Upper Colorado River Basin
Water Resources Planning Model
User's Manual

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COLORADO WATER CONSERVATION BOARD · STATE OF COLORADO · 1876 · 1937

COLORADO'S DECISION SUPPORT SYSTEMS

COLORADO DIVISION OF WATER RESOURCES
DEPARTMENT OF NATURAL RESOURCES

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1. Introduction

1.1 Background

The Colorado Decision Support System (CDSS) consists of a database of hydrologic and administrative information related to water use in Colorado, and a variety of tools and models for reviewing, reporting, and analyzing the data. The CDSS water resources planning models, of which the Upper Colorado River Basin Water Resources Planning Model (Upper Colorado River Model) is one, are water allocation models, which determine availability of water to individual users and projects, based on hydrology, water rights, and operating rules and practices. They are implementations of “StateMod,” a code developed by the State of Colorado for application in the CDSS project. The Upper Colorado River Model Baseline data set, which this document describes, extends from the most currently available hydrologic year (2013) back to 1909. It simulates current demands, current infrastructure and projects, and the current administrative environment as though they were in place throughout the modeled period.

The Upper Colorado River Model was developed as a tool to test the impacts of proposed diversions, reservoirs, water rights and/or changes in operations and management strategies. The model can simulate proposed changes using a highly variable physical water supply constrained by administrative water rights. The Baseline data set can serve as the starting point, demonstrating condition of the stream absent the proposed change but including current conditions. It is recommended the user compare the Baseline simulation results to results from a model to which they have added the proposed features, to determine the performance and effects of the proposed changes.

Information used in the model datasets are based on available data collected and developed through the CDSS, including information recorded by the State Engineer’s Office. The model datasets and results are intended for basin-wide planning purposes. Individuals seeking to use the model dataset or results in any legal proceeding are responsible for verifying the accuracy of information included in the model.

1.2 Development of the Upper Colorado River Basin Water Resources Planning Model

The Upper Colorado River Model was developed in a series of phases that have spanned 1996 through the present (2013). The earliest effort, designated Phase II following a Phase I scoping task, accomplished development of a calibrated model that simulated an estimated 75 percent of water use in the basin, leaving the remaining 25 percent of the use “in the gage”. The original model study period was 1975 through 1991, which also served as the model’s calibration period.

The objective of the CDSS endeavor was to represent all potential consumptive use within Colorado, and estimate actual consumptive use under water supply limitations. Therefore, in Phase IIIa, the previously unmodeled 25 percent use was added to the model as 65 aggregations of numerous small users. With the introduction of this demand, the calibration was reviewed and refined. The objective of Phase IIIb was to extend the model study period, using automated data filling techniques as well as "old-fashioned" research in the State's Records office to estimate or obtain historical gage and diversion information. The data set was extended back to 1909 and forward through 1996. The calibration was reviewed using the period 1975 through 1996. The State refined the Upper Colorado River Model again in 2006, adding the "variable efficiency" method for determining irrigation consumptive use and return flows, extending the study period through 2005, and creating daily simulation input files.

StateMod code enhancements made during 2009 allowed the annual Green Mountain Historical User Pool releases to be limited to 66,000 acre-feet. In addition, the Baseline model input files were enhanced to include the following:

- Current representation of transmountain demands for the Moffat System and Roberts Tunnel, provided by Denver Water Board
- Current representation of Colorado-Big Thompson and Windy Gap transmountain demands, provided by Northern Colorado Water Conservancy District
- Current representation of transmountain demands for the Con-Hoosier Project, provided by Colorado Springs Utilities
- More accurate representation of the Ute Water Conservancy District operations in the Plateau Creek basin
- Corrections to water rights associated with power demands on the lower Colorado River Basin
- Revised the Silt Project, Cameo Call, and 15-Mile Reach operations to better reflect current operations
- Reviewed and enhanced key structures and aggregates, as necessary, to reflect the 2005 and 2010 acreage assessments

1.3 Results

The key results of the Upper Colorado River Model efforts are as follows:

- A water resources planning model was developed that can make comparative analyses of historical and future water management policies in the Upper Colorado River Basin. The model includes 100 percent of the basin's surface water use.
- The model was calibrated for a study period extending from water year 1975 through 2013.
- The calibration in the Historic simulation is considered very good, based on a comparison of historical to simulated streamflows, reservoir contents, and diversions.
- A Baseline data set was prepared to simulate existing water resources systems on-line and operational for USGS water year 1909 through 2013. The Baseline data set is an appropriate starting point for evaluating various "what if" scenarios over a long hydrologic time period containing dry, average, and wet hydrologic cycles.

1.4 Acknowledgements

CDSS is a project of the Colorado Water Conservation Board (CWCB), with support from the Colorado Division of Water Resources. The Upper Colorado River Model was developed and enhanced at different stages by Riverside Technology, Inc., Boyle Engineering Corporation, Leonard Rice Engineers, Inc., and CWCB staff. The model update through 2013 was completed by Wilson Water Group.

2. What's in This Document

2.1 Scope of this Manual

This reference manual describes the CDSS Upper Colorado River Water Resources Planning Model, an application of the generic water allocation model StateMod and one component of the Colorado Decision Support System. It is intended for the reader who:

- Wants to understand basin operations and issues through review of the model,
- Needs to evaluate the model's applicability to a particular planning or management issue,
- Intends to use the model to analyze a particular Upper Colorado River Basin development or management scenario,
- Is interested in estimated conditions in the Upper Colorado River Basin under current development over a range of hydrologic conditions, as simulated by this model, and in understanding the modeling estimates.

For this manual to be most effective, the reader should have access to a complete set of data files for the Upper Colorado River Model, as well as other CDSS documentation as needed (see below).

The manual describes content and estimates in the model, implementation issues encountered, approaches used to estimate parameters, and results of both calibrating and simulating with the model. Limited general information is provided on the mechanics of assembling data sets and using various CDSS tools.

2.2 Manual Contents

This manual is divided into the following sections:

Section 3 The Upper Colorado River Basin – describes the physical setting for the model, provides general review of water resources development, and issues in the basin.

Section 4 Modeling Approach – provides an overview of methods and techniques used in the Upper Colorado River Model, addressing an array of typical modeling issues such as:

- Aerial extent and spatial detail, including the model network diagram
- Study period
- Aggregation of small structures
- Data filling methods

- Simulation of processes related to irrigation use, such as delivery loss, soil moisture storage, crop consumptive use, and returns of excess diversions
- Development of baseflows
- Calibration methods

Much of Section 4 is common to the other CDSS West Slope models and the Rio Grande model, although the section refers specifically to the Upper Colorado River Model.

Section 5 Baseline Data Set – refers to the Monthly Baseline data set input files for simulating under current demands, current infrastructure and projects, and the current administrative environment, as though they were in place throughout the modeled period. The data set is generic with respect to future projects, and could be used as the basis against which to compare a simulation that includes a new use or operation. The user is advised, before appropriating the data set, to become fully aware of how demands and operations are represented. Elements of these are subject to interpretation, and could legitimately be represented differently.

This section is organized by input file. The first is the response file, which lists the other files and therefore serves as a table of contents within the section. The content, source of data, and particular implementation issues are described for each file in specific detail.

Section 6 Baseline Results – presents summarized results of the Monthly Baseline simulation. It shows the state of the basin as the Upper Colorado River Model characterizes it under Baseline conditions. Both total flow and flow legally available to new development are presented for key sites.

Section 7 Calibration – describes the calibration process and demonstrates the model's ability to replicate historical conditions under historical demand and operations. Comparisons of streamflow, diversions, and reservoir levels are presented.

Appendices– present historical technical memoranda specific to the Gunnison model, written at various phases of the model's development. The body of the manual contains references to other CDSS technical memos that are more general in scope, which are available at the CDSS website.

There is some overlap of topics both within this manual and between this and other CDSS documentation. To help the user take advantage of all sources, pointers are included as applicable under the heading "**Where To Find More Information**," throughout the manual.

2.3 What's in other CDSS documentation

The user may well find the need to supplement this manual with information from other CDSS documentation. This is particularly true for the reader who wants to:

- Make significant changes to the Upper Colorado River Model to implement specific future operations,

- Introduce changes that require regenerating the baseflow data file,
- Regenerate input files using the Data Management Interface (DMI) tools and HydroBase,
- Develop a StateMod model for a different basin.

An ample body of documentation exists for CDSS, and is still growing. A user's biggest challenge may be in efficiently finding the information they need. This list of descriptions is intended to help in selecting the most relevant data source:

Consumptive Use Report – the report "Historical Crop Consumptive Use Analysis: Upper Colorado River Basin 2015" provides information on the consumptive use analysis that was used as input to the Baseline Demand scenario.

Basin Information – the report "Upper Colorado River Basin Information" provides information on specific structures, operations, and practices within the basin. While the information was gathered in support of the planning model when it was first undertaken, it is widely useful to anyone doing any kind of water resources investigation or analysis.

DMI user documentation – user documentation for **StateDMI** and **TSTool** is currently available, and covers aspects of executing these codes against the HydroBase database (Creating data sets for StateMod is only one aspect of their capabilities). The DMIs preprocess some of the StateMod input data. For example, StateDMI computed coefficients for distributing baseflow gains throughout the model and aggregated water rights for numerous small structures. TSTool filled missing time series data and computed headgate demands for irrigation structures. Thus the documentation, which explains algorithms for these processes, is helpful in understanding the planning model estimates. In addition, the documentation is essential for the user who is modifying and regenerating input files using the DMIs.

StateCU documentation – StateCU is the CDSS irrigation consumptive use analysis tool. It is used to generate structure-specific time series of irrigation water requirement, an input to StateMod. A model change that involves modified irrigated acreage or crop-type would require re-execution of StateCU

StateMod documentation – the StateMod user manual describes the model in generic terms and specific detail. Section 3 - Model Description and Section 7 - Technical Notes offer the best descriptions of StateMod functionality, and would enhance the Upper Colorado River Model user's understanding of results. If the user is modifying input files, they should consult Section 4 - Input Description to determine how to format files. To analyze model results in detail, they should review Section 5 - Output Description, which describes the wide variety of reports available to the user.

Self-documented input files – an important aspect of the StateMod input files is that their genesis was documented in the files themselves. Command files that directed the DMIs creation of the files were echoed in the file header. Generally, the model developers have incorporated comments in the command file that explain use of options, sources of data, etc.

Technical Memoranda – many aspects of the modeling methods adopted in CDSS were explored in feasibility or pilot studies before being implemented. Historical technical memoranda and reports for these activities are available on the CDSS website:

- Phase IIIb Task Memorandum 10.1 – Data Extension Feasibility
- Task Memorandum 10.2 – Evaluate Extension of Historical Data
- Task Memorandum 11.5 – Characterize Streamflow Data
- Task Memorandum 11.7 – Verify Diversion Estimates
- Task Memorandum 11.10 – Fill Missing Baseflow Data (include Mixed Station Model user instruction)
- Daily Yampa Model Task Memorandum 2 – Pilot Study
- Daily Yampa Model Task Memorandum 3 – Selecting a Daily or Monthly Model
- Variable Efficiency Evaluation Task Memorandum 1.3 – Run StateMod to create baseflows using the Variable Efficiency and Soil Moisture Accounting Approach
- Variable Efficiency Evaluation Task Memorandum 1.5 – Compare StateMod Variable Efficiency and Soil Moisture Accounting Historical Model Results to Previous CDSS Model Results and Historical Measurements
- CDSS Memorandum "Upper Colorado River Basin Representative Irrigation Return Flow Patterns"
- Task Memorandum 2.09-10 Consumptive Use Model – Non-Irrigation (Other Uses) Consumptive Uses and Losses in the Upper Colorado River Basin
- Upper Colorado River Basin Historical Crop Consumptive Use Report

3. The Upper Colorado River Basin

The Upper Colorado River basin lies in west-central Colorado, with the headwaters originating at the Continental Divide in Rocky Mountain National Park. The Upper Colorado River flows in a westerly direction through forested mountains and irrigated valleys before it leaves the state in Mesa County downstream of the City of Grand Junction. The basin encompasses all or a large majority of Grand, Summit, Eagle, Garfield and Pitkin counties; and portions of Mesa, Routt, and Gunnison counties in Colorado. Figure 3.1 is a map of the basin.

3.1 Physical Geography

The Upper Colorado River basin is approximately 9,916 square miles in size (excluding the Gunnison River basin). It ranges in elevation from 12,800 feet at its headwaters to 4,325 feet near the Colorado-Utah state line. The Upper Colorado River is the primary stream in the basin, with major tributaries including the Gunnison River, Fraser River, Williams Fork, Blue River, Muddy Creek, Eagle River, Roaring Fork River, Rifle Creek, and Plateau Creek. Average annual streamflow in the upper drainage (USGS gage near Grand Lake, Colorado) is approximately 57,000 acre-feet, which increases to an annual average of 4.6 million acre-feet below Grand Junction, Colorado (USGS gage near the state line), including the Gunnison River inflows, for water year 1975 through 2013. The water rights of the Gunnison River basin are not included in the Upper Colorado River Model; rather the Gunnison River is treated as a gaged inflow in the Upper Colorado River Model at USGS gage 09152500.

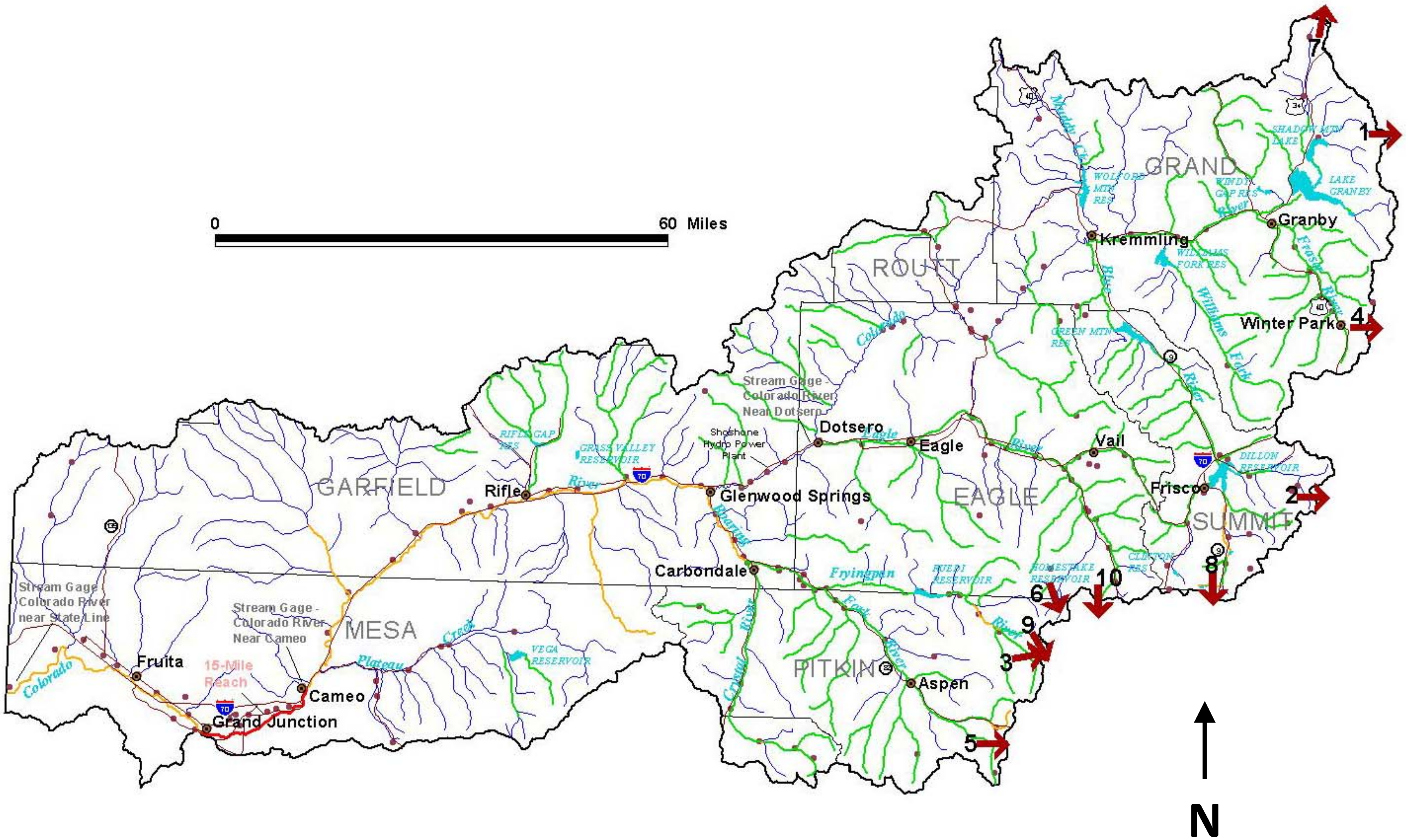

Figure 3.1 – Upper Colorado River Basin

3.2 Human and Economic Factors

The area remains moderately populated, with the 2010 census estimates placing the combined populations of Eagle, Garfield, Grand, Mesa, Pitkin, and Summit Counties at 315,294. Grand Junction and Glenwood Springs are the major population centers in the basin, with approximately 58,600 and 10,000 residents in 2010 and growth rates of 40 percent and 25 percent, respectively, from 2000 to 2010. Summit and Eagle Counties grew nearly 19 percent and 26 percent, respectively, from 2000 to 2010. Pitkin and Mesa Counties experienced similar growth rates of 15 percent and 26 percent, respectively, over the 2000 to 2010 period. The towns of Aspen and Vail experienced 13 and 17 percent growth, respectively, over the 2000 to 2010 period. Population growth was generally concentrated in the lower portions of the basin at the existing major population centers. Growth was seen in the upper portions of the basin at a more modest pace. This attests to the continued importance of recreation-based activities, as the ski areas and other outdoor recreation opportunities draw people and increase tourism within the basin.

The major water use in the basin is irrigation, with several thousand irrigation ditches diverting from the mainstem and the numerous tributary streams throughout the basin. Diversions from many of the small irrigation ditches average one or two thousand acre-feet per year. There are also several larger irrigation ditches, such as the Government Highline Canal which diverts approximately 780,000 acre-feet per year. According to the State's geographical information system (GIS) records, total irrigated acreage in the basin (based on 2010 imagery) was approximately 200,000 acres. Irrigated acreage decreased nearly 15 percent since 2000.

Another major water use in the Upper Colorado River is transmountain diversions. These diversions serve water supply needs for irrigation and municipal uses along the Front Range and eastern plains of Colorado. Major transmountain diversions and the average amount diverted over the model calibration period 1975-2013 are as follows:

- Colorado-Big Thompson (CBT) Project exported approximately 233, 000 acre-feet per year via the Alva B. Adams Tunnel for irrigation and municipal use in northern and eastern Colorado,
- City of Denver's Moffat Tunnel System diverted nearly 53,000 acre-feet per year,
- City of Denver's Roberts Tunnel System diverted approximately 66,000 acre-feet per year,
- Fryingpan-Arkansas Project exported approximately 51,000 acre-feet per year for irrigation and municipal use in southeastern Colorado,
- Independence Pass Transmountain Diversion System diverted approximately 41,000 acre-feet per year for municipal, industrial, and irrigation uses primarily in the Arkansas River basin,
- Homestake Diversion Project diverted approximately 26,00 acre-feet per year from the Upper Eagle River tributaries for municipal use in Colorado Springs and Aurora.

Other major water uses in the Upper Colorado River basin include power generation, industrial, municipal, and transbasin diversions within the basin. Principal power generation diverters include Shoshone Power Station, Grand Valley Power Plant, and Molina Power Plant, with collective historical diversions of approximately 1,002,000 acre-feet per year. Mining operations and snowmaking constitute the remaining major industrial uses in this basin. Diversions for municipal use include large population centers, municipal districts (i.e. Ute Water Conservancy District), and numerous small towns.

In addition to direct ditch diversions, there are 18 operational reservoirs in the model, including three that represent aggregations of numerous small facilities on Grand Mesa. Four reservoirs, including Rifle Gap Reservoir, Harvey Gap Reservoir, Vega Reservoir, and Leon Creek Aggregated Reservoir, are used primarily for irrigation. Six reservoirs, including Shadow Mountain/Grand Lake (modeled as one storage facility), Granby Reservoir, Willow Creek Reservoir, Meadow Creek Reservoir, Homestake Reservoir, and Upper Blue Reservoir, are predominantly used to store water for transmountain diversions. Bonham Aggregated Reservoir and Cottonwood Aggregated Reservoir serve industrial uses. The remaining reservoirs, including Williams Fork Reservoir, Green Mountain Reservoir, Dillon Reservoir, Clinton Gulch Reservoir, Ruedi Reservoir, and Wolford Mountain Reservoir, serve multiple uses, including municipal, industrial, irrigation, recreation, and endangered fish instream flows. With the exceptions of Meadow Creek Reservoir (1975), Clinton Gulch Reservoir (1977) and Wolford Mountain Reservoir (1995), all the above reservoirs were constructed prior to the 1975-2013 water year calibration period. Wolcott Reservoir, Eagle Park Reservoir, Roan Creek Reservoir, and Parachute Creek Reservoir are included in the model but only as placeholders for additional future scenarios. Three of these reservoirs are below the 4,000 acre-feet cutoff for inclusion in the model. However, Upper Blue Reservoir (2,113 acre-feet capacity) was added in Phase IIIa to better represent Continental Hoosier system operations; Cottonwood Aggregated Reservoir (3,812 acre-feet capacity) was included to better model the Molina Power Plant in the Collbran Project; and Eagle Park Reservoir was included for future modeling of augmentation operations in the Eagle River Basin.

There are also ten non-operational aggregated reservoirs and one aggregated stock pond in the model. These were added in Phase IIIa to represent an additional 89,833 acre-feet of decreed storage.

3.3 Water Resources Development

The Upper Colorado River basin has experienced substantial water resources development in the form of storage projects and pipelines developed by private groups and federal agencies. **Table 3.1** presents a timeline of key developments within the basin.

Table 3.1
Key Water Resources Developments

Date	Project (West Slope Reservoirs)	Agency
1882	Grand Valley Irrigation Canal	Grand Valley Irrigation Company
1890	Grand River Ditch	Water Supply and Storage Company
1915	Grand Valley Project	United States Bureau of Reclamation
1919	Orchard Mesa Irrigation District	Orchard Mesa Irrigation District
1935	Independence Pass Transmountain Diversion System (Grizzly Reservoir)	Twin Lakes Reservoir and Canal Company
1936	Fraser River Collection System (Meadow Creek Reservoir, Williams Fork Reservoir)	Denver Water Board
1938	Colorado-Big Thompson Project (Grand Lake and Shadow Mountain Reservoir, Granby Reservoir, Willow Creek Reservoir, Green Mountain Reservoir, Windy Gap Reservoir)	United States Bureau of Reclamation
1940	Williams Fork Diversion Project (Williams Fork Reservoir)	Denver Water Board
1948	Continental-Hoosier Diversion System (Upper Blue Lakes, Wolford Mountain Reservoir, Homestake Reservoir)	City of Colorado Springs
1959	Williams Fork Reservoir	Denver Water Board
1961	Homestake Diversion Project (Homestake Reservoir)	City of Colorado Springs - City of Aurora
1963	Collbran Project (Vega Reservoir, Bonham Reservoir, Big Creek Reservoirs, Leon Creek Reservoirs, Cottonwood Creek Reservoirs)	United States Bureau of Reclamation
1964	Blue River Diversion System (Dillon Reservoir, Williams Fork Reservoir, Wolford Reservoir)	Denver Water Board
1968	Silt Project (Rifle Gap Reservoir, Harvey Gap Reservoir)	United States Bureau of Reclamation
1972	Fryingpan-Arkansas Project (Ruedi Reservoir)	United States Bureau of Reclamation
1995	Wolford Mountain Reservoir	Colorado River Water Conservation District

3.4 Water Rights Administration and Operations

The primary call on the river during the irrigation season, known as the Cameo call, is located in the Grand Valley Area where some of the most senior water rights in the basin exist. This call is activated if the combined flows at the Cameo gage (USGS gage 09095500) and the Plateau Creek gage (USGS gage 09105000) fall below 2,260 cubic feet per second. The other significant call that affects the entire basin above the Roaring Fork is at Shoshone Power Plant, located eight miles downstream of the Dotsero gage (USGS gage 09070500). Senate Document 80 stipulates how water should be administered to satisfy demands at this location.

Two distinct periods revolving around Green Mountain Reservoir operations with respect to the Shoshone call define the historical water rights administration in the Upper Colorado River basin. Prior to 1985, the division engineer administered the river according to a strict interpretation of Senate Document 80. If flows fell below the 1,250 cfs minimum at the Dotsero gage, transmountain diversions were curtailed or replaced. If streamflow in the Upper Colorado River did not satisfy the Shoshone call, Green Mountain Reservoir would release water to satisfy the shortage. Following the publication of a new operating policy at Green Mountain and a restructuring of its reservoir accounts in 1984, the administration policy described above was revised. From 1985 forward, the division engineer began operating Green Mountain Reservoir as a true replacement facility to Western Slope beneficiaries. In addition, transmountain diversions senior to the Shoshone call were able to divert in priority. This change in policy triggered earlier releases than previously observed from Green Mountain Reservoir.

3.5 Section References

1. Colorado River Decision Support System Upper Colorado River Basin Water Resources Planning Model, Boyle Engineering Corporation, January 1998.

2. Colorado River Mainstem Basin Facts, Colorado Water Conservation Board, available at http://cwcb.state.co.us

3. Census and Population Estimate Data, HydroBase, March 2014.

4. Upper Colorado River Basin Information Report, July 2006

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4. Modeling Approach

This section describes the approach taken in modeling the Upper Colorado River Basin, from a general perspective. It addresses scope and level of detail of this model in both the space and time domains, and describes how certain hydrologic processes are parameterized.

4.1 Modeling Objectives

The objective of the Upper Colorado River Modeling effort was to develop a water allocation and accounting model that water resources professionals can apply to evaluations of planning issues or management alternatives. The resulting “Baseline” input data set is one representation of current water use, demand, and administrative conditions, which can serve as the base in paired runs comparing river conditions with and without proposed future changes. By modifying the Baseline data set to incorporate the proposed features to be analyzed, the user can create the second input data set of the pair.

The model estimates the basin’s current consumptive use by simulating 100 percent of basin demand. This objective was accomplished by representing large or administratively significant structures at model nodes identified with individual structures, and representing many small structures at “aggregated” nodes. Although the model was first developed and calibrated for the period from 1975 forward, the data set was extended backward to 1909, creating a long-term data set reflecting a wide variety of hydrologic subsequences and conditions.

Another objective of the CDSS modeling effort was to achieve good calibration, demonstrated by agreement between historical and simulated streamflows, reservoir contents, and diversions when the model was executed with historical demands and operating rules. This objective was achieved, as demonstrated in Section 7.

4.2 Model coverage and extent

4.2.1. Network Diagram

The network diagram for the Upper Colorado River Model can be viewed in StateDMI. It includes more than 800 nodes, beginning near the headwaters of the Upper Colorado River and ends at the Colorado-Utah Border.

4.2.1.1 Key Diversion Structures

Early in the CDSS process it was decided that, while all consumptive use should be represented in the models, it was not practical to model each and every water right or diversion structure individually. Seventy-five percent of use in the basin, however, should be represented at strictly correct river locations relative to other users, with strictly correct priorities relative to other users. With this objective in mind, key structures to be "explicitly" modeled were identified by:

- Identifying net absolute water rights for each structure and accumulating each structure's decreed amounts
- Ranking structures according to net total absolute water rights
- Identifying the decreed amount at 75 percent of the basin wide total decreed amount in the ranked list
- Generating a structures/water rights list consisting of structures at or above the threshold decreed amount
- Field verifying structures/water rights, or confirming their significance with basin water commissioners, and making adjustments

Based on this procedure, 11 cubic feet per second (cfs) was selected as the cutoff value for the Upper Colorado River basin. Key diversion structures are generally those with total absolute water rights equal to or greater than this cutoff. The Upper Colorado River Model includes approximately 375 key diversion structures.

Groups of key structures on the same tributary that operate in a similar fashion to satisfy a common demand are sometimes combined into "diversion systems". Diversion systems are modeled the same as other key structures.

Where to find more information

- Upper Colorado River Historical Crop Consumptive Use Analysis: Upper Colorado River Basin 2015 Report and Appendix A contains a detailed description of the method used to identify key structures.
- Section 3 of the CDSS document "Upper Colorado River Basin Information" lists candidate key structures and in some cases indicates why structures were or were not designated as "key". These decisions were often based on Water Commissioner input, which is also documented in the Upper Colorado River Basin Information section "Basin Meeting Notes".

4.2.1.2 Aggregation of Irrigation Structures

In general, the use associated with irrigation diversions having total absolute rights less than 11 cfs in the Upper Colorado River basin were included in the model at "aggregated nodes." These nodes represent the combined historical diversions, demand, and water rights of many small structures within a prescribed sub-basin. The aggregation boundaries were based generally on tributary boundaries, gage location, critical administrative reaches, and instream flow reaches. To the extent possible, aggregations were devised so that they represented no more than 2,200 irrigated acres. In the Upper Colorado River Model, 65 aggregated nodes were identified, representing around 61,000 acres of irrigated crops. These nodes were placed in the model at the most downstream position within the aggregated area.

Aggregated irrigation nodes were attributed the water rights associated with their constituent structures grouped into water right classes. Their historical diversions were developed by summing the historical diversions of the individual structures, and their irrigation water requirement is based on the total acreage associated with the aggregation.

Where to find more information

- Appendix A describes how aggregate structures were created and a complete list of all structures included in aggregates.
- The Upper Colorado River Historical Crop Consumptive Use Analysis: Upper Colorado River Basin 2015 Report contains a detailed description of the method used to create aggregate structures and complete lists of all structures included in aggregates

4.2.1.3 Municipal and Industrial Uses

One node in the model is a place-holder to represent the combined small diversions for municipal, industrial, and livestock use (M&I). Total non-irrigation consumptive use in the Upper Colorado River basin was estimated, as documented in the CDSS task memorandum "Non-Irrigation (Other Uses) Consumptive Uses and Losses in the Upper Colorado River Basin."

The one aggregated M&I node in the Upper Colorado River Model represents approximately 0 acre-feet of consumptive use. The diversion has a priority of 1.0 (very senior) in the model, and a decreed amount equal to 0 cfs. In other words, this structure is not used but was retained for future scenarios.

Several diversions for municipal and industrial use are modeled explicitly in the Upper Colorado River Model. These explicitly modeled municipal diversions include the Town of Breckenridge, Town of Keystone, Dillon Valley Water and Sanitation District, Town of Dillon, Town of Vail, Upper Eagle Valley Water Authority, Town of Eagle, Town of Rifle, City of Glenwood Springs, Town of Snowmass, City of Aspen, Town of Carbondale, City of Grand Junction, Town of Palisade, and the Ute Water Conservancy District. Five industrial diversions for power generation and mining are explicitly modeled including Molina Power Plant, Shoshone Power Plant (a.k.a. the Glenwood Power Canal), Redlands Power Canal, Climax Mine and Mill, and Henderson Mine.

Where to find more information

- Appendix B includes a memorandum describing the task in which municipal and industrial uses were aggregated.

4.2.2. Reservoirs

4.2.2.1 Key Reservoirs

Reservoirs with decreed capacities equal to or in excess of 4,000 acre-feet are considered key reservoirs, and are explicitly modeled. There are 18 key reservoirs with a combined total capacity of approximately 1,370,000 acre-feet, or 94 percent of the total modeled storage capacity of the basin. Two reservoirs with capacity of less than 4,000 acre-feet are included in the 18 key reservoirs and are explicitly modeled because they are key components in operational systems.

Two additional reservoirs were added as placeholders for future modeling efforts. Wolcott reservoir has not been constructed but has the potential to significantly impact basin operations and is likely to be analyzed in future “what-if” scenarios. Eagle Park reservoir is a small reservoir on the Eagle River used for augmentation.

4.2.2.2 Aggregation of Reservoirs

In keeping with CDSS’s objective of representing all consumptive use in the basin, the evaporation losses associated with small reservoirs and stock ponds were incorporated using 10 aggregated reservoir structures and 1 aggregated stock pond structure. Each aggregated reservoir and stock pond was assigned one account and an initial storage equal to its capacity. Surface area for the reservoirs was developed assuming they are straight-sided pits with a depth of 25 feet, based on available dam safety records.

Ten structures were used to represent the adjudicated, absolute storage rights in the database that are otherwise unaccounted for. Table 4.1 below summarizes storage capacity for the ten aggregated reservoirs.

Table 4.1
Aggregated Reservoirs

ID	WD	Name	Capacity (AF)	%
36_ARC001	36	36_ARC001	8,702	10
37_ARC002	37	37_ARC002	6,671	8
38_ARC003	38	38_ARC003	13,074	15
39_ARC004	39	39_ARC004	2,236	2
45_ARC005	45	45_ARC005	2,054	2
50_ARC006	50	50_ARC006	11,481	13
51_ARC007	51	51_ARC007	8,480	10
52_ARC008	52	52_ARC008	821	1
53_ARC009	53	53_ARC009	8,389	10
72_ARC010	72	72_ARC010	25,664	29
Total			**87,572**	**100**

The one remaining reservoir represents stock pond use, as documented in CDSS Task 2.09-10 Memorandum "Non-Irrigation (Other Uses) Consumptive Uses and Losses in the Upper Colorado River Basin". The total storage was aggregated into one stock pond as shown in Table 4.2.

Table 4.2
Aggregated Stock Ponds

ID	WD	Name	Capacity (AF)	%
72_ASC001	72	72_ASC001	2,261	100
Total			**2,261**	**100**

The aggregated reservoirs and stock pond do not release to the river in the model. However, they evaporate and fill to replace the evaporated amount. The effects of small reservoirs filling and releasing are left "in the gage" in the model, and are reflected in CDSS baseflow computations. The aggregated reservoirs are assigned storage rights with a priority of 1.0 (very senior) so that the evaporation use is not constrained by water rights.

Where to find more information

- Appendix B includes a memo describing the task in which small reservoir and stock ponds use was aggregated.

4.2.3. Instream Flow Structures

The model includes 131 instream flow reaches representing instream flow rights held by CWCB, minimum reservoir release agreements, filings by the U.S. Department of the Interior, and recreational instream channel diversions. These are a subset of the total CWCB tabulation of rights because many instream flow decrees are for stream reaches very high in the basin, above the model network.

4.3 Modeling Period

The Upper Colorado River Model data set extends from 1909 through 2013 and operates on USGS water year (October 1 through September 30). The calibration period was 1975 through 2013, a period selected because historical diversion data were readily available in electronic format for key structures. In addition, the period reflects most recent operations in the basin, and includes both drought (1977, 1989-1992, 2000-2007) and wet cycles (1983-1985, 2011).

As one goes back in time within the data set, more and more data are estimated. Before extending the data set, a feasibility study was done which included a survey of available data and methods for data extension. The scope of the study included all five West Slope planning models.

Where to find more information

- The feasibility study for the data extension is documented in two task memos, which are available at the CDSS website:

  - Phase IIIb Task Memo 10.1 Data Extension Feasibility

  - Phase IIIb Task Memo 10.2 Evaluate Extension of Historical Data

4.4 Data Filling

In order to extend the data set to 1909, a substantial amount of reservoir content, diversion, demand, and baseflow time series data needed to be estimated. In many areas of the Upper Colorado River basin, HydroBase data begins in 1975, although for some structures there is additional, earlier historical data. Therefore, major structures were selected for additional investigation outside the database, or outside the standard CDSS data tables in the case of reservoir contents. CDSS tools were then developed to automate the estimation process for the remaining structures. This section describes data filling and extension for the Upper Colorado River Model.

4.4.1. Historical Data Extension for Major Structures

4.4.1.1 Historical Diversions

Thirteen major diversions in the Upper Colorado River basin were identified as warranting additional investigation to find actual diversion records prior to 1975, as shown in Table 4.3. Most of the structures had diversion records stored in HydroBase from November 1974 through the current year. Available records prior to 1975 were digitized from SEO, Denver Water, and USBR records to complete historical diversions

Table 4.3
Investigated and Extended Major Structures

WDID	Name	Average Annual Diversions from 1909 – 2013 (acre-feet)
4200541	Redlands Power Canal	423,603
4200541_I	Redlands Irrigation Canal	27,224
7200646	Grand Valley Project – Roller Dam	758,573
5104655	Meadow Creek Reservoir Releases to Moffat Tunnel	217
5104634	Alva B. Adams Tunnel	136,188
5104603	Gumlick Tunnel	2,163
5101310	Vasquez Diversions	11,279
5101309	St. Louis Diversions	5,277
5101269	Denver Water Ranch Creek Diversions	4,646
5100958	Willow Creek Feeder	26,820
5100728	Englewood Ranch Creek Diversions	1,456
5100639	Jim Creek Diversions	10,053
5100529	Big Lake Ditch	25,135
3800757	Home Supply Ditch	16,955

4.4.1.2 Historical Reservoir Contents

Historical reservoir content data is not complete in HydroBase. Therefore, some historical information for the major reservoirs was collected from several sources, including the U.S.

