraser River basin. Although the overall reduction in flow rises in the downstream direction, the reductions in flow would be smaller relative to the overall stream flow. As a result, the maximum hydrological impact from the Proposed Action will occur in the upper reaches of the watershed at points immediately downstream of the diversions. Detailed information regarding projected changes in stream flow under the Proposed Action for each of the major tributaries in the Fraser River basin can be found in **Section 4.6.1.1.2** of the FEIS.

#### 2.3.1.2 Williams Fork River

Changes in flow and water storage in the Williams Fork River watershed under the Proposed Action will be due to the combined effects of several different actions beyond those directly related to the Proposed Action. The primary actions listed in the FEIS as impacting the Williams Fork River watershed include changes in scheduled releases from the Williams Fork Reservoir to meet USFWS recommendations, reductions in diverted water for irrigation purposes, increases in exchange releases from the Williams Fork Reservoir to compensate for out-of-priority use and storage in other basins, and increased diversions through the Gumlick Tunnel as part of the Proposed Action.

One RFFA unrelated to the Proposed Action discussed in the FEIS is the cessation of the current releases of approximately 5,412 AFY from the Williams Fork Reservoir to meet the USFWS recommendations for minimum flows to protect endangered fish downstream of the reservoir. The releases currently occur in late summer and fall, depending on the annual precipitation scenario, but will be discontinued due to expiration of contracts between Denver Water, the Colorado Water Conservation Board (CWCB), and the USFWS. Although the scheduled late summer and fall releases will cease, the projected future increase in storage in the Williams Fork Reservoir over winter would in some years lead to increased spillage and increased flow downstream of the dam in the spring of the following year. Changes in Williams Fork Reservoir storage and releases due to this RFFA would affect the timing of flows below the reservoir, but would have little effect on the annual quantity of flow on average.

Denver Water is currently under a temporary contract to deliver water for irrigation to Reeder Creek via the Big Lake Ditch, which would expire prior to full use of the Proposed Action in 2032. This will result in approximately 10,000 AFY of water remaining in the Williams Fork River watershed compared to the current conditions. The additional water could be captured in Williams Fork Reservoir when the reservoir rights are in priority.

The additional transbasin diversions from the Williams Fork, Fraser, and Blue River basins as part of the Proposed Action would require additional releases from the Williams Fork Reservoir to cover Denver Water's out of priority depletions. Increased substitution releases would also be required to cover the out of priority storage in Dillon Reservoir during years when Green Mountain Reservoir does not fill.

The Proposed Action will result in increased diversion from the Williams Fork River basin through the Gumlick Tunnel and ultimately through the Moffat Tunnel to help meet the projected increase in demand from 285,000 AF to 363,000 AF under the Proposed Action. Water diverted through the Gumlick Tunnel will no longer be available to augment flows downstream in the Williams Fork River watershed or to fill the Williams Fork Reservoir. Increased Gumlick Tunnel diversions would primarily occur in May, June, and July and would increase annually by 2,800 AF or 32 percent on average, 1,300 AF or 14 percent in dry years, and 2,200 AF or 34 percent in wet years.

The net result of these actions will reduce annual flows below the diversions on the Williams Fork River's four headwater tributaries (Steelman Creek, Bobtail Creek, Jones Creek, and McQuery Creek) by 31 to 37 percent in average years, 78 to 90 percent in dry years, and 11 to 14 percent in wet years. Flows in the mainstem Williams Fork River just below the headwater tributaries average annual flows would decrease by 2,800 AF or 29 percent on average, 1,300 AF or 59 percent in dry years, and 2,200 AF or 11 percent in wet years. Annual outflows from the Williams Fork Reservoir would increase by 7,200 AF or 8 percent on average, 9,100 AF or 13 percent in dry years, and 15,300 AF or 11 percent in wet years. A summary of the monthly flow and changes in flow between current use and

the Proposed Action plus RFFAs for select PACSM node locations in the Williams Fork River basin are provided in **Appendix A (Table A-2).**

#### 2.3.1.3 Upper Colorado River (from Fraser to Kremmling)

The analysis of changes in flow in the Upper Colorado River as a result of the Proposed Action and all RFFAs provided in the FEIS is limited in scope to assessments at three locations along the river – below the Windy Gap diversion, below the confluence with the Williams Fork River, and at the Kremmling gage. A summary of the monthly flow and changes in flow between current use and under the Proposed Action plus RFFAs for these PACSM node locations in the portion of the Colorado River basin above the Kremmling gage are provided in **Appendix A (Table A-3).**

The projected changes in Colorado River flows are due to a combination of the Proposed Action, the WGFP, and changes in the timing and quantities of municipal diversions. The increased diversion in the Blue, Williams Fork, and Fraser River basins as a result of the Proposed Action will lead to reductions in flows entering the Colorado River from these tributaries. Specific changes in flow for each of these tributaries are discussed separately in this report and in the FEIS.

In addition to the effects the changes in tributary flows will have on the mainstem Colorado River, the WGFP will result in 26,000 AFY of firm yield from the Colorado River through the increase in Windy Gap diversions and a reduction in spills from Granby Reservoir. Additional diversions would primarily occur during runoff months of May through July and would be greatest in wet years following dry years. In addition, municipal and industrial (M&I) diversions from the Colorado River above the Kremmling gage are projected to increase by approximately 3,200 AFY and would result in changes in return flow quantities and timing.

As a result, the change in flows in the Upper Colorado River below Windy Gap would include a decrease of 28,900 AF or 19 percent on average, 56,000 AF or 13 percent in wet years, and no significant change in flows below Windy Gap in dry years. Annual flows below the confluence with the Williams Fork River would decrease by 22,000 AF or 8 percent on average, decrease by 41,100 AF or 7 percent in wet years, and increase by 8,800 AF or 6 percent in dry years due to additional inflow from the Williams Fork River (see **Section 2.3.1.2**). Annual flows at Kremmling gage would decrease by 62,600 AF or 9 percent on average, decrease by 4,900 AF or 1 percent in dry years, and 87,900 AF or 7 percent in wet years.

#### 2.3.1.4 Blue River

The analysis of changes in flow in the Blue River as a result of the Proposed Action and all RFFAs provided in the FEIS is limited to assessments at three locations along the river – at the Roberts Tunnel diversion in Dillon Reservoir, below the Dillon Reservoir, and below Green Mountain Reservoir. A summary of the monthly flow and changes in flow between current use and under the Proposed Action plus RFFAs for these PACSM node locations in the Blue River basin are provided in **Appendix A (Table A-4).**

Changes in flow in the Blue River basin will be primarily due to the additional diversions through the Roberts Tunnel and a shift in seasonal operations and storage as part of Denver Water's Proposed Action to meet increased water demand. More water will be stored in Dillon Reservoir in winter months as the North System (Moffat WTP) operations will increase following implementation and overall supply from the East Slope will be shifted away from the South System (Foothills and Marston WTPs). Flows diverted through the Roberts Tunnel in summer will increase due to the overall higher demand. Changes in flows below Dillon Reservoir will be impacted by changes in the storage and spill

from the reservoir as a result of the Proposed Action. In addition to changes resulting from the Proposed Action, M&I diversions will increase by approximately 9,250 AFY due to development and population growth in Summit County.

Increased diversions through the Roberts Tunnel will primarily occur in June through October and will be greatest in wet years. Average annual Roberts Tunnel diversions will increase by 32,100 AF or 46 percent, 23,100 AF or 18 percent in dry years, and 25,300 or 72 percent in wet years primarily as a result of Denver Water's average annual demand increases from current conditions to full use of the existing system prior to implementation of the Proposed Action.

Flows below Dillon Reservoir are driven by changes in diversion through the Roberts Tunnel as well as increased local demand for snowmaking and municipal use. Flows will generally be lower throughout the year with the greatest reductions in flow occurring during summer months and only minor changes during winter months. Average annual outflow from Dillon Reservoir would decrease by 32,500 AF or 26 percent, 9,000 AF or 18 percent in dry years, and 31,200 AF or 13 percent in wet years.

Changes in flow below Green Mountain Reservoir will be due to the shift in operations between Denver Water's northern and southern treatment systems as well as increased demand from Denver Water, Colorado Springs, and municipalities in Summit County. Less water will be stored in Green Mountain Reservoir overall and there will be reductions in releases for power generation and demand. As a result, average annual outflow from Green Mountain Reservoir would decrease by 32,900 AF or 12 percent, 9,600 AF or 5 percent in dry years, and 38,000 AF or 8 percent in wet years.

## 2.3.2 East Slope Basins

In contrast to the projected overall reductions in instream flows seen throughout much of each basin on the West Slope, hydrological impacts of the Proposed Action to the affected watersheds on the East Slope of the Continental Divide typically consist of increased flows as increases in the quantity of water diverted to the East Slope occur. Specific impacts for each basin provided in the FEIS are summarized below.

### 2.3.2.1 South Boulder Creek

The South Boulder Creek basin receives water diverted from the West Slope via the Moffat Tunnel and includes Gross Reservoir. The analyses of changes in flow in South Boulder Creek as a result of the Proposed Action and all RFFAs provided in the FEIS is focused on three locations along the mainstem – at the Pinecliffe gage, below Gross Reservoir, and near the Eldorado Springs gage. The South Boulder Creek watershed is relatively undeveloped and the changes in flows under the Proposed Action with RFFAs would be entirely due to various aspects of the Proposed Action including the additional transbasin diversions through Moffat Tunnel, changes in storage and releases from Gross Reservoir, and increased diversions out of South Boulder Creek at the South Boulder Diversion Canal.

The Pinecliffe gage is located downstream of the Moffat Tunnel discharge and changes in flow at this location would directly reflect the Moffat Tunnel deliveries. Annual flows at the Pinecliffe gage would increase by 13,000 AF or 12 percent on average, 1,500 AF or 2 percent in dry years, and 17,900 AF or 17 percent in wet years. Increases in flow will be greatest during the runoff months (May through July) in wet years following dry years as additional water is diverted into the basin to fill the expanded Gross Reservoir. Reductions in bypass flows in the Fraser River basin as Denver Water's demands

increase from current conditions to full use of the existing system will result in flow increases above Gross Reservoir in dry years as well.

Changes in South Boulder Creek flows below Gross Reservoir will be directly impacted by the changes in Gross Reservoir storage and operations. The increase in winter operations of the Moffat WTP from 0 to 30 million gallons per day (mgd) and the transfer of water from Gross to Ralston Reservoirs will cause increased discharge from Gross Reservoir in winter months (October through April). Changes in flows below Gross Reservoir during the remainder of the year would vary based on annual hydrologic conditions. However, flows would typically decrease from May through September as the South System WTPs would meet a greater portion of the demand during these months and releases from Gross Reservoir will be reduced. Overall, annual outflow from Gross Reservoir would increase by 12,300 AF or 11 percent on average, 17,500 AF or 21 percent in dry years, and 18,600 AF or 17 percent in wet years.

Flows will generally decrease slightly in South Boulder Creek below the South Boulder Diversion Canal as Denver Water stores more water in Gross Reservoir and diverts more water via the South Boulder Diversion Canal. Additional diversions will primarily occur from May through June during wet years and annual flows at the Eldorado Springs gage would decrease by 1,300 AF or 3 percent on average, increase by 190 AF or <1 percent in dry years, and decrease by 4,800 AF or 8 percent in wet years.

A summary of the monthly flows and changes in flow between current use and under the Proposed Action for these three PACSM node locations in the South Boulder Creek basin is provided in **Appendix A (Table A-5).**

### 2.3.2.2 North Fork South Platte River

Analysis of changes in flow in the North Fork South Platte River as a result of the Proposed Action and all RFFAs is provided in the FEIS. The analysis in the FEIS is limited to an assessment of a single location on the river just below the confluence with Geneva Creek. The North Fork South Platte River receives diverted flow from the West Slope via the Roberts Tunnel and changes in flow in this basin will be due primarily to Denver Water's operational changes and overall increases in diverted flow.

Flows through the Roberts Tunnel will generally be lower during the winter months and higher during the summer months. As described in **Section 2.3.1.4**, increased diversions through the Roberts Tunnel will occur in June through October and would increase by 32,100 AF or 46 percent in average years, 23,100 AF or 18 percent in dry years, and 25,300 or 72 percent in wet years.

Changes in flows in the North Fork South Platte River below Geneva Creek are directly influenced by changes in Roberts Tunnel diversions. However, the State Engineer's Office assesses a 5 percent transit loss on Denver Water's Roberts Tunnel deliveries to the North Fork South Platte River, which is intended to offset channel losses and evaporation losses from any additional water surface area that is caused by the delivery of water along the North Fork South Platte River from the outfall of the Roberts Tunnel to the Denver Water Intake/Conduit 20. The average annual flows in the North Fork South Platte River at the Geneva Creek gage are less by the 5 percent transit loss applied to Robert Tunnel deliveries. Annual flows at the Geneva Creek gage would increase by 31,000 AF or 26 percent on average, 35,900 AF or 24 percent in dry years, and 16,800 AF or 17 percent in wet years.

A summary of the monthly flow and changes in flow between current use and under the Proposed Action for the Roberts Tunnel Diversion and for the North Fork South Platte River below the Geneva Creek gage is provided in **Appendix A (Table A-6).**

### 2.3.2.3 South Platte River (to Henderson)

The analysis of changes in flows in the South Platte River as a result of the Proposed Action and all RFFAs provided in the FEIS includes assessments at the following locations along the river – below Antero, Eleven Mile Canyon, Cheesman, and Chatfield Reservoirs, and at three U.S. Geological Survey (USGS) gages – Waterton, Denver, and Henderson.

Above the confluence with the North Fork South Platte River, changes in South Platte River flows would be influenced by the combined effects of Denver Water's increased demand level and the seasonal shift in operations between the Moffat WTP and Marston and Foothills WTPs. Since Antero and Eleven Mile Canyon Reservoirs are operated more for drought protection, there would be relatively little change in flows in the river below these reservoirs. Flow changes below Cheesman Reservoir will be highly variable depending on annual hydrologic conditions. Changes in annual outflow from Antero, Eleven Mile Canyon, and Cheesman Reservoirs are relatively minor at less than 700 AF or 1 percent on average and during wet years. Changes during dry years are more variable with increases of 610 AF or 7 percent below Antero Reservoir, increases of 1,600 AF or 2 percent below Eleven Mile Canyon, and increases of 9,300 AF or 7 percent below Cheesman Reservoir.

Flows at the South Platte River at Waterton gage, located below Cheesman Reservoir, Strontia Springs Reservoir, and Conduit 20, will be impacted due to the overall higher level of demand and the shift in seasonal operations between Denver Water's northern and southern WTPs. This shift in load will cause the timing of water moved between Strontia Springs, Chatfield, and Marston Reservoirs to change under the Proposed Action; however, the amount moved would be comparable to the current conditions. The increased diversions and exchanges with the WTPs via Conduit 20 will result in average annual flows at the Waterton gage decreasing by 14,200 AF or 13 percent, 1,000 AF or 3 percent in dry years, and 19,200 AF or 6 percent in wet years.

Due in large part to additional effluent returns at Bi-City Wastewater Treatment Plant (WWTP) and return flows accruing to the river from Denver Water's outdoor water usage as well as the changes in seasonal operations at the WTPs, the reductions in South Platte River flow at the Denver gage under the Proposed Action with RFFAs will be less than the reductions in flow upstream below Chatfield Reservoir. Average annual flows below Chatfield Reservoir would decrease by 15,300 AF or 13 percent, 1,600 AF or 7 percent in dry years, and 20,700 AF or 6 percent in wet years while flows downstream at the Denver gage will decrease by 7,900 AF or 3 percent in average years, increase by 7,300 AF or 8 percent in dry years, and decrease by 12,900 AF or 2 percent in wet years.

The reduction in flows at the Henderson gage under the Proposed Action plus RFFAs will be even less than those upstream at the Denver gage, primarily due to additional effluent returns at the Metro Wastewater Reclamation District WWTP and return flows accruing to the river due to Denver Water's additional outdoor water usage. Flows in the South Platte River during certain months (late summer) and in dry years would actually increase under the Proposed Action with RFFAs, mostly due to increases in return flows. Average annual flows at the Henderson gage would decrease by 2,400 AF or 1 percent, dry year average annual flows would increase by 6,600 AF or 5 percent, and wet year average annual flows would decrease by 8,000 AF or 1 percent.

A summary of the monthly flow and changes in flow between current use and under the Proposed Action plus RFFAs for the select locations on the South Platte River is provided in **Appendix A (Table A-7).**

## 2.4 Discussion

The FEIS provides a comprehensive set of details regarding the Moffat Project and its potential environmental impacts, along with the impacts of all other RFFAs, to watersheds on both sides of the Continental Divide. While the FEIS includes information on several of the project alternatives, the focus of this water quality impacts review document is the cumulative impacts of the Proposed Action and RFFAs. The Proposed Action includes the expansion of Gross Reservoir by 77,000 AF and a complex redistribution and expansion of water diverted across the Continental Divide. A corresponding shift in operations of Denver Water's three WTPs will result in a higher proportion of available water being directed to the North System (Moffat WTP).

The impacts of the Proposed Action and RFFAs will differ for each of the watersheds and waterbodies involved, making the comprehensive FEIS document critical to the review process. The FEIS also provided much of the information required for the development of this water quality review document as summarized above. Further detail regarding the Proposed Action, Study Area, Project Effects, and Total Effects beyond the summary provided here can be found in the FEIS document approved by and available from the Omaha District of the USACE at: http://www.nwo.usace.army.mil/Missions/RegulatoryProgram/Colorado/EISMoffat.aspx.

# Section 3

# Moffat Project Antidegradation and Water Quality Review Methodology

This application for 401 Certification addresses potential cumulative impacts of the Proposed Action and RFFAs that may cause or contribute to an exceedance of water quality standards or affect attainment of the aquatic life use, in addition to the antidegradation review.

Antidegradation provisions for Colorado surface waters can be found in Section 31.8 of The Basic Standards and Methodologies for Surface Waters (Regulation No. 31, 5 CCR 1002-31). This section establishes varying levels of AD protection based on the designation of a surface water as an "outstanding state or national resource," "reviewable," or "use-protected" water body. The AD protection-based designation for each water body is identified in the Classifications and Numeric Standards established for each state river basin. All water bodies affected by the Proposed Action are designated as reviewable,[1] and as such, are to be "maintained and protected at their existing quality unless it is determined that allowing poorer water quality is necessary to accommodate important economic or social development in the area in which the waters are located" (Regulation 31.8(1)(b)); *see also Appendix E*.

Regulation 31.8(3) states that the AD review procedures apply to regulated activities with new or increased water quality impacts that may degrade the quality of reviewable waters. The initial step in the AD review is the "Significance Determination:"

> "The initial step in an antidegradation review shall be a determination whether the regulated activity in question is likely to result in significant degradation of reviewable waters, with respect to adopted narrative or numeric standards…This significance determination shall be made with respect to the net effect of the new or increased water quality impacts of the proposed regulated activity, taking into account any environmental benefits resulting from the regulated activity and any water quality enhancement or mitigation measures impacting the segment or segments under review, if such measures are incorporated with the proposed regulated activity" (Regulation 31.8(3)(c)).

The significance determination considers the cumulative impacts of the Proposed Action, taking into account baseline water quality (defined as the low flow pollutant concentrations representative of water quality as of September 30, 2000[2]), water quality resulting from the Proposed Action, applicable water quality standards, as well as existing and future stream flows of affected reviewable waters.

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[1] See *Classifications and Numeric Standards for Upper Colorado River Basin and North Platte River (Planning Region 12)*: Regulation No. 33 (5 CCR 1002-33); and *Classifications and Numeric Standards for South Platte River Basin, Laramie River Basin, Republican River Basin and Smoky Hill River Basin*: Regulation No. 38: (5 CCR 1002-38)

[2] See Regulation 31.8(3)(c)(ii)(B)

Regulation 31.8(3)(c) identifies the types of analyses required to make a significance determination. This regulation is supplemented by the Division's Antidegradation Significance Determination for New or Increased Water Quality Impacts Procedural Guidance (Version 1.0, December 2001) (AD Guidance). Per the AD Guidance, significance determinations are based on four tests:

- **Bioaccumulative Toxic Pollutant Test** (applies only to bioaccumulative pollutants as defined in the AD Guidance) – degradation is not significant if the new or increased pollutant loading from the project under review is less than 10 percent of the existing load and the cumulative impacts of pollutant loadings from all sources do not exceed 10 percent of the baseline total load.
- **Dilution Test** – degradation is not significant if the flow rate or volume of the new or increased discharge will be diluted by 100 to 1 at low flow.
- **Concentration Test** – degradation is not significant if the new activity consumes less than 15 percent of the BAI (see discussion in **Section 3.4**).
- **Temporary Impacts Test** – degradation is not significant if the regulated activity will result in only temporary or short-term changes in water quality.

Evaluations of potential water quality impacts from the Proposed Action have been conducted according to the general principles of the AD review requirements as outlined in Regulation 31 and the AD Guidance, to the extent they could be applied. The AD Guidance was primarily developed for application to point sources, e.g., new or expanded wastewater facility discharges, and it was not ideally suited for evaluating potential degradation that could result from the implementation of large and complex water resources projects such as the Proposed Action. The evaluation of water quality impacts from water supply projects has several characteristics that differ from evaluations of new or expanded point sources typically evaluated through Regulation 31 and the AD Guidance. First, in water supply projects, loads are shifted in space and time rather than being increased more or less continuously at one location as would occur with a typical point source. When water supply diversions are operating, they can reduce loads to one stream, while concurrently increasing loads to another stream or reservoir. Shifting loads in this manner creates the possibility that water quality may be improved at some locations while simultaneously being degraded at other locations. Water supply diversions also typically function only under moderate-to-high flow conditions, and unlike most typical point source discharges, their impacts to water quality may not be evident during low flow conditions. Thus, the traditional methodologies described in the AD Guidance required adaptations to evaluate the Proposed Action.

The remainder of this section describes the general methodology used to establish each component necessary to complete the required significance determination tests, specifically the bioaccumulative toxic pollutant and concentrations tests. Because impacts of the Proposed Action will not be temporary and the overall impacts to flow will not be less than 100 to 1, the dilution and temporary impacts tests were not applicable to this application. Where necessary, river basin-specific adjustments to the methodology were made based on available data. Any basin-specific modifications to the general methodology presented herein, and the results of significance determination tests, are presented and discussed in Section 4.

## 3.1 Parameters of Concern Identification

Identification of parameters of concern for the AD review was achieved through a multi-step process. Water quality parameters considered within the established framework for significance determinations were first restricted to those parameters for which a regulatory basis[3] for determining assimilative capacity exists. Parameters were then selected based on those that are of general concern or those that are typically used as indicators for a particular aspect of water quality (e.g., nutrients or metals).

**Table 3-1** contains a list of water quality parameters used as a starting point for the assessment of each basin. Some parameters were not assessed in basins due to limited data availability or limitations in the precision of the analytical methods used for the available water quality data (i.e., detection limits (DLs) and the number of samples within a data set that were below the DLs). Parameters identified by the Colorado WQCC on the 2012 303(d) or Monitoring and Evaluation (M&E) list for an impacted segment were also reviewed and considered as part of the AD review for that segment (**Table 3-2**).

Parameters such as pH and dissolved oxygen (DO) that exhibit strong diel variation were not included in the AD review. Water temperature was identified as a parameter of concern in the Fraser River basin and in the South Boulder Creek basin below Gross Reservoir. Water temperature in these basins was evaluated either under a separate study with parameter-specific analytical procedures, or as part of an evaluation of compliance with a narrative water quality standard. The results of the temperature analyses are available in separate reports[4] and are generally summarized in Section 4 of this document. Additionally, potential impacts to aquatic life were reviewed through available multi-metric index (MMI) data in each basin. Results of the MMI data review are also presented in Section 4 of this document. Since antidegradation does not apply to the analysis of the aquatic life use, this analysis will focus on whether the use is protected and the potential for the Proposed Action to affect the protection of the aquatic life use as measured by the MMI.

**Table 3-1. Water Quality Parameters Used for Assessment of Impacts**

| Parameter | Indicator Group | Use |
|---|---|---|
| Total Phosphorus | Nutrient | Aquatic Life |
| Total Nitrogen | Nutrient | Aquatic Life |
| Manganese (diss) | Metals | Water Supply |
| Iron (diss) | Metals | Water Supply |
| Iron (Trec) | Metals | Aquatic Life |
| Selenium (diss) | Metals | Aquatic Life |
| Zinc (diss) | Metals | Aquatic Life |
| Lead (diss) | Metals | Aquatic Life |
| Copper (diss) | Metals | Aquatic Life |
| Sulfate | Other | Water Supply |
| Chloride | Other | Water Supply |

Trec = Total Recoverable
Diss = dissolved

[3] In this context, "regulatory basis" means that a water quality standard has been adopted in the segment (Regulation 33 or 38) or a criterion or interim value exists in the Basic Standards (Regulation 31).
[4] Final Report – Fraser River Dynamic Water Temperature Model and Antidegradation Review for Temperature Impacts (Miller Ecological Consultants, Inc. 2015a and b), Narrative Temperature Standard Analysis for South Boulder Creek (CDM Smith 2015). Copies of each report are also included in Appendix B of this document.

**Table 3-2. Water Quality Parameters Identified on the M&E and 303(d) List**

| Basin | Segment | M&E | 303(d) | Comments for Water Quality Review |
|---|---|---|---|---|
| Fraser | Fraser River(Rendezvous Bridge to Hammond Ditch), Vasquez Creek | | Aquatic Life (provisional) | Documented through evaluation of MMI data |
| | Ranch Creek | | Temperature | Addressed through additional temperature study |
| | Fraser River (from Hammond Ditch to the Colorado River) | | Temperature | |
| | Fraser River (From the Town of Fraser to the confluence with the Colorado River) | Copper | | Included in list of parameters of concern for quantifying impacts |
| | Fraser River (From the Town of Tabernash to the Town of Granby) | Lead | | |
| Blue River | Blue River (From outlet of Dillon Reservoir to North Rock Creek confluence) | Aquatic Life | | Documented through evaluation of MMI data |
| South Boulder Creek | Gross Reservoir | Aquatic Life Use (Mercury –Fish Tissue) | | Considered through Bioaccumulative Toxic Pollutant Test and discussed/presented in Sections 2 and 4 |
| North Fork South Platte | Hall Valley area to Geneva Creek | | pH | Not included in quantified AD review |

## 3.2 Colorado Water Quality Standards

General water quality standards applicable to all surface waters in Colorado are found in Regulation 31. Water quality standards specific to the Fraser River, Blue River, Williams Fork, and Upper Colorado River basins are found in Regulation 33. Water quality standards specific to the South Boulder Creek, Upper South Platte River, and North Fork South Platte River basins are found in Regulation 38.

### 3.2.1 Water Quality Standards for Parameters of Concern

**Table 3-3** presents the general water quality standards found in Regulation 31 for the parameters of concern (see Table 3-1 and Table 3-2). Segment-specific water quality standards that vary from (but supersede) the water quality standards presented in Table 3-3 are presented in each river basin's results section (Section 4). Standards for zinc, lead, and copper are calculated[5] using site-specific mean hardness data and are also included in the water quality results (Section 4).

[5] See Regulation 31.16 TVS Table III for specific equations for calculating basic water quality standards based on hardness (basin-specific equations, if any, are found in Regulations 33 or 38).

**Table 3-3. Water Quality Standards, Regulation 31, for All Surface Waters in Colorado**

| Parameter | Use | Water Quality Standard | Regulatory Reference |
|---|---|---|---|
| Total Phosphorus | Aquatic Life - cold | 110 µg/L | 31.17(b) |
| | Aquatic Life - warm | 170 µg/L | 31.17(b) |
| Total Nitrogen | Aquatic Life - cold | 1,250 µg/L | 31.17 (c) |
| | Aquatic Life - warm | 2,010 µg/L | 31.17 (c) |
| Manganese (diss) | Water Supply | 50 µg/L | 31.16(1) TVS (Table III) |
| Iron (Trec) | Aquatic Life[1] | 1,000 µg/L | 31.16(1) TVS (Table III) |
| Selenium (diss) | Aquatic Life[1] | 4.6 µg/L | 31.16(1) TVS (Table III) |
| Zinc (diss) | Aquatic Life[1] | $e^{(1.1021[\ln(hardness)]+2.2382)}$ µg/L | 31.16(1) TVS (Table III) |
| Lead (diss) | Aquatic Life[1] | $(1.46203-[(\ln(hardness)*(0.145712)])*e^{(1.273[\ln(hardness)]-4.705)}$ µg/L | 31.16(1) TVS (Table III) |
| Copper (diss) | Aquatic Life[1] | $e^{(0.8545[\ln(hardness)]-1.7428)}$ µg/L | 31.16(1) TVS (Table III) |
| Iron (diss) | Water Supply | 300 µg/L | 31.16(1) TVS (Table III) |
| Sulfate | Water Supply | 250 mg/L | 31.16(1) TVS (Table III) |
| Chloride | Water Supply | 250 mg/L | 31.16(1) TVS (Table III) |

TVS = Table Value Standards
ln = natural log
µg/L = micrograms per liter
[1] Chronic Standard

## 3.2.2 Water Quality Standards for Temperature

As stated in Section 3.1, water temperature was identified as a parameter of concern in the Fraser River basin and in the South Boulder Creek basin below Gross Reservoir. Colorado Regulations 31, 33, and 38 establish water quality standards applicable to state waters, the Fraser River and its tributaries, and South Boulder Creek, respectively. Under Regulation 33, the Fraser River and its tributaries are designated into Segments 10a (source to Rendezvous Bridge), 10b (Rendezvous Bridge to Hammond Ditch), and 10c (Hammond Ditch to the Colorado River) in the Upper Colorado River basin. South Boulder Creek from the outlet of Gross Reservoir to South Boulder Road (below the Diversion site) is designated Segment 4b in the Boulder Creek basin in Regulation 38. These segments have been assigned the Class 1 Cold Water Aquatic Life ("Aquatic Life Cold 1") beneficial use, which Regulation 31.13(1)(c)(i) defines as:

> *These are waters that (1) currently are capable of sustaining a wide variety of cold water biota, including sensitive species, or (2) could sustain such biota but for correctable water quality conditions. Waters shall be capable of sustaining such biota where physical habitat, water flows or levels, and water quality conditions result in no substantial impairment of the abundance and diversity of species.*

Regulations 33 and 38 establish narrative and numeric temperature standards applicable to the potentially impacted segments in the study area. These standards and their applicability to the Fraser River and South Boulder Creek are as follows:

- *Narrative Temperature Standard* – Regulations 33.5 and 38.5 establish the following narrative temperature standard: "*Temperature shall maintain a normal pattern of diel and seasonal fluctuations and spatial diversity with no abrupt changes and shall have no increase in temperature of a magnitude, rate, and duration deleterious to the resident aquatic life. These criteria shall not be interpreted or applied in a manner inconsistent with section 25-8-104, C.R.S.*"

- *Numeric Temperature Standard* – Regulations 33.6 and 38.6 establish waterbody-specific temperature standards for Fraser River (Segments 10a, 10b, and 10c) and South Boulder Creek (Segment 4b):
  - The WQCC has adopted specific Tier I Cold Water numeric temperature standards for Segment 10a of the Fraser River. These not to exceed acute and chronic criteria are as follows:
    a) June-September: 17.0°C (chronic); 21.7°C (acute); and
    b) October-May: 9.0°C (chronic); 13.0°C (acute).
  - The WQCC has adopted specific Tier II Cold Water numeric temperature standards for Fraser River segments 10b and 10c and for South Boulder Creek below Gross Reservoir. These not to exceed acute and chronic criteria are as follows:
    a) April – October: 18.3°C (chronic); 23.9°C (acute); and
    b) November – March: 9.0°C (chronic); 13.0°C (acute).

### 3.2.3 Mercury in Fish Tissue

The Division produced "A New Strategy for the Colorado Fish Consumption Advisory Program" in November 2010. In the document, the Division proposed eliminating the previous link between fish consumption advisories and an automatic 303(d) listing. Instead, waterbodies are now considered to have an aquatic life use impairment when the 85th percentile of fish tissue mercury is above a 0.3 parts per million (ppm) threshold. Additionally, the document states that, "a minimum of 30 fish tissue samples and 5 composite samples would be necessary to determine impairment of a waterbody. For waterbodies where the data is short of this requirement, the waterbody would be placed on the M&E List. If the sample size is between 10 and 30 and the 85th percentile is greater than 1.5 times the adopted threshold level, the waterbody would be placed on the 303(d) list based on the overwhelming evidence of impairment."

### 3.2.4 Measuring Aquatic Life Use Attainment through the Multi-Metric Index

Colorado Department of Public Health and Environment (CDPHE) Aquatic Life Policy 10-1, *Aquatic Life Use Attainment: Methodology to Determine Use Attainment for Rivers and Streams*, describes the methodology for determining, through direct measurement of the aquatic community, whether the aquatic life use is attained in rivers and streams.

CDPHE developed a MMI that is used as a macroinvertebrate bioassessment tool. The MMI is a composite of multiple pre-existing indices that are calibrated to specific aquatic community response to stressors and to specific biotypes. MMIs have been established for three biotypes defined for Colorado (mountain, transition, and plains) and are based on a determination of the reference or expected condition for waterbodies within each biotype. The separate indices used to collectively define the MMI represent categories of aquatic community characteristics including species richness and composition, functional feeding groups, mode of locomotion, and pollution tolerance. The MMI is designed to detect environmental stresses on the aquatic macroinvertebrate community. However, if an impairment finding is made based on an MMI result, the index provides no specific information regarding the cause of the impairment (e.g., a specific pollutant or habitat limitation, including flow).

Aquatic Life Policy 10-1 establishes the MMI aquatic life attainment and impairment thresholds for each biotype (**Table 3-4**). Where the MMI score does not clearly indicate attainment or impairment,

the policy establishes additional criteria specific to Class 1 and Class 2 waterbodies for use in making a final assessment decision (**Table 3-5**).

**Table 3-4. Aquatic Life Use Thresholds for MMI Scores**

| Biotype | Attainment Threshold | Impairment Threshold |
|---|---|---|
| 1. Transition | 52 | 42 |
| 2. Mountains | 50 | 42 |
| 3. Plains & Xeric | 37 | 22 |

**Table 3-5. Auxiliary Metric Thresholds for Class 1 Waters**

| Biotype | HBI[1] | Shannon Diversity Index |
|---|---|---|
| 1. Transition | <5.4 | >2.4 |
| 2. Mountains | <5.1 | >3.0 |
| 3. Plains & Xeric | <7.7 | >2.5 |

[1] Hilsenhoff Biotic Index

If the finding of impairment is made, but the cause of the impairment cannot be linked to any particular pollutant, the impairment finding is considered "provisional." In addition, per Aquatic Life Policy 10-1: "Consistent with Listing Methodology protocols, more data is not necessary to remove a segment than the amount of data used to list the segment. If one MMI score was used to list a segment, then a single, more recent, reliable and representative MMI score is sufficient to remove the segment from the 303(d) list for attainment."

Additionally, Appendix B of Policy 10-1 includes information on Standard Operating Procedures (SOPs) for sampling benthic communities. Appendix B states that "the standard index period utilized by the Division is summer to early fall, namely July 1 to October 1. This period is congruent with the central tendency of sample dates of macroinvertebrate replicates used to regionally calibrate the multimetric indices."

## 3.3 Baseline Conditions

Regulation 31 states that "the baseline low-flow pollutant concentration shall represent the water quality as of September 30, 2000" (Regulation 31.8(3)(c)(ii)(B)). Baseline conditions play a central role in AD review by establishing the level of water quality that must be protected in reviewable streams. Defining the baseline establishes the frame of reference for quantifying the assimilative capacity for each parameter evaluated (i.e., the difference between the water quality standard and the baseline concentration) that is to be maintained and protected.

The AD Guidance describes two methods for determining the baseline concentration for a parameter under critical low-flow conditions. The first method is based on characterizing ambient conditions using the 85th percentile of the available representative data; this method is a mainstay of the Division's assessment methodology. The second method uses the median concentration during low-flow conditions, where sufficient representative data are available. Application of either method relies on two assumptions:

- Higher concentrations are expected at lower flows (an inverse relationship of flow and concentration); and
- The proposed project is an essentially continuous discharge.

These assumptions work well for most point sources and they provide the basis for setting concentration limits in discharge permits. However, assuming continuous activity may not be appropriate for analysis of water quality impacts from large projects involving water management actions. For example, the operation of diversions during spring runoff would have no direct effect on concentrations during baseflow conditions, but would still have potential to use assimilative capacity at some point downstream.

AD Guidance is not available for defining baseline conditions when the potential for diminishing assimilative capacity is discontinuous and occurs outside of low-flow conditions, characteristics inherent in the Proposed Action. Yet, the obligation to maintain and protect assimilative capacity remains. For the Proposed Action, it was determined that the intent of the regulation would not be well-served by strict adherence to existing guidance for establishment of a low-flow baseline condition. Therefore, an alternative approach for defining baseline conditions was developed, as described in the following subsections. Basin-specific adjustments based on data availability and/or other considerations are detailed in Section 4.

## 3.3.1 Site Selection and Data Development

The initial effort for defining baseline conditions involved compiling the available data for each basin potentially affected by the Proposed Action. Water quality data were queried from USEPA's Storage and Retrieval (STORET) database. The STORET database contains data from a number of sources. Sources of water quality data queried from STORET for the Proposed Action basins included the Division, USGS, the Grand County Water Information Network (GCWIN), the Summit County Water Quality Committee, and River Watch. Data downloaded from STORET were supplemented with additional water quality data collected by Denver Water and other agencies. Denver Water maintains an extensive watershed sampling program to monitor water quality in its collection system. Since 2002, Denver Water has been collecting samples at approximately 32 stations in the upper Colorado, Williams Fork, Blue, North Fork South Platte and South Platte River basins.

The compiled data set for this AD review was then reviewed for completeness and correctness by the Division and was either approved or supplemented with additional data that were not available through STORET or Denver Water. The complete data set was then filtered to include only those parameters being considered under this AD review (refer to Section 3.1).

