INTRODUCTION

The City and County of Denver, acting by and through its Board of Water Commissioners (Denver Water) notified the United States (U.S.) Army Corps of Engineers (Corps) of their intent to apply for a Department of the Army Permit (Section 404 permit), pursuant to Section 404 of the Clean Water Act, to place fill material in jurisdictional waters of the U.S., including wetlands. The fill would be for the construction of a water storage facility associated with developing additional water supplies. The Corps determined that an analysis of the significant natural and human environmental effects of the proposed Moffat Collection System Project (Moffat Project) and reasonable range of alternatives is necessary to provide for full public disclosure and to aid in decision-making.

The Proposed Action and action alternatives would result in direct impacts to wetland and other waters of the U.S. The Proposed Action would result in 1.95 acres of permanent and 0.12 acre of temporary impact to wetlands, in addition to 3.53 acres of permanent and 0.49 acre of temporary impact to other waters of the U.S. This action requires authorization from the Corps under Section 404 of the Clean Water Act.

This Environmental Impact Statement (EIS) was prepared in accordance with the National Environmental Policy Act (NEPA) of 1969, as amended, and the Corps' regulations for implementing NEPA (33 Code of Federal Regulations [CFR] 325, Appendix B). This EIS has also been formulated to address the information requirements of the Section 404(b)(1) Guidelines (40 CFR 230). The Corps, Omaha District, Regulatory Branch, is the lead federal agency responsible for preparing the EIS. The Corps is assisted by a team of third-party contractors led by URS Corporation, working under the direction of, and in cooperation with, the Corps in accordance with December 17, 1997 guidance from the Chief of Engineers regarding preparation of an EIS.

Information contained in the EIS serves as the basis for a decision regarding issuance of a Section 404 permit. It also provides information for local and state agencies having jurisdictional responsibility for affected resources.

COOPERATING AGENCIES

The Corps requested that three federal agencies, with statutory authority over the proposed Project, participate in the NEPA process as cooperating agencies (40 CFR 1501.6 and 1508.5), including the U.S. Environmental Protection Agency (EPA), Federal Energy Regulatory Commission (FERC), and the U.S. Forest Service (USFS). The USFS declined the Corps' request to be a cooperating agency. Formal cooperating agency agreements were executed between the Corps and FERC and EPA. Although the Corps denied a request by Grand County to be a cooperating agency, they did grant consulting agency status relative to effects on county resources.

PUBLIC AND AGENCY PARTICIPATION

As required by NEPA, the Corps has provided for an early and open process to determine the scope of significant issues to be addressed in this EIS. An **Agency Scoping Meeting** was held on October 7, 2005 at the Corps' Denver Regulatory Office in Littleton, Colorado, to review the Moffat Project purpose and need, preliminary alternatives, and key environmental issues and

agency concerns, and data availability and data/field study needs. Representatives from the following agencies attended the meeting: Corps – Omaha District and Denver Regulatory Office; EPA; FERC; USFS; Colorado Department of Public Health and Environment (CDPHE), Water Quality Control Division; and Grand County. Representatives from the U.S. Fish and Wildlife Service, (USFWS), Colorado Division of Wildlife (CDOW), Colorado State Historic Preservation Officer (SHPO), Advisory Council on Historic Preservation, Boulder County, and Jefferson County were unable to attend the meeting, but have participated as needed throughout the NEPA process.

A **Notice of Intent** to prepare an EIS initiated the 45-day scoping period and was published in the *Federal Register* on September 17, 2003. The comment period was extended until November 7, 2003.

Three **Public Scoping Meetings** were held to present the Moffat Project to the public and solicit public and agency comments. The meetings were held in Boulder, Colorado, on October 7, in Denver, Colorado, on October 8, and in Silver Creek, Colorado, on October 9, 2003. A *Scoping Summary* was prepared by the Corps documenting the scoping process, and summarizing the issues and concerns raised to date. The document was distributed to all interested agencies and public participants.

Comments, concerns, and issues brought forth during the above mentioned public involvement process were incorporated into this EIS. The Corps will provide for a 90-day comment period on this Draft EIS for public and agency review. After the comment period has expired, the Corps will consider all of the information presented in the EIS as well as any comments received during the public comment period. The Corps will then issue a Final EIS, and ultimately issue its Section 404 permit decision and the rationale for the decision in a Record of Decision (ROD).

PURPOSE AND NEED

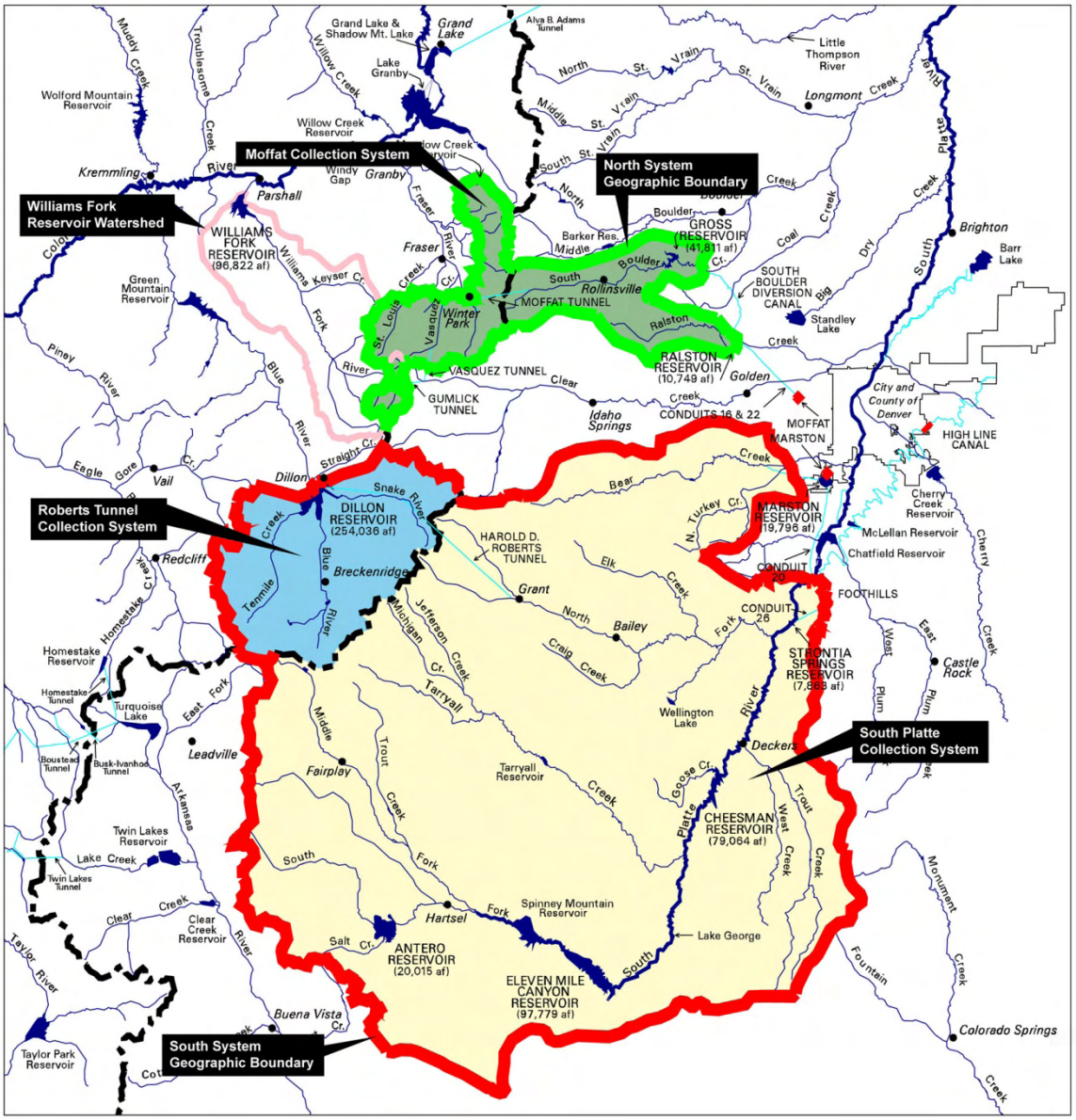
Denver Water's collection system is composed of two major systems: the North System (also known as the Moffat Collection System) and the South System. These two raw water systems are geographically distinct and are not physically connected.

The Need

Denver Water developed an *Integrated Resources Plan* (IRP) in 1997, with an update in 2002, to analyze existing and future water supplies and customer demands. Based on the IRP and recent events such as the 2002 drought and forest fires in Denver Water's watersheds, Denver Water identified four needs in the Moffat Collection System that have to be resolved. These needs are as follows:

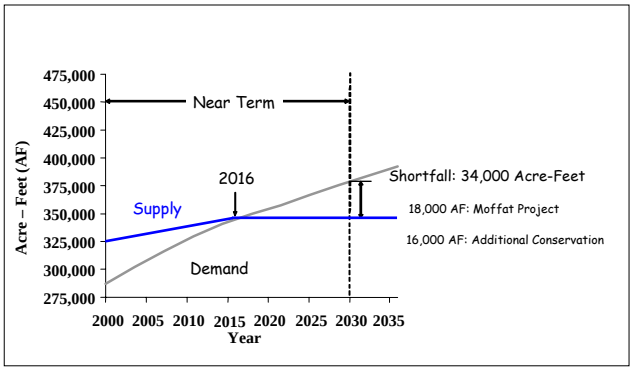
- **The Reliability Need** – Existing water demands served by Denver Water's Moffat Collection System exceed available supplies from the Moffat Collection System during a drought, causing a water supply reliability problem. In a severe drought, even in a single, severe dry year, the Moffat Water Treatment Plant (WTP)—one of three treatment plants in Denver's system—is at a significant level of risk of running out of water.

Denver Water's Collection System



- **The Vulnerability Need** – Denver Water's collection system is vulnerable to man-made 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 Water's South System.
- **The 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 that are 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.

- **The Firm Yield Need -** Denver Water's near-term (prior to 2030) water resource strategy and water service obligations, which have occurred since the IRP 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.



Total System Demand Versus Supply

Purpose and Need Statement

The Corps, exercising its independent judgment while considering Denver Water, and other agency and public perspectives [33 CFR 325, Appendix B.9(b)(4)], evaluated and determined the following Purpose and Need statement as the basis for defining and evaluating alternatives:

> *The purpose of the Moffat Collection System Project is to develop 18,000 acre-feet per year of new, annual 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.*

Denver Water's need for the proposed Moffat Project is based on two major issues:

1. Timeliness: Water Supply Shortage in the Near-Term Timeframe (Prior to 2030) - Beginning in 2016, and by 2030, Denver Water identifies an annual 34,000 AF/yr shortfall in water supplies available to meet the needs of its customers and near-term water commitments. This shortfall was determined after analyzing existing supply, projected demand, savings from system refinements, non-potable reuse, natural replacement, and cooperative projects with other water providers. Of this near-term 34,000 AF/yr shortfall, Denver Water is relying on 16,000 AF/yr forthcoming from the implementation of additional conservation efforts. The development of new, firm yield is necessary to meet the remaining 18,000 AF/yr shortfall.

2. Location: Need for Water to the Moffat Water Treatment Plant - Approximately 90% of the available reservoir storage and 80% of the available water supplies rely on the South System. This imbalance in reservoir storage and water supplies between the North and South systems has created water supply challenges that have resulted in:

- Unreliable water supply for the Moffat WTP and Moffat Collection System raw water customers
- System-wide vulnerability issues
- Limited operational flexibility of the treated water system

To address the two major issues, Denver Water is pursuing the proposed Moffat Project to provide 18,000 AF/yr of new, firm yield. Fifteen thousand AF of this firm yield would be for Denver Water and its customers, the remaining 3,000 AF would be for the City of Arvada. The

proposed Project would address both the overall near-term water supply shortage, and the imbalance in water storage and supply between the North and South systems.

ALTERNATIVES ANALYSIS

The Council on Environmental Quality (CEQ) regulations for implementing NEPA require that an EIS "rigorously explore and objectively evaluate all reasonable alternatives," including the No Action Alternative (40 CFR 1502.14[(a] and [d]). Reasonable alternatives, as defined by the CEQ, are "those that are practical or feasible from the technical and economic standpoint and using common sense, rather than simply desirable from the standpoint of the applicant." In contrast to reasonable alternatives under NEPA, the Corps' Section 404(b)(1) Guidelines define practicable alternatives as "available and capable of being done after taking into consideration cost, existing technology, and logistics in light of the overall project purposes" (40 CFR 231.10[a]). These guidelines are the substantive environmental standards by which all Section 404 permit applications are evaluated.

By integrating the alternatives analysis for actions subject to NEPA and the Section 404(b)(1) Guidelines early in the process, it helped ensure that the range of alternatives carried forward for detailed analysis in the EIS process met the Corps' Purpose and Need, and were practicable and reasonable.

Preliminary Screening

The alternative screening process for the Moffat Project was conducted in accordance with both NEPA and the Section 404(b)(1) Guidelines. The identification, verification, evaluation, and screening of all known alternatives were conducted by the Corps, with review and input from the cooperating and consulting agencies involved with the Project. The overall screening approach was performed in two phases—Screen 1 and Screen 2

Screen 1 progressed from a broad range of 303 potential water supplies 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 Project alternatives using criteria focused on environmental impacts to the aquatic environment and other natural ecosystems. The results of Screen 2 are a set of five alternatives carried forward for further analysis in the EIS. After the alternatives screening process was completed, components of the five alternatives were further refined and revised as Denver Water developed additional detail based on further investigations and engineering studies. These five alternatives represent a reasonable range of practicable alternatives that encompass a variety of potential water supplies and storage sites. Each action alternative is configured to increase the firm yield of Denver Water's system by 18,000 AF/yr, consistent with the Project Purpose and Need Statement.

The five action alternatives, plus the No Action Alternative, identified for further analysis in the EIS are:

- Proposed Action (Alternative 1a) – Gross Reservoir Expansion (Additional 72,000 AF)
- Alternative 1c – Gross Reservoir Expansion (Additional 40,700 AF)/New Leyden Gulch Reservoir (31,300 AF)

- Alternative 8a – Gross Reservoir Expansion (Additional 52,000 AF)/Reusable Return Flows/Gravel Pit Storage (5,000 AF)
- Alternative 10a – Gross Reservoir Expansion (Additional 52,000 AF)/Reusable Return Flows/Denver Basin Aquifer Storage (20,000 AF)
- Alternative 13a – Gross Reservoir Expansion (Additional 60,000 AF)/Transfer of Agricultural Water Rights/Gravel Pit Storage (3,625 AF)
- No Action Alternative – The No Action Alternative assumes that Denver Water would not receive approval from the Corps to implement the Moffat Project. The No Action Alternative would require Denver Water to use a combination of strategies to meet the need for additional water supply, including using a portion of its Strategic Water Reserve and imposing mandatory restrictions to help reduce demand during drought periods.