Bureau of Reclamation and reservoir owners and operators. It was necessary to include data from sources other than HydroBase for some of the explicitly modeled reservoirs.

4.4.2. Automated Time Series Filling

An automated procedure was adopted to fill time series (i.e., historical diversions, demand, historical reservoir contents, reservoir targets, and irrigation water requirement) input to the model. It is a refinement over using an overall monthly average as the estimated value. Each month of the modeling period was categorized as an Average, Wet, or Dry month based on the gage flow at long-term “indicator” gages in the Upper Colorado River basin. A data point missing for a Wet March, for example, was filled with the average of other Wet Marches in the partial time series, rather than all Marches.

The process of developing the Average, Wet, and Dry designation for each month is referred to as “streamflow characterization”. There are five streamflow characterizations in the Upper Colorado River basin, based on five indicator gages:

- 09034500 - Colorado River at Hot Sulphur Springs, CO
- 09037500 - Williams Fork River Near Parshall, CO
- 09085000 - Roaring Fork River at Glenwood Springs
- 09095500 - Colorado River Near Cameo
- 09152500 - Gunnison River Near Grand Junction

The characterization for the Hot Sulphur Springs gage is used when filling in time series for structures in Districts 50 and portions of 51. The Williams Fork gage characterization pertains to District 36 and portions of 51. The Roaring Fork gage characterization pertains to Districts 37, 38, 39, 52, and 53. The Cameo gage characterization pertains to Districts 45, 70, and 72. The Gunnison gage characterization pertains to District 42.

Months with gage flows at or below the 25^{th} percentile for that month are characterized as “Dry”, while months at or above the 75^{th} percentile are characterized as “Wet”, and months with flows in the middle are characterized as “Average”.

- When historical diversion records are filled, a constraint is added to the estimation procedure. The estimated diversion may not exceed the water rights that were available to the diversion at the time. For example, if a ditch was enlarged and a junior right added to it in the 1950s, then a diversion estimate for 1935 cannot exceed the amount of the original right. The date of first use is derived from the administration number of the water right, which reflects the appropriation date.

- Crop irrigation water requirements for each diversion are calculated for the period 1975 through the current year, based on historical climate data and current irrigated acreage and crop type. Irrigation water requirements are filled back to 1909 using the wet/dry/average approach adopted for historical diversion.

Where to find more information

- A proof-of-concept effort with respect to the automated data filling process produced the following task memos, which are available at the CDSS website:

  - Phase IIIb Task Memo 10.1 Data Extension Feasibility

  - Phase IIIb Task Memo 10.2 Evaluate Extension of Historical Data

  - Phase IIIb Task Memo 11.5 Characterize Streamflow Data

  - Phase IIIb Task Memo 11.7 Verify Diversion Estimates

  These memos describe rationale for the data-filling approach, explore availability of basic gage data, explain the streamflow characterization procedure, and provide validation of the methods.

- TSTool documentation describes the SetPatternFile() command, which categorizes months as Average, Wet, or Dry.
- TSTool and StateDMI documentation describes how to invoke the automated data filling procedure using those DMI's.

4.4.3. Baseflow Filling

A typical approach to filling missing hydrologic sequences in the process of basin modeling is to develop regression models between historical stream gages. The best fitting model is then applied to estimate missing data points in the dependent gage's record. Once gage flow time series are complete, observed or estimated diversions, changes in storage, and so forth are added to or subtracted from the gage value to produce an estimated naturalized flow or baseflow.

The typical approach was deemed inadequate for a study period that extended over decades and greatly changed operating environments. Gage relationships derived from late-century gage records probably are not applicable to much earlier conditions, because the later gages reflect water use that may not have occurred at the earlier time. The CDSS approach is therefore to estimate baseflows at points where actual gage records are available, and then correlate between naturalized flows, as permitted by availability of data. Ideally, since baseflows do not reflect human activity, the relationship between two sets of baseflows is independent of the resource use and can be applied to any period.

Baseflow filling is carried out more or less automatically using the USGS Mixed Station Model, enhanced for this application under the CDSS project. The name refers to its ability to fill many series, using data from available stations. Many independent stations can be used to fill one time series, but only one station is used to fill each individual missing value. The Mixed Station Model fits each combination of dependent and independent variable with a linear regression relationship on log-transformed values, using the common period of record. For each point to be filled, the model then selects the regression that yields the least standard error of prediction (SEP), among eligible correlations. Note that TSTool is being enhanced to include the functionality of the Mixed Station Model for use with future modeling updates.

The further one goes back in time, the fewer gage records exist to create baseflow series that can serve as independent variables. In 1920, there were 9 gages in the Upper Colorado River basin that have enough continuity in records to be used in the modeling effort. By 1950, the number of gages used in the model with data increased to 38. Approximately 58 percent of the gage site baseflows are filled.

Where to find more information

- The task memorandum documenting application of the Mixed Station Model to CDSS baseflows is entitled "Subtask 11.10 Fill Missing Baseflows" (*Appendix E.8*) and is available at the CDSS website. It describes a sensitivity investigation of the use of historical gage data in lieu of baseflow estimates when the latter is unavailable.

4.5 Consumptive Use and Return Flow Amounts

The related values, consumptive use and return flow, are key components of both baseflow estimation and simulation in water resources modeling. StateMod's baseflow estimating equation includes a term for return flows. Imports and reservoir releases aside, water that was in the gage historically is either natural runoff or delayed return flow. To estimate the natural runoff, or more generally, the baseflow, one must estimate return flow. During simulation, return flows affect availability of water in the stream in both the month of the diversion and subsequent months.

For non-irrigation uses, consumptive use is the depletive portion of a diversion, the amount that is taken from the stream and removed from the hydrologic system by virtue of the beneficial use. The difference between the diversion and the consumptive use constitutes the return flow to the stream.

For irrigation uses, the relationship between crop consumptive use and return flow is complicated by interactions with the water supply stored in the soil, i.e., the soil moisture reservoir, and losses not attributable to crop use. This is explained in greater detail below.

4.5.1. Variable Efficiency of Irrigation Use

Generally, the efficiency of irrigation structures in the Upper Colorado River Model is allowed to vary through time, up to a specified maximum efficiency. Setting aside soil moisture dynamics for the moment, the predetermined crop irrigation water requirement is met out of the simulated headgate diversion, and efficiency (the ratio of consumed water to diverted water) falls where it may – up to the specified maximum efficiency. If the diversion is too small to meet the irrigation requirement at the maximum efficiency, maximum efficiency becomes the controlling parameter. Crop consumption is limited to the diverted amount multiplied by maximum efficiency, and the balance of the diversion, less 3 percent of the non-consumed water, returns to the stream.

The model is supplied with time series of irrigation water requirements for each structure, based on its crop type and irrigated acreage. This information can be generated using the CDSS StateCU model. Maximum efficiency is also input to the model. For the Upper Colorado River basin, maximum efficiency is estimated to be 54 percent.

Headgate diversion is determined by the model, and is calculated in each time step as the minimum of 1) the water right, 2) available supply, 3) diversion capacity, and 4) headgate demand. Headgate demand is input as a time series for each structure. During calibration, headgate demand for each structure is simply its historical diversion time series. In the Baseline data set, headgate demand is set to the irrigation water requirement for the specific time step and structure, divided by the historical efficiency for that month of the year. Historical efficiency is defined as the smaller of 1) average historical diversion for the month, divided by average irrigation water requirement, and 2) maximum efficiency. In other words, if water supply is generally plentiful, the headgate demand reflects the water supply that has been typical in the past; and if water supply is generally limiting, it reflects the supply the crop needs in order to satisfy potential ET at the maximum efficiency.

StateMod also accounts for water supply available to the crop from the soil. Soil moisture capacity acts as a small reservoir, re-timing physical consumption of the water, and affecting the amount of return flow in any given month. Soil moisture capacity is input to the model for each irrigation structure, based on NRCS mapping. Formally, StateMod accounts for water supply to the crop as follows:

Let **DIV** be defined as the river diversion, $\boldsymbol{\eta_{max}}$ be defined as the maximum system efficiency, and let $\mathbf{CU_i}$ be defined as the crop irrigation water requirement.

Then, $SW = DIV * \eta_{max}$; (Max available water to crop)

when $SW \geq CU_i$: (Available water to crop is sufficient to meet crop demand)

$CU_w = CU_i$ (Water supply-limited CU = Crop irrigation water requirement)

$SS_f = SS_i + \min[(SS_m-SS_i),(SW-CU_w)]$ (Excess available water fills soil reservoir)

$SR = DIV - CU_w - (SS_f-SS_i)$ (Remaining diversion is “non-consumed)

$TR = 0.97 * SR$ (Non-consumed less incidental loss is total return flow)

when $SW < CU_i$: (Available water to Crop is not sufficient to meet crop demand)

$CU_w = SW + \min[(CU_i - SW), SS_i]$ (Water supply-limited CU = available water to crop + available soil storage)

$SS_f = SS_i - \min[(CU_i - SW), SS_i]$ (Soil storage used to meet unsatisfied crop demand)

$SR = DIV - SW$ (Remaining diversion is "non-consumed)

$TR = 0.97 * SR$ (Non-consumed less incidental loss is total return flow)

where **SW** is maximum water available to meet crop demand

CU_w is water supply limited consumptive use;

SS_m is the maximum soil moisture reservoir storage;

SS_i is the initial soil moisture reservoir storage;

SS_f is the final soil moisture reservoir storage;

SR is the diverted water in excess of crop requirement (non-consumed water);

TR is the total return to the stream attributable to this month's diversion.

For the following example, the maximum system efficiency is 60 percent; therefore, a maximum of 60 percent of the diverted amount can be delivered and available to the crop. When this amount exceeds the irrigation water requirement, the balance goes to the soil moisture reservoir, up to its capacity. Additional non-consumed water returns to the stream, subject to 3 percent incidental loss. In this case, the crop needs are completely satisfied, and the water supply-limited consumptive use equals the irrigation water requirement.

When 60 percent of the diverted amount (the water delivered and available to meet crop demands) is less than the irrigation water requirement, the crop pulls water out of soil moisture storage, limited by the available soil moisture and the unsatisfied irrigation water requirement. Water supply-limited consumptive use is the sum of diverted water available to the crop and supply taken from soil moisture, and may be less than the crop water requirement. Total return flow is the 40 percent of the diversion deemed unable to reach the field (non-consumed), less 3 percent incidental loss.

With respect to consumptive use and return flow, aggregated irrigation structures are treated as described above, where the irrigation water requirement is based on total acreage for the aggregate.

4.5.2. Constant Efficiency for Other Uses and Special Cases

In specific cases, the Upper Colorado River Model applies an assumed, specified annual or monthly efficiency to a diversion in order to determine consumptive use and return flows. Although the efficiency may vary by month, the monthly pattern is the same in each simulation year. This approach is applied to municipal, industrial, transbasin users, and reservoir feeder canals. It can also apply to irrigation diversions for which irrigation water requirement has not been developed.

In the Upper Colorado River Model, irrigation water requirements were developed for irrigation diversions. The transbasin and industrial diversions in the Upper Colorado River Model were assigned a diversion efficiency of 1.00 in all months. During both baseflow estimation and simulation, the entire amount of the diversion is estimated to be removed from the hydrologic system. Diversions for the use of hydroelectric power generation were assigned a diversion efficiency of zero in all months. The explicitly modeled municipal systems were assigned monthly efficiencies representing municipal consumptive use patterns. The one aggregated municipal demand, used as a placeholder for future scenarios, was modeled using zero demand and efficiencies set to 0.60 in all months.

Reservoir feeders and other carriers that do not irrigate lands were assigned a diversion efficiency of zero in all months, reflecting that 100 percent of the diversions "return" to the reservoirs or other locations. These feeders include the following:

- Elliott Creek Feeder Canal
- Missouri Tunnel
- Wolcott Pumping Pipeline
- West Three Mile Ditch
- Grass Valley Canal
- Silt Pump Canal
- Willow Creek Feeder Canal
- Windy Gap Pumping Plant Canal
- Bonham Branch Pipeline
- Cottonwood Branch Pipeline
- Leon Park Feeder Canal
- Park Creek Diversion System
- Southside Canal
- Grand Valley Project
- Orchard Mesa Check
- OMID Bypass
- Owens Creek Ditch

Where to find more information

- StateCU documentation describes different methods for estimating irrigation water requirement for structures, for input to the StateMod model.
- Section 7 of the StateMod documentation has subsections that describe “Variable Efficiency Considerations” and “Soil Moisture Accounting”
- Section 5 of this manual describes the input files where the parameters for computing consumptive use and return flow amounts are specified:
  - Irrigation water requirement in the Irrigation Water Requirement file (Section 5.5.3)
  - Headgate demand in the Direct Diversion Demand file (Section 5.4.4)
  - Historical efficiency in the Direct Diversion Station file (Section 5.4.1)
  - Maximum efficiency in the CU Irrigation Parameter Yearly file (Section 5.5.2)
  - Soil moisture capacity in the StateCU Structure file (Section 5.5.1)
  - Loss to the hydrologic system in the Return Flow Delay Table file (Section 5.4.2)

4.6 Return Flows

4.6.1. Return Flow Timing

Return flow timing is specified to the model as the percentage of the return flow accruing from a diversion reaching the stream in the same month as the diversion, and in each month following the diversion month. Four different return flow patterns are used in the Gunnison Model. One represents instantaneous (or within the same month as the diversion) returns and is applied to municipal and non-consumptive diversions. A second pattern places 100 percent of the diversion return in the fourth month following the diversion. This pattern is used for returns from artificial snowmaking.

The last two patterns are generalized irrigation return patterns, applicable to irrigated lands “close” to the stream (center of acreage is approximately 600 feet from the stream), and “further” from the stream (center of acreage is approximately 1500 feet from the stream). The two patterns were developed using the Glover analytical solution for parallel drain systems. The State’s Analytical Steam Depletion Model (September, 1978), which is widely used in determining return flows for water rights transfers and augmentation plans, permits this option for determining accretion factors.

The Glover analysis requires these input parameters:

T = Transmissivity in gallons per day per foot (gpd/ft). Transmissivity is the product of hydraulic conductivity (K) in feet per day, saturated thickness (b) in feet, and the appropriate conversion factor.

S = Specific Yield as a fraction

W = Distance from stream to impervious boundary in feet (ft)

x = Distance from point of recharge to stream in feet (ft)

Q = Recharge Rate in gallons per minute (gpm)

Regionalized values for the aquifer parameters were determined by selecting ten representative sites throughout the west slope, based partly on the ready availability of geologic data, and averaging them. The analysis estimated generalized transmissivity as 48,250 gpd/ft, specific yield as 0.13, and distance from the stream to the alluvial boundary as 3,500 ft. The Glover analysis was then executed for both 600 feet from the recharge center to the stream, and 1500 feet from the recharge center to the stream.

It was assumed that the resulting pattern applies to only half of the return flow, and that the other half returns within the month via the surface (tailwater returns, headgate losses, etc.). Combining surface water returns with groundwater returns resulted in the two irrigation return patterns shown in Table 4.4 and graphed in Figure 4.1**.** Month 1 is the month in which the diversion takes place. Note that the patterns shown reflect 100 percent of unused water returning to the river, both from surface runoff and subsurface flow. For each CDSS basin, the first month's return flow percent will be reduced to recognize incidental loss. As discussed above, incidental losses in the Gunnison Model are estimated to be 3 percent of unused water.

Where to find more information

- CDSS Memorandum "Upper Colorado River Basin Representative Irrigation Return Flow Patterns", Leonard Rice Engineers, January, 2003 in the CDSS Technical Papers

4.6.2. Return Flow Locations

Return flow locations were determined during the original data gathering, by examining irrigated lands mapping and USGS topographical maps, and confirming locations with Division 5 personnel. Some return flow locations were modified during calibration.

Table 4.4
Percent of Return Flow Entering Stream in Month n after Diversion

Month *n*	For Lands "Close" to Stream (%)	For lands "Further" from Stream (%)
1	75.6	57.4
2	11.3	14.5
3	3.2	7.2
4	2.2	5.0
5	1.6	3.7
6	1.2	2.7
7	0.8	2.0
8	0.6	1.5
9	0.5	1.1
10	0	0.8
11	0	0.6
12	0	0.5
13 - 14	0	0
15 - 36	0	0
Total	97	97

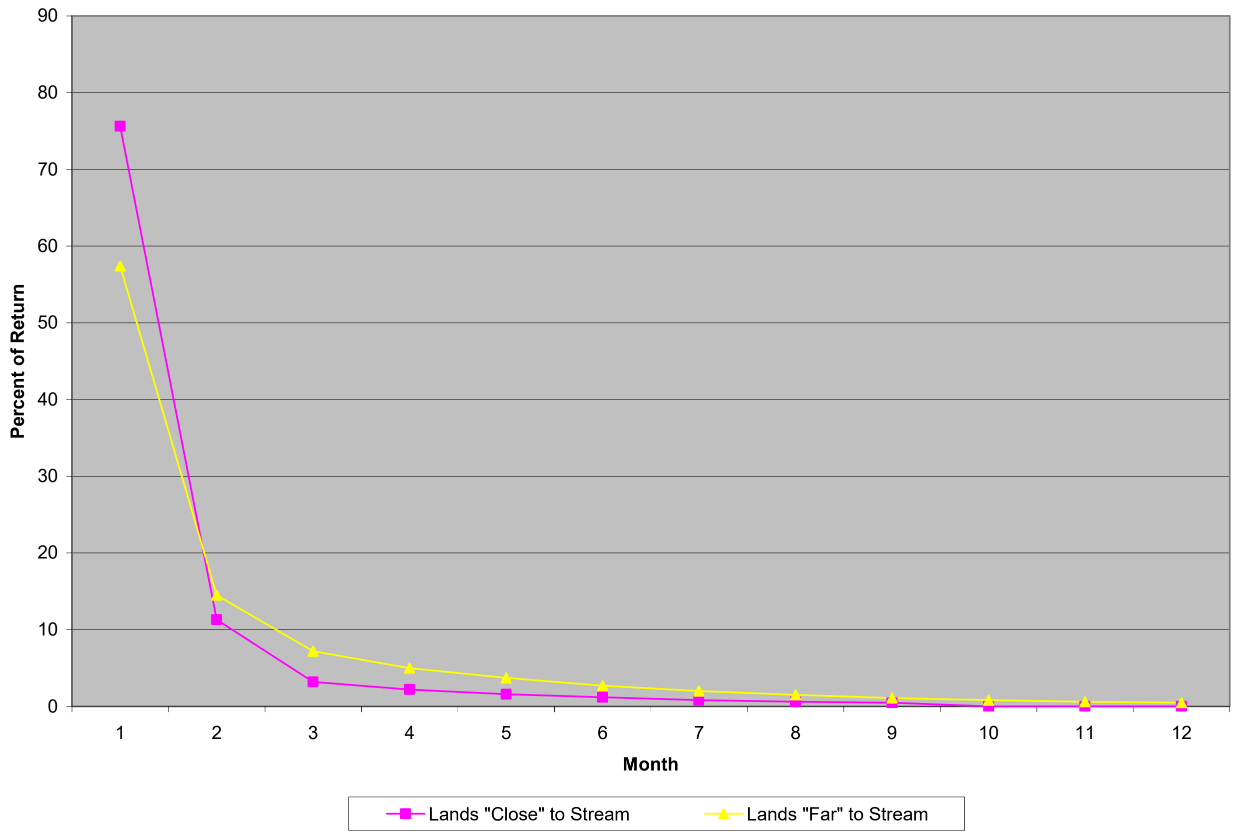


Figure 4.1 - Percent of Return in Months After Division

4.7 Baseflow Estimation

In order to simulate river basin operations, the model must have the amount of water that would have been in the stream if none of the operations being modeled had taken place. These undepleted flows are called “baseflows”. The term is used in favor of “virgin flow” or “naturalized flow” because it recognizes that some historical operations can be left “in the gage”, with the estimation that those operations and impacts will not change in the hypothetical situation being simulated.

Given data on historical depletions and reservoir operations, StateMod can estimate baseflow time series at specified discrete inflow nodes. This process was executed prior to executing simulations, and the resulting baseflow file became part of the input data set for subsequent simulations. Baseflow estimation requires three steps: 1) adjust USGS stream gage flows using historical records of operations to get baseflow time series at gaged points, for the gage period of record; 2) fill the baseflow time series by regression against other baseflow time series; 3) distribute baseflow gains above and between gages to user-specified, ungaged inflow nodes. These three steps are described below.

4.7.1. Baseflow Computations at Gages

Baseflow at a site where historical gage data is available is computed by adding historical values of all upstream depletive effects to the gaged value, and subtracting historical values of all upstream augmenting effects from the gaged value:

$$Q_{baseflow} = Q_{gage} + Diversions - Returns - Imports +/- \Delta Storage + Evap$$

Historical diversions, imports, and reservoir contents are provided directly to StateMod to make this computation. Evaporation is computed by StateMod based on historical evaporation rates and reservoir contents. Return flows are computed based on diversions, crop water requirements, and/or efficiencies as described in Section 4.5, and return flow parameters as described in Section 4.6.

Where to find more information

- When StateMod is executed to estimate baseflows at gages, it creates a Baseflow Information file *(*.xbi*) that shows this computation for each gage and each month of the time step.

4.7.2. Baseflow Filling

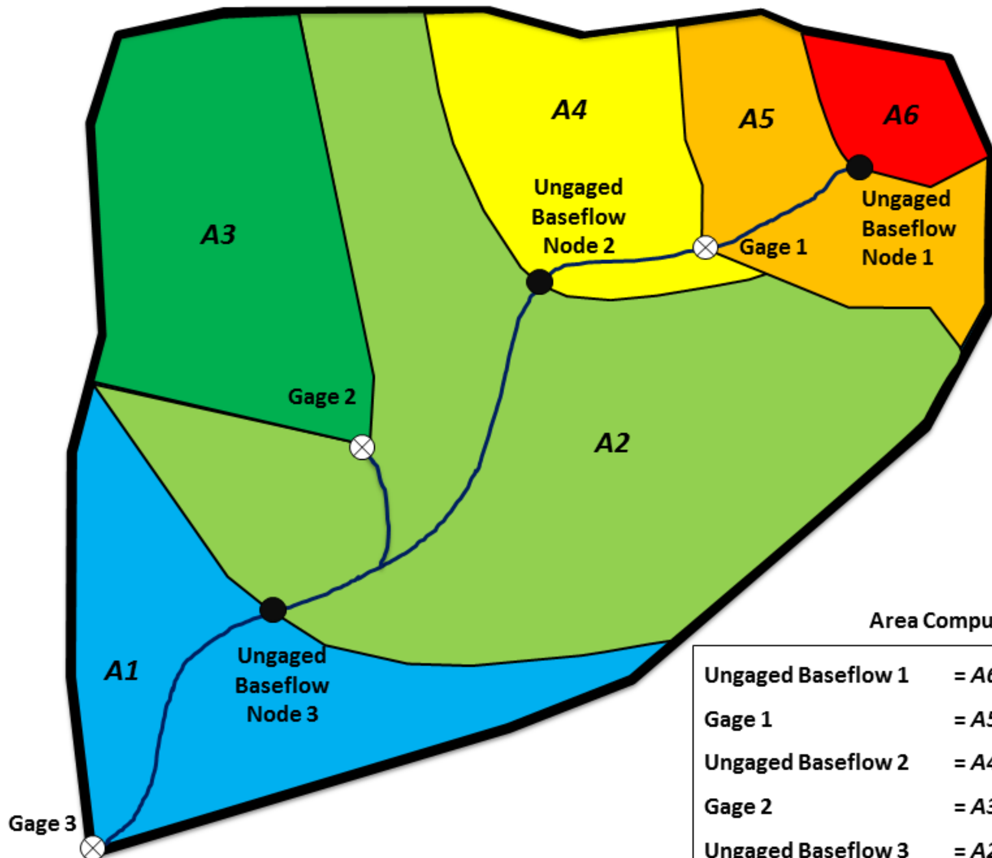
Wherever gage records are missing, baseflows are estimated as described in Section 4.4.3-Baseflow Filling.

4.7.3. Distribution of Baseflow to Ungaged Points

In order for StateMod to have flow on tributary headwaters, baseflow must be estimated at all ungaged headwater nodes. In addition, gains between gages are modeled as entering the system at locations to reflect increased flow due to unmodeled tributaries. Most key reservoirs were represented as baseflow nodes in order for the model to "see" all available water supply at the site. During calibration, other baseflow nodes were added to better simulate a water supply that would support historical operations.

StateMod has an operating mode that distributes a portion of baseflows at gaged locations to ungaged locations based on drainage area and average annual precipitation. The default method is the "gain approach". In this approach, StateMod pro-rates baseflow gain above or between gages to ungaged locations using the product of drainage area and average annual precipitation.

Figure 4.2 illustrates a hypothetical basin and the areas associated with three gages and three ungaged baseflow nodes.support historical operations.



Area Computation

Ungaged Baseflow 1	= A6
Gage 1	= A5 + A6
Ungaged Baseflow 2	= A4
Gage 2	= A3
Ungaged Baseflow 3	= A2 + A4
Gage 3	= A1+ A2+ A3+ A4+ A5+ A6

Figure 4.2 Hypothetical Basin Illustration

The area associated with gages is the total upstream area. The area associated with ungaged nodes only includes the incremental area from the ungaged location to the next upstream gage or gages. For example, Gage 3 area includes the entire basin. Ungaged Baseflow Node 3 area (light green) includes the upstream area between the Ungaged Baseflow Node 3 and Gage 2 and Gage 1.

In Figure 4.2, there are three ungaged baseflow nodes; the StateMod "gain approach" computes the total baseflow at each ungaged node based on the following:

The baseflow gain distributed to Ungaged Baseflow Node 1 is the baseflow gain above Gage 1 pro-rated on the A*P terms.

$$Gain_{ungaged,1} = \left(\frac{(A*P)_{ungaged,1}}{(A*P)_{gage,1}}\right)(BF_{gage,1})$$

Total baseflow at Ungaged Node 1 is equal to the $Gain_{ungaged,1}$ term.

The baseflow gain distributed to Ungaged Baseflow Node 2 is the baseflow gain between Gage 1, 2, and 3 pro-rated on the A*P terms.

$$Gain_{ungaged,2} = \left(\frac{(A*P)_{ungaged,2}}{(A*P)_{gage,3} - (A*P)_{gage,2} - (A*P)_{gage,1}}\right)(BF_{gage,3} - BF_{gage,2} - BF_{gage,1})$$

Total baseflow at Ungaged Node 2 is equal to the $Gain_{ungaged,2}$ term plus the baseflow at Gage 1.

$$BF_{ungaged,2} = Gain_{ungaged,2} + BF_{gage,1}$$

Ungaged Baseflow Node 3 calculations are very similar. The baseflow gain distributed to Ungaged Baseflow Node 3 is the baseflow gain between Gage 1, 2, and 3 pro-rated on the A*P term.

$$Gain_{ungaged,3} = \left(\frac{(A*P)_{ungaged,3}}{(A*P)_{gage,3} - (A*P)_{gage,2} - (A*P)_{gage,1}}\right)(BF_{gage,3} - BF_{gage,2} - BF_{gage,1})$$

Total baseflow at Ungaged Node 3 is equal to the $Gain_{ungaged,3}$ term plus baseflow at Gage 1 and Gage 2.

$$BF_{ungaged,3} = Gain_{ungaged,3} + BF_{gage,1} + BF_{gage,2}$$

A second option for estimating headwater baseflows can be used if the default “gain approach” method created results that do not seem credible. This method, referred to as the “neighboring gage approach”, creates a baseflow time series by multiplying the baseflows at a specified gage by the ratio $(A*P)_{headwater}/(A*P)_{gage}$. This approach is effective when the runoff at an ungaged location does not follow the same pattern as the gains along the main stem. For example, a small ungaged tributary that peaks much earlier or later than the main stem should use the neighboring gage approach with a streamgage in a similar watershed. The user is responsible for ensuring that the overall reach water balance is maintained when using the neighboring gage approach.

Where to find more information

- The **StateDMI** documentation in section 5.10 “Stream Estimate Data” for describes computation of baseflow distribution parameters based on A*P, incremental A*P, and the network configuration.

4.8 Calibration Approach

Calibration is the process of simulating the river basin under historical conditions, and judiciously adjusting parameter estimates to achieve agreement between observed and simulated values of streamflow gages, reservoir levels, and diversions. The Upper Colorado River Model was calibrated in a two-step process described below. The issues encountered and results obtained are described in Section 7.

4.8.1. First Step Calibration

In the first calibration run, the model was executed with relatively little freedom with respect to operating rules. Headgate demand was simulated by historical diversions, and historical reservoir contents served as operational targets. The reservoirs would not fill beyond the historical content even if water was legally and physically available. Operating rules caused the reservoir to release to satisfy beneficiaries' demands, but if simulated reservoir content was higher than historical after all demand was satisfied, the reservoir released water to the river to achieve the historical end-of-month content. In addition, multiple-headgate collection systems would feature the historical diversion as the demand at each diversion point.

The objective of the first calibration run was to refine baseflow hydrology and return flow locations before introducing uncertainties related to rule-based operations. Diversion shortages, that is, the inability of a water right to divert what it diverted historically, indicated possible problems with the way baseflows were represented or with the location assigned to return flows back to the river. Baseflow issues were also evidenced by poor simulation of the historical gages. Generally, the parameters that were adjusted related to the distribution of baseflows (i.e., A*P parameters or the method for distributing baseflows to ungaged locations), and locations of return flows.

4.8.2. Second Step Calibration

In the second calibration run, constraints on reservoir operations were relaxed. As in the first calibration run, reservoirs were simulated for the period in which they were on-line historically. Reservoir storage was limited by water right and availability, and generally, reservoir releases were controlled by downstream demands. Exceptions were made for reservoirs known to operate by power or flood control curves, or other unmodeled considerations. In these cases, targets were developed to express the operation. For multi-structures in the Upper Colorado River Model, the centralized demand was placed at the final destination nodes, and priorities and legal availability govern diversions from the various headgates.

The objective of the second calibration step was to refine operational parameters. For example, poor calibration at a reservoir might indicate poor representation of administration or operating objectives. Calibration was evaluated by comparing simulated gage flows, reservoir contents, and diversions with historical observations of these parameters.

Where to find more information

- Section 7 of this document describes calibration of the Upper Colorado River Model.

4.8.3. Baseline Data Set

The Baseline data set is intended as a generic representation of recent conditions on the Upper Colorado Rivers, to be used for “what if” analyses. It represents one interpretation of current use, operating, and administrative conditions, as though they prevailed throughout the modeling period. Existing water resources systems are online and operational in the model from 1909 forward, as are junior rights and modern levels of demand. The data set is a starting point, which the user may choose to add to or adapt for a given application or interpretation of probable demands and near-term conditions. A particular example for scenario comparison would be the administration of the Blue River Decree. The Baseline data set models the Interim Agreement, other administration interpretations of the Blue River Decree could be developed and compared against current operations.

4.8.4. Calculated Irrigation Demand

In the Baseline data set, irrigation demand is set to a time series determined from crop irrigation water requirement and average irrigation efficiency for the structure. This “Calculated Demand” is an estimate of the amount of water the structure would have been diverted absent physical or legal availability constraints. Thus if more water was to become available to the diverter under a proposed new regime, the model would show the irrigator with sufficient water rights diverting more than he did historically.

Calculated demands must account for both crop needs and irrigation practices. Monthly calculated demand for 1950 through 2013 is generated directly, by taking the maximum of crop irrigation water requirement divided by average monthly irrigation efficiency, and historical diversions. The irrigation efficiency may not exceed the defined maximum efficiency. Thus Calculated demand for a perennially shorted diversion will be greater than the historical diversion for at least some months. By estimating demand to be the maximum of calculated demand and historical diversions, such irrigation practices as diverting to fill the soil moisture zone or diverting for stock watering can be mimicked more accurately.

Prior to 1950, calculated demands were filled using the automated time series filling technique described in Section 4.4.2.

4.8.5. Municipal and Industrial Demand

Municipal and industrial demands were set to recent values or averages of recent records.

4.8.6. Transbasin and Transmountain Demands

Transmountain diversion demands for the Moffat System and Roberts Tunnel, representing current conditions over the 1950 through 2013 hydrologic modeling period, were provided by Denver Water Board. Transmountain diversion demands for Adams Tunnel and the Windy Gap Project representing current conditions over the 1950 through 2013 hydrologic modeling period were provided by Northern Colorado Water Conservancy District. Con-Hoosier transmountain diversion demands, representing current conditions over the 1950 through 2013 hydrologic modeling period, were provided by Colorado Springs. Demands for the period 1909 through 1949 were set to historical average monthly demands based on the provided data.

Other transbasin diversion demands used primarily for municipal purposes were set to historical average monthly diversions over the period 1998 through 2013 for the entire model period of 1909 through 2013. Transbasin diversion irrigation demands were filled from 1909 through 1974 and 1997 through 2013 using the “wet,” “dry,” and “average” patterns and previous baseline demands for the period 1975 through 1996.

4.8.7. Reservoirs

Reservoirs are represented as being on-line throughout the study period, at their current capacities. Initial reservoir contents were set to average end-of-month contents over the period of record. During simulation, StateMod allows reservoir releases to satisfy unmet headgate demand, based on the reservoir being a supplemental supply to direct flow rights.

5. Baseline Dataset

This section describes each StateMod input file in the Baseline Dataset. The dataset is expected to be a starting point for users who want to apply the Upper Colorado River water resources planning model to a particular management issue. Typically, the investigator wants to understand how the river regime would change under a new use or different operations. The change needs to be quantified relative to how the river would look today absent the new use or different operation, which may be quite different from the historical record. The Baseline dataset provides a basis against which to compare future scenarios. Users may opt to modify the Baseline dataset for their own interpretation of current or near-future conditions. For instance, they may want to look at the effect of conditional water rights on available flow. The following detailed, file-by-file description is intended to provide enough detail that this can be done with confidence.

This section is divided into several subsections:

- Section 5.1 describes the response file, which lists names of the rest of the data files. The section tells briefly what is contained in each of the named files, so refer to it if you need to know where to find specific information.

- Section 5.2 describes the control file, which sets execution parameters for the run.

- Section 5.3 includes files that together specify the river system. These files express the model network and baseflow hydrology.

- Section 5.4 includes files that define characteristics of the diversion structures in the model: physical characteristics, irrigation parameters, historical diversions, demand, and water rights.

- Section 5.5 includes files that further define irrigation parameters for diversion structures.

- Section 5.6 includes files that define characteristics of the reservoir structures in the model: physical characteristics, evaporation parameters, historical contents, operational targets, and water rights.

- Section 5.7 includes files that define characteristics of instream flow structures in the model: location, demand, and water rights.

- Section 5.8 describes the characteristics of plan structures in the model: type, efficiency, return flow location, and failure criteria. The plan structures work in conjunction with operating rules.

- Section 5.9 describes the operating rights file, which specifies operations other than simple diversions, on-stream reservoir storage, and instream flow requirements. For example, the file specifies rules for reservoir releases to downstream users, diversions by exchange, and movement of water from one reservoir to another

Where to find more information

- For generic information on every input file listed below, see the StateMod documentation. It describes how input parameters are used as well as format of the files.

5.1 Response File (*.rsp)

The response file was created by hand using a text editor, and lists other files in the dataset. StateMod reads the response file first, and then “knows” what files to open to retrieve the remainder of the input data. The list of input files was slightly different depending on whether StateMod was being run to generate baseflows or to simulate. Since the “Baseline dataset” refers to a particular simulation, the response file for the Baseline is presented first; it is followed by a description of the files used for baseflow generation.

5.1.1. For Baseline Simulation

The listing below shows the file names in *cm2015B.rsp*, describes contents of each file, and shows the subsection of this chapter where the file is described in more detail.