Water quality data are available from many sites in the river basins potentially impacted by the Proposed Action and the available period of record spans more than 20 years at some locations. The data sets represent the collective efforts of a number of entities, each of which collected samples to fulfill different objectives and interests. A review of the available water quality sites shows some redundancy in site selection and unevenness in temporal, spatial, and analytical coverage. In addition, available sites (for flow and water quality data) may also be affected to varying degrees by diversions, inputs, reservoir releases, etc. Given these variables, the challenge was to identify the most representative sites for analysis of potential future impacts from the Proposed Action. Consequently, the available data sets were examined carefully to determine which sites provided the best information for completing the AD review.

### 3.3.1.1 Site Selection

An initial exercise to evaluate the application of the AD review methodology for quantifying water quality impacts was piloted in the Fraser River basin. The Fraser River basin was selected due to the complexities present with regard to water diversions and data availability throughout the basin.

Development of a methodology for a complex basin with multiple diversion points would presumably be readily transferrable to the less complex basins with only a single input or diversion.

The Fraser River basin presents a very complicated AD review scenario because there are numerous diversion points in the upper basin. Assessment of impacts to each of the small tributaries is hampered by the absence of water quality data for most waterbodies. To address this lack of data, it was determined that water quality assessments should be targeted where loads could be calculated on the mainstem of the Fraser River. However, quantifying water quality impacts in the mainstem of the Fraser River is further complicated by the presence of several point sources and return flows (e.g., local municipalities) for which loads either are not known or can be expected to change in the future.

All of the above considerations led to an approach for the assessment of water quality in this basin whereby one well-studied site on the mainstem was used to determine the aggregated impact of diversions from only part of the upper basin; chiefly the upper mainstem and the Vasquez Creek basin. Impacts related to other tributaries, St Louis Creek and Ranch Creek, could not be incorporated directly due to limitations of the water quality data set.

Through the Fraser River basin pilot process, the methodology for assessing future water quality impacts in the remaining basins evolved with a focus on the "most impacted site" in each basin. The approach to the AD analysis was shaped by the expectation that the Proposed Action (plus RFFAs) will affect assimilative capacity by altering pollutant loads where additional flow is added to, or removed from, a stream. In cases like South Boulder Creek and the North Fork South Platte River, the scenario is relatively straightforward because there is just one point at which additional flow is brought into the system. Consequently, it is reasonable to expect the impact to be greatest near the outfall (the Moffat Tunnel or Roberts Tunnel, respectively), and that the impact would be diminished downstream as [unaffected] tributaries add flow. Similarly, in the case of Williams Fork, it is reasonable to expect the impact to be greatest at the site downstream of the upper tributary diversions.

The Blue River is less straightforward in that the diversion from this basin is from Dillon Reservoir and the most impacted site is in the Blue River just downstream of the Dillon Reservoir dam. Reservoirs complicate these assessments due to limited data availability and the necessity to use more complex modeling tools. Water quality data are generally less abundant for lakes than for streams and there is little information concerning the processes (e.g., sedimentation or biological uptake) that might alter concentrations between the inlet and the outlet of the reservoir. Prospects for modeling are not promising because of the mismatch of time-steps and influence of dam operations. Reservoirs have a relatively long residence time (e.g., approximately one year for Dillon Reservoir) that is not consistent with the time step implied in the mass balance impacts quantification for stream sites. Additionally, in-lake dynamic processes (e.g., settling, uptake, chemical transformations) confound the mass balance predictions. Reservoir operations will also change in other basins (Williams Fork and South Platte River basins).

With consideration of the factors presented above, the following water quality monitoring sites were selected within each major river basin for quantifying the water quality impacts of the Proposed Action for the selected parameters of concern:

- Fraser River below Vasquez Creek
- Williams Fork at Sugarloaf Campground
- South Boulder Creek below the Moffat Tunnel outfall
- North Fork South Platte above Geneva Creek

Impacts to the Blue River will be presented in a qualitative manner for reasons presented above. Although the Proposed Action will also affect portions of the South Platte River and Colorado River, sites for quantifying impacts were not selected on these rivers. The greatest impacts to the mainstem of the South Platte River are likely to occur downstream of the confluence with the North Fork South Platte River. Impacts to the North Fork South Platte are being quantified and will be lessened as flow moves down the river and meets the South Platte River. The Colorado River is far removed from the diversion points in the Fraser River and Williams Fork basins. Any potential for significant impacts will be of greater magnitude and more likely to be detected in the analyses completed for the Fraser River and Williams Fork watersheds upstream.

#### 3.3.1.2 Data Aggregation

Although the regulatory date for establishing baseline conditions is September 30, 2000, the Division recognizes that flexibility exists within the application of AD Guidance for determining an appropriate period of record for conducting the AD review for water supply projects. The usual time period for assessment of ambient conditions is 5 years, which is short enough to be relatively un-impacted by any temporal trends in water quality. In this case, however, a 5-year interval centered on the 2000 target date (1998 to 2002) often did not include enough observations to establish baseline conditions for many parameters at a given location. The decision to use data from a broader time period was driven by the following consideration: what approach would yield the most observations for the most parameters at the most sites through a reasonable amount of effort. For example, hardness data at one site might end in 2005, but dissolved metals or total nitrogen data might not have been measured before 2008. Including additional years of data results allowed for a more robust and useable data set for many locations.

In cases where data were available from sources with limited sampling frequency (USGS 09025010 in the Fraser River basin, for example) a relatively long data record (extending from 1998 to 2013) was required to build a robust data set for analysis of key parameters. While this approach resulted in a relatively robust data set, it also resulted in an increased possibility that one or more of the parameters may show an increasing or decreasing trend over time at one or more sites. The potential for water quality trends was assessed at the selected locations in each basin. Data were grouped into consecutive 5-year blocks of time such that a rolling average (hardness), median (nutrients), or 85th percentile (dissolved metals) could be plotted against time. The presence of an increasing concentration trend over time could overestimate baseline concentrations and the AD analysis could be overly-conservative resulting in an inappropriate significance determination. Parameters with a strong increasing trend at a given location were eliminated from further analysis.

In other cases, water quality data were primarily sourced from the Denver Water watershed sampling program that includes frequent and regular (typically bi-monthly) sampling at each station. Therefore, shorter periods of record were required to yield sufficient data sets. Due to issues related to elevated reporting limits and limited availability of information regarding method DLs within the Denver Water data set prior to 2006, data collected by Denver Water from 2006 to 2014 were the primary inputs at Denver Water's water quality sites. Denver Water's water quality data collected after 2006 were reported with relatively high reporting limits for several parameters (e.g., lead, selenium), but with sufficiently low DLs to allow for comparison to the instream water quality standards. Due to the relatively high reporting limits, many of the results are qualified with "J-flags," which indicate that, while the analyte was detected in a sample, the quantification of the sample concentration is not sufficiently reliable to meet laboratory quality assurance/quality control (QA/QC) requirements and some uncertainty exists as to the actual concentration of a j-flagged result. However, the it was

determined that use of j-flagged values in the water quality review calculations was justifiable in order to maintain reasonable sample sizes and allow for calculations of projected future concentrations for a wider range of the parameters of concern.

#### 3.3.1.3 Data Limitations

The available water quality data sets included a variety of analytical methodologies and a wide range of analytical precision. In a number of cases, the available data sets include high DLs relative to the typical instream concentrations and to the applicable water quality standards for a given parameter. This resulted in calculations of the baseline concentrations (median or 85th percentile) of some parameters at some locations being equal to the available DL and thus considered non-detects. High DLs and a high proportion of non-detects will result in considerable uncertainty regarding the actual assimilative capacity of a given water body for a given parameter.

In cases where the calculated baseline concentration was equivalent to the DL of a given parameter, the BAI could not be accurately calculated and a significance determination could not be made (see Section 3.4). Similarly, if the calculated median or 85th percentile concentration of a parameter in the input or diversion waters was equivalent to the DL, mass-balance concentrations could not be completed. These parameters were excluded from the AD review for a given location. Instances where these decisions were made are included in the results section (Section 4).

### 3.3.2 Calculating Baseline Concentrations

Once the AD review locations were selected and the baseline data set was completed for each river basin, ambient conditions were defined for each location following Division protocol (i.e., calculating the 85th percentile of concentrations for dissolved parameters and the median for total recoverable iron and nutrients). The results of these calculations for all basins, locations, and parameters are presented in Section 4.

## 3.4 Baseline Available Increment

The BAI is a term used in the AD Guidance and is applicable to the concentration test, which states that degradation is not significant if the new activity consumes less than 15 percent of the BAI. The BAI is the assimilative capacity available between the applicable water quality standard and the existing ambient concentration. The BAI was calculated using the following equation:

$$BAI = WQS - BWQ$$

Where:

WQS = water quality standard
BWQ = baseline water quality

## 3.5 Future Conditions

In order to assess the significance of potential changes in water quality associated with the Proposed Action, estimates must be made of future concentrations throughout the impacted basins. These future conditions are intended to be representative of the cumulative impacts of identified future changes in basin water use – inclusive of, but not limited to, the Proposed Action activities.

In this study, future concentrations were estimated using conservative mass balance calculations at key water quality monitoring locations in each basin. Modeled future flow changes, resulting from a

combination of diversions planned under the Proposed Action and changes in local municipality, or other, water use, were obtained from the Denver Water PACSM model. In cases where PACSM data sites were separated from the selected water quality monitoring sites, scaling calculations were performed to adjust the available flow values to be more representative of conditions at the selected water quality location. Tunnel input flows and known tributary flows were reviewed and compared to PACSM node data, when available, and area-ratio calculations were performed as necessary to account for differing watershed contribution area to calculate flows at water quality sites. Site-specific descriptions of where flow-scaling methodology was applied are detailed in each basin's result section. Recent historical measured water quality data (1998 to 2013) at key locations in the targeted basins were used to characterize the water quality associated with both current conditions and the projected flow changes. Modeled flow changes (scaled where appropriate, see discussion above) combined with the relevant concentration data, were used to quantify changes in load, and subsequently concentration, at specific locations based on the following mass balance equation:

$$Load_{future} = Load_{current} - \sum Load_{divout} + \sum Load_{divin} \qquad \text{Eqn 3.1}$$

where:

$Load_{future}$ = the total mass loading rate passing a specific stream location in the targeted basin (mass per unit of time) estimated for the future condition after full Proposed Action implementation,

$$Load_{current} = Q_{current} C_{current}$$

$Q_{current}$ = current (monthly) average stream flow at the calculation point,

$C_{current}$ = representative current stream concentration at the calculation point,

$\sum Load_{divout} =$ the sum of all future upstream loads leaving the basin associated with future flow changes,

$\sum Load_{divin} =$ the sum of all future upstream loads entering the basin associated with future flow changes.

Using the calculated future stream load (above), future stream concentrations can then be calculated as:

$$C_{future} = \frac{Load_{future}}{Q_{future}} \qquad \text{Eqn 3.2.}$$

Note that when the concentration of future diverted water leaving the basin is lower than the current concentration at the point of calculation, the resulting predicted concentration in the water body where the diversion occurred will *increase* (future vs. current). In contrast, when the concentration of diverted water leaving the basin is higher than the downstream point of calculation concentration, a concentration *decrease* will be predicted. The opposite is true of diverted water entering a basin: higher concentrations entering the basin result in concentration increases in the receiving stream; lower concentrations entering the basin result in receiving stream concentration decreases.

For this analysis, current concentrations ($C_{current}$) were set equal to the baseline concentrations described previously (Section 3.3). Implicit in this approach is the assumption that concentrations

have not changed significantly over time (i.e., no trends exist between the baseline analysis period and present day). As described above, this assumption was supported by trend analysis using available monitoring data.

Current and future stream flows, at specific basin locations, were set based on Denver Water PACSM modeling output. Site-specific total flow changes, due to a combination of Proposed Action impacts and projected changes in local municipal and/or industrial water use, were set equal to the difference between future and current flows, as quantified by PACSM. Further breakdown of projected flow changes was achieved using PACSM output to separate flow changes due to all other Denver Water diversions vs. changes due to non-Denver Water diversions or return flows (e.g., local municipalities). These projected flow changes were used in combination with representative concentration values to estimate future changes in mass load; i.e., the load associated with future water diversions ($Load_{divout}$, $Load_{divin}$).

Representative concentrations were set using site-specific water quality data. Attempts were made to utilize the best available data to characterize diversion water quality impacting the various calculation points. As in the calculation of current stream concentrations (Section 3.3), either 85th or 50th percentile values of the available data were used to characterize diversion water quality. The following approach was implemented depending on whether the analysis involved multiple West Slope diversion points or a single East Slope discharge point:

- For West Slope diversions (e.g., Fraser Basin), representative monitoring sites were selected to represent, separately, tributary diversion water (i.e., water diverted from small tributaries) and mainstem diversion water (i.e., water diverted from river mainstem locations). Where applicable, the two types of diversion water concentrations were combined with associated mainstem and tributary diversion water flow projections (from PACSM) and handled separately in the final mass balance calculations. Where possible, direct measurements of diversion canal water were used to characterize diversion water quality. For example, in the Fraser Basin, Fraser/Jim Canal data were used to characterize mainstem diversion water quality.

- For diversion water entering South Boulder Creek, Fraser River basin canal data were used to characterize the water quality of diversion inputs. This required calculating flow weighted average concentrations based on multiple canals contributing to the final diversion input. Flow weightings were derived from PACSM data. For the North Fork South Platte River, water quality data from Roberts Tunnel were used to characterize the water quality of diversion inputs to the basin.

- In the absence of better information, concentrations associated with changes in local municipal water use, as captured by PACSM simulations, were set equal to current concentrations at the point of calculation. Attempts to refine this approach based on specific locations of local municipalities and PACSM projections of facility water use were infeasible given the practical constraints of this study. Further details are provided in the descriptions of basin-specific analyses provided in Section 4.

Future concentrations were calculated on a monthly basis using mean monthly flow projections provided by PACSM. Water quality concentrations were not varied monthly in these calculations due to a lack of supporting data. A full set of monthly calculations were performed for each of three hydrologic scenarios: average, wet, and dry conditions. These scenarios were defined by PACSM simulations:

- Average conditions were parameterized using the full 45-year PACSM simulation period (1947-1991).
- Wet conditions were characterized using the average of selected wet years: 1952, 1962, 1983, 1984, and 1986 on the West Slope, and 1949, 1970, 1973, 1983 and 1984 on the East Slope.
- Dry conditions were characterized using selected dry years: 1954, 1955, 1963, 1977, and 1981 on the West Slope, and 1950, 1954, 1963, 1977, and 1981 on the East Slope.

It should be noted that the Proposed Action will not divert during dry years. However, the AD review was conducted for dry years to be inclusive of all potential cumulative effects of future water operations[6] (i.e., all RFFAs).

Output from the analysis described above is in the form of predicted future stream concentrations representative of cumulative basin impacts, for a range of water quality parameters and basin locations. In a subsequent step (described below), these predicted concentrations are compared to known water quality standards and baseline concentrations to make a significance determination. Additionally, the projected future concentrations are used to identify locations where water quality is expected to improve as a result of Proposed Action activities.

## 3.6 Significance Determination

The significance of future conditions was determined using the bioaccumulative toxic pollutant test (for mercury in South Boulder Creek) and the concentration test for the conservative parameters of concern in all Proposed Action basins (see Section 3.1). Additionally, impacts from changes in stream temperature were reviewed against the applicable numeric and narrative standards in the Fraser River basin and in South Boulder Creek below Gross Reservoir. Potential impacts to aquatic life were reviewed as measured by MMI.

The bioaccumulative toxic pollutant test was applied for mercury in South Boulder Creek and Gross Reservoir. In this case, a significance determination for bioaccumulative toxic pollutants was based on an assessment of the relative increase of pollutant load into the water body. Although stream water quality data for mercury in South Boulder Creek are limited, total changes in flows into Gross Reservoir were reviewed for each scenario. The degradation was determined to be significant if the annual flow changes from the Proposed Action under review was greater than 10 percent.

For the concentration test, a significant concentration threshold (SCT) was established for each parameter at each modeled location. The SCT is the level (in terms of concentration) that differentiates significant from insignificant degradation and is the baseline water quality plus 15 percent of the BAI (see Section 3.4):

$$SCT = (BAI*0.15) + BWQ$$

Where:

BAI = Baseline Available Increment

[6] Denver Water diverts during dry years. However, as compared to Full Use of the Existing System, with the Proposed Action, there will be no *additional* diversions in dry years because Denver Water diverts the maximum amount physically and legally available under its existing water rights. The availability of additional storage capacity will not result in increased diversions in dry years.

BWQ = Baseline Water Quality

The calculated SCT was compared to the modeled future conditions. Impacts were determined to be significant where the future conditions exceeded the SCT.

Impacts to water temperature in the Fraser River basin and in South Boulder Creek below Gross Reservoir have been evaluated under separate studies. These studies are available in **Appendix B** and provide details on how impacts were reviewed in terms of significance. Potential impacts to the aquatic community as measured by MMI were reviewed through available data in each basin. A discussion of potential impacts is presented in **Section 4** of this document.

## 3.7 Necessity of Degradation Determination

If a determination has been made in accordance with Regulation 31.8(3)(c) that a proposed regulated activity is likely to result in significant degradation of reviewable waters, a determination shall be made pursuant to Regulation 31.8(3)(d) as to whether the degradation is necessary to accommodate important economic or social development in the area in which the waters are located. Such determination shall be made from the facts on a case-by-case basis. Section 6 of this document analyzes in detail the "Necessity of Degradation Determination," demonstrating that the Proposed Action is in fact necessary to accommodate important economic or social development in the area in which the waters are located.

# Section 4

# Moffat Project Antidegradation and Water Quality Review Results

Results of the AD and other water quality impacts analyses for the cumulative effects of the Proposed Action and RFFAs are presented in this section and include quantified projections of future conditions to meet AD regulations as presented in Section 3. General methods are described in Section 3 and supplemented by basin-specific information throughout Section 4. Basin-specific additional parameters of concern are also included in the results. When possible, additional analyses have been completed and discussed in a quantitative manner. Where data are limited and/or reasonable estimates of future conditions cannot be predicted, a qualitative discussion of the AD and other water quality implications is included. A summary of impacts and improvements by basin is presented at the end of the section.

## 4.1 Fraser River

The Fraser River basin is located on the west side of the Continental Divide in Grand County (**Figure 4-1**). The Fraser River flows north through a drainage area of approximately 300 square miles from Berthoud Pass to the confluence with the Colorado River near the Town of Granby. Water is diverted into the Fraser River basin from the upper Williams Fork basin through the Gumlick and Vasquez Tunnels. Denver Water diverts water out of the Fraser River basin from the mainstem Fraser River and upper basin tributaries through 32 diversion points. Water is diverted through approximately 30 miles of canals, pipes, and siphons to the Moffat Tunnel. The Moffat Tunnel delivers water from the Fraser River basin to South Boulder Creek on the east side of the Continental Divide.

As presented in Section 2, future changes in flows in the basin are associated with Denver Water's increased demands and the Gross Reservoir expansion included in the Proposed Action. Additional diversions to the Moffat Tunnel will be concentrated to the months of May, June, and July during high runoff. According to the FEIS, Denver Water's average annual demand will increase from 285,000 AFY under Current Conditions (2006) to 363,000 AFY under the Proposed Action. Other flow changes in the basin will occur due to increased municipal and snowmaking diversions and changes to the timing and quantity of return flows throughout the basin.

### 4.1.1 Fraser River Quantified AD Results

As discussed in Section 3.3.1.1, the AD review methodology employed throughout this project was initially developed via an analysis focused solely on the Fraser River basin. This initial study was performed using an iterative approach. Due to the complex AD review scenario present in the Fraser River basin resulting from the multiple diversions and presence of several point sources and return flows throughout the basin, the AD review was based on an assessment of impacts at one well-studied site on the mainstem (Fraser River below Vasquez Creek), which represents the aggregated impact of diversions from the upper mainstem and the Vasquez Creek basins. Quantified mass-balance calculations were performed for selected parameters based on the available water quality data collected at USGS gage 09025010 – Fraser River below Vasquez Creek at Winter Park, and co-located

Division sampling location 12195 (**Figure 4-1**). Model outputs for PACSM site 2600 – Fraser River below Vasquez Creek served as the primary source of projected flow information.

#### 4.1.1.1 Fraser River Data Development

Existing baseline water quality data used in the mass-balance calculations for the assessment site chosen for the Fraser River were calculated from water quality data collected by the USGS at USGS gage 09025010 – the Fraser River below Vasquez Creek at Winter Park, Colorado (Figure 4-1). Water quality data for this location were supplemented where applicable by the available water quality dataset for the Division's sampling location 12195, which is co-located with the USGS site. All available water quality data for the study's parameters of concern collected at this location between 1998 and 2013 were queried for inclusion in the analyses. An insufficient number of data points were available for each parameter in the 5-year (1998 to 2002) window surrounding the regulatory baseline condition date of September 30, 2000. Therefore, an analysis of temporal trends in the data was conducted to determine if instream concentrations appear to be increasing or decreasing over time. No strong trends in the water quality data were observed and all data available from 1998 to 2013 were included in the AD analysis.

The available dataset for the Fraser River below Vasquez Creek includes approximately 188 discrete samples collected between March 1998 and August 2013. However, the parameters assessed in each sampling event were highly variable and the dataset for each of the parameters of concern range from the full 188 samples for chloride to as few as 10 results for dissolved iron. The available dataset underwent a data quality review, which resulted in the exclusion of 16 results for total phosphorus collected prior to December 1999 due to inordinately high detection limits (≥0.05 milligrams per liter [mg/L]). Insufficient data were available for total iron (0 results), dissolved manganese (3 results), dissolved selenium (4 results), and sulfate (4 results). These parameters were subsequently removed from the mass-balance calculations developed as part of the AD review for the Fraser River. Baseline water quality values for input into the mass-balance calculations were derived by using the 85th percentile of all dissolved fraction parameters and the median value for all parameters reported as a total fraction (see **Table 4-1**).

**Table 4-1. Calculated Baseline Water Quality Concentrations for the Fraser River below Vasquez Creek, the Fraser/Jim Canal, and Vasquez Creek at the Vasquez Canal Diversion Structure**

| Parameter | USGS 09025010/ WQCD 12195 Fraser River Below Vasquez Creek | WS-FR-002 Vasquez Creek at Vasquez Canal diversion | WS-FR-010 Fraser/Jim Canal at Gaging Station |
|---|---|---|---|
| Total Phosphorus (mg/L) | 0.040 | 0.005 | 0.004 |
| Total Nitrogen (mg/L) | 0.31 | No Data | No Data |
| Manganese (diss) (µg/L) | Insufficient Data | 4.0 | 7.0 |
| Iron (diss) (µg/L) | 225 | 20 | 40 |
| Iron (Trec) (µg/L) | No Data | 50 | 90 |
| Selenium (diss) (µg/L) | Insufficient Data | 0.2[1] | 0.2[1] |
| Zinc (diss) (µg/L) | 2.97 | 3.96 | 2.5 |
| Lead (diss) (µg/L) | 0.13 | 0.09 | 0.07[1] |
| Copper (diss) (µg/L) | 2.38 | 3.82 | 2.8 |
| Sulfate (mg/L) | No Data | No Data | No Data |
| Chloride (mg/L) | 15.9 | No Data | No Data |

[1] Baseline value equivalent to the analytical detection limit and not quantified, parameter eliminated from mass balance calculations.

The baseline water quality of the water diverted out of the Fraser River basin from locations above the Fraser River below Vasquez Creek AD review site was calculated from data collected at the following Denver Water monitoring locations:

- WS-FR-002 – Vasquez Creek at the Vasquez Canal Diversion
- WS-FR-010 – Fraser/Jim Canal at Gaging Station

Data from Vasquez Creek at the Vasquez Canal Diversion were used to estimate the baseline water quality characteristics of the water diverted from tributaries of the Fraser River. This location includes flows native to Vasquez Creek as well as the flows diverted into the Fraser River basin from the Williams Fork basin via the Gumlick and Vasquez Tunnels. Due to the largely undisturbed nature of the watersheds upgradient of, or diverted to this location, water quality data from WS-FR-002 are likely representative of the diverted water from tributaries throughout the Fraser River basin. Data from this location were also used to estimate the water quality of the water diverted by the local municipal water diversions currently in place in the basin. Water quality data from the Fraser/Jim Canal were used to estimate the baseline water quality of the upper mainstem Fraser River diversions.

The size of the available water quality dataset varied between the two diversion water quality monitoring locations. A total of 19 separate samples were collected from Vasquez Creek at WS-FR-002 between February 2005 and October 2013. The available dataset for the Fraser/Jim Canal was somewhat more robust with 33 to 34 separate samples collected for each parameter over the same time period. Of the parameters of concern included in the mainstem Fraser River water quality data, valid and sufficient data for all parameters except total nitrogen and chloride were included in the datasets for both of the Denver Water sites. Total nitrogen and chlorides were subsequently excluded from the mass-balance calculations for the Fraser River basin. As with other water quality data provided by Denver Water, "j-flagged" results were included in the analysis due to the elevated reporting limits inherent to the dataset (see discussion in Section 3.3). Baseline water quality values for input into the mass-balance calculations were derived by using the 85th percentile of all dissolved fraction parameters and the median value for all parameters reported as a total fraction.

Water quality data from the mainstem and diversion monitoring locations were coupled with flow data from the nearest available PACSM nodes for use in the mass-balance calculations developed to model future instream concentrations. Water quality data used for estimates of the existing municipal diversions were coupled with estimates of municipal diversion flows, which were calculated as the difference between the total mainstem flow and the sum of both tributary and mainstem diversion flows. As described in Section 3, future impacts and AD were assessed using conservative mass-balance calculations. In these calculations, future pollutant concentrations are estimated as a function of current conditions, future flow projections, and changes in diversion water loads.

#### 4.1.1.2 Fraser River Data Analysis Results

Representative baseline concentrations for the mainstem Fraser River and for the water diverted out of the Fraser River basin via the Moffat Tunnel are summarized in Table 4-1. WQSs, baseline concentrations, and SCTs for all modeled constituents in the Fraser River below Vasquez Creek, where mass-balance calculations were performed, are summarized in **Table 4-2**. Sufficient data exists for mass-balance calculations to be performed for four parameters – total phosphorus, dissolved iron, dissolved copper, and dissolved zinc. Table 4-1 shows that the concentrations of total phosphorus and dissolved iron are lower in the upper basin (Vasquez Creek and mainstem diversion) than in the mainstem Fraser River below Vasquez Creek. The opposite is true with regard to dissolved copper and zinc where concentrations in the upper basin are similar or higher than in the mainstem at the AD site.

The mass-balance calculations are available in Appendix C as an Excel spreadsheet dated September 8, 2014 (*Fraser River below Vasquez MB 09-08-14.xlsx*).

**Table 4-2. Fraser River below Vasquez Creek - Baseline Conditions and Significance Threshold**

| Parameter | Water Quality Standard (WQS) | Baseline Concentration (BWQ) | Significant Concentration Threshold (SCT)[2] |
|---|---|---|---|
| Total Phosphorus (mg/L) | 0.110 | 0.040 | 0.05 |
| Total Nitrogen (mg/L) | 1.3 | 0.31 | 0.5 |
| Manganese (diss) (µg/L) WS | 50.0 | Insufficient Data | N/A |
| Manganese (diss) (µg/L) [1] | 1,125 | Insufficient Data | N/A |
| Iron (diss) (µg/L) | 300 | 225 | 236.3 |
| Iron (Trec) (µg/L) | 1,000 | No Data | N/A |
| Selenium (diss) (µg/L) | 4.6 | Insufficient Data | N/A |
| Zinc (diss) (µg/L) [1] | 10.1 | 2.97 | 4.0 |
| Lead (diss) (µg/L) [1] | 0.71 | 0.13 | 0.22 |
| Copper (diss) (µg/L) [1] | 3.4 | 2.38 | 2.5 |
| Sulfate (mg/L) | 250 | No Data | No Data |
| Chloride (mg/L) | 250 | 15.9 | 51.0 |

WS = Water Supply Use

[1] WQS calculated using an average hardness of 31.7 mg/L at Fraser River Below Vasquez Creek

[2] SCT is calculated as SCT = [(WQS – BWQ) * 0.15] + BWQ

### 4.1.1.3 Fraser River AD Analysis Results

**Table 4-3** summarizes the results for each of the parameters analyzed through mass-balance calculations in the Fraser River basin. Erosion of assimilative capacity is predicted to be significant for the following pollutants:

- **Total Phosphorus** – the SCT for total phosphorus is exceeded during the majority of months under each hydrologic scenario. The exceptions are September in average years, May in dry years, and April and July in wet years. Phosphorus is highly sensitive to flow changes in the Fraser River basin because baseline conditions are very close to the SCT and the assumed quality of the diverted water is very high (low phosphorus concentrations). Only in the months of small increases in diverted water, or net decreases in diverted water, is the SCT not exceeded.

- **Dissolved Iron** – the SCT for dissolved iron for the protection of water supplies is predicted to be exceeded in all months under all hydrologic scenarios. The standard for dissolved iron is also predicted to be exceeded during the majority of months under each hydrologic scenario with the exception of September in average years; May in dry years; and April, July, September, and October in wet years. The dissolved iron standard is based on a secondary drinking water guideline for the aesthetic quality of drinking water.

**Table 4-3. Fraser River below Vasquez Creek SCT Exceedances**

| Parameter | Average | | | | | | | | | | | | Dry | | | | | | | | | | | | Wet | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ***Month*** | 10 | 11 | 12 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| Total P, mg/L | X | X | X | X | X | X | X | X | X | X | X | | X | X | X | X | X | X | X | | X | X | X | X | X | X | X | X | X | X | | X | X | | X | X |
| Iron (diss), µg/L (WS) | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| Copper (diss), µg/L | ↑ | ↑ | ↑ | ↑ | ↑ | ↑ | ↑ | ↑ | ↑ | ↑ | ↑ | ↑ | ↑ | ↑ | ↑ | ↑ | ↑ | ↑ | ↑ | ↑ | ↑ | ↑ | ↑ | ↑ | ↑ | ↑ | ↑ | ↑ | ↑ | ↑ | ↑ | ↑ | ↑ | | ↑ | ↑ |
| Zinc (diss), µg/L | ↑ | ↑ | ↑ | ↑ | ↑ | ↑ | | | | | | | ↑ | ↑ | ↑ | ↑ | ↑ | ↑ | ↑ | | | | | | | | ↑ | ↑ | ↑ | ↑ | | ↑ | | | | |

| | |
|---|---|
| X = | 15% of Baseline Available Increment exceeded |
| = | Contributes to an existing WQS exceedance |
| ↑ = | 15% water quality improvement |

As presented above (see Table 4-1), concentrations of total phosphorus and dissolved iron in diverted water (Denver Water and other municipalities) are low relative to baseline concentrations in the Fraser River below Vasquez Creek resulting in increased concentrations at the assessment site when increased diversions occur. No other significant adverse water quality impacts were identified for the Fraser River basin.

Additionally, water quality improvements resulting from the Proposed Action plus RFFAs that are greater than 15 percent are noted in the table with a "↑" symbol. Significant improvements to dissolved copper are predicted to occur under all months for all hydrologic scenarios with the exception of July in wet years. Dissolved zinc concentrations are also predicted to improve significantly during the following months: October through March during average years; October through April during dry years; and December through March and May of wet years.

## 4.1.2 Other Fraser River Basin Results

In addition to the findings presented above, additional areas were identified for investigation of potential cumulative impacts from the Proposed Action plus RFFAs. These areas of concern include:

- Stream Temperature in the Fraser River Basin: Denver Water and its consultant, Miller Ecological Consultants, Inc., developed a dynamic (mechanistic) stream temperature model of the Fraser River basin to simulate potential impacts from project implementation and RFFAs on stream temperatures throughout the Fraser River basin. Refer to **Section 4.1.2.1**.

- Potential impacts to the aquatic macroinvertebrate community as measured by MMI. Refer to **Section 4.1.2.2.**

### 4.1.2.1 Stream Temperature in the Fraser River Basin

Two streams in the Fraser River basin are currently on the Water Quality Control Commission's Section 303(d) List of Impaired Waters for temperature concerns: Ranch Creek and the mainstem Fraser River downstream of Hammond Ditch to the Colorado River. . Another stream tributary of the Fraser River, St. Louis Creek, has also experienced exceedances of temperature standards but is not currently on the 303(d) List of Impaired Waters due to temperature issues. The Proposed Action would increase water diversions out of the Fraser River basin resulting in lower flow rates in the mainstem of the Fraser River and its tributaries. Reductions in flow, along with other factors including air temperature, solar radiation, wind, channel geometry, and shading, contribute to increased water temperatures. A dynamic (mechanistic) stream temperature model was developed to predict temperature changes in the Fraser River under a range of flow conditions (Miller Ecological Consultants, Inc. 2015a). The model and assessment approaches were developed in close coordination with CDPHE staff. Key components of the Fraser River temperature model are summarized below.

**Geographic Extent:** The Fraser River was modeled from downstream of the Winter Park Water and Sanitation District WTP outfall to the Colorado River confluence, a distance of approximately 23 miles. This simulation covers the current 303(d) listed reach, plus approximately 4 additional miles upstream of the current listing.

The modeling results focused on three locations on the mainstem:

- Fraser River below Vasquez Creek at Rendezvous Bridge (near station 12186)
- Fraser River downstream of Crooked Creek
- Fraser River at the Colorado River confluence

**Streamflow Conditions:** The objective of modeling water temperature in the Fraser River was to assess the potential effects of three streamflow scenarios. The streamflow scenarios are:

- EIS 285 – Current Conditions – Streamflow conditions associated with Denver Water's existing system and an average demand of 285,000 AFY.
- EIS 345 – Full Use of the Existing System – Future streamflow conditions associated with Denver Water's existing system and Denver Water's projected future growth in demand to an average of 345,000 AFY. This condition also includes the addition of other RFFAs that are projected to occur.
- Alternative 1a (Alt 1a) – Cumulative Effects with Implementation of the Proposed Action plus RFFAs – Future streamflow conditions associated with Denver Water's proposed 72,000-AF enlargement of Gross Reservoir, a future average demand of 363,000 AFY, and the same RFFAs assumed in EIS 345. The only differences between Alt 1a and EIS 345 are the proposed increase in reservoir storage and an increase in demand of 18,000 AFY.

**Scenario Years:** The temperature model simulates hourly temperatures for the 5 years and months proposed by CDPHE: May 16 to October 15 of 1948, 1959, 1963, 1978, and 1987. These years were selected because they represent the critical conditions under which cumulative flow effects are greatest and temperature impacts are most likely to occur. These months were selected because these are the months when temperature exceedances have occurred in the Fraser River basin. Simulated flows for the 5 years were estimated using data from Denver Water's PACSM simulations of streamflow scenarios. A point flow model was used in conjunction with the PACSM flow data and mass balance equations to estimate streamflow at points of interest that were not available from the PACSM simulations (Wilson Water Group 2014).

**Meteorological Data:** Air temperature data from 2007 were used for each model simulation because 2007 was one of the warmest years in 63 years of temperature record (1948 through 2010). As air temperature is an important factor influencing river temperatures, combining the unusually high temperatures in the 2007 meteorological data with the 5 selected critical-conditions years may have caused the model to overestimate the temperatures, and therefore the impacts, of the various scenarios.

**Tributary Temperature Data:** The Fraser River Model requires temperature data for all inputs into the Fraser River. However, the lack of paired temperature and flow data in the tributaries limited the development of mechanistic models. Instead, empirical models were developed using available meteorological, hydrologic, and water temperature data for Vasquez, Ranch, and St. Louis creeks. The predictor variables included flow, air temperature, solar radiation, and Julian date. The empirical models were used to fill in missing temperature data from these three tributaries as well as estimate temperatures for the other tributaries that lack data (Miller Ecological Consultants, Inc. 2014a).

**Model Calibration and Validation:** The Fraser River Model was calibrated and validated against two different years of observed temperature data. The years were selected based on 1) availability of meteorological, flow, and river temperature data; and 2) variation in observed flow rates and water temperatures, including some exceedances of temperature standards, to test the model's ability to capture changes. Based on these factors, 2010 was selected as the calibration year. Once calibration was complete, the model was validated with 2007 data. The calibration and validation runs of the

model met all targets and the model is considered suitable to simulate potential changes in stream temperature (Miller Ecological Consultants, Inc. 2014b)

**State Water Temperature Standards:** The Colorado Water Quality Control Commission has adopted the acute and chronic water temperature criteria for the Fraser River to protect against negative effects to aquatic life, shown in **Table 4-4**:

**Table 4-4. State Water Temperature Standards**

| Stream Classification | Applicable Months | Temperature Standard (°C) | | Location on Fraser River Where Applied |
|---|---|---|---|---|
| | | Weekly Average Temp. (WAT) (Chronic) | Daily Maximum (DM) (Acute) | |
| Cold Stream Tier I | June – Sept. | 17.0 | 21.7 | Rendezvous Bridge (near station 12186) |
| | Oct. - May | 9.0 | 13.0 | |
| Cold Stream Tier II | April – Oct. | 18.2 | 23.8 | Below Crooked Creek; Colorado River Confluence |
| | Nov. - March | 9.0 | 13.0 | |

**Model Results:** For each scenario year, exceedances of the chronic (WAT) and acute (DM) temperature standards were counted to assess potential stream temperature effects under cumulative conditions with the Proposed Action and RFFAs (Alt 1a) compared to current conditions (EIS 285). To understand when the Proposed Action would potentially contribute to exceedances, exceedance counts for EIS 345 (cumulative conditions without the Proposed Action) and Alt 1a (Proposed Action plus RFFAs) were compared.

### *Overall Summary of the Temperature Model Results for the Fraser River Mainstem*

In general, river temperatures will be warmer under future conditions compared to current conditions. The model identified temperature exceedances under current conditions near the Town of Fraser (Rendezvous Bridge), none near the confluence with Crooked Creek, and exceedances again at the confluence with the Colorado River. Under the Proposed Action plus RFFAs, there will be additional temperature exceedances at both locations. Approximately 20 percent of the exceedances (4 days out of 20 days) at Rendezvous Bridge are attributable to the Proposed Action and none of the exceedances at the confluence with the Colorado River are attributable to the Proposed Action.