Proposed Action (Alternative 1a) – Gross Reservoir Expansion (Additional 72,000 AF)

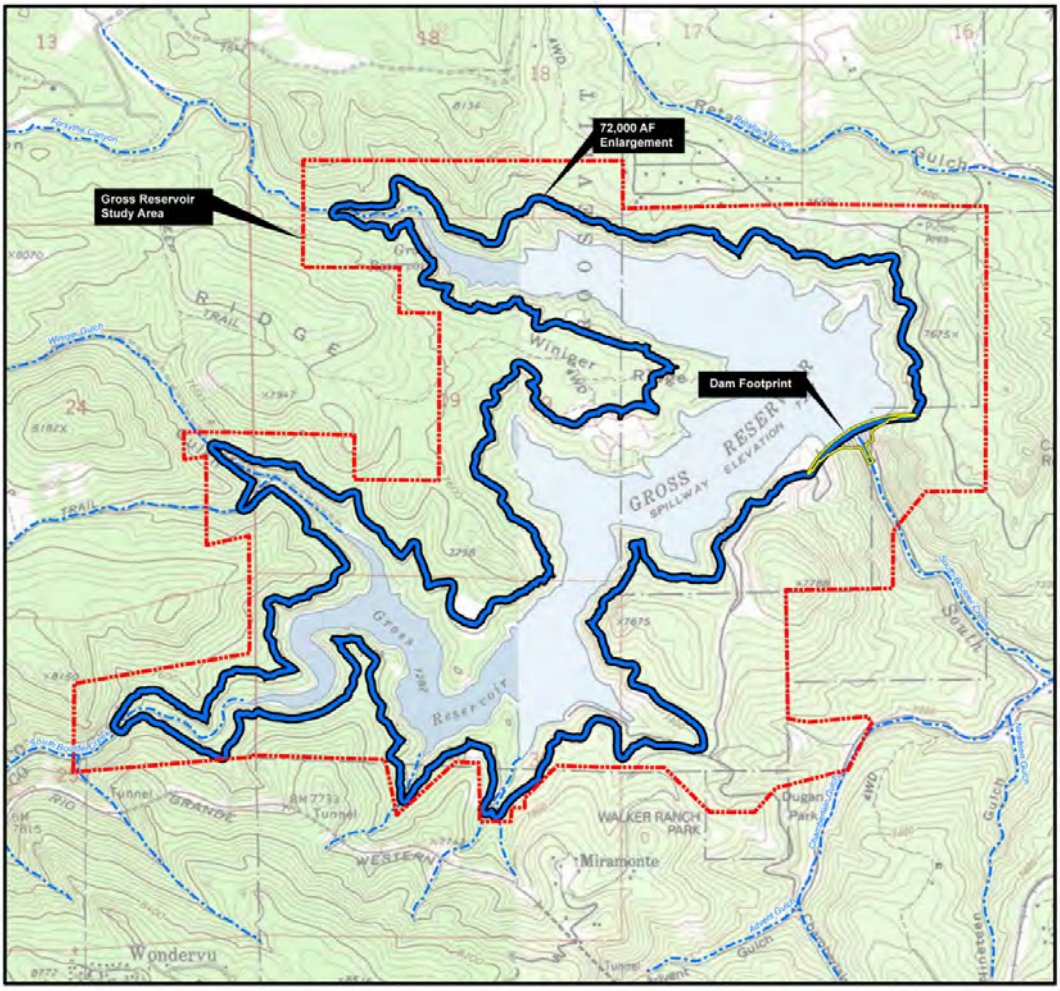
Gross Reservoir

Using existing collection infrastructure, average to wet-year **Fraser River, Williams Fork River,** and **South Boulder Creek** water would be diverted and delivered via the Moffat Tunnel and **South Boulder Creek** to the existing Gross Reservoir site. The existing Gross Dam would be raised 125 feet to provide 18,000 AF of new yield. The existing Gross Reservoir would be expanded from 41,811 to 113,811 AF in order to provide an additional 72,000 AF of storage capacity. Existing facilities would be used to deliver water from the Gross Reservoir Expansion to the Moffat WTP, including the South Boulder Diversion Canal, Ralston Reservoir, and Conduits 16 and 22. The following is a list of the major components of the Gross Dam and Reservoir Expansion (Proposed Action).

Proposed Action (Alternative 1a) – Primary Components

Facility	Component Description
Gross Reservoir Expansion and Dam Raise	Additional 72,000 AF of storage capacity
	125-foot dam raise
	New concrete spillway over dam raise
	New auxiliary spillway south of dam
	Four construction staging areas
	Relocation of existing recreation and visitation facilities
	Borrow material: approximately 60% of the total borrow material produced on site; up to 40% of fine aggregate obtained from off-site commercial sources
	Relocation of existing dam and spillway access roads
	Two stockpile and two spoil areas and associated haul roads
	No modification to existing outlet works

Notes:
AF = acre-feet
% = percent



Gross Dam and Reservoir Expansion

Alternative 1c – Gross Reservoir Expansion (Additional 40,700 AF)/New Leyden Gulch Reservoir (31,300 AF)

Alternative 1c would combine additional Moffat Collection System supplies and two reservoir storage facilities to provide 18,000 AF/year (yr) of new, firm yield. The existing Gross Dam would be raised 85 feet to provide an additional 40,700 AF of new storage capacity at Gross Reservoir. A new off-stream reservoir would be constructed in Leyden Gulch to provide 31,300 AF of active storage capacity. This combination of reservoir storage represents a balance of construction cost, relocation requirements, operational considerations, and potential environmental impacts based on existing information and analyses. The exact combination of storage sizes may vary, based on more precise design data, but would still total 72,000 AF of new reservoir storage.

Using existing Denver Water collection infrastructure, average to wet-year **Fraser River**, **Williams Fork River,** and **South Boulder Creek** water would be delivered via the Moffat Tunnel and **South Boulder Creek** to an enlarged Gross Reservoir and via the South Boulder Diversion Canal to a new Leyden Gulch Reservoir. A combination of existing and new facilities would be used to deliver water from the enlarged Gross Reservoir and the new Leyden Gulch Reservoir to the Moffat WTP. Water would be released from storage and delivered to Denver Water customers when needed. The following is a list of the major components of the Gross Reservoir enlargement and the new Leyden Gulch Reservoir (Alternative 1c).

Leyden Gulch

Alternative 1c – Primary Components

Facility	Component Description
Gross Reservoir Expansion and Dam Raise	Additional 40,700 AF of storage capacity
	85-foot dam raise
	New concrete spillway over dam raise
	New auxiliary spillway south of dam
	Four construction staging areas
	Relocation of existing recreation and visitation facilities
	Borrow material: approximately 60% of the total borrow material produced on site; up to 40% of fine aggregate obtained from off-site commercial sources
	Relocation of existing dam and spillway access roads
	Three stockpile and spoil areas and associated haul roads
	No modification to existing outlet works
New Leyden Gulch Reservoir	31,300 AF of new storage volume
	177-feet high new earthfill dam
	Relocation of approx. 4,000 feet of SH 93
	South Boulder Diversion Canal relocation (1-mile segment)
	All borrow material from reservoir pool area
	8-foot diameter outlet tunnel and buried pipelines connecting to Conduits 16 and 22

Notes:
AF = acre-feet % = percent SH = State Highway

Alternative 8a – Gross Reservoir Expansion (Additional 52,000 AF)/Reusable Return Flows/Gravel Pit Storage (5,000 AF)

This alternative would combine storage of Moffat Collection System supplies in an expansion of the existing Gross Reservoir with reusable return flows to provide 18,000 AF/yr of new, firm yield. Approximately 13,000 AF/yr of new, firm yield would be provided by the expansion of Gross Reservoir, while 5,000 AF/yr of new, firm yield would be provided by reusable return flows stored in gravel pits along the **South Platte River.**

The existing Gross Dam would be raised 101 feet to provide an additional 52,000 AF of new storage capacity in an expanded Gross Reservoir. When available, additional water diverted from the **Fraser River, Williams Fork River,** and **South Boulder Creek** at existing Denver Water facilities under existing Denver Water water rights, would be stored in an expanded Gross Reservoir.

A new diversion structure and gravel pit storage facilities would be constructed along the **South Platte River.** Reusable return flows would be diverted from the **South Platte River,** when available, to fill the new gravel pit storage facilities. When needed, water would be recovered from gravel pit storage, treated at a new advanced water treatment (AWT) plant, and conveyed via new pipelines to the Moffat Collection System.

The gravel pit storage facilities (gravel pits, diversion structure, pipelines, and WTP) are considered representative of typical facilities of other existing facilities along the **South Platte River.** The actual location and configuration of the gravel pits, the AWT plant, and associated facilities would be determined during the design phase should this alternative be permitted by the Corps. The following table lists the major components of Alternative 8a.

Alternative 8a – Primary Components

Facility	Component Description
Gross Reservoir Expansion and Dam Raise	Additional 52,000 AF of storage capacity
	101-foot dam raise
	New concrete spillway over dam raise
	New auxiliary spillway south of dam
	Four construction staging areas
	Relocation of existing recreation and visitation facilities
	Borrow material: approximately 60% of the total borrow material produced on site; up to 40% of fine aggregate obtained from off-site commercial sources
	Relocation of existing dam and spillway access roads
	Three stockpile and spoil areas and associated haul roads
	No modification to existing outlet works
South Platte River Diversion	150-foot long concrete diversion in the South Platte River – representative design
	750-foot, 54-inch pipeline from diversion to gravel pit storage
Gravel Pit Storage	Worthing, North Tower, and South Tower pits – representative sites
	Practical storage volume of approximately 5,000 AF (total of all pits)
	Perimeter slurry wall to prevent groundwater seepage
	1.4 miles of 36-inch pipeline and pump stations connecting three gravel pits
Advanced Water Treatment Plant	Located near Worthing Pit – representative site
	Process train: sedimentation, low-pressure membrane pretreatment, reverse osmosis, advanced oxidation, disinfection, and zero-liquid discharge
	13.6 mgd capacity
	4-acre plant site
Dechlorination Facility	0.1 acre site – representative site
Pipeline (Conduit O)	25 miles long, 36-in diameter pipeline connecting the new AWT plant and the Moffat Collection System – representative alignment
	Three 2,000-horsepower pump stations

Notes:
AF = acre-feet
AWT = advanced water treatment
mgd = million gallons per day
% = percent

Alternative 10a – Gross Reservoir Expansion (Additional 52,000 AF) / Reusable Return Flows / Denver Basin Aquifer Storage (20,000 AF)

Alternative 10a would combine storage of Moffat Collection System supplies in an expansion of the existing Gross Reservoir with deep aquifer storage of reusable return flows to provide 18,000 AF/yr of new, firm yield. Approximately 13,000 AF/yr of new, firm yield would be provided by the enlargement of Gross Reservoir, while 5,000 AF/yr of new, firm yield would be provided by reusable return flows and deep aquifer storage and recovery (ASR).

The existing Gross Dam would be raised 101 feet to provide an additional 52,000 AF of new storage capacity. When available, additional water diverted from the **Fraser River, Williams Fork River,** and **South Boulder Creek** at existing Denver Water facilities under existing Denver Water water rights, would be stored in an enlarged Gross Reservoir.

When available, reusable return flows at the Denver Water Recycling Plant would be treated at a new AWT plant and conveyed via a new pipeline distribution system to an injection/recovery well field in the city of Denver. This water would be injected into the Denver Basin deep aquifers for storage. The estimated storage capacity would be 20,000 AF. When needed, previously stored water would be recovered from the groundwater basin and conveyed through new pipelines to the Moffat Collection System.

The locations of the new AWT plant, well sites, and distribution pipeline system are considered representative to illustrate how this alternative would be configured for purposes of this EIS analysis. The exact location of these components would be determined during the design phase should this alternative be permitted.

Denver Water currently uses the bulk of their reusable supplies during the summer months primarily to meet non-potable demands and as an exchange supply. As with Alternative 8a, reusable return flows for this Project would be available primarily during the winter months from November through March when Denver Water's non-potable demands and exchange potential are lowest. The following table lists the major components of the Gross Dam and Reservoir enlargement and deep aquifer storage recovery for Alternative 10a.

Alternative 10a – Primary Components

Facility	Component Description
Gross Reservoir Expansion and Dam Raise (same as Alternative 8a)	Additional 52,000 AF of storage capacity
	101-foot dam raise
	New concrete spillway over dam raise
	New auxiliary spillway south of dam
	Four construction staging areas
	Relocation of existing recreation and visitation facilities
	Borrow material: approximately 60% of the total borrow material produced on site; up to 40% of fine aggregate obtained from off-site commercial sources
	Relocation of existing dam and spillway access roads
	Three stockpile and spoil areas and associated haul roads
	No modification to existing outlet works
Advanced Water Treatment Plant	Located near the Denver Water Recycling Plant – representative site
	Process train; sedimentation, low-pressure membrane pre-treatment, reverse osmosis, advanced oxidation, disinfection, and zero-liquid discharge
	13.6 mgd capacity
	4-acre plant site
Denver Basin Aquifer Storage and Recovery System	Approximately 27 injection/recovery well sites (three-well cluster at each site) – representative sites
	Storage volume of approximately 20,000 AF
	36 miles of 12- to 48-inch diameter distribution pipelines – representative alignment
Pipeline (Conduit M)	18 miles long, 36-inch diameter pipeline connecting the new AWT plant and the Moffat Collection System – representative alignment
	Three 2,000-horsepower pump stations

Notes:
AF = acre-feet
AWT = advanced water treatment
mgd = million gallons per day
% = percent

Alternative 13a – Gross Reservoir Expansion (Additional 60,000 AF)/Transfer of Agricultural Water Rights/Gravel Pit Storage (3,625 AF)

This alternative would combine storage of Moffat Collection System supplies in an expansion of the existing Gross Reservoir with a purchase and transfer of existing **South Platte River** agricultural water rights stored in gravel pit storage facilities to provide 18,000 AF/yr of new, firm yield. Approximately 15,000 AF/yr of new, firm yield would be provided by Moffat Collection System supplies and the enlargement of Gross Reservoir, while 3,000 AF/yr of new, firm yield would be provided by gravel pit storage and transferred South Platte agricultural water rights.

The existing Gross Dam would be raised 110 feet to provide an additional 60,000 AF of new storage capacity in an expanded Gross Reservoir. When available, additional water diverted from the **Fraser River, Williams Fork River,** and **South Boulder Creek** at existing Denver Water facilities, under existing Denver Water water rights, would be stored in an expanded Gross Reservoir.

Senior agricultural water rights, owned by ditch companies diverting from the **South Platte River** downstream of Denver, would be purchased and converted to municipal/industrial use. Water rights sufficient in quantity and priority would be purchased to produce approximately 3,000 AF/yr of new, firm yield when combined with 3,625 AF of new gravel pit storage. Gravel pit storage is needed to firm the agricultural water rights supply, provide operational storage, and meet winter return flow obligations associated with historical use of the agricultural water rights. A new diversion from the **South Platte River,** as described in Alternative 8a, would divert water to the gravel pit storage facility.

The gravel pit storage facilities (gravel pits, diversion structure, and pipelines) are considered representative of typical existing facilities found along the **South Platte River.** The actual location and configuration of the gravel pits, AWT plant, and associated facilities would be determined during the design phase should this alternative be permitted by the Corps. The following table lists the major components of Alternative 13a.