File Name	Description	Reference
cm2015.ctl	Control file – specifies execution parameters, such as run title, modeling period, options switches	Section 5.2
cm2015.rin	River Network file – lists every model node and specifies connectivity of network	Section 5.3.1
cm2015.ris	River Station file – lists model nodes, both gaged and ungaged, where hydrologic inflow enters the system	Section 5.3.2
cm2015.rib	Baseflow Parameter file – gives coefficients and related gage ID’s for each baseflow node, with which StateMod computes baseflow gain at the node	Section 5.3.3
cm2015.rih	Historical Streamflow file – Monthly time series of streamflows at modeled gages	Section 5.3.4
cm2015x.xbm	Baseflow Data file – time series of undepleted flows at nodes listed in cm2015.ris	Section 5.3.5
cm2015.dds	Direct Diversion Station file – contains parameters for each diversion structure in the model, such as diversion capacity, return flow characteristics, and irrigated acreage served	Section 5.4.1

File Name	Description	Reference
cm2015.dly	Delay Table file – contains several return flow patterns that express how much of the return flow accruing from diversions in one month reach the stream in each of the subsequent months, until the return is extinguished	Section 5.4.2
cm2015.ddh	Historical Diversions file – Monthly time series of historical diversions	Section 5.4.3
cm2015B.ddm	Monthly Demand file – monthly time series of headgate demands for each direct diversion structure	Section 5.4.4
cm2015.ddr	Direct Diversion Rights file – lists water rights for direct diversion	Section 5.4.5
cm2015.str	StateCU Structure file – soil moisture capacity by structure, for variable efficiency structures	Section 5.5.1
cm2015.ipy	CU Irrigation Parameter Yearly file – maximum efficiency and irrigated acreage by year and by structure, for variable efficiency structures	Section 5.5.2
cm2015B.iwr	Irrigation Water Requirement file – monthly time series of crop water requirement by structure, for variable efficiency structures	Section 5.5.3
cm2015B.res	Reservoir Station file – lists physical reservoir characteristics such as volume, area-capacity table, and some administration parameters	Section 5.6.1
cm2015.eva	Evaporation file – gives monthly rates for net evaporation from free water surface	Section 5.6.2
cm2015.eom	Reservoir End-of-Month Contents file – Monthly time series of historical reservoir contents	Section 5.6.3
cm2015B.tar	Reservoir Target file – monthly time series of maximum and minimum targets for each reservoir. A reservoir may not store above its maximum target, and may not release below the minimum target	Section 5.6.4
cm2015B.rer	Reservoir Rights file – lists storage rights for reservoirs	Section 5.6.5
cm2015.ifs	Instream Flow Station file – lists instream flow reaches	Section 5.7.1
cm2015.ifa	Instream Flow Annual Demand file – gives the decreed monthly instream flow demand rates	Section 5.7.2
cm2015B.ifm	Instream Flow Monthly Demand file – gives the decreed monthly instream flow demand rates that vary by year	Section 5.7.3
cm2015.ifr	Instream Flow Right file – gives decreed amount and administration number of instream flow rights associated with instream flow reaches	Section 5.7.4
cm2015.pln	Plan Data file – contains parameters for plan structures	Section 5.8
cm2015B.opr	Operational Rights file – specifies many different kinds of operations that were more complex than a direct diversion or an on-stream storage right. Operational rights could specify, for	Section 5.9

File Name	Description	Reference
	example, a reservoir release for delivery to a downstream diversion point, a reservoir release to allow diversion by exchange at a point which was not downstream, or a direct diversion to fill a reservoir via a feeder	

5.1.2. For Generating Baseflow

The baseflow file (*.xbm) that was part of the Baseline dataset was created by StateMod and the Mixed Station Model in three steps described in Sections 4.7. In the first step, StateMod estimated baseflows at gaged locations, using the files listed in the cm2015.rsp response file. The baseflow response file reflects historical data and uses different diversion demands, reservoir station, reservoir targets, reservoir rights, instream flow demands, irrigation water requirement, and operational rights files from the Baseline response file.

The baseflow time series created in the first run were partial series, because gage data was missing some of the time for most gages. The Mixed Station Model was used to fill the series, creating a complete series of baseflows at gages in a file named cm2015.xbf. The response file for the third step, in which StateMod distributed baseflow to ungaged points, was named cm2015x.rsp. The difference between the first-step response file (cm2015.rsp) and third-step response file (cm2015x.rsp) was that the cm2015.xbf file replaced the historical gage file cm2015.rih.

5.2 Control File (*.ctl)

The control file was hand-created using a text editor. It contains execution parameters for the model run, including the starting and ending year for the simulation, the number of entries in certain files, conversion factors, and operational switches. Many of the switches relate to either debugging output, or to integrated simulation of groundwater and surface water supply sources. The latter was developed for the Rio Grande basin and was not a feature of the Upper Colorado River Model. Control file switches are specifically described in the StateMod documentation. The simulation period parameters (starting and ending year) are the ones that users most typically adjust.

5.3 River System Files

5.3.1. River Network File (*.rin)

The river network file was created by StateDMI from the graphical network representation file created within StateDMI – StateMod Network interface (cm2015.net). The river network file describes the location and connectivity of each node in the model. Specifically, it is a list of each structure ID and name, along with the ID of the next structure downstream. It is an inherent characteristic of the network that, with the exception of the downstream terminal node, each node had exactly one downstream node.

River gage nodes are labeled with United States Geological Survey (USGS) stream gaging station numbers (i.e., 09000000). In general, diversion and reservoir structure identification numbers are composed of Water District number followed by the State Engineer's four-digit structure ID. Instream flow water rights are also identified by the Water District number followed by the assigned State Engineer's four-digit identifier. Table 5.1 shows how many nodes of each type are in the Upper Colorado River Model.

Table 5.1
River Network Elements

Type	Number
Diversion	443
Instream Flow	131
Reservoirs	36
Stream Gages*	81
Plan Structures	8
Other	107
Total	806
**4 of the gages are not streamflow gages, but are imports from the Gunnison and Yampa basins.*	

Where to find more information

- StateDMI documentation gives the file layout and format for the *.net* file.

5.3.2. River Station File (*.ris)

The river station file was created by StateDMI. It lists the model's baseflow nodes, both gaged and ungaged. These are the discrete locations where streamflow is added to the modeled system.

There are 77 gages in the model and 132 ungaged baseflow locations, for a total of 209 hydrologic inflows to the Upper Colorado River Model. Ungaged baseflow nodes include ungaged headwater nodes and other nodes where calibration revealed a need for additional baseflows. In the last case, a portion of the water that is simulated as entering the system further down (e.g., at the next gage) is moved up the system to the ungaged baseflow location.

5.3.3. Baseflow Parameter File (*.rib)

The baseflow parameter file contains an entry for each ungaged baseflow node in the model, specifying coefficients, or "proration factors", used to calculate the baseflow gain at that point. StateDMI computed proration factors based on the network structure and *area* multiplied by *precipitation* values supplied for both gages and ungaged baseflow nodes. This information is in the network file, which was input to StateDMI. Under the default "gain approach", described in Section 4.7.3, the factors reflect the ratio of the product of incremental area and local average precipitation above the ungaged point to the product of incremental area and local average precipitation for the entire gage-to-gage reach.

At some locations, the hydrograph developed using the gain approach showed an attenuated shape that was not representative of a "natural" hydrograph. This occurred in headwater areas where the hydrograph was dominated by runoff from spring snowmelt. In these situations, baseflow was determined as a function of baseflow at a nearby stream gage, specified by the user. Ideally, this "neighboring gage" was from a drainage basin with similar physiographic characteristics. Baseflow at the ungaged site was estimated to be in the same proportion to baseflow at the nearby gage as the product of area and average precipitation at the two locations. This procedure, referred to as the "neighboring gage approach", was applied to these structures:

Table 5.2
Baseflow Nodes Using the Neighboring Gage Approach

Tributary Name	Baseflow WDID	Neighboring Gage
Elliot Creek	3600645	09055300
Deep Creek	3600801	09055300
Brush Creek	3602002	09054000
Straight Creek	3600829	09047500
Snowmass Creek	3801441	09075700
Capitol Creek	3802013	09075700
Snowmass Creek	3800959	09075700
Willow Creek	3801104	09075700
West & Middle Rifle Creeks	BaseFlow	09091500
Mamm Creek	4500685	09089500
Divide Creek	4500810	09089500
Garfield Creek	4500788	09089500
Little Muddy Creek	5000601	09041200
Pass Creek	5000627	09041200
Crooked Creek	5102075	09026500
Hamilton Creek	5100728	09032000
Corral Creek	5102061	09039000
Cottonwood Creek	5200658	09060500
Sheephorn Creek	5202006	09060500
Red Dirt Creek	5300883	09060500
Lake Creek	5300632	09071300
No Name Creek	5302013	09085200

Tributary Name	Baseflow WDID	Neighboring Gage
Grizzly Creek	5301051	09085200
Grove Creek	7200649	09097500
Kimball Creek	7200580	09097500
Bull Creek	7200557	09104500
Coon Creek	09104000	09104500
Bull Creek	09101500	09104500
Big Creek	7203904AG	09097500
Rapid Creek	7200764_I	09104500

In addition, a straight proration was used when an appropriate "neighboring gage" could not be identified due to unique characteristics of a structures' drainage basin. For the structures in the following table, a percent of downstream baseflow to be applied at the structure location was directly set in StateDMI.

Table 5.3
Baseflow Nodes with Set Proration Factors

Tributary Name	Baseflow WDID	Baseflow Percent	Downstream Gage
Blue River	3604512	100 %	09050700
Columbine Ditch	3702066	20 %	09063000
Eagle River	3704648	35 %	09063000
Hunter Creek	3801594	80 %	09074000
Roaring Fork River	3804617	70 %	09073400
Bobtail Creek	5104603	80 %	09035500
Colorado River	5104055	100 %	09019500
North Fork of Derby Creek	5300555_D	18 %	09070500
Egeria Creek	5301082	100 %	09060700
Monte Cristo Creek	3604683SU	40 %	09046600

Where to find more information

- Section 4.7.3 describes how baseflows were distributed spatially.

5.3.4. Historical Streamflow File (*.rih)

Created by TSTool, the historical streamflow file contains historical gage records from 1909 through 2013, for modeled gages. This file is used in stream baseflow generation and to create comparison output that is useful during model calibration. Records were taken directly from USGS tables in the database. In most cases, missing values, when the gage was not in operation, were denoted as such, using the value "-999."

Table 5.4 lists the USGS gages used, their periods of record, and their average annual flows over the period of record. As footnoted in

Table 5.4, some missing records were filled from other sources in the historical streamflow file. Large periods of missing data are specified, however, most gages listed had days, months, or years missing within the full period.

Table 5.4
Historical Average Annual Flows for Modeled Upper Colorado River Stream Gages

Gage ID	Gage Name	Period of Record	Historical Flow (acre-feet/year)
09010500	Colorado R Below Baker Gulch, Nr Grand Lake, CO.	1954-2013	46,353
09019500	Colorado River Near Granby [1]	1909-1911 1935-2013	99,132
09021000	Willow Creek Below Willow Creek Reservoir [2]	1935-1982	20,196
09024000	Fraser River at Winter Park	1911-2013	17,659
09025000	Vasquez Creek at Winter Park, CO.	1935-2013	10,660
09026500	St. Louis Creek Near Fraser, CO.	1935-2013	18,366
09032000	Ranch Creek Near Fraser, CO.	1935-2013	10,065
09032499	Meadow Creek Reservoir Inflow [3]	1976-2013	7,662
09032500	Ranch Creek Near Tabernash, CO.	1935-1960	27,147
09033500	Strawberry Creek Near Granby, CO.	1937-1945	4,835
09034250	Colorado River at Windy Gap, Near Granby, CO.	1982-2013	186,672
09034800	Little Muddy Creek Near Parshall, CO.	1959-1965	2,140
09034900	Bobtail Creek Near Jones Pass, CO.	1966-2013	7,482
09035500	Williams Fork Below Steelman Creek, CO.	1934-1941 1966-2013	14,369
09036000	Williams Fork River Near Leal, Co	1934-2013	71,740
09037500	Williams Fork River Near Parshall, Co	1905-1924 1934-2013	91,871
09038500	Williams Fork River Below Williams Fork Reservoir	1949-1954 1959-2013	93,719
09039000	Troublesome Creek Near Pearmont, CO.	1954-1993	21,626
09040000	East Fork Troublesome C Near Troublesome, CO.	1937-1943 1954-1983	20,611
09041000	Muddy Creek Near Kremmling, CO.	1938-1943 1956-1971 1994-1999	40,495
09041200	Red Dirt Creek Near Kremmling, CO.	1956-1974	13,741
09041500	Muddy Creek at Kremmling, CO.	1982-1995	66,932

Gage ID	Gage Name	Period of Record	Historical Flow (acre-feet/year)
09046600	Blue River Near Dillon, CO.	1958-2013	67,337
09047500	Snake River Near Montezuma, CO.	1943-1946 1952-2013	44,440
09050100	Tenmile Creek Below North Tenmile Creek at Frisco	1958-2013	72,660
09050700	Blue River Below Dillon Reservoir	1960-2013	148,585
09052800	Slate Creek at Upper Station, Near Dillon, CO.	1967-1994	18,652
09053500	Blue River Above Green Mountain Reservoir, CO.	1944-1971 1986-1987	292,701
09054000	Black Creek Below Black Lake, Near Dillon, CO.	1942-1949 1967-1994	22,992
09055300	Cataract Creek Near Kremmling, CO.	1967-1994	14,490
09057500	Blue River Below Green Mountain Reservoir	1943-2013	324,014
09058000	Colorado River Near Kremmling	1905-1918 1962-1970 1972-2013	837,375
09060500	Rock Creek Near Toponas, CO.	1953-1980	23,862
09060700	Egeria Creek Near Toponas, CO.	1966-1973	7,520
09063000	Eagle River at Red Cliff, CO.	1911-1925 1945-2013	32,578
09064000	Homestake Creek at Gold Park, CO.[4]	1948-2005	23,917
09065100	Cross Creek Near Minturn	1957-1963 1968-2013	37,906
09065500	Gore Creek at Upper Station, Near Minturn, CO.	1948-1956 1964-2013	21,512
09067300	Alkali Creek Near Wolcott, CO.	1959-1965	1,540
09068000	Brush Creek Near Eagle, CO.	1951-1972	31,966
09069500	Gypsum Creek Near Gypsum, CO.	1951-1955 1966-1972	23,470
09070000	Eagle River Below Gypsum	1947-2013	413,411
09070500	Colorado River Near Dotsero	1941-2013	1,500,105
09071300	Grizzly Creek Near Glenwood Springs, CO.	1977-1996	9,755
09073400	Roaring Fork River Near Aspen [5]	1911-1921 1933-2013	66,736
09074000	Hunter Creek Near Aspen	1950-1956 1970-2013	31,525
09074800	Castle Creek Above Aspen, CO.	1970-1994	31,448
09075700	Maroon Creek Above Aspen, CO.	1970-1994	49,075
09078600	Fryingpan River Near Thomasville [6]	1976-1999 2002-2013	75,897
09080400	Fryingpan River Near Ruedi	1965-2013	129,925
09080800	West Sopris Creek Near Basalt, CO.	1964-1968	2,858
09081600	Crystal River Above Avalanche Creek Near Redstone	1956-2013	213,695
09082800	North Thompson Creek Near Carbondale, CO.	1964-1979	12,055
09084000	Cattle Creek Near Carbondale, CO.	1951-1955 1963-1972	11,069
09084600	Fourmile Creek Near Glenwood Springs, CO.	1958-1965	6,010
09085000	Roaring Fork River at Glenwood Springs	1906-1909 1911-2013	923,980
09085100	Colorado River Below Glenwood Springs	1967-2013	2,412,992

Gage ID	Gage Name	Period of Record	Historical Flow (acre-feet/year)
09085200	Canyon Creek Above New Castle, CO.	1969-1986	39,583
09087500	Elk Creek at New Castle, CO.	1922-1924 1955-1960	70,994
09088000	Baldy Creek Near New Castle	1956-1961	3,842
09089500	West Divide Creek Near Raven [7]	1956-2013	25,180
09090700	East Divide Creek Near Silt, CO.	1960-1965	7,712
09091500	East Rifle Creek Near Rifle, CO.	1937-1943 1957-1964	27,734
09092500	Beaver Creek Near Rifle	1953-1982	3,369
09092600	Battlement Creek Near Parachute	1957-1965	6,033
09093500	Parachute Creek at Parachute, CO.	1921-1927 1949-1954 1975-1982	22,935
09093700	Colorado River Near De Beque	1967-1997	2,795,201
09094200	Roan Creek Above Clear Creek Near De Beque, CO.	1963-1968	12,478
09095000	Roan Creek Near De Beque, CO.	1921-1926 1963-1972 1975-1981	31,412
09095500	Colorado River Near Cameo	1934-2013	2,769,211
09096500	Plateau Creek Near Collbran, CO.	1922-1980	51,966
09097500	Buzzard Creek Near Collbran	1922-1980	33,775
09100500	Cottonwood Creek at Upper Sta, Near Molina, CO.	1945-1957	10,994
09104500	Mesa Creek Near Mesa, CO.	1941-1960	8,515
09105000	Plateau Creek Near Cameo [8]	1936-1995 1997-2013	136,011
09152500	Gunnison River Near Grand Junction	1897-1899 1902-1906 1917-2013	1,816,228
09163500	Colorado River Near Colorado-Utah State Line	1951-2013	4,407,970

1) Winter months, where missing, were set to the minimum bypass requirement of 20 cubic feet per second; ungaged preemptive reservoir releases were added; data from 1954 through 1960 was filled from gage 09019000 – Colorado River below Lake Granby.
2) Data from 1935 through 1953 was filled from gage 09020000 – Willow Creek Near Granby, CO.; missing data from 1983 through 2005 was filled from daily Willow Creek Reservoir operation data provided by the U.S. Bureau of Reclamation.
3) Data from 1975 through 2013 provided by the Denver Water Board.
4) Missing data filled by log regression from gage 09064500 – Homestake Creek near Red Cliff, CO.
5) Missing data in 1983 filled by log regression from gage 09073300 – Roaring Fork River above Difficult Creek near Aspen; data prior to 1965 filled from gage 09073500 – Roaring Fork River at Aspen, CO.
6) Data prior to 1976 filled by log regression from gage 09078000 – Fryingpan River Near Norrie, CO.
7) For the water years 2000 through 2011 the months of November through March had missing data.
8) Data for water years 1984 and 1985 were filled using recommendations from the Leonard Rice Colorado River Basin Physical Water Availability Study (1995).

5.3.5. Baseflow File (*.xbm)

The baseflow file contains estimates of base streamflows throughout the modeling period, at the locations listed in the river station file. Baseflows represent the conditions upon which simulated diversion, reservoir, and minimum streamflow demands were superimposed. StateMod estimates baseflows at stream gages during the gage's period of record from historical streamflows, diversions, end-of-month contents of modeled reservoirs, and estimated consumption and return flow patterns. It then distributes baseflow at gage sites to ungaged locations using proration factors representing the fraction of the reach gain estimated to be tributary to a baseflow point.

Table 5.5 compares historical gage flows with simulated baseflows for the gages that operated continuously during the calibration period (1975-2013). The difference between the two represents estimated historical consumptive use upstream of the gage over this period.

Table 5.5
Average Baseflow Comparison from 1975-2013
(Acre-Feet/Year)

Gage ID	Gage Name	Baseflow	Historical	Difference
09010500	Colorado R Below Baker Gulch, Nr Grand Lake, CO.	64,976	46,878	18,098
09019500	Colorado River Near Granby	276,162	41,849	234,312
09024000	Fraser River at Winter Park	28,079	13,542	14,537
09025000	Vasquez Creek at Winter Park, CO.	26,815	11,122	15,693
09026500	St. Louis Creek Near Fraser, CO.	25,043	15,676	9,367
09032000	Ranch Creek Near Fraser, CO.	16,885	8,938	7,947
09034900	Bobtail Creek Near Jones Pass, CO.	7,544	7,544	0
09035500	Williams Fork Below Steelman Creek, CO.	18,107	13,972	4,135
09036000	Williams Fork River Near Leal, Co	77,902	73,767	4,135
09037500	Williams Fork River Near Parshall, Co	114,061	84,066	29,996
09038500	Williams Fork River Below Williams Fork Reservoir	123,596	97,264	26,332
09046600	Blue River Near Dillon, CO.	78,953	69,503	9,451
09047500	Snake River Near Montezuma, CO.	46,008	45,154	855
09050100	Tenmile Creek Below North Tenmile Creek at Frisco	76,955	75,129	1,826
09050700	Blue River Below Dillon Reservoir	230,271	146,064	84,207
09057500	Blue River Below Green Mountain Reservoir	394,021	304,217	89,804
09058000	Colorado River Near Kremmling	1,235,219	735,546	499,672
09063000	Eagle River at Red Cliff, CO.	33,620	28,423	5,197
09064000	Homestake Creek at Gold Park, CO.	45,761	20,352	25,410
09065100	Cross Creek Near Minturn	38,237	37,450	786
09065500	Gore Creek at Upper Station, Near Minturn, CO.	22,109	22,109	0
09070000	Eagle River Below Gypsum	466,039	414,477	51,562
09070500	Colorado River Near Dotsero	2,050,249	1,474,478	575,770
09073400	Roaring Fork River Near Aspen	108,735	67,955	40,780
09074000	Hunter Creek Near Aspen	39,918	29,607	10,310
09080400	Fryingpan River Near Ruedi	171,588	123,774	47,813

Gage ID	Gage Name	Baseflow	Historical	Difference
09010500	Colorado R Below Baker Gulch, Nr Grand Lake, CO.	64,976	46,878	18,098
09019500	Colorado River Near Granby	276,162	41,849	234,312
09024000	Fraser River at Winter Park	28,079	13,542	14,537
09025000	Vasquez Creek at Winter Park, CO.	26,815	11,122	15,693
09026500	St. Louis Creek Near Fraser, CO.	25,043	15,676	9,367
09032000	Ranch Creek Near Fraser, CO.	16,885	8,938	7,947
09034900	Bobtail Creek Near Jones Pass, CO.	7,544	7,544	0
09035500	Williams Fork Below Steelman Creek, CO.	18,107	13,972	4,135
09036000	Williams Fork River Near Leal, Co	77,902	73,767	4,135
09037500	Williams Fork River Near Parshall, Co	114,061	84,066	29,996
09081600	Crystal River Above Avalanche Creek Near Redstone	215,584	215,584	0
09085000	Roaring Fork River at Glenwood Springs	1,016,356	854,665	161,692
09085100	Colorado River Below Glenwood Springs	3,130,775	2,388,411	742,363
09095500	Colorado River Near Cameo	3,565,429	2,737,562	827,867
09152500	Gunnison River Near Grand Junction[1)]	1,794,352	1,794,352	0
09163500	Colorado River Near Colorado-Utah State Line	5,596,663	4,522,322	1,074,340

1) Historical streamflow for the Gunnison is used as an input to the Colorado StateMod model

Where to find more information

- Sections 4.7.1 through 4.7.3 explain how StateMod and the Mixed Station Model were used to create baseflows.
- When StateMod is executed to estimate baseflows at gages, it creates a Baseflow Information file *(*.xbi*) that shows this computation for each gage and each month of the time step.
- When the Mixed Station Model is used to fill baseflows, it creates two reports, cm2015.*sum* and cm2015.*sts*. The first indicates which stations were used to estimate each missing data point, and the second compares statistics of the unfilled time series with statistics of the filled series for each gage.

5.4 Diversion Files

5.4.1. Direct Diversion Station File (*.dds)

StateDMI creates the direct diversion file through a two-step process. The direct diversion station file describes the physical properties of each diversion simulated in the Upper Colorado River Model. Table 5.6 is a summary of the Upper Colorado River Model's diversion station file contents, including each structure's diversion capacity, irrigated acreage served, average annual system efficiency, and average annual headgate demand. The average annual headgate demand parameter was summarized from data in the diversion demand file rather than the diversion station file, but it was included here as an important characteristic of each diversion station. In addition to the tabulated parameters, the *.dds file also specifies return flow nodes and average monthly efficiencies.

Generally, the diversion station ID, name, diversion capacity, and irrigated acreage were gathered from HydroBase, by StateDMI. Return flow locations were specified to StateDMI in a hand-edited file cm2015.rtn. The return flow locations and distribution were based on physical location of irrigated lands, discussions with Division 5 personnel, as well as calibration efforts. StateCU computes monthly system efficiency for irrigation structures from historical diversions and historical crop irrigation requirements, and StateDMI writes the average monthly efficiencies into the *.dds file.

For non-irrigation structures, monthly efficiency is specified by the user as input to StateDMI. Baseline irrigation demand are assigned to primary structures of multi-structure systems—therefore the primary and secondary structures are assigned the average monthly efficiencies calculated for the irrigation system based on irrigation water requirements and water delivered from all sources. If efficiency is constant for each month, it can be specified in the hand-edited cm2015.rtn file.

Note, StateDMI sets the unknown capacity to 999. This number is intentionally large so diversions are not limited.

Table 5.6
Direct Flow Diversion Summary Average
1975-2013

#	Model ID	Name	Capacity (cfs)	2010 Irrigated Acreage	Average System Efficiency (%)	Average Annual Demand (af)
1	3600507	ALBER DITCH	11	37	21	756
2	3600603	ED WARD DITCH	17	42	20	1,033
3	3600606	ELLIOTT CREEK FEEDER [2]	112	0	0	0
4	3600642	GREEN MOUNTAIN CANAL	43	84	19	2,950
5	3600645	GUTHRIE THOMAS DITCH	38	569	36	5,293
6	3600649_D	HAMILTON DAVIDSON DIVSYS	100	702	18	11,461
7	3600658	HIGHLINE DITCH	12	46	10	907
8	3600660	HIGH MILLER DITCH	32	141	13	3,602
9	3600662_D	HOAGLAND DIVSYS	91	1,014	26	9,976
10	3600671	INDEPENDENT BLUE DITCH	40	28	4	3,120
11	3600687	KIRKWOOD DITCH	17	24	13	1,279

#	Model ID	Name	Capacity (cfs)	2010 Irrigated Acreage	Average System Efficiency (%)	Average Annual Demand (af)
12	3600709	LOBACK DITCH	76	534	31	7,748
13	3600725	MARY DITCH	14	5	2	539
14	3600728	MAT NO 1 DITCH	16	10	2	1,021
15	3600729	MAT NO 2 DITCH	17	10	2	1,207
16	3600734	MCKAY DITCH	23	16	12	1,525
17	3600765	PALMER-MCKINLEY DITCH	25	56	14	2,099
18	3600775	PHARO DITCH	17	87	22	1,206
19	3600776_D	PHARO BAUER DIVSYS	52	194	6	7,167
20	3600780	PLUNGER DITCH	62	8	2	1,139
21	3600784	RANKIN NO 1 DITCH [3]	4	0	36	1,033
22	3600796	SAUMS DITCH	25	98	26	1,869
23	3600801	SMITH DITCH [1]	40	269	32	3,726
24	3600829	STRAIGHT CREEK DITCH [3]	4	0	36	1,240
25	3600832	SUTTON NO 1 DITCH [1]	15	0	40	0
26	3600841	TENMILE DIVERSION NO 1 [3]	53	0	100	0
27	3600868_D	WESTLAKE DIVSYS	23	157	9	3,029
28	3600881	GREEN MTN HYDRO-ELECTRIC [2]	1,726	0	0	263,761
29	3600908	KEYSTONE SNOWLINE DITCH [3]	8	0	30	660
30	3600989	MAGGIE POND (SNOWMAKING) [3]	999	0	100	250
31	3601008	BRECKENRIDGE PIPELINE [3]	9	0	36	2,477
32	3601016	COPPER MTN SNOWMAKING [3]	3	0	30	324
33	3604512HU	HUP RELEASE NODE [5]	99,999	0	0	0
34	3604626	VIDLER TUNNEL WEST PORTAL [4]	28	0	100	580
35	3604683	CON-HOOSIER SYS BLUE RIV [2,4]	500	0	100	0
36	3604683SU	CONTINENTAL_HOOSIER_TUNNEL [2,4]	500	0	100	10,276
37	3604684	BLUE RIVER DIVR PROJECT [4]	523	0	100	71,796
38	3604685	BOREAS NO 2 DITCH [2,4]	16	0	100	145
39	3604699	CON-HOOSIER TUNNEL [4]	77	0	100	0
40	36GMCON	GREEN_MTN_CONTRACT_DEM.[2]	999	0	60	4,020
41	36_ADC017	DIVERSION AGGREGATE	226	1,331	23	20,818
42	36_ADC018	DIVERSION AGGREGATE	90	737	22	10,805
43	36_ADC019	DIVERSION AGGREGATE	86	1,102	44	7,261
44	36_KeyMun	KEYSTONE MUNICIPAL [3]	2	0	36	413
45	3700519	BRAGG NO 1 DITCH	12	20	5	1,541
46	3700539	CHATFIELD BARTHOLOMEW D	42	298	19	4,632

#	Model ID	Name	Capacity (cfs)	2010 Irrigated Acreage	Average System Efficiency (%)	Average Annual Demand (af)
47	3700545	C K P DITCH	25	30	9	2,117
48	3700548	C M STREMME GATES DITCH	28	93	13	3,566
49	3700560	CREAMERY DITCH	29	35	8	2,256
50	3700561	DAGGETT AND PARKER DITCH	23	576	40	3,606
51	3700571	J M DODD DITCH	18	67	18	2,169
52	3700642	HOLLINGSWORTH DITCH	50	193	12	5,192
53	3700655	H O R DITCH	20	84	12	2,470
54	3700658	HOWARD DITCH	17	24	3	2,596
55	3700686	LOVE AND WHITE DITCH	20	256	37	2,348
56	3700694	MATHEWS DITCH	22	463	46	3,155
57	3700708	METCALF DITCH [3]	29	0	36	2,250
58	3700723	NEILSON SOUTH DITCH	10	21	6	1,054
59	3700743	ONEILL AND HOLLAND DITCH	30	225	17	3,530
60	3700823	STRATTON AND CO DITCH	54	524	26	7,794
61	3700830	TERRELL AND FORD DITCH	32	144	30	2,189
62	3700843	UPPER FROST DITCH	12	150	35	1,547
63	3700848	WARREN DITCH	36	136	9	3,978
64	3700857	WILKINSON DITCH	30	121	16	2,984
65	3701146	WOLCOTT PUMPING PIPELINE [3,6]	500	0	0	0
66	3704516HU	HUP RELEASE NODE [5]	99999	0	0	0
67	3704614	HOMESTAKE PROJ TUNNEL [4]	300	0	100	26,933
68	3704641	COLUMBINE DITCH [4]	30	0	100	1,135
69	3704642	EWING DITCH [4]	19	0	100	874
70	3704643	HOMESTAKE PROJ CONDUIT [2,4]	600	0	0	0
71	3704648	WARREN E WURTS DITCH [4]	85	0	100	1,997
72	37VAILIRR	VAIL VALLEY CONSOLIDATED	11	0	36	1,440
73	37VAILMUN	VAIL VALLEY CONSOLIDATED [3]	13	0	36	1,343
74	37_ADC029	DIVERSION AGGREGATE	121	1,365	28	14,117
75	37_ADC030	DIVERSION AGGREGATE	113	874	25	12,539
76	37_ADC031	DIVERSION AGGREGATE	66	792	34	6,937
77	3800516	ATKINSON DITCH	17	82	12	1,948
78	3800528	BASIN DITCH	45	280	8	8,505
79	3800545	BORAM AND WHITE DITCH	17	192	23	2,009
80	3800547	BOWLES AND HOLLAND DITCH	39	90	5	5,075
81	3800569	C AND M DITCH	16	589	59	2,713
82	3800572	CAPITOL FALLS DITCH	22	144	14	2,403

#	Model ID	Name	Capacity (cfs)	2010 Irrigated Acreage	Average System Efficiency (%)	Average Annual Demand (af)
83	3800573	CAPITOL PARK DITCH	11	84	10	1,711
84	3800574	CARBONDALE DITCH	62	13	0	7,309
85	3800606	COLLINS CREEK DITCH	17	79	22	1,230
86	3800618	CRANE AND PEEBLES DITCH	29	49	4	6,105
87	3800639	DESERT DITCH	17	214	35	1,785
88	3800651	EAST MESA DITCH	49	383	4	11,620
89	3800659	ELI CERISE DITCH	15	44	12	2,865
90	3800660	ELK CREEK DITCH	19	97	26	991
91	3800663	ELLA DITCH	35	180	3	5,645
92	3800667	EUREKA NO 1 DITCH	12	202	59	874
93	3800688	FOUR MILE DITCH	13	69	19	989
94	3800712	GLENWOOD DITCH	61	164	6	15,250
95	3800715	GRACE AND SHEHI DITCH	34	159	4	7,735
96	3800720	GREEN MEADOW DITCH	25	540	35	4,107
97	3800740	HARRIS & REED DITCH	32	102	7	5,968
98	3800749	HERRICK DITCH	65	61	7	3,961
99	3800755	HOLDEN DITCH	30	126	4	4,676
100	3800757	HOME SUPPLY DITCH	91	915	9	21,728
101	3800798	KELSO DITCH	27	54	8	1,578
102	3800800	KESTER DITCH	30	129	4	5,071
103	3800822	LIGNITE DITCH	15	54	45	424
104	3800838	LOWER DITCH	13	44	6	1,751
105	3800840	LOWLINE DITCH	53	351	3	13,454
106	3800854	MAROON DITCH [3]	68	0	36	4,143
107	3800861	MAURIN DITCH	13	216	38	1,457
108	3800869	MIDLAND FLUME DITCH [3]	160	0	36	4,914
109	3800879	MONARCH DITCH	11	196	52	1,211
110	3800880_D	MT. SOPRIS DIVSYS	51	971	39	4,954
111	3800881	MOUNTAIN MEADOW DITCH	107	156	18	7,919
112	3800890	MCKENZIE WILDCAT DITCH	30	179	30	1,917
113	3800893	MCKOWN DITCH	30	466	46	3,119
114	3800902	NEEDHAM DITCH	27	641	53	3,478
115	3800920	OXFORD NO 1 DITCH	12	76	8	1,984
116	3800924	PARADISE DITCH	25	58	18	1,537
117	3800925	PARK DITCH	25	260	19	3,894
118	3800930	PATERSON D JACOB EXT	109	35	0	26,649

#	Model ID	Name	Capacity (cfs)	2010 Irrigated Acreage	Average System Efficiency (%)	Average Annual Demand (af)
119	3800939	PIONEER DITCH	29	115	4	2,702
120	3800959	RED ROCK BLUFF DITCH	17	165	16	3,364
121	3800966	ROBERTSON DITCH	38	26	2	4,915
122	3800968	ROBINSON DITCH	57	146	2	15,737
123	3800970	ROCKFORD DITCH	45	125	6	9,289
124	3800981	SALVATION DITCH	110	317	13	8,309
125	3800989	SHIPPEE DITCH	15	83	24	1,043
126	3800994	SLOSS DITCH	13	224	42	1,129
127	3800996	SLOUGH D AND BANNING LAT	49	194	11	7,072
128	3801012	SNOWMASS DIVIDE DITCH	33	266	28	3,400
129	3801018	SOUTHARD AND CAVANAUGH D	26	28	4	5,772
130	3801038	SWEET JESSUP CANAL	75	1,170	19	15,443
131	3801052	CARBONDALE WTR SYS & PL [3]	15	0	36	835
132	3801062	UNION DITCH	37	177	15	3,277
133	3801066	VAN CLEVE NO 1 DITCH	2	183	56	812
134	3801073	WACO DITCH	40	258	10	6,138
135	3801078	WALKER WONDER DITCH	72	91	5	4,861
136	3801082	WEAVER AND LEONHARDY D	30	11	1	3,563
137	3801096_D	WILLIAMS NO 2 DIVSYS	24	554	40	2,700
138	3801101	WILLOW CREEK DITCH	40	138	11	2,586
139	3801104	WILLOW AND OWL DITCH	13	181	44	1,087
140	3801121	ALEXIS ARBANEY DITCH	10	18	11	1,343
141	3801132	WALTHEN DITCH	18	28	3	2,046
142	3801147	KAISER AND SIEVERS DITCH	29	86	4	6,044
143	3801441	EAST SNOWMASS BRUSH C PL [3]	15	0	36	2,301
144	3801481	VAN CLEVE-FISHER FDR D	26	304	50	1,721
145	3801594	FRY ARK PR HUNTER TUNNEL [2]	332	0	100	0
146	3801661	SALVATION DITCH VAGN EXT	15	441	60	1,600
147	3801790	RED MOUNTAIN EXT DITCH	27	300	22	4,788
148	3803713I1	RUEDI RND 1-IND DEMAND	999	0	100	6,000
149	3803713I2	RUEDI RND 2-IND DEMAND	999	0	100	5,440
150	3803713M1	RUEDI RND 1-MUNI DEMAND	999	0	100	1,850
151	3803713M2	RUEDI RND 2-MUNI DEMAND	999	0	100	11,714
152	3803713M3	RUEDI ADDL DEMAND [6]	999	0	60	0
153	3804613	IVANHOE RESERVOIR TUNNEL [4]	120	0	100	4,359
154	3804617	IND P TM DVR TUNNEL NO 1 [4]	625	0	100	55,980