Based on the simulated conditions, the additional diversions associated with the Proposed Action will contribute to an increase in stream temperatures during certain times of year. The anticipated changes in stream temperatures will not contribute to violations of the summertime (June through September) stream temperature standards; however, in May during the shoulder season, the Proposed Action does contribute to DM temperature standard violations in the Fraser River at Rendezvous Bridge for 4 days out of the 5 years simulated.

### *Overall Summary for Fraser River Tributaries*

- Vasquez Creek – No WAT or DM exceedances were identified in any of the 5 critical years for any of the three streamflow scenarios.

- St. Louis Creek – Exceedances of the WAT and DM standards occur under current and future conditions. Under current conditions, the WAT standard is exceeded one day and the DM standard is exceeded 17 days out of the 5 years simulated. Under future cumulative conditions (Proposed Action plus RFFAs), the WAT standard continues to be exceeded one day and the DM standard is exceeded 21 days. The 4 additional days of DM temperature exceedance are due to the hydrologic conditions simulated for May 1987. In the 1987 simulation, Gross Reservoir

would begin the runoff season (May) with slightly less water under Alt1a, therefore the Proposed Action would case a larger reduction of Fraser River flows to fill the reservoir compared to current conditions.

- Ranch Creek – There are exceedances of both the WAT and DM standard under current and future conditions. Under current conditions, the WAT standard is exceeded 19 days and the DM standard is exceeded 36 days out of the 5 years simulated. Under future cumulative conditions (Proposed Action plus RFFAs), the WAT standard would be exceeded 24 days and the DM standard would be exceeded 45 days. The 5 additional days of WAT temperature exceedance and 9 additional days of DM temperature exceedance are due to the hydrologic conditions simulated for May 1987, as described under St. Louis Creek above.

Based on the simulated conditions, the additional diversions associated with the Proposed Action contribute to DM and WAT temperature standard exceedances in St. Louis and Ranch creeks. These exceedances occur in the month of May (St. Louis Creek: 5 days of DM standard exceedances and Ranch Creek: 10 days of DM and 5 days of WAT standard exceedances).

### *Antidegradation and Water Quality Impacts Review*

To support the AD and water quality review of the Fraser River, the Fraser River temperature model was used to assess how much of the available assimilative capacity would be lost in the future through operation of the Proposed Action and all RFFAs. The model was used to simulate baseline conditions for the Fraser River. Once the baseline was defined, the remaining assimilative capacity (defined as the BAI) was calculated. The BAI, which is the difference between the temperature standard and the baseline temperature, was used to determine the significance threshold for impacts. If the predicted increase in temperature exceeds 15 percent of the BAI, the result is considered a significant degradation under the AD review protocol.

The AD review focused on potential increases in stream temperatures at two locations on the Fraser River:

- Fraser River below Vasquez Creek at Rendezvous Bridge (near station 12186), the downstream boundary of the Tier I temperature standard designation
- Fraser River below the Granby Sanitation District WWTP, the closest location to the Colorado River confluence that had historical (observed) data (Tier II temperature standard)

The model was used to simulate stream temperatures for current and future conditions. The changes in temperature between current conditions (EIS 285) and future, cumulative flow scenarios (EIS 345 and Alt 1a) were compared to the assimilative capacity thresholds. Results are presented as follows:

- Excursions – The number of days the simulated *cumulative* stream temperatures (Proposed Action plus RFFAs) exceed the BAI threshold for DMs and WATs is counted. To understand the Proposed Action's potential contributions to the excursions, the differences between EIS 345 and the Proposed Action with RFFAs are also presented.
- Exceedances – The number of days the simulated *cumulative* stream temperatures (Proposed Action plus RFFAs) exceed the DM and WAT standard is counted. Similar to above, the exceedances attributable to Proposed Action's diversions are also presented. The summary of exceedances gives further context as to when excursions of the assimilative capacity threshold occur.

These specific results were simulated for the 5 scenario years – 1948, 1959, 1963, 1978, and 1987.

### *Temperature AD Review Results*

The modeling results for the 5 scenario years indicate that increases in water temperature in excess of the 15 percent available assimilative capacity will occur in the future under cumulative conditions at both locations in the Fraser River. The focus of the review is on cumulative effects, but it was also used to understand the Proposed Action's contributions to the simulated temperature increases.

- At Rendezvous Bridge, the DM and WAT excursions occur in all months (June through September) in all 5 years. The number of days simulated to have stream temperature increases greater than 15 percent of the assimilative capacity ranged from 38 to 103 days for DMs and 13 to 94 days for WATs (out of the 122 days between June 1 through September 30), depending on the year. The Proposed Action would contribute to the DM and WAT excursions primarily in June and to a limited extent in July for WAT excursions. The increases in temperature resulting in excursions result in exceedances of the DM standards for 5 days in the 1963 simulation. There were no days above the WAT standard in any of the 5 years.

- Further downstream below the Granby Sanitation District, DM and WAT excursions occur in May through August, but much less frequently than upstream at Rendezvous Bridge. The number of days simulated to have stream temperature increases greater than 15 percent of the assimilative capacity ranged from 9 to 24 days for DMs and 15 to 59 days for WATs (out of the 153 days between May 16 through October 15), depending on the year. The Proposed Action would contribute to a small portion of the DM and WAT excursions primarily in May and June and to a limited extent in July. The increases in temperature resulting in excursions that would also result in exceedances of the temperature standards would occur approximately 1 percent of the time for DM and approximately 4 percent of the time for WAT standards.

The 5 scenario years were selected from a 45-year dataset. To provide context for these years, the results were extrapolated to the 45-year dataset to understand the likelihood of the temperature excursions predicted in the 5 modeled years occurring in the future. **Tables 4-5 and 4-6** summarize the findings.

**Table 4-5. Excursions Generalized to the 45-Year Study Period Fraser River at Rendezvous Bridge June through September**

| Conditions | DM Threshold Exceeded | WAT Threshold Exceeded |
|---|---|---|
| Cumulative Conditions | 43% of time | 28% of time |
| Attributable to the Proposed Action | 0.9% of time | 2% of time |

**Table 4-6. Excursions Generalized to the 45-Year Study Period Fraser River below Granby Sanitation District Mid-May through Mid-October**

| Conditions | DM Threshold Exceeded | WAT Threshold Exceeded |
|---|---|---|
| Cumulative Conditions | 5% of time | 12% of time |
| Attributable to the Proposed Action | 1% of time | 1% of time |

## 4.1.2.2 MMI

### *Overview*

**Figure 4-1** identifies locations in this river basin where the Division has collected MMI data. **Table 4-7** summarizes available information from these findings. The table includes findings of aquatic life impairment based on MMI data in the basin; however, per the Commission, where there

have been findings of impairment based on MMI data, but no pollutant has been identified, these findings are considered "provisional."

Table 4-7 summarizes the potential impact of water diversions from the Proposed Action and RFFAs on sites where MMI data have been collected in the Fraser River basin. Where the finding is "no," this is because the site is located upstream of water diversions. In general, potential cumulative impacts from the Proposed Action and RFFAs will decrease with distance downstream of diversions, particularly in cases where unaffected tributaries make significant flow contributions to the stream between the diversion point and the MMI monitoring location.

The FEIS includes detailed findings on the total (cumulative) environmental effects of the Proposed Action and RFFAs on waterbodies within the Fraser River basin. These findings include information on specific potential impacts to aquatic communities for certain waterbodies within the basin (**Table 4-8)**. These findings are discussed below within the context of available MMI data.

### *Water Quality Impacts and MMI Scores*

The quantified findings from the AD water quality analysis for the Fraser River basin are provided above (see Table 4-3). Under each of the three hydrologic scenarios presented (average, wet, and dry years), SCT exceedances are consistently reported for two parameters – dissolved iron and total phosphorus. Conversely, modeled reductions in monthly mean concentrations of dissolved copper and dissolved zinc will provide significant benefit (i.e., a greater than 15 percent reduction in concentration) for much of the year under each flow condition scenario. Although the AD review for water quality was developed using a single location within the watershed, the location was selected to be the site within the watershed most impacted by the Proposed Action and RFFAs, and therefore it is assumed that these results can be conservatively applied to the entire basin. The potential impacts and benefits within the Fraser River basin for each of the modeled parameters and the possible relationship between these findings and MMI scores are discussed below; however, many factors influence aquatic communities and the metrics used to assess them (MMI scores) and the direct correlation between predicted changes to water quality and the impacts to MMI scores is not readily discernable.

- **Total Phosphorus -** The SCT exceedances for total phosphorus suggests there may be potential for an adverse impact to the aquatic macroinvertebrate community as a result of future elevated phosphorus concentrations. However, the maximum future total phosphorus concentration projected by the mass balance model is 0.07 mg/L, which remains well below the current WQS of 0.11 mg/L. Elevated phosphorus concentrations in a stream have the potential to impact aquatic life when they are sufficiently high as to cause an excess of algae growth. Excess algae growth impacts aquatic habitat and is often associated with extreme diel fluctuation in DO concentrations, which can include extremely low concentrations that may adversely affect aquatic organisms. However, excess algae growth is typically only an issue when nutrient levels within a waterbody exceed a threshold value, generally associated with the WQS established to protect aquatic life. Since the projected increases in total phosphorus concentrations in the Fraser River basin are not expected to raise instream concentrations to levels approaching the WQS, no adverse impact to MMI is expected.

**Table 4-7. MMI Data Results for the Fraser River Basin**

| Assessment ID or WBID | Segment | Waterbody | MMI Data | | | | | | | CDPHE Assessment 2012 | | Downstream of a Denver Water Diversion? |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Location | Bio-Type | Sample Date | MMI | HBI | SDI | MMI Assessment | 2012 Assessment | Notes/Comment | |
| COUCUC10a | Mainstem of the Fraser River from the source to a point immediately below the Rendezvous Bridge; all tributaries to Fraser River from the source to the Colorado River | Fraser River | CU-FRRR – d/s of Robber's Roost Campground | 2 | 9/9/04 | 63.6 | 4.60 | 3.11 | Attain | Provisional Impairment (pollutant not identified)- Aquatic Life - Low Priority for TMDL Development | See comment below regarding CU-FRBW | No |
| | | | 12199 – at Robber's Roost | 2 | 10/8/07 | 58.0 | 3.52 | 3.88 | Attain | | Site essentially same coordinates as CU-FRRR | No |
| | | | CU-FRBW – at Winter Park Ski Resort | 1? | 9/10/04 | 30.4 | 2.97 | 3.15 | Impair | | This site has the same coordinates as CU-FRRR; sites sampled one day apart; with different methods; based on results, likely different sites | Based on coordinates – no; based on site description - yes |
| | | | 12197 – below Buck Creek | 1 | 10/8/07 | 27.3 | 5.38 | 3.77 | Impair | | | Yes |
| | | | | | 9/30/10 | 23.2 | 7.27 | 2.35 | Impair | | | |
| | | | | | 9/26/11 | 30.1 | 4.04 | 3.52 | Impair | | | |
| | | | 12163 – at Fraser River Trail in Winter Park | 1 | 10/3/97 | 57.1 | 4.03 | 3.45 | Attain | | | Yes |
| | | | | | 10/8/07 | 38.0 | 3.27 | 3.01 | Impair | | | |
| | | | 12186 – at Rendezvous Bridge | 1 | 9/30/10 | 32.0 | 4.44 | 2.40 | Impair | | | Yes |
| | | | | | 9/26/11 | 18.4 | 5.22 | 2.52 | Impair | | | |
| | | | 12195 – below Vasquez Creek | 1 | 10/9/07 | 30.4 | 4.82 | 3.10 | Impair | | | Yes |
| | | Byers Creek | 12183A – above diversion | 2 | 8/8/13 | 61.6 | 3.01 | 3.89 | Attain | Not Assessed | | No |
| | | Elk Creek | 12194 – near Fraser | 1 | 11/8/00 | 38.3 | 3.90 | 3.29 | Impair | Not Assessed | | Yes |
| | | | | | 9/13/10 | 53.6 | 4.41 | 4.13 | Attain | | | |
| | | Jim Creek | 12188A – above diversion | 2 | 8/9/13 | 79.0 | 2.63 | 3.62 | Attain | Not Assessed | | No |
| | | | 12188B – 250 yards below diversion | 2 | 8/9/13 | 63.8 | 5.04 | 3.56 | Attain | | | Yes |
| | | Ranch Creek | 12168 – near Tabernash | 1 | 9/13/10 | 65.3 | 3.80 | 3.24 | Attain | Listed as impaired for temperature | | Yes |
| | | | | | 9/26/11 | 63 | 3.66 | 3.66 | Attain | | | |
| | | North Fork Ranch Creek | 12189A - above diversion | 2 | 9/10/13 | 77.1 | 2.88 | 4.01 | Attain | Not Assessed | | No |
| | | | 12189A - below diversion | 2 | 9/10/13 | 71.1 | 3.33 | 4.16 | Attain | | | Yes |
| COUCUC10a | Mainstem of the Fraser River from the source to a point immediately below the Rendezvous | St. Louis Creek | 12165C – upstream of West St. Louis Creek | 2 | 11/8/00 | 69.6 | 4.68 | 3.70 | Attain | Not Assessed | | Yes |
| | | | 12165A – downstream St. Louis Creek Campground | 1 | 9/10/97 | 73.2 | 2.79 | 3.55 | Attain | | | Yes |

**Table 4-7. MMI Data Results for the Fraser River Basin**

| Assessment ID or WBID | Segment | Waterbody | MMI Data | | | | | | | CDPHE Assessment 2012 | | Downstream of a Denver Water Diversion? |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Location | Bio-Type | Sample Date | MMI | HBI | SDI | MMI Assessment | 2012 Assessment | Notes/Comment | |
| | Bridge; all tributaries to Fraser River from the source to the Colorado River | | 12165B – downstream of West St. Louis Creek | 1 | 11/8/00 | 65.7 | 3.69 | 4.26 | Attain | | Per coordinates, site appears to be a ditch | Yes |
| | | | CU-SLNT –above Fraser at the St. Louis Creek Campground | 1 | 9/3/04 | 35.1 | 3.49 | 3.48 | Impair | | | Yes |
| | | East St. Louis Creek | 12184A –above diversion | 2 | 8/8/13 | 65.6 | 1.69 | 3.14 | Attain | Not Assessed | | No |
| | | | 12184B –0.2 mi below diversion | 2 | 8/8/13 | 75.8 | 4.13 | 4.66 | Attain | | | Yes |
| | | Vasquez Creek | 12196 –at Gage at Hwy 40 | 1 | 11/8/00 | 65.2 | 3.54 | 4.10 | Attain | Provisional Impairment (pollutant not identified) - Aquatic Life - Low Priority for TMDL development | | Yes |
| | | | | | 9/13/10 | 23.0 | 5.01 | 2.82 | Impair | | | |
| | | | | | 9/23/11 | 22.7 | 4.69 | 3.23 | Impair | | | |
| COUCUC10b | Mainstem of the Fraser River from point below Rendezvous Bridge to Hammond Ditch | Fraser River | 12192 – below St. Louis Creek | 1 | 10/9/07 | 26.2 | 4.14 | 2.83 | Impair | Not Assessed | | Yes – but site well downstream of upstream diversion points |
| COUCUC10c | Mainstem of the Fraser River, from the Hammond Ditch to the confluence with the Colorado River | Fraser River | 12191 – at County Rd 83 near Tabernash | 1 | 5/31/07 | 52.7 | 3.75 | 3.70 | Attain | Listed as impaired for temperature | | Yes – but site well downstream of upstream diversion points |
| | | | | | 10/9/07 | 55.3 | 3.73 | 4.08 | Attain | | | |
| | | | | | 9/30/10 | 46.7 | 3.74 | 3.76 | Attain | | | |
| | | | | | 9/26/11 | 26.2 | 3.77 | 3.66 | Impair | | | |

**Table 4-8. Excerpts from the FEIS Total Environmental Effects Findings Related to MMI and Aquatic Macroinvertebrate Communities in the Fraser River Watershed**

| FEIS Waterbody | Segment | Summary of FEIS Total Environmental Effects Findings Pertaining to MMI (Excerpted from Section 4.6.11.1 of the FEIS) | Most Closely Associated MMI Site | Current Listing Status and Potential Impact to Waterbody MMI Score |
|---|---|---|---|---|
| Fraser River | 1) Headwaters to Vasquez Creek | *Macroinvertebrate communities that exist after the flow reductions with the Proposed Action and RFFAs may include more species and higher densities than Current Conditions. However, macroinvertebrates with more generalized flow requirements may replace rheophilic species, leading to changes in the invertebrate community and similar or lower species richness...short-term accumulations of sediment and the likely changes in benthic macroinvertebrate species composition indicate that the RFFAs and Proposed Action would have minor adverse cumulative impacts on aquatic resources.* | • 12197– below Buck Creek<br>• 12163 – at Fraser River Trail in Winter Park | This Fraser River reach is already provisionally listed as impaired for Aquatic Life based on MMI because the pollutant(s) responsible have not been identified. Proposed Action and RFFAs expected to impact MMI score, but unknown to what degree and what direction. |
| | 2) Vasquez Creek to St. Louis Creek | *There may be changes in macroinvertebrate species composition as rheophilic species are reduced and replaced by species that prefer lower current velocity…Moderate adverse cumulative impacts to aquatic resources are expected as a result of reduced fish habitat availability and changes to the macroinvertebrate community with future actions...However, cumulative impacts are not expected to preclude the maintenance of fish and invertebrate populations and this segment will not be degraded past a tipping point.* | 12192 – below St. Louis Creek | Based on MMI score the site is impaired, but it has not been included on the State's 303(3) list of impaired waters. Proposed Action and RFFAs expected to impact MMI score, but unknown to what degree and what direction. |
| | 3) St. Louis Creek to Ranch Creek | *The reductions in peak flows and increased frequency of dry years would increase habitat availability for fish and likely for macroinvertebrates as well. The RFFAs and Proposed Action would have a moderate beneficial cumulative impact to aquatic resources in Segment 3 of the Fraser River.* | 12191 – at County Rd 83 near Tabernash | Three MMI results (2007-2010) show the site in attainment; 2011 MMI result shows the site impaired. Unknown why the significant change in MMI score occurred between 2010 and 2011 under existing conditions. |

**Table 4-8. Excerpts from the FEIS Total Environmental Effects Findings Related to MMI and Aquatic Macroinvertebrate Communities in the Fraser River Watershed**

| FEIS Waterbody | Segment | Summary of FEIS Total Environmental Effects Findings Pertaining to MMI (Excerpted from Section 4.6.11.1 of the FEIS) | Most Closely Associated MMI Site | Current Listing Status and Potential Impact to Waterbody MMI Score |
|---|---|---|---|---|
| Fraser River | 4) Ranch Creek to Mouth of Canyon | *Exceedances of temperature standards have not occurred in this segment and changes are expected to be minimal. Changes to sedimentation and channel morphology are not expected. The result of the RFFAs and Proposed Action would be negligible cumulative impacts to aquatic resources compared to Current Conditions, and density changes to existing fish and macroinvertebrate populations are not expected.* | No relevant MMI sites. Nearest sites are near confluence with Colorado River | Not Applicable |
| | 5) Mouth of Canyon to Colorado River | *small reductions in peak flows...Temperature changes are expected to be minimal… long-term sedimentation is not expected...the Proposed Action and RFFAs is expected to have cumulative negligible impacts to aquatic resources in Segment 5 of the Fraser River* | No relevant MMI sites. Nearest sites are near confluence with Colorado River | Not Applicable |
| St. Louis Creek | Tributaries | *Additional diversions would extend the period of no flow by approximately two weeks...Small and large floods would remain largely unaffected…impacts would be minor because any organisms that persist downstream of these diversions are tolerant of very low flows and because proposed changes are small in relation to historic diversions...could lead to a decrease in macroinvertebrate densities and may further restrict the presence of rheophilic species.* | East St. Louis Creek, 12184B – 0.2 mi below diversion (other tributary sites are upstream of diversions) | One 2013 MMI result shows site to be in attainment. General statement regarding impacts to "tributaries" difficult to apply on a site-specific basis. However, site currently experiences diversions, yet recent MMI score shows site to be well in attainment. |
| | Mainstem | *No reduction in minimum flows…frequency of high flows would not change, but the magnitude would increase slightly, and the duration would decrease slightly…Because of the lower spring flows, there may be changes to the macroinvertebrate community with fewer rheophilic species. St. Louis Creek has minimum bypass flows in summer and winter. The reductions in flow would result in negligible cumulative impacts to aquatic resources...* | • 12165C – upstream of West St. Louis Creek<br>• 12165A – downstream St. Louis Creek Campground<br>• 12165B – downstream of West St. Louis Creek<br>• CU-SLNT –above Fraser at the St. Louis Creek Campground | (Note: Assumed Site 12165B is on the mainstem, but it maps to a ditch based on Division GIS coordinates – see Figure 4-1). Three sites (12165A, B, C) indicate segment is in attainment (based on 1997-2000 data); site CU-SLNT is physically very close to 12165A (they map together) but it shows the location as impaired based on a 2004 sample. |

**Table 4-8. Excerpts from the FEIS Total Environmental Effects Findings Related to MMI and Aquatic Macroinvertebrate Communities in the Fraser River Watershed**

| FEIS Waterbody | Segment | Summary of FEIS Total Environmental Effects Findings Pertaining to MMI (Excerpted from Section 4.6.11.1 of the FEIS) | Most Closely Associated MMI Site | Current Listing Status and Potential Impact to Waterbody MMI Score |
|---|---|---|---|---|
| King Creek | NA | *The Proposed Action and RFFAs would not change winter flows but would reduce the flows that pass the diversion during wet months and extend the period when water does not pass the diversion by approximately two weeks on average. King Creek is already severely diverted and may be near a tipping point. No flow-based threshold effects are expected. However, a slightly longer no-flow period could lead to decreases in macroinvertebrate densities and slight changes in species composition.* (Tipping point refers to point beyond which environmental change could lead to non-linear and potentially irreversible effects. Flow-based threshold is defined as 60% reduction in maximum flows or 60% reduction in annual flows [FEIS, page 4-480]). | No MMI sites on this waterbody; nearest sites are on downstream St. Louis Creek | MMI scores and species composition for this reach are currently unknown. Potential impact possible due to further reduction in flows. |
| Elk Creek and Tributaries | NA | *The reductions in flow with the RFFAs and Proposed Action would result in minor cumulative impacts that would reduce connectivity to upstream macroinvertebrate populations. There could be minor reductions in fish and/or invertebrate populations downstream of the diversions. The reductions in flow in this stream may be sufficient to cross an ecological tipping point.* | 12194 – near Fraser | One MMI site is located near the confluence of mainstream Elk Creek and the Fraser River. A 2000 sample showed the site to be impaired, but a 2010 sample showed the site in attainment. The distance between the diversion sites and this MMI site is considerable. |
| Vasquez Creek | NA | *The lower runoff flows could tend to provide more favorable habitat for invertebrates in average and wet years. However, the large magnitude of flow changes, especially in the lower reaches of Vasquez Creek, would change the species composition of the benthic invertebrate community and may be low enough to exclude some rheophilic species. The decrease in wetted area associated with the increased diversions would probably lead to smaller macroinvertebrate populations as well. The stream would still maintain populations of fish and invertebrates and likely will not cross an ecological tipping point.* | 12196 – at Gage at Hwy 40 | Vasquez Creek is already provisionally listed as impaired for Aquatic Life based on MMI scores and the lack of identified pollutants (attained in 2000, but impaired in 2010 and 2011 samples). |

**Table 4-8. Excerpts from the FEIS Total Environmental Effects Findings Related to MMI and Aquatic Macroinvertebrate Communities in the Fraser River Watershed**

| FEIS Waterbody | Segment | Summary of FEIS Total Environmental Effects Findings Pertaining to MMI (Excerpted from Section 4.6.11.1 of the FEIS) | Most Closely Associated MMI Site | Current Listing Status and Potential Impact to Waterbody MMI Score |
|---|---|---|---|---|
| Little Vasquez Creek | NA | *Reduce the flows that pass the diversion in wet months, extend the period when little flow passes the diversion by one to two weeks on average, and have minor adverse cumulative impacts on aquatic resources. Flow-based threshold effects are possible on Little Vasquez Creek because it is already near a tipping point.* | No MMI sites on this waterbody; nearest site is located downstream on Vasquez Creek | Not applicable |
| Cooper Creek | NA | *Reductions in macroinvertebrate densities and changes in species composition are possible under the Proposed Action with RFFAs, given that the number of zero flow days would increase slightly and further limit the water and time available to support macroinvertebrates.* | No MMI sites on this waterbody; nearest site is located downstream on Fraser River | Not Applicable |
| Jim Creek | NA | *There is no bypass flow for Jim Creek and it is fully diverted much of the year and this would be extended by a few more days…decrease the duration of small floods and large floods...increase in zero flow days could cause a decrease in fish and macroinvertebrate densities* | 12188B – 250 yards below diversion | 2013 MMI data show site to be well in attainment of the MMI threshold for this site. |
| Ranch Creek | North Fork Ranch and Dribble Creeks | *Additional diversions during the wet months would extend the dry period by more than a week on average and up to several weeks in some years…Reductions in flow of this magnitude would have a minor adverse impact on the fish and invertebrate communities in North Fork Ranch Creek and on macroinvertebrates in Dribble Creek. Fish densities would likely not change appreciably, but an increase in the number of zero flow days may cause a decrease in macroinvertebrate densities.* | • 12189A – below diversion on North Fork Ranch<br>• No MMI site on Dribble Creek | 2013 MMI data show this site to be well in attainment of the MMI threshold for this site. |
| | Mainstem | *The Proposed Action and RFFAs would reduce flows below the diversion in wet months. This would extend the period of low flows in the stream. The RFFAs and Proposed Action would have a minor adverse impact on the fish and invertebrate communities of Ranch Creek.* | 12168 – near Tabernash | MMI site is well downstream of diversions on Ranch Creek. MMI scores from 2010 and 2011 show the site to be in attainment. |

**Table 4-8. Excerpts from the FEIS Total Environmental Effects Findings Related to MMI and Aquatic Macroinvertebrate Communities in the Fraser River Watershed**

| FEIS Waterbody | Segment | Summary of FEIS Total Environmental Effects Findings Pertaining to MMI (Excerpted from Section 4.6.11.1 of the FEIS) | Most Closely Associated MMI Site | Current Listing Status and Potential Impact to Waterbody MMI Score |
|---|---|---|---|---|
| Ranch Creek | Middle Fork and South Fork Ranch Creek | *Zero flow days would increase slightly…the duration of small and large floods would decrease…the extension of the period when the streams are fully diverted by approximately two weeks on average…A minor decrease in macroinvertebrate densities is possible.* | No MMI sites on these waterbodies; nearest site is located well downstream on Ranch Creek near its confluence with Fraser River | Not Applicable – waterbodies are too far upstream from nearest downstream MMI site to expect activities in these waterbodies to influence the MMI score on Ranch Creek. |
| Wolverine Creek | NA | *Minor cumulative decreases in macroinvertebrate densities may occur as a result of a small increase in the number of zero flow days* | No MMI sites on this waterbody; nearest site is located downstream on Fraser River | Not Applicable |
| Cub and Buck Creeks | NA | *Minor cumulative decreases in macroinvertebrate densities may occur as a result of a small increase in the number of zero flow days.* | No MMI sites on these waterbodies; nearest site is located downstream on Fraser River | Not Applicable |
| Englewood Ranch Gravity System | Meadow, South Trail, North Trail, Hurd, Hamilton, Cabin, and Little Cabin Creeks | *Changes in average annual flow would be 4% in average years and 5% in wet years with no changes in dry years on an average annual basis. The additional diversions would occur during spring runoff. The small changes in flow with the Proposed Action and RFFAs would have negligible cumulative impacts on fish and invertebrates in these streams.* | No MMI sites on these waterbodies; nearest site is located far downstream on Ranch Creek | Not Applicable |

- **Dissolved Iron** – SCT exceedances are projected for dissolved iron in each month of the year under all three scenarios (wet, dry, and average conditions). In most months, the projected concentrations of dissolved iron exceed the lowest applicable WQS of 300 mg/L to protect the domestic water supply beneficial use. Currently, there is no WQS established for dissolved iron for the protection of aquatic life (although there is a total iron WQS of 1,000 mg/L to protect aquatic life under chronic exposure conditions; this threshold is substantially higher than the criterion established to protect the domestic water supply use).

- **Dissolved Copper and Dissolved Zinc** – The results of the AD analysis for water quality parameters indicate that dissolved copper and dissolved zinc concentrations in the Fraser River basin are projected to decrease under each scenario (average, dry, and wet conditions) as a result of the Proposed Action and RFFAs. Future concentrations of dissolved copper show a greater than 15 percent reduction from current conditions during every month of the year, indicating a significant benefit. Future concentrations of dissolved zinc are also projected to be lower providing a significantly beneficial reduction (>15 percent) for approximately 6 months of the year (October through March under average conditions).

Based on the findings of the water quality AD review and the discussion above, the projected impact of water quality changes on MMI scores is minimal.

### 4.1.3 Summary of Fraser River Findings

The water quality impacts analyses presented above indicate that the Proposed Action plus RFFAs may have impacts or contribute to a WQS exceedance in the Fraser River basin for the following parameters during specified times:

- **Total Phosphorus** – because total phosphorus baseline concentrations are very close to the SCT and tributary concentrations are relatively low, most increases in diversions result in SCT exceedances. The exceptions are September in average years, May in dry years, and April and July in wet years.

- **Dissolved Iron** – the SCT for dissolved iron is predicted to be exceeded in all months under all hydrologic scenarios. The standard for dissolved iron is also predicted to be exceeded during the majority of months under each hydrologic scenario with the exception of September in average years; May in dry years; and April, July, September, and October in wet years.

Significant improvements to dissolved copper are predicted to occur under all months for all hydrologic scenarios with the exception of July in wet years. Dissolved zinc concentrations are also predicted to improve significantly during the following months: October through March during average years; October through April during dry years; and December through March and May of wet years.

Additional analyses were performed for basin-specific parameters of concern. The results of impacts analyses for these parameters indicate:

- **Stream Temperature** – The modeling analysis indicates that there would be days during May through September at both modeled locations on the Fraser River (Rendezvous Bridge and near the confluence with the Colorado River) when increased water temperatures due to cumulative conditions (Proposed Action plus RFFAs) would exceed the 15 percent BAI threshold. The Proposed Action would contribute to only a small portion of the DM and WAT excursions.

- **Potential Impacts to the Aquatic Macroinvertebrate Community as Measured by MMI** – Future changes in flow below diversions may impact the macroinvertebrate community; however, locations and significance are unknown. The upper reaches of the Fraser River and Vasquez Creek are currently on the 303(d) list of impaired waterbodies with impairments to the aquatic life use based on application of MMI; these listings are provisional because a pollutant has not been identified. Lower reaches of the Fraser River as well as the entirety of Ranch Creek are 303(d) listed based on elevated water temperatures. Future reductions in flow expected under the Proposed Action plus RFFAs have a potential to impact these existing impairment findings.

## 4.2 Williams Fork River

The Williams Fork River basin is located on the west side of the Continental Divide between the Fraser River basin to the east and the Blue River basin to the west (**Figure 4-2**). The Williams Fork River flows to the northwest for approximately 30 miles through a 230-square-mile drainage area into the Colorado River. Water is diverted from four upper basin tributaries to Vasquez Creek in the Fraser River basin through the Gumlick and Vasquez Tunnels.

As described in Section 2, under the Proposed Action, average annual Gumlick Tunnel diversions will increase in average and wet years. No additional diversions will occur in dry years under the Proposed Action compared to Full Use of the Existing System because Denver Water already diverts the maximum amount physically and legally available under their existing water rights and without additional storage in their system. Additional diversions from the upper basin tributaries will primarily occur during periods of high runoff in May through July.

### 4.2.1 Williams Fork River Quantified AD Results

Flows are diverted from upper basin tributaries in the Williams Fork River basin. Consequently, it is reasonable to expect that potential impacts from the Proposed Action plus RFFAs will be greatest at a site that is located downstream but relatively close to the diversions. Quantified mass-balance calculations were performed for selected parameters based on the available water quality data collected at the closest water quality monitoring site downstream of the diversions: Denver Water station WS-WF-004 – Williams Fork River at Sugarloaf Campground (Figure 4-2). Model outputs for PACSM site 3600 – Williams Fork River above Darling Creek gage served as the primary source of projected flow information for this watershed.

#### 4.2.1.1 Williams Fork River Data Development

Existing baseline water quality data used in the mass-balance calculations for the Williams Fork River were calculated from water quality data available from Denver Water's monitoring location WS-WF-004 (Williams Fork River at Sugarloaf Campground). This site is located approximately 8 miles downstream of where water is diverted from tributaries in the upper Williams Fork River basin into the Fraser River basin via the Gumlick and Vasquez tunnels (Figure 4-2). The available dataset for station WS-WF-004 includes 18 discrete samples collected between March 2005 and September 2013. Analytical results were available for 8 of the 11 parameters of concern identified in Section 3.1. No data were available for this site for total nitrogen, sulfate, or chloride. As with other water quality data provided by Denver Water, "j-flagged" results were included in the analysis due to the elevated reporting limits inherent to the dataset (see discussion in Section 3.3). Baseline water quality values for input into the mass-balance calculations were derived by using the 85th percentile of all dissolved fraction parameters and the median value for all parameters reported as a total fraction. Due to the

high proportion of non-detects, the calculated baseline input values for dissolved selenium and dissolved lead were equivalent to the DLs for each parameter and the calculated baseline concentrations could not be quantified. These parameters were subsequently removed from the mass-balance calculations for the Williams Fork River.

The baseline water quality of water diverted out of the Williams Fork River basin was calculated from data collected at the following Denver Water monitoring locations:

- WS-WF-005 – Steelman Creek above the diversion dam
- WS-WF-006 – McQueary Creek above the diversion dam
- WS-WF-008 – Bobtail Creek above the diversion dam

These water quality stations are all in close proximity to the tributary diversion structures and were used to estimate the baseline water quality characteristics of the water diverted from each respective tributary (**Table 4-9**). A smaller, fourth tributary diversion is located in the upper Williams Fork River basin on Jones Creek. No water quality data are available from this tributary, so water quality data from the nearby Bobtail Creek (approximately 0.25 miles to the south) were used to estimate the conditions in this stream.

**Table 4-9. Calculated Baseline Water Quality Concentrations for Water Diverted Out of the Williams Fork River from Steelman Creek, McQueary Creek, and Bobtail Creek above their Diversion Structures**

| Parameter | WS-WF-005 Steelman Creek above diversion dam | WS-WF-006 McQueary Creek above diversion dam | WS-WF-008 Bobtail Creek above diversion dam |
|---|---|---|---|
| Total Phosphorus (mg/L) | 0.008 | 0.009 | 0.008 |
| Total Nitrogen (mg/L) | No Data | No Data | No Data |
| Manganese (diss) (µg/L) | 7.0 | 2.6 | 3.6 |
| Iron (diss) (µg/L) | 66 | 39 | 32 |
| Iron (Trec) (µg/L) | 89 | 62 | 65 |
| Selenium (diss) (µg/L) | 0.2 | 0.2 | 0.2 |
| Zinc (diss) (µg/L) | 3.9 | 2.7 | 5.0 |
| Lead (diss) (µg/L) | 0.19 | 0.10 | 0.08 |
| Copper (diss) (µg/L) | 2.3 | 3.2 | 1.78 |
| Sulfate (mg/L) | No Data | No Data | No Data |
| Chloride (mg/L) | No Data | No Data | No Data |

[1] Baseline value equivalent to the analytical detection limit and not quantified, parameter eliminated from mass balance calculations.

The sizes of the available water quality dataset were similar for each of the three diversion water quality monitoring locations. A total of 17 separate samples were collected from each location between June 2005 and September 2013. Analytical results were again available for all of the identified parameters of concern except for total nitrogen, sulfate, or chloride. As with other water quality data provided by Denver Water, "j-flagged" results were included in the analysis due to the elevated reporting limits inherent to the dataset (see discussion in Section 3.3). Baseline water quality values for input into the mass-balance calculations were derived by using the 85th percentile for all dissolved fraction parameters and the median value for all parameters reported as a total fraction. Water quality data from the mainstem and diversion monitoring locations were coupled with monthly flow data from the closest available PACSM nodes for use in the mass balance calculations developed

to predict future instream concentrations. PACSM nodes exist at each of the tributary diversions and are co-located with the water quality monitoring locations, except in the case of the Jones Creek diversion, which does not have a water quality station. The nearest PACSM node to the Williams Fork River at Sugarloaf Campground water quality monitoring location (WS-WF-004) was located approximately 0.5 miles upstream (Node 3600). As described in Section 3, future impacts and AD were assessed using conservative mass balance calculations. In these calculations, future pollutant concentrations are estimated as a function of current conditions, future flow projections, and changes in diversion water loads.

#### 4.2.1.2 Williams Fork River Data Analysis Results

Representative baseline concentrations for the Williams Fork River and for the water diverted out of the Williams Fork River basin via the Gumlick and Vasquez Tunnels are summarized in Table 4-9 above. WQS, baseline concentrations, and SCTs for all modeled constituents in the Williams Fork River at the Sugarloaf Campground, where mass-balance calculations were performed, are summarized in **Table 4-10**. The mass balance calculations are available in Appendix C as an Excel spreadsheet dated October 21, 2014 *(Williams Fork MB 10-21-14.xlsx)*.

**Table 4-10. Williams Fork River at Sugarloaf Campground - Baseline Conditions and Significance Threshold**

| Parameter | Water Quality Standard (WQS) | Baseline Water Quality (BWQ) | Significant Concentration Threshold (SCT)[3] |
|---|---|---|---|
| Total Phosphorus (mg/L) | 0.110 | 0.009 | 0.024 |
| Total Nitrogen (mg/L) | 1.3 | No Data | N/A |
| Manganese (diss) (µg/L) WS | 50 | 23 | 27 |
| Iron (diss) (µg/L) | 300 | 119 | 146 |
| Iron (Trec) (µg/L) | 1,000 | 464 | 544 |
| Selenium (diss) (µg/L) | 4.6 | 0.2[2] | N/A |
| Zinc (diss) (µg/L)[1] | 6.7 | 2.5 | 3.1 |
| Lead (diss) (µg/L)[1] | 0.57 | 0.07[2] | N/A |
| Copper (diss) (µg/L)[1] | 2.8 | 3.0 | 3.0 |
| Sulfate (mg/L) | 250 | No Data | N/A |
| Chloride (mg/L) | 250 | No Data | N/A |

WS = Water Supply Use

1 WQS calculated using an average hardness of 26.1 mg/L at Williams Fork River at Sugarloaf Campground

2 Baseline value equivalent to the analytical detection limit and not quantified, parameter eliminated from mass balance calculations.