Alternative 13a – Primary Components

Facility	Component Description
Gross Reservoir Expansion and Dam Raise	Additional 60,000 AF of storage capacity
	110-foot dam raise
	New concrete spillway over dam raise
	New auxiliary spillway south of dam
	Four construction staging areas
	Relocation of existing recreation and visitation facilities
	Borrow material: approximately 60% of the total borrow material produced on site; up to 40% of fine aggregate obtained from off-site commercial sources
	Relocation of existing dam and spillway access roads
	Three stockpile and spoil areas and associated haul roads
	No modification to existing outlet works
South Platte River Diversion	150-foot long concrete diversion in the South Platte River – representative design
	750-foot, 54-inch pipeline from diversion to gravel pit storage
	Diversion via the existing Brighton Ditch to the Challenger Pit

Alternative 13a – Primary Components (continued)

Facility	Component Description
Gravel Pit Storage	Worthing, South Tower, and Challenger pits – representative sites
	Practical storage volume of approximately 3,625 AF (total of all pits)
	Perimeter slurry wall to prevent groundwater seepage
	5 miles of 30-inch diameter pipeline and pump stations connecting the three gravel pits
	Controlled outlet on at least one pit to meet winter return flow obligation
Advanced Water Treatment Plant	Located near Worthing Pit – representative site
	Process train; sedimentation, low-pressure membrane pretreatment, reverse osmosis, advanced oxidation, disinfection, and zero-liquid discharge
	10.8 mgd capacity
	4-acre plant site
Dechlorination Facility	0.1 acre site – representative site
Pipeline (Conduit O)	25 miles, 30-inch diameter pipeline connecting the new AWT plant and the Moffat Collection System – representative alignment
	Three 1,500-horsepower pump stations

Notes:
AF = acre-feet
AWT = advanced water treatment
mgd = million gallons per day
% = percent

No Action Alternative

NEPA requires that the EIS alternatives analysis include the alternative of "no action" [40 CFR 1502.14(d)]. The CEQ explains that No Action means "the proposed activity would not take place and the resulting environmental effects from taking no action would be compared with the effects of permitting the proposed activity or an alternative activity to go forward."

For this EIS, the No Action Alternative considers what Denver Water would do to meet its water supply needs if it could not obtain a Section 404 permit for the Moffat Project (33 CFR 325 Appendix B). In the event that a Section 404 permit is not issued, 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. Assuming these projects and activities are fully implemented, demand on the Denver Water system is still projected to exceed supply beginning in 2016. If additional supplies are not developed, Denver Water's average demand would exceed its supply by 18,000 AF/yr in 2030, of which Arvada's average demand would be 3,000 AF/yr.

Consistent with the action alternatives, the No Action Alternative is based on the following assumptions and conditions:

- Hydrologic modeling of the No Action Alternative is based on the same future water demands as the action alternatives (363,000 AF/yr by the year 2030–the demand includes the 3,000 AF of firm yield for the City of Arvada).
- All planned water system improvements currently under development are accomplished. These are designed to provide additional sources of water supply to Denver Water's customers through 2016. Examples include the non-potable recycling project and downstream gravel pit storage.

- Demand projections assume 100% success in implementing Denver Water's conservation goals identified in the 2002 IRP.
- There is no Colorado River Compact Call.
- The treated and raw water systems would always operate error-free.
- The No Action Alternative has the same interpretation of water rights, agreements, and permit requirements as the action alternatives.
- Hydrologic modeling of the No Action Alternative is based on the same water supply study period (1947 to 1991) as the action alternatives.

As compared to past droughts when the Denver Board of Water Commissioners' (Denver Water) estimated water supply exceeded demand, under the No Action Alternative there is no water supply surplus. During the recent 2002 through 2005 drought period, the Denver Water's average annual water supply was 315,000 AF, and the average unrestricted customer demand was 285,000 AF/yr. Denver Water's estimated average annual surplus was 30,000 AF (315,000 AF minus 285,000 AF). However, droughts occur with unpredictable intensity and duration. During drought events, it is unknown how long the drought will last or how severe it will be, and drought periods more severe than the 1947 to 1991 study period can be eventually expected. Even though Denver Water had an estimated surplus during the recent drought, they enacted severe and mandatory restrictions on their customers' use of water. Under the No Action Alternative, Denver Water's average annual demand is 78,000 AF greater than the demand during the recent drought (363,000 AF minus 285,000 AF). This represents a 27% increase in demand, however, supplies are only estimated to increase by 30,000 AF/yr on average by 2016. The demand under the No Action Alternative would be even higher except that conservation is expected to produce an additional 16,000 AF/yr of annual savings. The 16,000 AF/yr of conservation savings is expected every year and is not available as an additional savings due to drought restrictions. This "demand hardening" will make it more difficult for customers to save water during restrictions. With 78,000 AF of additional demand and the expected demand hardening, the No Action Alternative would require more frequent and severe restrictions.

The No Action Alternative would require Denver Water to use a combination of strategies to meet the need for additional water supply (i.e., Combination Strategy), including using a portion of its Strategic Water Reserve and imposing more frequent and severe mandatory restrictions than the action alternatives to help reduce demand during drought periods. However, these strategies would not resolve the system vulnerabilities, flexibility, or reliability problems identified in the Purpose and Need.

AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

Potential effects of each alternative were evaluated for the issues identified during the scoping process. The following summarizes each issue.

Surface Water

Hydrology

Denver Water's Platte and Colorado Simulation Model (PACSM), which is a water allocation daily-time-step computer model, was used as the tool to generate hydrologic information for the

analysis of the EIS alternatives. The model was used to generate hydrologic output, including stream flows and reservoir data. The following scenarios were evaluated using PACSM:

- Current Conditions (2006)
- Full Use of the Existing System (2016)
- Action Alternatives - Proposed Action (Alternative 1a) and Alternatives 1c, 8a, 10a, and 13a
- No Action Alternative

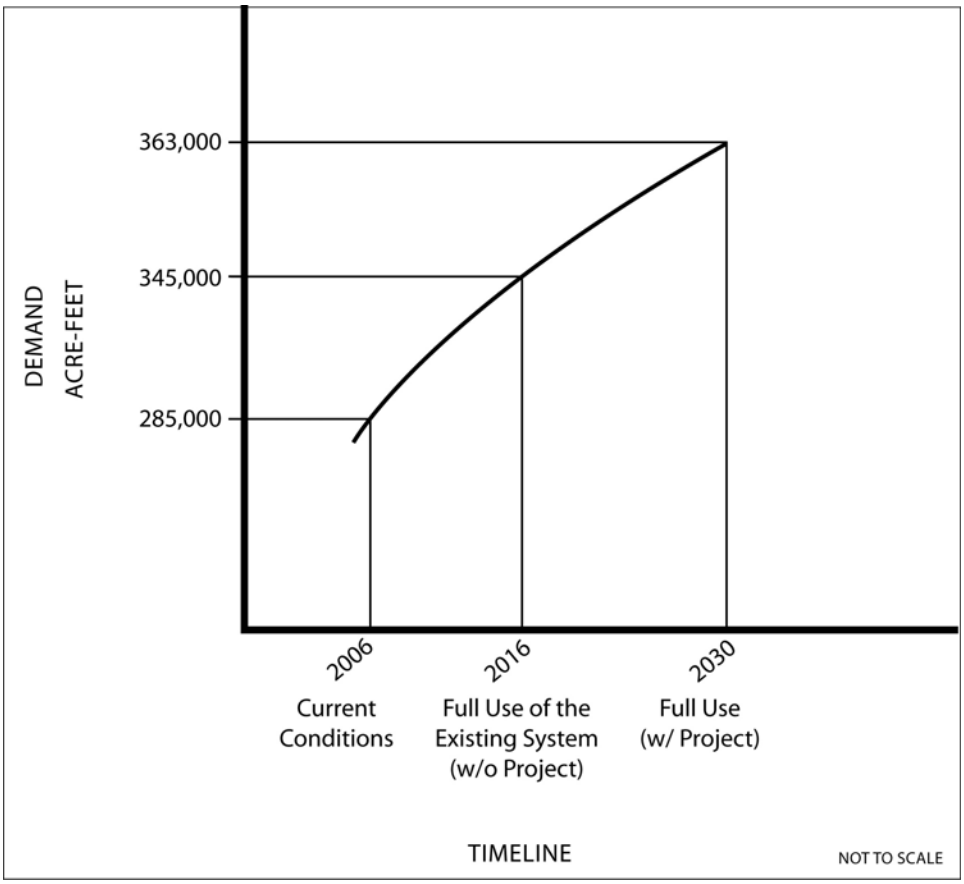
Hydrologic impacts directly or indirectly related to implementing an action alternative are based on a comparison of hydrologic data for Full Use of the Existing System (2016) and each of the action alternatives (2030). To understand the hydrologic conditions under Full Use of the Existing System (2016), a description of hydrologic changes that would occur between 2006 and 2016 is needed. Thus, a comparison of the Current Conditions (2006) and Full Use of the Existing System (2016) scenarios was conducted to describe the hydrologic changes that would occur between 2006 and 2016. Refer to Appendix H-1 for a discussion of this comparison.

- **Current Conditions (2006):** The Current Conditions scenario reflects existing conditions in 2006, including demands, facilities, agreements, operations, and administration of the **Colorado River** and **South Platte River** basins. Under the Current Conditions scenario, Denver Water's existing average annual demand is 285,000 AF/yr. The purpose of the Current Conditions scenario is to model Denver Water's and other existing water rights and facilities under the hydrologic conditions that existed throughout the study period (1947 through 1991). In addition, the operations of all existing reservoirs and diversion facilities are simulated for the entire study period, regardless of when they came on-line.
- **Full Use of the Existing System (2016):** The Full Use of the Existing System scenario reflects the operation of Denver Water's existing system in year 2016 at an average annual demand of 345,000 AF/yr. The Full Use of the Existing System is without a Moffat Project on-line. Denver Water's projected demands are estimated to begin to exceed system supplies in year 2016. Under this scenario, Denver Water would maximize the yield of their existing water supplies using their current facilities and infrastructure. This scenario also includes other entities' actions/projects that would occur between 2006 and 2016, such as changes due to the expiration of temporary operational agreements associated with Williams Fork and Wolford Mountain reservoirs to provide flows for downstream endangered fish needs (known as "10,825" water), and increasing demands for Grand and Summit counties. The actions/projects that are anticipated to occur between 2006 and 2016 are summarized in *Review of Modifications Made to PACSM to Reflect the Baseline Scenario and EIS Alternatives* Technical Memorandum (Boyle 2006d).
- **Action Alternatives:** The action alternatives reflect the operation of Denver Water's system in year 2030 with a Moffat Project implemented. Denver Water's average demand in year 2030 is estimated to be 363,000 AF/yr (379,000 AF/yr average demand less 16,000 AF/yr demand, which is anticipated to be met by additional conservation measures). Each action alternative provides 18,000 AF/yr of new, firm yield. Model parameters and assumptions included in PACSM for each action alternative are summarized in *Review of Modifications Made to PACSM to Reflect the Baseline Scenario and EIS Alternatives* Technical Memorandum (Boyle 2006d).

- **No Action Alternative:** The No Action Alternative scenario reflects the operation of Denver Water's system in year 2030 at an average demand of 363,000 AF/yr without any modifications to their existing facilities or water rights. Denver Water's average annual total supply is 345,000 AF/yr because an action alternative was not implemented. Denver Water's average demand exceeds supply by 18,000 AF/yr (363,000 AF/yr demand versus 345,000 AF/yr supply).

The following figure displays forecasted growth in Denver Water's average annual water demands.

Denver Water's Average Annual Water Demand



The Moffat Project would result in increased diversions by Denver Water from both the **Colorado** and **South Platte River** basins. For all action alternatives, additional Denver Water diversions would occur in average and wet years and would be highly concentrated during the runoff months in May, June, and July. Typically, additional diversions would be greatest in wet years following dry-year sequences. On average, *additional* diversions would be greatest from the **Fraser** and **Williams Fork river** basins, then from the **Blue River** basin, and least from the **South Platte River** and **South Boulder Creek**. Most of the additional diversions in the Fraser and Williams Fork river basins would occur along tributaries to those rivers. Average annual diversions through the Moffat Tunnel would increase about 2,300 AF (3%) under the No Action Alternative, 10,300 AF (15%) under the Proposed Action, and between 9,200 AF and 10,100 AF

(14 to 15%) for the other alternatives. Average annual diversions through the Roberts Tunnel would increase about 10,300 AF (11%) under the No Action Alternative, 4,800 AF (5%) under the Proposed Action, and between 4,300 AF and 5,300 AF (4 to 5%) for the other alternatives. There would be no additional diversions in dry-years for all action alternatives, because Denver Water already diverts the maximum amount physically and legally available under their existing water rights without additional storage in their system.

Stream Flows

For all action alternatives, changes in stream flow in affected river basins would be greatest in average and wet years during the runoff months, which coincide with the period that Denver Water's additional diversions would be greatest. On the West Slope, flows would decrease due primarily to Denver Water's additional diversions. On the East Slope, there would be both flow increases and decreases due primarily to the combined impacts of Denver Water's additional diversions, a shift in seasonal operations between Denver Water's North (Moffat) and South (Foothill and Marston) WTPs, additional effluent returns at Bi-City and Metro Wastewater Treatment Plants (WWTPs), and additional return flows accruing to the river due to Denver Water's outdoor water usage. Estimated flow changes in each affected river basin are generally described below and shown on the following table entitled "Comparison of Average Annual Flows, Reservoir Outflows, and Diversions at Key Locations (AF)."

1. Flows in the **Fraser River** and **Williams Fork river** basins would decrease in average and wet years during the runoff months due to Denver Water's additional diversions. Most of the additional diversions would occur along tributaries to the Fraser and Williams Fork rivers, therefore, the percentage change in flows would typically be highest along these tributaries. Moving downstream, the volume of change rises in the downstream direction, but the reductions in flows would be smaller relative to the total stream, which is growing. Average annual flows high in the Fraser River basin below Denver Water's diversion from the Fraser River would decrease about 360 AF (7%) under the No Action Alternative, 1,440 AF (30%) under the Proposed Action, and between 1,350 AF and 1,420 AF (28 to 29%) for the other alternatives. Average annual flows in the **Fraser River** at the Granby gage would decrease about 1,900 AF (2%) under the No Action Alternative, 8,400 AF (9%) under the Proposed Action, and between 7,500 AF and 8,300 AF (8 to 9%) for the other action alternatives. Average annual flows high in the Williams Fork River basin at the Williams Fork River below Steelman Creek gage would decrease about 420 AF (5%) under the No Action Alternative, 1,910 AF (22%) under the Proposed Action, and between 1,620 AF and 1,880 AF (19 to 22%) for the other alternatives. Average annual flows in the **Williams Fork River** below Williams Fork Reservoir would decrease about 200 AF (less than 1%) under the No Action Alternative, 1,700 AF (2%) under the Proposed Action, and between 1,400 AF and 1,700 AF (1 to 2%) for the other action alternatives.
2. Flows in the **Blue River** basin would decrease in average and wet years during summer months and increase slightly during winter months due to differences in Roberts Tunnel diversions and spills at Dillon Reservoir. Flow changes in the **Blue River** basin would be driven primarily by the seasonal shift in WTP operations. Under the No Action Alternative, Denver Water would rely heavily on their **Blue River** supplies to meet a higher demand, particularly during droughts without additional storage. Average annual flows in the **Blue River** at the confluence with the **Colorado River** would decrease about 10,200 AF (4%)

under the No Action Alternative, 4,800 AF (2%) under the Proposed Action, and between 4,300 AF and 5,200 AF (2%) for the other action alternatives.