#	Model ID	Name	Capacity (cfs)	2010 Irrigated Acreage	Average System Efficiency (%)	Average Annual Demand (af)
155	3804625	FRY ARK PR BOUSTEAD TUNN [4]	1,000	0	100	0
156	3804625SU	BOUSTEAD_SUMMARY [4]	1,600	0	100	53,387
157	3804717	WEST THREE MILE DITCH [4]	14	0	0	345
158	38_ADC033	DIVERSION AGGREGATE	68	638	17	11,208
159	38_ADC034	DIVERSION AGGREGATE	103	1,288	21	17,506
160	38_ADC035	DIVERSION AGGREGATE	48	276	12	6,324
161	38_ADC036	DIVERSION AGGREGATE	69	654	21	9,779
162	38_ADC037	DIVERSION AGGREGATE	100	1,002	10	22,755
163	38_ADC038	DIVERSION AGGREGATE	45	918	26	7,360
164	38_ADC039	DIVERSION AGGREGATE	46	1,012	33	6870
165	38_ADC040	DIVERSION AGGREGATE	16	265	35	1,715
166	3900532	CLOUGH NO 1 DITCH	23	49	4	2,835
167	3900537	CORNELL DITCH[7]	16	0	27	1,318
168	3900539	CORYELL DITCH	17	73	12	2,149
169	3900540	CORYELL JOINT STOCK IRRI	20	145	36	1,827
170	3900546_D	DAVENPORT DIVSYS	20	0	8	891
171	3900547	DAVIE DITCH	18	474	53	2,039
172	3900548	DEWEESE DITCH	35	31	5	2,301
173	3900562	GRANLEE DITCH	18	89	14	2,399
174	3900563	GRASS VALLEY CANAL [2]	124	0	0	0
175	3900563_I	DRY ELK VALLEY IRR	45	2,042	48	8,531
176	3900574	GRAND TUNNEL DITCH	29	482	18	6,787
177	3900585	HIBSCHLE BENBOW DITCH	7	138	26	1,280
178	3900590	JANGLE DITCH	16	105	11	2,173
179	3900610	LOW COST DITCH	29	98	6	4,243
180	3900612	LOWER CACTUS VALLEY D	59	666	10	18,044
181	3900635	PARACHUTE DITCH	27	120	22	1,948
182	3900638	PIERSON AND HARRIS DITCH	28	42	16	961
183	3900645	RIFLE CREEK CANON DITCH	41	788	18	10,259
184	3900663	SILT PUMP CANAL [2]	36	0	0	0
185	3900672	THOMPKINS DITCH	26	282	11	6,664
186	3900687	WARE AND HINDS DITCH	57	790	14	12,894
187	3900701	RED ROCK DITCH	10	10	5	1,208
188	3900710	DRAGERT PUMP PLANT & PL [2]	94	0	0	0
189	3900712	EATON PUMP & PIPELINE [2]	100	0	0	0
190	3900728	PUMPING PL UNION OIL CAL [2]	118	0	100	0

#	Model ID	Name	Capacity (cfs)	2010 Irrigated Acreage	Average System Efficiency (%)	Average Annual Demand (af)
191	3900825	WILLIAMS CANAL	37	418	14	7,878
192	3900967	RIFLE TOWN OF PUMP & PL [2]	15	0	36	1,594
193	3900990	WEST LAT RIFLE CR CANON	7	229	34	1,561
194	3903505_I	FARMERS IRRIGATION COMP	72	2,830	38	16,120
195	39_ADC041	DIVERSION AGGREGATE	102	970	22	16,959
196	39_ADC045	DIVERSION AGGREGATE	60	488	17	7,185
197	4200520	GRAND JCT GUNNISON PL [3]	19	0	36	41
198	4200541	REDLANDS POWER CANAL [3]	888	0	0	488,305
199	4200541_I	REDLANDS POWER CANAL IRR	140	1,713	18	29,060
200	4500514	BATTLEMENT DITCH	21	534	50	3,253
201	4500572	DOW DITCH	12	83	51	492
202	4500576_D	DIVIDE CREEK HIGHLINE DITCH	156	4,331	49	19,611
203	4500584	EAST DIVIDE CREEK DITCH	25	278	36	2,324
204	4500616	H AND S DITCH	12	141	30	1,758
205	4500632_D	HOLMES DIVSYS	23	390	40	2,478
206	4500635	HUDSON & SULLIVAN DITCH	16	160	48	960
207	4500638	HUNTLEY DITCH	13	28	6	1,512
208	4500648	JOE TAYLOR DITCH	11	46	41	289
209	4500668	LAST CHANCE DITCH	60	666	14	11,164
210	4500675	LOUIS REYNOLDS DITCH	10	26	13	681
211	4500685	MAMM CREEK DITCH	12	366	52	1,867
212	4500693_D	MINEOTA DIVSYS	32	746	42	4,079
213	4500704	MULTA-TRINA DITCH	59	730	35	6,712
214	4500705	MURRAY AND YULE DITCH	31	364	50	1,913
215	4500725	PORTER DITCH	62	1,795	50	8,189
216	4500743	RISING SUN DITCH	58	100	6	6,873
217	4500749	RODERICK DITCH	20	488	54	2,072
218	4500788	SYKES AND ALVORD DITCH	12	558	48	2,558
219	4500790	TALLMADGE AND GIBSON D	53	950	48	4,590
220	4500793	TAUGHENBAUGH DITCH	49	432	46	2,878
221	4500810	WARD AND REYNOLDS DITCH	10	118	41	985
222	4500818	WEST DIVIDE CREEK DITCH	18	743	56	3,154
223	4500861	LARKIN DITCH	43	198	9	8,796
224	4500969	BLUESTONE VALLEY DITCH	106	1280	11	30,475
225	45_ADC042	DIVERSION AGGREGATE	108	1,222	27	11,876
226	45_ADC043	DIVERSION AGGREGATE	104	1,088	39	8,180

#	Model ID	Name	Capacity (cfs)	2010 Irrigated Acreage	Average System Efficiency (%)	Average Annual Demand (af)
227	45_ADC044	DIVERSION AGGREGATE	64	1,462	46	6,695
228	45_ADC046	DIVERSION AGGREGATE	33	591	38	3,736
229	45_ADC047	DIVERSION AGGREGATE	52	851	33	6,135
230	45_ADC048	DIVERSION AGGREGATE	156	848	18	12,880
231	5000517	BECKER NO 3 DITCH	14	256	55	1,230
232	5000526	BLICKLEY DITCH	19	156	39	1,685
233	5000539	CLIFF DITCH	31	270	53	1,328
234	5000574	HARDSCRABBLE DITCH	37	482	44	3,487
235	5000576	HAYPARK CANAL HGT NO 1	75	558	40	5,888
236	5000582	HERDE DITCH	23	389	53	2,203
237	5000585	HOGBACK DITCH	27	138	41	1,197
238	5000593	KIRTZ DITCH NO 2	81	1,294	41	8,401
239	5000598	LANDSLIDE DITCH	16	64	33	991
240	5000601	MARTIN NO 1 DITCH	31	178	48	1,489
241	5000606	MISSOURI DITCH	98	814	46	5,902
242	5000612	MCELROY NO 1 DITCH	13	132	33	1,262
243	5000613	MCELROY NO 2 DITCH	12	87	33	982
244	5000617	MCMAHON DITCH	72	381	43	4,145
245	5000627	PASS CREEK DITCH	13	313	45	1,512
246	5000628	PICKERING DITCH	27	241	51	1,577
247	5000632	PLEASANT VIEW DITCH	11	174	52	1,021
248	5000653_D	TOM ENNIS DIVSYS	60	493	21	5,552
249	5000654	TROUBLESOME DITCH	30	383	23	3,874
250	5000656	TYLER DITCH	18	191	49	1,264
251	5000731	CLIFF DITCH HGT NO 2	999	136	39	1,136
252	5000734_D	DEBERARD DIVSYS	106	970	28	8,752
253	5000744	NORTH MEADOW FEEDER DITCH	18	209	55	1,120
254	5003668FR	WOLFORD FRASER DEMAND [6]	999	0	50	291
255	5003668HU	HUP RELEASE NODE [5]	99999	0	0	0
256	5003668MK	WOLFORD MARKET DEMAND [6]	999	0	60	0
257	5003668MP	WOLFORD MIDPARK DEMAND [6]	999	0	50	1,114
258	50_ADC012	DIVERSION AGGREGATE	121	2,481	53	12,951
259	50_ADC013	DIVERSION AGGREGATE	62	1,474	55	6,875
260	50_ADC014	DIVERSION AGGREGATE	83	1,168	44	7,888
261	50_ADC015	DIVERSION AGGREGATE	63	835	48	4,049

#	Model ID	Name	Capacity (cfs)	2010 Irrigated Acreage	Average System Efficiency (%)	Average Annual Demand (af)
262	50_ADC016	DIVERSION AGGREGATE	39	733	55	3,592
263	50_ADC020	DIVERSION AGGREGATE	45	828	48	5,268
264	5100529_D	BIG LAKE DIVSYS	261	2,400	11	30,703
265	5100546	BUNTE HIGHLINE DITCH	50	142	7	7,266
266	5100585	COFFEE MCQUEARY DITCH	30	304	28	4,058
267	5100594	CROOKED CREEK DITCH NO 1	25	723	58	2,872
268	5100629	FARRIS SOUTH SIDE DITCH	18	271	38	2,236
269	5100639	JIM_CREEK [2,4]	999	0	100	0
270	5100660	GASKILL DITCH	9	363	57	1,328
271	5100686	GRIFFITH DITCH	17	189	39	1,656
272	5100699	HAMMOND NO 1 DITCH	18	218	20	2,833
273	5100700	HAMMOND NO 2 DITCH	11	464	57	1,740
274	5100728	HAMILTON-CABIN CR DITCH [2,4]	70	0	100	0
275	5100763	KINNEY BARRIGER DITCH	114	449	15	10,272
276	5100788	LYMAN DITCH	27	114	16	3,309
277	5100810	MUSGRAVE DITCH	31	396	36	3,227
278	5100826	OSTRANDER DITCH	31	72	29	1,707
279	5100829	PEAVEY NO 2 DITCH	6	554	60	1,841
280	5100831	PETERSON DITCH NO 1	13	109	41	1,275
281	5100848	RED TOP VALLEY DITCH	150	1,878	44	13,932
282	5100858	ROCK CREEK DITCH [7]	14	0	23	265
283	5100876	SCYBERT DITCH	999	227	34	2,151
284	5100880_D	SELAK LARRABEE DITCH DIV	31	193	28	2,769
285	5100883	SHERIFF DITCH (156)	20	143	36	2,184
286	5100893	SOPHRONIA DAY DITCH	39	647	36	5,149
287	5100924	SYLVAN DITCH	77	58	17	2,952
288	5100934	TRAIL CREEK DITCH	19	246	52	1,510
289	5100939	UTE BILL NO 2 DITCH	15	46	7	2,049
290	5100941	VAIL IRR SYS HGT NO 2	64	556	20	5,783
291	5100948	WALDON HOLLOW DITCH	20	590	56	2,466
292	5100958	CBT WILLOW CREEK FEEDER [2]	446	0	0	30,429
293	5101070	HENDERSON MINE WATER SYS [3]	16	0	100	1,700
294	5101148	THOMPSON PUMP NO 1	14	178	36	1,519
295	5101149	THOMPSON PUMP NO 2	14	115	18	1,824
296	5101231	VAIL_IRR_SYS [1]	999	0	45	0
297	5101237	WILLIAMS FORK POWER COND [2]	295	0	0	0

#	Model ID	Name	Capacity (cfs)	2010 Irrigated Acreage	Average System Efficiency (%)	Average Annual Demand (af)
298	5101269	RANCH_CREEK [2,4]	999	0	100	0
299	5101309_D	FRASER RIVER DIVR PROJ [2,4]	161	0	100	0
300	5101310	VASQUEZ_CREEK [2,4]	999	0	100	0
301	5103709HU	HUP RELEASE NODE [5]	99999	0	0	0
302	5104601	GRAND RIVER DITCH [4]	525	0	100	18,098
303	5104603	WILLIAMS FORK TUNNEL [4]	500	0	100	0
304	5104625	BERTHOUD CANAL TUNNEL [4]	53	0	100	585
305	5104634	CBT ALVA B ADAMS TUNNEL [4]	561	0	100	23,8439
306	5104655	MOFFAT WATER TUNNEL [4]	928	0	100	56,344
307	5104700	WINDY GAP PUMP PL CANAL [2]	600	0	0	28,971
308	51_ADC001	DIVERSION AGGREGATE	109	874	46	7,259
309	51_ADC002	DIVERSION AGGREGATE	49	841	53	4,291
310	51_ADC003	DIVERSION AGGREGATE	33	839	55	3,689
311	51_ADC004	DIVERSION AGGREGATE	52	743	41	4,391
312	51_ADC005	DIVERSION AGGREGATE	74	1,971	51	8,828
313	51_ADC006	DIVERSION AGGREGATE	47	549	41	4,441
314	51_ADC007	DIVERSION AGGREGATE	50	497	26	6,119
315	51_ADC008	DIVERSION AGGREGATE	42	764	43	5,007
316	51_ADC009	DIVERSION AGGREGATE	50	779	51	4,238
317	51_ADC010	DIVERSION AGGREGATE	44	984	52	4,448
318	51_ADC011	DIVERSION AGGREGATE	56	758	33	6,586
319	5200559	GUTZLER DITCH	13	33	9	1,230
320	5200572	HOG EYE DITCH	14	63	32	935
321	5200658	WILMOT DITCH	17	258	42	1,577
322	5200731	NOTTINGHAM PUMP [1]	999	0	29	0
323	52_ADC021	DIVERSION AGGREGATE	216	1,614	25	18,830
324	52_ADC027	DIVERSION AGGREGATE	89	979	44	6,001
325	5300555_D	DERBY DIVSYS	61	1,191	14	10,386
326	5300584	SHOSHONE POWER PLANT [3]	2,141	0	0	636,519
327	5300585	GLENWOOD L WTR CO SYS/NO [3]	38	0	36	5,589
328	5300621	HIGHWATER DITCH	16	374	60	1,393
329	5300632	HORSE MEADOWS DITCH	7	17	12	545
330	5300657	KAYSER DITCH	29	422	18	4,192
331	5300678	LION BASIN DITCH	32	740	56	3,112
332	5300767_D	HMS RELOCATED DIVSYS	24	88	3	3,384
333	5300780	ROGERS DITCH	21	596	43	3,609

#	Model ID	Name	Capacity (cfs)	2010 Irrigated Acreage	Average System Efficiency (%)	Average Annual Demand (af)
334	5300783	ROYAL FLUSH DITCH	5	57	31	604
335	5300800	SOUTH DERBY DITCH	32	574	32	5,266
336	5300883	WILSON AND DOLL DITCH	61	240	15	2,965
337	5301051	GLENWOOD L WTR CO SYS/GR [3]	11	0	36	0
338	5301082	MACFARLANE DITCH	5	91	56	485
339	53_ADC022	DIVERSION AGGREGATE	24	941	60	3,546
340	53_ADC023	DIVERSION AGGREGATE	30	1,244	60	4,613
341	53_ADC024	DIVERSION AGGREGATE	40	937	48	5,567
342	53_ADC025	DIVERSION AGGREGATE	35	554	45	3,292
343	53_ADC026	DIVERSION AGGREGATE	68	540	18	6,909
344	53_ADC028	DIVERSION AGGREGATE	96	1,735	38	11,982
345	53_ADC032	DIVERSION AGGREGATE	155	1,862	22	20,902
346	7000520	CITIES SERVICE PL AND PP [2]	100	0	100	0
347	7000521	CLEAR CREEK DITCH	50	38	2	4,502
348	7000530	CREEK AND NEWMAN DITCH	33	204	13	4,130
349	7000550	H V C AND S DITCH	24	273	33	2,313
350	7000558	KOBE CANAL [2]	50	0	100	0
351	7000571	NEW HOBO DITCH	12	221	51	1,022
352	7000580	RESERVOIR DITCH	37	373	12	6,688
353	7000583_D	ROAN CREEK NO 2 DIVSYS	18	218	15	3,040
354	7000584	ROAN CREEK NO 3 DITCH	16	198	22	2,245
355	7000596	UPPER ROAN CREEK DITCH	14	114	20	1,410
356	70FD1	FUTURE DEPLETION #1 [6]	999	0	60	0
357	70FD2	FUTURE DEPLETION #2 [6]	999	0	60	0
358	70_ADC049	DIVERSION AGGREGATE	110	1,571	22	16,986
359	70_ADC050	DIVERSION AGGREGATE	53	785	36	4,449
360	7200512_D	ARBOGAST PUMP DIVSYS	20	250	24	2,238
361	7200514	ARKANSAS DITCH	54	245	39	1,901
362	7200533	BERTHOLF LANHAM UPDIKE D	62	811	53	4,029
363	7200542	BONHAM BRANCH PIPELINE [2,3]	70	0	0	0
364	7200557	BULL BASIN HIGHLINE D	13	86	51	604
365	7200558	BULL CREEK DITCH	18	462	26	4,071
366	7200574	COAKLEY KIGGINS DITCH	16	586	56	2,659
367	7200580	COOK DITCH	14	299	52	1,632
368	7200583	COTTONWOOD BRANCH PL [2,3]	70	0	0	0

#	Model ID	Name	Capacity (cfs)	2010 Irrigated Acreage	Average System Efficiency (%)	Average Annual Demand (af)
369	7200607	EAKIN-SMITH DITCH	9	99	37	896
370	7200616	NEW ERIE CANAL	36	214	43	1,971
371	7200628	GALBRAITH DITCH	18	353	59	1,758
372	7200643	GOLDEN AGE DITCH	20	147	29	1,595
373	7200644	GRAND JCT COLO R PL [3]	23	0	36	3,151
374	7200645	GRAND VALLEY CANAL	650	17,405	16	284,843
375	7200646	GRAND VALLEY PROJECT [2]	1,672	0	0	0
376	7200646_I	GRAND VALLEY PROJECT	850	23,246	20	347,659
377	7200649	GROVE CR DITCH CO NO 1 D	18	433	52	2,352
378	7200652	GUNDERSON CARTER DITCH	12	152	60	771
379	7200703	HOOSIER DITCH	28	502	27	5,254
380	7200721	JOHNSON AND STUART DITCH	10	289	49	1,212
381	7200729	KIGGINS GOYN DITCH	17	254	48	1,870
382	7200730_D	KIGGINS SALISBURY DIVSYS	33	106	30	2,166
383	7200731	KING DITCH	22	430	39	3,461
384	7200744	LEON DITCH	17	401	60	1,605
385	7200746	LEON PARK FEEDER CANAL [2]	450	0	0	0
386	7200764	MARTINCRAWFORD-UTE [3]	8	0	36	149
387	7200764_I	MARTINCRAWFORD-UTE IRR	4	30	44	169
388	7200766	MASON EDDY-UTE [3]	7	0	36	396
389	7200766_I	MASON EDDY-UTE IRR	5	176	56	165
390	7200784	MESA CREEK DITCH	24	595	37	6,346
391	7200799	MORMON MESA DITCH	36	993	41	7,065
392	7200807	MOLINA POWER PLANT [3]	54	0	0	12,619
393	7200813	ORCHARD MESA IRR DIS SYS	461	3,997	16	63,905
394	7200813BP	OMID BYPASS [8]	1,072	0	0	720,000
395	7200813CH	ORCHARD MESA CHECK [8]	1,072	0	0	1,200,000
396	7200813PP	OMID HYDRAULIC PUMP [2]	272	0	0	87,282
397	7200813PW	USA PP-OM STIP [3]	1,255	0	0	409,397
398	7200816	PALISADE TOWN PL (RAPID) [3]	5	0	36	912
399	7200818	PALMER DITCH	22	455	21	4,609
400	7200820_D	PARK CREEK DIVSYS [2]	106	0	0	0
401	7200821	PARKER DITCH	14	331	51	1,977
402	7200823	PARK VIEW DITCH	12	206	38	1,732
403	7200831	PIONEER OF PLATEAU DITCH	15	73	8	2,426

#	Model ID	Name	Capacity (cfs)	2010 Irrigated Acreage	Average System Efficiency (%)	Average Annual Demand (af)
404	7200852_D	RMG DIVSYS	20	269	42	1,550
405	7200870	SILVER GAUGE DITCH	33	1,126	53	5,353
406	7200879	SOUTHSIDE CANAL [2]	240	0	0	0
407	7200911	TEMS DITCH	10	265	49	1,441
408	7200920	UTE PIPELINE HGT NO 2 [3]	50	0	36	0
409	7200933	WEST SIDE DITCH	14	1,050	56	4,000
410	7200938	WILDCAT DITCH (BIG CR)	28	751	42	5,294
411	7201233	UPPER HIGHT DITCH	19	86	18	1,785
412	7201329_D	RAPID CREEK PP DIVSYS [3]	12	0	36	0
413	7201330	COLORADO R PUMPING PLANT [1,8]	14	0	30	0
414	7201334	CARVER RANCH PIPELINE [3]	11	0	36	980
415	7201339	COON CREEK PIPELINE [3]	4	0	36	133
416	7201478	GETTY PIPELINE ALT PT [2]	56	0	0	0
417	7201487	MOLINA TAIL RACE [3]	50	0	36	0
418	7201523	PACIFIC OIL CO PL NO 1 [2]	57	0	0	0
419	7201574	CRUM-JOHNSON LATERAL	2	77	46	506
420	7202003	15-MILE_REACH_USFWS_DEMAND [9]	1,630	0	0	44,143
421	7202003_M	15-MILE FISH REQUIREMENT [9]	999	0	60	0
422	7204715	LEON TUNNEL CANAL [4]	54	0	100	1,583
423	7204721	OWENS CREEK DITCH [2,4]	20	0	0	0
424	72_ADC051	DIVERSION AGGREGATE	38	445	43	2,257
425	72_ADC052	DIVERSION AGGREGATE	29	891	34	4,683
426	72_ADC053	DIVERSION AGGREGATE	41	1,077	36	7,055
427	72_ADC054	DIVERSION AGGREGATE	45	531	35	3,928
428	72_ADC055	DIVERSION AGGREGATE	64	1,159	42	5,733
429	72_ADC056	DIVERSION AGGREGATE	29	659	42	3,556
430	72_ADC057	DIVERSION AGGREGATE	22	682	30	4,498
431	72_ADC058	DIVERSION AGGREGATE	23	350	23	3,436
432	72_ADC059	DIVERSION AGGREGATE	44	1,109	29	7,117
433	72_ADC060	DIVERSION AGGREGATE	41	1,465	36	8,239
434	72_ADC061	DIVERSION AGGREGATE	26	332	35	2,282
435	72_ADC062	DIVERSION AGGREGATE	33	771	34	4,274
436	72_ADC063	DIVERSION AGGREGATE	25	871	40	3,893
437	72_ADC064	DIVERSION AGGREGATE	12	57	7	1,860
438	72_ADC065	DIVERSION AGGREGATE	70	1,025	25	10,447
439	72_AMC001	72_AMC001 COLORADO RIVER [3,6]	999	0	60	0
440	72_GJMun	GRAND JUNCTION DEMANDS [3]	21	0	36	6,659

#	Model ID	Name	Capacity (cfs)	2010 Irrigated Acreage	Average System Efficiency (%)	Average Annual Demand (af)
441	72_UWCD	UTE WATER TREATMENT [3]	34	0	36	13,000
442	ChevDem	CHEVRON DEMAND NODE [3,6]	170	0	100	0
443	MoffatBF	MOFFAT_BASEFLOW [10]	24	0	0	0

1) Secondary Structure of a Multi-Structure Irrigation System
2) Reservoir Feeder or Carrier Ditch
3) Municipal/Industrial
4) Basin Export
5) Demand nodes that allow for release of excess HUP water in Williams Fork, Wolford, and Homestake Reservoirs
6) Future Modeling Node (no demand in Baseline dataset)
7) Historical diversions and water rights, but no acreage assigned in 2010.
8) Orchard Mesa Check/System
9) Fish demand node for historical releases from Ruedi Reservoir
10) Node used in baseflow generation diversion to Moffat Tunnel from Meadow Creek Reservoir

5.4.1.1 Key Structures

Key diversion structures were those modeled explicitly. The node associated with a key structure represents that single structure. In the Upper Colorado River Model, diversion structures with water rights totaling 11 cubic feet per second or more were generally designated key structures. They were identified by a seven-digit number, which was a combination of water district number and structure ID from the State Engineer's structure and water rights tabulations.

The majority of the diversion structures in the Upper Colorado River basin were used for irrigation. Structures diverting for non-irrigation use were noted in the table above and include structures that carry water to reservoirs or other structure's irrigation demands, municipal and industrial structures, and transbasin export structures.

Average historical monthly efficiencies for each structure appear in the diversion station file; however, StateMod operates in the "variable efficiency" mode for most irrigation structures, in which case, the values are not used during simulation. Efficiency in a given month of the simulation is a function of the amount diverted that month, and the consumptive use, as limited by the water supply.

For municipal, industrial, carriers, and transbasin diverters, StateMod uses the efficiencies in the diversion station file directly during simulation to compute consumptive use and return flows. Diversion efficiency was set to values consistent with the type of use based on engineering judgment, or, if available, user information. Municipal structures were assigned efficiencies that varied by month to reflect indoor and outdoor use patterns. Reservoir feeders and other carriers were assigned an efficiency of 0 percent, allowing their diversions delivered without loss. Exports from the basin were assigned an efficiency of 100 percent because there were no return flows to the basin.

Diversion capacity is stored in HydroBase for most structures and was generally taken directly from the database. Capacities and irrigated acreage were accumulated by StateDMI for defined diversion systems. In preparing the direct diversion station file, however, StateDMI determined whether historical diversion records indicated diversions greater than the database capacity. If so, the diversion capacity was modified to reflect the recorded maximum diversion.

Return flow parameters in the diversion station file specify the nodes at which return flows will re-enter the stream, and divided the returns among several locations as appropriate. The locations were determined primarily case-by-case based on topography, locations of irrigated acreage, and conversations with water commissioners and users.

Where to find more information

- When StateMod is executed in the "data check" mode, it generates an *.xtb file which contains summary tables of input. One of these tables provides the return flow locations and percent of return flow to each location, for every diversion structure in the model. Another table provides the information shown in Table 5.6.
- Section 4.2.1.1 describes how key structures were selected.
- Section 4.5.1 describes the variable efficiency approach for irrigation structures, and describes how diversions, consumptive use, and efficiency interact in the model for different types of structures.

5.4.1.2 Aggregate Structures

Small structures within specific sub-basin were combined and represented at aggregated nodes. Aggregated irrigation structures were given the identifiers "WD_ADCxxx", where "WD" was the Water District number, and "ADC" stands for Aggregated Diversions Colorado; the "xxx" ranged from 001 to 065. Similarly, aggregated municipal and industrial structures were named "WD_AMCxxx" for Aggregated Municipal Colorado.

For the one aggregated M&I diversion, efficiency was not set because this structure was not used but had been retained for future scenarios.

Where to find more information

- Section 4.2.1.2 describes how small irrigation structures were aggregated into larger structures
- Appendix A – Task 10 Memorandum describes the Colorado aggregation, updated from the 2000 irrigated acreage assessment.

5.4.1.3 Special Structures

Grand Valley Area Water Demand (Cameo Call)

The Grand Valley Area is situated adjacent to the Upper Colorado River near the City of Grand Junction, extending a distance of about 35 miles from the diversion dam for the Government Highline Canal to the end of the irrigated area near West Salt Creek. Two large systems, the Grand Valley Irrigation Company and the Grand Valley Project, provide the majority of the irrigation water for the Grand Valley.

These two major systems provide irrigation water to over 75,000 acres in the valley. Because of the seniority of the water rights in these systems, and as a result of the operations of Green Mountain Reservoir, these systems generally receive a full supply of water. The amount of water available for diversion by these two systems is typically represented by the flow in the Colorado River at the Cameo stream gage (USGS Gage 09095500) and the flows of Plateau Creek; the cumulative demands are often referred to as the Cameo Demand.

There are two main structures that divert from the mainstem of the Colorado River; the Grand Valley Project (7200646, Grand Valley Water Users Association) and the Grand Valley Canal (7200645, Grand Valley Irrigation Company). The Grand Valley Project (7200646) is modeled as a carrier structure, which delivers water to the following modeled diversion demand structures:

WDID	Name
7200813	Orchard Mesa Irrigation District (OMID)
7200646_I	Grand Valley Project
7200813PW	USA Power Plant
7200813PP	OMID Hydraulic Pump

Additional diversion structures associated with, but not receiving water directly from the Grand Valley Project are the OMID Bypass and Check structures. These two structures allow the model to operate the agreements in the OMID Check Case No. 91CW247:

WDID	Name
7200813CH	Orchard Mesa Check
7200813BP	OMID Bypass

The structures in the above two tables are non-consumptive structures except 7200813 and 7200646_I which deliver water to irrigated acreage.

Through mutual agreements between the Grand Valley Canal (7200645) and the Grand Valley Project (7200646), the two irrigation systems can be operated in a manner to enhance the delivery of water at times when the total river flow (Upper Colorado River plus Plateau Creek) is insufficient to meet the cumulative Cameo demand of approximately 2,260 cubic feet per second. To avoid a situation in which the senior water rights of the Grand Valley Canal (7200645) call out the more junior water rights of the upstream Grand Valley Project (7200646), return flows from the power diversions at the USA Power Plant and the OMID Pump can be physically returned to the Upper Colorado River at a location upstream of the headgate of the Grand Valley Canal (7200645). This is accomplished by utilizing a movable structure known as the Orchard Mesa Check (7200813CH).

Continental-Hoosier Tunnel

The Continental-Hoosier Diversion System diverts water from several tributaries at the headwaters of the Blue River (near Hoosier Pass) and delivers it through the Hoosier Pass Tunnel into Montgomery Reservoir in the headwaters of the Middle Fork of the South Platte River (Division 1). The collection and diversion facilities and the pertinent water rights are owned by the City of Colorado Springs, which uses the diversions as a major source of municipal water supply. The demand sits at the Continental Hoosier Summary Node (3604683SU) and water is carried to the demand from Continental Hoosier System Blue River Diversion (3604683), Continental Hoosier Tunnel (3604699), and from storage in Continental Hoosier Upper Blue Lakes (3603570).

The approximate capacity of the Continental Hoosier Tunnel is 500 cubic feet per second. Transmountain diversions through the Tunnel are measured and recorded at the east portal of the tunnel. Records of the historical diversions were obtained from the Division of Water Resources database, supplemented by USGS records.

Boustead Tunnel

Charles H. Boustead Tunnel extends approximately 5.4 miles under the Continental Divide and is used to convey water collected at the project facilities in the headwaters of the Fryingpan River and Hunter Creek to Turquoise Lake in the Arkansas River drainage. The rated capacity of the 10.5 foot diameter tunnel is 945 cubic feet per second. Transmountain diversions through the Boustead Tunnel are measured and recorded at the east portal of the tunnel. Records of the historical diversions were obtained from the Division of Water Resources database, supplemented by USGS records.

The North Side Collection System is designed to divert, collect and transport an average of about 18,400 acre-feet of water annually through facilities at Mormon, Carter, Ivanhoe, Granite, Lily Pad, North Cunningham, Middle Cunningham and South Cunningham Creeks. This collection system consists of diversion structures on each of the major tributaries of the North Fork of the Fryingpan River and a series of tunnels (Carter Tunnel, Mormon Tunnel, Cunningham Tunnel and Nast Tunnel) to deliver the water to the west portal of the Boustead Tunnel. The diversions at each of the tributaries are measured and recorded by the division engineer in cooperation with the USBR and the Southeastern Colorado Water Conservancy District (SECWCD). The diversion locations are modeled by North & South Boustead Collection (3804625).

The South Side Collection System is designed to transport an average of 50,800 acre-feet of water annually from the Fryingpan and Roaring Fork river basins. Facilities located on No Name, Midway and Hunter Creeks are used to collect water in the headwaters of the Hunter Creek basin for delivery via the Hunter Tunnel to the Fryingpan River basin, which in turn is delivered to the Boustead Tunnel. Additional facilities on Sawyer Creek, Chapman Creek, the South Fork of the Fryingpan River, and the mainstem of the Fryingpan are used to collect and transport water from the tributaries to the west portal of the Boustead Tunnel. The diversions at each of the tributaries are measured and recorded. The operating principles provide for minimum bypass requirements at each of the diversion structures on the South Side Collection System (except Sawyer Creek). The diversion locations are modeled by North & South Boustead Collection (3804625) and Hunter Collection (3801594).

The total Boustead Tunnel demand is located at Boustead Summary (3804625SU). Water is carried to this demand from the two collection nodes North & South Boustead Collection (3804625) and Hunter Collection (3801594) along with reservoir water exchanged to the collection nodes from Ruedi Reservoir (3803713).

Municipal Diversion Structures

In the historical and calibration simulations of the CRDSS Upper Colorado River Model, historical diversions for municipal uses are utilized and were generated using data from the State database and/or user-supplied data. For future operations under the CRDSS Baseline simulation, the monthly municipal demands were estimated to be equivalent to the monthly average values for the time period 1998 through 2013. The municipal structures included in the CRDSS Upper Colorado River Model are as follows:

WDID	Name
3600784	Rankin No 1 Ditch
3600829	Straight Creek Ditch
3601008	Breckenridge Pipeline
36_KeyMun	Keystone Municipal
3700708	Metcalf Ditch
37VAILMUN	Vail Valley Consolidated
3800854	Maroon Ditch
3800869	Midland Flume Ditch
3801052	Carbondale Wtr Sys & Pl
3801441	East Snowmass Brush C Pl
3900967	Rifle Town Of Pump & Pl

WDID	Name
4200520	Grand Jct Gunnison Pl
5300585	Glenwood L Water Co Sys
5301051	Glenwood L Water Co Sys
7200542	Bohnam Branch Pipeline
7200583	Cottonwood Branch Pipeline
7200644	Grand Jct Colo R Pl
7200766	Mason Eddy-Ute
7200764	Martin Crawford Ditch
7200784	Mesa Creek Ditch
7200816	Palisade Town Pl (Rapid)
7200920	Ute Pipeline Hgt No 2
7201329_D	Rapid Creek Pp DivSys
7201334	Carver Ranch Pipeline
7201339	Coon Creek Pipeline
7201487	Molina Tail Race/Ute Pipeline Hgt No 1
72_UWCD	Ute Water Treatment
72_GJMun	Grand Junction Demands

Municipal water use does not constitute a significant depletion to the natural streamflow since much of the water returns to the stream as domestic wastewater and/or urban irrigation return flows.

Municipal Monthly Efficiencies (%)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
10	12	14	44	55	62	61	56	44	26	0	10

Return flow patterns from municipal uses were based on the return flow analysis performed for the CRDSS. Locations of return flows were determined from inspection of topographic mapping and through interviews with the water users.

Operations of complex augmentation plans were not included in the CRDSS Upper Colorado River Model. Efforts have been made to simplify the municipal operations, including diversions. This was justified in that the municipal usage and depletions were relatively small.

Redlands Power Canal

The Redlands Canal physically diverts water from the Gunnison River (Division 4) and its diversions are not affected by administration of the more junior water rights on the mainstem of the Upper Colorado River (Division 5) downstream of Gunnison. However, the irrigated lands under the Redlands Canal are located in the Upper Colorado River basin and the return flows from irrigation and from hydroelectric power generation accrue to the Upper Colorado River downstream of Grand Junction. The canal serves about 1,800 acres and is owned and operated by the Redlands Water and Power Company.

During the summer irrigation season, the Redlands Canal is normally operated to divert about 610 cubic feet per second for power generation and about 60 cubic feet per second for irrigation use. During the non-irrigation season, the system is operated to divert up to 750 cubic feet per second solely for hydroelectric power generation. Hydroelectric and irrigation demands are modeled separately due to differences in consumptive use, return flow patterns, and return flow locations. The hydroelectric demands are modeled at node 4200541 and irrigation demands at 4200541_I.

Silt Project

The Silt Project is located in west-central Colorado near the Towns of Rifle and Silt. The Project was authorized in 1956 in accordance with the Colorado River Storage Project Act and was constructed by the USBR from 1964 to 1967. The Project is operated to provide a supplemental supply of irrigation water for approximately 2,042 acres and a full service supply to 2,830 acres on the north side of the Upper Colorado River.

The main features of the Silt Project include Rifle Gap Dam and Reservoir on Rifle Creek and the Silt Pump Plant on the mainstem of the Upper Colorado River. The project enhances the use of existing irrigation facilities owned by the Farmers Irrigation Company—including the Grass Valley Canal, Grass Valley Reservoir (a.k.a Harvey Gap Reservoir), the East Lateral, and the West Lateral.

Project acreage and demands are located at Dry Elk Valley Irr (3900563_I) and Farmers Irrigation Comp (3903505_I). The carrier structure Grass Valley Canal (3900563) delivers water from East Rifle Creek and water exchanged from Rifle Gap Reservoir to both demand locations and Grass Valley Reservoir (3903505). Farmers Irrigation Comp (3903505_I) receives additional water from Grass Valley Reservoir and from the Colorado River via the carrier structure Silt Pump (3900663).