3 SCT is calculated as SCT = [(WQS – BWQ) * 0.15] + BWQ

#### 4.2.1.3 Williams Fork River AD Results

**Table 4-11** summarizes the results for each of the parameters analyzed through mass-balance calculations in the Williams Fork River basin. Erosion of assimilative capacity was predicted for the following pollutants:

- **Total Iron and Dissolved Manganese** – the SCTs for total iron and dissolved manganese are predicted to be exceeded in July during average and dry years, and in May of wet years. Total iron and dissolved manganese concentrations are low in the diverted tributaries relative to the baseline concentration at the downstream AD site and each significance finding corresponds to the month of highest diversions for each hydrologic scenario.

- **Dissolved Iron** – the SCT for dissolved iron is predicted to be exceeded in July of dry years. Similar to the circumstances described above for total iron, dissolved iron concentrations are relatively low in the diversion water when compared to baseline concentrations at the AD site. July is the month of greatest diversions during dry years.

- **Dissolved Copper** – the baseline dissolved copper concentration (85th percentile of measured data) in Williams Fork River at Sugarloaf Campground is 3.0 µg/L. This concentration is above the lowest applicable WQS for dissolved copper of 2.8 µg/L (calculated using an average hardness of 26.1 mg/L). As such, even without implementation of the Proposed Action plus RFFAs, the dissolved copper standard is already exceeded at this site. Months where the dissolved copper concentrations are projected to increase under cumulative effects are highlighted in the table. The maximum increase in dissolved copper is predicted to be 0.26 µg/L.

Additionally, water quality improvements resulting from the Proposed Action plus RFFAs that are greater than 15 percent are noted in the table with a "↑" symbol. Because dissolved zinc concentrations are higher in the tributary diversions than they are at the AD site, significant improvements to dissolved zinc are predicted to occur in July during average and dry years, and in May of wet years.

**Table 4-11. Williams Fork River at Sugarloaf Campground SCT Exceedances**

| Parameter | Average | | | | | | | | | | | | Dry | | | | | | | | | | | | Wet | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ***Month*** | 10 | 11 | 12 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| Copper, Dissolved (µg/L) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Iron, Dissolved (µg/L) | | | | | | | | | | | | | | | | | | | | | | X | | | | | | | | | | | | | | |
| Iron, Total (µg/L) | | | | | | | | | | X | | | | | | | | | | | | X | | | | | | | | | | X | | | | |
| Manganese, Dissolved (µg/L) | | | | | | | | | | X | | | | | | | | | | | | X | | | | | | | | | | X | | | | |
| Phosphorus, Total (mg/L) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Zinc, Dissolved (µg/L) | | | | | | | | | | ↑ | | | | | | | | | | | | ↑ | | | | | | | | | | ↑ | | | | |

| | |
|---|---|
| X = | 15% of Baseline Available Increment exceeded |
| = | Projected increase in concentration; WQS exceeded in all months under current and future conditions |
| ↑ = | 15% water quality improvement |

## 4.2.2 Other Williams Fork River Basin Results

In addition to the AD analysis findings presented above, the potential impacts to the aquatic community as measured by MMI were reviewed. The results of this analysis are presented below.

### 4.2.2.1 MMI in Williams Fork River

Figure 4-2 identifies three sites in the Williams Fork River basin where the Division has collected MMI data. **Table 4-12** summarizes these findings. The Division did not use these MMI results in its 2012 Integrated Report; however, based on the MMI assessment results (based on Aquatic Life Policy 10-1), the aquatic life use was found to be attained based on MMI results.

Table 4-12 also summarizes the potential impact of water diversions from the Proposed Action plus RFFAs on the sites where MMI data have been collected. Only two sites have the potential to be impacted by the Proposed Action plus RFFAs. These sites and potential impacts include:

- Site 12205 – located in the upper Williams Fork River watershed, this site is closest to where water diversions would occur (see Figure 4-2). This site is located in close proximity to the Most Impacted Site (Williams Fork River at Sugarloaf Campground) for purposes of the current analysis.
- Site 12230 – located several miles downstream of Site 12205. Two major tributaries (Darling Creek and South Fork Williams Fork River), unaffected by the Proposed Action and RFFAs, contribute flow to this site. Any potential impacts to the aquatic community at this site from the Proposed Action plus RFFAs would be expected to be substantially less than could occur at Site 12205; accordingly, Site 12205 site serves as the key site for evaluation of potential impacts to the aquatic community from the Proposed Action plus RFFAs.

**Table 4-12. MMI Data Results for Williams Fork River Basin**

| Assessment ID or WBID | Segment | MMI Data | | | | | | | Potential Impact of Proposed Action Plus RFFAs |
|---|---|---|---|---|---|---|---|---|---|
| | | Location | Bio-Type | Sample Date | MMI | HBI | SDI | MMI Assessment | |
| COUCUC08_6100 | Williams Fork River | 12205 – at Henderson Mine | 2 | 9/20/06 | 58.50 | 3.40 | 3.44 | Attain | Site at location of Most Impacted Site for the current analysis. |
| | | 12230 – at FR 141 bridge at gage | 1 | 9/19/06 | 55.5 | 2.58 | 3.46 | Attain | Site located several miles downstream of Site 12205. At least two major tributaries (South Fork Williams Fork River and Darling Creek) unaffected by the Proposed Action plus RFFAs enter the Williams Fork River upstream of this site. |
| | Keyser Creek | 12225 - near Mouth | 1 | 9/19/06 | 60.7 | 3.02 | 2.22 | Attain | None – no water diversions in this subwatershed. |

The FEIS included the following findings for the Williams Fork River:

> *For aquatic resources, the small differences in flow for the Proposed Action with RFFAs would have negligible cumulative impacts compared to Current Conditions. MMI samples from the Williams Fork River indicated attainment and the changes in flow are not expected to affect MMI scores. Because the current flow depletions from this stream do not approach either of the flow-based thresholds* (defined on page 4-480 of the FEIS as 60% reduction in maximum flows or 60% reduction in annual flows)*, and because additional proposed diversions are small, no flow-related threshold effects are expected with the Proposed Action with RFFAs (FEIS, page 4-505).*

The findings from the current analysis for the Williams Fork River basin (refer to Table 4-11) are generally consistent with the FEIS findings with regards to MMI scores and aquatic life protection.

### 4.2.3 Summary of Williams Fork River Findings

The water quality impacts analyses presented above indicate that the Proposed Action plus RFFAs may have impacts or contribute to a water quality exceedance in the Williams Fork River basin for the following parameters during specified times:

- **Dissolved Copper** - the baseline dissolved copper concentration (85th percentile of measured data) in Williams Fork River at Sugarloaf Campground is 3.0 µg/L. This concentration is above the lowest applicable WQS for dissolved copper of 2.8 µg/L (calculated using an average hardness of 26.1 mg/L). The Proposed Action plus RFFAs will contribute to dissolved copper in excess of the standard at this site. Months where the dissolved copper concentrations are projected to increase under cumulative effects include all months except April in average years, October through May in dry years, and October through April in wet years.
- **Total Iron and Dissolved Manganese** – the SCTs for total iron and dissolved manganese are predicted to be exceeded in July during average and dry years, and in May of wet years.
- **Dissolved Iron** – the SCT for dissolved iron is predicted to be exceeded in July of dry years.

The SCT exceedances for total iron, dissolved manganese, and dissolved iron are predicted to occur in the single month of greatest diversions under the various hydrologic scenario.

Significant water quality improvements for dissolved zinc are predicted to occur in July during average and dry years, and in May of wet years.

## 4.3 Blue River

The Blue River drains an approximately 680-square-mile area on the west side of the Continental Divide between the Williams Fork basin and the Gore Mountain Range. The Blue River flows from the Continental Divide in a northwesterly direction toward Dillon Reservoir. From Dillon Reservoir, the river continues below the dam in Silverthorne onto the confluence with the Colorado River near the Town of Kremmling (**Figure 4-3**). Water is diverted under the Continental Divide from Dillon Reservoir to the North Fork South Platte River basin via the Roberts Tunnel.

Future changes in flows below Dillon Reservoir will be caused by changes in Roberts Tunnel diversions and Dillon Reservoir spills (Proposed Action) and additional depletions and changes in returns flows due to growth in municipal and snowmaking water demands in Summit County (RFFAs). Average monthly flows below the dam will be lower throughout the year with the greatest reductions

in flow occurring during summer months. Flow changes during the winter months will be relatively minimal.

## 4.3.1 Blue River Qualitative Analysis Results

The most impacted site in the basin, with respect to altered flow regimes, is on the mainstem just downstream of the Dillon Reservoir dam. The timing of reservoir spills and resulting downstream flows will change in the future due to the Proposed Action plus RFFAs. However, what effect this has on water quality is difficult to determine due to the lack of information/data concerning the processes (e.g., sedimentation or biological uptake) that might alter concentrations between the inlet and the outlet of the reservoir. The time scales relevant to modeling reservoir processes versus instream concentrations are also mismatched. Thus, as discussed in Section 3.3.1.1, quantification of AD and water quality impacts through mass balance modeling is not an appropriate approach in the Blue River basin.

Chapter 4 of the FEIS (Total Environmental Effects) discusses potential water quality impacts from the Proposed Action plus RFFAs within the Blue River basin. The Proposed Action plus RFFAs do not affect tributaries to Dillon Reservoir, and dischargers above the reservoir operate under a nutrient control regulation. According to the FEIS:

> *Variations in reservoir elevations would be greater and remain at lower levels longer under Full Use with a Project Alternative with RFFAs (2032) compared to Current Conditions (2006). This variation would potentially affect reservoir water quality. Lower elevations and corresponding reduced reservoir volume may increase phosphorus and nitrogen concentrations. This would increase the chlorophyll a concentrations and reduce clarity…The impact associated with the increased variation in reservoir elevation cannot be explicitly predicted and would be heavily affected by future levels and potential reductions in nutrient loading from WWTPs and non-point sources.*

Minimal future concentration changes to tributaries of Dillon Reservoir and the large assimilative capacity of the water body likely make the downstream river segment less sensitive to project impacts. Tributaries to the Blue River below Dillon Reservoir are also unimpacted by the Proposed Action and contribute dilution flow as the river progresses downstream. These factors make it unlikely that the Proposed Action plus RFFAs will cause significant water quality impacts to the Blue River.

## 4.3.2 Other Blue River Basin Results

In addition to the qualitative analysis findings presented above, the potential impacts to the aquatic community as measured by MMI were reviewed. The results of this analysis are presented below.

### 4.3.2.1 Blue River MMI Results

Figure 4-3 identifies five sites in the Blue River basin where the Division has collected MMI data; **Table 4-13** summarizes these findings. The Division appears to have included only a portion of its MMI data in the development of its 2012 Integrated Report. Based on the MMI assessment results, the Division included Segment COUCBL17_6201 (Blue River from the Dillon Reservoir to North Rock Creek) on its M&E list for possible non-attainment of the aquatic life use. Table 4-13 summarizes the potential impact of water diversions from the Proposed Action plus RFFAs on the sites where MMI data have been collected.

**Table 4-13. MMI Data Results for Blue River Basin**

| Assessment ID or WBID | Segment | MMI Data | | | | | | | Potential Impact of Proposed Action Plus RFFAs |
|---|---|---|---|---|---|---|---|---|---|
| | | Location | Bio-Type | Sample Date | MMI | HBI | SDI | MMI Assessment | |
| COUCBL17_6200 | Blue River from N. Rock Creek confluence to Colorado River[1] | 12300A: At mouth 3 miles below Trough Road | 1 | 10/11/11 | 4.2 | 7.49 | 2.12 | Impair | No impact – sites below Green Mountain Reservoir |
| | | RW-251: Knorr | 1 | 12/7/08 | 50.3 | 4.59 | 2.62 | Attain | |
| | | RW-252: Trough Road | 1 | 10/25/04 | 17.5 | 6.75 | 2.63 | Impair | |
| | | 12303: At Blue River Camp-ground | 2 | 5/13/04 | 61.7 | 3 | 3.93 | Attain | Site well below Dillon Reservoir; several major tributaries unaffected by Proposed Action enter Blue River upstream of this site; site downstream of M&E listed segment. |
| | | | 2 | 8/31/11 | 23.6 | 4.57 | 2.78 | Attain | |
| | Blue River from outlet of Dillon Reservoir to N. Rock Creek confluence | 12304D: Below Dillon Reservoir at Gage | 2 | 5/12/04 | 21.7 | 5.66 | 2.75 | Impair | Reach included on M&E List; potential impacts include decreased flows below Dillon Reservoir, reduced frequency of spillover, modified temperature regime. |
| | | | 2 | 8/31/11 | 23.6 | 4.57 | 2.78 | Impair | |

[1] Segment not included on the 2012 303(d) or M&E lists due to data collection outside of the assessed period of record.

For the Proposed Action, the diversion point for waters from the Blue River basin is located within Dillon Reservoir; therefore, if the Proposed Action were to impact the Blue River below Dillon Reservoir, the most likely locations where an impact could be observed would be the site nearest the dam outlet (MMI site #12304D). Potential impacts would be expected to decrease with distance downstream of the dam.

Regarding potential impacts to the aquatic community, the FEIS divides the Blue River into several segments. Potential impacts are relatively minor and decrease with distance downstream of Dillon Reservoir. The greatest potential impact described in the FEIS is for Segment 1: Blue River, from Dillon Reservoir to the confluence with Rock Creek. FEIS findings include:

> *There would be minor increases in sedimentation in some years with the Proposed Action with RFFAs (refer to Section 4.6.3), which could be unfavorable to both fish and macroinvertebrates. These accumulations would be transported during wet years so that there would be no long-term changes in channel morphology. There are not expected to be any substantial changes to most water quality parameters. However, in years when Dillon Reservoir is full and spills, relatively warm water from the top of the reservoir enters the Blue River and raises the temperature to levels that may result in better growth of trout. With the Proposed Action with RFFAs, Dillon Reservoir spills*

> *would decrease by 30 to 40%, which could reduce the time in some years when temperatures are more favorable for trout growth. These reductions in water temperature and the minor increases in sedimentation in some years would result in minor adverse cumulative impacts to aquatic resources in Segment 1 of the Blue River. Density of both fish and macroinvertebrates could be reduced. Segment 1 of the Blue River is on the Monitoring and Evaluation List for low MMI scores. With the Proposed Action with RFFAs, MMI scores would likely continue to be below the threshold for attainment. This segment of the Blue River is not near an ecological tipping point and these changes would not cause it to approach a threshold (FEIS, p. 4-512).*

As discussed in Section 4.3.1, the mass-balance calculations for the potential impacts of the Proposed Action plus RFFAs were not included in the water quality or AD review for the Blue River basin due to data and modeling limitations associated with the diversion's location being within Dillon Reservoir. Water quality impacts below the dam are not likely to be significant, and as such, the Proposed Action is not expected to cause significant impacts to existing MMI scores in the Blue River as a result of changes in water quality composition.

The Blue River below Dillon Reservoir to the confluence of the Colorado River is considered to be Gold Medal Waters by Colorado Parks and Wildlife (CPW). A portion of this river segment (Dillon Reservoir to Rock Creek) is already on the Water Quality Control Commission's M&E List because of potential impairment to aquatic life based on MMI scores. This potential impairment already exists under current dam operations. Based on the narrative assessment presented in the water quality review, and considering the findings presented in the FEIS, no additional significant impacts to the aquatic macroinvertebrate community in the Blue River below Dillon Reservoir are expected as a result of the Proposed Action plus RFFAs.

### 4.3.3 Summary of Blue River Findings

The qualitative water quality and MMI impacts discussion presented above suggest that the Proposed Action plus RFFAs will not have significant impacts to water quality or to MMI scores in the Blue River downstream of Dillon Reservoir. The Proposed Action plus RFFAs may contribute to a potential existing impairment to aquatic life (based on MMI scores) due to future changes in flows and temperature regime. However, the extent of impacts to the aquatic community are unknown.

## 4.4 Upper Colorado River

The affected section of the Upper Colorado River begins at the confluence with the Fraser River and continues approximately 27 miles downstream to the Kremmling gage (**Figure 4-4**). Changes in future Colorado River flows are due to a combination of the Proposed Action, the WGFP, and changes in the timing and quantities of municipal diversions. The changes in diversions in the Blue River, Williams Fork, and Fraser River as a result of the Proposed Action plus RFFAs will lead to an overall reduction in flow entering the Colorado River from these tributaries.

### 4.4.1 Upper Colorado River Qualitative Results

Although the Proposed Action plus RFFAs results in water diverted from tributary watersheds in the Upper Colorado River basin, no quantitative AD analysis was conducted for this basin. This approach was implemented because the Colorado River is far removed from the water diversion points in the upstream Blue, Fraser, and Williams Fork River basins. Any potential for significant impacts from the Proposed Action plus RFFAs will likely be detected in the analyses completed for these upstream

watersheds (see discussions in Section 4.1 through 4.3). Moreover, water management activities that occur downstream of where the AD analyses were conducted and upstream of the Colorado River would make it exceedingly difficult to separate out any specific potential impacts from the Proposed Action plus RFFAs on the Upper Colorado River basin.

## 4.4.2 Other Colorado River Basin Results

In addition to the qualitative analysis findings for the Upper Colorado River basin presented above, the potential impacts to the aquatic community as measured by MMI were reviewed along with the potential impacts to instream temperatures resulting from the Proposed Action plus RFFAs. The results of these analyses are presented below.

### 4.4.2.1 Upper Colorado River MMI Results

The Division has collected MMI data from various sites in the Colorado River watershed, but for the reasons described above in Section 4.4.1, it is not possible to evaluate any potential direct impacts to the aquatic community as measured by MMI on these sites. Instead, MMI evaluations were completed for sites in the Blue (Section 4.3.2), Williams Fork (Section 4.2.2), and Fraser River (Section 4.1.2) basins.

### 4.4.2.2 Stream Temperature in the Upper Colorado River Basin

Potential effects to stream temperature in the Colorado River were evaluated using results from the Upper Colorado River dynamic temperature model prepared for the WGFP (Hydros Consulting Inc. 2011; Miller Ecological Consultants, Inc. 2015a). The Moffat Project was included as one of the RFFAs in the cumulative effects analysis completed for the WGFP. The model results indicate that under future conditions with RFFAs, the number of exceedances of both acute (DM) and chronic (WAT) standards will increase in July compared to existing conditions. However, releases of water from Granby Reservoir in August for compliance with the Endangered Species Act (5412 Releases) will decrease stream temperatures and decrease exceedances. The net cumulative effect is fewer exceedances of both the acute and chronic standards in the future compared to existing conditions.

A quantitative analysis was also conducted to assess the simulated increases in water temperature that exceeded 15 percent of the BAI (Hydros Consulting Inc. 2014; Miller Ecological Consultants, Inc. 2015b). The BAI, which is the difference between the temperature standard and baseline temperature, was used to determine the significance threshold for impacts. The number of excursions (counted as days) the simulated cumulative stream temperatures exceed the BAI threshold for the DM and WAT standards was tallied. In summary, summer days of increased WAT and DM water temperatures in excess of 15 percent of the BAI are anticipated in 4 of the 15 years simulated. However, due to the cooling effect of the 5412 Releases, the net number of WAT and DM excursions and exceedances is expected to decrease.

## 4.4.3 Colorado River Findings

Significant impacts to tribuatry watersheds of the Upper Colorado River basin have been detailed in the preceding sections. As water moves downstream from the modeled sites, unimpacted tributaries add dilution flow and lessen the significance of any identified impacts associated with the Proposed Action plus RFFAs.

# 4.5 South Boulder Creek

South Boulder Creek is a tributary of Boulder Creek in the St. Vrain Creek basin on the east side of the Continental Divide. The study area of South Boulder Creek begins at the outfall of the East Portal of the Moffat Tunnel, where Denver Water's diversions from the Fraser and Williams Fork Rivers flow into the creek, to the South Boulder Creek Canal Diversion approximately 3 miles west of Eldorado Springs (**Figure 4-5**). At this diversion structure, Denver Water diverts flow to the South Boulder Diversion Canal for delivery to Ralston Reservoir, raw water customers, and the Moffat WTP. The affected reach includes Gross Reservoir.

Under the Proposed Action plus RFFAs, additional Moffat Tunnel diversion flows (from the Fraser River and Williams Fork basins) would occur in average and wet years primarily during peak snow melt and runoff periods in May, June, and July. Typically, additional diversions through the Moffat Tunnel would be greatest in wet years following dry year sequences. The Proposed Action would enlarge Gross Reservoir storage capacity from 41,811 AF to 118,811 AF (including the Environmental Pool for mitigation) by increasing the dam height from 340 to 471 feet.

## 4.5.1 South Boulder Creek Quantified AD Results

Flows diverted from the Williams Fork and Fraser River basins are brought into South Boulder Creek at a single location – the Moffat Tunnel. Consequently, it is reasonable to expect impacts from the Proposed Action plus RFFAs will be greatest near the Moffat Tunnel outfall and that impacts will decrease downstream as unaffected tributaries contribute additional flow to the mainstem of South Boulder Creek. Quantitative mass-balance calculations were performed for selected parameters based on the available water quality data collected at the closest water quality monitoring site downstream of the Moffat Tunnel outfall (Figure 4-5). The closest water quality site (Denver Water monitoring location WS-RL-19: South Boulder Creek below East Portal) is located 3.5 miles upstream of the nearest PACSM site (Node 57100: South Boulder Creek at Buckeye Mountain). For water quality analyses to be more representative of flow at the water quality site, PACSM flow values were scaled, based on the drainage areas associated with the two sites (WS-RL-19 and PACSM Node 57100), to subtract any watershed flow contributions that occur between the water quality and PACSM sites.

### 4.5.1.1 South Boulder Creek Data Development

Existing baseline water quality concentrations used in the mass-balance calculations for South Boulder Creek were calculated from water quality data available from Denver Water's monitoring location WS-RL-19 (South Boulder Creek below East Portal). This monitoring station is located approximately 1.75 miles downstream of where diverted water coming through the Moffat Tunnel enters South Boulder Creek (Figure 4-5). The available dataset for station WS-RL-19 includes 37 discrete samples collected between March 2005 and February 2014. Analytical results were available for 8 of the 11 parameters of concern (identified in Section 3.1) (see **Table 4-14**). No data were available for this site for total nitrogen, sulfate, or chloride. As with other water quality data provided by Denver Water, "j-flagged" results were included in the analysis due to the elevated reporting limits inherent to the dataset (see discussion in Section 3.3). Baseline water quality concentrations for input into the mass-balance calculations were derived by using the 85th percentile of all dissolved fraction parameters and the median value for all parameters reported as a total fraction. The baseline input values for dissolved selenium and dissolved lead were equivalent to the DLs for each parameter, indicating that the calculated baseline concentrations were effectively non-detects and could not be quantified. These parameters were subsequently removed from the mass-balance calculations for South Boulder Creek.

**Table 4-14. Calculated Baseline Water Quality Concentrations for Moffat Tunnel Water**

| Parameter | WS-FR-009 Vasquez Canal at Vasquez #1 Gaging Station | WS-FR-011 Ranch Canal at Gaging Station | WS-FR-010 Fraser/Jim Canal at Gaging Station |
|---|---|---|---|
| Total Phosphorus (mg/L) | 0.0085 | 0.0075 | 0.004 |
| Total Nitrogen (mg/L) | No Data | No Data | No Data |
| Manganese (diss) (µg/L) | 5.0 | 5.8 | 7.0 |
| Iron (diss) (µg/L) | 28 | 50 | 40 |
| Iron (Trec) (µg/L) | 40 | 60 | 90 |
| Selenium (diss) (µg/L) | 0.2[1] | 0.2[1] | 0.2[1] |
| Zinc (diss) (µg/L) | 2.5 | 4.2 | 2.5 |
| Lead (diss) (µg/L) | 0.07[1] | 0.07[1] | 0.07[1] |
| Copper (diss) (µg/L) | 2.1 | 2.4 | 2.8 |
| Sulfate (mg/L) | No Data | No Data | No Data |
| Chloride (mg/L) | No Data | No Data | No Data |

[1] Baseline value equivalent to the analytical detection limit and not quantified, parameter eliminated from mass balance calculations.

For diversion water entering South Boulder Creek, data from monitoring stations located on Fraser River basin diversion canals were used to characterize the water quality of diversion inputs into the South Boulder Creek basin. Incorporation of these data required calculating flow weighted average concentrations based on multiple canals contributing to the final diversion input entering the basin via Moffat Tunnel. Canals included in this calculation were: Vasquez Canal (representing diversions from the western portion of the Fraser River basin), Fraser/Jim Canal, and Ranch Canal (representing diversions from the eastern portion of the Fraser River basin). Water quality data for each canal were available from the following Denver Water monitoring locations (Figure 4-1):

- WS-FR-009 – Vasquez Canal at Vasquez #1 Gaging Station
- WS-FR-010 – Fraser/Jim Canal at Gaging Station
- WS-FR-011 – Ranch Canal at Gaging Station

At each diversion water quality monitoring location, the available dataset includes 33 to 36 samples collected between February 2005 and February 2014 for each of the available parameters. As with the South Boulder Creek water quality sampling data, analytical results were not available for total nitrogen, sulfate, or chloride in these datasets and "j-flagged" results were again included in the analyses.

Water quality data from each of these monitoring locations were aggregated into a single flow-weighted concentration for each parameter. Flow weightings were derived from PACSM data based on mean monthly flow projections for each canal and each hydrologic scenario. Canal data were deemed the most directly representative of diversion inputs to the basin and maintained a close coupling with the Fraser River basin mass balance calculations (i.e., Fraser River basin outflow load = South Boulder Creek basin inflow load). As described in Section 3, future impacts and AD were assessed using conservative mass balance calculations. In these calculations, future pollutant concentrations are estimated as a function of current conditions, future flow projections, and changes in diversion water loads.

#### 4.5.1.2 South Boulder Creek Data Analysis Results

Representative baseline water quality concentrations for diverted water entering South Boulder Creek via the Moffat Tunnel (calculated as a representative blend of diverted waters from the Fraser River basin, as described above) were calculated as 85th or median concentrations and are summarized in Table 4-14. WQS, baseline concentrations, and SCTs for all modeled constituents in South Boulder Creek below East Portal, where mass-balance calculations were performed, are summarized in **Table 4-15**. Appendix C contains the mass balance calculations for each basin. Calculations for South Boulder Creek are available in an Excel spreadsheet dated March 25, 2015 (*South Boulder Creek MB 03-25-15.xlsx*).

**Table 4-15. South Boulder Creek below East Portal - Baseline Conditions and Significance Threshold**

| Parameter | Water Quality Standard (WQS) | Baseline Concentration (BWQ) | Significant Concentration Threshold (SCT)[3] |
|---|---|---|---|
| Total Phosphorus (mg/L) | 0.110 | 0.004 | 0.020 |
| Total Nitrogen (mg/L) | 1.3 | No Data | No Data |
| Manganese (diss) (µg/L) WS | 50.0 | 7.0 | 13.5 |
| Manganese (diss) (µg/L)[1] | 1,010 | 7.0 | 157.4 |
| Iron (diss) (µg/L) | 300 | 66.0 | 101.1 |
| Iron (Trec) (µg/L) | 1,000 | 80.0 | 218.0 |
| Selenium (diss) (µg/L)[1] | 4.6 | 0.2[2] | N/A |
| Zinc (diss) (µg/L)[1] | 31.7 | 4.7 | 8.76 |
| Lead (diss) (µg/L)[1] | 0.5 | 0.1[2] | N/A |
| Copper (diss) (µg/L)[1] | 2.5 | 3.4 | 3.4 |
| Sulfate (mg/L) | 250 | No Data | No Data |
| Chloride (mg/L) | 250 | No Data | No Data |

WS = Water Supply Use

1 WQS calculated using an average hardness of 22.9 mg/L at South Boulder Creek near East Portal

2 Baseline value equivalent to the analytical detection limit and not quantified, parameter eliminated from mass balance calculations.

3 SCT is calculated as SCT = [(WQS – BWQ) * 0.15] + BWQ

#### 4.5.1.3 South Boulder Creek AD Results

**Table 4-16** summarizes the results for each of the parameters analyzed through mass-balance calculations in the South Boulder Creek basin. SCT exceedances occur for:

- **Dissolved Copper** - the baseline dissolved copper concentration (85th percentile of measured data) in South Boulder Creek below East Portal is 3.4 µg/L. This concentration is above the lowest applicable WQS for dissolved copper of 2.5 µg/L (calculated using an average hardness of 22.9 mg/L). The Proposed Action plus RFFAS will contribute to exceedances of the dissolved copper standard at this site. Months where the dissolved copper concentrations are projected to increase under cumulative effects are highlighted in the table. The maximum increase in dissolved copper is predicted to be less than 0.2 µg/L.

**Table 4-16. South Boulder Creek below Moffat Tunnel SCT Exceedances**

| Parameter | Average | | | | | | | | | | | | Dry | | | | | | | | | | | | Wet | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ***Month*** | 10 | 11 | 12 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| Copper, Dissolved (µg/L) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | ↑ | | | |
| Iron, Dissolved (µg/L) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | ↑ | | | |
| Iron, Total (µg/L) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | ↑ | | | |
| Manganese, Dissolved (µg/L) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Manganese, Dissolved (µg/L) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Phosphorus, Total (mg/L) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Zinc, Dissolved (µg/L) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | ↑ | | | |
| X = | 15% of Baseline Available Increment exceeded | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| = | Projected Increase in concentration; WQS exceeded in all months under current and future conditions | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ↑ = | 15% water quality improvement | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

No other adverse water quality impacts were quantified for South Boulder Creek.

Additionally, water quality improvements resulting from the Proposed Action plus RFFAs that are greater than 15 percent are noted in the table with "↑" symbol. Significant improvements are predicted to occur in June under the wet scenario for dissolved copper, total and dissolved iron, and dissolved zinc. This is due to the large increase in water brought through the Moffat Tunnel resulting in dilution flows in South Boulder Creek.

## 4.5.2 Other South Boulder Creek Basin Results

In addition to the AD analysis findings presented above, additional areas were identified for investigation of potential cumulative impacts from the Proposed Action plus RFFAs. These areas of concern include:

- **Methylmercury in Gross Reservoir** – Gross Reservoir is on the M&E List for Aquatic Life Use due to elevated mercury in fish tissue.
- **Stream Temperature below Gross Reservoir** – As part of FEIS development, the USACE commissioned preparation of a Gross Reservoir Temperature Model to simulate potential impacts from project implementation on reservoir temperatures and the temperature of water released from the reservoir into South Boulder Creek.[1]
- **MMI** - Potential impacts to the aquatic macroinvertebrate community as measured by MMI.

### 4.5.2.1 Methylmercury in Gross Reservoir

Mercury bioaccumulation in fish tissue is a concern in reservoirs throughout Colorado. Many reservoirs in and around the Project area – including Cheesman Reservoir, Carter Lake, and Horsetooth Reservoir – have posted fish consumption advisories because of elevated mercury in fish tissue. The source of mercury in the environment is primarily from anthropogenic sources such as burning of fossil fuels, which is transported to the aquatic ecosystem through atmospheric deposition. Point source discharges related to mining and urban activities can also contribute mercury to waterbodies. Mercury can bioaccumulate in fish and pose health risks to humans and wildlife that consume large quantities of contaminated fish.

Gross Reservoir is not currently under a fish consumption advisory; however, fish sample results from Gross Reservoir (2001, 2007, 2008, and 2013) indicate some fish have elevated mercury in their tissue. As a result, Gross Reservoir is on the M&E List for Aquatic Life Use due to mercury in fish tissue. Because mercury is listed as a bioaccumulative pollutant (as defined in the AD guidance), degradation can be quantified through the Bioaccumulative Toxic Pollutant Test, which states that degradation is "not significant if the new or increased pollutant loading from the project under review is less than 10 percent of the existing load and the cumulative impacts of pollutant loadings from all sources do not exceed 10 percent of the baseline total load." Available water quality data results for mercury in South Boulder Creek and the Fraser River basin diversion canals are all below the method detection limit (0.01 µg/L) so comparisons based directly on instream concentrations are not possible (the analytical method employed for mercury resulted in a relatively high method detection limit

[1] Hydros Consulting, 2013. Gross Reservoir Temperature Model: Model Development, Calibration, and Application for the Moffat Collection System EIS. Prepared for the USACE. September 27, 2013.

which is equivalent to the lowest applicable water quality standard (0.01µg/L), so direct comparisons of current conditions to the standard is also not possible based on this dataset). However, sufficient flow data are available to estimate an annual percent increase in flows into Gross Reservoir that can serve as a limited proxy for expected increases in mercury loads assuming the current loads are equally distributed among all water sources and that future concentrations of mercury in each water source will remain relatively constant.

PACSM site 57140 represents the total inflows to Gross Reservoir. Average annual inflow at this site was compared to the current contribution of flows from the Moffat Tunnel (PACSM site Pipe #32) as well as the future contributions of flows from the Moffat Tunnel under the Proposed Action plus RFFAs (**Table 4-17**). Changes in flows from the Moffat Tunnel as a percent of total inflow into Gross Reservoir will increase 12 percent during an average year. Using flow as a surrogate for load, this increase may be considered significant under the Bioaccumulative Toxic Pollutant Test. However, it is important to note that although the load may increase by greater than 10 percent, the overall mercury load to Gross Reservoir is likely very small (in terms of pounds/day contributions) given that mercury concentrations measured in the diverted water are below the analytical method detection limit.

**Table 4-17. Change in Moffat Tunnel Flows as a Percent of Current Gross Reservoir Inflow**

| Site | Scenario | TOTAL (AFY) |
|---|---|---|
| Gross Reservoir Inflow (Node # 57140) | Gross Reservoir Existing Use Average | 112,000 |
| Moffat Tunnel (Pipe #32) | Gross Reservoir Existing Use Average | 63,799 |
| | Gross Reservoir Enlargement(Alt 1a) Average | 76,797 |
| | Change in Flow from Existing Use to Alt 1a | 12,997 |
| *Change in Moffat Tunnel flows as a percent of current Gross Reservoir Inflow* | | 12% |

The FEIS provides further detail on additional concerns related to the Proposed Action and methylmercury (MeHg). Section 3.11.1.6 of the FEIS states that:

> "*the inundation of terrestrial vegetation, whether by the creation of a new reservoir or the enlargement of an existing one, invariably results in increased body burdens of mercury in fish (Hecky et al. 1991; Mailman et al. 2006; Goodchild and Gerstenberger 2011). This is exacerbated if large areas of warm, shallow water are created (Mailman et al. 2006) or if the flooded vegetation contains large amounts of material (e.g., peatlands or wetlands) (Brinkmann and Rasmussen 2010; St. Louis et al. 2004). Upon reservoir enlargement, a spike in fish tissue MeHg concentrations occurs shortly after construction and can take decades to attenuate (Brinkmann and Rasmussen 2010; Weiner et al. 2003). The FEIS also noted that water level fluctuations can also increase MeHg formation (Selch et al. 2009; Sorensen et al. 2005; St. Louis et al. 2004), particularly in reservoirs with gently sloping sides due to the large surface area of the exposed lake bottom zone at low water (Mast and Krabbenhoft 2010).*"

The land surrounding Gross Reservoir is mostly rock and forest and is generally steeply sloped. Prior to inundation, Denver Water intends to remove all woody vegetation along the shoreline. **Table 4-18** shows the area of ground subject to exposure and re-wetting due to Gross Reservoir fluctuations for average, dry, and wet years for Base 285 (Existing Use), Base 345 (Full Use plus RFFSs), and under the Proposed Action (including the Environmental Pool). Compared to current conditions, approximately

50 to 59 additional acres of primarily rock and soil will be exposed and re-wetted. Of this, approximately 2 acres are identified as wetland habitat and 4 acres as riparian habitat (FEIS, Section 5.8.1.1). Steep-sided reservoirs with organic-poor substrates are expected to display less efficient MeHg production than reservoirs with wide basins and large littoral areas with more organic matter (Mast and Krabbenhoft 2010). At Gross Reservoir, given the shoreline characteristics, the water level fluctuation associated with the Proposed Action may result in a less dramatic initial spike in fish tissue MeHg as well as a less pronounced increase associated with water level fluctuations. The number of years needed for attenuation at Gross Reservoir is unknown. Denver Water, in consultation with CDPHE, will coordinate with CPW to monitor and evaluate mercury levels in fish tissue for 5 years after the initial fill. The Division and CPW will coordinate to determine if fish consumption advisory regulations are necessary for the reservoir.

**Table 4-18. Area Subject to Exposure and Re-wetting Due to Gross Reservoir Fluctuation (Denver Water 2014)**

| | Scenario | Average Minimum Content (AF) | Average Maximum Content (AF) | Exposed Ground Surface (acres) | Change from Existing Use (acres) |
|---|---|---|---|---|---|
| Gross Reservoir Existing Use | All Years | 18,600 | 40,080 | **186** | - |
| | Dry Years | 18,210 | 33,342 | **137** | - |
| | Wet Years | 24,131 | 41,810 | **145** | - |
| Gross Reservoir Full Use | All Years | 19,652 | 40,109 | **175** | **-11** |
| | Dry Years | 20,404 | 36,654 | **140** | **3** |
| | Wet Years | 23,100 | 41,810 | **154** | **9** |
| Gross Reservoir Enlargement Including Environmental Pool (Alt 1a) | All Years | 70,841 | 111,199 | **238** | **52** |
| | Dry Years | 72,902 | 105,591 | **194** | **57** |
| | Wet Years | 83,299 | 118,980 | **204** | **59** |

### 4.5.2.2 Temperature Downstream of Gross Reservoir

The purpose of this section is to evaluate whether the implementation of the Proposed Action and RFFAs could cause significant degradation with regards to the narrative temperature water quality standard applicable to South Boulder Creek (Regulation 38.5). This evaluation considers the two key elements associated with the narrative temperature standard. Paraphrased for simplicity, these two elements include: 1) maintenance of a normal temperature pattern with no abrupt changes; and 2) ensuring that the resident aquatic community is not impacted in a deleterious manner. Because the purpose of the narrative temperature is to protect aquatic life, the best means to evaluate the potential for significant degradation is to evaluate potential impacts to the aquatic community, in particular reproductive function in fish.