3. Flows along the **Colorado River** would decrease in average and wet years during the runoff months due to changes in surface water flows in the **Fraser River, Williams Fork,** and **Blue River** basins which would be translated downstream and into the **Colorado River**. Average annual flows in the **Colorado River** near Kremmling gage would decrease about 12,100 AF (2%) under the No Action Alternative, 14,400 AF (2%) under the Proposed Action, and between 12,700 AF and 14,600 AF (2%) for the other action alternatives.
4. Flows in **South Boulder Creek** upstream of Gross Reservoir would increase in average and wet years during the runoff months due to Denver Water's additional diversions through the Moffat Tunnel. Average annual flows in **South Boulder Creek** at the Pinecliffe gage (above Gross Reservoir) would increase about 2,300 AF (2%) under the No Action Alternative, 10,400 AF (10%) under the Proposed Action, and between 9,300 AF and 10,300 AF (8 to 9%) for the other action alternatives.

   From Gross Reservoir to the South Boulder Diversion Canal, changes in flow reflect Gross Reservoir operations. In general, flows would be higher during winter months as water would be moved out of Gross Reservoir and into Ralston Reservoir in response to the WTP load shift. Increases in outflow from Gross Reservoir would generally be greatest in dry years because Denver Water would typically draw more water from their north system storage as a drought begins. Flows during the summer would be lower on average under the action alternatives than both Full Use of the Existing System and No Action because Foothills and Marston WTPs would meet a greater portion of the overall demand during these months and as a result, Gross Reservoir releases would decrease. Average annual flows below Gross Reservoir would increase about 2,300 AF (2%) under the No Action Alternative, 9,700 AF (8%) under the Proposed Action, and between 8,700 AF and 9,700 AF (8 to 9%) for the other action alternatives. Downstream of the South Boulder Diversion Canal, flows would generally decrease in wet years because Denver Water would divert more native **South Boulder Creek** water. Average annual flows in **South Boulder Creek** near the Eldorado Springs gage would decrease about 200 AF (1%) under the No Action Alternative and 1,000 AF (2%) under the Proposed Action and other action alternatives.
5. Flows in the **North Fork South Platte River** would decrease on average during winter months and increase during summer months. While flows would increase on average during summer months, there would be no change in the maximum flows experienced. Flow changes in the **North Fork South Platte River** would be driven primarily by the load shift in WTP operations. Diversions through the Roberts Tunnel during winter months would be lower on average, which results in equivalent lower flows in the **North Fork South Platte River** in these months. Summer diversions through Roberts Tunnel would generally be higher, and consequently flows in the **North Fork South Platte River** would be higher on average from May through September. Average annual flows in the **North Fork South Platte River** below Geneva Creek gage would increase about 9,900 AF (7%) under the No Action Alternative, 4,700 AF (3%) under the Proposed Action, and between 4,200 AF and 5,100 AF (3 to 4%) for the other action alternatives.

Comparison of Average Annual Flows, Reservoir Outflows, and Diversions at Key Locations (AF)

Location	PACSM Node[1]	Full Use Existing System	Alternative 1a			Alternative 1c			Alternative 8a			Alternative 10a			Alternative 13a			No Action		
		Avg. Annual Flow	Avg. Annual Flow	Diff.	Percent Diff.	Avg. Annual Flow	Diff.	Percent Diff.	Avg. Annual Flow	Diff.	Percent Diff.	Avg. Annual Flow	Diff.	Percent Diff.	Avg. Annual Flow	Diff.	Percent Diff.	Avg. Annual Flow	Diff.	Percent Diff.
Fraser River Basin																				
Moffat Tunnel diversions	N/A	**66,512**	**76,797**	10,284	15%	**76,639**	10,127	15%	**75,674**	9,162	14%	**75,667**	9,155	14%	**76,328**	9,816	15%	**68,817**	2,305	3%
Fraser River at Granby gage	2900	**91,562**	**83,187**	-8,375	-9%	**83,312**	-8,250	-9%	**84,032**	-7,530	-8%	**84,025**	-7,538	-8%	**83,534**	-8,028	-9%	**89,674**	-1,888	-2%
Williams Fork Basin																				
Gumlick Tunnel diversions	N/A	**9,740**	**11,648**	1,907	20%	**11,615**	1,875	19%	**11,370**	1,630	17%	**11,357**	1,616	17%	**11,526**	1,786	18%	**10,155**	415	4%
Williams Fork Reservoir outflow	3950	**96,664**	**94,963**	-1,701	-2%	**95,008**	-1,656	-2%	**95,236**	-1,428	-1%	**95,258**	-1,405	-1%	**95,066**	-1,598	-2%	**96,453**	-211	<1%
Colorado River Mainstem																				
Colorado near Kremmling gage	5020	**650,723**	**636,349**	-14,373	-2%	**636,113**	-14,610	-2%	**637,978**	-12,745	-2%	**637,944**	-12,779	-2%	**637,118**	-13,605	-2%	**638,639**	-12,084	-2%
Muddy Creek Basin																				
Wolford Mountain Reservoir outflow	1600	**63,824**	**63,878**	54	<1%	**63,878**	54	<1%	**63,879**	54	<1%	**63,881**	57	<1%	**63,880**	56	<1%	**63,930**	106	<1%
Blue River Basin																				
Roberts Tunnel diversion	4240	**96,939**	**101,775**	4,836	5%	**102,191**	5,252	5%	**101,281**	4,342	4%	**101,321**	4,382	5%	**101,461**	4,522	5%	**107,254**	10,315	11%
Blue River at mouth	4800	**278,089**	**273,279**	-4,810	-2%	**272,898**	-5,191	-2%	**273,775**	-4,314	-2%	**273,724**	-4,365	-2%	**273,588**	-4,501	-2%	**267,882**	-10,207	-4%
South Boulder Creek Basin																				
South Boulder Creek at Pinecliffe gage	57120	**109,748**	**120,186**	10,438	10%	**120,026**	10,278	9%	**119,046**	9,299	8%	**119,040**	9,292	8%	**119,710**	9,962	9%	**112,087**	2,339	2%
Gross Reservoir outflow	57140	**114,079**	**123,757**	9,678	8%	**123,815**	9,736	9%	**122,776**	8,697	8%	**122,773**	8,694	8%	**123,363**	9,284	8%	**116,378**	2,299	2%
South Boulder Creek near Eldorado Springs gage	57180	**46,330**	**45,345**	-985	-2%	**45,310**	-1,020	-2%	**45,330**	-1,000	-2%	**45,332**	-998	-2%	**45,337**	-993	-2%	**46,091**	-239	-1%
North Fork South Platte River Basin																				
North Fork South Platte below Geneva Creek gage	50700	**143,778**	**148,480**	4,702	3%	**148,878**	5,100	4%	**148,005**	4,226	3%	**148,043**	4,265	3%	**148,180**	4,402	3%	**153,685**	9,907	7%
South Platte River Mainstem																				
South Platte at Henderson gage	58440	**279,342**	**283,614**	4,272	2%	**283,537**	4,195	2%	**282,036**	2,693	1%	**282,662**	3,320	1%	**285,029**	5,686	2%	**281,256**	1,914	1%

Notes:
A positive difference denotes an increase in flow, whereas a negative difference denotes a decrease in flow.
[1] Nodes in PACSM represent locations of stream flow gages, diversions, reservoirs, upstream and downstream extents of instream flow or bypass requirements, imports to a basin, baseflow gains, and return flows.

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6. Flow changes along the South Platte River would be relatively minor and vary depending on the location. In general, flows would change due to additional direct diversions and exchanges to Strontia Springs Reservoir and Conduit 20, changes in Moffat WTP operations, and the load shift between Denver Water's Northern and Southern WTPs. In addition, the demand that would be met with additional storage on-line is higher under the action alternatives; therefore, effluent returns at Bi-City and Metro WWTPs and return flows accruing to the river due to Denver Water's outdoor water usage would increase. Average annual flows in the South Platte River at Henderson gage would increase about 1,900 AF (1%) under the No Action Alternative, 4,300 AF (2%) under the Proposed Action, and between 2,700 AF and 5,700 AF (1 to 2%) for the other action alternatives.

Reservoirs

For all action alternatives, changes in Denver Water's diversions, the load shift between Denver Water's Northern and Southern WTPs and the higher overall demand that would be met with additional storage on-line would result in changes in reservoir contents and levels. Estimated changes in each affected reservoir are generally described below:

1. Williams Fork Reservoir contents would generally be lower under all alternatives, primarily due to additional diversions at Gumlick Tunnel and exchanges to reservoirs in the Denver Water system. The maximum monthly average reservoir elevation change would be a decrease of 1 foot under all the alternatives.
2. The load shift between Denver Water's Northern and Southern WTPs and the higher overall demand that would be met with additional storage on-line would affect Dillon Reservoir contents. The maximum monthly average reservoir elevation change would be a decrease of 3 feet under all the action alternatives, and 7 feet under the No Action Alternative. Under the No Action Alternative, Denver Water would rely heavily on their **Blue River** supplies to meet a higher demand, particularly during droughts without additional storage.
3. Under the Proposed Action, Gross Reservoir's volume would increase by 72,000 AF to 113,811 AF, well over twice its current volume. Under Alternatives 1c, 8a and 10a, and 13a, Gross Reservoir's volume would increase by 40,700 AF, 52,000 AF, and 60,000 AF, respectively. Operations under all the action alternatives would be similar. Gross Reservoir would be at its lowest level at the end of April, reach its highest level in June or July, and would be drawn down through the fall and winter. Under Full Use of the Existing System, the Moffat WTP does not operate in the winter months; therefore, contents increase on average from December through February. However, under the action alternatives, Gross Reservoir contents would drop steadily through the winter because Moffat WTP would be operating at a minimum of 30 million gallons per day (mgd). Differences in reservoir contents under the action alternatives are greatest in wet years following a drought, when the enlarged capacity of Gross Reservoir would be able to fill. Under the No Action Alternative, Gross Reservoir average end-of-month contents would be consistently lower than Full Use of the Existing System in all months and would be drained to the minimum pool more frequently.
4. Under Alternative 1c, a new 31,300 AF reservoir would be constructed at Leyden Gulch. Leyden Gulch Reservoir would be maintained more or less at capacity except in an extended drought when it would be drawn upon. Monthly average, dry, and wet end-of-month contents are approximately 28,000 AF to 31,000 AF or up to 3,000 AF below capacity.

5. There would be very few and relatively small differences in operations at Wolford Mountain Reservoir in most months under the action alternatives. The maximum monthly average reservoir elevation change would be a decrease of less than 1 foot under all the alternatives.
6. There would be very few and relatively small differences in contents and levels at Antero and Eleven Mile Canyon reservoirs in most years under the action alternatives. The maximum monthly average elevation change at Antero Reservoir would be a decrease of less than 1 foot. The maximum monthly average elevation change at Eleven Mile Canyon Reservoir would be an increase of less than 1 foot under the action alternatives and a decrease of less than 1 foot under the No Action Alternative.
7. The shift in treatment plant operations during the winter and the higher demand level met under the action alternatives would affect Cheesman Reservoir contents. In general, Cheesman Reservoir would be used more heavily through the summer and less during the winter. The maximum monthly average reservoir elevation change would be a decrease of 4 feet under all the alternatives.
8. Alternatives 8a and 13a include approximately 5,000 AF and 3,625 AF of storage, respectively, in reclaimed gravel pits adjacent to the **South Platte River.** The pits would typically fill with either Denver Water's reusable effluent (Alternative 8a) or agricultural water supplies (Alternative 13a) when it is available. The gravel pits would generally only be depleted in advanced stages of a drought.

Stream Morphology and Sedimentation

To assess the impacts of changes in sediment transport capacity on channel morphology, calculated bedload capacity was compared to anticipated sediment supply at representative sampling sites along the **Fraser, Williams Fork, Colorado, North Fork South Platte rivers,** and **South Boulder Creek.** Given the minor flow changes predicted in the **Blue** and **South Platte rivers**, impacts to channel morphology under the alternatives along these rivers are predicted to be negligible.

1. Under all alternatives, decreases in flow would result in a decrease in sediment transport capacity along the **Fraser, Williams Fork, Blue,** and **Colorado rivers**. However, for the range of flows expected, sediment transport capacity exceeds available sediment supply and, for all but the smallest flows, sediment transport capacity is orders of magnitude greater than available sediment supply. All alternatives would result in changes in flow during average and wet conditions and then primarily during the wettest months of the year; therefore, reductions in sediment transport capacity resulting from the alternatives are not expected to have notable impacts on channel morphology.
2. Due to anticipated flow reductions resulting from the alternatives, only minor amounts of localized sediment deposition are anticipated. Any deposition that occurs should be limited in extent and magnitude and should not pose significant changes to channel morphology.
3. Under all alternatives, increases in flow would result in an increase in sediment transport capacity along **South Boulder Creek** and the **North Fork South Platte River**. It is possible that the increase in sediment transport capacity in these basins could lead to localized bed and bank erosion.

Floodplains

More water would be exported from the **Fraser, Williams Fork** and **Blue river** basins under the alternatives as compared to the Full Use of the Existing System scenario. As a result, it is expected that flood flows and areas of inundation would decrease in the affected river basins on the West Slope under the alternatives.

On the East Slope, more water would be imported to **South Boulder Creek** and the **North Fork South Platte River**. However, Denver Water regulates Roberts Tunnel and Moffat Tunnel diversions such that there would be no change in the maximum flows experienced. Because Denver Water limits their diversions into these basins, there would be no increase in flood flows and floodplain boundaries that could be attributed to the alternatives. Also, because Gross Reservoir is currently not operated to provide flood control, there is not expected to be any increase in flood flows or the floodplain extent along **South Boulder Creek** below Gross Reservoir.

Along the **South Platte River** mainstem above the confluence with the **North Fork South Platte River**, annual peak flows would generally be at the same level or smaller under the alternatives. From this information, it can be inferred that the floodplain extent would not be significantly altered in the upper **South Platte River**. At the **South Platte River** at Denver gage, annual flood flows under the alternatives are very similar to Full Use of the Existing System since changes in stream flows are expected to be relatively minor. Peak flows associated with more frequent flood events would occasionally increase slightly; however, changes to the floodplain extent in this reach of the river are not considered significant.

Water Quality

Action Alternatives

No changes to water quality in Williams Fork, Dillon, Wolford Mountain, Antero, Eleven Mile Canyon, Cheesman, Strontia Springs, and Chatfield reservoirs would occur under the action alternatives. The expansion of Gross Reservoir, however, is likely to temporarily affect water quality by increasing organic matter and total organic carbon and may decrease dissolved oxygen. These effects are anticipated to diminish over time, and the long-term impact of the change in water quality would be negligible.

Changes to stream temperature range from negligible to moderate for different reaches of the **Fraser River**. Changes near Ranch Creek would have a moderate potential for increasing the frequency of approaching or exceeding stream standards. Areas near Fraser and Granby would have negligible to minor potential for increasing the frequency of approaching or exceeding the stream standard for temperature. Stream temperature changes on the **Colorado River** would be negligible. Changes in other water quality parameters would be negligible to minor in the **Fraser, Blue,** and **North Fork South Platte rivers** under the action alternatives. Changes in water quality would be no impact to negligible in the **Williams Fork** and **South Platte rivers** under all action alternatives. An increase in wastewater in the **Blue River** could occur in October of wet years under the action alternatives. Depending on the water quality of the discharge, this may or may not impact water quality in the **Blue River**. No change to permit limits in the **Blue River** is anticipated because the acute low flow is not expected to change under the action alternatives. Changes in the concentrations of copper, iron, and nickel are anticipated to occur in the **North Fork South Platte River** under all action alternatives. The

concentration of these parameters is anticipated to increase during periods of reduced deliveries from the Roberts Tunnel and decrease during periods of increased deliveries through the Roberts Tunnel. Water quality changes in **South Boulder Creek** are not anticipated between the Moffat Tunnel discharge point and Gross Reservoir. Water quality in **South Boulder Creek**, however, may be temporarily affected downstream of Gross Reservoir due to potential changes in water quality in the reservoir.