15-Mile Endangered Fish Reach

The reach of the Upper Colorado River between the headgate of the Grand Valley Irrigation Canal (GVIC) and the confluence of the Upper Colorado River and the Gunnison River is often referred to as the 15-Mile Reach. This reach is considered a critical flow reach for the protection of endangered fish species because the river can be physically dried up at the GVIC headgate. The USFWS recommended flows for the months of July through October are 1,630 cubic feet per second, 1,240 cubic feet per second, and 810 cubic feet per second under wet, average, and dry hydrologic conditions. In 1997, the Recovery Implementation Program – Recovery Action Plan (RIPRAP) was developed and set aside storage within the Upper Colorado River Basin to be released to the 15-Mile Reach during times of low flows.

During the period August 1991 through September 1996, releases were made from the Colorado Water Conservation Board's contract water in the regulatory capacity of Ruedi Reservoir to provide supplemental flows to the 15-Mile Reach. In the Historic simulation, releases from Ruedi Reservoir are modeled using the 15-Mile Fish Requirement (7202003_M) diversion node from August 1991 through September 1996.

For water years 1997 through 2013 in the Historical simulation and for the entire study period in the Baseline simulation, the fish requirements are modeled using a USFWS Recommended Fish Flow diversion node—7202003. The fish demand is from several fish pools in reservoirs throughout the basin (see section 5.9.19).

Excess HUP Demand Structures

The operations of the Blue River Decree and supplemental agreements allow Denver and Colorado Springs to replace water stored out-of-priority to Green Mountain Reservoir from their reservoir supplies, including Dillon Reservoir, Wolford Mountain Reservoir and Williams Fork Reservoir. Future agreements and/or decrees may allow Colorado Springs to replace water from Homestake Reservoir. Obligated water is released from these reservoirs to make replacements to all uses of Green Mountain Reservoir in lieu of releasing water from Green Mountain Reservoir. Historical and future operations of these alternate sources of replacement water requires replacements be made in the current year. To ensure that complete replacement is made in the current year from these reservoirs, four additional structures were added, one for each reservoir, Wolford HUP Release Node (5003668HU), Williams Fork HUP Release Node (5103709HU), Homestake HUP Release Node (3704516HU), and Dillon HUP Release Node (3604512HU). These nodes are non-consumptive and return water to the next downstream node acting as a release to target for a specific reservoir account.

Future Reservoir Demand Structures

Several diversion structures in the network are “placeholders” for modeling future anticipated reservoir demands in the Upper Colorado River basin. Strictly speaking, they are not part of the Baseline dataset because their demands are set to zero or their rights are either absent or decree limits are set to zero. The structures that fall into this category include:

WDID	Name
3803713M3	Ruedi Addl Demand
3903943	Parachute Creek Reservoir
5003668MP	Wolford Mid Park Demand
5003668MK	Wolford Market Demand
7003602	Roan Creek Reservoir

Future Depletions

Several diversion structures in the network are “placeholders” for modeling future anticipated demands in the Upper Colorado River basin. Strictly speaking, they are not part of the Baseline dataset because their demands are set to zero or their rights are either absent or decree limits are set to zero. The diversion structures that fall into this category include:

WDID	Name
72_AMC001	72_AMC001 Colorado River
70FD1	Future Depletion #1
70FD2	Future Depletion #2
ChevDem	Chevron Demand

5.4.2. Return Flow Delay Tables (*.dly)

The cm2015.dly file, which was hand-built with a text editor, describes the estimated re-entry of return flows into the river system. The irrigation return patterns are based on Glover analysis for generalized characteristics of the alluvium, and have been applied in other west slope basin models. The return flow patterns also account for surface water returns. Percent return flow in the first month for the Glover-derived patterns are adjusted to reflect 3 percent loss of returns due to non-crop consumption or evaporation, termed “incidental losses.” In all cases, these lag times represent the combined impact of surface and subsurface returns.

The 3 percent of non-consumed water, used to represent incidental loss, is based on a recommendation used in the Upper Colorado River Consumptive Uses and Losses Report, developed for the Colorado Water Conservation Board (Consumptive Uses and Losses Report, Comparison between StateCU CU & Losses Report and the USBR CU & Losses Report (1998-1995), October 1999, Leonard Rice Engineers). In the CU and Losses Report, incidental losses were estimated to be 10 percent of basin-wide crop consumptive use. However, StateMod applied a loss factor to unused diverted water, not crop consumptive use. Therefore, an equivalent loss factor was developed for non-consumed diverted water from the results of the StateCU consumptive use analyses performed in support of the Upper Colorado River Model as follows:

StateCU Total Basin Crop Consumptive Use (Ave 1975 – 2004) = 453,940 acre-feet

Incidental loss = 10% of Total Crop CU = 45,394 acre-feet

StateCU Unused Water (Ave 1975 – 2004) = 1,472,033

Incidental Loss as percent of Unused Water = 45,394 / 1,472,033 = 3%

Four of the seven patterns available in this file are used in the Upper Colorado River Model, as shown in Table 5.7. Pattern 1 represents returns from irrigated lands relatively close to a live stream or drain (<1,200 feet). Pattern 2 is used for irrigation further from a live stream (>1200 feet). Pattern 3 represents ground water returns to Long Hollow from irrigation on Red Mesa in the San Juan River Basin (not used in the Upper Colorado River Model). Pattern 4 represents immediate returns, as for municipal and industrial uses. Pattern 5 is applicable to snowmaking diversions. Pattern 6 and 7 are previous patterns 1 and 2 without consideration of incidental losses (not used in the Upper Colorado River Model).

Table 5.7
Percent of Return Flow Entering Stream in Months Following Diversion

Month n	Pattern 1	Pattern 2	Pattern 3	Pattern 4	Pattern 5	Pattern 6	Pattern 7
1	75.6	57.4	53.8	100	0	78.6	60.4
2	11.3	14.5	5.6	0	0	11.3	14.5
3	3.2	7.2	3.6	0	0	3.2	7.2
4	2.2	5.0	2.9	0	0	2.2	5.0
5	1.6	3.7	2.5	0	100	1.6	3.7
6	1.2	2.7	2.2	0	0	1.2	2.7
7	0.8	2.0	2.0	0	0	0.8	2
8	0.6	1.5	1.8	0	0	0.6	1.5
9	0.5	1.1	1.8	0	0	0.5	1.1
10	0	0.8	1.6	0	0	0	0.8
11	0	0.6	1.6	0	0	0	0.6

12	0	0.5	1.5	0	0	0	0.5
13 – 14	0	0	2.8	0	0	0	0
15 - 36	0	0	13.3	0	0	0	0
Total	97	97	97	100	100	100	100
Note: Month 1 is the same month as diversion							

Where to find more information

- Section 4.6.1 describes how irrigation return flow delay patterns were developed.

5.4.3. Historical Diversion File (*.ddh)

The historical diversion file contains time series of diversions for each structure. The file was created by StateDMI, which filled missing records as described in Section 4.4.2. StateMod uses the file for baseflow estimations at stream gage locations, and for comparison output during calibration.

The file was referenced by StateDMI when developing the headgate demand time series for the diversion demand file.

5.4.3.1 Key Structures

For most explicitly modeled irrigation and M&I structures, StateDMI accessed HydroBase for historical diversion records. Historical diversions were accumulated by StateDMI for defined diversion systems. For certain structures, the data was assembled from other sources or developed from database data into a time-series file which StateDMI read. These included the Moffat Tunnel and Fraser River Diversion Project plus other larger diverters as follows:

WDID	Name
3600784	RANKIN NO 1 DITCH
3600829	STRAIGHT CREEK DITCH
3600841	TENMILE DIVERSION NO 1
3600908	KEYSTONE SNOWLINE DITCH
3601008	BRECKENRIDGE PIPELINE
3601016	COPPER MTN SNOWMAKING

WDID	Name
36GMCON	GREEN MTN CONTRACT DEMAND
36_KeyMun	KEYSTONE MUNI
3700708	METCALF DITCH
37VAILIRR	VAIL VALLEY CONSOLIDATED
37VAILMUN	VAIL VALLEY CONSOLIDATED
3800757	HOME SUPPLY DITCH
3800869	MIDLAND FLUME DITCH
3801052	CARBONDALE WTR SYS & PL
3801441	EAST SNOWMASS BRUSH C PL
3801594	FRY ARK PR HUNTER TUNNEL
3804625	FRY ARK PR BOUSTEAD TUNL
3900563_I	DRY ELK VALLEY IRRIGATION
3903505_I	FARMERS IRRIGATION CO
4200520	GRAND JCT GUNNISON PL
4200541	REDLANDS POWER CANAL
4200541_I	REDLANDS POWER CANAL IRR
4500969	BLUESTONE VALLEY DITCH
5100529_D	BIG LAKE DIVERSION SYSTEM
5100639	FRASER RIVER DIVR PROJ
5100728	HAMILTON-CABIN CR DITCH
5100941	VAIL IRRIGATION
5100958	C-BT WILLOW CREEK FEEDER
5101070	HENDERSON MINE WTR SYS
5101269	FRASER RIVER DIVR PROJ
5101309_D	FRASER RIVER DIVR PROJ
5101310	FRASER RIVER DIVR PROJ
5104700	WINDY GAP PUMP PL CANAL
5300584	SHOSHONE POWER PLANT
7200542	BONHAM BRANCH PIPELINE
7200583	COTTONWOOD BRANCH PL
7200628	GALBRAITH DITCH
7200644	GRAND JCT COLO R PL
7200646_I	GRAND VALLEY PROJECT
7200729	KIGGINS GOYN DITCH

WDID	Name
7200766	MASON EDDY UTE
7200746	LEON PARK FEEDER CANAL
7200764_I	MARTIN CRAWFORD
7200766	MASON EDDY DITCH - MUNI
7200766_I	MASON EDDY DITCH - IRRIGATION
7200784	MESA CREEK DITCH
7200799	MORMON MESA DITCH
7200807	MOLINA POWER PLANT
7200813	ORCHARD MESA IRR DIS SYS
7200816	PALISADE TOWN PL (RAPID)
7200820_D	PARK CREEK DIVSERION SYS
7200821	PARKER DITCH
7200823	PARK VIEW DITCH
7200831	PIONEER OF PLATEAU DITCH
7200852_D	RMG DIVERSION SYSTEM
7200879	SOUTHSIDE CANAL
7200920	UTE PIPELINE HGT NO 2
7201334	CARVER RANCH PIPELINE
7201339	COON CREEK PIPELINE
7204715	LEON TUNNEL CANAL
7200813PW	USA POWER PLANT
7200813CH	ORCHARD MESA CHECK
7200813PP	OMID HYDRAULIC PUMP
72_GJMun	GRAND JUNCTION DEMANDS
7202003_M	15-MILE FISH REQS.

The following carrier, summary, and future use structures have their diversions set to zero. For carrier structures, the demands are represented at the end-user demands nodes:

WDID	Name
3600606	ELLIOTT CREEK FEEDER
3604512HU	EXCESS HUP (DILLION)
3701146	WOLCOTT PUMPING PIPELINE
3704516HU	EXCESS HUP (HOMESTAKE)
3704643	HOMESTAKE PROJ CONDUIT

WDID	Name
3900710	DRAGERT PL
3900712	EATON PL
3900728	PUMPING PL UNION OIL CAL
5003668HU	EXCESS HUP (WOLFORD)
5103709HU	EXCESS HUP (WILLIAMS FORK)
7000520	CITY SERVICE PL
7000558	KOBE CANAL
7201478	GETTY PL
7201523	PACIFIC PL
7202003	15 MILE FISH REQ.

Historical diversions for the following transbasin structures were extracted from USGS or DNR streamflow records in HydroBase, as shown, which are more complete than records stored in HydroBase under the WDID.

WDID	Name	USGS or DNR Streamflow Gage
3604626	VIDLER TUNNEL COLL SYS	09047300
3604684	BLUE RIVER DIVR PROJECT	09050590
3604685	BOREAS NO 2 DITCH	09046000
3704614	HOMESTAKE PROJ TUNNEL	09063700
3704641	COLUMBINE DITCH	09061500
3704642	EWING PLACER DITCH	09062000
3704648	WARREN E WURTS DITCH	09062500
3804613	IVANHOE RESERVOIR TUNNEL	09077500
3804617	IND P TM DVR TUNNEL NO 1	09073000
5104601	GRAND RIVER DITCH	09010000
5104603	WILLIAMS FORK TUNNEL[1]	APGTUNCO
5104625	BERTHOUD CANAL TUNNEL	09021500
5104634	C-BT ALVA B ADAMS TUNNEL[2]	09013000
5104634	C-BT ALVA B ADAMS TUNNEL[2]	ADANETCO
5104655	MOFFAT WATER TUNNEL[1]	09022500
364683SU	CONTINENTAL HOOSIER TUNNEL	HSPTUNCO

1) Streamflow gage data used in calculations for the Moffat System
2) Streamflow gage ID for the Adams Tunnel changed in October 1996 from 09013000 to ADANETCO

5.4.3.2 Aggregate Structures

Aggregated irrigation structures were assigned the sum of the constituent structures' historical diversion records from HydroBase.

5.4.3.3 Special Structures

Collbran Project

Constructed by the USBR during 1957-1962, the Collbran Project is a multi-use water project designed to develop the surplus water supplies in the Plateau Creek basin. Main components of the Project include, the Vega Dam and Reservoir, the Leon-Park Creek Feeder Canal, the Southside Canal, Bonham Dam and Reservoir, East Fork Diversion Dam and Feeder Canal, the Bonham-Cottonwood Pipeline, and the Upper/Lower Molina penstock and power plants. The Project is used to generate hydro-electric power, provide storage in several small privately owned storage facilities, and irrigate acreage adjacent to Plateau Creek and a number of its tributaries.

The Project acreage is served by senior water rights on the tributaries, plus received project water from Vega Reservoir via the Southside Canal. Southside Canal delivers water directly through more than 50 individual canal headgates plus releases water to the individual tributaries to be picked up at the structure river headgates. The diversion data from the individual Southside Canal headgates for the period 2004 through 2009 was provided by the Collbran Water Conservancy District, along with the acreage association between the canal headgates and the primary river structure. Starting in 2010, data for the canal headgates is now recorded and stored in HydroBase. For baseflow calculations, the diversions from the Southside Canal headgates and the tributary structure headgates were combined in the historical diversion file.

Where to find more information

- The feasibility study for the data extension is documented in two task memos, which were collected in the CDSS *(Technical Papers)*:

  -Data Extension Feasibility

  -Evaluate Extension of Historical Data

5.4.4. Direct Diversion Demand File (*.ddm)

Created by StateDMI, this file contains time series of demand for each structure in the model. Demand is the amount of water the structure "wanted" to divert during simulation. Thus demand differs from historical diversions, as it represents what the structure would divert in order to get a full water supply. Table 5.6 in Section 5.4.1 lists average annual demand for each diversion structure. Note that the Baseline demands do not include demands associated with conditional water rights.

5.4.4.1 Key Structures

Irrigation demand was computed as the maximum of crop irrigation water requirement divided by average monthly efficiency for the structure or historical diversions. Note that the irrigation water requirement is based on actual climate data beginning in 1975. Prior to that, it was filled using the automatic data filling algorithm described in Section 4.4.2. Monthly efficiency is the average system (combined conveyance and application) efficiency over the efficiency period (1975 through 2013) but capped at 0.54.

Transbasin and municipal and industrial demands were set to recent values or averages of recent records for the entire simulation period.

5.4.4.2 Aggregate Structures

Aggregated irrigation structure demand was computed as for key irrigation structures. The only difference is that the irrigated acreage, which was the basis of irrigation water requirement, is the sum of irrigated acreage for constituent structures. Similarly, filled diversions are summed across all constituent structures, and average efficiency is based on efficiency of the aggregation as a unit. As discussed above, there is no demand assigned to the aggregated M&I structure.

5.4.4.3 Special Structures

Grand Valley Area Water Demand (Cameo Call)

Total demands for the Grand Valley Project, Orchard Mesa Irrigation District, and USA Power are located at their individual "demand" nodes and the carrier structure Grand Valley Project (7200646) was set to zero. Grand Valley Project (7200646_I) irrigation demand was calculated based on irrigation water requirement extending throughout the study period. OMID Pump (7200813PP) demands were filled using the dry, average, and wet demands determined for the period 1975 through 1991, and extended to the entire model period of 1909 through 2013. The Orchard Mesa Check (7200813CH) demand was set to 100,000 acre-feet per month and the OMID Bypass (7200813BP) demand was set to 60,000 acre-feet per month. The USA Power

Plant (7200813PW) demand was set to 800 cubic feet per second during the winter (November through March) and 400 cubic feet per second during the summer (April through October).

Transbasin Demands

The techniques used to fill the transbasin diversion demands are based on what was done previously for each individual transbasin diversion during the last model update. The following transbasin diversion demands were set to average monthly diversions over the period 1998 through 2013 for the entire model period of 1909 through 2013.

WDID	Name
3604626	VIDLER TUNNEL COLL SYS
3604685	BOREAS NO 2 DITCH
3704642	EWING PLACER DITCH
3704641	COLUMBINE DITCH
3704648	WARREN E WURTS DITCH
3804613	IVANHOE RESERVOIR TUNNEL
5104625	BERTHOUD CANAL TUNNEL

The following transbasin diversion demands were filled using the dry, average, and wet demands determined for the period 1975 through 1996, and extended to the entire model period of 1909 through 2013.

WDID	Name
3804617	IND P TM DVR TUNNEL NO 1
3704614	HOMESTAKE PROJECT TUNNEL

The Blue River Diversion Project (3604684, aka Roberts Tunnel) and the Moffat Water Tunnel (5104655) demands for 1947 through 1991 were provided by the Denver Water Board. Demands from 1992 through 2013 were filled using historical diversions and demands from 1909 through 1946 were filled using the dry, average, and wet demands.

The Continental Hoosier Tunnel (3604683SU) demand for 1952 through 2005 was provided by Colorado Springs. Missing demands were filled using wet, dry, average, demands.

The C-BT Alva B Adams Tunnel (5104634) and Windy Gap (5104700) demands for 1950 through 1996 were provided by the Northern Colorado Water Conservancy

District. Demands were filled using historical diversions when available, and using the dry, average, and wet demands.

Municipalities and Industrial Demands

Municipal demands in the baseline dataset were based on average monthly diversions over the recent period 1998 through 2013 for the entire model period of 1909 through 2013.

WDID	Name
3600784	RANKIN NO 1 DITCH
3600829	STRAIGHT CREEK DITCH
3601008	BRECKENRIDGE PIPELINE
36_KeyMun	KEYSTONE MUNICIPAL
3700708	METCALF DITCH
37VAILIRR	VAIL VALLEY CONSOLIDATED
37VAILMUN	VAIL VALLEY WATER-NONIRR
3801052	CARBONDALE WTR SYS & PL
3801441	EAST SNOWMASS BRUSH C PL
3900967	RIFLE TOWN OF PUMP & PL
4200520	GRAND JCT GUNNISON PL
5300585	GLENWOOD L WATER CO SYS
7200644	GRAND JCT COLO R PL
7200816	PALISADE TOWN PL (RAPID)
72_GJMun	GRAND JUNCTION DEMANDS

Industrial demands were filled on an individual basis based on previously used techniques. Henderson Mine (5101070) was set to the 1993 through 2013 average depletion. Molina Power Plant (7200807), Redlands Power Canal (4200541), and the Shoshone Power Plant (5300584) were set to their average demand over the period 1993 through 2013. Maggie Pond (3600989), used for snowmaking at Breckenridge Ski Area, was filled with zeros for all months except November, which was set to 250 acre-feet. Tenmile Diversion No. 1 (Climax) (3600841) was filled with zeros because the mine was no longer in operation. Snowmaking demands at Keystone (3600908) and Copper Mountain (3601016) were set to the average monthly values for the most recent thirteen years (2000 through 2013). Demands for Ute Water Treatment (72_UWCD) were provided by the Ute Water Conservancy District.

Silt Project

Project demands are located at Dry Elk Valley Irr (3900563_I) and Farmers Irrigation Comp (3903505_I) and were computed as for key irrigation structures based on crop demand. Demands for the carrier structures Grass Valley Canal (3900563) and Silt Pump (3900663) were set to zero and operating rules pull water through these structures to the demand locations.

15-Mile Endangered Fish Reach

The 15-Mile Fish Requirement (7202003_M) demand was set to zero and the Baseline demand was modeled by an instream flow node USFWS Recommended Fish Flow (7202003).

Excess HUP Demand Structures

The four excess HUP demand structures, Wolford HUP Release Node (5003668HU); Williams Fork HUP Release Node (5103709_M); Homestake HUP Release Node (3704516HU); and Dillon HUP Release Node (3604512HU), all have constant demands of 999999 acre-feet. These high demands ensure that excess HUP water is released from the reservoirs based on operating rules.

Reservoir Demand Structures

Green Mountain Hydro-Electric (3600881) and Williams Fork Power Conduit (5101237) have baseline demands based on their average use from 1993 through 2013. Green Mountain Contract Water (36GMCON) demand is based on the 2006 monthly user release schedule and an annual demand of 4,020 acre-feet.

Wolford Mountain Reservoir demands from Fraser Basin (5003668FR) and Middle Park (5003668MP) are based on an analysis over the period of 1953 through 1994 from "Wolford Mountain Reservoir - Assessment of Reservoir Operations and Hydrologic Impacts", February 1997, provided by CRWCD. A Market (5003668MK) demand was added based on the C1 version 5 dataset. These demands were filled using the dry, average, and wet patterns and extended to the entire model period of 1909 through 2013.

Ruedi Reservoir demands, which include Round 1 Municipal (3803713M1), Round 1 Industrial (3803713I1), Round 2 Municipal (3803713M2), Round 2 Industrial (3803713I2), and Additional Demand (3803713M3), were filled with constant annual demands. Round 1 and Round 2 demands are based on the C1 version 5 dataset. The additional demand node was set to zero and can be modified for future scenarios.

Future Depletions

Demands for future depletion nodes (70FD1, 70FD2, ChevDem, 7000520, and 3900728) were set to zero, as they were not active in the Baseline dataset. These nodes can be used for future scenarios.

Carrier Structures and Multistructures

Most demands for carrier structures and secondary components of multistructures were set to zero in the Baseline dataset. Operating rules are used to carry water from these structures to satisfy demands at destination structures or reservoirs. The following carriers have demands in the Baseline dataset:

- Windy Gap Pump (5104700)
- Willow Creek Feeder (5100958)
- Mason Eddy (7200766)
- Martin Crawford (7200764)

The Windy Gap Pump and the Willow Creek Feeder both deliver water to Granby Reservoir using the Type 14 operating rule that requires demands at the diverting structure. Similarly, the Mason Eddy Ditch and the Martin Crawford Ditch deliver water to the Ute Water Conservancy District using a Type 14 operating rule.

WDID	Name
3600606	ELLIOTT CREEK FEEDER
3600832	SUTTON NO 1 DITCH
3600841	TENMILE DIVERSION NO 1
3704643	HOMESTAKE PROJ CONDUIT
3801594	FRY ARK PR HUNTER TUNNEL
3804625	FRY ARK PR BOUSTEAD TUNL
3900563	GRASS VALLEY CANAL
3900663	SILT PUMP CANAL
5100639	FRASER RIVER DIVR PROJ
5100728	HAMILTON-CABIN CR DITCH
5101231	VAIL IRRIGATION SYSTEM – MEADOW
5101269	FRASER RIVER DIVR PROJ
5101309_D	FRASER RIVER DIVR PROJ
5101310	FRASER RIVER DIVR PROJ
5104603	WILLIAMS FORK TUNNEL
5200731	NOTTINGHAM PUMP

WDID	Name
7200542	BONHAM BRANCH PIPELINE
7200583	COTTONWOOD BRANCH PL
7200646	GRAND VALLEY PROJECT
7200746	LEON PARK FEEDER CANAL
7200820_D	PARK CREEK DIV SYS
7200879	SOUTHSIDE CANAL
7200920	UTE PIPELINE HGT NO 2
7201329_D	RAPID CREEK PP DIV SYS
7201330	COLORADO R PUMPING PLANT
7201487	UTE PIPELINE HGT NO 1
7204721	OWENS CREEK DITCH
MoffatBF	MOFFAT BASEFLOW

5.4.5. Direct Diversion Right File (*.ddr)

The direct diversion right file contains water rights information for each diversion structure in the model. StateDMI created the diversion right file based on the structure list in the diversion station file. Note that the Baseline direct diversion right file does not include conditional water rights. It is recommended for future updates that the StateDMI commands be run initially without the "set" commands. This allows the modeler to view any changes to water rights (transfers, conditional to absolute, abandonment, etc.) reflected in updated versions of HydroBase and modify the "set" commands as necessary.

The information in this file is used during simulation to allocate water in the right sequence or priority and to limit the allocation by decreed amount. The file is also an input to StateDMI when filling historical diversion time series. Based on the appropriation dates expressed in the administration number located in the rights file, StateDMI determines the total amount of the water right during the time of the missing data in the Historical dataset, and constrains the diversion estimates accordingly. For example, suppose a ditch has two decrees, one for 2.5 cubic feet per second with an appropriation date of 1886, and the other for 6 cubic feet per second with an appropriation data of 1932. When StateDMI estimates diversions prior to 1932, it limits them to a maximum rate of 2.5 cubic feet per second for the month, regardless of the average from available diversion records. This approach was adopted so the water development of the historical study period could be simulated. The Baseline dataset is not limited to the historical diversion rights but rather incorporates the current right regime of the river.

All diversion rights were set “on” in the Upper Colorado River Model. Operating rules and/or demands are used to limit direct diversion rights for some structures, for example structures that only carry water to demands at other structures.

5.4.5.1 Key Structures

Water rights for explicitly modeled structures were taken from HydroBase and match the State Engineer’s official water rights tabulation. Water rights for each individual structure in a diversion system are included under the defined diversion system identifier. In addition, many structures that historically diverted more than their decreed water rights were assigned a “free river right”, with an extremely junior administration number of 99999.99999 and a decreed amount of 999.0 cubic feet per second. These rights allow structures to divert more than their decreed water rights under free river conditions; provided their demand is unsatisfied and water is legally available.

5.4.5.2 Aggregate Structures

In the Upper Colorado River Model, aggregated structures include, in some cases, more than 70 individual structures each having multiple water rights. Therefore, aggregated irrigation structures were assigned up to 11 water rights, one for each of 11 water right (administration) classes. Dates for water rights classes generally correspond to major basin-wide adjudications and key calling water rights. For example, Shoshone Power Plant senior and junior rights, and Grand Valley Project senior and junior rights. The decreed amount for a given water right class was set to the sum of all water rights that 1) were associated with individual structures included in the aggregated irrigation structure, and 2) had an administration number that fell within the water right class. The administration number for each right was calculated to be the weighted average by summing the product of each administration number and decree and dividing by the total decree within the water right class. For example, given 2 water rights; one for 10 cubic feet per second at an administration number of 1 and one for 2 cubic feet per second at an administration number of 4, the weighted administration number would be (10 x 1 + 2 x 4) / (10 + 2) = 1.5.

The aggregated M&I (72_AMC001) node was assigned a water right with an administration number of 1.00000 and a decree limit of 0.0 cubic feet per second because the structure was a placeholder for future depletions and was not used in the Baseline dataset.

5.4.5.3 Special Diversion Rights

Grand Valley Area Water Demand (Cameo Call)

Total demands for the Grand Valley Project, Orchard Mesa Irrigation District, and USA Power are located at their individual demand structures and the demand for carrier structure Grand Valley Project (7200646) was set to zero. Water rights are assigned to the Grand Valley Project structure and operating rules are used to deliver water to the demand structures in this system.

Water Right ID	Name	Administration No.	Rate (cfs)
7200646.01	Grand Valley Proj	22729.14519	80
7200646.02	Orchard Mesa Irr Dist Sy	22729.18536	10.2
7200646.03	Orchard Mesa Irr Dist Sy	22729.21116	450
7200646.04	Grand Valley Proj	22729.21241	730
7200646.05	USA Power Plant (Winter)	30895.21241	800
7200646.06	Grand Valley Proj	30895.24988	23.5
7200646.07	Grand Valley Proj	22729.19544	40
7200646.08	USA Power Plant (Summer)	99999.90009	400
7200646.09	USA Power Plant (Summer Jr.)	100000.1000	999
7200813BP.01	OMID Bypass	30895.23492	1100.00
7200813BP.02	OMID Bypass	999998.0000	1100.00
7200813CH.01	Orchard Mesa Check	999999.00000	640

Transbasin Demands

Many transbasin collection system rights are consolidated at one or more structures within the model; therefore, water rights were assigned specifically. The rights associated with the Bunte Highline Ditch were set senior to the C-BT rights at Willow Creek Reservoir to simplify reservoir operations. Egeria Creek Above Toponas aggregate structure receives transbasin water from the Stillwater Ditch and was assigned a senior water right and a sufficient decree rate to ensure its diversion.

Water Right ID	Name	Administration No.	Rate (cfs)
3604683.01	Con-Hoosier Modif 1929 W	35927.00000	540
3604699.01	Con-Hoosier Blue R Div	30184.29071	77
3801594.01	Hunter Tunnel Collection	39291.00001	1,262
3804613.02	Ivanhoe Reservoir Tunnel	28394.27306	25
3804613.03	Ivanhoe Reservoir Tunnel	28394.27299	50
3804613.04	Ivanhoe Reservoir Tunnel	28394.28365	70
5100639.01	Jim Creek Div	30870.26117	75
5101309_D.01	St Louis Creek Div	30870.26117	25.22
5101309_D.02	St Louis Creek Div	30870.26117	214

Water Right ID	Name	Administration No.	Rate (cfs)
5101310.01	Vasquez Creek Div	30870.26117	105
5101269.01	Den Ranch Creek Div	30870.26117	180
3604626.01	Vidler Tunnel Collection	15829.00000	4.5
3604626.02	Vidler Tunnel Collection	19875.00000	4
3604626.03	Vidler Tunnel Collection	23296.22400	4
3604626.04	Vidler Tunnel Collection	30184.16801	5.48
3604626.05	Vidler Tunnel Collection	30184.23561	10
3604626.06	Vidler Tunnel Collection	30951.00000	3
3604626.07	Vidler Tunnel Collection	32075.18444	2.72
3604626.08	Vidler Tunnel Collection	32075.23561	10
3604626.09	Vidler Tunnel Collection	33289.00000	13
3604626.10	Vidler Tunnel Collection	40020.00000	31.8
5104700.01	Windy Gap Pump PL Canal	47671.00001	300
5104700.02	Windy Gap Pump PL Canal	47671.00002	100
5104700.03	Windy Gap Pump PL Canal	47671.00003	200
5100958.01	C-BT WILLOW CREEK FEEDER	31258.00000	400
5100546.02	Bunte Highline Ditch	31257.99998	14.1
5100546.03	Bunte Highline Ditch	31257.99999	8.04
53_ADC024.02	Stillwater Ditch	1.00000	9.87

Municipalities and Industrial Demands

Many municipal and industrial system demands are consolidated at one or more structures within the model, therefore individual water rights were assigned as follows:

Water Right ID	Name	Administration No.	Rate
3600841.01	TenMile Diversion No.1	31566.00000	35
3600989.01	Maggie Pond Snowmaking	99999.99999	999
3601016.01	Copper Mtn Snowmaking	99999.99999	999
36_KeyMun.01	Snake R Water Dist Well	18181.00000	0.03
36_KeyMun.02	Snake R Water Dist Well	32075.25333	0.12
36_KeyMun.03	Snake R Water Dist Well	44741.00000	1.23
37VAILIRR.01	Vail Valley Water - Irr	15646.00000	11.2
37VAILMUN.01	Vail Valley Water - NonI	42420.41366	13

Water Right ID	Name	Administration No.	Rate
5300585.02	Glenwood L Water Sys Co	33023.31607	3
5301051.03	Glenwood L Water Co Sys	19573.13680	12
7200807.01	Molina Power Plant	99999.99999	999
7200816.01	Palisade Town Pipeline	12797.00000	1.44
7200816.02	Palisade Town Pipeline	14222.00000	3.55
7200920.01	Ute Pipeline Hdg No.2	38847.00000	20
7200920.02	Ute Pipeline Hdg No.2	40013.39608	30
7201487.01	Ute Pipeline Hdg No.1	38846.99999	20.0
7201487.02	Ute Pipeline Hdg No.1	40013.39607	30.0
7200766.01	Mason Eddy Ditch-Ute	12753.00000	4.03
7200766.02	Mason Eddy Ditch-Ute	30895.12724	1.95
7200766.03	Mason Eddy Ditch-Ute	30895.24260	0.74
7200766.04	Mason Eddy Ditch-Ute	32811.00000	2.12
7201339.01	Coon Creek Pipeline	46995.00000	4.1
721329_D.01	Rapid Creek PP	41791.00000	15
7201334.01	Carver Ranch PL-Ute	46751.46599	11
72_GJMun.01	City of Grand Jnct	1.00000	999

Redlands Power Canal

Redlands Power Canal rights are assigned to two structures that model the power demand (4200541) and the irrigation demand (4200541_I). The original first right is divided into its proportionate amounts based on use.

Water Right ID	Name	Administration No.	Rate
4200541.01	Redlands Power Canal	22283.20300	610
4200541_I.01	Redlands Power Canal-Irr	22283.20300	60
4200541_I.02	Redlands Power Canal-Irr	34419.33414	80

15-Mile Endangered Fish Reach

The 15-Mile Endangered Fish Reach demand is met by operating rules that release water from Ruedi Reservoir in the Historic simulation and have zero demand in the Baseline simulation. A free water right was assigned because StateMod expects rights in the diversion right file for each structure in the diversion station file.

Water Right ID	Name	Administration No.	Rate
7202003_M.01	15-Mile Fish Require	99999.91000	0

Excess HUP Demand Structures

Demands at the Excess HUP Demand Structures are met by operating rules. Water rights for these structures were included in the *.ddr file as placeholders because StateMod expects rights in the diversion right file for each structure in the diversion station file.

Water Right ID	Name	Administration No.	Rate
3604512HU.01	HUP Release Node	99999.99999	0
3704516HU.01	HUP Release Node	99999.99999	0
5103709HU.01	HUP Release Node	99999.99999	0
5003668HU.01	HUP Release Node	99999.99999	0

Reservoir Demand Structures

Demands located at the Reservoir Demand Structures are exclusively met by operating rules or the structures are used as placeholders for alternate future scenarios. The water rights associated with these structures have a decreed rate of diversion of 0 cubic feet per second. The one exception is the Wolcott Pumping Plant where the demand was set to zero in the *.ddm file and the decreed rate of diversion was set by values located in HydroBase.

Water Right ID	Name	Administration No.	Rate
5003668FR.01	Wolford_Fraser_Dem	99999.00000	0
5003668MP.01	Wolford_MidPark_Dem	99999.00000	0
5003668MK.01	Wolford_Market_Dem	99999.00000	0
37001146.01	Wolcott_Pumping_Plant	42485.00000	500
3803713M1.01	Ruedi_Rnd_1-Mun.Demand	99999.00000	0
3803713I1.01	Ruedi_Rnd_1-Ind.Demand	99999.00000	0
3803713M2.01	Ruedi_Rnd_2-Mun.Demand	99999.00000	0
3803713I2.01	Ruedi_Rnd_2-Ind.Demand	99999.00000	0
3803713M3.01	Ruedi_Addl_Dem	99999.00000	0
36GMCON.01	Grn_Mtn_Contract_Dem	99999.00000	0

Future Depletions

Future Depletion structures are included as placeholders for alternate future scenarios and therefore the decreed rate of diversion was set to 0 cubic feet per second.

Water Right ID	Name	Administration No.	Rate
70FD1.01	Future_Depletion_#1	99999.00000	0
70FD2.01	Future_Depletion_#2	99999.00000	0

Cliff Ditch Water Rights

Cliff Ditch has two headgates that are represented in the model network, structure 5000539 – Cliff Ditch and 5000731 – Cliff Ditch Headgate No. 2. Structure 5000539 has two water rights and the second water right can be diverted at the alternate point 5000731. Structure 5000731 does not have a water right. Based on their locations, with a gaged tributary entering the mainstem of Troublesome Creek between the two structures, and inspection of the water rights and historical diversions, it was determined that the shared water right could be divided equally between the two structures.

Water Right ID	Name	Administration No.	Rate
5000731.01	Cliff Ditch Hdg No 2	20676.19665	12
500539.01	Cliff Ditch	13300.00000	7.33
500539.02	Cliff Ditch	20676.19665	12

Free Water Rights

Free water rights, with a junior administration number 99999.99999 and decreed rate of diversion of 999 cubic feet per second, were added during calibration for those structures whose historical demands were observed to exceed the water rights for the structure.