The full details of this analysis are provided in **Appendix B1** of this document. Sections B1.1.2 and B1.1.3 of Appendix B1 evaluate the potential for (a) changes in water temperature patterns; and (b) impacts of water temperature changes on resident fish and macroinvertebrate communities. Following are key findings from each evaluation.

### *Water Temperature Patterns – Key Technical Findings*

**Table 4-19** summarizes the average monthly water temperatures in South Boulder Creek below Gross Reservoir based on various data sources, including both modeled and observed results. Based on these data sources, the following findings can be made:

- The enlargement of Gross Reservoir is expected to create a larger and colder hypolimnion. This outcome is expected to result in colder water to be discharged to South Boulder Creek.
- The FEIS incorporates the findings of modeling analyses that attempt to quantify the degree to which water will be colder when discharged and the effect this colder water will have on South Boulder Creek below Gross Reservoir. The primary period of time when the discharged water is expected to have the most impact on downstream water temperatures is August to October (highlighted in Table 4-19).
- A comparison of observed water temperature data from South Boulder Creek below Gross Reservoir (historical and present conditions) and the Diversion site with simulated data generated by the model, suggests that the estimated impact of the Proposed Action on water temperatures below the dam is potentially overestimated.
- Table 4-19 shows that the average monthly water temperatures observed from 2009 to 2014 below Gross Reservoir are more like the simulated temperatures expected following project implementation for the months of August and September than the simulated baseline temperatures (compare average Alt 1a monthly temperatures with Gross Reservoir Outlet [2009 to 2014] average monthly temperatures).
- Regarding the narrative temperature standard Temperature Pattern element (*Temperature shall maintain a normal pattern of diel and seasonal fluctuations and spatial diversity with no abrupt changes*):
  - The present conditions for the reach of South Boulder Creek below Gross Reservoir is dictated by the presence of the dam, which was completed in 1954; thus a colder temperature pattern already exists as part of the present condition.
  - Under future conditions, it is reasonable to expect somewhat cooler water temperatures overall as a result of project implementation; both in the hypolimnion and in the water discharged from the hypolimnion.
  - While the overall water temperature may become cooler under future conditions, there is no expectation for the diel and spatial diversity of temperatures to change in any ecologically significant manner, i.e., the lack of a diel pattern under present conditions will not change in the future.

**Table 4-19. Comparison of Simulated Monthly Average Baseline and Alt 1a Water Temperatures with Actual Monthly Average Water Temperature Observations in South Boulder Creek at the Gross Reservoir Outlet and Diversion Sites**

| Month | Simulated Average Baseline Temperature | | | | Simulated Average 1a Temperature | | | | Actual Temperature Observations | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2009 (1971-1972) | | 2012 (1971-1972) | | 2009 (1971-1972) | | 2012 (1971-1972) | | Gross Reservoir Outlet (2009-2014) | | South Boulder Creek Canal Diversion (2005-2014) | |
| | Range | Average | Range | Average | Range | Average | Range | Average | Range | Average | Range) | Average |
| January | 1.3-3.0 | 2.1 | 2.5-4.0 | 3.3 | 1.8-2.7 | 2.3 | 2.7-3.6 | 3.2 | 2.0-3.0 | 2.6 | 0-7 | 2 |
| February | 1.0-2.8 | 1.9 | 1.1-4.0 | 2.5 | 0.2-1.6 | 0.9 | 1.2-2.7 | 1.9 | 1.7-3.1 | 2.3 | 0-7 | 3 |
| March | 2.1-3.0 | 2.6 | 1.6-3.9 | 2.8 | 0.8-2.0 | 1.4 | 1.0-1.7 | 1.4 | 2.3-3.2 | 2.7 | 2-6 | 4 |
| April | 3.3-3.9 | 3.6 | 3.6-4.1 | 3.9 | 2.0-2.0 | 2.0 | 3.1-3.6 | 3.3 | 2.8-4.2 | 3.5 | 1-9 | 6 |
| May | 4.9-5.5 | 5.2 | 4.1-5.7 | 4.9 | 4.0-4.0 | 4.0 | 4.7-4.7 | 4.7 | 3.3-5.0 | 4.4 | 4-14 | 8 |
| June | 5.8-6.4 | 6.1 | 6.1-6.2 | 6.1 | 5.8-6.2 | 6.0 | 6.4-7.0 | 6.7 | 4.6-6.4 | 5.7 | 8-12 | 9 |
| July | 6.1-7.8 | 6.9 | 6.2-8.4 | 7.3 | 7.1-7.5 | 7.3 | 6.8-7.9 | 7.3 | 5.4-7.5 | 6.5 | 8-13 | 10 |
| August | 8.2-10.0 | 9.1 | 7.5-9.4 | 8.4 | 7.4-8.1 | 7.7 | 6.8-8.1 | 7.5 | 5.9-8.8 | 7.7 | 10-15 | 12 |
| September | 12.1-12.7 | 12.4 | 11.8-12.7 | 12.2 | 7.5-8.4 | 8.0 | 6.9-8.3 | 7.6 | 6.6-10.6 | 8.8 | 10-15 | 12 |
| October | 9.2-9.5 | 9.3 | 11.0-11.1 | 11.0 | 7.9-8.8 | 8.4 | 6.9-8.5 | 7.7 | 7.6-10.9 | 9.5 | 8-12 | 10 |
| November | 5.4-5.6 | 5.5 | 7.0-7.3 | 7.2 | 6.3-6.6 | 6.5 | 7.1-7.9 | 7.5 | 6.0-9.0 | 7.8 | 0-8 | 4 |
| December | 2.2-3.7 | 3.0 | 4.2-4.5 | 4.3 | 3.9-4.0 | 4.0 | 5.0-5.3 | 5.1 | 3.0-5.0 | 4.1 | 0-4 | 2 |
| **Average** | **5.6** | **5.6** | **6.0-6.4** | **6.2** | **4.9-4.9** | **4.9** | **5.2-5.5** | **5.3** | **4.3-6.4** | 5.5 | **4.3-10.2** | **7.0** |

[1] Both the range and average of the range are provided for each month (simulated or observed data). The highlighted months are the months when the impact of the Proposed Project (w/ RFFAs) is expected to be the most significant, based on modeled results.

- The simulated baseline temperatures from the Gross Reservoir model (simulated present conditions) do not correspond well with water temperatures observed during the 2009 to 2014 period (actual present conditions) below Gross Reservoir for the months of August to October. Existing temperatures are cooler. Given the observed differences between the model and observations in recent years, uncertainty has been created with regards to the degree that the model simulates future conditions, which predict a truncated peak temperature, generally in the months of August to October.

- To the degree that peak temperatures are actually truncated under future conditions, this would constitute an impact to the seasonal temperature pattern that occurs under present conditions. However, as noted above, uncertainty exists with regards to the degree that peak temperatures will be truncated in the future.

- There is no expectation of an "abrupt change" in temperature with the Proposed Action. If the project results in a colder hypolimnion and colder water is discharged, this change will occur somewhat gradually. This is important given that there will be opportunity for the aquatic community to acclimate to the small changes (see Appendix B1 regarding importance of acclimation with regards to potential temperature impacts).

### *Aquatic Life Protection – Key Technical Findings*

Based on a review of potential impacts of the Proposed Action on the resident aquatic community, the following findings can be made:

- Rainbow trout is the dominant fish species in South Boulder Creek below Gross Reservoir; a review of temperature preferences for this fish species demonstrates the following:

  - Under present conditions, water temperatures in the reach of concern are already well below "optimal" temperatures for all life stages except spawning (see Tables B1-11, B1-12a; Figures B1-17, and B1-19 in Appendix B1).

  - While present water temperature conditions are well below optimal, minimum acceptable temperatures for rainbow trout currently exist under present conditions and will continue to exist for the most part under future conditions (see Table B1-12, B1-12a; Figures B1-18, and B1-20 in Appendix B1).

  - If the Proposed Action results in the colder water temperatures to the degree simulated in the temperature model, the resulting temperatures are still well within the minimum acceptable temperature range for rainbow trout life stages (see Table B1-12 in Appendix B1).

  - Even with existing cold temperatures, previous studies in the reach of concern observed that the biomass of rainbow trout is "the highest of any section of South Boulder Creek in the study areas. It is over five times the level found in any of the other sections" (Denver Water 1998). It is a reasonable assumption that the local population has acclimated well to temperatures below Gross Reservoir and reproductive functions of adult fish are not being impacted.

  - If colder temperatures result from project implementation, the FEIS notes that the primary impact of these colder temperatures will be on trout growth rates, and can also influence reproductive function (see TableB1-6 in Appendix B1). A review of the literature agrees

with this finding (e.g., see discussion of fish temperature requirements in Section B1.1.3 and Figure B1-12 in Appendix B1).

  - The most likely period of impact from lower temperatures would be the months of August to October (e.g., see Tables B1-7 or B1-12 in Appendix B1). During this period, fry, juvenile, and adult life stages will be present. While growth rates may be lower, the minimum temperature needs for all of these life stages is within the modeled future temperature conditions for the reach.

  - The effect of the cooler temperatures expected as a result of the Proposed Action and RFFAs on the metabolism and growth of the fish community below Gross Reservoir cannot be estimated based on available data. This creates uncertainty with regards to evaluating potential impacts to this characteristic of the fish community; thus, it is not possible to classify the impact of the Proposed Action and RFFAs as significant or not within the context of this antidegradation review.

- A brief review of the temperature preferences of the other two common species in the reach of concern, longnose dace and longnose sucker, finds that the temperature preferences for longnose sucker are similar to those of rainbow trout. Longnose dace appear to prefer warmer water, yet they have been found to be regularly present under present cold temperature conditions.

- The reach between Gross Reservoir Outlet and the Diversion site is approximately 4.9 river miles. Figure B1-9 illustrated the typical temperature differential in this reach over the last few years. Given the >2 degrees C temperature difference over the reach and the expected warmer water near the outlet during winter months (in particular December and January), the impact of colder water during certain months would likely be mitigated in part by fish movement within the reach.

- An evaluation of potential impairment of the Aquatic Life Cold 1 designated use centers on a demonstration of fulfillment of this requirement: *Waters shall be capable of sustaining such biota where physical habitat, water flows or levels, and water quality conditions result in no substantial impairment of the abundance and diversity of species* (Regulation 31.13(1)(c)(i)). A review of the available fish and macroinvertebrate community data demonstrate the following support for this requirement:

  - Fish surveys have shown that the existing fish community is sustaining; in fact, it has been previously reported that fish biomass in South Boulder Creek below Gross Reservoir is substantially higher than other sites in the upper watershed of South Boulder Creek (Denver Water 1998). It is a reasonable assumption from these findings that the reproductive function of adult fish is not being impacted.

  - Fish abundance is high as evidenced by the 1983 to 1996 fish surveys (see Table B1-9).

  - Overall fish diversity is low compared to some waters (only three to four species/survey, see Table B1-9). However, low fish diversity is common in cooler waters. Moreover, low fish diversity has been reported from this reach of South Boulder Creek over a 20-year period and represents the present condition before project implementation. Based on a review of temperature preferences for the resident fish community, no significant impact on existing fish diversity would be expected following project implementation.

- Available macroinvertebrate data from the location below the Diversion site demonstrate an abundant and diverse community. Macroinvertebrate metabolism and growth can be affected by cooler temperatures; however, similar to the fish community potential effects cannot be estimated based on available data. This creates uncertainty with regards to evaluating potential impacts from cooler temperatures on metabolism and growth. Accordingly, it is not possible to classify the potential impact of the Proposed Action and RFFAs as significant or not within the context of this review.

***Conclusions***

The final conclusions from the temperature and aquatic life technical analyses provided in Appendix B1 are as follows:

- *Temperature Pattern* – Under present conditions, the temperature pattern in the reach below Gross Reservoir is influenced by the operation of the Gross Reservoir dam. While the existing diel pattern and spatial diversity of temperature is not expected to change below the reservoir under future conditions, the potential exists for peak temperatures during the August to October period to be truncated, resulting in a seasonal change in the existing temperature pattern (cooler water temperature). This has been documented through a model simulation, but as noted above, based on actual temperature observations, the model may be overestimating the degree to which peak temperatures will be truncated. Moreover, as ambient temperatures naturally increase as waters flow downstream, the potential impact from truncated temperatures would decrease.

- *Aquatic Life Protection* – A review of the known resident fish and macroinvertebrate communities below Gross Reservoir coupled with an evaluation of species-specific water temperature preferences and tolerances finds that the Proposed Action and RFFAs will likely not impact overall aquatic community characteristics. The potential does exist for cooler temperatures to impact the metabolism and growth of fish and macroinvertebrate species. However, it is not possible to measure or classify this impact given the available data to determine if the impact is significant. Decreases in water temperature at this location would be gradual, allowing time for aquatic life to adjust and benefit from improved habitat as a result of higher flows during normal low flow period. Moreover, with distance downstream ambient water temperatures would naturally increase, thus under future conditions water temperatures would remain in the acceptable range.

### 4.5.2.3 MMI in South Boulder Creek

**Figure 4-5** identifies two locations in this river basin where the Division has collected MMI data. **Table 4-20** summarizes available information from these findings. It appears that the Division did not use these MMI results in its 2012 Integrated Report for evaluating aquatic life use attainment; however, based on the MMI assessment results, the aquatic life use was found to be attained based on the MMI data.

Table 4-20 also summarizes the potential impact of water diversions from the Proposed Action plus RFFAs on the sites where MMI data have been collected in South Boulder Creek. The sites with MMI data have limited potential to be impacted by the Proposed Action plus RFFAs since both sites are well downstream of the South Boulder Creek Canal Diversion. Relatively small changes in flows are expected downstream of this diversion [Average –3 percent, Wet – 8 percent, Dry – +1 percent (percent change in yearly average from Current Conditions to Proposed Action plus RFFAs)].

**Table 4-20. MMI Data Results for South Boulder Creek Basin**

| Assessment ID or WBID | Segment | MMI Data | Potential Impact of Proposed Action Plus RFFAs |
|---|---|---|---|
| COSPBO04A_0800 | Source to outlet of Gross Reservoir | No MMI data available | Reach will receive water from west slope diversions; 2012 Integrated Report indicates this reach is fully supporting its Aquatic Life Cold 1 use; no corresponding MMI data available |
| COSPBO04B_0800 | South Boulder Creek below Gross Reservoir | Below Gross Reservoir to South Boulder Creek Canal Diversion - No MMI data available; no assessment information in Integrated Report | Increased flows below Gross Reservoir; modified temperature regime. |
| | | MMI data available from sites:<br>• Site 5589 – at South Mesa Open Space; and<br>• Site 5588 – at South Boulder Road<br><br>Both sites are well downstream of South Boulder Creek Canal Diversion; all MMI results from sites show that this portion of South Boulder Creek is in attainment of the Aquatic Life Use | Impact unknown – sites well below the South Boulder Creek Canal Diversion |

For other reaches of South Boulder Creek where the Proposed Action plus RFFAs has the potential to impact flow and water quality, the lack of MMI data limits this evaluation of potential direct impacts to the aquatic community. Given the lack of MMI data, no additional evaluation of potential project direct impacts on the aquatic community based on MMI data was made. Instead, any potential impacts to aquatic life are evaluated through the water quality analyses for the river basin (see Sections 4.5.1 and 4.5.2.2).

### 4.5.3 Summary of South Boulder Creek Findings

The water quality impacts analyses presented above indicate that the Proposed Action plus RFFAs may have impacts or contribute to a water quality exceedance in the South Boulder Creek basin for the following parameters during specified times:

- **Dissolved copper** – the baseline condition for dissolved copper in South Boulder Creek near East Portal currently exceeds the applicable hardness-based WQS. Through mass-balance calculations, slight increases are predicted to occur during November and December during average years, October through April (excluding February) during dry years, and October through February and April of wet years.

Significant water quality improvements are predicted to occur in June under the wet scenario for dissolved copper, total and dissolved iron, and dissolved zinc.

Additional analyses were performed for basin-specific parameters of concern. The results of impacts analyses for these parameters indicate:

- **Methylmercury** – through the Bioaccumulative Toxic Pollutant Test, the mercury load to Gross Reservoir is likely to increase more than 10 percent based on a surrogate estimate of changes in annual flow contributions during the average scenario. MeHg in fish tissue may also increase

following reservoir enlargement and as a result of annual shoreline fluctuations associated with reservoir operations.

- **Temperature below Gross Reservoir** –The potential exists for expected cooler temperatures to impact the metabolism and growth of fish and macroinvertebrate species below Gross Reservoir. However, it is not possible to measure or classify this impact given the available data.
- **Potential Impacts to the Aquatic Macroinvertebrate Community as Measured by MMI** – MMI data are limited to sites below the South Boulder Creek Canal Diversion and impacts to these sites are unknown and likely limited as flow changes below the Denver Water diversion as a result of the Proposed Action plus RFFAs will be minimal.

## 4.6 North Fork South Platte River

The North Fork South Platte River basin is located on the east side of the Continental Divide. The river flows from Kenosha Pass to the South Platte River, and drains approximately 480 square miles total, including approximately 130 square miles above Geneva Creek (**Figure 4-6**). Water is diverted across the Continental Divide to the North Fork South Platte River from Dillon Reservoir in the Blue River basin via the Roberts tunnel. The east portal of the Roberts Tunnel is located 12 miles downstream of the Continental Divide.

Changes in flow in the North Fork South Platte River associated with the Proposed Action plus RFFAs would occur as a result of a change in Denver Water's seasonal operations and overall increased diversions. Diversions through the Roberts Tunnel during average years, compared to current conditions, will decrease from November through April resulting in lower flows in the North Fork South Platte River during these months. In average years, summer diversions through Roberts Tunnel will generally be higher, and flows in the North Fork South Platte River will be higher on average from May through October. Seasonal decreases in diversions occur during dry years in January, February, and March, and occur during wet years in November through April.

### 4.6.1 North Fork South Platte River Quantified AD Results

Flows diverted from the Blue River basin are brought into the North Fork South Platte River basin via the Roberts Tunnel. Consequently, it is reasonable to expect that potential impacts from the Proposed Action plus RFFAs will be greatest immediately downstream of the Roberts Tunnel outfall and that impacts will decrease with distance downstream as unaffected tributaries contribute additional flow to the mainstem of the river. Quantified mass-balance calculations were performed for selected parameters based on the available water quality data collected at the closest water quality monitoring site downstream of the Roberts Tunnel outfall (Figure 4-6). The water quality site (Denver Water monitoring location WS-NF-005: North Fork South Platte above Geneva Creek) is located 0.75 miles downstream of the Roberts Tunnel outfall and 0.5 miles upstream of the closest PACSM site (Node 50700 – North Fork South Platte below Geneva Creek). For water quality analyses to be more representative of flow at the water quality site, PACSM flow values were scaled, based on the drainage areas associated with the two sites (WS-NF-005 and PACSM Node 50700), to subtract any watershed flow contributions that occur between the water quality and PACSM sites.

#### 4.6.1.1 North Fork South Platte River Data Development

Existing baseline water quality conditions used in the mass-balance calculations for the North Fork South Platte River were calculated using water quality data available from Denver Water's monitoring location WS-NF-005 (North Fork South Platte River above Geneva Creek). The available dataset for

station WS-NF-005 includes 68 discrete samples collected between January 2006 and June 2014. Analytical results were available for all of the parameters of concern (identified in Section 3.1) except total nitrogen, sulfate, and chloride (see **Table 4-21**). As with other water quality data provided by Denver Water, "j-flagged" results were included in the analysis due to the elevated reporting limits inherent to the dataset (see discussion in Section 3.3). Baseline water quality values for input into the mass-balance calculations were derived by using the 85th percentile of all dissolved fraction parameters and the median value for parameters reported as a total fraction.

**Table 4-21. Calculated Baseline Water Quality Concentrations for the North Fork South Platte above Geneva Creek and for the Roberts Tunnel Outfall**

| Parameter | WS-NF-005 North Fork South Platte above Geneva Creek | WS-BL-005 Roberts Tunnel Outfall |
|---|---|---|
| Total Phosphorus (mg/L) | 0.004 | 0.004 |
| Total Nitrogen (mg/L) | No Data | No Data |
| Manganese (diss) (µg/L) | 31 | 9.0 |
| Iron (diss) (µg/L) | 70 | 20 |
| Iron (Trec) (µg/L) | 390 | 40 |
| Selenium (diss) (µg/L) | 0.3 | 0.3 |
| Zinc (diss) (µg/L) | 38 | 39 |
| Lead (diss) (µg/L) | 0.11 | 0.07 |
| Copper (diss) (µg/L) | 7.0 | 2.4 |
| Sulfate (mg/L) | No Data | No Data |
| Chloride (mg/L) | No Data | No Data |

To characterize the water quality of the water entering the North Fork South Platte River watershed via the diversion from the Blue River watershed, data from a Denver Water monitoring station located at the outlet of the Roberts Tunnel was used (WS-BL-005). The available dataset from this location includes 51 samples collected between January 2006 and September 2013 for each of the available parameters. As with the water quality sampling data from the mainstem of the North Fork South Platte River, analytical results were not available for total nitrogen, sulfate, or chloride in these datasets and "j-flagged" results were included in the analyses.

As described in Section 3, future impacts and AD were assessed using conservative mass-balance calculations. In these calculations, future pollutant concentrations are estimated as a function of current conditions, future flow projections, and changes in diversion water loads.

### 4.6.1.2 North Fork South Platte River Data Analysis Results

Representative baseline concentrations for the North Fork South Platte River and for diverted water entering the North Fork South Platte River via the Roberts Tunnel were calculated as 85th percentile or median concentrations (Table 4-21). Water quality standards, baseline concentrations, and SCTs for all modeled constituents in the North Fork South Platte River are summarized in **Table 4-22**. The mass balance calculations are available in Appendix C and can be found in an *Excel* spreadsheet dated March 25, 2015 (*North Fork South Platte MB 03-25-15.xlsx*).

**Table 4-22. North Fork South Platte above Geneva Creek - Baseline Conditions and Significance Threshold**

| Parameter | Water Quality Standard (WQS) | Baseline Concentration (BWQ) | Significant Concentration Threshold (SCT)[2] |
|---|---|---|---|
| Total Phosphorus (mg/L) | 0.11 | 0.004 | 0.02 |
| Total Nitrogen (mg/L) | 1.3 | No Data | No Data |
| Manganese (diss) (µg/L) WS | 50.0 | 31 | 34 |
| Manganese (diss) (µg/L) [1] | 1,570 | 31 | 262 |
| Iron (diss) (µg/L) | 300 | 70 | 104 |
| Iron (Trec) (µg/L) | 1,000 | 390 | 482 |
| Selenium (diss) (µg/L) | 4.6 | 0.30 | 0.94 |
| Zinc (diss) (µg/L) [1] | 106 | 38 | 45 |
| Lead (diss) (µg/L) [1] | 2.14 | 0.11 | 0.42 |
| Copper (diss) (µg/L) [1] | 7.9 | 7.0 | 7.1 |
| Sulfate (mg/L) | 250 | No Data | No Data |
| Chloride (mg/L) | 250 | No Data | No Data |

WS = Water Supply Use

[1] WQS calculated using an average hardness of 86.2 mg/L at North Fork South Platte above Geneva Creek

[2] SCT is calculated as SCT = [(WQS – BWQ) * 0.15] + BWQ

### 4.6.1.3 North Fork South Platte River AD Results

**Table 4-23** summarizes the results for each of the parameters analyzed through mass-balance calculations in the North Fork South Platte River basin. Erosion of assimilative capacity was predicted for the following pollutants:

- **Dissolved Copper** – the SCTs for dissolved copper are predicted to be exceeded from November through March in average years; January through March in dry years; and November through April in wet years. Copper is sensitive to flow changes in the North Fork South Platte River basin because baseline concentrations are very close to the SCT and the quality of the diverted water is high (lower copper concentrations than in the receiving water). All SCT exceedances are seen during months when flows are projected to decrease from the Proposed Action and RFFAs. In addition, exceedances of the dissolved copper standard are predicted during the months of greatest flow decreases under each hydrologic scenario: December through March in average years; March in dry years; and January through March in wet years.

- **Total Iron** – the SCT for total iron is predicted to be exceeded January through March of average and wet years. Baseline concentrations of total iron are much lower in the diverted water than in the receiving water and impacts are greatest during the months associated with the greatest decreases in water diverted into the basin.

- **Dissolved Manganese** – the water supply standard derived SCTs for dissolved manganese are predicted to be exceeded November through March in average years; January through March in dry years; and December through March in wet years. Similar to copper, manganese is sensitive to flow changes in the North Fork South Platte River basin because baseline conditions are very close to the water supply standard derived SCT and the assumed quality of the diverted water is high (lower manganese concentrations than in the receiving water). All SCT exceedances are seen during months when flows are projected to decrease from the Proposed Action and RFFAs.

**Table 4-23. North Fork South Platte River above Geneva Creek SCT Exceedances**

| Parameter | Average | | | | | | | | | | | | Dry | | | | | | | | | | | | Wet | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Month* | 10 | 11 | 12 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| Copper, Dissolved (µg/L) | ↑ | X | X | X | X | X | | ↑ | ↑ | ↑ | ↑ | ↑ | ↑ | | | X | X | X | | ↑ | ↑ | ↑ | | | ↑ | X | X | X | X | X | X | | | | ↑ | ↑ |
| Iron, Dissolved (µg/L) (WS) | ↑ | | | | | | | ↑ | ↑ | ↑ | ↑ | ↑ | ↑ | | | | | | | ↑ | ↑ | ↑ | ↑ | | ↑ | | | | | | | | | | ↑ | ↑ |
| Iron, Total (µg/L) | ↑ | | | X | X | X | | ↑ | ↑ | ↑ | ↑ | ↑ | ↑ | | | | | | | ↑ | ↑ | ↑ | ↑ | | ↑ | | | X | X | X | | ↑ | | | ↑ | ↑ |
| Lead, Dissolved (µg/L) | | | | | | | | ↑ | | ↑ | | | | | | | | | | | | | | | | | | | | | | | | | ↑ | ↑ |
| Manganese, Dissolved (µg/L) (WS) | ↑ | X | X | X | X | X | | ↑ | ↑ | ↑ | ↑ | ↑ | ↑ | | | X | X | X | | ↑ | ↑ | ↑ | ↑ | | ↑ | | X | X | X | X | | | | | ↑ | ↑ |
| Manganese, Dissolved (µg/L) | ↑ | | | | | | | ↑ | ↑ | ↑ | ↑ | ↑ | ↑ | | | | | | | ↑ | ↑ | ↑ | ↑ | | ↑ | | | | | | | | | | ↑ | ↑ |
| Phosphorus, Total (mg/L) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Selenium, Dissolved (µg/L) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Zinc, Dissolved (µg/L) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

| | |
|---|---|
| X = | 15% of Baseline Available Increment exceeded |
| = | Contributes to an existing WQS exceedance |
| ↑ = | 15% water quality improvement |

Additionally, water quality improvements resulting from the Proposed Action plus RFFAs that are greater than 15 percent are noted in the table with a "↑" symbol. Significant improvement to water quality is predicted for dissolved copper, dissolved and total iron, dissolved lead, and dissolved manganese during many of the months when flows increase due to the Proposed Action plus RFFAs (typically summer and fall) (Table 4-23).

## 4.6.2 Other North Fork South Platte Basin Results

In addition to the AD analysis findings presented above, the potential impacts to the aquatic community as measured by MMI were reviewed. The results of this exercise are presented below.

### 4.6.2.1 MMI in North Fork South Platte River

**Figure 4-6** identifies one location in this river basin where the Division has collected MMI data. **Table 4-24** summarizes the available information from this dataset. It appears that the Division did not use these MMI results in its 2012 Integrated Report for evaluating aquatic life use attainment; however, based on the MMI assessment results, the aquatic life use was found to be impaired based on the MMI data.

**Table 4-24. MMI Data Results for North Fork South Platte River Basin**

| Assessment ID or WBID | Segment | MMI Data | | | | | | | Potential Impact of Proposed Action Plus RFFAS |
|---|---|---|---|---|---|---|---|---|---|
| | | Location | Bio-Type | Sample Date | MMI | HBI | SDI | MMI Assessment | |
| COUSPUS04 | Source to South Platte River confluence | CU-NFSP -Above Roberts Tunnel | 1 | 10/5/04 | 25.8 | 3.34 | 2.94 | Impair | MMI data from a location upstream of the Roberts Tunnel, which is where diverted water enters the watershed. |

The one site where MMI data are available (CU-NFSP) is located upstream of where water delivered by the Roberts Tunnel enters the watershed (Table 4-24). Given that this site is upstream of any potential impacts from increased or decreased water deliveries, assessment of impacts as measured by MMI data cannot be performed. Given the lack of MMI data in the North Fork South Platte River segment below the Roberts Tunnel, no additional effort was made to evaluate potential project impacts on the aquatic community based on MMI data (although it is noted that the 2012 Integrated Report indicates that the North Fork South Platte River from source to South Platte River is fully supporting its Aquatic Life Cold 1 use). Instead, any potential impacts to aquatic life are evaluated through the quantified water quality analyses for the river basin (see Table 4-23 for AD analysis results).

## 4.6.3 Summary of North Fork South Platte Findings

The water quality impacts analyses presented above indicate that the Proposed Action plus RFFAs may have impacts or contribute to a water quality exceedance in the North Fork South Platte River basin for the following parameters during specified times:

- **Dissolved Copper** – the SCTs for dissolved copper are predicted to be exceeded November through March in average years; January through March in dry years; and November through April in wet years. In addition, the dissolved copper standard is predicted to be exceeded during the months of greatest flow decreases under each hydrologic scenario: December through March in average years; March in dry years; and January through March in wet years.

- **Total Iron** – the SCT for total iron is predicted to be exceeded January through March of average and wet years.
- **Dissolved Manganese** – the water supply standard derived SCTs for dissolved manganese are predicted to be exceeded November through March in average years; January through March in dry years; and December through March in wet years. It should be noted that the standard for dissolved manganese is based on secondary drinking water guidelines for the aesthetic quality of drinking water.

Significant water quality improvements are predicted for dissolved copper in May through October of average years, May through July and October of dry years, and August through October of wet years; dissolved iron in May through October of average years, May through August and October of dry years, and August through October of wet years; total iron in May through October of average years, May through August and October of dry years, and August through October and May of wet years; and dissolved manganese in May through October of average years, May through August and October of dry years, and August through October of wet years.

Additional review for the assessment of impacts to the macroinvertebrate community as measured by MMI could not be performed because data are currently only available from a site that is upstream of the Roberts Tunnel outfall and is not impacted by the Proposed Action plus RFFAs.

## 4.7 South Platte River

The affected section of the mainstem South Platte River extends from Antero Reservoir to Big Dry Creek near the Henderson gage (**Figure 4-7**). This reach contains six mainstem reservoirs: Antero, Spinney Mountain, Eleven Mile Canyon, Cheesman, Strontia Springs, and Chatfield. The drainage area of the South Platte River at the Henderson gage is over 4,750 square miles and includes both undeveloped and highly developed lands along the base of the Front Range. A large number of water users and diversions exist within the basin making the system very complex. Denver Water diverts water into the greater South Platte River drainage through the Roberts Tunnel, which enters the North Fork South Platte River subbasin as described above (Section 4.6).

### 4.7.1 South Platte River Qualitative Review Results

Although the Proposed Action plus RFFAs results in increased water deliveries to the South Platte River basin, no quantitative AD or water quality impact analysis was conducted for this basin. This approach was implemented because any impacts to South Platte River sites as a result of changes to the volume and timing of trans-basin diversion related to the Proposed Action plus RFFAs would occur downstream of the confluence with the North Fork South Platte River. Impacts are being quantified in the North Fork South Platte River basin, but any potential impacts will be lessened downstream of this basin in the mainstem South Platte River basin.

The Proposed Action will result in changes to operations at Antero, Eleven Mile, and Cheesman reservoirs as a greater proportion of the annual flows diverted to water treatment facilities will be directed through the North System and the Moffat WTP. In general, these changes would result in flow changes of less than 10 percent from the three reservoirs but will vary somewhat under each flow scenario. Assessment of the water quality impacts caused by changes in flows from these reservoirs is not possible due to the limited availability of reservoir water quality data, the lack of information/data concerning the processes (e.g., sedimentation or biological uptake) that might alter concentrations between the inlet and the outlet of each reservoir, and the mismatch in time scales relevant to modeling

reservoir processes versus instream concentrations. Moreover, the complexity of water management activities in the South Platte River basin would make it very difficult to separate out any specific potential impacts from the Proposed Action plus RFFAs on this river basin.

### 4.7.2 South Platte River MMI Results

The Division has collected MMI data from various sites in this river basin, but for the reasons described above it is not possible to evaluate any potential direct impacts to the aquatic community as measured by MMI at these sites.

### 4.7.3 South Platte River Findings

Impacts to the North Fork South Platte River basin were detailed in the preceeding section. As water moves downstream from the selected site, unimpacted tributaries and return flows from a number of municipal wastewater treatment facilities add dilution flow and lessen the significance of any identified impacts associated with the Proposed Action plus RFFAs.