No Action Alternative

No water quality impacts would occur to Dillon, Williams Fork, Wolford Mountain, Antero, Eleven Mile Canyon, and Strontia Springs reservoirs under the No Action Alternative. Chatfield Reservoir would have minor impacts due to increased phosphorus loadings from greater deliveries through the Roberts Tunnel. Gross Reservoir water quality under the No Action Alternative, however, is anticipated to change as a result of the expected fluctuations in depth. Greater variations in depth would likely induce more mixing and increase turnover which could lead to lower levels of dissolved oxygen, increased nutrient and/or metal releases from sediment, and changes in temperature in Gross Reservoir. Unlike the other alternatives, this is not a short-term increase but would likely persist due to increased turnover of the reservoir; however, the impact to water quality in Gross Reservoir is minor.

Changes to stream temperature range from negligible to minor for different reaches of the **Fraser River**. Changes near Ranch Creek would have a minor potential for increasing the frequency of approaching or exceeding stream standards. Areas near Fraser and Granby would have negligible potential for increasing the frequency of approaching or exceeding the stream standard for temperature. Stream temperature changes on the **Colorado River** would be negligible. No impacts to other water quality parameters are expected to occur in the **Fraser, Williams Fork, North Fork South Platte,** and **Colorado rivers**. Water quality impacts in the **Blue River** and **South Boulder Creek** under the No Action Alternative are similar to those described under the Proposed Action. An increase in wastewater in the **Blue River** could occur in October of wet years under the No Action Alternative. Depending on the water quality of the discharge, this may or may not impact water quality in the **Blue River**. No change to permit limits in the **Blue River** is anticipated. Water quality impacts in the South Platte River at Chatfield Reservoir are anticipated to be negligible due to an increase in the annual water deliveries through the Roberts Tunnel that would result in an increased phosphorous loading into the Chatfield watershed.

Groundwater

Action Alternatives

All of the action alternatives contain an enlarged Gross Reservoir component, which would increase groundwater levels in the area due to seepage. Additionally, there would be a decrease in hydraulic gradients upstream of Gross Reservoir for all action alternatives. Similar seepage and mounding effects as those described for Gross Reservoir would occur at the proposed Leyden Gulch Reservoir.

Under Alternative 1c, unknown contaminants from Rocky Flats could, if present on site, be remobilized from soil to groundwater during construction of the Leyden Gulch Reservoir. However, seepage of good quality water out of the proposed reservoir would provide natural attenuation by dilution. Alternative 10a would not degrade existing groundwater quality because the reusable water would be treated to meet all water quality standards prior to injection into the

Denver Basin aquifers. The gravel pit components of Alternatives 8a and 13a would be designed and constructed with slurry walls to prevent groundwater quality impacts. Similarly, Conduits M and O would be designed and constructed as closed pipelines to prevent impacts to groundwater quality.

The net long-term effect on groundwater levels due to the Denver Water wells under Alternative 10a would be insignificant to other groundwater users in the area. Groundwater in wells within the vicinity of the Denver Water wells may fluctuate in response to injection and withdrawal pumping. The conversion of agricultural water rights to municipal or other non-irrigation uses under Alternative 13a would result in less groundwater recharge in localized areas that are no longer irrigated.

Decreases in flows during average years would occur in various portions of West Slope streams under all action alternatives, resulting in indirect, localized impacts to groundwater. Groundwater gradients near the streams would increase slightly as the hydrologic system works to balance the change in stream flow with additional groundwater input to the streams. Alternatives 8a, 10a, and 13a include reusable water components, which would lessen impacts to groundwater.

No Action Alternative

West Slope streams would be narrower and shallower primarily during runoff months (May through July) due to the withdrawal of water to meet higher demands. The groundwater inflows to these streams would increase during low-flow periods, which would likely decrease groundwater levels. In areas having an upward hydraulic gradient during these low-flow periods, groundwater flow into the streams would increase to compensate, in part, for the reduction in stream flow caused by the diversions. On the East Slope, the Moffat Collection System components would remain the same under the No Action Alternative as those currently in use. However, due to the higher future demands and without additional storage capacity, the water levels and volumes of water stored in the reservoirs would be lower than average more often. More frequent low reservoir levels would decrease the seepage from the reservoirs and cause groundwater levels to decline, which could cause a long-term adverse impact to the local groundwater resource near the reservoirs.

Geology

Action Alternatives

Geologic impacts resulting from the action alternatives are primarily associated with the reservoir components. The expansion of Gross Reservoir and the construction of Leyden Gulch Reservoir may slightly increase the potential for reservoir-induced seismicity. Potential issues related to geologic resources will be addressed through geotechnical and seismic studies in the design and construction phases. Both reservoir sites may be susceptible to potentially unstable slopes and reservoir rim instability as a result of erosion, seepage, wave action, and water level fluctuations. A hogback occurs east of the proposed Leyden Gulch Reservoir dam. This geologic feature contains clay mine workings that would need to be stabilized during relocation of State Highway (SH) 93.

No Action Alternative

No direct geologic impacts are anticipated to occur under the No Action Alternative since there will be no construction activities. Operational activities at Gross Reservoir, however, may potentially create unstable slopes and reservoir rim instability as a result of erosion, seepage, wave action, and water level fluctuations.

Soils

Action Alternatives

Soils would be permanently and temporarily disturbed from construction of proposed Project components and inundation at the reservoir sites. Approximately 465 acres of soils would be permanently impacted (89 acres of temporary impacts) from the Proposed Action. Smaller Gross Reservoir expansions associated with Alternatives 1c, 8a, 10a, and 13a would create less permanent and temporary soils impacts. Approximately 389 acres of permanent soil loss (176 acres of temporary impacts) would result from the construction of Leyden Gulch Reservoir and associated facilities. The South Platte River Facilities under Alternatives 8a and 13a would result in 6 acres of permanent soil loss (11 and 12 acres of temporary impacts, respectively) associated with construction of an AWT plant and ancillary facilities; direct impacts to soils resulting from the gravel pit storage lakes were not quantified since ground-disturbing activities are assumed to be previously completed prior to Denver Water acquisition. Approximately 19 acres of permanent soil loss (25 acres of temporary impacts) would result from construction of the Denver Basin Aquifer Facilities under Alternative 10a. Minimal direct impacts to soils would result from Conduits M and O, the gravel pit pipelines, and the Denver Basin distribution pipelines since a majority of construction would occur within existing roadways.

The reservoir sites would experience fluctuating water levels that could create stresses and erode shoreline slopes. Additionally, the Leyden Gulch Reservoir site contains moderately to highly expansive soils that would be mitigated for in design and construction. Areas that are temporarily disturbed would be reclaimed with vegetation. Limitations at the reservoir sites for vegetation re-establishment include steep slopes, shallow depths to bedrock, and areas of erodible soils.

No Action Alternative

There are no ground disturbing activities associated with the No Action Alternative; thus no direct impacts to soils would occur. Shoreline impacts associated with fluctuating water levels at the reservoir sites would be the same as described for the action alternatives. Under the Combination Strategy, reservoir levels would fluctuate less, particularly in dry years, but would also create similar impacts as described from the action alternatives.

Vegetation

Action Alternatives

Vegetation would be permanently and temporarily disturbed from construction of proposed Project components. Approximately 456 acres of vegetation would be permanently impacted (52 acres of temporary impacts) by the Proposed Action. Smaller Gross Reservoir expansions associated with Alternatives 1c, 8a, 10a, and 13a would create less permanent and temporary impacts to vegetation. Most of the impacts at Gross Reservoir would occur in the ponderosa and

ponderosa pine/Douglas fir communities. Approximately 383 acres of permanent vegetation loss (172 acres of temporary impacts) would result from the construction of Leyden Gulch Reservoir and associated facilities. The vegetation types at the Leyden Gulch Reservoir site that would be affected are predominantly grass/forb rangeland with small inclusions of cottonwoods, herbaceous riparian, snowberry/shrub mix, disturbed rangeland, and disturbed soil areas. The South Platte River Facilities under Alternatives 8a and 13a would result in approximately 6 acres of permanent vegetation loss (11 and 12 acres of temporary impacts, respectively). Vegetation communities that would be affected by Alternatives 8a and 13a include disturbed areas colonized by weedy species, disturbed rangeland, forest riparian, shrub riparian, and herbaceous riparian. Approximately 18 acres of permanent vegetation loss (21 acres of temporary impacts) would result from construction of the Denver Basin Aquifer Facilities under Alternative 10a. Affected vegetation within Denver Parks' properties primarily consists of lawns, trees, and ornamental vegetation typical of parks and golf courses. Minimal direct impacts to vegetation would result from Conduits M and O, the gravel pit pipelines, and the Denver Basin distribution pipelines since a majority of construction would occur within existing roadways. Transfer of agricultural water rights under Alternative 13a (approximately 3,900 acres) would primarily affect irrigated croplands used for pasture, as well as growing alfalfa, corn, hay, sugar beets, and other crops. Construction and operation of the Project components may introduce or spread noxious weeds in disturbed areas.

Operation of the reservoir sites and gravel pits may also affect vegetation. For instance, the drawdown area at Gross Reservoir would continue to be relatively barren because of large annual fluctuations in water level. The shoreline areas at the proposed Leyden Gulch Reservoir and the gravel pits, however, are likely to establish vegetation, including riparian and wetland plant species.

No Action Alternative

There would be no direct vegetation impacts as a result of the No Action Alternative. However, indirect impacts to vegetation resources would occur at Gross Reservoir as a result of more frequent and prolonged drawdowns. The area between the normal water elevation and the minimum drawdown level would remain barren of vegetation, but would be increasingly susceptible to noxious weed infestations.

With the exception of mandatory restrictions imposed during drought periods, vegetation resources in the vicinity of Project components and throughout the greater service area would remain largely unchanged under the No Action Alternative. Non-native lawn species, trees, and ornamental landscaping would be impacted by mandatory restrictions resulting in temporary stresses to irrigation-dependent vegetation. Under mandatory drought restrictions, all outdoor watering is prohibited, including trees, shrubs, and high-use public turf areas. Mortality, although impossible to quantify, is likely in some irrigation-dependent areas.

Wetlands, Waters of the U.S., and Riparian Areas

Action Alternatives

Wetlands, other waters of the U.S., and riparian areas would be directly impacted by the Project. Permanent impacts would occur if these areas are destroyed or if their function were permanently altered as a result of the Project. Direct permanent impacts would result from clearing, excavating, inundation, filling, and/or other grading that would modify existing functions.

Additionally, transfer of agricultural water rights under Alternative 13a would adversely affect wetlands and other water features in ditches and ponds and in wetlands sustained by leakage, overflows, and/or return water flows. Riparian areas along streams are not likely to be affected by agricultural transfers. The following table summarizes the potential direct permanent impacts to wetlands, other waters of the U.S., and riparian areas for each Project alternative.

Total Permanent Impacts to Wetlands, Other Waters of the U.S., and Riparian Areas (acres)

Resource Type	Proposed Action	Alternative 1c	Alternative 8a	Alternative 10a	Alternative 13a
Wetlands	1.95	6.15	1.77	1.75	83.87
Other Waters of the U.S.	3.53	3.12	3.20	3.16	11.40
Riparian Areas	4.08	3.45	3.62	3.62	3.88

Indirect permanent impacts to wetlands and riparian zones include constriction of stream flow from open cut trenching, erosion resulting from sedimentation, hydrologic modifications as a result of earthwork in adjacent areas, off-highway vehicle use, or noxious weed invasion.

Temporary impacts are primarily associated with construction activities and generally do not have long-term impacts on hydrology and/or function. Construction impacts may include cutting vegetation and covering to facilitate construction activities, or temporarily placing fill into a wetland area. The topography and hydrology of temporarily effected areas would be re-established after construction. The following table summarizes the potential temporary impacts to wetlands, other waters of the U.S., and riparian areas for each Project alternative.

Total Temporary Impacts to Wetlands, Other Waters of the U.S., and Riparian Areas (acres)

Resource Type	Proposed Action	Alternative 1c	Alternative 8a	Alternative 10a	Alternative 13a
Wetlands	0.12	13.43	0.4	0.19	0.42
Other Waters of the U.S.	0.49	2.04	1.18	2.19	1.72
Riparian Areas	0.04	1.36	0.08	0.59	0.14

Changes in stream flow associated with the action alternatives would have no measurable effects to wetlands, waters, and riparian areas along the **Williams Fork, Colorado**, or **South Platte rivers**. Reductions in **Fraser River** and **Blue River** flows under all action alternatives would impact herbaceous plant composition and would change to species less dependent on frequent flooding, but there would be minimal effects on woody riparian species. **South Boulder Creek** flows would both increase and decrease at different times of year within the normal range of variability, thus creating minimal impacts to riparian and wetland vegetation. Decreased flows in winter on the **North Fork South Platte River** would not affect dormant riparian vegetation; increased flows in summer would be within normal range of variability and effects would be minimal.

No Action Alternative

No direct permanent impacts to wetlands, other waters of the U.S., or riparian habitats would occur under the No Action Alternative because there would be no ground-disturbing activities.

Depleting the Strategic Water Reserve Strategy would generally create minor impacts to streams in the Project area. Changes in flow are unlikely to adversely affect riparian and wetland habitats along the **South Platte River**, because they would generally be small on both an annual average and monthly basis. Similarly, there would be no impacts to riparian vegetation along **South Boulder Creek**. Flows in the **Fraser River** would decrease between May and August, but would be much smaller than those associated with action alternatives. These small scale changes would reduce inundation resulting in minor impacts to riparian and wetland areas. The **Williams Fork River** would experience reduction in high flow months below the level of change associated with the action alternatives. The amount of area affected by a reduction in stage associated with a 2-year event would therefore be very small and any impacts on riparian vegetation would be very minor. The **Colorado River** would experience small stage changes (less than an inch for a 2-year event) and the amount of wetland and riparian areas affected would be correspondingly very small. Wetland and riparian areas along the **Blue River** would experience a reduction in inundation that would be similar to that described for the action alternatives, approximately 0.2 acre/mile, and the types of vegetation changes that might occur would also be similar. Under the No Action Alternative, an increase in flow would occur every month of the year in the North Fork of the **South Platte River**. Over time, these increased flows would likely produce a minor shift in riparian and wetland vegetation within the narrow zone affected by an increased 2-year flow event.

No additional impacts on wetland and riparian vegetation would result from implementing the Combination Strategy. During a drought, stream flows could decrease in some streams because less water would be released from storage. Changes in stream flow between the two No Action Alternative strategies are not expected to be significant.

Wildlife

Action Alternatives

Wildlife present in the Gross Reservoir area include big game and other mammals, raptors, migratory birds, reptiles and amphibians, and fish. In general, Gross Reservoir would experience loss of elk winter range and concentration areas, loss of non-crucial habitat for big game species (i.e., mule deer, black bear, and mountain lion), habitat fragmentation due to the inundation of **South Boulder Creek** and Winiger Gulch. Small areas of wetland and riparian vegetation would also be affected. Direct impacts to wildlife would result from loss or degradation of habitat and mortality from ground-disturbing activities. Indirect impacts consist of permanent or temporary displacement of wildlife. The following table compares direct permanent and temporary impacts to wildlife habitats by alternative at Gross Reservoir.