Water Right ID	Name	Administration No.	Rate
3600662_D.99	HOAGLAND CANAL SPRUCE	99999.99999	999
3600729.99	MAT NO 2 DITCH	99999.99999	999
3600734.99	MCKAY DITCH	99999.99999	999
3600765.99	PALMER-MCKINLEY DITCH	99999.99999	999
3600780.99	PLUNGER DITCH	99999.99999	999
3600801.99	SMITH DITCH	99999.99999	999

Water Right ID	Name	Administration No.	Rate
3600841.99	TENMILE DIVERSION NO 1	99999.99999	999
3604626.99	VIDLER TUNNERL COLLECTION	99999.99999	999
3700519.99	BRAGG NO 1 DITCH	99999.99999	999
3700548.99	C M STREMME GATES DITCH	99999.99999	999
3700571.99	J M DODD DITCH	99999.99999	999
3700655.99	H O R DITCH	99999.99999	999
3700723.99	NEILSON SOUTH DITCH	99999.99999	999
3700743.99	ONEILL AND HOLLAND DITCH	99999.99999	999
3700823.99	STRATTON AND CO DITCH	99999.99999	999
3700830.99	TERRELL AND FORD DITCH	99999.99999	999
3700848.99	WARREN DITCH	99999.99999	999
3704642.99	EWING PLACER DITCH	99999.99999	999
3800547.99	BOWLES AND HOLLAND DITCH	99999.99999	999
3800573.99	CAPITOL PARK DITCH	99999.99999	999
3800618.99	CRANE AND PEEBLES DITCH	99999.99999	999
3800663.99	ELLA DITCH	99999.99999	999
3800667.99	EUREKA NO 1 DITCH	99999.99999	999
3800688.99	FOUR MILE DITCH	99999.99999	999
38000712.99	GLENWOOD DITCH	99999.99999	999
3800715.99	GRACE AND SHEHI DITCH	99999.99999	999
3800720.99	GREEN MEADOW DITCH	99999.99999	999
3800740.99	HARRIS & REED DITCH	99999.99999	999
3800757.99	HOME SUPPLY DITCH	99999.99999	999
3800838.99	LOWER DITCH	99999.99999	999
3800840.99	LOWLINE DITCH	99999.99999	999
3800854.99	MAROON DITCH	99999.99999	999
3800881.99	MOUNTAIN MEADOW DITCH	99999.99999	999
3800890.99	MCKENZIE WILDCAT DITCH	99999.99999	999
3800893.99	MCKOWN DITCH	99999.99999	999
3800925.99	PARK DITCH	99999.99999	999
3800930.99	PATERSON D JACOB EXT	99999.99999	999
3800939.99	PIONEER DITCH	99999.99999	999
3800959.99	RED ROCK BLUFF DITCH	99999.99999	999
3800968.99	ROBINSON DITCH	99999.99999	999

Water Right ID	Name	Administration No.	Rate
3800970.99	ROCKFORD DITCH	99999.99999	999
3800981.99	SALVATION DITCH	99999.99999	999
3801018.99	SOUTHARD AND CAVANAUGH D	99999.99999	999
3801038.99	SWEET JESSUP CANAL	99999.99999	999
3801073.99	WACO DITCH	99999.99999	999
3801101.99	WILLOW CREEK DITCH	99999.99999	999
3801121.99	ALEXIS ARBANEY DITCH	99999.99999	999
3801132.99	WALTHEN DITCH	99999.99999	999
3801147.99	KAISER AND SIEVERS DITCH	99999.99999	999
3804613.99	IVANHOE RESERVOIR TUNNEL	99999.99999	999
3900532.99	CLOUGH NO 1 DITCH	99999.99999	999
3900537.99	CORNELL DITCH	99999.99999	999
3900540.99	CORYELL JOINT STOCK IRRI	99999.99999	999
3900562.99	GRANLEE DITCH	99999.99999	999
3900590.99	JANGLE DITCH	99999.99999	999
3900610.99	LOW COST DITCH	99999.99999	999
3900612.99	LOWER CACTUS VALLEY D	99999.99999	999
3900635.99	PARACHUTE DITCH	99999.99999	999
390638.99	PIERSON AND HARRIS DITCH	99999.99999	999
390645.99	RIFLE CREEK CANON DITCH	99999.99999	999
390672.99	THOMPKINS DITCH	99999.99999	999
390687.99	WARE AND HINDS DITCH	99999.99999	999
390825.99	WILLIAMS CANAL	99999.99999	999
4200541_I	REDLANDS POWER CANAL IRR	99999.99999	999
4500616.99	H AND S DITCH	99999.99999	999
4500668.99	LAST CHANCE DITCH	99999.99999	999
4500685.99	MAMM CREEK DITCH	99999.99999	999
4500704.99	MULTA-TRINA DITCH	99999.99999	999
4500743.99	RISING SUN DITCH	99999.99999	999
4500788.99	SYKES AND ALVORD DITCH	99999.99999	999
4500793.99	TAUGHENBAUGH DITCH	99999.99999	999
4500818.99	WEST DIVIDE CREEK DITCH	99999.99999	999
4500861.99	LARKIN DITCH	99999.99999	999
5000539.99	CLIFF DITCH	99999.99999	999

Water Right ID	Name	Administration No.	Rate
5000582.99	HERDE DITCH	99999.99999	999
5000627.99	PASS CREEK DITCH	99999.99999	999
5000628.99	PICKERING DITCH	99999.99999	999
5000654.99	TROUBLESOME DITCH	99999.99999	999
5000656.99	TYLER DITCH	99999.99999	999
5000731.99	CLIFF DITCH HDGT NO 2	99999.99999	999
5000734_D.99	DEBERARD DITCH	99999.99999	999
5100546.99	BUNTE HIGHLINE DITCH	99999.99999	999
5100585.99	COFFEE MCQUEARY DITCH	99999.99999	999
5100660.99	GASKILL DITCH	99999.99999	999
5100699.99	HAMMOND NO 1 DITCH	99999.99999	999
5100763.99	KINNEY BARRIGER DITCH	99999.99999	999
5100829.99	PEAVEY NO 2 DITCH	99999.99999	999
5100831.99	PETERSON DITCH NO 1	99999.99999	999
5100876.99	SCYBERT DITCH	99999.99999	999
5100880_D.99	SELAK LARRABEE DITCH	99999.99999	999
5100883.99	SHERIFF DITCH 156	99999.99999	999
5100893.99	SOPHRONIA DAY DITCH	99999.99999	999
5100934.99	TRAIL CREEK DITCH	99999.99999	999
5100939.99	UTE BILL NO 2 DITCH	99999.99999	999
5101070.99	HENDERSON MINE WTR SYS	99999.99999	999
5101310.99	VASQUEZ CREEK DIV	99999.99999	999
5200559.99	GUTZLER DITCH	99999.99999	999
5200658.99	WILMOT DITCH	99999.99999	999
5300555_D.99	CABIN CREEK DITCH	99999.99999	999
5300632.99	HORSE MEADOWS DITCH	99999.99999	999
5300783.99	ROYAL FLUSH DITCH	99999.99999	999
7000550.99	H V C AND S DITCH	99999.99999	999
7000584.99	ROAN CREEK NO 3 DITCH	99999.99999	999
7200533.99	BERTHOLF LANHAM UPDIKE D	99999.99999	999
7200580.99	COOK DITCH	99999.99999	999
7200645.99	GRAND VALLEY CANAL	99999.99999	999
7200911.99	TEMS DITCH	99999.99999	999
38_ADC035.99	FRYING PAN RIVER	99999.99999	999

Water Right ID	Name	Administration No.	Rate
38_ADC036.99	WEST SOPRIS CREEL	99999.99999	999
45_ADC047.99	Colorado River BL CACHE	99999.99999	999
50_ADC012.99	TROUBLESOME CREEK	99999.99999	999
50_ADC016.99	LOWER MUDDY CREEK	99999.99999	999
51_ADC001.99	Colorado River nr GRANBY	99999.99999	999
51_ADC002.99	WILLOW CREEK	99999.99999	999
51_ADC003.99	RANCH CREEK	99999.99999	999
51_ADC006.99	FRASER RIVER AT GRANBY	99999.99999	999
51_ADC007.99	COLORADO RIVER ABV HOT S	99999.99999	999
51_ADC008.99	COLORADO RIVER ABV WILLI	99999.99999	999
51_ADC011.99	COLORADO RIVER ABV TROUB	99999.99999	999
53_ADC024.99	COLORADO RIVER ABV TOPONA	99999.99999	999
53_ADC028.99	DERBY CREEK	99999.99999	999
53_ADC032.99	COLORADO RIVER ABV GLENW	99999.99999	999

5.5 Irrigation Files

The irrigation files provide parameters used during simulation to compute on-farm consumptive use and return flow volumes related to a given month's diversion.

5.5.1. StateCU Structure File (*.str)

This file contains the soil moisture capacity of each irrigation structure in inches per inch of soil depth. It is required for StateMod's soil moisture accounting in both baseflow and simulation modes. Soil moisture capacity values were gathered from Natural Resources Conservation Service (NRCS) mapping. The file was created by StateDMI.

5.5.2. Irrigation Parameter Yearly (*.ipy)

This file contains conveyance efficiency and maximum application efficiency by irrigation type for each irrigation structure for each year of the study period. The file also contains acreage by irrigation type – either flood or sprinkler. In the Upper Colorado River basin, all acreage was assigned flood irrigation type. Maximum system efficiency (includes both conveyance and application efficiencies) was estimated to be 54 percent for Colorado structures. Because overall system efficiency was considered, conveyance efficiency was set to 1.0 and maximum flood application efficiency was set to the system efficiencies outlined here. This file was created by StateDMI. Although this is an annual time-series file, StateMod will not simulate the

Colorado datasets if the irrigation parameter yearly file header is not changed from CYR to WYR. This change has to be done by hand in a text editor.

5.5.3. Irrigation Water Requirement File (*.iwr)

Data for the irrigation water requirement file was generated by StateCU for the period 1975 through 2013, then extended back to 1909 using TSTool. StateCU was executed using the SCS modified Blaney-Criddle monthly evapotranspiration option with TR-21 crop parameters for lands irrigated below elevation 6,500 feet. A standard elevation adjustment was applied to TR-21 crop coefficients. For structures irrigating pasture grass above 6,500 feet, StateCU was executed using the original Blaney-Criddle method with high-altitude crop coefficients, as described in the SPDSS 59.2 Task Memorandum *Develop Locally Calibrated Blaney-Criddle Crop Coefficients*, March 2005. Acreage for each structure was set to the acreage defined in 2010 for the entire study period. The irrigation water requirement file contains the time series of monthly irrigation water requirements for structures whose efficiency varied through the simulation.

5.6 Reservoir Files

5.6.1. Reservoir Station File (*.res)

This file describes physical properties and some administrative characteristics of each reservoir simulated in the Upper Colorado River basin. It was assembled by StateDMI, using considerable amount of information provided in the commands file. Twenty-three key reservoirs are modeled explicitly. Thirteen aggregated reservoirs and stock ponds account for evaporation from numerous small storage facilities.

The modeled reservoirs are listed below with their capacity and their number of accounts or pools.

Table 5.8 - Modeled Reservoirs

#	ID #	Name	Capacity (af)	# of Accounts
1	3603543	Green Mountain Reservoir	154,645	6
2	3603570	Cont Hoosier Blue Res	2,113	3
3	3603575	Clinton Gulch Reservoir	4,300	9
4	3604512	Dillon Reservoir	257,000	5
5	36_ARC001	36_Arc001	8,702	1
6	3703639	Wolcott Reservoir	65,975	1
7	3703699	Eagle Park Reservoir	3,148	4
8	3704516	Homestake Proj Reservoir	43,600	3
9	37_ARC002	37_Arc002	6,671	1
10	3803713	Ruedi Reservoir	102,373	6
11	38_ARC003	38_Arc003	13,074	1
12	3903505	Grass Valley Reservoir	5,920	1
13	3903508	Rifle Gap Reservoir	13,602	2
14	3903508_Ex	Phantom Reservoir	999,999	1
15	3903943	Parachute Creek Reservoir	33,773	2
16	39_ARC004	39_Arc004	2,236	1
17	45_ARC005	45_Arc005	2,054	1
18	5003668	Wolford Mountain Res	65,985	9
19	50_ARC006	50_Arc006	11,481	1
20	5103686	Meadow Creek Reservoir	5,930	3
21	5103695	C-BT Shadow Mtn Grand L	18,369	2
22	5130709	Williams Fork Reservoir	96,822	5
23	5103710	C-BT Willow Creek Res	10,553	2
24	5104055	C-BT Granby Reservoir	539,758	3
25	51_ARC007	51_Arc007	8,480	1
26	52_ARC008	52_Arc008	821	1
27	53_ARC009	53_Arc009	8,389	1
28	7003602	Roan Creek Reservoir	71,390	1
29	7203839	Leon Lake Aggreg Res	2,904	1
30	7203842	Monument Aggreg Res	987	1
31	7203844	Vega Reservoir	34,131	2
32	7203961	Jerry Creek Aggreg Res	8,623	1
33	72_ARC010	72_Arc010	25,664	1
34	72_ASC001	72_Asc001	2,261	1
35	7203904AGG	Bonham Creek Aggregated Res	6,778	1
36	7204033AGG	Cottonwood Creek Aggreg Res	3,812	1

Leon Lake Aggregate Reservoir includes Leon Lake and Colby Horse Reservoir. Monument Aggregate Reservoir includes Monument Reservoir 1 (aka Hunter Reservoir), Monument Reservoir 2, and Big Park Reservoir. Cottonwood Creek Aggregate Reservoir includes Cottonwood Reservoirs 1, 2, 4 and 5, Never Sweet Reservoir, Little Meadows Reservoir, and Big Meadows Reservoir. Bonham Creek Aggregate Reservoir includes Bohnam Resevoir, Big Creek Reservoir, Atkinson Reservoir, Forty-acre Reservoir, Silver Lake, and Dawson Reservoir.

Roan Creek Reservoir and Parachute Reservoir are included in the model network for modeling future scenarios; however, they currently do not exist.

Note, 3903508_Ex, is not a real reservoir; however, it is included in the model for operation purposes. See Section 5.9.11 for more information.

5.6.1.1 Key Reservoirs

Parameters related to the physical attributes of key reservoirs include inactive storage, where applicable, total storage, area-capacity data, applicable evaporation/precipitation stations, and initial reservoir contents. For explicitly modeled reservoirs, storage and area-capacity information were obtained from either the Division Engineer or the reservoir owners. Initial contents for all reservoirs were set to average September end-of-month contents over the period 1975 through 2013. After filling dead pools, initial contents were prorated to reservoir accounts based on account size.

Administrative information includes reservoir account ownership, administrative fill date, and evaporation charge specifications. This information was obtained from interviews with the Division Engineer, local water commissioners, and the owner/operator of the individual reservoirs.

5.6.1.2 Aggregate Reservoirs

The amount of storage for aggregate reservoirs and stock ponds is based on storage decrees and the CDSS Task 2.09-10 Memorandum "Non-Irrigation (Other Uses) Consumptive Uses and Losses in the Upper Colorado River basin" (see Appendix B). Based on available dam safety records, the surface area for the aggregate reservoirs was developed assuming they are straight-sided pits with a depth of 25 feet. Similarly, the surface area for the aggregate stockponds was developed assuming they are straight-sided pits with a depth of 10 feet. Initial contents were set to capacity.

5.6.1.3 Reservoir Accounts

Except as noted below, Upper Colorado River Model reservoirs are modeled with one active account and possibly a dead pool.

Green Mountain Reservoir

This reservoir was constructed as an integral part of the C-BT Project with the primary objective of providing replacement water to Western Slope water users and providing water that could be exchanged up to Granby Reservoir. Additional uses of the reservoir include contract users, a supply source for the Silt Project, and deliveries to meet the 15-Mile Endangered Fish Reach instream flow requirement. Hydroelectric power generation is driven by power demand and releases for other uses, therefore difficult to model. The reservoir is modeled with the following six accounts:

Account	Storage Amount (af)
Historic Users	66,000
C-BT Pool	52,000
Contract	20,000
Silt Project	5,000
Inactive	11,645
Surplus Fish	66,000

Continental Hoosier – Upper Blue Lakes

The Upper Blue Lakes are an integral part of the Continental Hoosier transbasin diversion for the City of Colorado Springs. The reservoir stores water that is later taken through the Continental Hoosier tunnel and/or used as a replacement source for diversions out-of-priority to Green Mountain Reservoir in accordance with the Blue River Decree and subsequent agreements. The combined reservoir is modeled with three accounts, Active (2,140 acre-feet), Colorado Springs Out-of-priority (2,100 acre-feet), and the 2003 MOA (250 acre-feet).

Clinton Gulch Reservoir

Clinton Gulch Reservoir was initially used in the operations of the Climax Mine. Around 1992 the reservoir was acquired by west slope users to firm additional yield for Summit County and Grand County users by way of an agreement with Denver, known as the Clinton Agreement. Due to the numerous entities involved in the agreement eight accounts are modeled:

Account	Storage Amount (af)
Town of Breckenridge	390
Town of Dillon	60
Town of Silverthorne	165
Breckenridge Ski Area	455
Copper Mountain Ski Area	490
Keystone Ski Area	1,305
Winter Park Ski Area	270
Summit County	465
Dead Pool	700

Dillon Reservoir

The Denver Board of Water Commissioners (Denver) operates Dillon Reservoir and the Harold D. Roberts Tunnel as primary features of its raw water collection and transmountain diversion system. Water diverted pursuant to the direct flow decree of Roberts Tunnel, together with releases from storage in Dillon Reservoir, are conveyed under the Continental Divide to the headwaters of the North Fork of the South Platte River on Colorado's Eastern Slope. Beyond Denver's direct use of the reservoir, Denver has entered into additional agreements with west slope users - two notable agreements are the Blue River Decree and the Clinton Agreement. Dillon Reservoir is modeled with five accounts:

Account	Storage Amount (af)
Denver	252,015
Summit County	1,021
Dead Pool	3,269
1000 ac-ft minimum stream flow	1,000
Denver out-of-priority	154,645

Eagle Park Reservoir

Eagle Park Reservoir is used to provide augmentation water for multiple entities on the Eagle River. The reservoir is not operated in the baseline dataset, but is setup as a placeholder for future modeling. The reservoir is modeled with four accounts:

Account	Storage Amount (af)
Eagle River Water & Sanitation	330
Upper Eagle River Regional Water Authority	383
Vail Valley Association	1,100
River District	200

Homestake Reservoir

Homestake Reservoir is owned and operated by the City of Aurora and the City of Colorado Springs as part of the Homestake transbasin project. The City of Colorado Springs is in the process of evaluating the use of the reservoir as a replacement source for their out-of-priority diversions associated with the Continental Hoosier transbasin project. The reservoir is modeled with three accounts:

Account	Storage Amount (af)
Colorado Springs and Aurora	42,881
Dead Pool	211
Homestake – Green Mountain Replacement	21,440

Ruedi Reservoir

Ruedi Reservoir is used to provide replacement storage for out-of-priority diversions at the North Side and South Side collection systems of the Fryingpan – Arkansas transbasin diversion project. Additional storage is available for contract sale to meet irrigation, municipal, and industrial water needs in western Colorado and is a source of supply for instream flow benefits on the lower Upper Colorado River, including the 15-Mile Reach, critical to habitat for endangered fish species. The reservoir is modeled with the following six accounts:

Account	Storage Amount (af)
Round 1 and 2 Contracts	30,263
Replacement	28,000
Dead Pool / Unallocated	28,698
CWCB Fish	5,413
Unallocated 5k	5,000
USFWS 5k 4/5	5,000

Wolford Mountain Reservoir

Wolford Mountain Reservoir is used to provide additional contracted water to west slope users, a supplemental replacement source for out-of-priority diversions to Green Mountain Reservoir, and for supplemental flows in the 15-Mile Reach for endangered fish species. The reservoir is modeled with nine accounts:

Account	Storage Amount (af)
West Slope	39,796
Denver	25,610
Fish Account 1	3,000
Fish Account 2	3,000
Denver Replacement 1	5,000
Denver Replacement 2	20,610
Colorado Springs	1,750
Colorado Springs Book-over	250
Colorado Springs Replacement	1,750

Meadow Creek Reservoir

Meadow Creek Reservoir is one of the structures included in an agreement between Denver, Englewood, and Climax – Henderson Mill. A majority of the water stored in the reservoir is diverted through the Moffat Tunnel for use on the east slope. A small portion of the reservoir is reserved for the use in the Vail Ditch (Grand County Irrigation Company). The reservoir is modeled as having three accounts:

Account	Storage Amount (af)
Denver-Englewood	4,780
Vail Ditch	850
Dead Pool	300

Williams Fork Reservoir

Denver's Williams Fork Reservoir is an integral part of their transbasin projects. Water is exchanged to the Moffat collection system (Fraser River), Gumlick Tunnel (Williams Fork River), and Dillon Reservoir and Roberts Tunnel (Blue River), and is used for replacement in agreements with Climax – Henderson Mill and the Blue River Decree. Due to a change in operations (see Section 5.9.19), Williams Fork is no longer used to as a supplemental source for the fish flows in the 15-Mile Reach. There are five accounts modeled:

Account	Storage Amount (af)
Denver	99,765
Henderson	2,200
Williams Fork Fish Temp	0
Williams Fork – Green Mountain Replacement 1	10,000
Williams Fork – Green Mountain Replacement 2	25,000

5.6.2. Net Evaporation File (*.eva)

The evaporation file contains monthly average evaporation data (12 values that are applied in every year). The annual net reservoir evaporation was estimated by subtracting the weighted average effective monthly precipitation from the estimated gross monthly free water surface evaporation. Annual estimates of gross free water surface evaporation were taken from the National Oceanic and Atmospheric Administration (NOAA) Technical Report NWS 33. The annual estimates of evaporation were distributed to monthly values based on elevation through the distributions listed in Table 5.9. These monthly distributions are used by the State Engineer's Office.

Table 5.9
Monthly Distribution of Evaporation as a Function of Elevation (percent)

Month	Greater than 6,500 feet	Less than 6,500 feet
Jan	3.0	1.0
Feb	3.5	3.0
Mar	5.5	6.0
Apr	9.0	9.0
May	12.0	12.5
Jun	14.5	15.5
Jul	15.0	16.0
Aug	13.5	13.0
Sep	10.0	11.0
Oct	7.0	7.5
Nov	4.0	4.0
Dec	3.0	1.5

Four evaporation stations are used in the calculation of annual net evaporation in the Upper Colorado River Model:

1. Rifle (10005) is used to calculate evaporation for the following reservoirs: Grass Valley, Rifle Gap, 39_ARC004, and 45_ARC005.
2. Glenwood Springs 1 N and Aspen (10006) are used to calculate evaporation for the following reservoirs: Wolcott, Homestake, 37_ARC002, Ruedi, 38_ARC003, 52_ARC008, 53_ARC009, Vega, 72_ARC010, 72_ASC001, Bonham Aggregated, Cottonwood Aggregated, Leon Creek Aggregated, Monument Aggregated, and Jerry Creek Aggregated.
3. Green Mountain Dam and Dillon 1 E (10008) are used to calculate evaporation for the following reservoirs: Green Mountain, Continental Hoosier Upper Blue Lakes, Clinton Gulch, Dillon, 36_ARC001, Wolford Mountain, 50_ARC006, and Williams Fork.
4. Shadow Mountain Reservoir (10009) is used to calculate evaporation for the following reservoirs: Meadow Creek, Grand Lake/Shadow Mountain, Willow Creek, Granby, and 51_ARC007.

The resulting net monthly free water surface evaporation estimates, in feet, used in the Upper Colorado River Model are as follows:

Station	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
10005	0.13	0.06	0.02	0.03	0.06	0.11	0.22	0.32	0.42	0.41	0.35	0.24	2.37
10006	0.13	0.02	-0.09	-0.1	-0.02	0.07	0.17	0.32	0.41	0.42	0.29	0.24	1.86
10008	0.14	0.03	-0.05	-0.05	0.01	0.06	0.16	0.25	0.35	0.32	0.26	0.22	1.70
10009	0.03	0.01	-0.06	-0.06	0.01	0.05	0.07	0.29	0.38	0.32	0.22	0.08	1.34

5.6.3. End-Of-Month Content File (*.eom)

The end-of-month content file contains historical end-of-month storage contents for reservoirs in the reservoir station file. The historical EOM reservoir contents in this file are used by StateMod when estimating baseflow to reverse the effects of reservoir storage and evaporation on gaged streamflows, and to produce comparison output useful for calibration. The file was created by TSTool, which reads data from HydroBase and filled missing data with a variety of user-specified algorithms.

5.6.3.1 Key Reservoirs

Data for the Upper Colorado River Model key reservoirs was primarily generated by converting daily observations stored in HydroBase to month-end data, supplemented by USBR data. Missing end-of-month contents were filled with the average of available values for months with the same hydrologic condition and remaining missing values were filled with average monthly values. For reservoirs with little or no historical data available end-of-month contents were set to reservoir capacity. Table 5.10 presents the on-line date for each reservoir and the primary data source for end-of-month contents. Historical contents in the *.eom file were set to zero prior to the on-line date.

Table 5.10
Reservoir On-line Dates and EOM Contents Data Source

WDID	Reservoir Name	On-Line Date	Primary Data Source
3603543	Green Mountain Reservoir	1943	HydroBase Daily
3603570	Cont Hoosier Blue Res	1962	HydroBase Daily
3603575	Clinton Gulch Reservoir	1977	HydroBase Daily
3604512	Dillon Reservoir	1963	HydroBase Daily
3703639	Wolcott Reservoir	N/A	N/A
3703699	Eagle Park Reservoir	1990	N/A
3704516	Homestake Proj Reservoir	1967	HydroBase Daily

WDID	Reservoir Name	On-Line Date	Primary Data Source
3803713	Ruedi Reservoir	1968	HydroBase Daily
3903943	Roan Creek Reservoir	N/A	N/A
3903505	Grass Valley Reservoir	1890	HydroBase Daily
3903508	Rifle Gap Reservoir	1967	HydroBase Daily
5003668	Wolford Mountain Res	1995	HydroBase Daily
5103686	Meadow Creek Reservoir	1975	HydroBase Daily
5103695	C-BT Shadow Mtn Grand L	1946	HydroBase Daily
5103709	Williams Fork Reservoir	1939	HydroBase Daily
5103710	C-BT Willow Creek Res	1953	HydroBase Daily
5104055	C-BT Granby Reservoir	1949	HydroBase Daily
7003602	Parachute Creek Reservoir	N/A	N/A
7203844	Vega Reservoir	1960	USBR
7203961	Jerry Creek Agg Reservoir	1980	HydroBase Daily

5.6.3.2 Aggregate Reservoirs

Aggregated reservoirs were assigned contents equal to their capacity, because actual data was not available. Aggregated reservoirs are modeled as though in operation throughout the study period.

5.6.4. Reservoir Target File (*.tar)

The reservoir target file contains minimum and maximum target storage limits for reservoirs in the reservoir station file. The reservoir may not store more than the maximum target, or release to the extent that storage falls below the minimum target. In the Baseline dataset, the minimum targets were set to zero, and the maximum targets were set to capacity for reservoirs that operated primarily for agricultural and municipal diversion storage. Maximum targets were set to operational targets according to rule curves provided by USBR for Ruedi, Green Mountain, and Willow Creek reservoirs and rule curves provided by Denver Water for Williams Fork reservoir. The file was created by TSTool.

5.6.5. Reservoir Right File (*.rer)

The reservoir right file contains water rights associated with each reservoir in the reservoir station file. Specifically, the parameters for each storage right include the reservoir, administration number, decreed amount, the account(s) to which exercise of the right accrues, and whether the right was used as a first or second fill. It is recommended for future updates that the StateDMI commands be run initially without the “set” commands. This allows the modeler to view any changes to water rights (transfers, conditional to absolute, abandonment, etc.) reflected in updated versions of HydroBase and modify the "set" commands as necessary.

5.6.5.1 Key Reservoirs

In general, water rights for explicitly modeled reservoirs were taken from HydroBase and correspond to the State Engineer's official water rights tabulation. In addition, many key reservoirs were assigned a "free water right", with an extremely junior administration number to allow storage under free river conditions.

5.6.5.2 Aggregate Reservoirs

Aggregated reservoirs and stock ponds were assigned a decreed amount equal to their capacity, and an administration number 1.00000.

5.6.5.3 Special Reservoir Rights

Green Mountain Reservoir

Green Mountain Reservoir (3603543) has two senior rights with the same administration number that are combined in HydroBase. It was necessary to split these rights because their combined decreed volumes exceeded the reservoir's capacity. Additionally, there was an understanding between Colorado Springs, Denver, and the USBR that the senior refill right would not be exercised to call out upstream junior storage rights. The senior first fill right, split into two rights, has an administration number of 31258.00000 with corresponding volumes of 154,645 acre-feet and 6,316 acre-feet. The senior refill right was assigned an administration number of 38628.00000. Additionally, the junior refill right was set to include the conditional portion of the right with an administration number of 50403.49309 and a volume of 154,645.

Clinton Gulch Reservoir

Clinton Gulch Reservoir (3603575) has three rights in HydroBase. The first fill right is split into two different rights in the modeled because the Clinton Reservoir Agreement allows Denver to store 3,650 acre-feet in Clinton Gulch Reservoir prior to exercising its Roberts Tunnel and Dillon Reservoir right. In the model, these rights have volumes of 3,650 acre-feet and 600 acre-feet and administration numbers of 31257.99999 and 45290.35239, respectively. The second first fill right for 210 acre-feet has a junior administration number of 56978.56753. The junior refill right has a volume of 4,250 and an administration number of 51864.51194.

Dillon Reservoir

Dillon Reservoir (3604512) has two water rights, a modified senior first fill right and a junior refill right. The senior first fill right was modified to be junior to Colorado Springs' Continental Hoosier Tunnel diversions and Cont Hoosier Blue Reservoir storage based on an agreement between Colorado Springs and Denver. The first fill reservoir right was also set slightly junior to the Roberts Tunnel diversion right. The senior first fill right has a storage volume of 252,678 acre-feet and an administration number set to 35927.00005. The junior refill right has a volume of 252,678 acre-feet and an administration number set to 50038.49309.

Cont Hoosier Blue Reservoir

Continental Hoosier Blue Reservoir (3603570), also known as Upper Blue Lakes, is part of Colorado Springs' Continental Hoosier project. The senior first fill right was modified so that it was slightly junior to the Continental Hoosier Tunnel diversion right with a modified administration number of 35927.00001.

Ruedi Reservoir

Ruedi Reservoir (3803713) has a conditional portion to its refill. The junior refill right was set to a volume of 101,280 acre-feet.

Free Reservoir Rights

There are a few reservoirs in the Upper Colorado River Model that are assigned a free river fill right. These free river rights allow the reservoirs to fill when unappropriated water is available and there is available capacity in the reservoir.

Water Right ID	Name	Administration No.	Volume	On/Off
363570.02	CON_HOOSIER_RES-free	99999.99999	10,000	On
3704516.02	HOMESTAKE_RES-refill	99999.99999	43,505	On
3903505.03	GRASS_VALLEY_RES-refill	99999.99999	5,920	On
3903508.02	RIFLE_GAP_RES-refill	99999.99999	13,601	On
5003668.03	WOLFORD_MOUNTAIN-refill	99999.99999	30,000	On
5103686.02	MEADOW_CREEK_RES-refill	99999.99999	5,100	On
5103695.02	SHADOW_MTN_RES-refill	99999.99999	19,669	On
5103710.02	WILLOW_CREEK_RES-refill	99999.99999	10,553	On
5104055.02	GRANBY_RESERVOIR-refill	99999.99999	543,758	On
7203844.02	VEGA_RESERVOIR_refill	99999.99999	33,500	On

5.7 Instream Flow Files

5.7.1. Instream Station File (*.ifs)

One hundred thirty-one instream flow reaches are defined in this file, which was created in StateDMI. The file specifies an instream flow station and downstream terminus node for each reach, through which instream flow rights can exert a demand in priority. Table 5.11 lists each instream flow station included in the Upper Colorado River Model, along with their location and maximum daily demand. These rights represent decrees acquired by CWCB, with the exception of instream flow stations listed under the following section.

5.7.1.1 Special Instream Flow Stations

Several reservoir bypass agreements, bypass agreements associated with transbasin diversions, and other operations are represented as instream flow reaches as follows:

Reservoir Bypass Agreements:

- Rifle Gap Reservoir Bypass (3903508_M)
- Green Mountain Reservoir Bypass (3603543_M)
- Wolford Mountain Reservoir Bypass (5003668_M)
- Shadow Mountain Reservoir and Grand Lake Bypass (5103695_M)
- Williams Fork Reservoir Bypass (5103709_M)
- Willow Creek Reservoir Bypass (5103710_M)
- Ruedi Reservoir Bypass (3803713_M)
- Dillon Reservoir Bypass (3604512_M)
- Granby Reservoir Bypass (5104055_M)
- Wolcott Reservoir Pumping Pipeline Bypass (3701146_M)

Transbasin Diversion Bypass Agreements:

- Ranch Creek below the Moffat Tunnel project diversion (5101269_M)
- St. Louis Creek below the Moffat Tunnel project diversion (5101309_M)
- Vasquez Creek below the Moffat Tunnel project diversion (5101310_M)
- Hunter Creek below the Moffat Tunnel project diversion (3801594_M)
- Jim Creek below the Moffat Tunnel project diversion (5101264_M)
- Below the Thomasville Gage on the Fryingpan River for the Fryingpan-Arkansas project (3804625M2)
- Homestake Creek downstream of the Gold Park Gage for the Homestake project (3704516_M)
- Bobtail Creek downstream of the Gumlick Tunnel for the Williams Fork River portion of the Moffat Tunnel project (5104603_M)

- Fryingpan River downstream of the Boustead Tunnel for the Fryingpan-Arkansas project (3804625_M)

Other Instream Flow Reaches:

- An instream flow node was added to continue the Eagle River instream flow section below the minimum bypass at the proposed Wolcott Reservoir Pumping Pipeline diversion location (3702059_2). StateMod does not allow an instream flow within an instream flow.
- An instream flow node was added to reflect minimum flow requirements at the Shoshone power plant (5300584P). This node was used in the Historic simulation to reflect releases from Green Mountain to satisfy Shoshone's demand prior to 1984.
- An instream flow node was added on the mainstem of the Colorado to simulate the USFWS recommended endangered fish flows through the critical 15-Mile Reach (7202003).
- An instream flow node was added to reflect the minimum bypass flow requirement for Ute Water Conservancy District Plateau Creek diversions (7200920_M).

Recreational Instream Channel Diversions:

- An instream flow node was added represent the Blue River Whitewater Course (3601123). This conditional water right is turned off in the baseline dataset.
- An instream flow node was added represent the Town of Vail Whitewater Course (3701412). This conditional water right is turned off in the baseline dataset.
- An instream flow node was added represent the Avon Whitewater Course (3701416). This conditional water right is turned off in the baseline dataset.
- An instream flow node was added represent the Aspen Whitewater Course (3801418).

5.7.2. Instream Flow Annual Annual File (*.ifa)

Instream flow demands were developed from decreed amounts and comments in the State Engineer's water rights tabulation or from agreements as listed in Section 5.7.1. One hundred twenty-nine monthly instream flow demands are used and repeated for each year of the simulation. The file contains monthly demands for each instream flow structure included in the Upper Colorado River Model, except for structures included in the Instream Demand Monthly File (*.ifm), see below.

5.7.3. Instream Flow Monthly Demand File (*.ifm)

There are two instream flow structures with demands that vary by hydrologic year type—the USFWS Recommended Fish Flow (7202003) and the Granby Reservoir Mininum Release (5104055_M). The demands are based on hydrologic conditions (dry, average, and wet conditions). Twelve monthly instream flow demands were developed for each year in the study period.

5.7.4. Instream Right File (*.ifr)

Water rights for each instream flow reach modeled in the Upper Colorado River Model are contained in the instream flow right file, and shown in Table 5.11. Note that the decree represents the maximum demand, which may vary throughout the year. These data were obtained from HydroBase with the exception of instream flow reaches listed under Section 5.7.4.1. It is recommended for future updates that the StateDMI commands be run initially without the "set" commands. This allows the modeler to view changes to water rights (transfers, conditional to absolute, abandonment, etc.) reflected in updated versions of HydroBase and modify the "set" commands as necessary.