## 4.8 Summary of Water Quality Findings

The results of the water quality analyses indicate that, based on the Concentration Test for AD and the "cause or contribute" test for other water quality impacts, the cumulative effects of the Proposed Action plus RFFAs will be an erosion of assimilative capacity for several pollutants in the affected waterbodies in five river basins:

- Fraser River basin: total phosphorus, dissolved iron, and temperature
- Williams Fork River basin: total and dissolved iron, dissolved manganese, and dissolved copper
- Upper Colorado River: temperature
- South Boulder Creek: dissolved copper, and temperature
  - Gross Reservoir: methylmercury (based on the Bioaccumulative Toxic Pollutant Test)
- North Fork South Platte River basin: dissolved copper, total iron, dissolved manganese

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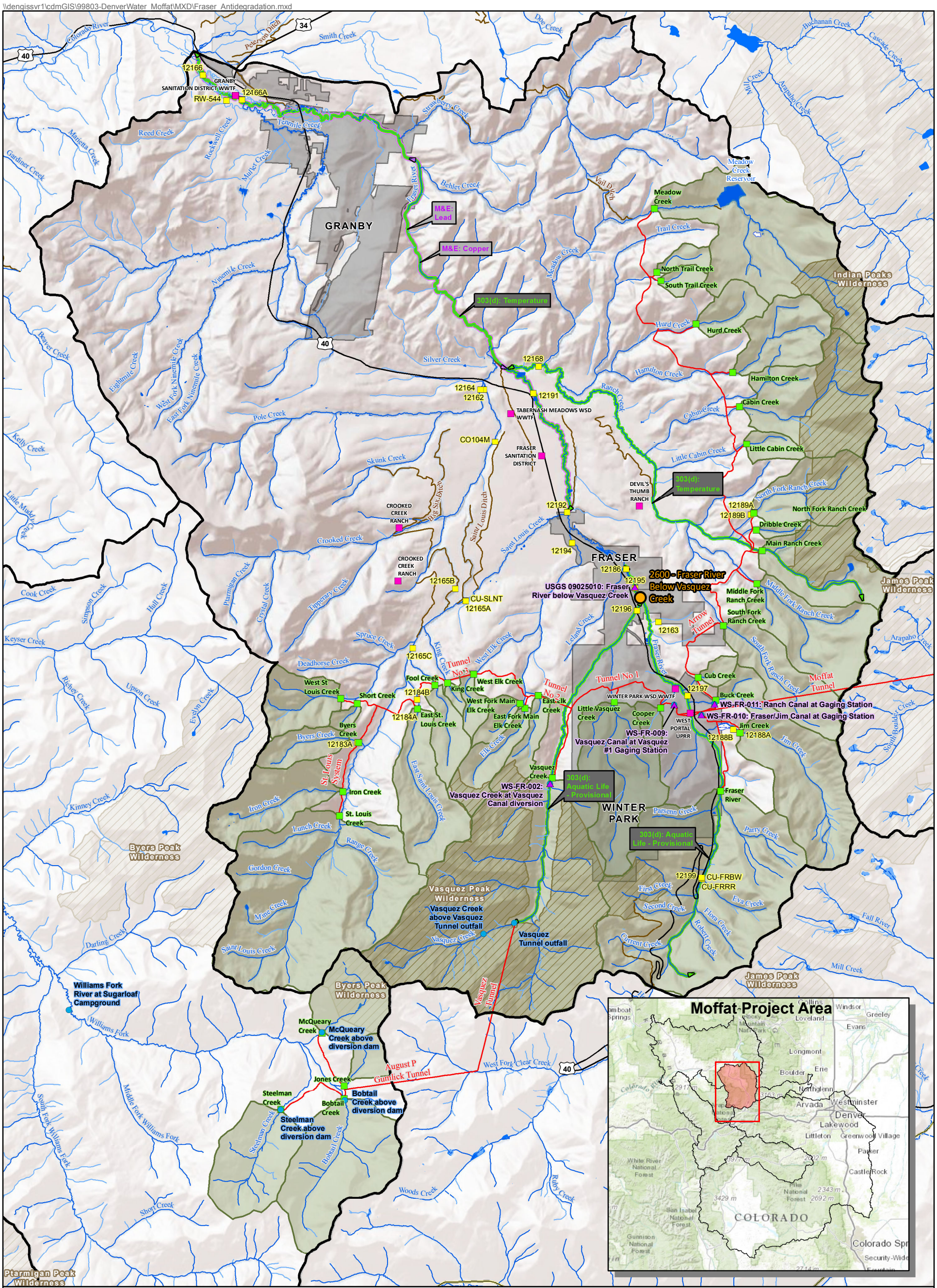


N
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- WQ Site Used for AD Calculations
- PACSM Node Selected for AD Review
- MMI Station
- Denver Water Diversion
- Denver Water WQ Site
- Individual NPDES Permit
- 303(d) Reach
- M&E Reach
- Study Basin
- Collection Watershed
- Wilderness Area
- DW Pipeline, Canal, Tunnel
- Canal/Ditch
- Stream/River (Intermittent)
- Stream/River (Perennial)

**Figure 4-1**
**Fraser River Antidegradation Review**
(April 2015)

CDM Smith

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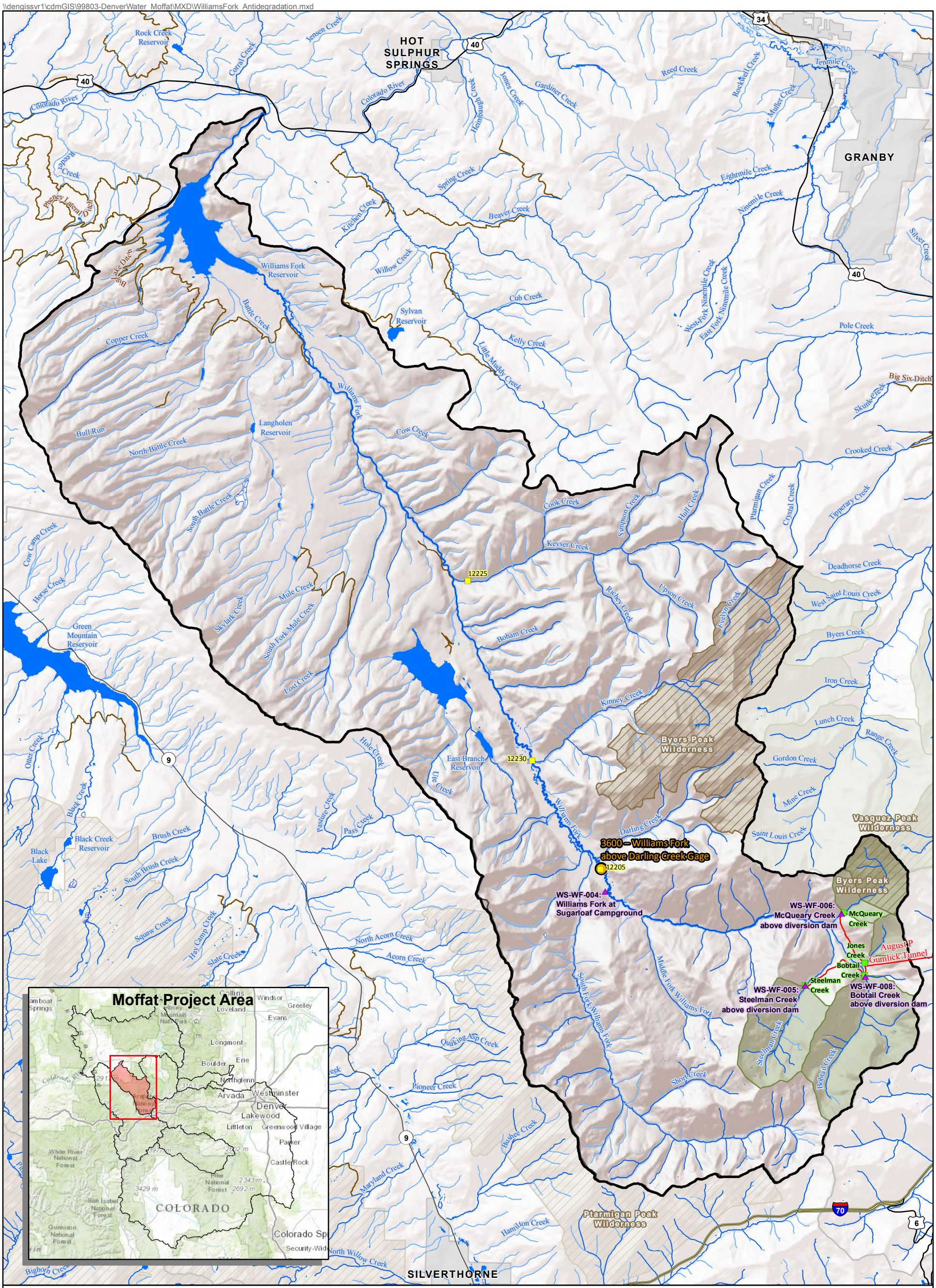


N
W E
S

0 1 2 4 Miles

- PACSM Node Selected for AD Review
- WQ Site Used for AD Calculations
- MMI Station
- DW Diversion
- Williams Fork Mainstem
- Study Basin
- Collection Watershed
- Wilderness Area
- DW Pipeline, Canal, Tunnel
- Canal/Ditch
- Stream/River (Intermittent)
- Stream/River (Perennial)

**Figure 4-2**
**Williams Fork Antidegradation Review**
(April 2015)

CDM Smith

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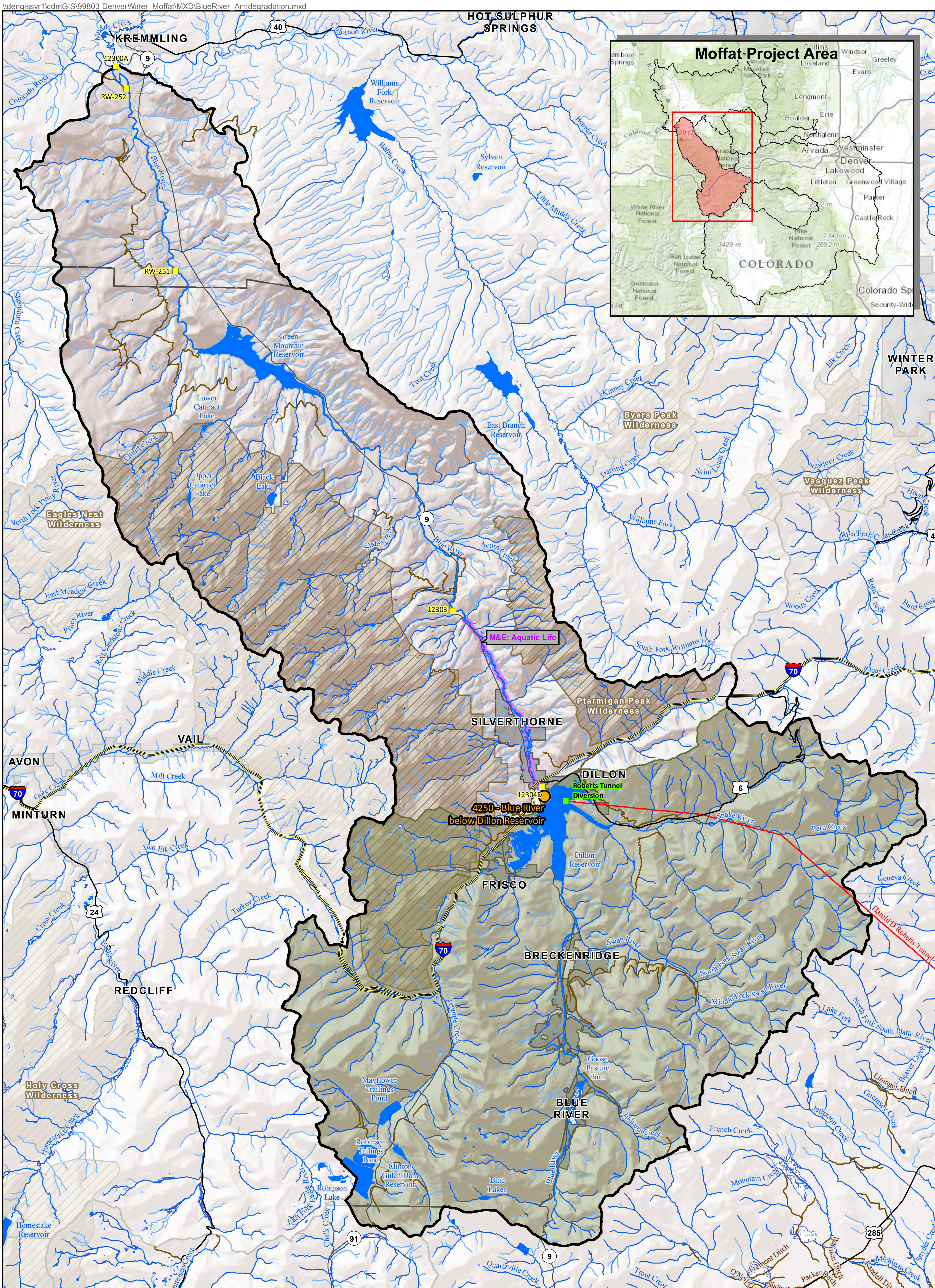


N
W E
S

0 1.5 3 6 Miles

PACSM Node Selected for AD Review
Diversion
MMI Station

Blue River Mainstem
Study Basin
Collection Watershed
Wilderness Area
M&E Reach

Pipeline/Tunnel
Canal/Ditch
Stream/River (Intermittent)
Stream/River (Perennial)

**Figure 4-3**
**Blue River**
**Antidegradation Review**
(April 2015)

CDM Smith

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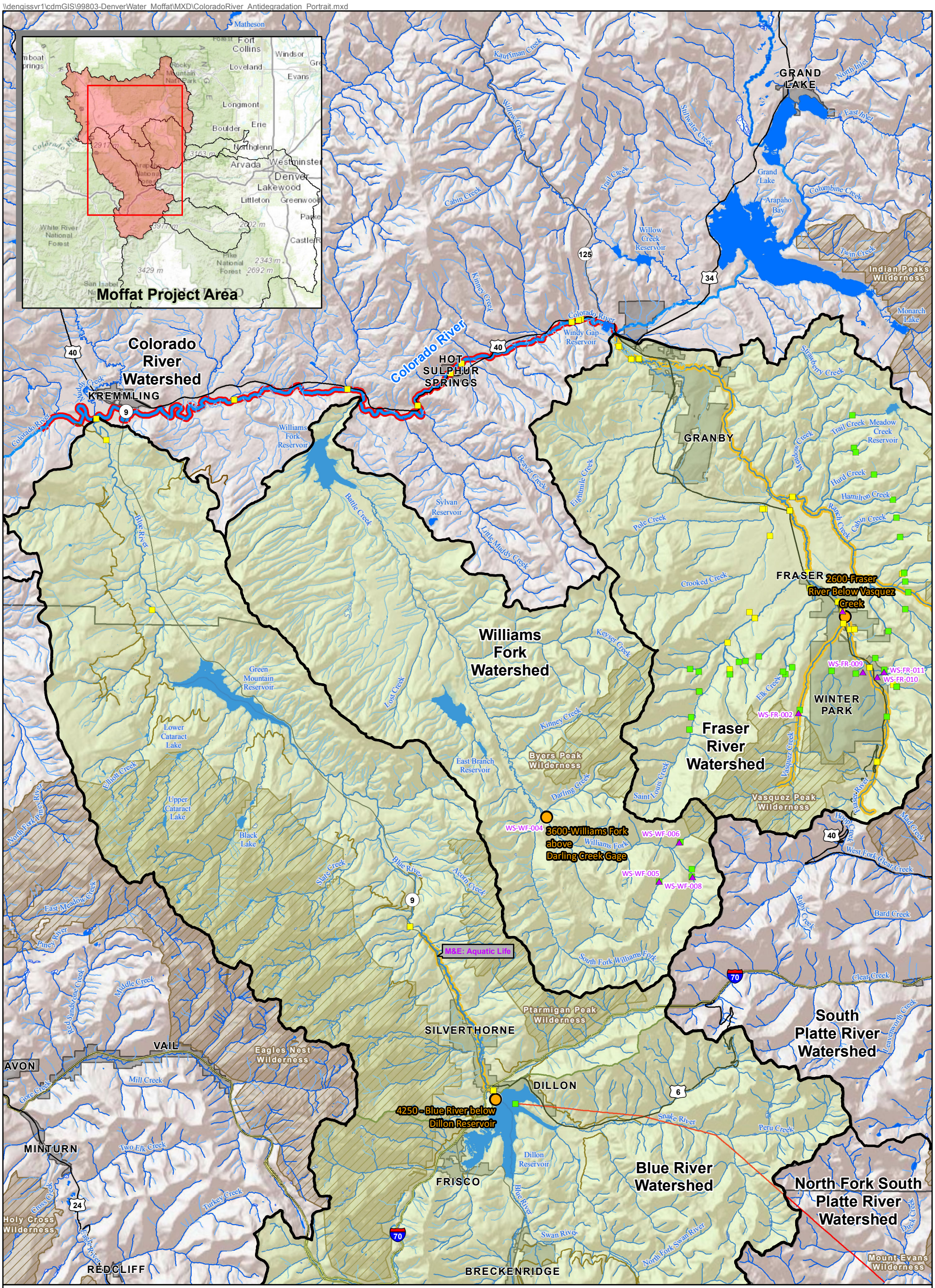
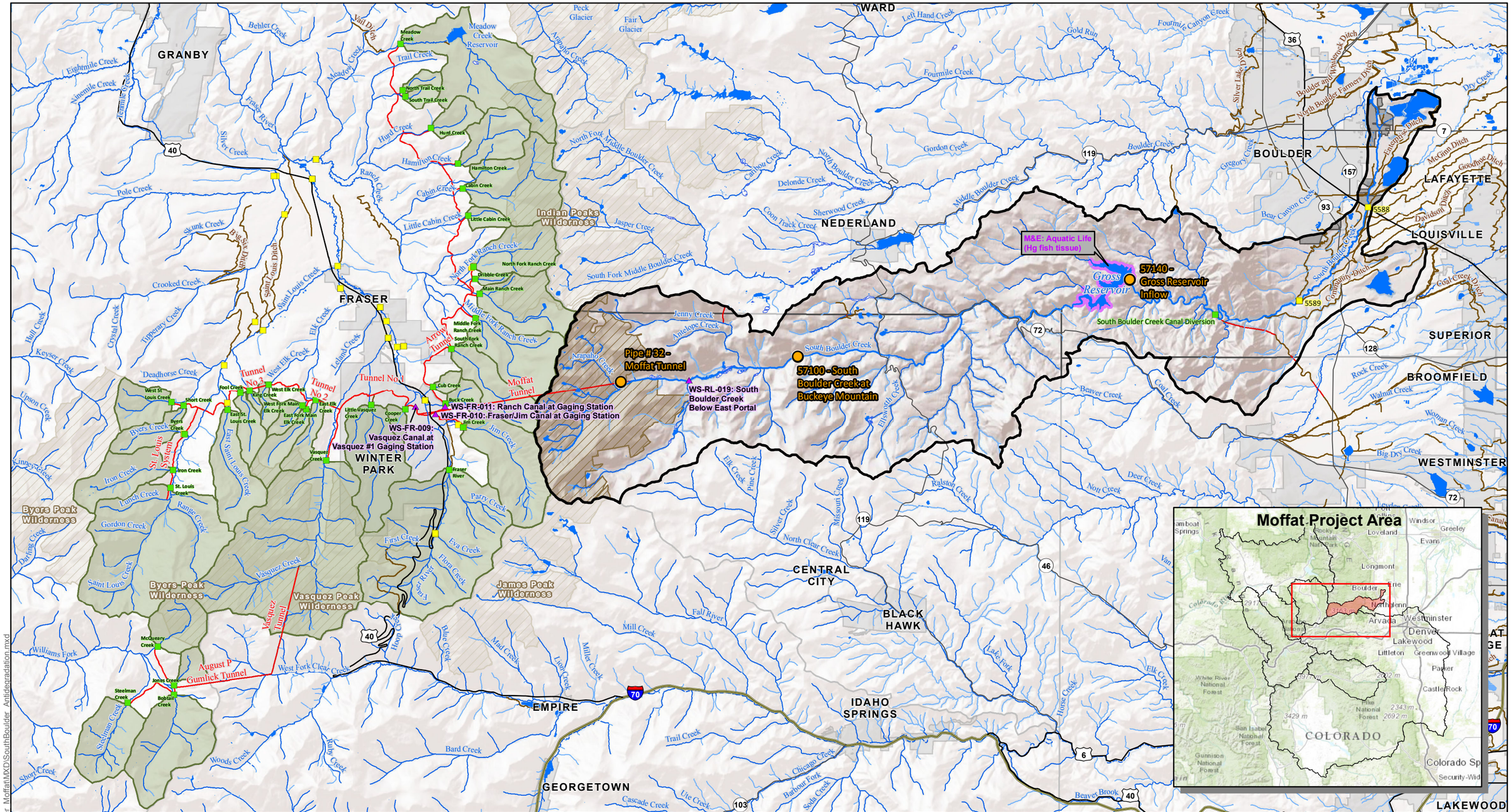



**Figure 4-4**
**Upper Colorado River Antidegradation Review**
(April 2015)

CDM Smith




N
W E
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0 1.5 3 6 Miles

PACSM Node Selected for AD Review
WQ Site Used for AD Calculations
MMI Station
DW Diversion
South Boulder Creek Mainstem
Study Basin
Collection Watershed
Wilderness Area
M&E Reach
Pipeline/Tunnel
Canal/Ditch
Stream/River (Intermittent)
Stream/River (Perennial)

**Figure 4-5**
**South Boulder Creek Antidegradation Review**
(April 2015)

CDM Smith

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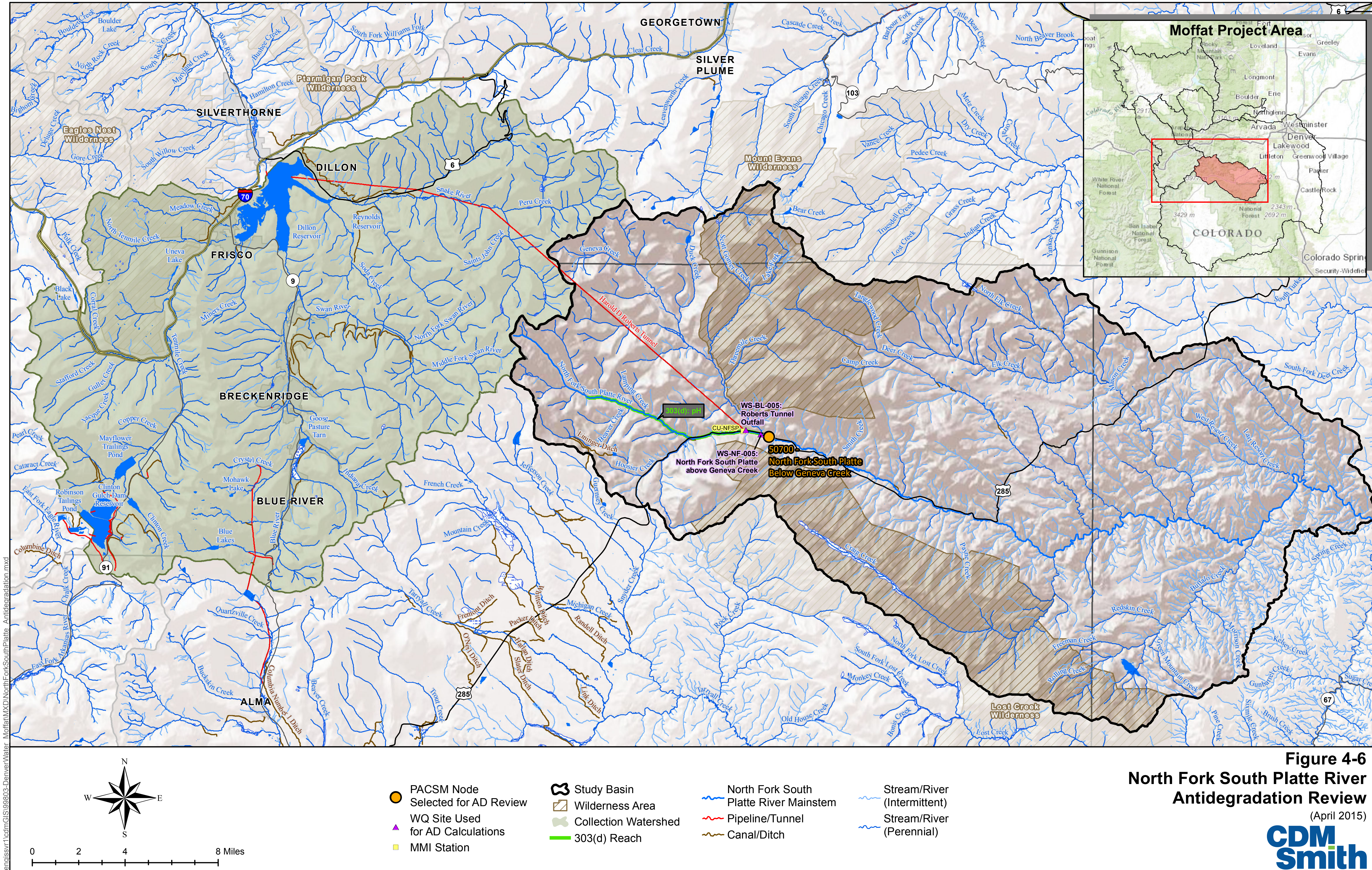


**Figure 4-6**
**North Fork South Platte River Antidegradation Review**
(April 2015)

CDM Smith

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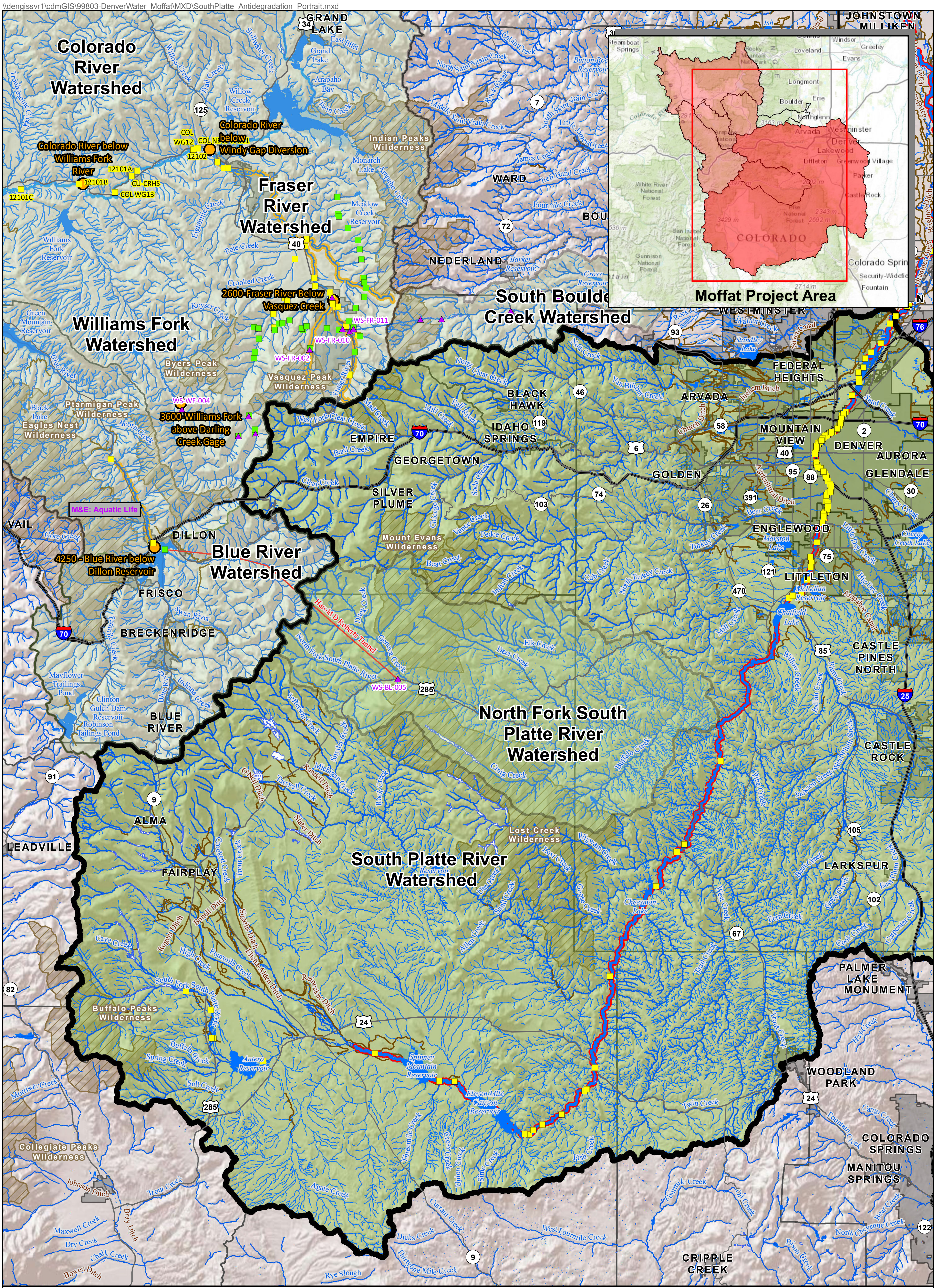


PACSM Node Selected for AD Review
WQ Site Used for AD Calculations
Diversion
MMI Station
South Platte River Basin
Other Study Area Basins
Wilderness Area
303(d)/M&E Reach
South Platte River Mainstem
Pipeline/Tunnel
Canal/Ditch
Stream/River (Intermittent)
Stream/River (Perennial)

N W E S

0 3.25 6.5 13 Miles

**Figure 4-7**
**South Platte River Antidegradation Review**
(April 2015)

CDM Smith

# Section 5

# Mitigation and Environmental Enhancement Commitments

The results of the water quality review in Section 4 indicate that, based on the Concentration Test for AD and the "cause or contribute" test for other water quality impacts, the cumulative effects of the Proposed Action plus RFFAs will be an erosion of assimilative capacity and/or exceedance of standards for several pollutants in the affected waterbodies in five river basins and in Gross Reservoir:

- Fraser River basin: total phosphorus, dissolved iron, and temperature
- Williams Fork River basin: total and dissolved iron, dissolved manganese, and dissolved copper
- Upper Colorado River: temperature
- South Boulder Creek: dissolved copper, and temperature
- Gross Reservoir: methylmercury (based on the Bioaccumulative Toxic Pollutant Test)
- North Fork South Platte River basin: dissolved copper, total iron, dissolved manganese

Denver Water is committed to providing significant resources to mitigate unavoidable effects from construction and implementation of the Proposed Action, and to restore and enhance the environment to address both current and future effects from Denver Water diversions. These commitments include regulatory obligations to mitigate potential impacts of the Proposed Action and nonregulatory environmental enhancements committed to by Denver Water in separate stakeholder agreements such as the CRCA discussed in more detail below. In total, these commitments will provide a net benefit to the environment by preventing declines in water quality and improving overall conditions.

The Division's Statement of Basis for Regulation No. 31 [31.23(A)(5)(c)] states:

> "The 'mitigation' concept that is incorporated into the determination of 'significant degradation' is intended to encourage a practical approach to water quality protection. If anticipated impacts are offset by substantial water quality-enhancing mitigation measures, the Commission could find that the net effect of a proposed new activity would be insignificant degradation. For example in some circumstances an activity could result in lowering the water quality for two or three parameters by an amount that would not be deemed insignificant pursuant to the criteria set forth in the regulation; however, in such circumstances any impact on classified uses of the segment may be largely hypothetical and relatively minor. If an applicant incorporates into a project water quality-enhancing mitigation measure for the same segment, such as substantial habitat improvement measures, it may be reasonable to conclude that the net effect of the activity is no significant degradation."

When Denver Water's commitment to mitigation, including additional environmental enhancement, is taken into consideration, the net effect of the Proposed Action with RFFAs is not significant, and in some instances water quality is likely to improve. **Table 5-1** summarizes the AD and water quality impact review results from Section 4 and identifies associated proposed mitigation and enhancement commitments. The application of these commitments to affected river basins is described in the following subsections.

**Table 5-1. Summary of Antidegradation and Water Quality Impact Significance Determination and Proposed Mitigation and Enhancement Measures[1]**

| River Basin | Cumulative Impacts – AD and Water Quality Impact Significance Determination | Proposed Mitigation and Enhancement Measures (Enforcement or Commitment Mechanism) |
|---|---|---|
| **Fraser River** | • **Total Phosphorus** – The SCT is predicted to be exceeded in most months under all hydrologic conditions. The exceptions are September in average years, May in dry years, and April and July in wet years.<br>• **Dissolved Iron** – The SCT is predicted to be exceeded in all months under all hydrologic scenarios. The standard for dissolved iron is also predicted to be exceeded during the majority of months under each hydrologic scenario with the exception of September in average years; May in dry years; and April, July, September, and October in wet years.<br>• **Dissolved Copper and Zinc (Improvements)** – Significant improvements to dissolved copper are predicted to occur under all months for all hydrologic scenarios with the exception of July in wet years. Dissolved zinc concentrations are also predicted to improve significantly during the following months: October through March during average years; October through April during dry years; and December through March and May of wet years.<br>• **MMI** – Future changes in flow below diversions may impact the macroinvertebrate community; however, locations and significance are unknown. The upper reaches of the Fraser River and Vasquez Creek are currently on the 303(d) list of impaired waterbodies with provisional impairments based on application of MMI to the aquatic life use. Future reductions in flow expected under the Proposed Action plus RFFAs have a potential to impact these existing impairment findings.<br>• **Temperature** – Future temperature increases in excess of the 15 percent BAI are predicted to occur in the Fraser River near the Town of Fraser (Rendezvous Bridge) and near the confluence with the Colorado River. The simulated temperatures are well below the temperature standards when most of the excursions occur. The Proposed Action would contribute to only a small portion of the excursions.<br>• There will be additional exceedances of temperature standards in the future near the Town of Fraser (Rendezvous Bridge) and near the confluence with the Colorado River. The additional diversions associated with the Proposed Action do not contribute to violations of the summertime (June-September) stream temperature standards. However, in May during the shoulder-season, the Proposed Action does contribute to DM temperature standard violations in the Fraser River at Rendezvous Bridge (4 days out of the 5 years simulated) | 1. Aquatic Habitat (404 Permit. MECP)<br>a. Denver Water will provide $750,000 for stream habitat restoration projects in the Fraser and Upper Williams Fork rivers.<br>b. Denver Water will provide $72,500 for restoration of cutthroat habitat in Grand County.<br>2. Temperature (404 Permit, MECP)<br>a. Denver Water will monitor stream temperature on Ranch Creek and the Fraser River.<br>b. If temperature standards are exceeded between July 15 and August 31, Denver Water will bypass up to 250 AF of water.<br>c. If additional temperature response is needed, Denver Water will bypass additional flows at the Ranch Creek, Fraser River, and/or Jim Creek diversion(s) when the Proposed Action is diverting.<br>d. If response actions have *de minimis* effects, Denver Water will contribute $1 million to Learning by Doing (LBD) to implement projects designed to address stream temperature issues in the Fraser River basin.<br>3. Flushing Flows (404 Permit, MECP)<br>a. Denver Water will provide flushing flows in 3 out of every 10 years on the Fraser River, St. Louis Creek, Vasquez Creek, and Ranch Creek.<br>b. Denver Water will operate and maintain the Fraser River Sediment Pond to reduce sediment loads.<br>c. If response actions are ineffective, Denver Water will contribute $1 million to LBD for project(s) to improve channel stability and sediment transport in the Fraser River basin.<br>4. Colorado River Cooperative Agreement (CRCA), Denver Water will:<br>a. Provide $2 million for water quality projects in Grand County.<br>b. Provide $1.25 million for aquatic habitat improvements.<br>c. Provide $50,000 toward construction, and operate and maintain the Fraser River Sediment Pond to reduce sediment loads. (Colorado Department of Transportation [CDOT] IGA)<br>d. Execute the LBD IGA (refer to #5).<br>e. Provide $2 million for environmental enhancements in Grand County.<br>f. Provide 1,000 AFY in the Fraser River basin for instream flows.<br>g. Not reduce U.S. Forest Service (USFS) minimum bypass flows in Fraser River, Vasquez Creek, St. Louis Creek, and Ranch Creek during |

**Table 5-1. Summary of Antidegradation and Water Quality Impact Significance Determination and Proposed Mitigation and Enhancement Measures[1]**

| River Basin | Cumulative Impacts – AD and Water Quality Impact Significance Determination | Proposed Mitigation and Enhancement Measures (Enforcement or Commitment Mechanism) |
|---|---|---|
| | | droughts (2,000 to 3,000 AF) to maintain aquatic habitats, except when Denver Water has banned residential lawn watering.<br>h. Set aside lands currently owned by Denver Water in Grand County that have value for wildlife habitat and public fishing access.<br>i. Provide funding for forest and watershed health in Grand County.<br>5. LBD Cooperative Effort (LBD IGA)<br>a. Denver Water with the LBD Committee will develop an annual operations plan to maximize environmental benefits.<br>b. Denver Water with the LBD Committee will develop an Aquatic Resource Monitoring Plan for the Fraser River and Colorado River basins<br>i. Additional temperature monitoring.<br>ii. Additional channel stability and sediment transport evaluation.<br>iii. Benthic macroinvertebrate monitoring.<br>iv. Riparian and wetland habitat monitoring. |
| **Williams Fork** | • **Total Iron and Dissolved Manganese** – The SCTs are predicted to be exceeded in July during average and dry years, and in May of wet years. Total iron and dissolved manganese concentrations are low in the diverted tributaries relative to the baseline concentration at the downstream AD site and each significance finding corresponds to the month of highest diversions for each hydrologic scenario.<br>• **Dissolved Iron** – The SCT is predicted to be exceeded in July of dry years. Similar to total iron, dissolved iron concentrations are relatively low in the diversion water when compared to baseline concentrations at the AD site. July is the month of greatest diversions during dry years.<br>• **Dissolved Copper** – There is no available assimilative capacity because the dissolved copper standard is already exceeded at this site, even without implementation of the Proposed Action plus RFFAs. There are several months under each hydrologic scenario where the dissolved copper concentrations are projected to increase under cumulative effects.<br>• **Dissolved Zinc (Improvements)** - Because dissolved zinc concentrations are higher in the tributary diversions than they are at the AD site, significant improvements to dissolved zinc are predicted to occur in July during average and dry years, and in May of wet years. | 6. Aquatic Habitat (404 Permit, MECP)<br>a. Denver Water will provide $750,000 for stream habitat restoration projects in the Fraser and upper Williams Fork rivers.<br>b. Denver Water will provide $72,500 for restoration of cutthroat habitat in Grand County.<br>c. Denver Water will provide flushing flows in 3 out of every 10 years on Steelman, McQueary, and Bobtail creeks.<br>d. Denver Water will keep the sluice gates at the Bobtail and Steelman diversion closed to prevent fish migrating upstream, and will physically remove sediment accumulated behind the diversions. (USFS)<br>7. Colorado River Cooperative Agreement (CRCA)<br>a. Provide 1,000 AFY in the Williams Fork River for instream flows downstream of the reservoir, with up to 2,500 AFY in reservoir storage to manage releases. |

**Table 5-1. Summary of Antidegradation and Water Quality Impact Significance Determination and Proposed Mitigation and Enhancement Measures[1]**

| River Basin | Cumulative Impacts – AD and Water Quality Impact Significance Determination | Proposed Mitigation and Enhancement Measures (Enforcement or Commitment Mechanism) |
|---|---|---|
| | • **MMI** - No significant impacts to the aquatic macroinvertebrate communities within the Williams Fork River basin are expected | |
| **Blue River** | The Proposed Action plus RFFAs will not have significant impacts to water quality or to MMI scores in the Blue River downstream of Dillon Reservoir. The Blue River from Dillon Reservoir to North Rock Creek is currently on the Division's M&E list for possible non-attainment of aquatic life uses. | 8. Colorado River Cooperative Agreement (CRCA)<br>a. Denver Water will provide $1 million to a wastewater treatment fund.<br>b. Denver Water will provide $1 million to an environmental enhancement fund.<br>c. Denver Water will provide $9 million to fund water-related projects in Summit County.<br>d. Denver Water will provide an additional 250 AF of yield from Dillon Reservoir.<br>e. Denver Water will not reduce bypass flows from Dillon Reservoir unless it bans outdoor lawn watering. |
| **Upper Colorado River** | **Temperature** – The 15% BAI threshold is expected to be exceeded during summer months in 4 out of the 15 years simulated for the Northern Colorado Water Conservancy District's Windy Gap Firming Project. Due to cooling effects of the 5412 Releases, the net number of temperature excursions and exceedances is expected to decrease. | 9. Temperature (404 Permit, MECP)<br>a. Denver Water will install two temperature monitoring stations and monitor stream temperature on the Colorado River.<br>b. If temperature standards are exceeded between July 15 and August 31, Denver Water will bypass up to 250 AF of water.<br>c. Denver Water and seven other East Slope water users jointly provide 5,412.5 AFY of water from Granby Reservoir for the recovery of endangered fish in the 15-mile reach east of Grand Junction, while also providing cooling effects to water temperatures in the upper Colorado River.<br>10. Upper Colorado River Habitat Project IGA, Denver Water will provide (Habitat Project IGA):<br>a. $4.5 million with Northern Water Conservancy District (Municipal Subdistrict) to improve aquatic habitat below Windy Gap Reservoir ($1.5 million Denver Water's portion).<br>b. In-kind support for the Upper Colorado River Habitat Project.<br>c. $1.5 million with the Municipal Subdistrict for adaptive management and maintenance associated with the Upper Colorado River Habitat Project ($0.5 million Denver Water's portion).<br>11. Colorado River Cooperative Agreement (CRCA), Denver Water will:<br>a. Provide $1 million for pumping at Windy Gap to Granby Reservoir to improve aquatic habitat in the Colorado River below Windy Gap Reservoir. |

**Table 5-1. Summary of Antidegradation and Water Quality Impact Significance Determination and Proposed Mitigation and Enhancement Measures[1]**

| River Basin | Cumulative Impacts – AD and Water Quality Impact Significance Determination | Proposed Mitigation and Enhancement Measures (Enforcement or Commitment Mechanism) |
|---|---|---|
| | | b. Provide $1 million for flow-related projects in the Wild and Scenic River management program. |
| **South Boulder Creek and Gross Reservoir** | • **Dissolved Zinc** - The SCT is predicted to be exceeded during November and December under all future hydrologic scenarios. This is due to increased water use projected for the Fraser River municipalities (which are included in the RFFAs) during the winter months causing Denver Water to divert less water through the Moffat Tunnel, resulting in a reduction of dilution flows in South Boulder Creek.<br>• **Dissolved Copper** - There is no available assimilative capacity because the dissolved copper standard is already exceeded in the Creek below the East Portal, even without implementation of the Proposed Action plus RFFAs. There are several months under each hydrologic scenario where the dissolved copper concentrations are projected to increase under cumulative effects. The maximum increase in dissolved copper is predicted to be less than 0.02 µg/L.<br>• **Dissolved Copper, Total and Dissolved Iron (Improvements)** - Significant improvements are predicted to occur in June under the wet scenario. This is due to the large increase in water brought through the Moffat Tunnel resulting in dilution flows in South Boulder Creek. Dissolved zinc concentrations are also predicted to improve significantly during October in average years.<br>• **Methylmercury in Gross Reservoir** – Through the Bioaccumulative Toxic Pollutant Test, the mercury load to Gross Reservoir is likely to increase more than 10% based on a surrogate estimate of changes in annual flow contributions during the average scenario. Methylmercury in fish tissue may also increase following reservoir enlargement and as a result of annual shoreline fluctuations associated with reservoir operations.<br>• **Temperature below Gross Reservoir** - Some change in the seasonal temperature pattern is anticipated following project implementation due to the colder water to be released from the reservoir. The potential temperature decrease will not result in significant degradation.<br>• **MMI** – MMI data are limited to sites below the South Boulder Creek Canal Diversion and impacts to these sites are unknown and likely limited as flow changes below the Denver Water diversion as a result of the Proposed Action will be minimal. | 12. Denver Water will prepare a final tree removal plan to remove as much organic material as practicable from the inundation area prior to filling per FERC license. (FERC)<br>13. Denver Water will continue its current monitoring of temperature and DO in the Gross Reservoir outflow per FERC license Article 402. The purpose of the article is to ensure that streamflow downstream from the Project maintains adequate temperature and DO levels. (FERC)<br>14. Denver Water and its contractor will prepare a SWMP and conduct periodic inspections to provide appropriate BMPs for sediment and erosion control, materials handling and spill prevention, concrete batch plant, vehicle tracking control, waste management, and disposal and dewatering. (CDPHE, FERC)<br>15. Denver Water, in consultation with the Division, will coordinate with Colorado Parks and Wildlife (CPW) to monitor and evaluate metals levels in fish tissue for 5 years after the initial fill. The Division will determine fish consumption advisory regulations for the reservoir. (CDPHE)<br>16. Denver Water, in cooperation with the cities of Boulder and Lafayette, will establish a 5,000-AF Environmental Pool in Gross Reservoir to augment flows during low-flow periods benefiting 17 miles of aquatic habitat in South Boulder Creek from the dam to the confluence with Boulder Creek. (Environmental Pool IGA)<br>17. Denver Water will continue its monitoring program of South Boulder Creek upstream of the reservoir per FERC license Forest Service Condition 110, and will install protective measures, if needed. The monitoring locations will be relocated in consultation with the Forest Service. (FERC)<br>18. Denver Water will purchase sufficient credits from a wetland mitigation bank to compensate for 1.95 acres of permanent wetland impacts. (404 Permit)<br>19. Denver Water will prepare a riparian vegetation establishment plan and will plant 4 acres of native riparian vegetation in suitable locations surrounding Gross Reservoir. (404 Permit)<br>20. Denver Water will continue its water quality monitoring in South Boulder Creek (flowing into and out of the reservoir) and within Gross Reservoir. (FERC) |

**Table 5-1. Summary of Antidegradation and Water Quality Impact Significance Determination and Proposed Mitigation and Enhancement Measures[1]**

| River Basin | Cumulative Impacts – AD and Water Quality Impact Significance Determination | Proposed Mitigation and Enhancement Measures (Enforcement or Commitment Mechanism) |
|---|---|---|
| **North Fork South Platte River** | • **Dissolved Copper** – The SCT is predicted to be exceeded November through March in average years; January through March in dry years; and November through April in wet years. In addition, the dissolved copper standard is predicted to be exceeded during the months of greatest flow decreases under each hydrologic scenario: December through March in average years; March in dry years; and January through March in wet years.<br>• **Total Iron** – The SCT is predicted to be exceeded January through March of average and wet years.<br>• **Dissolved Manganese** – The SCT is predicted to be exceeded November through March in average years; January through March in dry years; and December through March in wet years. It should be noted that the standard for dissolved manganese is based on secondary drinking water guidelines for the aesthetic quality of drinking water.<br>• **Dissolved Copper, Manganese, and Lead, Total and Dissolved Iron (Improvements)** - Significant improvement to water quality is predicted during many of the months when flows increase due to the Proposed Action plus RFFAs (typically summer and fall).<br>• **MMI** - Additional review for the assessment of impacts to the macroinvertebrate community as measured by MMI could not be performed because data are currently only available from a site that is upstream of the Roberts Tunnel outfall, which is not impacted by the Proposed Action. | 21. Denver Water will provide $1.5 million for stream habitat improvements in the North Fork South Platte River and/or mainstem South Platte River. (404 Permit)<br>22. Denver Water will monitor five locations for channel instability. If problems occur, Denver Water will contribute $250,000 for the design and installation of remediation project(s) in cooperation with CPW and USFS. (404 Permit) |
| **South Platte River** | No significant impacts are anticipated. | |

[1] Impacts are determined to be significant (unless otherwise noted) where the future conditions with the Proposed Action and all RFFAs exceeded the SCT, also termed the 15% BAI threshold.