Direct Impacts to Wildlife Habitat in Gross Reservoir Study Area by Alternative

Wildlife Habitat	Acres of Impact to Wildlife Habitat									
	Proposed Action		Alternative 1c		Alternative 8a		Alternative 10a		Alternative 13a	
	Permanent	Temporary	Permanent	Temporary	Permanent	Temporary	Permanent	Temporary	Permanent	Temporary
Ponderosa Pine	169.9	7.4	109.7	10.8	133.8	8.6	133.8	8.6	150.8	7.9
Ponderosa Pine/ Douglas-fir mix	253.0	42.5	162.7	54.2	195.4	49.8	195.4	49.8	223.2	46.0
Grassland/forb mix	32.9	2.1	20.1	2.1	24.6	2.1	24.6	2.1	29.5	2.1
Disturbed/ Unvegetated	8.9	3.6	8.6	3.9	8.8	3.7	8.8	3.7	8.8	3.7
Open Water	0.0	33.7	0.0	33.7	0.0	33.7	0.0	33.7	0.0	33.7
Talus slope/ Rock outcrop	0.4	0.0	0.4	0.0	0.4	0.0	0.4	0.0	0.4	0.0
Total	**465.1**	**89.3**	**301.5**	**104.7**	**363.0**	**97.9**	**363.0**	**97.9**	**412.7**	**93.4**

Note: The area of temporary impacts goes up as the area of permanent impacts go down, because the smaller reservoir size means that smaller portions of the temporarily affected areas would be inundated after construction. With a larger reservoir size, more of the areas of temporary impact are considered permanent because they are in the reservoir pool. With a smaller reservoir size, more areas of impact would be left exposed and considered temporary. Temporary impacts do not represent the entire area of impact, but the residual amount that would not be also affected permanently.

Habitats affected by construction and operation of the proposed Leyden Gulch Reservoir include grassland/forb mix, foothills deciduous shrub, wetlands, rural residential (deciduous trees, ornamental plantings), open water (South Boulder Diversion Canal), and disturbed/unvegetated. In general, the Leyden Gulch Reservoir site would experience a loss of elk winter range and concentration areas and loss of non-crucial habitat for big game. Specific wildlife impacts include the loss of 7.2 acres of black-tailed prairie dog colonies and temporary construction disturbance to nesting red-tailed hawks. Construction and operation of the proposed Leyden Gulch Reservoir, however, would be beneficial to water birds. The following table summarizes the acres of direct temporary and permanent impacts to wildlife habitats at the Leyden Gulch Reservoir site.

Direct Impacts to Wildlife Habitat at the Leyden Gulch Reservoir Site

Wildlife Community	Acres of Direct Impact	
	Permanent	Temporary
Cottonwood	0.0	8.7
Foothills deciduous shrub	2.1	4.6
Wetland	6.2	14.7
Open Water	0.1	1.3
Rural Residential	0.1	0.3
Grass/Forb mix	374.8	143.5
Disturbed/Unvegetated	5.7	3.3
Total	**389.0**	**176.4**

Construction of the South Platte River Facilities would result in relatively minor impacts. The gravel pits would be excavated when Denver Water acquires them, so no additional ground disturbance or subsequent adverse impacts to wildlife would occur. Filling and operation of the gravel pit reservoirs would provide a beneficial impact to wildlife because approximately

5,000 AF of open water habitat would be created for waterfowl, shorebirds, migratory birds, as well as for amphibians and reptiles. Construction of the AWT plant adjacent to Worthing Pit would result in a permanent impact to 4 acres of habitat and temporary disturbance to 7 acres. However, the site of the AWT plant is not good quality wildlife habitat due to the lack of vegetation. Temporary disturbance to nesting raptors in the area, however, may occur during construction activities. Transfer of agricultural water rights under Alternative 13a would increase upland grassland habitats. Therefore, prairie dog towns are likely to expand.

Potential Conservation Areas (PCAs) identified by the Colorado Natural Heritage Program (CNHP) and Environmental Conservation Areas (ECAs) identified by Boulder County would be directly impacted by the action alternatives. The largest expansion of Gross Reservoir would impact approximately 17% of the Winiger Gulch PCA, 10.5% of South Boulder Creek PCA, and 7% of Winiger Ridge ECA. Temporary disturbance of approximately 1% of Rocky Flats PCA for construction staging and spoil storage would occur at the Leyden Gulch Reservoir site. Alternatives 8a, 10a, and 13a would temporarily disturb portions of the **South Platte River** PCA and Greenway, but would not result in adverse effects to wildlife.

Impacts to wildlife from changes in river flows would not have a noticeable impact on wildlife habitat or wildlife species, because changes in flow would have minimal impacts on wetland and riparian habitats.

No Action Alternative

The No Action Alternative would not result in any changes to wildlife habitat because no ground-disturbing activities would occur. Changes in operation of the existing system would result in changes in stream flows in the Project area, which would result in only minor changes to wetland and riparian habitat. Therefore, similar to the action alternatives, implementation of the No Action Alternative would not have a noticeable effect on wildlife habitat or species.

Special Status Species

Action Alternatives

Federal and State Species

Two federally listed species, bald eagle and slender moonwort, have the potential to occur at Gross Reservoir but would not be impacted under any of the action alternatives. Construction activities associated with the proposed Leyden Gulch Reservoir, the **South Platte River** Facilities, and Conduits M and O may temporarily impact nesting burrowing owls. The expansion of Gross Reservoir, and Alternatives 1c, 8a, and 13a would result in beneficial impacts to bald eagle by creation of more open water habitat.

Flow changes in the **Fraser, Williams Fork, Colorado**, and **Blue rivers** would adversely affect **Colorado River** system endangered fish species (Colorado pikeminnow, bonytail chub, humpback chub, and razorback sucker) and have minimal effects to bald eagle, river otter, and boreal toad. Flow changes in **South Boulder Creek, North Fork South Platte River**, and the **South Platte River** would contribute to adverse effects on Platte River system threatened and endangered species including whooping crane, piping plover, least tern, and pallid sturgeon. Minor flow changes in the Project area are unlikely to result in adverse changes to riparian habitat occupied by Preble's meadow jumping mouse along the **South Platte River** between Waterton Canyon and Chatfield Reservoir or along **South Boulder Creek**. Denver Water

currently participates in the South Platte River Recovery Program and the Upper Colorado River Recovery Program to aid in the recovery of several of these species.

Other Special Status Species

Expansion of Gross Reservoir would reduce dwarf shrew and northern leopard frog habitat and create minor indirect impacts to several bird and bat species. Construction of the proposed Leyden Gulch Reservoir site would impact 7.2 acres of black-tailed prairie dog towns and reduce habitat for hawk, sensitive butterflies, and northern leopard frog. The South Platte River Facilities would temporarily displace or disturb snowy egret and white-faced ibis. Beneficial impacts to several species, however, would occur under all action alternatives from creation of new open water and shoreline habitat. Construction of the gravel pit pipelines, the aquifer distribution pipelines, and Conduits M and O would temporarily disturb or displace common garter snake and northern leopard frog at stream and riparian crossings. Transfer of agricultural water rights under Alternative 13a would reduce habitat for common garter snake and northern leopard frog, but likely expand black-tailed prairie dog towns, providing more habitat for burrowing owls and foraging ferruginous hawks.

No Action Alternative

Under the No Action Alternative, there would be no direct or indirect impacts to special status species from construction of new facilities, but changes in operation of the existing system would result in changes in stream flow in areas occupied by special status species. Four federally listed endangered fish species (Colorado pikeminnow, bonytail chub, humpback chub, and razorback sucker) occur in the **Colorado River**. Flow reductions in the **Colorado River** resulting from the No Action Alternative would be very similar to the impacts associated with the action alternatives. Similarly, flow changes that would occur downstream in the Platte River in Nebraska would impact several federally listed species. Similar to the action alternatives, minor flow changes in the Project area are unlikely to result in adverse changes to riparian habitat occupied by Preble's meadow jumping mouse along the **South Platte River** and **South Boulder Creek**.

Aquatic Biological Resources

Action Alternatives

Most of the impacts to aquatic resources in the Project area would be subsequent to changes in stream flow or reservoir operation, and generally related to the ability of the stream to support aquatic life. Direct impacts would be very limited and temporary, and would include disturbances of reservoirs or short sections of streams during construction.

Construction of Conduits M and O, the gravel pit pipelines, and the aquifer distribution pipelines would have temporary, direct adverse impacts on aquatic resources at stream crossings. Disruption of normal reservoir operations during construction at Gross Reservoir would also have temporary adverse impacts on fish and invertebrates. The enlargement of Gross Reservoir and the creation of a new Leyden Gulch Reservoir and gravel pit lakes, however, would provide more habitat for fish and invertebrates and may provide opportunities for additional species of fish to become established.

There would be no changes to water quality or channel geomorphology in the **Fraser, Williams Fork, Colorado, Blue, South Platte rivers** and **South Boulder Creek** that would affect fish

and other aquatic biological resources. Habitat suitability for benthic invertebrates is usually more favorable at lower runoff flows. The invertebrate communities may include more species and higher density than Full Use of the Existing System (2016) under the action alternatives. Increases in runoff flows would have adverse impacts to fish and invertebrates in **South Boulder Creek** upstream of Gross Reservoir. Downstream of Gross Reservoir, the increases in winter flows and reductions in runoff flows would have a beneficial impact to fish and invertebrates in **South Boulder Creek**. Similarly, more favorable winter flows would have a beneficial impact to fish and invertebrates in the **South Platte River.** Increases in runoff flows would have an adverse impact to fish and invertebrates in the **North Fork South Platte River**.

No Action Alternative

Under the No Action Alternative, there would be an adverse impact to the fish and invertebrate communities of Gross Reservoir since the expansion would not occur and drawdown to the minimum pool would occur approximately 50% more often than under the action alternatives.

There would be no impacts to fish and invertebrates in the **Colorado**, **South Platte**, **North Fork South Platte**, **Fraser,** and **Blue rivers,** and **South Boulder Creek**. However, under certain conditions, bypass flows in the **Fraser and Blue rivers** may not be met which could further reduce flows compared to Full Use of the Existing System (2016) during periods of low habitat availability for fish and invertebrates. If bypass flows are not met, there would be an adverse impact to aquatic resources in these affected river segments.

The No Action Alternative would have no impact on the fish and invertebrate communities in the **Williams Fork River**. The No Action Alternative, however, would divert more water from the **Williams Fork tributaries** in some months resulting in adverse impacts to fish and invertebrates.

Transportation

Action Alternatives

The temporary indirect impacts to traffic operations at Gross Reservoir during construction activities would be passenger vehicle delays due to queuing behind slower-moving haul and supply vehicles on two-lane roads, and queuing at intersections where large vehicle turn movements are more difficult. The frequency (times per day) and duration (total minutes) of traffic delays, and the numbers of people affected by them, pose no significant indirect impacts. Additional traffic associated with vegetation removal was not evaluated in the EIS because the amounts would vary depending on which disposal options would be selected. No change from Current Conditions (2006) in maintenance and operation trips for the dam and reservoir are anticipated once construction activities are complete.

Although some recreational areas would be inundated under the action alternatives, public access to Gross Reservoir would not be changed. Vehicle access would remain unchanged via the existing north and south public access points. During construction, recreational access in the area of the dam would be limited. The north side of the reservoir would still be accessible by Flagstaff Road (County Road [CR] 77) from Boulder.

Unlike the expansion of Gross Reservoir, transporting borrow material from off-site locations would not be required to construct a new Leyden Gulch Reservoir. Construction-related traffic would primarily consist of workers commuting to and from the construction site. Approximately

4,000 feet of SH 93 would be permanently relocated under Alternative 1c; the existing SH 93 would remain in service while the realignment is constructed.

Passenger vehicle delays and higher than average volumes of commuter traffic during peak construction would affect local roads in the Denver and Brighton area during construction of Alternatives 8a, 10a, and 13a.

No Action Alternative

Since no construction activities would occur under the No Action Alternative, no direct or indirect impacts to transportation resources are anticipated. Traffic associated with operations and maintenance of existing facilities would remain unchanged.

Air Quality

Action Alternatives

Short-term direct air quality impacts under the action alternatives are related to construction activities. All action alternatives would result in emissions of dust and combustion products during construction activities. Construction emissions include exhaust emissions from heavy-duty construction equipment, exhaust emissions from construction workers' vehicles and delivery vehicles, and fugitive dust emissions. Under the Proposed Action, average annual emissions of carbon monoxide (CO) and oxides of nitrogen (NO_x) are greater than the conformity *de minimis* levels of 100 tons per year. For Alternatives 1c, 8a, 10a, and 13a the combined average annual emissions of CO, NO_x, and particulate matter less than 10 microns in diameter (PM_{10}) are greater than the conformity *de minimis* levels of 100 tons per year. All action alternatives would undergo a general conformity analysis to ensure that the region remains in compliance with the National Ambient Air Quality Standards (NAAQS).

No Action Alternative

There are no ground-disturbing activities associated with the No Action Alternative; thus no impacts to air quality are anticipated.

Noise

Action Alternatives

Any Project related impacts from noise are anticipated to be temporary and direct. Indirect impacts from noise are not anticipated.

At the reservoir sites, off-site and on-site construction-related noise was evaluated. The proposed activities associated with the enlargement of Gross Reservoir and the construction of Leyden Gulch Reservoir is not predicted to exceed relevant standards or guidelines. On-site construction noise may periodically exceed the EPA noise threshold of 70 decibel rating A scale (dBA) for public exposure, but the public would not be exposed to these levels on a continuous basis. Temporary off-site noise impacts would be related to construction traffic.

Intermittent noise impacts associated with construction activity occurring within the urban portions of Conduits M and O would be negligible in the context of the Denver metropolitan area. The rural portions of Conduits M and O are likely to be more affected by temporary construction noise than the more developed areas. Similarly, short-term noise impacts during construction of the Denver Basin Aquifer Facilities would be negligible in the urban context of

Denver. Minimal noise-related impacts would result from construction of the gravel pits. The AWT plant component of Alternatives 8a, 10a, and 13a would be equipped with sound mitigation features to comply with applicable local noise ordinances.

No Action Alternative

There are no ground-disturbing activities associated with the No Action Alternative; thus, no noise impacts are anticipated.

Recreation

Action Alternatives

All action alternatives would have direct and indirect impacts on both current and future recreation opportunities at Gross Reservoir. Six of the nine developed recreation areas within the Project area would be inundated under the action alternatives and would need to be relocated to allow for the continuation of their current uses. In addition to restrictions and closures of areas, impacts to the recreation experience may occur from visual and sound disturbances during construction of an enlarged reservoir. During construction, access to some areas of shoreline, on-water access, and associated parking areas may be restricted. Some of these areas would need to be relocated upon inundation. Increased surface area and extended shoreline may result in the creation of additional recreation opportunities. A larger reservoir available for boating and additional fishing access may be an attraction for recreationists in the area.