Table 5.11
Instream Flow Summary

#	ID	Name	Decree (cfs)
1	3601123*	BLUE RIVER WHITEWATER CO	0.00
2	3602000	MIN FLOW CATARACT CR LOW	6.00
3	3602002	MIN FLOW BRUSH CREEK	3.00
4	3602012	MIN FLOW SLATE CREEK	7.00
5	3602030	MIN FLOW BLUE RIVER 3	20.00
6	3602032	MIN FLOW TENMILE CREEK	10.00
7	3602033	MIN FLOW SNAKE RIVER LOW	12.00
8	3602034	MIN FLOW BLUE RIVER SEG1	2.00
9	3602035	MIN FLOW BLUE RIVER SEG2	5.00
10	3602037	MIN FLOW BLUE RIVER 4	32.00
11	3602043	MIN FLOW BLUE RIVER 5	50.00
12	3602044	MIN FLOW BLUE RIVER 6	55.00
13	3602045	MIN FLOW BLUE RIVER 7	75.00
14	3602046	MIN FLOW BLUE RIVER 8	115.00
15	3602047	MIN FLOW BLUE RIVER 9	125.00
16	3602048	MIN FLOW BLUE RIVER 10	125.00
17	3602049	MIN FLOW BLUE RIVER 11	60.00
18	3603543_M	GREEN MTN RES BYPASS	85.00
19	3604512_M	DILLON RES M REL	50.00
20	3701146_M	WOLCOTT PP BYPASS	110.00
21	3701412	TOWN OF VAIL WHITEWATER	400.00
22	3701416	AVON WHITEWATER COURSE R	0.00

#	ID	Name	Decree (cfs)
23	3702000	MIN FLOW GYPSUM CREEK LO	6.00
24	3702012	MIN FLOW EAGLE RIVER	130.00
25	3702018	MIN FLOW CROSS CR LOWER	20.00
26	3702028	MIN FLOW EAGLE RIVER	25.00
27	3702034	MIN FLOW EAGLE RIVER	15.00
28	3702041	MIN FLOW EAGLE RIVER	35.00
29	3702042	MIN FLOW EAGLE RIVER	50.00
30	3702043	MIN FLOW BRUSH CREEK	12.00
31	3702046	MIN FLOW EAGLE RIVER	12.00
32	3702056	MIN FLOW GORE CR LOWER	36.00
33	3702057	MIN FLOW GORE CR MIDDLE	26.00
34	3702059	MIN FLOW EAGLE RIVER	45.00
35	3702059_2	MIN FLOW EAGLE RIVER 2	155.00
36	3702065	MIN FLOW E FK EAGLE LOW	2.00
37	3702066	MIN FLOW E FK EAGLE UP	1.50
38	3704516_M	GOLD PARK GAGE M FLOW	24.00
39	3801418	ASPEN WHITEWATER COURSE	653.00
40	3801594_M	HUNTER CR BYPASS	21.00
41	3802000	MIN FLOW HUNTER CR LOWER	30.00
42	3802013	MIN FLOW CAPITOL CREEK	10.00
43	3802015	MIN FLOW CASTLE CREEK	12.00
44	3802020	MIN FLOW FRYINGPAN R MID	200.00
45	3802027	MIN FLOW MAROON CREEK	14.00
46	3802039	MIN FLOW ROARING FORK 2	15.00
47	3802040	MIN FLOW SNOWMASS CR LWR	15.00
48	3802041	MIN FLOW SOPRIS CREEK	5.00
49	3802044	MIN FLOW FRYINGPAN R UP	12.00
50	3802048	MIN FLOW WOODY CREEK	6.00
51	3802049	MIN FLOW ROARING FORK 3	32.00
52	3802050	MIN FLOW ROARING FORK 1	10.00
53	3802077	MIN FLOW FRYINGPAN R LOW	110.00
54	3802080	MIN FLOW CATTLE CREEK	6.00
55	3802111	MIN FLOW ROARING FORK 4	55.00
56	3802112	MIN FLOW ROARING FORK 5	75.00
57	3802114	MIN FLOW CRYSTAL R LOWER	100.00
58	3803713_M	RUEDI RES BYPASS	110.00
59	3804625M2	THOMASVILLE GAGE BYPASS	200.00
60	3804625_M	BOUSTEAD TUNNEL BYPASS	30.00
61	3902001	MIN FLOW EAST ELK CREEK	6.00

#	ID	Name	Decree (cfs)
62	3902002	MIN FLOW ELK CREEK UPPER	10.00
63	3902004	MIN FLOW RIFLE CREEK	5.00
64	3902007	MIN FLOW EAST RIFLE CR L	6.00
65	3902010	MIN FLOW ELK CREEK LOWER	8.00
66	3903508_M	RIFLE GAP RES BYPASS	5.00
67	5002000	MIN FLOW MUDDY CREEK	20.00
68	5003668_M	WOLFORD RES BYPASS	13.00
69	5101264_M	JIM CR BYPASS	10.00
70	5101269_M	DEN RANCH CR BYPASS	4.00
71	5101309_M	ST LOUIS CR BYPASS	10.00
72	5101310_M	VASQUEZ CRK BYPASS	8.00
73	5102014	MIN FLOW WILLIAMS FORK R	32.00
74	5102016	MIN FLOW WILLIAMS FORK R	28.00
75	5102018	MIN FLOW BOBTAIL CREEK	1.00
76	5102019	MIN FLOW BOBTAIL CREEK	2.00
77	5102027	MIN FLOW WILLIAMS FORK R	12.00
78	5102028	MIN FLOW WILLIAMS FORK R	15.00
79	5102029	MIN FLOW WILLIAMS FORK R	9.00
80	5102031	MIN FLOW WILLIAMS FORK R	7.00
81	5102032	MIN FLOW WILLIAMS FORK R	6.00
82	5102033	MIN FLOW WILLIAMS FORK R	5.00
83	5102034	MIN FLOW WILLIAMS FORK R	2.00
84	5102035	MIN FLOW WILLIAMS FORK R	25.00
85	5102036	MIN FLOW COLORADO R LOW	150.00
86	5102037	MIN FLOW COLORADO R MID2	135.00
87	5102038	MIN FLOW COLORADO R MID1	90.00
88	5102039	MIN FLOW WILLIAMS FORK R	57.00
89	5102061	MIN FLOW CORRAL CREEK	1.50
90	5102068	MIN FLOW N FK COLORADO R	18.00
91	5102069	MIN FLOW COLORADO R UP 1	50.00
92	5102075	MIN FLOW CROOKED CR MID1	4.50
93	5102076	MIN FLOW CROOKED CR LOW	8.00
94	5102078	MIN FLOW STRAWBERRY CR M	2.00
95	5102084	MIN FLOW FRASER RIVER UP	6.00
96	5102089	MIN FLOW COLORADO R UP 2	40.00
97	5102090	MIN FLOW CROOKED CR MID2	6.00
98	5102096	MIN FLOW FRASER RIVER VA	11.00
99	5102097	MIN FLOW HAMILTON CR LOW	1.50
100	5102101	MIN FLOW RANCH CREEK HUR	7.00

#	ID	Name	Decree (cfs)
101	5102102	MIN FLOW RANCH CREEK LOW	8.00
102	5102104	MIN FLOW ST LOUIS CR LOW	6.00
103	5102106	MIN FLOW MEADOW CREEK L	1.00
104	5102108	MIN FLOW FRASER RIVER JI	8.00
105	5102109	MIN FLOW FRASER RIVER ST	17.00
106	5102110	MIN FLOW MEADOW CREEK 1	3.50
107	5102111	MIN FLOW ST LOUIS CR 1	11.00
108	5102112	MIN FLOW ST LOUIS CR 2	11.00
109	5102114	MIN FLOW FRASER RIVER LO	30.00
110	5103695_M	SHADOWN MTN RES BYPASS	50.00
111	5103709_M	WILLIAMS FORK RES BYPASS	15.00
112	5103710_M	WILLOW CR RES BYPASS	7.00
113	5104055_M	GRANBY RES M REL	75.00
114	5104603_M	GUMLICK TUNNEL BYPASS	1.00
115	5202006	MIN FLOW SHEEPHORN CREEK	4.50
116	5202009	MIN FLOW COTTONWOOD CR	2.00
117	5300584P	SHOSHONE CALL FLOWS	250.00
118	5302002	MIN FLOW ROCK CREEK	10.00
119	5302006	MIN FLOW SWEETWATER CR	18.00
120	5302011	MIN FLOW EGERIA CREEK	4.00
121	5302012	MIN FLOW GRIZZLY CREEK	3.00
122	5302013	MIN FLOW NO NAME CREEK	2.00
123	5302014	MIN FLOW DERBY CREEK	7.50
124	5302018	MIN FLOW S F DERBY CREEK	4.50
125	5302023	MIN FLOW EGERIA CREEK	8.00
126	7200920_M	UWCD PLATEAU BYPASS	20.00
127	7202000	MIN FLOW PLATEAU CREEK U	3.00
128	7202001	MIN FLOW PLATEAU CREEK L	16.00
129	7202001_2	MIN FLOW PLATEAU 2	16.00
130	7202002	MIN FLOW LEON CREEK	3.50
131	7202005	MIN FLOW MESA CREEK LOW	2.50
*Water right is conditional.			

5.7.4.1 Special Instream Flow rights

Several reservoir bypass agreements, bypass agreements associated with transbasin diversions, and other operations represented as instream flows have water rights set as follows:

Reservoir Bypass Rights:

- Rifle Gap Reservoir Bypass (3903508_M) was set to 5.00 cubic feet per second with an administration number of 37503.36898
- Green Mountain Reservoir Bypass (3603543_M) was set to 85.00 cubic feet per second with an administration number of 31257.99994
- Wolford Mountain Reservoir Bypass (5003668_M) was set to 13.00 cubic feet per second with an administration number of 50385.99999
- Shadow Mountain Reservoir and Grand Lake Bypass (5103695_M) was set to 50.00 cubic feet per second with an administration number of 31257.99999
- Williams Fork Reservoir Bypass (5103709_M) was set to 15.00 cubic feet per second with an administration number of 31358.99999
- Willow Creek Reservoir Bypass (5103710_M) was set to 7.00 cubic feet per second with an administration number of 31257.99999
- Ruedi Reservoir Bypass (3803713_M) was set to 110.00 cubic feet per second with an administration number of 39290.99999
- Dillon Reservoir Bypass (3604512_M) was set to 50.00 cubic feet per second with an administration number of 31257.99997
- Granby Reservoir Bypass (5104055_M) was set to 75.00 cubic feet per second with an administration number of 31257.99999
- Wolcott Reservoir Pumping Pipeline Bypass (3701146_M) was set to 110.00 cubic feet per second with an administration number of 42484.99999

Transbasin Diversion Bypass Agreement Rights:

- Ranch Creek below the Moffat Tunnel project diversion (5101269_M) was set to 4.00 cubic feet per second with an administration number of 30870.26116
- St. Louis Creek below the Moffat Tunnel project diversion (5101309_M) was set to 10.00 cubic feet per second with an administration number of 30870.26116
- Vasquez Creek below the Moffat Tunnel project diversion (5101310_M) was set to 8.00 cubic feet per second with an administration number of 30870.26116
- Hunter Creek below the Moffat Tunnel project diversion (3801594_M) was set to 21.00 cubic feet per second with an administration number of 39290.99999
- Jim Creek below the Moffat Tunnel project diversion (5101264_M) was set to 10.00 cubic feet per second with an administration number of 30870.26116
- Fryingpan River below the Thomasville Gage (3804625M2) was set to 200.00 cubic feet per second with an administration number of 39290.99999
- Homestake Creek below the Gold Park Gage (3704516_M) was set to 24.00 cubic feet per second with an administration number of 39650.37519
- Bobtail Creek downstream of the Gumlick Tunnel diversion (5104603_M) was set to 1.00 cubic feet per second with an administration number of 30870.26116

- Fryingpan River downstream of the Boustead Tunnel diversion (3804625_M) was set to 30.00 cubic feet per second with an administration number of 39290.99999

Other Instream Flow Reach Rights:

- Eagle River Instream Flow (3702059_2) was set to 155.00 cubic feet per second with an administration number of 47558.00000
- Shoshone Power Plant instream flow (5300584P) was set to 1250.00 cubic feet per second with an administration number of 99999.80000.
- The Ute Water Conservancy District Plateau Creek bypass (7200920_M) was set to 20 cubic feet per second with an administration number of 38846.99999, just senior to the Ute Water Conservancy District Plateau Creek diversion.

5.8 Plan Data File (*.pln)

The plan data file can contain information related to operating terms and conditions, well augmentation, water reuse, recharge, and out-of-priority plans. Plan structures are accounting tools used in coordination with operating rights to model complicated systems. In the Upper Colorado River Model, out-of-priority plan structures are used to model the Blue River Decree. The first four plan structures track the amount of water Denver and Colorado Springs divert out-of-priority and corresponding replacements made to Green Mountain Reservoir under Blue River Decree operating rules. Numerous operating rules work in conjunction with the plan structures to model the complexities of the Blue River Decree, see Section 5.9.18.

The HUP Replacement Limit plan limits the annual volume of water released to historical users to 66,000 acre-feet. The CSU Replacement Limit plan limits the annual volume of water that the Continental Hoosier Project can divert or store out of priority to 2,100 acre-feet. The

The ColRivPlan is an accounting plan that is used to better reflect the order of diversions to the Ute's Treatment Plant. The Ute typically choose to divert their Coon Creek pipeline, Carver Ranch pipeline, and Martin Crawford Ditch rights prior to diverting from their senior Colorado River right due to water quality issues. When in priority, water is diverted from the Colorado River to the ColRivPlan. This water is released from the plan to 72_UWCD if needed after water is diverted from Coon Creek pipeline, Carver Ranch pipeline, and Martin Crawford Ditch. Any excess water in the plan is spilled back to the river at the end of the timestep.

The Silt Project, Dry Elk, and Farmers Irrigation Company plan structures are used to model the Silt Project operations. All three plans account for water available to fill Harvey Gap reservoir, and meet the Dry Elk Valley and Farmers Irrigation Company irrigation demands. Additional details are provided in Section 5.9.11.

#	Name	Structure ID	Plan ID
1	Continental Hoosier Tunnel	3604683	3604683PL

2	Upper Blue Lakes	3603570	3603570PL
3	Roberts Tunnel	3604684	3604684PL
4	Dillon Reservoir	3604512	3604512PL
5	HUP Replacement Limit	HUPLimitPLN	HUPLimitPLN
6	CSU Replacement Limit	CSULimitPLN	CSULimitPLN
7	Ute Water Treatment Plant	ColRivPln	ColRivPln
8	Silt Project	3900563	3900563PL
9	Dry Elk	3900563_I	563PLN
10	Farmers Irrigation Co.	3903505_I	3505PLN

5.9 Operating Rights File (*.opr)

The operating rights file specifies operations that are more complicated than a direct diversion or direct storage in an on-stream reservoir. Typically, these are reservoir operations involving two or more structures, such as a release from a reservoir to a diversion structure, a release from one reservoir to a second reservoir, or a diversion to an off-stream reservoir. The file was created by hand. Each operating right was assigned an administration number consistent with the structures' other rights and operations.

In the Upper Colorado River Model, twenty-three different types of operating rights are used:

- **Type 1** – a release from storage to the stream to satisfy an instream flow demand. In the Upper Colorado River Model, this rule is used to satisfy minimum reservoir release requirements at Granby and Dillon Reservoirs, historical demands at Shoshone Power Plant, and USFWS recommended endangered fish flows through the critical 15-Mile Reach.
- **Type 2** – a release from storage to the stream, for shepherded delivery to a downstream diversion or carrier. Typically, the reservoir supply is supplemental, and its release was given an administration number junior to direct flow rights at the destination structure. A release is made only if demand at the diversion structure is not satisfied after direct flow rights have diverted. Releases to irrigation structures are made only if there is remaining crop irrigation requirement.
- **Type 3** – a release from storage directly to a carrier (a ditch or canal as opposed to the river), for delivery to a diversion station. Typically, the reservoir supply is supplemental, and its release is given an administration number junior to direct flow rights at the destination structure. A release is made only if demand at the diversion structure is not satisfied after direct flow rights have diverted. Releases to irrigation structures are made only if there is remaining crop irrigation requirement.
- **Type 4** – a release from storage in exchange for a direct diversion elsewhere in the system. The release can occur only to the extent that there is legally available water in the exchange reach. Typically, the storage water is supplemental, and is given an administration number junior to direct flow rights at the diverting structure.

- **Type 5 –** a release from storage in exchange for reservoir storage elsewhere in the system. The release can occur only to the extent that there is legally available water in the exchange reach. Typically, the storage water is supplemental, and is given an administration number junior to storage rights at the storing reservoir.
- **Type 6 –** a reservoir to reservoir transfer (book-over). The book-over is commonly used to transfer water from one reservoir storage account to another in a particular month. It can also transfer water from one storage account to another based on the amount of water diverted by an operating rule. For example, in the Upper Colorado River Model, water is transferred from the Wolford Mountain Reservoir West Slope account to the Wolford Mountain Reservoir Temporary Fish account on June 30.
- **Type 7 –** a release from storage in exchange for diversion by a carrier elsewhere in the system. The release can occur only to the extent that there is legally available water in the exchange reach. Typically, the storage water is supplemental, and is given an administration number junior to carrier's operating right. Releases to irrigation structures are made only if there is remaining crop irrigation requirement.
- **Type 9** – a release from storage to the river to meet a reservoir target. This operation is used in the Upper Colorado Baseline simulation at reservoirs with forecasting operations (Green Mountain, Upper Blue Lakes, Ruedi, Williams Fork, and Willow Creek). Targets allow maximum storage control of reservoir levels by storage rights and releases to meet demands.
- **Type 10** – a general replacement release from storage for a diversion by river direct or by exchange elsewhere in the system. This rule is used to supply Historic Users in the basin supplemental water for diversions made by the Colorado Big Thompson Project.
- **Type 11** – a direct flow diversion to another diversion or reservoir through an intervening carrier. This rule type uses the administration number and decreed amount of the direct flow right associated with the carrier, regardless of the administration number assigned to the operating right itself. In the Upper Colorado River Model, the Type 11 operating rule is used both as a direct flow diversion to another diversion and as a direct flow diversion to a reservoir. For example, this rule type is used to deliver water from St. Louis Creek to meet Moffat Tunnel demands on the Fraser River. This rule type is also used to deliver water to Vega Reservoir through the Leon Creek Feeder Canal where the demand is Vega Reservoir's storage target.
- **Type 14** – a direct flow diversion to another diversion or reservoir through an intervening carrier limited by the demand at the carrier. This rule type uses the administration number and decreed amount of the direct flow right associated with the carrier, regardless of the administration number assigned to the operating rule itself. In the Upper Colorado River Model, the Type 14 operating rule is used to limit the amount and timing of water diverted through the Willow Creek Feeder and Windy Gap diversions into Granby Reservoir.
- **Type 22** – The type 22 operating rule directs StateMod to consider soil moisture in the variable efficiency accounting. For structures with crop irrigation water requirements, excess diverted water not required by the crops during the month of diversion is stored in the soil reservoir zone, up to the soil reservoir's available capacity. If diversions are not adequate to meet crop irrigation water requirements during the month of diversion,

water is withdrawn from the soil reservoir to meet unsatisfied demands. The depth of the soil zone is defined in the control file (*.ctl). For the Upper Colorado River Model, the effective soil depth or root zone was set to 3 feet. As discussed in section 5.5.1, the available water content, in inches per inch, was defined for each irrigating structure in the StateCU structure file (*.str).

- **Type 26** –The type 26 operating rule allows a changed water right to be diverted from the river and temporarily stored in an accounting plan. Once the changed water right is stored in an accounting plan it can be released at a junior priority by a direct release, by exchange, or spilled using either a Type 27, Type 28, or Type 29 operating rule. In the Upper Colorado River Model, the Type 26 operating rule is used to model the water rights associated with the Silt Project.
- **Type 27** – a release from storage tied to a reuse plan to a diversion or reservoir and corresponding plan structure directly via the river or a carrier. This rule type is used to release water stored out-of-priority in Upper Blue Lakes and Dillon Reservoir to Green Mountain Reservoir pursuant to the Blue River Decree.
- **Type 28** – The type 28 operating rule provides a method to release water from a Reservoir, a ReUse Plan, an Out-of-Priority Plan, an Accounting Plan, or Changed Water Right Plan to a diversion, reservoir, instream flow, or carrier by exchange. In the Upper Colorado River Model, this operating rule is used to release excess HUP water.
- **Type 29 –** The type 29 operating rule provides a method to spill water from a Reservoir, a Reuse Plan, an Accounting Plan, or a Changed Water Right Plan to the system. This rule is used to in the Silt Project to spill excess water from the accounting plans back to the river and the Rifle Gap Reservoir.
- **Type 34** – a reservoir to reservoir transfer, which could be used to book-over water from one account to another within a reservoir or transfer water from one reservoir to another reservoir via a pipeline or carrier. This rule type can also limit the amount of the book-over or transfer based on another operating rule or amount within a plan structure. In the Upper Colorado River Model this rule type is used to book-over water within a reservoir and transfer water from one reservoir to another to repay obligations owed from out-of-priority operations pursuant to the Blue River Decree.
- **Type 38** – the out-of-priority diversion rule provides a method to divert to a reservoir or diversion based on the upstream storage statute (out-of-priority). This rule works in coordination with the subordinating water right and a plan structure to track the volume of water diverted and subsequently owed to the subordinating water right. In the Upper Colorado River Model, the rule is used to allow Denver and Colorado Springs to operate their systems under the guidelines set forth in the Blue River Decree.
- **Type 41** – reservoir storage with special limits allows a reservoir to store water via a reservoir right up to the volume of water stored in out-of-priority plans. The rule also reduces more than one out-of-priority plans pro rata by the amount stored under this rule. In the Upper Colorado River Model, the rule is used to allow Green Mountain Reservoir to fill after the paper fill of its subordinating right has been reached. The amount that can be filled under this right is limited to the amount of water stored and diverted out-of-priority to Green Mountain Reservoir by Denver and Colorado Springs as allowed by the Blue River Decree. Additionally, the amount owed to Green Mountain

Reservoir by Denver and Colorado Springs due to out-of-priority operations is reduced by the amount stored under this rule.

- **Type 42** – the plan demand reset rule provides a method to reset a plan demand at a given time. In the Upper Colorado River Model this rule is used to reset Denver's and Colorado Springs' out-of-priority plan demands remaining at the end of the administration year. This allows the "books to be clear" going into a new administration year and eases the user's ability to track the complicated accounting of the out-of-priority operations under the Blue River Decree. Note: in years this rule triggers, Denver and/or Colorado Springs are not able to repay in full their obligations to Green Mountain Reservoir under the Blue River Decree.
- **Type 45** – The type 45 operating rule provides a method to divert water to a carrier with loss. The carrier then delivers water to a diversion or reservoir. This rule is used to model the Owens and West Divide Creek operations where water is carried from Owens Creek to West Divide Creek and shepherded to its final destination.
- **Type 46** – The type 46 operating rule provides a method to distribute water from one accounting plan to multiple accounting plans at the same priority. As part of the Silt Project, a Type 26 operating rule places the two Grass Valley Canal water rights into one Accounting Plan. The Type 46 operating rule is then used to split the water rights from the initial Accounting Plan into two separate Accounting Plans which deliver water to either the irrigated acreage in the Dry Elk Valley, Harvey Gap Reservoir, or the irrigated acreage under the Farmers Irrigation Company system.
- **Type 47** – The type 47 operating rule provides a method to impose monthly and annual limits for one or more operating rules. This rule is implemented to limit the HUP releases and the Colorado Springs' substitution operations.

The presentation of operating rights for the Upper Colorado River Model is generally organized by project:

Section	Description
5.9.1	Colorado-Big Thompson (C-BT) Project
5.9.2	Green Mountain Reservoir Operations
5.9.3	Denver – Dillon Operations
5.9.4	Continental-Hoosier Project
5.9.5	Wolford Mountain Reservoir Operations
5.9.6	Williams Fork Reservoir and Moffat Tunnel
5.9.7	Fryingpan-Arkansas Project
5.9.8	Ruedi Reservoir
5.9.9	Grand Valley Operations
5.9.10	Homestake Project
5.9.11	Silt Project
5.9.12	Glenwood Springs Operations

Section	Description
5.9.13	Owens Creek Ditch Transbasin
5.9.14	Ute Water Conservancy District Operations
5.9.15	Collbran Project and Vega Reservoir
5.9.16	Leon Creek Transbasin Operations
5.9.17	Soil Moisture Operations
5.9.18	Blue River Decree Operations
5.9.19	15-Mile Reach Endangered Fish Flow Operations
5.9.20	Eagle Park Reservoir

Where to find more information

- StateMod documentation describes the different types of operating rights that could be specified in this file, and describes the required format for the file.
- The section “Colorado River Projects and Special Operations” in the document “Upper Colorado River Basin Information” describes each reservoir’s typical operations.

5.9.1. Colorado-Big Thompson Project and Windy Gap Project

The Colorado-Big Thompson (C-BT) Project diverts water from the Upper Colorado River basin via the Alva B. Adams Tunnel (560 cubic feet per second capacity) for irrigation and municipal use in the South Platte River basin. This system is operated through the use of carrier ditches, exchange agreements, and four reservoirs (Willow Creek, Granby, Green Mountain, and Shadow Mountain/Grand Lake modeled as one storage facility). The Windy Gap Project, located on the Colorado River below the confluence with the Fraser River, was added to this system in 1985 to help acquire additional water.

Shadow Mountain/Grand Lake (18,369 acre-feet capacity) receives water from its local drainage as well as from Granby Reservoir through the use of the Granby Pumping Plant. This reservoir and natural lake is the source from which the Adams Tunnel diverted. Granby Reservoir (539,758 acre-feet capacity) serves as the primary storage facility for the C-BT Project. Willow Creek Reservoir (10,553 acre-feet capacity) stores flows from the Willow Creek drainage and provides water to Granby Reservoir through the Willow Creek Feeder Canal (445 cubic feet per second capacity). Green Mountain Reservoir (154,645 acre-feet capacity) serves as the replacement reservoir for the C-BT system (see Section 5.9.2).

Reservoir	Acct	Account Name	Capacity (acre-feet)
Granby	1	C-BT Pool	460,155[A]
Granby	2	Fish Account	5,413[B]
Granby	3	Dead Pool	74,190
Shadow Mountain/Grand Lake	1	Account	1,839
Shadow Mountain/Grand Lake	2	Dead Pool	16,530
Willow Creek	1	C-BT Pool	3,329
Willow Creek	2	Dead Pool	7,224

[A] Capacity is 465,568 acre-feet in Historic simulation. 15-Mile reach fish flow operations changed after 2012.
[B] Capacity is 0 acre-feet in Historic simulation. 15-Mile reach fish flow operations changed after 2012.

Eleven operating rules are used to simulate the C-BT Project and Windy Gap Project operations. Operations are split into four sections below.

Granby Reservoir Operations

Right #	Destination	Account or Carrier	Admin #	Right Type	Description
1	Adams Tunnel	1	31258.00004	3	Release to direct diversion via pipeline
2	Granby Reservoir Bypass	1	31258.00001	1	Release to instream flow
3	Shadow Mtn/Grand Lake	1	31258.00003	3	Release to reservoir via pipeline
4	Reservoir to Target	All	99999.99999	9	Release to river by target

Operating rule 1 simulates the Granby Pumping Plant, moving water from Granby Reservoir through Shadow Mountain/Grand Lake and ultimately Adams Tunnel. The administration number was set junior to Granby Reservoir's storage right and Adams Tunnel's direct right. This rule is on in the Historic and Baseline simulations.

Operating rule 2 is a minimum release from Granby Reservoir to ensure the following instream flows below the dam:

- October through April: 20 cubic feet per second
- May through July: 75 cubic feet per second
- August: 40 cubic feet per second
- September: 20 cubic feet per second

The releases during May through September are reduced if the USBR forecasts that the total inflows to Shadow Mountain, Grand Lake, and Lake Granby—less the decreed rights in the reach of the Colorado River mainstem between Granby Dam and the mouth of the Fraser River—and the water capable of being pumped from Willow Creek Reservoir will be 230,000 acre-feet or less during the water year. The administration number was set junior to the instream flow right. This rule is on in the Historic and Baseline simulations.

Operating rule 3 moves water from Granby Reservoir to Shadow Mountain/Grand Lake Reservoir. The rule transfers water to the C-BT and Dead Pool accounts in Shadow Mountain/Grand Lake Reservoir to replace evaporation losses. This rule is on in the Historic and Baseline simulations.

Operating rule 4 releases water from all accounts proportionally to meet the end-of-month target values. The junior administration number ensures this is the last operating rule to fire at the reservoir. This rule is on in the Historic and Baseline simulations.

Shadow Mountain/Grand Lake Reservoir Operations

Right #	Destination	Account or Carrier	Admin #	Right Type	Description
1	Reservoir to Target	All	99999.99999	9	Release to river by target

Operating rule 1 releases water from all accounts proportionally to meet the historical end-of-month target values at Shadow Mountain/Grand Lake Reservoir. The junior administration number ensures this is the last operating rule to fire at the reservoir. Shadow Mountain/Grand Lake Reservoir is a flow through structure and is maintained year-round with a pool height variation of no more than 1 ft. Targets reflect historical operation in the Historic and Baseline simulations because of the strict water level requirements that were maintained over the historical period of the reservoir.

Willow Creek Reservoir and Feeder Canal Operations

Right #	Destination	Account or Carrier	Admin #	Right Type	Description
1	Granby Reservoir	Willow Creek Feeder	31258.00000	14	Carrier with constrained demand
2	Granby Reservoir	1, Willow Creek Feeder	31258.00002	2	Release to river to carrier
3	Reservoir to Target	All	99999.99999	9	Release to river by target

Operating rule 1 simulates the Willow Creek Feeder Canal direct diversions from Willow Creek to Granby Reservoir. The administration number is set equal to the direct diversion right for Willow Creek Feeder Canal. This rule turns off the direct diversion right for the Willow Creek Feeder Canal. Information provided in the direct diversion structure (*.dds), right (*.ddr), and demand (*.ddm) files and reservoir demand located at Granby Reservoir limits the amount of water diverted. This rule is on in the Historic and Baseline simulations.

Operating rule 2 simulates releases from Willow Creek Reservoir to Willow Creek Feeder Canal, which carries water to Granby Reservoir. This rule is set junior to operating rule 1 to allow the direct diversion to meet the demand before water is released from storage. Willow Creek Feeder Canal has the added variable of pumping costs that are not simulated directly within StateMod. The demand for the Baseline simulation is filled

Historical data and can be adjusted to model different future scenarios. This rule is on in the Historic and Baseline simulations.

Operating rule 3 releases water from all accounts proportionally to meet the historical end-of-month target values at Willow Creek Reservoir. The junior administration number ensures this is the last operating rule to fire at the reservoir. In the Historic and Baseline simulations, targets are set to historical end-of-month storage. This rule is on in the Historic and Baseline simulations.

Windy Gap Operations

Right #	Destination	Account or Carrier	Admin #	Right Type	Description
1	Granby Reservoir	Windy Gap Pipeline	47671.00001	14	Carrier with constrained demand
2	Granby Reservoir	Windy Gap Pipeline	47671.00002	14	Carrier with constrained demand
3	Granby Reservoir	Windy Gap Pipeline	47671.00003	14	Carrier with constrained demand

Operating rules 1 through 3 simulates the Windy Gap direct diversions from the Colorado River to Granby Reservoir. The administration numbers correspond to the direct diversion rights for Windy Gap, which are set junior to the Colorado River instream flow downstream of the diversion (5102038). These rules turn off the direct diversion rights for Windy Gap. Information provided in the direct diversion structure (*.dds), right (*.ddr), and demand (*.ddm) files and reservoir demand located at Granby Reservoir limit the amount of water diverted. Windy Gap has the added variable of pumping costs that are not simulated directly within StateMod. The demands for the Baseline simulation are projected depletions provided by Northern Colorado Water Conservancy District. These rules are on in the Historic and Baseline simulations.

5.9.2. Green Mountain Reservoir Operations

Green Mountain Reservoir (154,645 acre-feet capacity) serves as the replacement reservoir for the C-BT system. In addition to the C-BT replacement account, Green Mountain has a Historic Users Pool (HUP) western slope account for agriculture and municipal users; a Contract account for diverters other than the C-BT and HUP beneficiaries; a Silt Project account, which stores water for demand met by the Silt Pump Canal; and a Surplus Fish account for future applications of the Upper Colorado Model.

From the time Green Mountain Reservoir was completed in 1948 until 1984, the reservoir operated in strict accordance with provisions laid out in Senate Document 80. During this time period, if the flow at the Shoshone Diversion Dam (WDID 5300584), as measured at the Dotsero stream gage (09070500), was less than 1,250 cubic feet per second, the division engineer would first curtail all transmountain diversions (other than C-BT) before making a release from Green Mountain Reservoir. As a result of this method of administration, Green Mountain typically remained reasonably full during the summer irrigation season and was drawn down beginning in September, reaching its low point in storage by the end of April of the following year. A significant portion of the water was being released for power generation without the additional benefit of supplementing existing Western Slope irrigation uses.

In 1985, the division engineer began to administer the river in accordance with the priority system, with the result that many of the transmountain diversions that historically had been curtailed by the division engineer (Denver and Colorado Springs) were actually in priority and entitled to divert. The junior rights that would be called out by the Shoshone Call and/or the Cameo Call were more likely to be junior Western Slope water users. Green Mountain Reservoir provided general depletion replacement releases from the HUP account to historical irrigation and municipal diverters who had water rights that were senior to January 24, 1984.

In 1997, the division engineer revised the administration of the HUP account in Green Mountain Reservoir as a result of the litigation in Case No. 91CW247 (Orchard Mesa Check Case). Green Mountain Reservoir continues to provide general depletion replacement releases from the Historic Users Pool (HUP) account to historical irrigation and municipal diverters who have water rights that are senior to October 15, 1977.

Reservoir	Acct	Account Name	Capacity (acre-feet)
Green Mountain	1	Historic Users Pool	66,000
Green Mountain	2	C-BT Pool	52,000
Green Mountain	3	Contract	20,000
Green Mountain	4	Silt Project	5,000
Green Mountain	5	Inactive	11,645
Green Mountain	6	Surplus Fish	66,000

Twenty-eight operating rules are used to simulate the operations associated with Green Mountain Reservoir. Operations are split into seven sections below.

Elliot Feeder Canal Operations

Right #	Destination	Account or Carrier	Admin #	Right Type	Description
1	Green Mountain Reservoir	Elliot Creek Feeder	31258.00000	11	Carrier to reservoir
2	Green Mountain Hydroelectric	Elliot Creek Feeder	31258.00000	11	Carrier to diversion

Operating rules 1 and 2 simulate the Elliot Creek Feeder Canal transporting water from Elliot Creek to demands at Green Mountain Reservoir for storage and hydroelectric power generation. The administration number for Elliot Creek Feeder Canal diversion right, Green Mountain Reservoir first fill right, and Green Mountain Reservoir Hydroelectric Power diversion right are the same – 31258.00000. Because of the same administration number, rule 1 uses Green Mountain Reservoir's fill right, and rule 2 uses Green Mountain Reservoir Hydroelectric Power's right—both at the Elliot Creek Feeder Canal location. The diversions are limited to times of demand at the reservoir and power plant and to the physical limitations of the Elliot Creek Feeder Canal. These rules are on in the Historic and Baseline simulations.

C-BT Project Operations

Right #	Destination	Account or Carrier	Admin #	Right Type	Description
1	Granby Reservoir	2	31258.00011	5	Release to river exch to storage
2	Willow Creek Reservoir	2	31258.00018	5	Release to river exch to storage
3	Shadow Mtn/Grand Lake	2	31258.00025	5	Release to river exch to storage
4	Granby Reservoir	2, Willow Creek Feeder	31258.00032	7	Release to river exch to carrier

Operating rule 1 deliver water by exchange from the C-BT account in Green Mountain Reservoir to the C-BT, Fish and Dead Pool accounts in Granby Reservoir. Operating rules 2 and 3 deliver water by exchange from the C-BT account in Green Mountain Reservoir to the C-BT the C-BT and Dead Pool accounts in Willow Creek Reservoir and Shadow Mountain/Grand Lake. The administration numbers were set junior to the fill rights of the associated reservoirs and are part of a sequence of replacements associated with the Blue River Decree (see Section 5.9.18). These rules are modeled because Green Mountain Reservoir was built as a replacement source for the C-BT Project. These rules are on in the Historic and Baseline simulations; however, the capacity of Granby's Fish Account in the Historic simulation is set to zero.

Operating rule 4 exchanges water from the C-BT account in Green Mountain Reservoir to the Willow Creek Feeder Canal. This rule is linked with rule 1 of section 5.9.1 Colorado-Big Thompson Project – Willow Creek Reservoir and Feeder Canal Operations, above; see this section for more details. The administration number is set junior to the carrier operation right and is part of a sequence of replacements associated with the Blue River Decree (see Section 5.9.18). This rule is on in the Historic and Baseline simulations.