The enforcement mechanism for Denver Water's commitments, such as conditions imposed by other regulatory agencies or IGAs, are identified in Table 5-1 and described in Section 5.1. By complying with all of these agreements and other regulatory conditions, the Moffat Project will minimize or avoid water quality effects that could result from the construction or operation of the project. In particular, the success of the Grand County Mitigation and Enhancement Coordination Plan (MECP) relies upon the success of Learning by Doing (described in more detail in Section 5.1); therefore, Denver Water requests that the Division add a condition to the 401 Certification requiring Denver Water to remain in good standing and actively participate in LBD as long as LBD is functioning. If LBD ceases to function, the requirement will be for Denver Water to participate in an alternative process approved by the Division and USACE that is dedicated to implementing the elements of the MECP.

## 5.1 Summary of Environmental Commitments

Denver Water is committed to providing significant resources to mitigate unavoidable effects from construction and implementation of the Moffat Project (the Proposed Action), and to restore and enhance the environment to address both current and future effects from Denver Water diversions. Denver Water's total commitments are solidified in numerous permanent agreements that ensure long-term cooperative partnerships to provide benefits to the environment and sustainable supplies for water users. When viewed as a comprehensive package of mitigation and environmental enhancements, these commitments address the impacts of the Proposed Action, and will result in improvements in water quality and aquatic habitat.

Denver Water's commitments for mitigation, including additional environmental enhancement, are found in the following documents:

- *Moffat Project Final Environmental Impact Statement*, USACE (2014) – Detailed evaluation of project alternatives, environmental effects, and recommended mitigation measures.
- *Moffat Collection System Project Mitigation Plan*, Denver Water (2014) – Describes mitigation measures, additional environmental protections in Grand County and voluntary enhancements for aquatic resources (refer to Appendix M of the FEIS).
- *Moffat Collection System Project Fish and Wildlife Mitigation Plan (FWMP)*, Denver Water, prepared for the Colorado Wildlife Commission (CWC) (2011) – Constitutes the official State of Colorado position with regard to mitigation of impacts from the Project on fish and wildlife resources.
- *Moffat Collection System Project Fish and Wildlife Enhancement Plan*, Denver Water and the CWC (2011) – Describes additional measures to enhance fish and wildlife resources beyond mitigation requirements, which will be implemented per the Intergovernmental Grant Agreement to Implement Upper Colorado River Habitat Project between Colorado Parks and Wildlife and Denver Water dated March 26, 2014 (Habitat Project IGA). The goal of the Habitat Project is to design and implement a stream restoration program to improve the existing aquatic environment in the upper Colorado River from the Windy Gap Diversion to the lower terminus of the Kemp-Breeze State Wildlife Area. Denver Water, Northern Colorado Water Conservation District (Municipal Subdistrict), CPW and other stakeholders will participate in a cooperative effort to implement the desired stream improvements.
- *Colorado River Cooperative Agreement,* multiple entities (2013) – Multiparty agreement by and between various entities to benefit water supply, water quality, environmental resources, and

recreation providing benefits on both sides of the Continental Divide. Denver Water, along with Grand County, Summit County, the Colorado River Water Conservation District (River District), and numerous other entities, signed the CRCA. The CRCA provides a framework for numerous actions to benefit water supply, water quality, recreation and the environment. Denver Water's resource commitments are contingent upon the issuance of permits necessary for the construction of the Moffat Project.

- *Grand County MECP,* prepared by Grand County, Trout Unlimited and Denver Water (2014) – Describes comprehensive mitigation and enhancements measures to protect the health of the Fraser River including monitoring, habitat restoration, flushing flows, and cooperative implementation of the CRCA resources and commitments.

  The success of the MECP relies upon the success of Learning by Doing (LBD, described below); therefore, Denver Water requests that the Division add a condition to the 401 Certification requiring Denver Water to remain in good standing and actively participate in LBD as long as LBD is functioning. If LBD ceases to function, the requirement will be for Denver Water to participate in an alternative process approved by the Division and Corps that is dedicated to implementing the elements of the MECP.

- *LBD Cooperative Effort* (2012) – IGA to cooperatively maintain, restore, and enhance the aquatic environment in the Fraser and upper Colorado River basins. Under the CRCA, Denver Water entered into the LBD IGA with Grand County, the River District, and Middle Park Water Conservancy District. The explicit purpose of LBD is to "maintain and, where reasonably possible, restore or enhance the condition of the aquatic environment in Grand County." The parties to LBD intend "to build and promote a stable, permanent relationship that respects the interests and legal responsibilities of the parties, while achieving the goals of the Cooperative Effort."

  LBD is a unique and groundbreaking effort to manage an aquatic environment on a permanent cooperative basis. Importantly, LBD "will not seek a culprit for changes in the condition of the stream, but will provide a mechanism to identify issues of concern and focus available resources to address those issues." LBD will be implemented through the ongoing work of a management committee comprised of the parties to the LBD IGA, plus Northern Colorado Water Conservancy District (Municipal Subdistrict), Colorado Parks and Wildlife and Trout Unlimited. All the parties to the LBD IGA have agreed to contribute resources on an ongoing basis. The most significant resources are those provided to Grand County by Denver Water under the CRCA, not the least of which is its ongoing permanent involvement in the LBD effort. The actions undertaken by LBD are to be coordinated with mitigation actions related to the Moffat Project, thereby increasing the effectiveness of both efforts.

- *IGA between CDOT, Grand County, Town of Winter Park, and Denver Water for the Fraser Sediment Pond* (2011) – IGA to operate and maintain the Fraser Sediment Pond to reduce sediment load in the Fraser River.

- *Gross Reservoir Hydropower License* (Project No. 2035), FERC, 1951, relicensed 2001; amended 2004 - Requires compliance with license articles and Section 4e conditions from the USFS regarding water quality and stream channel monitoring; management of vegetation, wildlife, erosion control, rehabilitation and recreation, within the FERC boundary around Gross Reservoir.

- *IGA between the City and County of Denver, the City of Boulder, and the City of Lafayette for an Environmental Pool in Gross Reservoir* (2010) – Creates a 5,000 AF permanent, year-round pool for storage of water that can be released to augment stream flows in South Boulder Creek.

## 5.2 Fraser River Basin

The AD and water quality impact review set forth in Section 4 of this application identified water quality impacts for total phosphorus, dissolved iron and temperature. The review also identified significant improvements to dissolved copper and dissolved zinc.

### 5.2.1 Total Phosphorus

Denver Water will provide $2 million for water quality projects in Grand County, including but not limited to improvements to the capacity and treatment capabilities of WWTPs. This fund will be administered by Grand County and several sanitation districts, under the CRCA. Since the Colorado River basin is a priority basin for implementation of the Colorado WQCC's Nutrient Control Regulation No. 85, these improvements will likely include implementation of biological nutrient removal to reduce effluent phosphorus. The addition of phosphorus removal at the WWTPs will mitigate the increases in phosphorus concentrations in the Fraser River as a result of increased diversions from upstream tributaries with lower phosphorus concentrations. (CRCA).

Furthermore, the Municipal Subdistrict has committed to mitigate nutrient loading to the Three Lakes system (Granby Reservoir, Shadow Mountain Reservoir, and Grand Lake) resulting from additional pumping associated with the Northern Colorado Water Conservancy District's WGFP. One of the nutrient reduction measures includes improvements to the Fraser Sanitation District wastewater treatment plant. The Fraser River downstream of the treatment plant and the Colorado River downstream of the confluence with the Fraser River will benefit from this nutrient reduction.

Stream bank erosion and the resultant sedimentation have also been identified as a potential source of phosphorus in other basins. Denver Water will provide significant funds for stream restoration and aquatic habitat improvements in the Fraser River basin, which may reduce the phosphorus load and also address increases in total phosphorus as a result of increased diversions. These improvements include:

- $750,000 for stream habitat restoration projects in the Fraser and Upper Williams Fork rivers (404 Permit)
- $72,500 for restoration of cutthroat habitat in Grand County (404 Permit)
- $1.25 million for aquatic habitat improvements (CRCA)
- $2 million for environmental enhancements in Grand County (CRCA)

### 5.2.2 Dissolved Iron

Potential significant impacts are projected for dissolved iron with increased diversions. However, it should be noted that while dissolved iron, which is not toxic to aquatic life, is projected to increase, dissolved copper and zinc, both metals with potential toxicity for aquatic life, are projected to be reduced. The impact of increased dissolved iron concentrations will be ameliorated by Denver Water's commitment to release water for environmental benefits, which will dilute dissolved iron

concentrations, and implement stream restoration projects, which will control sediments that could be a source of dissolved iron. These commitments include:

- 1,000 AFY in the Fraser River basin for instream flows (CRCA)
- No reduction to the USFS minimum bypass flows on the Fraser River, Vasquez Creek, St. Louis Creek, and Ranch Creek during drought (2,000 to 3,000 cfs) to maintain aquatic habitat, except when Denver Water has banned residential lawn watering in its services area (CRCA)
- Provide flushing flows in 3 out of every 10 years on the Fraser River, St. Louis Creek, Vasquez Creek, and Ranch Creek (MECP)
- Operate and maintain the Fraser River Sediment Pond to remove sediment loads (CRCA, IGA with CDOT)

If the flushing flows are ineffective, Denver Water will contribute $1 million to the LBD Committee for project(s) to improve channel stability and sediment transport in the Fraser River basin.

In addition, metals, including iron, are anticipated to be further reduced in the Fraser River due to Union Pacific Railroad's installation of a treatment facility to attain compliance with the final effluent limitations set forth in National Pollutant Discharge Elimination System (NPDES) permit CO-0047554 for the Moffat Tunnel west portal discharge to the Fraser River near Winter Park. This treatment facility is expected to be operational prior to April 30, 2017.

## 5.2.3 Temperature

As set forth in Section 4 of this application, the dynamic temperature model developed for this analysis indicates there will be days when temperature standards are projected to be exceeded under the Proposed Action plus RFFAs. Denver Water will implement the following measures to address stream temperature concerns in the Fraser River basin (404 Permit, MECP).

### 5.2.3.1 Temperature Mitigation Monitoring

Commencing when acceptable regulatory approvals are received for the Moffat Project, Denver Water will monitor temperature at the locations listed below.

- Fraser River below Crooked Creek near Tabernash (USGS gage #09033300) - an existing real-time gaging and temperature station maintained by the USGS.
- Ranch Creek near Fraser, Colorado (USGS gage #09032000) - an existing USGS gaging station. In 2014, Denver Water coordinated with the USGS to install a real-time temperature monitoring station on this gaging station.
- Ranch Creek below Meadow Creek (USGS gage #09033100) - an existing USGS gaging station. In 2014, Denver Water coordinated with the USGS to reactivate this retired gage by installing real-time flow and temperature gages.
- Colorado River downstream of Windy Gap - Denver Water will work with the Municipal Subdistrict to install, monitor, and maintain two continuous, real-time temperature monitoring stations on the Colorado River at the Windy Gap gage and upstream of the Williams Fork River confluence. (Refer to Section 5.5 for more discussion on the upper Colorado River.)

#### 5.2.3.2 Temperature Mitigation Response

Denver Water will bypass up to 250 AF of water, at a rate up to 4 cfs, to alleviate temperature problems. This bypass of the 250 AF will be triggered by the occurrence of any of the following temperature action levels during the period from July 15 to August 31, whether or not the Moffat Project is diverting water at the time the trigger occurs:

- DM temperature of 21.2°C (70.2°F) at any of the Fraser River basin gages and 23.8°C (74.8°F) at either of the Colorado River gages, based on the current acute standard.
- Maximum Weekly Average Temperature (MWAT) of 17°C (62.6°F) at any of the Fraser River basin gages and 18.2°C (64.8°F) at either of the Colorado River gages, based on the current chronic standard.

Once the Moffat Project is operational, whenever stream temperature approaches a temperature action level, the LBD Committee will determine which of Denver Water's facilities should bypass the 250 AF. (See below for more details on the LBD cooperative effort.) If an agreement cannot be reached by the members of LBD, CPW will decide. Any decision to implement a bypass must:

- Involve a location at which Denver Water is currently diverting, and
- Determine there is sufficient streamflow available for bypass so as to make up to 250 AF available.

The operational response of water temperature to a 250 AF bypass flow was evaluated with the Fraser River Dynamic Water Temperature Model. The model results show a reduction in water temperature can be expected as a result of the additional bypassed water (Miller Ecological Consultants, Inc. 2015c). Denver Water agrees to make the Fraser River Dynamic Temperature Model available to the LBD Committee to evaluate the best use of the 250 AF to mitigate anticipated temperature issues.

#### 5.2.3.3 Additional Actions for Elevated Stream Temperature

The Additional Actions describe commitments by Denver Water to assure the environment in Grand County is protected beyond purely mitigating impacts identified by the USACE in the FEIS potentially caused by the Proposed Action. These commitments will be incorporated as Section 404 Permit conditions for the Proposed Action and implemented through the LBD cooperative effort.

If Denver Water has already bypassed the 250 AF, additional environmental protections will be warranted by the occurrence of either of the following temperature response triggers during the period from July 15 to August 31 when the Moffat Project is diverting.[1]

- Any of the Fraser River basin gages (USGS gages #09033300, 09032000 or 9033100) records a DM temperature of 21.2°C (70.2°F).
- Any of the Fraser River basin gages records an MWAT of 17°C (62.6°F).

Depending on where the Response Triggers occur, Denver Water will coordinate with the LBD Committee and implement either one or both of the following measures.

- **Ranch Creek:** At its Ranch Creek diversion, Denver Water will bypass an amount of water up to the natural inflow at the Ranch Creek diversion that will maintain the flow in Ranch Creek at the USGS gaging station near Fraser, Colorado (USGS gage #09032000) at 6 cfs (which is 2 cfs above the CWCB's instream flow right). This operation will continue until the temperature falls below the Response Trigger or Project Water is no longer being diverted.
- **Fraser River:** At its Fraser River and/or Jim Creek diversion(s), Denver Water will bypass an amount of water up to the combined natural inflow at the Fraser River and/or Jim Creek diversions that will maintain the flow in the Fraser River at the Winter Park USGS gage (#0902400) at 14 cfs (which is 6 cfs above the CWCB's instream flow right for the Fraser River at this location). This operation will continue until the temperature falls below the Response Trigger or Project Water is no longer being diverted. Denver Water will use reasonable efforts to provide the additional flows from the Jim Creek diversion to assure a flow in Jim Creek.

If after no more than 20 years of Moffat Project operation, the Additional Actions for Elevated Temperature are determined by the LBD Committee and verified by the Division to have a *de minimis* effect in reducing the stream temperature below the temperature response triggers at USGS gages #09032000, 09033300 or 09033100 when the Moffat Project is diverting, Denver Water will contribute $1 million to LBD for the exclusive purpose of designing and constructing projects to address stream temperature issues in the Fraser River basin.

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[1] **Determining When Diversions Are Moffat Project Diversions:** When dealing with mitigation, enhancement measures and additional environmental protections, all intended to address the aquatic environment, it is important to distinguish between flow changes caused by diversions attributable to Denver Water's existing system and the incremental impacts caused by diversions related to operation of the Moffat Project, so that mitigation can be measured for regulatory compliance purposes. The following accounting procedure will be used to distinguish whether a flow change is being caused by the diversions for Denver Water's existing system (which is not subject to mitigation requirements) or by diversions for the Moffat Project.

After the Moffat Project is constructed, daily reservoir accounting will first credit the water diverted by Denver Water from the Williams Fork and Fraser river basins to fill the existing, "Old Water" capacity of Gross Reservoir, which is 41,811 AF. When the amount of Old Water in storage equals 41,811 AF, the next increment of water put into storage at Gross Reservoir from the Williams Fork and Fraser River basins will be counted as "Project Water." The Old Water is the first water stored in Gross Reservoir and the first water taken out of storage. Project Water does not include water stored from South Boulder Creek or flow-through water. [Note: Flow-through water is water diverted and passed directly through Gross Reservoir to meet demand without being stored in the enlarged reservoir. Flow-through water is not considered Project Water because Denver Water could and would divert and pass through that water without the Moffat Project.]

#### 5.2.3.4 Additional Voluntary Temperature Monitoring per the LBD and MECP

In the LBD IGA, the LBD parties specifically agreed to develop a stream monitoring plan to monitor conditions for the purposes of identifying and responding to potential changes to the environment; defining desired improvements and modifications; and measuring the effectiveness of actions taken.

Monitoring water temperature will help improve the understanding of the relationship between water temperature at the mouth of tributaries and higher up in the watershed, and the thermal interactions among water flow, air temperature, shading, and channel configuration. Specific recommendations of this agreement include:

- LBD should expand the existing network of water temperature data loggers to other streams and locations in the Fraser River basin where flow data is available. Temporary loggers should be placed near the mouth and at upstream locations in streams experiencing temperature issues. The LBD Committee will identify locations for additional data loggers and how long loggers remain in the field.
- Air temperature should be monitored at each water temperature data logger location and at a few general locations in the watershed.
- Data from the loggers would be used to determine where and how many real-time temperature monitoring stations LBD should deploy throughout the basin.

The parties to LBD, including Denver Water, have committed to developing an annual operations plan to maximize the stream environmental benefits produced by the available resources, including the water and funding contributed by Denver Water. Refer to Section 5.2.4 for a description of the annual operations plan. Denver Water and Grand County agree that some of these resources should be dedicated to the same issues addressed by the mitigation measures, such as elevated stream temperatures, to leverage benefits to the stream environment, as follows:

- As part of the voluntary pilot projects, Denver Water will release available water in excess of its needs when stream temperatures are measured within 1°C of the daily maximum acute temperature standard and when stream temperatures are measured at or above the MWAT chronic standard at agreed upon locations.

### 5.2.4 Other Commitments under LBD and MECP

While the AD and water quality impact analysis did not identify any significant impact to aquatic life from the Proposed Action plus RFFAs, through the LBD IGA, Denver Water has already agreed to implement other measures to ensure the protection of aquatic life in the Fraser and Upper Colorado River basins. These activities will be conducted through the LBD Cooperative Effort and MECP, and include the actions described below.

#### 5.2.4.1 Aquatic Resources Monitoring Plan

In the LBD IGA, the LBD parties specifically agreed to develop a stream monitoring plan to monitor conditions for the purposes of identifying and responding to potential changes to the environment; defining desired improvements and modifications; and measuring the effectiveness of actions taken. Monitoring will help identify the stressors that may cause impacts to the aquatic environment, regardless of causation, so the stressors can be addressed by LBD. This monitoring program is a voluntary effort as defined in the CRCA and is not part of the regulatory process.

- *Defining Stream Conditions in Grand County.* A common database for the Fraser River Watershed should be established to better understand the relationship between hydrologic changes and impacts to the aquatic environment and water quality; the role of climate change, and naturally-occurring conditions such as beetle kill, air temperature or wildfire; and the effectiveness of different management responses to address problem areas. An example of potential hydrologic changes is the increased diversions by Denver Water using its existing infrastructure, which will occur prior to Project operation. Using the common database, Denver Water and other parties in the Fraser River basin can participate in voluntary operational experiments to develop prescriptions for important stream reaches. Prescriptions might include operational actions, restoration projects and other voluntary efforts.

  The LBD parties have agreed to rely on the information contained in the Grand County Stream Management Plan (GCSMP) and to enhance the information in the Plan. The LBD Monitoring Plan will incorporate elements used during Phase 3B of the GCSMP. Monitoring under LBD "will be used to identify changes in the aquatic environment, identify critical stream reaches, assign priorities for action steps, evaluate the effectiveness of actions taken, and to modify and refine strategies for achieving goals of the Cooperative Effort." As members of the LBD management team, Denver Water and Grand County will advocate for the LBD Monitoring Plan to address the issues described below.

- *Water Temperature.* Monitoring water temperature will help improve the understanding of the relationship between water temperature at the mouth of tributaries and higher up in the watershed, and the thermal interactions among water flow, air temperature, shading and channel configuration. (Refer to Section 5.2.3)

- *Channel Stability and Sediment Transport.* Enhancement of the GCSMP described in the LBD IGA should include additional channel stability and sediment transport data and analysis, including the analysis used in the Moffat Project FEIS, to develop valid prescriptions for specific stream reaches.

- *Benthic Macroinvertebrate Monitoring.* LBD should design and implement annual monitoring for macroinvertebrates, using Colorado's MMI or another agreed to methodology. Monitoring locations should represent, at a minimum, the four stream segments in the Fraser River Watershed defined in the CDPHE-WQCC's Standards and Classifications for the Upper Colorado River (5 CCR 1002-33). The purpose of the monitoring is to establish a baseline to identify priority stream reaches and test the effectiveness of management activities initiated by LBD.

- *Riparian Areas and Wetland Monitoring.* Denver Water will work with LBD to design and implement a mapping program for riparian vegetation in the Fraser River Watershed. Locations for the monitoring efforts will be determined by LBD, and should include, at a minimum, a species inventory and photo documentation.

#### 5.2.4.2 Annual Operations Plan

The parties to LBD, including Denver Water, have committed to develop an annual operations plan to maximize the stream environmental benefits produced by the available resources, including the water and funding contributed by Denver Water. The plan will explore opportunities for coordinated operations of diversion structures and reservoir releases among all water users in Grand County, including Northern Water; the Municipal Subdistrict; Reclamation, Denver Water; Middle Park; River District; and in-county diversions for agricultural, municipal, industrial, and others uses. The purpose

of coordinated operations is to allow the water users to meet the supply requirements of their systems, while maximizing the effectiveness of LBD. It is anticipated that coordinated operations could greatly enhance the effectiveness of such activities. Denver Water and Grand County agree that some of these resources should be dedicated to the same issues addressed by the mitigation measures to leverage benefits to the stream environment.

- **Temperature:** Helping to ameliorate temperature issues in the Fraser River basin and the Colorado River is one of LBD's priorities. Using the data generated through the LBD Monitoring Plan described above, experimental voluntary responses (e.g., changes in diversions, increased shading and modified channel configurations) will be tested to define possible combinations of actions to address temperature issues. As part of voluntary pilot projects, Denver Water will release available water in excess of its needs when stream temperatures are measured within 1°C of the daily maximum acute temperature standard and when stream temperatures are measured at or above the MWAT chronic standard at agreed upon locations.

- **Channel Stability:** Based on the supplemental data and analysis provided through the LBD Monitoring Plan, LBD should begin to develop prescriptions to address channel stability and sediment transport. As part of voluntary pilot projects, Denver Water will use water on a voluntary basis to test the prescription for flushing flows and to determine potential operational issues with releasing flushing flows. In addition, LBD should address sediment loading issues through mechanical means. For example, Denver Water has already proposed a joint effort with LBD to replace the culvert downstream of the Fraser River diversion structure with one that is more fish friendly and designed to reduce sediment into the Fraser River.

## 5.3 Williams Fork River Basin

As described in Section 2, under the Proposed Action average annual Gumlick Tunnel diversions will increase in average and wet years. No additional diversions will occur in dry years. The findings from the AD and water quality impact analysis for the Williams Fork River basin (Section 4) are consistent with the FEIS, which found negligible cumulative impacts compared to Current Conditions. Erosion of assimilative capacity is only consistently reported for dissolved copper. For all other modeled parameters, significant impacts were identified only for total and dissolved iron and dissolved manganese, and these impacts were limited to only one month of the year. Significant water quality improvements are projected for dissolved zinc in July during average and dry years, and in May of wet years.

### 5.3.1 Dissolved Copper

The Proposed Action plus RFFAs will result in a nominal increase in dissolved copper concentrations. The baseline dissolved copper concentrations in the Williams Fork River already exceed the applicable water quality standard for the protection of aquatic life.

### 5.3.2 Total and Dissolved Iron

The SCT for total iron is only predicted to be exceeded in July during average and dry years (the Proposed Action will not result in additional diversions in dry years) and in May of wet years, and is not expected to approach the stream standard for protection of aquatic life.

The SCT for dissolved iron is predicted to be exceeded in July of dry years, but the Proposed Action will not result in additional diversions in dry years.

### 5.3.3 Dissolved Manganese

The SCT for dissolved manganese is predicted to be exceeded in July during average and dry years (the Proposed Action will not increase diversions in dry years), and in May of wet years.

### 5.3.4 Environmental Commitments in the Williams Fork Basin

Denver Water will provide the following commitments in the Williams Fork basin to improve environmental conditions:

- $750,000 for stream restoration and aquatic habitat improvements that will be implemented in both the Upper Williams Fork and Fraser River basins (404 Permit).
- $72,500 for restoration of cutthroat habitat in the Williams Fork or Fraser River basins (404 Permit).
- Under the CRCA, Denver Water will make available up to 1,000 AFY from the Williams Fork Reservoir for instream flows downstream of the reservoir, with up to 2,500 AFY in carry-over storage in the reservoir to manage environmental flow releases. Denver Water commits to annually forgo 1,000 AF of water that has been historically diverted from the Fraser collection system (Environmental Water). If a portion of this water is made available during a call on the river, Denver Water would reduce the outflow of Williams Fork Reservoir. This results in additional water being stored in Williams Fork Reservoir (Saved Water), which will be released for environmental purposes. These two water sources (Environmental Water and Saved Water) provide Grand County with control of 2,000 AF of water for the aquatic environment on an annual basis with the possibility of carrying water over from year to year. Denver Water will coordinate with Grand County and the LBD Committee regarding the timing of these flow releases.
- Denver Water will provide flushing flows at the following locations: Steelman Creek (35 cfs), McQueary Creek (25 cfs), and Bobtail Creek (80 cfs). Denver Water will make a good faith effort to provide these flows for a minimum of 72 hours in 40 percent of the years (16 out of 40 years) and 3 out of every 10 years. (404 Permit, FERC).
- Denver Water will keep the sluice gates at the Bobtail and Steelman diversions closed at all times except for when draining the diversions to allow for mechanical removal of sediment and when maintenance is required. At times when the sluice gates are open, Denver Water will have in place a temporary barrier on the downstream side of the diversions to prevent fish migrating upstream (USFS).

## 5.4 Blue River

As described in Section 2, under the Proposed Action changes in flow in the Blue River basin will be primarily due to the additional diversion through the Roberts Tunnel and a shift in seasonal operations and storage to meet increased water demands. Flow changes downstream of Dillon Reservoir are also affected by increased local demand for snowmaking and municipal uses (RFFAs). Average monthly flows below the dam will be lower throughout the year with the greatest reductions in flow occurring during the summer months. A segment of the Blue River from Dillon Reservoir to Rock Creek is currently on the Division's M&E List because of potential impairment to aquatic life based on MMI scores.

The findings of the qualitative analysis for the Blue River basin (Section 4) are consistent with the FEIS, which found no significant cumulative impacts to water quality or MMI scores downstream of Dillon Reservoir compared to Current Conditions. With the Proposed Action plus RFFAs, MMI scores will likely continue to be below the threshold for attainment. The following commitments are provided to illustrate Denver Water's commitment to environmental enhancement.

### 5.4.1 Environmental Commitments in the Blue River Basin

Under the CRCA, Denver Water will provide the following commitments in the Blue River basin to improve environmental conditions:

- $1 million to a wastewater treatment fund
- $1 million to an environmental enhancement fund
- $9 million to fund water-related projects in Summit County
- An additional 250 AF of yield from Dillon Reservoir
- Not reduce bypass flows from Dillon Reservoir unless it bans outdoor lawn watering

## 5.5 Upper Colorado River

Changes in future flows in the Colorado River are due to a combination of the Proposed Action, the WGFP, and changes in the timing and quantities of municipal diversions within the basin. The changes in diversions in the Blue River, Williams Fork River, and Fraser River as a result of the Proposed Action plus RFFAs will lead to an overall reduction in flow entering the Colorado River from these tributaries. The findings from the qualitative analysis do not identify significant impacts to the upper Colorado River.

### 5.5.1 Environmental Commitments in the Upper Colorado River Basin

Regardless of the qualitative analysis findings of no significant degradation, Denver Water has made commitments for environmental enhancements in the upper Colorado River basin.

#### 5.5.1.1 Temperature Mitigation

Portions of the mitigation and environmental enhancement commitments Denver Water has made for the Fraser River and Williams Fork River will also apply to the Upper Colorado River basin, as follows:

- **Temperature Monitoring** (404 Permit, MECP): In addition to the stream temperature monitoring in the Fraser River basin, Denver Water will work with Municipal Subdistrict to install, monitor, and maintain two continuous, real-time temperature monitoring stations on the Colorado River at the Windy Gap gage and upstream of the Williams Fork River confluence. Denver Water will bypass up to 250 AF of water, at a rate up to 4 cfs, to alleviate temperature problems measured either in the Colorado River or Fraser River basin. (Refer to Section 5.2.3 for more discussion on temperature monitoring.)

- **Temperature Benefits of 5412 Releases from Granby Reservoir:** Denver Water and seven other East Slope water users jointly provide 5,412.5 AFY of water from Granby Reservoir to meet USFWS flow recommendations in the Programmatic Biological Opinion for the recovery of endangered fish in the 15-mile reach of the Colorado River east of Grand Junction. The release of water from Granby Reservoir would occur from mid-summer through fall to optimize habitat benefits in the upper Colorado River below the reservoir. These releases will also provide significant cooling effects to water temperatures in the upper Colorado River. The net

cumulative effect is fewer exceedances of both acute and chronic temperature standards in the future compared to current conditions.

#### 5.5.1.2 Upper Colorado River Habitat Project IGA

Denver Water and the Municipal Subdistrict will jointly fund the Upper Colorado River Habitat Project to implement a stream restoration program to improve the existing aquatic habitat in the mainstem of the Colorado River between Windy Gap Reservoir and the Kemp-Breeze State Wildlife Area. The project will be implemented through an IGA between Denver Water, the Municipal Subdistrict, and CPW. (Habitat Project IGA) Under this IGA, Denver Water will provide a total of $2 million:

- $4.5 million with the Municipal Subdistrict to improve aquatic habitat below Windy Gap Reservoir ($1.5 million contributed by Denver Water)
- In-kind support for the Upper Colorado River Habitat Project
- $1.5 million with the Municipal Subdistrict for adaptive management and maintenance associated with the Upper Colorado River Habitat Project ($0.5 million contributed by Denver Water)

#### 5.5.1.3 Funds for Environmental Flows

Under the CRCA, Denver Water will provide $1 million to a Windy Gap Pumping Fund to be used by Grand County for the purpose of paying up to 50 percent of the annual costs for using the Windy Gap pumps to provide water for environmental purposes to benefit flow and aquatic habitat in the upper Colorado River.

## 5.6 South Boulder Creek

Under the Proposed Action plus RFFAs, additional Moffat Tunnel diversion flows from the Fraser and Williams Fork River basins would occur in average and wet years primarily during peak snow melt and runoff periods in May, June, and July. The analysis for the Proposed Action and RFFAs identified significant impacts for dissolved copper and temperature. Water quality is predicted to significantly improve in June under the wet scenario for dissolved copper, total iron, and dissolved iron with the Proposed Action plus RFFAs. This improvement in water quality is due to the large increase in water diverted through the Moffat Tunnel resulting in increased dilution flows in South Boulder Creek (Environmental Pool IGA).

In addition, reservoir outflow water quality in South Boulder Creek will continue to be monitored during the range of flow conditions, capturing at least four high-flow periods and four low-flow periods. Parameters to continue monitoring include alkalinity, conductivity, pH, total suspended solids (TSS), turbidity, metals, phosphorus, hardness, DO, coliforms, total Kjeldahl nitrogen, ammonia, and total organic carbon (TOC).

### 5.6.1 Dissolved Copper

The baseline dissolved copper in South Boulder Creek below the East Portal of the Moffat Tunnel is 3.4 µg/L, which is above the water quality standard of 2.5 µg/L calculated using an average hardness of 22.9 mg/L. In other words, even without implementation of the Proposed Action plus RFFAs, the dissolved copper standard is already exceeded at this site, and there is no evidence the aquatic life use of South Boulder Creek is impaired as a result of copper. The maximum increase in dissolved copper is predicted to be less than 0.02 µg/L.

### 5.6.2 Temperature

While some change in the seasonal temperature pattern is anticipated following implementation of the Proposed Action and RFFAs, impacts to the aquatic community are not anticipated to the degree that the aquatic life beneficial use would not be protected. Therefore, the analysis concluded the potential decrease in temperature would not result in significant impacts. However, to monitor overall water quality in South Boulder Creek above and below Gross Reservoir, Denver Water will continue its current water quality monitoring in South Boulder Creek flowing into and out of the reservoir, including temperature and DO. In addition, Denver Water will establish a 5,000 AF Environmental Pool in Gross Reservoir to augment flows during low-flow periods benefiting 17 miles of aquatic habitat in South Boulder Creek from the dam to the confluence with Boulder Creek.