The construction of a new reservoir at Leyden Gulch would have little impact on existing recreation since the site is currently undeveloped rangeland with no developed recreation opportunities or public access. There would be a temporary impact to road bicyclists who utilize SH 93 due to its realignment and the reservoir construction; primarily a result of increased heavy traffic. Denver Water has indicated that no recreation opportunities would be provided at Leyden Gulch Reservoir and public access to the site would be prohibited. Therefore, there would be no change in the current recreational character at the Leyden Gulch Reservoir site.

Construction of the South Platte River Facilities under Alternatives 8a and 13a would impact the existing recreation opportunities at the Worthing Pit. As a result of the removal of the pit as a recreation resource, water skiing as well as the existing trailers used as seasonal residences, would no longer be permitted. In addition, portions of the proposed South Platte Heritage Project Trail Corridor would need to be re-routed. Construction of the South Platte River Facilities would also temporarily disturb bicyclists on Brighton Road.

Construction of well sites as part of the Denver Basin Aquifer Facilities under Alternative 10a would result in the permanent removal of small acreages of land within existing City and County of Denver developed parks and golf courses. This may impact the visitor experience due to presence of well houses.

No long-term impacts to recreation are expected as a result of constructing Conduits O and M under Alternatives 8a, 10a, and 13a. The delivery pipelines would be within existing road right-of-way (ROW) and would not significantly interfere with any potential future recreation activities. Construction of these pipelines may create a temporary disturbance to bicyclists who use the same roadways where the pipelines would be buried. Crossings of waterways would require construction via an open cut on the channel, temporarily precluding recreational use of

the river for activities such as kayaking while construction is ongoing. It would also preclude recreational fishing in the immediate vicinity of the open cut during construction.

Implementation of any of the action alternatives would result in negligible adverse long-term effects to boating on the **Colorado, Blue, and South Platte rivers** and **Lower South Boulder Creek** (Gross Reservoir through Eldorado Canyon). Implementation of any of the action alternatives would result in major long-term effects to boating on the **Fraser River** as a result of the reduction in number of available use days. Minor beneficial long-term effects on boating in the **North Fork South Platte River** and **Upper South Boulder Creek** (Pinecliffe to Gross Reservoir) would occur from an increase in flows in summer months.

Generally, no negative impacts to fishing would occur, although possibly some improvements to the quality of fishing. One exception would be with the **North Fork Ranch Creek**. If there is an adverse impact on the fish community in this tributary, it is likely it will also have a direct, long-term moderate impact on the quality of the recreation fishing experience.

Flow changes under the action alternatives on the **Fraser River** would result in adverse visual or aesthetic impacts in May, June, and July of average and wet years. Although the stream flows would not drop to the level of dry year flows, the difference would be noticeable and adverse. This may have an indirect impact on the overall recreation experience that is somewhat dependent on scenery.

No Action Alternative

The implementation of using the Strategic Water Reserve in combination with mandatory restrictions would be less intense than if either strategy were implemented alone; however, use of the Strategic Water Reserve alone may still affect recreation.

Reductions in reservoir contents in Antero, Eleven Mile Canyon, and Cheesman reservoirs under the No Action Alternative may have an impact on recreation at each facility due to lower water levels. Lowered water levels would limit shoreline recreation activities, such as fishing, and may render boat ramps inoperable. The lower water levels would also have a negative impact on the recreational experience for other activities, such as hiking, camping, and day use due to the potential unsightly nature of reduced water levels during peak use periods.

Dillon Reservoir would be used more heavily and would have a negative impact on recreation by limiting shoreline recreation activities, such as fishing, and may render boat ramps inoperable. The lower water levels would also have a negative impact on the recreational experience for other activities, such as hiking, camping, and day use due to the potential unsightly nature of reduced water levels during peak use periods.

Gross Reservoir would be drained to the minimum pool more frequently under the No Action Alternative. Decreases of this magnitude would have an impact on recreation by limiting shoreline recreation activities, such as fishing, which are particularly popular at Gross Reservoir. Car top boating would likely also be impacted as it would make access to the waterline more difficult. The lower water levels would also have a negative impact on the recreational experience for other activities, such as hiking, camping, and day use due to the potential unsightly nature of reduced water levels during peak use periods.

There are no ground disturbing activities under the No Action Alternative and generally only minor changes in stream depletions. Therefore, impacts on river segments and associated

recreational use associated with the No Action Alternative are similar to those previously described under the action alternatives above.

As related to recreation at municipal parks, pools, golf courses, and other areas where water is required, Denver Water has described emergency water use restrictions that may be instituted as part of its drought response that would likely be part of the combination strategy. However, because of emergency water use restrictions, only minor effects would result in fewer visitors to parks and recreation areas with fountains due to the reduced visual appeal and overall park experience.

Land Use

Action Alternatives

Impacts to land use would occur if the Project conflicts with adopted planning goals or policies, terminates or has a major impact on existing land uses, or results in changes that would interfere with planned land uses in the area.

Overall, impacts to existing land uses at or adjacent to Gross Reservoir are expected to be minor. Recreation is the primary non-water-storage use at Gross Reservoir. Construction activities would have site-specific direct land use impacts, primarily relating to recreation access and use areas. Construction-related activities would also temporarily impact adjacent land uses from increased noise levels, dust pollution, and possibly ground vibrations from quarrying activities. Expansion of Gross Reservoir would present minor conflicts with Boulder County zoning regulations stipulating that the Gross Reservoir area is zoned as "Forestry" to conserve forest resources, protect the natural environment, and preserve open areas. There would be no impacts to Boulder County Open Space properties. Management of USFS lands within and adjacent to Gross Reservoir are subject to Management Area 3.5 direction, *Forested Flora and Fauna Habitats*. Management objectives in this area emphasize maintaining and improving wildlife and plant habitats and promoting recreational use in the Winiger Ridge area during summer and fall. Conflicts with USFS management direction include minor, permanent impacts to wildlife and plant habitats and temporary impacts to recreational objectives for the duration of Project construction. Generally, land use within the Gross Reservoir area is stable with only minor development or changes planned, such as individual residential building/improvement permits. There would be no impacts to planned land uses as a result of the action alternatives.

Temporary land use impacts at the Leyden Gulch Reservoir site would occur during construction activities and may include increased noise, dust, and traffic. The new reservoir would be constructed immediately south of the Union Pacific; there would be no impacts to the railroad under Alternative 1c. The inundation of Leyden Gulch would also result in minor losses of livestock grazing opportunities. Residential land uses in nearby developments would not be impacted by Project construction; however, these residences would be affected by altered views. Land use in the Leyden Gulch area is currently stable, but the potential for future development is moderate to high. Additionally, portions of the Leyden Gulch Reservoir site are identified as a "potential open space preservation area" containing two trails. Construction of a new reservoir in Leyden Gulch may impact the future alignment of these trails.

The South Platte River Facilities would not conflict with existing or planned land uses. Gravel pit storage under Alternatives 8a and 13a would be located at existing gravel extraction lakes in areas currently characterized by industrial and agricultural uses. As such, there would be

minimal impacts to existing land uses. Structure design criteria, such as sound mitigation and architectural styling would ensure that the AWT plant would have no adverse impact on existing or future land uses and would be consistent with current county zoning.

In general, the Denver Basin Aquifer Facilities would result in minor, adverse, long-term impacts to City properties. Short-term construction impacts may include noise, dust, and temporary street closures. Long-term, permanent impacts to uses of these City parks are expected to be minor and primarily related to diminished recreational experiences or aesthetics.

Construction of Conduits M and O would result in temporary adverse impacts. Because the conduits would be constructed in existing streets and ROWs, lane closures and traffic detours would be necessary to accommodate construction activities. Reduced or modified access may temporarily affect retail and commercial land uses along the conduit alignments.

Under Alternative 13a, some of the lands that could no longer be irrigated due to the removal of water rights might remain in dryland cultivation or some other agricultural use. However, these uses are less productive than irrigated farmland. This fact, when combined with urban development pressures, would indicate that conversion of these lands to non-agricultural uses is the most likely outcome.

No Action Alternative

There would be no direct, measurable impacts to land use as a result of the No Action Alternative.

Visual Resources

Action Alternatives

The extent to which the action alternatives would affect visual resources depends on the amount of visual contrast created between the proposed Project facilities and the existing landscape character. The resource would be impacted if visual change in the landscape had a negative impact on existing viewpoints, high quality scenery, or impacted the view from the setting of visually-sensitive land uses. Impacts would also occur if the predicted visual contrast created by each action alternative would be consistent with management guidelines for each affected area. In general, all action alternatives would create direct, temporary effects to visual resources during construction activities.

Post-construction impacts at Gross Reservoir include short-term effects in disturbed areas until reclamation efforts lessen visual contrasts. Long-term direct impacts to visual resources at Gross Reservoir would include changes in scale to the shoreline, reservoir elevation, and dam profile; permanent inundation of scenic areas; relocation of existing facilities and roads; disturbed areas undergoing restoration; a permanently disturbed quarry site; and a new auxiliary spillway. The new shoreline and recreational use areas would retain the existing, valued landscape character. The quarry and auxiliary spillway, and temporary dam staging and stockpile areas would not be compliant with management guidelines (i.e., Denver Water Article 414 Visual Resource Protection Plan and USFS Arapaho & Roosevelt National Forest Plan) and would be considered major impacts.

The visual character and scenic attributes of Leyden Gulch would unavoidably change due to a new water storage feature. The most visible primary components of the new reservoir would include the earthfill dam, dam spillway structure and outlet works, relocation of SH 93, an

increase in reinforced or impervious surfaces, new access roads, site fencing, service lighting, aboveground wood-post transmission line, and ongoing restoration of three staging areas. Construction of a new reservoir and dam at Leyden Gulch would result in a marked change in visual environment by obstructing views, converting a natural-appearing setting to a more developed condition, and potentially degrading scenic features. Therefore, it would not be compliant with existing management and policy guidance, and would be considered a long-term impact. The proposed reservoir, however, would appear compatible with and potentially be an improvement to the open, rangeland character of the region which already consists of scattered open water storage facilities.

Utilizing available water storage capacity in previously constructed gravel pits would improve the scenic quality of the Alternatives 8a and 13a study area, which would result in minor beneficial long-term visual improvements. Visual contrast resulting from the construction of a new AWT plant would be negligible since buildings of similar scale and architecture currently exist within the study area. Construction of the AWT plant and associated facilities would create short-term contrasts to existing visual resources, but would not conflict with the scenic management guidelines for the area.

Under Alternative 10a, adverse impacts from the visual contrast created by well clusters would vary based on their placement within each park as well as the size and type of park. Generally, the smaller parks and special interest locations (such as sculpture parks or memory gardens) would experience adverse impacts to visual character. Larger parks that offer a variety of built amenities or a diversity of topography and vegetation for screening would experience only minor impacts. Building architecture for the AWT plant would be designed to be consistent with the surrounding area, which is dominated by heavy industrial and manufacturing uses. No visual contrast would result from the new facilities as industrial buildings of similar scale and architecture currently exist within the area.

Transfer of agricultural water rights under Alternative 13a would primarily affect irrigated croplands. Generally, the types of visual impacts would be expected to include conversion of irrigated cropland to dryland cultivation and/or urban development. Either scenario has the potential to affect scenic character in the area. The conversion to dryland agricultural uses or pasture grasslands would likely result in an increase in noxious weed infestations and urban development would create contrasts with the otherwise rural or scenic qualities. Some emergent wetlands would also convert to grassland when water sources are removed. These changes are likely to be perceived by viewers as an adverse impact on visual resources.

There would be no impacts to visual resources or aesthetics in the **Colorado, Blue**, or **Williams Fork rivers** under the action alternatives.

Flow changes under the action alternatives on the **Fraser River** would result in adverse visual or aesthetic impacts in May, June, and July of average and wet years. Although the stream flows would not drop to the level of dry year flows, the difference would be noticeable and adverse. In the upper reaches, impacts would be adverse and moderate, however, flow changes would not fundamentally alter the character of the stream.

Overall, visual impacts to **South Boulder Creek** above Gross Reservoir would be minor and beneficial. Immediately below Gross Reservoir, reservoir outflow changes would be significantly higher under the action alternatives in winter months creating a major, adverse effect on stream appearance and characteristics. Downstream (near Eldorado Springs gage), the

Proposed Action would result in no perceptible impacts to stream appearance or other visual resources and aesthetics.

Moderate to major adverse visual impacts, including impacts to stream appearance and characteristics, are expected in all winter months of all years as a result of flow reductions on the **North Fork South Platte River**. Flow changes on the **South Platte River**, with the exception of immediately below Chatfield Reservoir, would be imperceptible to the casual observer.

No Action Alternative

Since there would be no ground-disturbing activities under the No Action Alternative, there would be no direct impacts to visual resources. Minor indirect impacts, however, to visual resources would occur at Gross Reservoir as a result of more frequent and prolonged drawdowns that would create unattractive visual contrasts for observers, particularly recreationists.

With the exception of mandatory restrictions imposed during drought periods, visual resources would remain relatively unchanged under the No Action Alternative. Under mandatory drought restrictions, lawn watering would be prohibited. Subsequently, visual resources may be impacted due to the temporary die-back or browning of vegetation cover.

Cultural Resources/Paleontology

Action Alternatives

Prehistoric and historic sites and traditional cultural properties are considered significant if they are listed in or eligible for listing in the National Register of Historic Places (NRHP). All action alternatives would permanently affect the Gross Dam and Reservoir, and a portion of the Resumption Flume. These impacts are considered to be an adverse effect and treatment of this effect would be required before construction begins. Eighteen significant sites are located within the Leyden Gulch Reservoir site; Alternative 1c would have temporary impacts to three significant cultural resources and permanent impacts to six significant cultural resources. Construction of Conduit O would temporarily impact three significant cultural resources and permanently impact to two significant cultural resources. Construction of Conduit M would temporarily impact one significant cultural resource and permanently impact three significant cultural resources. No significant cultural resources are anticipated to be impacted by the South Platte River Facilities.

It is not anticipated that the enlargement of Gross Reservoir or construction of the South Platte River Facilities, Denver Basin Aquifer Facilities, and Conduits M and O would impact paleontological resources. Although no paleontological resources were identified at the Leyden Gulch Reservoir site, the area is underlain by the Pierre Shale, which is characterized as Class I (i.e., area has good potential for containing vertebrate, invertebrate, or plant fossils) for paleontological resources.

No Action Alternative

The operational changes associated with the No Action Alternative are not anticipated to impact cultural or paleontological resources.

Socioeconomics

Action Alternatives

Overall, the majority of socioeconomic impacts resulting from an enlargement of Gross Reservoir would be temporary and associated with the construction period. Generally, temporary impacts as a result of a Gross Reservoir enlargement would be positive in nature, but relatively minor and include the addition of new jobs during the construction period (between 187 to 222 full-time employees), resulting in an increase in annual employment-related income (ranging from approximately $11 to $13 million). Denver Water would expend money on materials and supplies during construction, much of it in the Denver metropolitan area and surrounding counties. Purchases made by Denver Water for labor and materials plus spending by persons employed as a result of constructing Gross Reservoir would amount to economic output ranging from approximately $52 to $63 million per year.

Temporary impacts as a result of construction of a new Leyden Gulch Reservoir would be similar to those described for Gross Reservoir. An additional 499 full-time employees would be required for construction, as well as an additional $29 million in annual employment-related income. Denver Water would spend additional monies on non-labor costs, much of which would be for materials and supplies, during the construction period. In addition to purchases made by Denver Water on labor and materials plus spending by persons employed, would amount to an economic output of $95 million per year during the construction period.