### 5.6.3 Methylmercury in Gross Reservoir

Gross Reservoir is currently included on the State of Colorado's M&E List adopted in Regulation No. 93 for aquatic life use due to elevated methylmercury in fish tissue. While Gross Reservoir is not currently under a fish consumption advisory, fish sample results from previous years indicate some fish have elevated methylmercury (MeHg) in their tissue. Results of the Bioaccumulative Toxic Pollutant Test suggest that the total mercury load to Gross Reservoir is likely to increase by more than 10 percent based on a surrogate estimate of changes in annual flow contributions during the average scenario. MeHg in fish tissue may also increase following reservoir enlargement and as a result of annual shoreline fluctuations associated with reservoir operations. Mitigation for this potential impact will include the following:

- Denver Water will prepare a final tree removal plan to remove as much organic material as practicable from the inundation prior to filling. (FERC)
- Denver Water and its contractor will prepare a Stormwater Management Plan (SWMP) and conduct periodic inspections to provide appropriate BMPs for sediment and erosion control, concrete batch plant control, vehicle tracking control, waste management and disposal, and dewatering. (CDPHE, FERC)
- Denver Water, in consultation with the Division, will coordinate with CPW to monitor and evaluate metals levels in fish tissue for 5 years after the initial fill. CPW will determine fish consumption advisories for the reservoir. (CDPHE)
- Denver Water will purchase sufficient credits from a wetland mitigation bank to compensate for 1.95 acres of permanent wetland impacts. (404 Permit)
- Denver Water will prepare a riparian vegetation establishment plan and will plant 4 acres of native riparian vegetation in suitable locations surrounding Gross Reservoir. (404 Permit)
- Denver Water will continue water quality monitoring within Gross Reservoir including (FERC):
  - Reservoir inflow water quality in South Boulder Creek during the range of flow conditions, capturing four high-flow periods and four low-flow periods. Parameters to continue monitoring include alkalinity, conductivity, acidity (pH), TSS, turbidity, metals, phosphorus, hardness, and DO.
  - Over the depth profiles of the photic zone, with three samples in the photic zone at two locations. Photic zone samples will be combined into one composite sample and analyzed

for phosphorus and chlorophyll-a. Water quality in the hypolimnion will also be sampled at the same two locations and analyzed for DO, temperature, turbidity, pH, and specific conductance.

- Water clarity from the surface of the reservoir will be assessed by Secchi disk periodically throughout the periods when the reservoir surface is not frozen.

## 5.7 North Fork of the South Platte River Basin

The AD and water quality impacts analysis predicts water quality in the North Fork of the South Platte River will be impacted for dissolved copper, total iron, and dissolved manganese. It should be noted that these impacts are the result of Denver Water diverting less water through the Roberts Tunnel during the winter months with the Proposed Action plus RFFAs than under Current Conditions, resulting in less dilution flow. However, water quality is expected to significantly improve during many months when flows increase as a result of the Proposed Action plus RFFAs.

### 5.7.1 Dissolved Copper

The SCT is predicted to be exceeded November through March in average years, January through March in dry years, and November through April in wet years. In addition, the dissolved copper standard is predicted to be exceeded during the months of greatest flow decreases under each hydrologic scenario.

### 5.7.2 Total Iron

The SCT is predicted to be exceeded January through March of average and wet years.

### 5.7.3 Dissolved Manganese

The SCT is predicted to be exceeded November through March in wet years, January through March in dry years, and December through March in wet years.

### 5.7.4 North Fork of the South Platte Mitigation

As noted above, while dissolved copper, total iron, and dissolved manganese will increase above the SCT in some months, water quality for these metals plus dissolved iron are predicted to improve significantly during many months when flows increase as a result of the Proposed Action plus RFFAs, typically in the summer and fall. In addition, Denver Water has committed to the following additional mitigation:

- Provide $1.5 million for stream habitat improvements in the North Fork of the South Platte River and/or mainstem South Platte River. Habitat improvements reduce channel erosion and may reduce metals concentrations as a result. (404 Permit)
- Monitor five locations for channel instability. If problems occur, Denver Water will contribute $250,000 for the design and installation of remediation projects in cooperation with CPW and USFS. (404 Permit)

## 5.8 Best Management Practices

In addition to the mitigation and environmental enhancement commitments described in previous sections, Denver Water will also comply with other federal, state, and local permits and approvals to implement the Moffat Project. As part of these approvals, Denver Water will implement a variety of

BMPs during and following construction to reduce erosion, protect water quality, manage invasive species, suppress dust and noise, re-vegetate disturbed areas, and protect or avoid important wildlife habitat. The environmental permits and approvals that include BMPs and environmental protection measures addressing water quality and aquatic habitat include:

- Section 404 Permit from USACE
- CDPHE SWMP and General Permit for Stormwater Discharges Associated with Construction Activities
- Materials Handling Plan and Material Abatement Plan, if needed
- FERC Hydropower License Amendment for Gross Reservoir Hydroelectric Plant
- Quality Control and Inspection Program (required in FERC Article 302)
- CDPHE Fugitive Dust Control Plan and Air Pollution Emission Notice (APEN)

Denver Water commits to implementing several types of BMPs to address erosion and stormwater management, materials handling and spill prevention, waste management, and general pollution prevention pertaining to water quality protection during and after construction. The actual BMPs to be used will be developed in preparation of the various plans for the above-referenced permits.

The final plan will be submitted to the Division prior to commencing any ground-disturbing activities and will include the general types of BMPs described below.

### 5.8.1 Stormwater Management Plan

Denver Water and its contractor will prepare a SWMP and comply with the Division's General Permit for Stormwater Discharges Associated with Construction Activities to minimize erosion of, and siltation into, sensitive habitats and natural drainages outside the approved construction limits. The SWMP will consist of the following elements:

- Roles and responsibilities of the SWMP Administrator and other project staff, contractors, and subcontractors who will have stormwater responsibilities on the project site
- Description and sequence of Construction Activities
- Identification of potential pollutant sources
- BMP selection, implementation, and phasing
- Material handling and spill prevention
- Waste management and disposal
- Other environmental permits that are associated with stormwater control and water quality
- Final stabilization and long-term stormwater management
- Inspection and maintenance

- A site plan or plans depicting the affected site in sufficient detail to show significant site features (natural and manmade), areas proposed to be disturbed and developed, existing easement areas and restricted development areas, and locations of proposed temporary BMPs

#### 5.8.1.1 Site-specific BMPs, Plans, and Details

The SWMP will identify temporary and permanent stormwater runoff controls and BMPs tailored to specific site conditions such as pre-construction vegetative cover, soil types at the site, and receiving waters, to prevent the deterioration of water quality related to stormwater discharges from construction activities and sites. The site-specific BMP maps will be developed prior to the start of construction and will be updated in the field as construction progresses and BMPs are implemented and/or removed. The site-specific BMP plan will include:

- Map with the specific project boundary, construction limits, disturbance limits, receiving waters, outfalls, drainages, wetlands, springs, storm sewers, and any other conveyance systems.
- Location of temporary and permanent BMPs and references to typical details.
- Location of BMPs and activities to achieve final stabilization. Pre-construction photographic documentation of pre-project surface cover conditions will be used to gauge final stabilization.

#### 5.8.1.2 BMP Selection

The BMPs to be selected for the site-specific SWMP will be based on the following state and local guidance documents:

- CDPHE, WQCC, Regulation 82
- Urban Drainage and Flood Control District, Urban Storm Drainage Criteria Manual, Volume 3 – Best Management Practices
- CDOT - "Erosion Control and Stormwater Quality Guide"
- Boulder County, Stormwater Quality Management Requirements

**Table 5-2** lists typical BMPs for potential pollutant sources and activities that could contribute pollutants to stormwater discharges. **Table 5-3** presents guidelines for BMP selection, implementation, and phasing for construction project activities.

**Table 5-2. Potential Pollution Sources and BMPs**

| Potential Pollution Source | BMPs |
|---|---|
| Disturbed and stored soils | Activities associated with this pollution source are the earth-disturbing activities typically associated with excavation, cutting and filing, and backfilling. BMPs selected to control this source are straw wattles (sediment control logs), rock socks, vehicle tracking control, inlet protection, check dams, restoration of landscaped areas and repaving. Non-structural measures include phasing construction to the extent feasible to limit the amount of trench open at any one time. |
| Vehicle tracking of sediments | Activities associated with this pollution source are the movement of vehicles from disturbed areas to paved streets. BMPs selected to control this source are VTC, stabilized construction entrances including vehicle tracking control pads, geotextiles, and street cleaning. Construction fencing may be used to limit entry to designated access points. |

**Table 5-2. Potential Pollution Sources and BMPs**

| Potential Pollution Source | BMPs |
|---|---|
| Management of contaminated soils | If contaminated soils are encountered, all activity will be stopped until the situation can be assessed by project environmental personnel. The Project Manager will be contacted for further direction. |
| Loading and unloading operations | Activities associated with this pollution source are potential spills during delivery and unloading of materials. Loading and unloading operations should occur on stabilized surfaces. BMPs selected to control this source are materials management practices, personnel training, providing spill kits where needed, and following standard Materials Handling and Spill Prevention Procedures. |
| Outdoor storage activities (including building materials, chemicals, etc.) | The activities associated with this pollution source are storage of material at the staging areas and the potential for spills and leaks from these materials. BMPs selected to control this source are use and installation of straw wattles on the downgradient side of temporary stock piles, materials management practices, secondary containment, berms, personnel training, providing spill kits where needed, and following standard Materials Handling and Spill Prevention Procedures. |
| Vehicle and equipment maintenance and fueling | Activities associated with this pollution source are fueling and equipment repair. Routine vehicle maintenance will not occur on the site. However, if heavy equipment breaks on the site, on-site maintenance may become necessary and appropriate BMPs such as materials management practices, laying down a plastic liner, personnel training, providing spill kits, berms, drip pans, and following standard Materials Handling and Spill Prevention Procedures. Typically, fueling will be performed from delivery vehicles by drivers who will provide necessary spill prevention and response capability. |
| Significant dust or particulate generating processes | Activities associated with this pollution source are the earth-disturbing activities and equipment movement on disturbed area. There is also the potential for wind to transport dust from disturbed areas. BMPs selected to control this source are watering of disturbed areas on an as-needed basis during construction, interim stabilization measures such as surface roughening, final stabilization, and minimizing the duration that disturbed areas are exposed to the extent practical. |
| On-site industrial waste management practices (waste piles, liquid wastes, dumpsters, etc.) | Activities associated with this pollution source are the generation of industrial waste materials during project activities including waste generated from demolition of existing aboveground infrastructure (pavement, sidewalks etc.), boring mud and fluids, saw cutting water, pipe and joint sealing, and waste from clearing and grubbing. BMPs selected to control this source are materials and waste management practices as well as personnel training, and use of concrete washouts. For boring fluids, waste is vacuumed as it is excavated from the bore and it is disposed of offsite. |
| Concrete truck/equipment washing, including the concrete truck chute and associated fixtures and equipment | Activities associated with this pollution source are concrete pours for vault or switch cabinet floors, concrete anchoring at bends in conduit or pipe, pipe coating, and concrete replacement on the sidewalks or roads. The BMP selected to control this source are using a designated concrete washout area or offsite washout, and personnel training. |
| Non-industrial waste sources worker trash and portable toilets | Activities associated with this potential pollutant source include the generation of non-industrial waste such as discarded building materials, litter, and sanitary waste at the construction site that may cause adverse impacts to water quality. BMPs to control this source include the use of waste containers and location and placement of portable toilets which will be located as far as feasible from surface waters and inlets. |
| Non-stormwater discharges | Discharges to the ground of water from construction dewatering activities may be authorized by this SWMP, provided that the source is groundwater and/or groundwater combined with stormwater that does not contain pollutants in concentrations exceeding the State groundwater standards in Regulations 5 CCR 1002- |

### Table 5-2. Potential Pollution Sources and BMPs

| Potential Pollution Source | BMPs |
|---|---|
| | 41 and 42; and does not leave the site as surface runoff or discharge to surface waters. These same provisions apply to concrete washout water discharged to the ground. Other allowable non-stormwater discharges include discharges from fire-fighting activities, natural springs and irrigation return flows. If any of these non-stormwater discharges are identified in the field, the site-specific information for that project will be updated to include the location and characteristics of the discharge. |

### Table 5-3. Phased BMP Selection and Implementation

| Stage | | Description | About |
|---|---|---|---|
| Phase of Construction | Pre- Construction | Identify and Protect Trees and Structures (as appropriate) | Before construction, evaluate, mark and protect important trees and associated rooting zones, unique areas (e.g. wetlands), and other areas to be preserved. |
| | | Vehicle Tracking Control | Identify all access points and determine how to minimize equipment tracking onto streets. If necessary, provide stabilized site entrances and access prior to construction. |
| | | Inlet Protection | Install and inspect inlet protection as needed prior to any construction activities at all down-gradient inlets that project might impact. Inlet protection may be required even for inlets that are upgradient of the work area if there is potential for sediments tracked from the work area to reach inlets. |
| | | Perimeter Control | Install and inspect perimeter controls (rock socks, silt fence, sediment control logs, etc.) at downgradient perimeter of initial construction site prior to construction activities. Install additional perimeter control BMPs during construction as work progresses if applicable. |
| | | Materials Storage | Prepare material storage areas for loading and unloading. Prepare industrial and non-industrial waste management areas as applicable. Most projects covered under this SWMP will not have designated material storage areas. Typically equipment is brought on to the site daily. If materials or equipment are stored overnight, they will generally be stored on small trailers in the right-of-way. Materials that have to potential to interact with stormwater will be covered if they are stored overnight. |
| | During Construction | Implement SOPs and BMPs | Implement SOPs and BMPs during construction to minimize erosion and sediment loss from the project site; sweep daily; inspect, monitor, maintain BMPs. |
| | | Street Sweeping | Street sweeping is required daily and as needed. Street sweeping can be with street sweeping equipment or laborers with brooms. |
| | | Stockpile Management | Cover stockpiles with anchored tarp or use perimeter control (rock bags or sediment control logs) to prevent sediment from leaving site. |
| | | Materials Management | Maintain and inspect industrial and non-industrial waste management areas. |
| | | Construction Dewatering | Typically dewatering is not performed during this type of work since the excavations are relatively shallow. However, there may be situations where dewatering operations are necessary. Dewatering must infiltrate onsite to be covered under the Division's General Stormwater Permit. If the discharges do not meet the Division's requirements for construction dewatering discharges authorized under the General Stormwater Permit, then a separate permit must be obtained. |

**Table 5-3. Phased BMP Selection and Implementation**

| Stage | | Description | About |
|---|---|---|---|
| | | Backfilling and Compacting | Remove limited stored materials and equipment from the sites. Remove temporary BMPs around stockpiles. |
| | Post Construction | Site Restoration/Stabilization | Stabilize disturbed areas after construction activities have been completed. Re-vegetate landscaped areas and pave or place concrete or gravel for hardscape areas. Install final BMPs and remove temporary BMPs after the site has final stabilization (minimum of 70% stabilized on overall, aerial basis) |
| | | BMP Maintenance and Monitoring | Maintain and monitor SOPs and BMPs until final stabilization is in place (70% stabilized or better). |
| | | Close out all stormwater permits | Terminate stormwater permits after a close-out meeting. |

## 5.8.2 Section 404 Permit

The following is a list of General Conditions and BMPs that Denver Water assumes would be part of the Section 404 Permit, if issued.

1. All construction debris will be disposed of on land in such a manner that it cannot enter a waterway or wetland.
2. Equipment for handling and conveying materials during construction shall be operated to prevent dumping or spilling the materials into the water except as approved herein.
3. Care will be taken to prevent any petroleum products, chemicals, or other deleterious materials from entering the water.
4. Steps will be taken to prevent materials spilled or stored on shore from washing into the water as a result of cleanup activities, natural runoff, flooding, and that, during construction, any materials which are accidentally spilled into the water will be retrieved.
5. All work in the waterway will be performed in such a manner so as to minimize increases in suspended solids and turbidity that may degrade water quality and damage aquatic life outside the immediate area of operation.
6. All areas along the bank disturbed or newly created by the construction activity will be seeded with vegetation indigenous to the area for protection against subsequent erosion.
7. The clearing of vegetation will be limited to that which is absolutely necessary for construction of the project.
8. Close coordination will be maintained by the contractor with downstream water users, advising them of any water quality changes to be caused by the construction.
9. All dredged or excavated materials, with the exception of that authorized herein, will be placed on an upland site above the ordinary high water line in a confined area, not classified as a wetland, to prevent the return of such materials to the waterway.
10. Deposition of excavated materials on shore and all earthwork operations on shore will be carried out in such a way that sediment runoff and soil erosion to the water are controlled.

11. Adequate pipes shall be installed in any temporary crossing to carry normal flows and prevent the restriction of expected high flows during construction.
12. Concrete trucks will be washed at a site and in such a manner that washwater cannot enter the waterway.
13. The use of machinery in the waterway will be kept to a minimum.
14. When the District Engineer has been notified that a filling activity is adversely affecting fish or wildlife resources or the harvest thereof and the District Engineer subsequently directs remedial measures, the permittee will comply with such directions as may be received to suspend or modify the activity to the extent necessary to mitigate or eliminate the adverse effect as required.
15. Fuel storage tanks above ground shall be diked or curbed or other suitable means provided to prevent the spread of liquids in case of leakage in the tanks or piping.

# Section 6

# Summary and Conclusion

Evaluation of water quality cumulative impacts from the Proposed Action and RFFAs was based primarily on the Significant Concentration Test, as well as the Bioaccumulative Toxic Pollutant Test (for methylmercury in Gross Reservoir) and Aquatic Life Policy 10-1 (MMI) for assessing impacts to aquatic life.

The methodologies (Section 3) to determine the significance of impacts to water quality incorporated cumulative impacts (the Proposed Action plus RFFAs). The cumulative impacts analysis (Section 4) shows that the Proposed Action plus RFFAs may result in new or increased water quality impacts for a narrow range of parameters and under certain conditions. In two segments (South Boulder Creek and the North Fork South Platte River), there is no available assimilative capacity for dissolved copper because background concentrations already exceed the water quality standard, and while this is not a result of new or increased impacts from the Proposed Action or from the Proposed Action plus RFFAs, the Proposed Action plus RFFAs may contribute to future impairment. The Proposed Action plus RFFAs may result in new or increased water quality impacts as identified in this document.

The second step in determining the significance of degradation, under the antidegradation procedures, takes into consideration the net effect of the regulated activity and environmental benefits. "Antidegradation procedures shall apply to the review of regulated activities with new or increased water quality impacts that may degrade the quality of state surface waters that have not been designated as outstanding waters or use-protected waters, including waters previously designated as high quality class 2." 5 CCR 1002-31.8(3)(a). All of the water bodies potentially affected by Denver Water's Proposed Action are Reviewable Waters, and subject to the AD procedures.

Under Colorado's AD regulations (5 CCR 1002-31.8(3), the initial step to a significance determination is a review of the regulated activity with respect to narrative or numeric standards. As stated above, the conclusion of this review is that with RFFAs the Proposed Action may have new or increased water quality impacts that exceed the significance thresholds. The next step in the determination of "significant degradation" incorporates a review of the significant water quality impacts combined with water quality enhancing measures. The regulation provides:

> "This significance determination shall be made with respect to the net effect of the new or increased water quality impacts of the proposed regulated activity, taking into account any environmental benefits resulting from the regulated activity and any water quality enhancement or mitigation measures impacting the segment or segments under review, if such measures are incorporated with the proposed regulated activity."

The WQCC's Statement of Basis and Purpose to the regulations describe this "net effect" analysis further by adding:

> "The 'mitigation' concept that is incorporated into the determination of 'significant degradation' is intended to encourage a practical approach to water quality protection. If anticipated impacts are offset by substantial water quality-enhancing mitigation measures, the Commission could find that the net effect of a proposed new activity would be insignificant

degradation. For example in some circumstances an activity could result in lowering the water quality for two or three parameters by an amount that would not be deemed insignificant pursuant to the criteria set forth in the regulation; however, in such circumstances any impact on classified uses of the segment may be largely hypothetical and relatively minor. If an applicant incorporates into a project water quality-enhancing mitigation measure for the same segment, such as substantial habitat improvement measures, it may be reasonable to conclude that the net effect of the activity is no significant degradation."

Section 5.3 and Table 5-1 describe in detail a series of mitigation and environmental enhancement measures Denver Water has committed to implementing with the Proposed Action. **Table 6-1** represents the steps to determine if the net effects (including those cumulative impacts to the Proposed Action) to water quality will result in "significant degradation" when consideration is given to the environmental benefits incorporated with the Proposed Action. Although the water-quality enhancing measures incorporated with the Proposed Action may not directly mitigate the potential exceedances in the segments identified in this evaluation, the "practical approach" of looking at the net effect of Proposed Action plus RFFA exceedances with the "substantial water quality-enhancing measures" committed by Denver Water leads to the conclusion that the "net effect of the activity is no significant degradation."

**Table 6-1. Net Effects Summary**

| **Is there a new or increased water quality impact from a regulated activity in a reviewable segment?** |
|---|
| Yes, in the following river basins (refer to Sections 3 and 4):<br>• Fraser River<br>• Williams Fork River<br>• Colorado River<br>• South Boulder Creek, including Gross Reservoir<br>• North Fork South Platte River |
| **Is the cumulative impact significant; will a significance threshold be exceeded?** |
| Yes, in the following river basins for the listed parameters (refer to Section 4):<br>• Significant Concentration Test<br>– Fraser River: total phosphorus, dissolved iron, and temperature<br>– Williams Fork River: total and dissolved iron, dissolved manganese, and dissolved copper<br>– Colorado River: temperature<br>– South Boulder Creek: dissolved copper and temperature<br>– North Fork South Platte River basin: dissolved copper, total iron, dissolved manganese<br>• Bioaccumulative Toxic Pollutant Test<br>– Gross Reservoir: methyl-mercury |
| **Will the cumulative impacts be offset by water quality mitigation or enhancement measures?** |
| Yes (refer to Section 5):<br>• In all cases where a significant threshold was exceeded, Denver Water has committed to implementing a series of mitigation and enhancement measures that will result in an overall net environmental benefit. |
| **Conclusion?** |
| The net effect of the regulated activity, taking into account all environmental benefits, is no significant water quality degradation. |

After considering the net effects of the potential exceedances of the Proposed Action plus RFFAs and the cumulative benefit to the environment provided by the significant mitigation and other voluntary environmental enhancements committed to by Denver Water, no significant degradation will occur as a result of the Proposed Action plus RFFAs.

However, if it is determined that the potential exceedances in certain segments that may result from the Proposed Action plus RFFAs is not offset by this "practical approach," which recognizes the net environmental benefits to the affected river basins, a determination shall be made whether the significant degradation is necessary to accommodate important economic or social development in the area in which the waters are located, pursuant to Regulation 31.8(d). To ensure submittal of a comprehensive application and to facilitate the Division's review, Denver Water has completed a necessity determination and included it in **Section 7, Project Necessity**.

# Section 7

# Project Necessity for Economic and Social Development

As described in the cover letter to Denver Water's application, a qualitative approach to antidegradation would have been more appropriate for this water supply project, which does not involve a discharge of pollutants. Even using the quantitative approach selected by the Division, however, the analysis of cumulative impacts to water quality of the Project and all Reasonably Foreseeable Future Projects plus environmental benefits should result in a conclusion of no significant degradation to water quality.

If the Division should reach a contrary conclusion that the significant degradation of water quality will occur, the Division should nonetheless issue the 401 certification because Denver Water's Project is "necessary to accommodate important economic or social development in the area in which the waters are located." 5 C.C.R. 1002-31.8(1)(b).

The antidegradation policy was adopted "to assure that important economic or social development will be allowed to proceed even where such development requires limited degradation of high-quality waters, so long as there has been an adequate investigation of potentially non-degrading alternatives." *See* 5 C.C.R. 1002-31, Statement of Basis and Purpose, 31.23(A)(1). The determination of necessity has two components:

1. The Division must determine that the activity is "important economic and social development in the area in which the waters are located;" 5 C.C.R. 1002-31.8(30(d)(i)-(ii); and

2. If the proposed activity is determined to be important economic or social development, the Division shall determine whether the degradation that would result from such regulated activity is "necessary to accommodate that development." *See* 5 C.C.R. 1002-31.8(3)(d)(iii).

## 7.1 Denver Water's Proposed Activity Constitutes Important Economic and Social Development in the Area in Which the Waters are Located

### 7.1.1 Area in Which the Waters are Located

The antidegradation regulation requires that the "area in which the waters are located" must be determined "from the facts on a case-by-case basis" and must include "all the areas directly impacted by the proposed regulated activity." 5 C.C.R. 1002-31.8(3)(d)(i). The antidegradation review contained in Denver Water's Certification Request identified potential impacts to water quality in Grand, Boulder, Gilpin, and Park counties. However, this list does not include all the areas impacted by the Project. As recognized in the regulations, water diversion projects should be examined differently. "For water diversion projects, the 'area' would include both the basin from which the diversion occurs

and the area in which the water use will occur." 5 C.C.R. § 1002- 31, Statement of Basis and Purpose, 31.23(A)(5)(d)[1]

For the Moffat Project the "area in which the waters are located" must include both the basins from which the diversions occur – Grand, Park, Boulder, Summit, and Gilpin counties – and the area in which the water use will occur – the City and County of Denver, the City and County of Broomfield, and Arapahoe, Adams, Jefferson, and Douglas counties. All these counties constitute the area in which the waters are located (collectively, the "Affected Communities").

### 7.1.2 Important Economic or Social Activity

The Division determines whether the proposed activity represents important economic or social development "from the facts on a case-by-case basis." 5 C.C.R. 1002-31.8(3)(d)(ii); *see* 5 C.C.R. § 1002-31, Statement of Basis and Purpose, 31.23(A)(5)(e) ("The Commission intends that the case-by-case determinations regarding this issue will take into account all available information and will recognize that the primary responsibilities and expertise of the Commission and the Division are not in making land use decisions that assess the importance of specific development.") (emphasis added).

Because Denver Water is submitting the evidence contained in this Appendix D that the Moffat Project is important development, "it shall be presumed important unless information to the contrary is submitted in the public review process." 5 C.C.R. 1002-31.8(3)(d)(ii); *see* 5 C.C.R. 1002-31, Statement of Basis and Purpose, 31.23(A)(5)(e) ("The Commission anticipates that in many instances if there is no information presented to the contrary, the Division will appropriately assume that the proposed development in question is 'important.'"). Furthermore, the Division must base its determination of importance "on the net impacts of a project, after considering both positive and negative impacts." 5 C.C.R. 1002-31, Statement of Basis and Purpose, 31.23(A)(5)(e).

Denver Water provides water service to 1.3 million people, nearly one-quarter of Colorado's population. Denver Water serves most of the Denver metro region, located in the South Platte River Basin. Denver Water's ability to operate effectively to meet the needs of its present and future customers is essential to the economic health of the State of Colorado.

In Executive Order D 2013-005, Governor Hickenlooper directed the Colorado Water Conservation Board to develop the first Colorado Water Plan. The first issue listed in the Order to explain the purpose and need for the Colorado Water Plan is:

The gap between our water supply and water demand is real and looming. The Statewide Water Supply Initiative forecasts that this gap could exceed 500,000 acre feet by 2050. Moreover, our largest regional gap is set to occur in the South Platte Basin, our most populous as well as our largest agriculture-producing basin.

The successful implementation of previously identified multipurpose supply projects has been identified as a critical element in meeting the state's water needs by the Draft Colorado Water Plan, the Draft South Platte Basin Implementation Plan, and the 2010 Statewide Water Supply Initiative. *See* Colorado Water Plan Draft (Dec. 2014) (http://coloradowaterplan.com/); Draft South Platte Basin Implementation Plan (BIP) (July 2014)

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[1] "The provision as adopted also will help accommodate the language of EPA's water quality regulations with the established Colorado water rights system, which authorizes transbasin water transfer."

(http://cwcbweblink.state.co.us/WebLink/ElectronicFile.aspx?docid=191973&searchid=e44aa41d-46ee-43e3-bd91-c4302c3a1b2d&dbid=0); Statewide Water Supply Initiative (SWSI) (2010) (http://cwcb.state.co.us/water-management/water-supply-planning/pages/swsi2010.aspx). The Moffat Project was identified in SWSI 2010 as one of several Identified Projects and Processes or IPP's that could help close the water supply gap. The Draft South Platte BIP describes implementation of South Platte IPP's, including the Moffat Project, as critical to meeting future needs of the South Platte Basin and the State of Colorado. *See* Draft South Platte BIP, section 5.5.1. Storage and the associated infrastructure are described in the state Water Plan as being important for minimizing agricultural losses, maximizing the use of conservation and reuse savings, and allowing for additional new supplies. *See* Draft Colorado Water Plan, at 209.

In the Final Environmental Impact Statement ("FEIS"), the U.S. Army Corps of Engineers ("USACE") evaluated the Moffat Project. The Colorado Department of Public Health and Environment was a Cooperating Agency with the USACE and contributed to and participated in the development of the FEIS with regard to water quality issues. The FEIS demonstrates that the Moffat Project constitutes important economic or social development.

The Moffat Project will satisfy the "Purpose and Need" described in the FEIS. The FEIS states that "[t]he purpose of the Moffat Collection System Project is to develop 18,000 acre-feet per year of new, firm yield to the Moffat Treatment Plant and raw water customers upstream of the Moffat Treatment Plant pursuant to the Board of Water Commissioners' commitment to its customers." FEIS, at 1–4. The FEIS identifies four important needs that the Moffat Project will resolve:

- **Reliability Need** – Existing water demands served by Denver Water's Moffat Collection System exceed available supplies from the System during a drought. Even in a single severe dry year, the Moffat Water Treatment Plant (WTP)—one of three treatment plants in Denver Water's system—is at a significant level of risk of running out of water. The thousands of people served by northern raw water customers of Denver Water such as Arvada and North Table Mountain are also at risk in a single dry year.

- **Vulnerability Need** – Denver Water's Collection System is vulnerable to manmade and natural disasters because 90% of available reservoir storage and 80% of available water supplies rely on the unimpeded operation of Strontia Springs Reservoir and other components of Denver's Water's South System.

- **Flexibility Need** – Denver Water's treated water transmission, distribution, and water collection systems are subject to failures and outages caused by routine maintenance, pipe failures, treatment plant problems, and a host of other unpredictable occurrences inherent in operating and maintaining a large municipal water supply system. These stresses to Denver Water's ability to meet its customers' water supply demands require a level of flexibility within system operations that is not presently available.

- **Firm Yield Need** – Denver Water's near-term (prior to 2032) water resource strategy and water service obligations, which have occurred since the integrated resource plan was developed, have resulted in a need for 18,000 acre-feet per year (AF/yr) of new near-term firm yield. This need was identified after first assuming successful implementation of a conservation program, construction of a non-potable recycling project, and implementation of a system refinement program.

*See* Project FEIS, at 1–2. The need for the Project also requires consideration of two other major components: (1) timeliness, having additional water available before a critical shortfall occurs; and (2) location, adding water in the north part of Denver Water's system where the reliability and vulnerability needs occur. *See* Project FEIS, at 1-4.

With respect to social and economic development, the USACE fully and comprehensively evaluated the socioeconomic impacts of the Moffat Project in the FEIS, including a detailed analysis of the socioeconomic impacts in the Denver Metropolitan Area.[2] *See* FEIS, Chapter 5, Section 5.19 at 5-487 to 5-578. In total, the Proposed Action will result in 213 full-time jobs, $12.6 million in total annual income, $62.1 million in total annual economic output, all while having no negligible or minor impacts to water rates and tap fees, other public facilities and services, housing conditions, and fiscal conditions. *See* FEIS, Chapter 5, Table 5.19-24 at 5-577 to 5-578; *see also* FEIS, Chapter 4, Section 5.19.1 at 5-488 to 578. In the FEIS, the USACE concludes that the Project's "developed water supplies would meet demands of existing and new customers along the Front Range; supporting economic activity and contributing to the quality of life for residents. In combination with anticipated development and other water-based projects and actions, the Proposed Action with [reasonably foreseeable future actions] would result in temporary, positive, cumulative economic stimulus through job creation and Project-related expenditures." FEIS at 4-580.

While the benefits analyzed in the FEIS relate primarily to the communities where the water from Moffat Project will be used, Denver, Jefferson, Adams, Arapahoe, Douglas and Broomfield, upon full permitting (and operation, in certain circumstances) of the Moffat Project, Denver Water has committed to significant investments and improvements in Park, Boulder, Summit, Gilpin, and Grand counties from which diversions will occur, which will undeniably improve the social and economic environment in those counties. Denver Water describes in detail in Section 5 of the Certification Request the resources it has committed to mitigation and enhancement of the Affected Communities and incorporates Section 5 by reference. Some of Denver Water's most prominent commitments include: Learning by Doing, a perpetual intergovernmental effort to "maintain and, where reasonably possible, restore or enhance the condition of the aquatic environment in Grand County;" under the Colorado River Cooperative Agreement, millions of dollars and thousands of acre-feet of water for environmental, water quality and water supply projects in Summit and Grand counties; an environmental pool in Gross Reservoir that will provide environmental and water supply benefits in Boulder County; the state-approved Fish and Wildlife Enhancement Plan.

After considering both positive and negative impacts of the Moffat Project as required in a necessity of degradation determination, the net impacts to the Affected Communities are overwhelmingly positive. *See* 5 C.C.R. § 1002-31, Statement of Basis and Purpose, 31.23(A)(5)(e). Denver Water's Moffat Project provides for important social and economic development in the area in which the waters are located.

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[2] For purposes of the FEIS analysis, "the Denver Metropolitan area" included Boulder County (location of Gross Reservoir), Adams County (location of the gravel pits, Advanced Water Treatment Plant, and a portion of the conduit), and Jefferson County (location of a portion of the conduit) in addition to other Denver Metropolitan area counties, not limited to Summit, Broomfield, and Grand counties. *See* FEIS, at 5–532.

### 7.1.3 Necessity of Degradation

After determining that the proposed activity represents important economic or social development in the area in which the waters are located, the Division then turns to the determination of "necessity." The degradation will be considered "necessary" if "there are no water quality control alternatives available that (A) would result in no degradation or less degradation of the state waters and (B) are determined to be economically, environmentally, and technologically reasonable." 5 C.C.R. § 1002-31.8(3)(d)(iii).

This particular provision demonstrates the awkwardness of applying antidegradation to water supply projects, as distinguished from point source discharges. The regulation refers to water quality control alternatives and states that evaluation of alternatives should be based in part on "accepted engineering practice." *Id.* Guidance from the Commission likewise focuses on discharges: "the intent is to focus on alternatives directly related to protecting water quality—[ ] different treatment techniques, different discharge locations, applications of additional best management practices, or process changes that improve discharge quality." 5 C.C.R. § 1002-31, Statement of Basis and Purpose, 31.23(A)(5)(e). These concepts do not apply to evaluation of a project that removes and adds water to the stream rather than involving a point source discharge.

However, the Commission has provided additional guidance more helpful and more closely related to water supply projects, and Denver Water proposes that the Division rely on that guidance with regard to the Moffat Project. "[A]vailable alternatives are limited to those that would accomplish the proposed activity's purpose." 5 C.C.R. § 1002-31, Statement of Basis and Purpose, 31.23(A)(5)(e). As described above, The FEIS thoroughly analyzed alternatives to determine which one would satisfy the Purpose and Need.

The Division should rely on the analysis of alternatives in the FEIS. The USACE began with 303 potential water supply sources and infrastructure components. *See* FEIS at 2-3. The USACE then applied several screens to these potential alternatives, which included consistency with the project's purpose and need, public health, geography, and technical feasibility. *See* FEIS Table 2-1. After applying these screens, the USACE fully analyzed five action alternatives and the No Action Alternative.[3] *See* FEIS at 2-25. The USACE then examined in detail the environmental impacts of these alternatives. *See* FEIS at Chapters 4 and 5. The USACE is also evaluating these alternatives under the Section 404(b)(1) Guidelines, which require that the USACE permit the least environmentally damaging practicable alternative ("LEDPA"). We have attached the USACE's detailed preliminary analysis. Essentially, the agency evaluated whether these alternatives are, in the language of Colorado's necessity regulation, "economically, environmentally, and technologically reasonable." 5 C.C.R. § 1002-31.8(3)(d)(iii).

Commission guidance makes it clear that reliance on the FEIS is appropriate for a project like the Moffat Project that requires a section 404 permit. "Projects subject to federal NEPA requirements already are faced with an alternative analysis requirement that goes substantially beyond that required here. . . . So long as a reasonable effort has been made to assess less-degrading alternatives, in many circumstances these other reviews may be sufficient to satisfy the antidegradation review

[3] The "no action alternative" cannot be considered by the Division as an available alternative. "So long as a project has passed the 'important development' test and reached this stage of the review, the 'no-action' alternative (i.e., not proceeding with the project) will not be considered an available alternative." 5 C.C.R. § 1002-31, Statement of Basis and Purpose, 31.23(A)(5)(e).

requirements." 5 C.C.R. § 1002-31, Statement of Basis and Purpose, 31.23(A)(5)(e). Neither the USACE's preliminary LEDPA analysis nor the FEIS identified any available alternative to the Moffat Project that would result in lesser impacts to state waters and remain "economically, environmentally, and technologically reasonable." *See* FEIS § 4.6.2 (examining the cumulative water quality impacts of each alternative).

## 7.2 Conclusion

Denver Water believes that the analysis in its Request for Certification demonstrates the net effect of the Moffat Project would be insignificant degradation of water quality. However, should the Division find that the Moffat Project would cause significant degradation, Denver Water has demonstrated both that the activity is "important economic and social development in the area in which the waters are located;" and that the degradation that would result from such regulated activity is "necessary to accommodate that development." 5 C.C.R. 1002-31(3)(d). The Division should therefore approve the 401 Certification because the Moffat Project is "necessary to accommodate important economic or social development in the area in which the waters are located." 5 C.C.R. 1002-31.8(1)(b).

# Section 8
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