Alternatives 8a, 10a, and 13a would result primarily in temporary impacts associated with construction of the South Platte River Facilities, Denver Basin Aquifer Facilities, and Conduits O and M. An average of between 169 and 481 new jobs would be created as a result of each of these components during the construction period, resulting in approximately $9 to $27 million in annual employment-related income. Denver Water would spend additional monies on non-labor costs, much of which would be for materials and supplies, during the construction period. In addition to purchases made by Denver Water on labor and materials plus spending by persons employed would amount to an economic output ranging from $22 to $111 million per year during the construction period for each component.

For all action alternatives, the positive impacts to revenues of public entities from increased sales tax collections would be negligible. Impacts to expenditures of public entities would be related to road and bridge maintenance and would be negligible. Several public service providers would experience negligible or minor increases in demands during the construction period. Denver Water and its customers would experience a long-term positive impact from a more reliable water supply. All action alternatives would result in minor to moderate rate and tap fee increases. None of the action alternatives are expected to impact demographic or housing conditions within the Project Area.

Capital costs for construction were developed from feasibility-level designs of the components for each action alternative. These costs include materials, supplies, labor, contractor mobilization, and contractor overhead. Contingency factors and engineering costs are also incorporated into capital costs. Costs associated with ROW acquisitions or easements are not included in the construction costs. Fixed annual operation and maintenance (O&M) costs are those associated with physically maintaining the project facilities, operational costs including the cost of power, and the routine replacement of mechanical equipment. The estimated costs are

indexed to January 2006 conditions. Capital and O&M costs associated with each alternative are summarized in the following table.

Summary of Estimated Costs of Each Action Alternative (2006)

Costs	Alternatives				
	Proposed Action	**1c**	**8a**	**10a**	**13a**
Total Capital Construction Costs	$139,878,000	$293,748,000	$362,007,000	$393,198,000	$426,738,000
Present Worth of Annual O&M (for an 80-year period, discounted at 3%)	$8,788,000	$18,483,000	$147,712,000	$181,476,000	$118,417,000
Total Present Worth Cost	**$148,666,000**	**$312,231,000**	**$509,719,000**	**$574,674,000**	**$545,155,000**

No Action Alternative

Long-term and permanent socioeconomic impacts would result from the No Action Alternative. Increased chances of a major system failure through the treated water or raw water systems may result in a loss of trust in Denver Water on the part of individual water customers and Denver metropolitan area institutions. This could result in a change in Denver Water's management structure and responsibilities. Denver Water may also experience an increase in expenditures related to planning for and responding to system failures.

In dry years, customers may experience periodic raw water and treated water shortages. The cities of Arvada and Westminster and the North Table Mountain Water and Sanitation District would be especially vulnerable to raw water shortages. Raw water customers would attempt to acquire temporary supplies when shortages are likely to occur. However, these supplies may not be readily available or may be more expensive during dry periods.

Severe and more frequent mandatory watering restrictions, including surcharges, may result in a reduced quality of life and place financial burdens on customers. Though still infrequent, mandatory restrictions would reduce production, employment, and other business activity in the Denver metropolitan area.

Minor water rate increases may result. Even with these increased water rates, Denver Water would collect less in total revenue as a result of reduced sales during periods of watering restrictions.

Reduced recreational economic benefits may result from Gross Reservoir due to more frequent drawdown, likely resulting in decreased visitation. The reduced desirability of the Gross Reservoir Primary Impact Area (PIA) as a place to live or own a home would reduce property values in this area.

The No Action Alternative would have no direct and clearly discernible costs to Denver Water since facility construction or purchases would not occur. It is possible that additional operational costs for pumping or treatment might occur under the No Action Alternative, but such costs would be episodic and unpredictable. By depleting the Strategic Water Reserve and instituting

water restrictions with greater frequency and severity, Denver Water and its customers would experience some indirect costs.

Hazardous Materials

Action Alternatives

Direct impacts may result from construction-related activities in areas where contaminated soil or groundwater occur. An example of an indirect impact from a hazardous material site would be reduced landfill capacity due to disposal of large volumes of contaminated soil. Direct impacts as a result of use, storage, and disposal of hazardous materials would be managed in compliance with state and federal regulations, and would result in low potential for adverse impacts.

For all action alternatives, no direct or indirect impacts associated with hazardous material sites were identified within the Gross Reservoir study area. Seven hazardous material sites were identified adjacent to and within the Leyden Gulch Reservoir site. The sites have a low or unknown potential for an environmental release.

Related to the South Platte River Facilities associated with Alternatives 8a and 13a, eight sites with a high potential for an environmental release were identified within and adjacent to Worthing and South Tower gravel pits. Under Alternative 8a, no impacts associated with hazardous material sites were identified near the North Tower Gravel Pit. Under Alternative 13a, one site with a moderate potential for impact to the Challenger Gravel Pit was identified, however, no report of any release or violations were documented.

The Denver Basin Aquifer Facilities and Conduits O and M associated with Alternatives 8a, 10a, and 13a are expected to have a high number of hazardous waste sites associated with the urban location of many of the alternative components. If Alternative 8a, 10a, or 13a is selected and permitted by the Corps, any hazardous waste sites would be dealt with in accordance with federal, state, and local regulations.

No Action Alternative

No ground-disturbing activities would result from the No Action Alternative. Therefore, no hazardous material impacts are anticipated.

CUMULATIVE IMPACTS

The cumulative effects analysis for this Project evaluated past and present water and land-based actions that continue to influence existing environmental conditions. The cumulative effects analysis also included reasonably foreseeable water-based or land-based actions that, when combined with one of the action alternatives, may result in a cumulative effect on the environment.

Land- and Water-based Projects and Geographic Boundaries

Cumulative effects analyses were conducted for past, present, and reasonably foreseeable future land-based and water-based actions. Geographically, cumulative effects resulting from water-based actions are likely to occur on both the East and West slopes, thus, cumulative effects were evaluated within the local operational and socio-political boundaries of these activities. The effects of land-based actions are limited to the Front Range (East Slope) since no Project-related

ground-disturbing activities would occur on the West Slope. Land-based actions were identified by reviewing various city and county comprehensive plans, recreation management plans, proposed transportation improvement project plans, regional population statistics, and land parcel database searches.

Future Water-Based Actions

Several water-based actions on the East and West slopes were considered in the evaluation of cumulative hydrologic effects:

East Slope

- Halligan-Seaman Water Management Project
- Northern Integrated Supply Project
- Denver Water Reuse Project
- Aurora Prairie Waters Project
- Rueter-Hess Reservoir (Current and Enlargement)
- Dry Creek Reservoir Project
- Chatfield Reservoir Reallocation
- Augmentation of Lower South Platte Wells
- East Cherry Creek Valley Project
- Cache la Poudre Flood Reduction/Ecosystem Restoration

West Slope

- Windy Gap Firming Project
- 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 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

Water-based actions refer to proposed water storage and diversion, water rights changes, and Section 404 activities on Colorado's East and West slopes.

Future Land-Based Actions

Future land-based actions considered for the cumulative effects analysis included construction of residential, commercial, and industrial structures; construction and expansion of city, county, state, and federal roads and highways; and gravel mining. The following descriptions of future land-based actions provide information on regional development trends that, in turn, provide context for Moffat Project impacts.

Cumulative Resource Effects

The evaluation of cumulative effects includes an analysis of both water-based and land-based projects. Generally, past and present projects were included in the analysis if they overlap in geographic boundary where the effects from the Moffat Project alternatives are expected to occur. Future actions were included if they overlap geographically with the Moffat Project, could impact the same resources, and have a reasonable certainty of occurring. Many of the identified future water-based actions were included in PACSM and were thereby included in the analysis for the Project alternatives, including the No Action Alternative.

Cumulative effects were analyzed for all resources. An important focus of the analysis, due to the nature of the Moffat Project and its potential effects, was on hydrology (both surface and groundwater). Overall, cumulative effects to both surface and groundwater are considered minor, with the exception of several of the upper tributaries of both the **Williams Fork** and **Fraser rivers** where moderate effects to stream flow could be expected during average to wet years. Cumulative effects to riparian and wetland areas are expected to be minor in all of the geographic areas affected by Moffat Project alternatives, except for the Front Range/Weld County area where past, present, and future agricultural water right transfers would cause moderate to major cumulative effects. There would also be moderate cumulative effects to wildlife in the Front Range/Weld County area from the loss of aquatic and mesic habitats associated with the transfer of agricultural water rights. Minor cumulative effects to wildlife may occur in other portions of the Project area.

None to negligible cumulative impacts to fish, benthic invertebrates, and their habitats are anticipated to occur for most East Slope stream segments. Exceptions include minor adverse impacts to fish and invertebrates in South Boulder Creek upstream of Gross Reservoir, and the North Fork South Platte River which could experience increased flows and increased concentrations of copper. Cumulative impacts to aquatic resources in West Slope streams would be negligible, except for minor adverse impacts to fish and invertebrates in the North Fork Ranch Creek (tributary of the Fraser River), McQueary, Jones, Bobtail, and Steelman creeks (tributaries of the Williams Fork River). The effects of the reduction in the Shoshone Call would tend to occur 1 out of every 6 or 7 years, usually in dry years, and usually in the spring. The exact consequences to cumulative hydrology are difficult to predict. However, slight, infrequent reductions in flows during the spring, when there is usually sufficient water to sustain fish and invertebrates, would likely have no additional cumulative effect on aquatic resources as a result of the Project.

Construction of Moffat Project alternatives could result in minor to moderate, short-term impacts to air quality, and could overlap with other construction or ground-disturbing activities. All other air cumulative impacts would be minor. Stream flow changes in the **Fraser River** during average flow years could result in moderate impacts to the number of days with optimal stream flow for recreational boating use. This is somewhat moderated by the fact that the **Fraser River** segment has no commercial rafting, and boating use is considered low compared to other rivers in Colorado that experience a substantial amount of boating use, such as the Colorado and Arkansas rivers. Construction of Leyden Gulch Reservoir could result in moderate cumulative effects to land use and visual resources, due to the potential for other activities in the area such as transportation, residential, and commercial development that could result in changes in existing land use and visual quality.

Minor, beneficial, cumulative socioeconomic effects would be experienced during construction of Project facilities due to employment and other economic factors. Another minor, beneficial effect would be associated with the Moffat Project by meeting the existing and future water demands of water users along the Front Range, supporting economic activity. A moderate negative socioeconomic effect would be experienced in the Front Range/Weld County area from water right transfers, which would result in the conversion of irrigated farmland to dryland agricultural use, which generates less income.

All other resources evaluated for cumulative effects, including geology, soils, vegetation, special status species, transportation, noise, cultural resources, and hazardous materials would experience negligible to minor cumulative effects.

MITIGATION

Denver Water has identified potential mitigation measures to reduce the impacts associated with implementation of the alternatives. Depending on the alternative carried forward, mitigation activities may include, but will not be limited to, stormwater management, channel and bank erosion measures and stabilization, construction containment, revegetation, habitat restoration, raptor and migratory bird protection, watershed-based drainage and wetland functional replacement, visual and cultural resource management, gravel pit ecological management, protected species management, aquatic biological resource preservation, and air quality and noise control.

Denver Water has prepared a proposed Mitigation Plan for the Proposed Action (see Appendix M). Final mitigation measures will be included as conditions to any Section 404 permit issued to Denver Water by the Corps. This Mitigation Plan is Denver Water's proposal to provide compensatory mitigation for unavoidable adverse effects associated with the Proposed Action for the Moffat Project. The Mitigation Plan is conceptual and intended to provide the agencies and public with information for review and comments as part of the NEPA process. Based on comments received, additional coordination with the resource agencies and direction from the Corps, the proposed Mitigation Plan will be revised and possibly included in the Final EIS.

A final detailed Mitigation Plan will be submitted to the Corps by Denver Water prior to issuance of a Section 404 permit. The final detailed plan will include the following information for each compensatory mitigation measure in accordance with the 2008 compensatory mitigation rule established by the Corps and EPA (*Federal Register*, Vol. 73, No. 70, April 10, 2008, p. 19670).

- **Objectives** – A description of the resources, the amount of affected resources, the amount of mitigation, and the method of compensation.
- **Site Selection** – A description of the methods used to select a mitigation site and the proposed location of the mitigation site.
- **Baseline Information** – A description and photograph of the existing conditions of the proposed mitigation site.
- **Mitigation Work Plan** – Detailed specifications and work descriptions for the proposed mitigation, which will include as appropriate: geographic boundaries of the mitigation site, construction methods, grading plan, erosion control measures, revegetation and planting specifications, and schedule.

- **Maintenance Plan** – A description and schedule of maintenance needed to ensure the mitigation is properly functioning.
- **Performance Standards** – Standards and criteria used to determine if the mitigation project has been successfully implemented and is achieving its objectives.
- **Monitoring Requirements** – A description of what will be monitored to determine if the performance criteria are met, and a schedule for monitoring and reporting.
- **Long-term Management Plan** – A description of how the mitigation project will be managed after the performance standards are met to ensure the long-term viability of the mitigation.
- **Adaptive Management** – A description of how unforeseen changes in site conditions, the inability to fully implement the proposed mitigation, or the inability to fully meet performance standards will be addressed.
- **Financial Assurances** – A description of sufficient financial assurances to ensure a high level of confidence that the compensatory mitigation will be successfully completed.

All practicable steps have been taken to minimize potential adverse effects associated with construction and operation of the Proposed Action. The proposed Mitigation Plan addresses the following unavoidable effects for the Proposed Action:

- **Riparian, Wetland and Stream Resources**
  - Inundation of riparian areas by an expanded Gross Reservoir
  - Inundation of wetlands and waters of the U.S. by an expanded Gross Reservoir
- **Aquatic Habitat**
  - Effects to aquatic habitat in the North Fork South Platte River downstream of the Roberts Tunnel outlet
  - Effects to aquatic habitat in South Boulder Creek upstream of Gross Reservoir and downstream of the East Portal of the Moffat Tunnel
  - Effects to flow and aquatic habitat in tributaries to the Fraser River
- **Threatened and Endangered Species**
  - Depletions to the Colorado River and Platte River
- **Recreation**
  - Inundation of recreation facilities by an expanded Gross Reservoir
- **Construction Traffic**
  - Effects to local traffic from construction activities

Potential mitigation options were developed based in part on discussions with the Colorado Division of Wildlife (CDOW), Trout Unlimited, Western Resource Advocates, Colorado Environmental Coalition, The Nature Conservancy, Boulder County, City of Boulder, Grand County, and the Northwest Council of Governments. While these entities have not endorsed this proposed Mitigation Plan, the information and preferences they provided during discussions with

representatives from Denver Water were used in the design of the Plan. Denver Water will continue to discuss mitigation with the agencies and interested parties as part of the EIS process.

The following are examples of preliminary mitigation measures identified to mitigate Project impacts to aquatic resources:

- Establish a viable Colorado River cutthroat trout fishery in a suitable location in Grand County
- Colorado River and Fraser River water temperature monitoring
- Aquatic habitat improvements in the North Fork South Platte River
- Additional environmental storage in Gross Reservoir to store water for enhancement flows for South Boulder Creek downstream of Gross Reservoir

In addition to the proposed mitigation measures, Denver Water is pursuing additional environmental enhancement opportunities separate from, but in some instances parallel to, the EIS process that will provide additional benefits to the environment and other West and East Slope interests.