Silt Project Operations

Right #	Destination	Account or Carrier	Admin #	Right Type	Description
1	Farmers Irrigation Company	Silt Pump Canal	39041.00007	2	Release to river to carrier

Operating rule 1 releases water from the Green Mountain's Silt project account when the Farmers Irrigation Company (3903505_I) demand cannot be met by its local sources. Water is delivered via the Silt Pump Canal. The administration number was set junior to the operation right of the Silt Pump Canal (see section 5.9.11) and is part of a sequence of replacements associated with the Blue River Decree (see section 5.9.18). This rule is on in the Historic and Baseline simulations.

Historic Users Replacement Operations

Right #	Destination	Account or Carrier	Admin #	Right Type	Description
1	Shoshone Call Flows	1	99999.90000	1	Release to instream flow demand
2	Historic Users	1	48966.00000	10	Release to general replace demand
3	Government Highline	1, Grand Valley Project	48966.00000	2	Release to river to carrier
4	OMID Irrigation	1, Grand Valley Project	48966.00000	2	Release to river to carrier
5	OMID Pump	1, Grand Valley Project	48966.00000	2	Release to river to carrier
6	Historic Users	1	46674.00000	10	Release to general replace demand
7	Government Highline	1, Grand Valley Project	46674.00000	2	Release to river to carrier
8	OMID Irrigation	1, Grand Valley Project	46674.00000	2	Release to river to carrier
9	OMID Pump	1, Grand Valley Project	46674.00000	2	Release to river to carrier

Operating rule 1 provides water from the HUP account to an instream flow reach upstream of Shoshone Power Plant. The junior administration number ensures this rule is operated when Shoshone cannot achieve its demand from the natural flow in the river. The instream flow is used to limit the amount of water released to Shoshone's senior right, which is 1,250 cubic feet per second. This rule is on in the Historical simulation from the start of the study period through 1984. This rule is off in the Baseline simulation.

Operating rule 2 provides general replacement releases from Green Mountain to historical irrigation and municipal diverters. Water rights that are senior to January 24, 1984, receive water from this operating rule, except for industrial uses, transmountain diversions, and carrier systems. This rule is operational from 1985 through 1996, allowing historical Green Mountain reservoir operations to be simulated. This rule is on for the Historical simulation and off in the Baseline simulation.

Operating rules 3 through 5 are extensions of rule 2, which provide replacement water to the Grand Valley Project roller dam (7200646). These rules are operational from 1985 through 1996. The general replacement rule (Right Type 10) does not provide replacement water to structures that receive water via a carrier, and therefore these rules are required to deliver replacement water to the Grand Valley Project demands. These rules are on for the Historical simulation and off in the Baseline simulation.

Operating rules 6 through 9 replace the functions of rules 2 through 5, respectively, within the Historic simulation starting in 1997 and are on throughout the entire study period in the Baseline simulation. These rules use a date of October 15, 1977, which represents the adjudication date for the HUP pool in Senate Document 80.

Contract Demands Operations

Right #	Destination	Account or Carrier	Admin #	Right Type	Description
1	Vail Valley Cons. (non-irrigation)	3	42420.41373	4	Exchange to direct diversion
2	Atkinson Ditch	3	49308.48667	4	Exchange to direct diversion
3	Needham Ditch	3	46751.42648	4	Exchange to direct diversion
4	Derby Diversion System	3	47481.12662	4	Exchange to direct diversion
5	Coon Creek Pipeline	3	46995.00007	4	Exchange to direct diversion
6	Green Mountain Contract Demand	3	48966.00007	2	Release to direct diversion
7	Reservoir to Target	1	99999.99999	9	Release to river by target
8	Reservoir to Target	3	99999.99999	9	Release to river by target
9	Reservoir to Target	4	99999.99999	9	Release to river by target
10	Reservoir to Target	2	100000.00000	9	Release to river by target

Operating rules 1 through 5 release water from the contract pool, by exchange, to the individual contract pool users. The administration numbers were set junior to the direct diversion rights and are part of a sequence of replacements associated with the Blue River Decree (see Section 5.9.18). These rules are operational from 1985 on for the Historic simulation to reflect the change in Green Mountain Reservoir HUP operations, and are on for the entire study period in the Baseline simulation.

Operating rule 6 is similar to rules 1 through 5 except that releases are made directly to the demand rather than by exchange.

Operating rules 7 through 10 release water from the historic user pool, contract, Silt project, and C-BT accounts, respectively, to meet the historical end-of-month target values at Green Mountain Reservoir. These releases represent releases not explicitly modeled in the Historic simulation, and are set so the C-BT account releases last. In the Baseline simulation these rules are used to release to a reservoir forecasting operating curve.

15-Mile Reach Fish Flow Operations

Right #	Destination	Account or Carrier	Admin #	Right Type	Description
1	Fish Instream Flow	1	99999.93008	2	Release to direct diversion

Operating rule 1 allows water from the historic user pool in Green Mountain Reservoir to supplement the endangered fish demands in the 15-mile reach (see Section 5.9.19). This rule is operating from August through October and is turned on in 1997 for Historical simulation and is on for the entire study period in the Baseline simulation. The administration number is different in the Historic simulation due to different operations pre-2013 (see Section 5.9.19). The junior administration number assures that only "excess" HUP water is released.

Blue River Decree Operations

Right #	Destination	Account or Carrier	Admin #	Right Type	Description
1	Green Mountain Reservoir	First 5	38628.00000	41	Reservoir storage with special limits

Operating rule 1 simulates Green Mountain Reservoir's 1955 Blue River Decree Exchange storage right. This operating rule allows Green Mountain to store under a 1955 right the amount of water that was diverted and stored out-of-priority to Green Mountain's senior first fill right by Denver and Colorado Springs. When water is stored under this right it reduces the out-of-priority obligation owed by Denver and Colorado Springs proportionately (see Section 5.9.18 for additional information).

5.9.3. Continental-Hoosier Project

The Continental-Hoosier (Con-Hoosier) Project, sometimes called the Blue River Project, diverts water from the headwaters of the Blue River and its tributaries into the South Platte River Basin for municipal water supply. The collection, diversion facilities, and associated water rights are owned by the City of Colorado Springs. Water collected from two structures (3604683 and 3604699) and stored in Upper Blue Lakes (3603570, capacity 2,113 acre-feet) is exported through the Con-Hoosier Tunnel (3604683SU, 500 cubic feet per second capacity).

Reservoir	Acct	Account Name	Capacity (acre-feet)
Upper Blue	1	Active	2,140
Upper Blue	2	Colorado Springs – Out-Of-Priority	2,100
Upper Blue	3	MOA Releases	250

Twenty-two operating rules are used to simulate the operations associated with the Con-Hoosier Project. Operations are split below into four sections.

Continental-Hoosier Tunnel Operations

Right #	Destination	Account or Carrier	Admin #	Right Type	Description
1	Continental-Hoosier Summary Node	3604699, 1929 Right	30184.29071	11	Carrier to diversion

2	Continental-Hoosier Summary Node	3604683, 1948 Right	35927.00000	11	Carrier to diversion

Operating rules 1 and 2 carry water from collection nodes (3604699 and 3604683) to demand at the summary node (3604683SU). The administration numbers of these rules were set equal to the administration numbers of the direct diversion rights associated with the carrier structures. These two rules are turned on in the Historic and Baseline simulations.

Con-Hoosier Tunnel Out-Of-Priority Operations

Right #	Destination	Account or Carrier	Admin #	Right Type	Description
1	Continental-Hoosier Summary	3604683, 1948 Right	31257.99995	38	Out-of-priority diversion
2	Continental-Hoosier Plan	NA	99999.99999	42	Plan demand reset

Operating rule 1 simulates Colorado Springs' diversions through the Con-Hoosier Tunnel out-of-priority to Green Mountain Reservoir. This is the only right needed to represent out-of-priority diversions because the 1929 water right, associated with structure 3604699, is senior to Green Mountain Reservoir's first fill right. The administration number was set senior to Green Mountain Reservoir's first fill right and is the first out-of-priority operation associated with the Blue River Decree (see Section 5.9.18 for additional information). Out-of-priority diversion accounting is simulated at plan structure 3604683PL. This rule is on in the Historic and Baseline simulations, with diversions limited to months of April through July.

Operating rule 2 resets accounting to zero at plan structure 3604683PL. The administration number was set junior and operates on the last day of March. This operating rule is used to simplify review of plan accounting and to highlight years when out-of-priority diversions are not replaced. This rule is on in the Historic and Baseline simulations.

Upper Blue Lakes Reservoir Operations

Right #	Destination	Account or Carrier	Admin #	Right Type	Description
1	Continental-Hoosier Summary Node	1	35927.00002	3	Release to demand via pipeline
2	Continental-Hoosier Summary Node	2	35927.00003	3	Release to demand via pipeline
3	Reservoir to Target	1	1.00000	9	Release to river by target
4	Reservoir to Target	2	1.00001	9	Release to river by target

Operating rules 1 and 2 release water from Upper Blue Lakes to the Con-Hoosier demand located at the summary node (3604683SU). The administration number was set junior to the direct diversion rights and the reservoir fill right, which maximizes the amount of water available to meet the demand. This rule is on in the Historic and

Baseline simulations.

Operating rules 3 and 4 release water from Upper Blue Lakes on the first day of August to simulate the trade of 250 acre-feet of water to the West Slope users in the Blue River Basin for 250 acre-feet of water in Wolford Mountain Reservoir. This is a simplified operation to mimic the trade of water in the Blue River Basin and is used because the amount of water is minimal and the individual beneficiary demands are not modeled (see Section 5.9.18 for additional information). These rules are turned on from 2004 forward in the Historic simulation and turned on for the entire study period in the Baseline simulation.

Reservoir Out-Of-Priority Operations

Right #	Destination	Account or Carrier	Admin #	Right Type	Description
1	Upper Blue out-of-priority account	NA	31257.99996	38	Out-of-priority storage
2	Upper Blue Plan	NA	99999.99999	42	Plan demand reset
3	Dillon Reservoir out-of-priority account	2	1.00002	34	Reservoir exchange with plan
4	Dillon Reservoir out-of-priority account	2	1.00003	34	Reservoir exchange with plan
5	Green Mountain Reservoir first 5 accounts	2	1.00004	27	Release to reservoir with plan
6	Green Mountain Reservoir first 5 accounts	2	1.00005	27	Release to reservoir with plan
7	Dillon Reservoir out-of-priority account	1	1.00006	34	Reservoir exchange with plan
8	Dillon Reservoir out-of-priority account	1	1.00007	34	Reservoir exchange with plan
9	Green Mountain Reservoir first 5 accounts	1	1.00008	27	Release to reservoir with plan
10	Green Mountain Reservoir first 5 accounts	1	1.00009	27	Release to reservoir with plan
11	MOA Release account	1 to 3	1.00000	6	Reservoir account book-over
12	MOA Release account	2 to 3	1.00001	6	Reservoir account book-over
13	Maggie Pond	3	1.00002	2	Release to direct diversion
14	Upper Blue Active account	2 to 1	1.00015	6	Reservoir account book-over

Operating rule 1 simulates Colorado Springs' storage in Upper Blue Lakes out-of-priority to Green Mountain Reservoir. The administration number was set senior to Green Mountain Reservoir's first fill right and is the second out-of-priority operation associated with the Blue River Decree (see Section 5.9.18 for additional information). Out-of-priority storage from this rule is accounted for with the plan structure 3603570PL. This rule is on in the Historic and Baseline simulations and storage is limited to the months of April through July.

Operating rule 2 resets accounting to zero at plan structure 3603570PL. The administration number was set junior and operates on the last day of March. This operating rule is used to simplify the review of the plan accounting and to highlight years when the out-of-priority storage is not replaced. This rule is on in the Historic and Baseline simulations.

Operating rules 3 through 10 release water from the Upper Blue Reservoir to either Dillon or Green Mountain reservoirs to replace remaining out-of-priority obligations on August 1st. The administration numbers were set senior so that operations occur at the beginning of the August 1st time step. Releases to Dillon reservoir decrease Colorado Springs' out-of-priority obligation while increasing Denver's out-of-priority obligation. Releases to Green Mountain Reservoir reduce Colorado Springs' out-of-priority obligation. These operating rules are tied to either the out-of-priority diversion plan (3604683PL) or to the out-of-priority storage plan (3603570PL) for accounting of replacements. These rules are on in the Historic and Baseline simulations.

Operating rules 11 and 12 transfer water from Colorado Springs' active and OOP accounts to the 250 acre-feet MOA Release account in Upper Blue Lakes in June and July to reflect the delivery to Upper Blue River water users per the 2003 MOA. Operating rule 13 release the water in the MOA Release account to Maggie Pond (3600989) in November. Operating Rule 13 transfers water from Colorado Springs' out-of-priority storage account to the active account in Upper Blue Lakes. This rule empties the out-of-priority storage account and makes the water available for Colorado Springs to use through the Con-Hoosier Tunnel or other uses. The administration number was set junior to the replacement rules to ensure Green Mountain is satisfied before Colorado Springs can claim the water. These rules are on in the Historic and Baseline simulations.

5.9.4. Denver – Dillon Operations

The city of Denver uses two facilities to draw water from the Upper Colorado River basin into the South Platte River basin: Moffat Tunnel (see Section 5.9.6) and the Harold D. Roberts Tunnel (Roberts Tunnel). Roberts Tunnel is located in District 36 on the Blue River. Dillon Reservoir, which is owned by the City of Denver and has a capacity of 257,000 acre-feet, provides water to Roberts Tunnel when the tunnel's direct diversion right is not in priority. Both Roberts Tunnel and Dillon Reservoir operate out-of-priority to Green Mountain Reservoir as part of the Blue River Decree (see Section 5.9.18).

In addition to serving Denver's needs, Dillon Reservoir stores water for several other users. The Summit County account stores water for the beneficiaries of the original Summit County Agreement and the Clinton Reservoir Agreement (see the Colorado River Basin Information Report for more information). The 1,000 acre-foot pool, in substitution years, supplies water for the 50 cubic feet per second instream flow below Dillon Reservoir. The final account in Dillon is used to store out-of-priority water.

Clinton Gulch Reservoir (capacity 4,300 acre-feet) was purchased by Summit County Agreement beneficiaries to obtain additional storage water to satisfy their demands.

Operational rules assigned to Clinton Gulch Reservoir in the Upper Colorado Model are related to Climax mine operations. Since the Summit County and Clinton Reservoir-Fraser River agreements are not explicitly modeled, some operations were omitted. This reservoir is included in the model to facilitate the inclusion of these agreements in future model enhancements. Clinton Gulch Reservoir is divided into nine accounts—one for each of the shareholders of the Clinton Ditch and Reservoir Company and one Dead Pool.

Reservoir	Acct	Account Name	Capacity (acre-feet)
Dillon	1	Denver / Roberts Tunnel	252,015
Dillon	2	Summit County	1,021
Dillon	3	Dead Pool	3,269
Dillon	4	1000 acre-feet	1,000
Dillon	5	Denver (Out-Of-Priority)	154,645
Clinton Gulch	1	Town of Breckenridge	390
Clinton Gulch	2	Town of Dillon	60
Clinton Gulch	3	Town of Silverthorne	165
Clinton Gulch	4	Breckenridge Ski Area	455
Clinton Gulch	5	Cooper Mountain Ski Area	490
Clinton Gulch	6	Keystone Ski Area	1,305
Clinton Gulch	7	Winter Park Ski Area	270
Clinton Gulch	8	Summit County	465
Clinton Gulch	9	Dead Pool	700

Forty-one operating rules are used to simulate the operations associated with Roberts Tunnel, Dillon Reservoir, and Clinton Gulch Reservoir. Operations are split below into five sections.

Roberts Tunnel Operations

Right #	Destination	Account or Carrier	Admin #	Right Type	Description
1	Roberts Tunnel	NA	31257.99998	38	Out-of-priority diversion
2	Roberts Tunnel Plan	NA	99999.99999	42	Plan demand reset

Operating rule 1 simulates Denver’s diversion through the Roberts Tunnel out-of-priority to Green Mountain Reservoir. The administration number was set senior to Green Mountain Reservoir’s first fill right and is the third out-of-priority operation associated with the Blue River Decree (see Section 5.9.18 for additional information). Out-of-priority diversions from this rule are accounted for with the plan structure 3604684PL. This rule is on in the Historic and Baseline simulations and the diversions are limited to the months of April through July.

Operating rule 2 resets accounting to zero at plan structure 3604684PL. The administration number was set junior and operates on the last day of March. This operating rule is used to simplify the review of the plan accounting and to highlight years when the out-of-priority diversions are not replaced. This rule is on in the Historic and Baseline simulations.

Dillon Reservoir Operations

Right #	Destination	Account or Carrier	Admin #	Right Type	Description
1	Roberts Tunnel	1	35927.00008	2	Release to river to direct diversion
2	Roberts Tunnel	5	35927.00009	2	Release to river to direct diversion
3	Green Mountain Reservoir	4	99999.00000	2	Release to river to reservoir
4	Excess HUP Release	4	100000.00000	2	Release to river to direct diversion
5	Below Dillon Minimum Stream Flow	4	31257.99998	1	Release to instream flow demand
6	Reservoir to Target	All	99999.99999	9	Release to river by target

Operating rules 1 and 2 release water to Roberts Tunnel from Dillon Reservoir. Through agreements with Colorado Springs, Denver subordinates their operations of Dillon Reservoir and Roberts Tunnel to the operations of the Continental Hoosier Project. Therefore, the administration numbers were set, in sequence, junior to Colorado Springs' operations, Roberts Tunnel direct diversion right, Dillon Reservoir direct storage right, and exchanges from Williams Fork Reservoir to both Roberts Tunnel and Dillon Reservoir. These rules are on in the Historic and Baseline simulations.

Operating rules 3 through 5 release water from the 1000 acre-feet account in substitution years to replace Denver's out-of-priority operation obligations. Releases to the minimum stream flow between Dillon Reservoir and Green Mountain Reservoir (3604512_M) occur when there is water in the account and a demand exists at the instream flow node. Releases are then made in March to Green Mountain Reservoir and the Excess HUP Release node (3604512HU) to ensure all replacement water is released within the same administration year. These rules are on in the Historic and Baseline simulations.

Operating rule 6 releases water from all accounts in Dillon Reservoir to meet the end-of-month target values. The administration number was set junior so that it was the last reservoir operation. This rule is on in the Historic and Baseline simulations.

Dillon Reservoir Out-Of-Priority Operations

Right #	Destination	Account or Carrier	Admin #	Right Type	Description
1	Dillon: Denver – Out-Of-Priority	NA	31257.99999	38	Out-of-priority storage
2	Dillon Reservoir Plan	NA	99999.99999	42	Plan demand reset

3	1000 acre-feet account	5 to 4	1.00016	34	Reservoir exchange with plan
4	Green Mountain Reservoir	5	1.00025	27	Release to reservoir with plan
5	Green Mountain Reservoir	5	1.00026	27	Release to reservoir with plan
6	Green Mountain Reservoir	1	1.00027	27	Release to reservoir with plan
7	Green Mountain Reservoir	1	1.00028	27	Release to reservoir with plan
8	Dillon: Denver / Roberts Tunnel	5 to 1	1.00029	6	Reservoir account book-over
9	Green Mountain Reservoir	5	1.00038	27	Release to reservoir with plan
10	Green Mountain Reservoir	5	1.00039	27	Release to reservoir with plan
11	Green Mountain Reservoir	1	1.00040	27	Release to reservoir with plan
12	Green Mountain Reservoir	1	1.00041	27	Release to reservoir with plan

Operating rule 1 simulates Denver's storage in Dillon Reservoir out-of-priority to Green Mountain Reservoir. The administration number was set senior to Green Mountain Reservoir's first fill right and is the fourth and final out-of-priority operation associated with the Blue River Decree (see Section 5.9.18 for additional information). Out-of-priority storage from this rule is accounted for with the plan structure 3604512PL. This rule is on in the Historic and Baseline simulations and storage is limited to the months of April through July.

Operating rule 2 resets accounting to zero at plan structure 3604512PL. The administration number was set junior and operates on the last day of March. This operating rule is used to simplify the review of the plan accounting and to highlight years when the out-of-priority storage is not replaced. This rule is on in the Historic and Baseline simulations.

Operating rule 3 books-over water to the 1,000 acre-feet account from the out-of-priority account. The administration number was set senior so that operations occur at the beginning of the August 1st time step. Water booked-over reduces Denver's out-of-priority obligation and is tied to the out-of-priority storage plan (3604512PL) for accounting of replacements. The water books-over into the 1000 acre-feet account is used as described above in the Dillon Reservoir Operations section. The rule is on in the Historic and Baseline simulations.

Operating rules 4 through 7 release water from Dillon to Green Mountain reservoirs to replace remaining out-of-priority obligations on August 1st. The administration numbers were set senior so that operations occur at the beginning of the August 1st time step, but junior to replacement releases from Williams Fork and Wolford Mountain Reservoirs. Releases to Green Mountain Reservoir reduce Denver's out-of-priority obligation. These operating rules are tied to the out-of-priority diversion plan (3604684PL) and to the out-of-priority storage plan (3604512PL) for accounting of replacements. These rules are on in the Historic and Baseline simulations.

Operating rule 8 transfers water from Denver's out-of-priority storage account to the Denver / Roberts Tunnel account in Dillon Reservoir. This rule empties the out-of-priority storage account and makes the water available for Denver to use through the Roberts Tunnel or other uses. The administration number was set junior to the replacement rules to ensure Green Mountain is satisfied before Denver could claim the water. This rule is on in the Historic and Baseline simulations.

Operating rules 9 through 12 release water from Dillon to Green Mountain reservoirs to replace remaining out-of-priority Colorado Springs obligations on August 1st. The administration numbers were set senior so that operations occur at the beginning of the August 1st time step, but junior to replacement releases from Williams Fork and Wolford Mountain Reservoirs. Releases to Green Mountain Reservoir reduce Colorado Spring's out-of-priority obligation. These operating rules are tied to the out-of-priority diversion plan (3603570PL) and to the out-of-priority storage plan (3603570PL) for accounting of replacements. These rules are on in the Historic and Baseline simulations.

Clinton Gulch Reservoir Operations

Right #	Destination	Account or Carrier	Admin #	Right Type	Description
1	Climax-Ten Mile Creek Div No.1	1	100000.00000	3	Release to direct diversion via pipeline
2	Climax-Ten Mile Creek Div No.1	2	100000.00000	3	Release to direct diversion via pipeline
3	Climax-Ten Mile Creek Div No.1	3	100000.00000	3	Release to direct diversion via pipeline
4	Climax-Ten Mile Creek Div No.1	4	100000.00000	3	Release to direct diversion via pipeline
5	Climax-Ten Mile Creek Div No.1	5	100000.00000	3	Release to direct diversion via pipeline
6	Climax-Ten Mile Creek Div No.1	6	100000.00000	3	Release to direct diversion via pipeline
7	Climax-Ten Mile Creek Div No.1	7	100000.00000	3	Release to direct diversion via pipeline
8	Climax-Ten Mile Creek Div No.1	8	100000.00000	3	Release to direct diversion via pipeline
9	Reservoir to target	All	100000.00000	9	Release to River by target

Operating rules 1 through 8 release water from Clinton Gulch Reservoir to Climax's Ten Mile Creek Diversion No.1. The administration numbers were set junior to Climax's Ten Mile Creek Diversion No.1 direct diversion right. These rules are on in the Historic and Baseline simulations.

Operating rule 9 releases water from all accounts in Clinton Gulch Reservoir to meet the end-of-month target values. The administration number was set junior so that it is the last reservoir operation. This rule is on in the Historic and Baseline simulations.

Clinton Gulch Agreement Dillon Reservoir Operations

Right #	Destination	Account or Carrier	Admin #	Right Type	Description
1	Town of Breckenridge	2	47483.00001	4	Exchange to direct diversion
2	Town of Breckenridge	1	47483.00002	4	Exchange to direct diversion
3	Town of Dillon	2	18005.00001	4	Exchange to direct diversion
4	Town of Dillon	1	18005.00002	4	Exchange to direct diversion
5	Breckenridge Ski Area	2	100000.00000	4	Exchange to direct diversion
6	Breckenridge Ski Area	1	100000.00001	4	Exchange to direct diversion
7	Copper Mountain Ski Area	2	100000.00000	4	Exchange to direct diversion
8	Copper Mountain Ski Area	1	100000.00001	4	Exchange to direct diversion
9	Keystone Ski Area	2	47968.00001	4	Exchange to direct diversion
10	Keystone Ski Area	1	47968.00002	4	Exchange to direct diversion
11	Town of Keystone	2	44741.00001	4	Exchange to direct diversion
12	Town of Keystone	1	44741.00002	4	Exchange to direct diversion

Operating rules 1 through 12 release water from Dillon Reservoir to beneficiaries of the Summit County and Clinton Reservoir-Fraser River agreements. The administration numbers were set junior to direct diversion right for each of the individual structures. These rules are included to represent a simplification of the two agreements and a starting point for future model updates of the two agreements. These rules are on in the Historic simulation from 1992 forward and on the entire study period in the Baseline simulation.

5.9.5. Wolford Mountain Reservoir Operations

Wolford Mountain Reservoir (capacity 65,985 acre-feet) was constructed and is operated by the Colorado River Water Conservation District. The reservoir began storing water during 1995 and filled over two seasons. In the Historical dataset, many operating rules are turned on in 1997 because Wolford Mountain did not follow normal operations during the filling sequence.

Wolford Mountain Reservoir was divided into nine accounts, including a general West Slope account; a Denver account that serves as a general replacement in lieu of Green Mountain; two 15-mile reach endangered fish accounts; two Denver Replacement accounts that receive water from Denver's reserve account and then releases to Green Mountain demands or for fish flows; a Colorado Springs account that serves for general replacement in lieu of Green Mountain; a Colorado Springs account used to book-over 250 acre-feet per year to their reserve account from the West Slope account; and a Colorado Springs Replacement account that receives water from Colorado Springs' reserve account and then releases to Green Mountain demands or for fish flows. Many of the reservoir's accounts are used to ensure proper accounting of the Blue River Decree and the Interim Policy along with proper release schedules between the many accounts throughout the basin that are used to replace in lieu of Green Mountain. Note, due to changes in operations beginning in 2013 (see Section 5.9.19), accounts 3 and 4 are different in the Historic and Baseline simulations. The table below illustrates the Baseline accounts:

Reservoir	Acct	Account Name	Capacity (acre-feet)
Wolford Mountain	1	West Slope	39,796
Wolford Mountain	2	Denver	25,610
Wolford Mountain	3	Fish Account 1	3,000
Wolford Mountain	4	Fish Account 2	3,000
Wolford Mountain	5	Denver Replacement 1	5,000
Wolford Mountain	6	Denver Replacement 2	20,610
Wolford Mountain	7	Colorado Springs	1,750
Wolford Mountain	8	Colorado Springs Book-over	250
Wolford Mountain	9	Colorado Springs Replacement	1,750

In the Historic simulation, account 3 has a capacity of 6,000 acre-feet and account 4 is a temporary fish account with a capacity of 5,413 acre-feet.

Eighty-eight operating rules are used to simulate the operations associated with Wolford Mountain Reservoir. Operations are split below into six sections.

15-Mile Reach Fish Flow Operations

Right #	Destination	Account or Carrier	Admin #	Right Type	Description
1	Fish Account 1	3	99999.93003	2	Release to river to direct diversion
2	Fish Account 2	4	99999.93011	2	Release to river to direct diversion

Operating rules 1 and 2 release water from the Fish Accounts to the USFWS fish flow demand in the 15-Mile reach. These rules operate in the months of August through October. The administration numbers are slightly different in the Historic and Baseline simulations due an operational change in the release sequence described below in Section 5.9.19.

The Historic simulation contains similar rules; however, instead of releasing from two permanent fish accounts, there is a Temporary Fish account and a book-over rule that transfers water from the West Slope account to the Temporary Fish account.

Wolford Contract Demands Operations

Right #	Destination	Account or Carrier	Admin #	Right Type	Description
1	Fraser Contract Demand	1	99999.00000	4	Exchange to direct diversion
2	Middle Park Contract Demand	1	99999.00000	4	Exchange to direct diversion

Operating rules 1 and 2 releases water from the West Slope account to the two contract demands. The administration numbers were set junior to most diversions and operations. The demands for both the Fraser and Middle Park nodes are satisfied solely by releases from Wolford Mountain Reservoir. These rules are on in the Historic and Baseline simulations.

A third Wolford Mountain Contract demand node exists – Market Demand (5003668MK). This node is a placeholder for future scenarios and, therefore, does not have a demand in the Historic or Baseline simulations. Operating rules will need to be added for this node in the future.

Other General Wolford Operations

Right #	Destination	Account or Carrier	Admin #	Right Type	Description
1	Reservoir to target	All	99999.99999	9	Release to River by target

Operating rule 1 releases water from all accounts in Wolford Mountain Reservoir to meet the end-of-month target values. The administration number was set junior so that it is the last reservoir operation. This rule is on in the Historic and Baseline simulations.

Colorado Springs Replacement Operations

Right #	Destination	Account or Carrier	Admin #	Right Type	Description
1	Colorado Springs Replacement acct	7 to 9	1.00042	34	Reservoir book-over with plan
2	Colorado Springs Replacement acct	7 to 9	1.00043	34	Reservoir book-over with plan
3	Colorado Springs Book-over acct	1 to 8	1.00046	6	Reservoir account book-over
4	Colorado Springs account	8 to 7	999999.9998	6	Reservoir account book-over
5	West Slope account	8 to 1	999999.9999	6	Reservoir account book-over

Operating rules 1 and 2 book-over water to the Colorado Springs Replacement account from the Colorado Springs account. The administration numbers were set senior so that operations occur at the beginning of the August 1st time step. Water booked-over reduces Colorado Springs' out-of-priority obligations and are tied to the out-of-priority diversion and storage plans, 3604683PLand 3603570PL, respectively, for accounting of replacements. The water booked-over into the Colorado Springs Replacement account is used to meet Green Mountain Reservoir obligations—as described below in the Green

Mountain Operations from Alternate Replacement Pools section. These rules are on in the Historic and Baseline simulations.

Operating rules 3 through 5 book-over water between the West Slope, Colorado Springs Book-over, and Colorado Springs accounts. The administration number for rule 3 was set senior so that operations occur at the beginning of the August 1st time step. The administration number for rules 4 and 5 were set to the last two rights in the Upper Colorado River Model so that operations occur at the end of the August 1st time step. It is critical that these two rules do not repeat with rule 3 when StateMod iterates. These rules are part of the Blue River Decree and Interim Policy operations (see section 5.9.18 for additional information). These rules are on in the Historic and simulation starting in 2004 and the entire study period for the Baseline simulation.

Denver Replacement Operations

Right #	Destination	Account or Carrier	Admin #	Right Type	Description
1	Denver Replacement 1 account	2 to 5	1.00017	34	Reservoir book-over with plan
2	Denver Replacement 1 account	2 to 5	1.00018	34	Reservoir book-over with plan
3	Denver Replacement 2 account	2 to 6	1.00021	34	Reservoir book-over with plan
4	Denver Replacement 2 account	2 to 6	1.00022	34	Reservoir book-over with plan
5	Denver Replacement 2 account	2 to 2	1.00030	34	Reservoir book-over with plan
6	Denver Replacement 2 account	2 to 2	1.00031	34	Reservoir book-over with plan

Operating rules 1 through 4 book-over water to the two Denver Replacement accounts from the Denver account. The administration numbers were set senior so that operations occur at the beginning of the August 1st time step. Water booked-over reduces Denver's out-of-priority obligations and are tied to the out-of-priority diversion and storage plans, 3604684PL and 3604512PL, respectively, for accounting of replacements. Operating rules 5 and 6 book-over water to the Denver Replacement account from the Denver Replacement account, increasing Denver's out of priority plan obligation by the remaining amount in Colorado Spring's out-of-priority plan. Water booked-over reduces Colorado Springs' out-of-priority obligations and are tied to the out-of-priority diversion and storage plans, 3603570PL and 3604683PL, respectively, for accounting of replacements, and subject to CSULimit obligations. The water booked-over into the Denver Replacement accounts is used to meet Green Mountain Reservoir obligations, as described below in the Green Mountain Operations from Alternate Replacement Pools section. The rules are on in the Historic and Baseline simulations.

Green Mountain Operations from Alternate Replacement Pools

Right #	Destination	Account or Carrier	Admin #	Right Type	Description
1	Granby Reservoir	5	31258.00005	5	Release to river exch to storage
2	Granby Reservoir	9	31258.00007	5	Release to river exch to storage
3	Granby Reservoir	6	31258.00009	5	Release to river exch to storage
4	Willow Creek Reservoir	5	31258.00012	5	Release to river exch to storage
5	Willow Creek Reservoir	9	31258.00014	5	Release to river exch to storage
6	Willow Creek Reservoir	6	31258.00015	5	Release to river exch to storage
7	Shadow Mtn/Grand Lake	5	31258.00019	5	Release to river exch to storage
8	Shadow Mtn/Grand Lake	9	31258.00021	5	Release to river exch to storage
9	Shadow Mtn/Grand Lake	6	31258.00022	5	Release to river exch to storage
10	Granby Reservoir	5, Willow Creek Feeder	31258.00026	7	Release to river exch to carrier
11	Granby Reservoir	9, Willow Creek Feeder	31258.00028	7	Release to river exch to carrier
12	Granby Reservoir	6, Willow Creek Feeder	31258.00029	7	Release to river exch to carrier
13	Farmers Irrigation Co	5, Silt Pump Canal	39041.00001	2	Release to river to carrier
14	Farmers Irrigation Co	9, Silt Pump Canal	39041.00003	2	Release to river to carrier
15	Farmers Irrigation Co	6, Silt Pump Canal	39041.00004	2	Release to river to carrier
16	Historic Users	5	48965.99994	10	Release to general replace dem
17	Historic Users	9	48965.99996	10	Release to general replace dem
18	Historic Users	6	48965.99997	10	Release to general replace dem
19	Government Highline	5, Grand Valley Project	48965.99994	2	Release to river to carrier
20	Government Highline	9, Grand Valley Project	48965.99996	2	Release to river to carrier
21	Government Highline	6, Grand Valley Project	48965.99997	2	Release to river to carrier
22	OMID Irrigation	5, Grand Valley Project	48965.99994	2	Release to river to carrier
23	OMID Irrigation	9, Grand Valley Project	48965.99996	2	Release to river to carrier
24	OMID Irrigation	6, Grand Valley Project	48965.99997	2	Release to river to carrier
25	OMID Pump	5, Grand Valley Project	48965.99994	2	Release to river to carrier
26	OMID Pump	9, Grand Valley Project	48965.99996	2	Release to river to carrier
27	OMID Pump	6, Grand Valley Project	48965.99997	2	Release to river to carrier
28	Historic Users	5	46673.99994	10	Release to general replace dem
29	Historic Users	9	46673.99996	10	Release to general replace dem
30	Historic Users	6	46673.99997	10	Release to general replace dem
31	Government Highline	5, Grand Valley Project	46673.99994	2	Release to river to carrier
32	Government Highline	9, Grand Valley Project	46673.99996	2	Release to river to carrier
33	Government Highline	6, Grand Valley Project	46673.99997	2	Release to river to carrier

Right #	Destination	Account or Carrier	Admin #	Right Type	Description
34	OMID Irrigation	5, Grand Valley Project	46673.99994	2	Release to river to carrier
35	OMID Irrigation	9, Grand Valley Project	46673.99996	2	Release to river to carrier
36	OMID Irrigation	6, Grand Valley Project	46673.99997	2	Release to river to carrier
37	OMID Pump	5, Grand Valley Project	46673.99994	2	Release to river to carrier
38	OMID Pump	9, Grand Valley Project	46673.99996	2	Release to river to carrier
39	OMID Pump	6, Grand Valley Project	46673.99997	2	Release to river to carrier
40	Vail Valley Consolidated	5	42420.41367	4	Exchange to direct diversion
41	Vail Valley Consolidated	9	42420.41369	4	Exchange to direct diversion
42	Vail Valley Consolidated	6	42420.41370	4	Exchange to direct diversion
43	Atkinson Ditch	5	49308.48661	4	Exchange to direct diversion
44	Atkinson Ditch	9	49308.48663	4	Exchange to direct diversion
45	Atkinson Ditch	6	49308.48664	4	Exchange to direct diversion
46	Needham Ditch	5	46751.42642	4	Exchange to direct diversion
47	Needham Ditch	9	46751.42644	4	Exchange to direct diversion
48	Needham Ditch	6	46751.42645	4	Exchange to direct diversion
49	Derby Diversion System	5	47481.12656	4	Exchange to direct diversion
50	Derby Diversion System	9	47481.12658	4	Exchange to direct diversion
51	Derby Diversion System	6	47481.12659	4	Exchange to direct diversion
52	Coon Creek Pipeline	5	46995.00001	4	Exchange to direct diversion
53	Coon Creek Pipeline	9	46995.00003	4	Exchange to direct diversion
54	Coon Creek Pipeline	6	46995.00004	4	Exchange to direct diversion
55	Green Mtn Contract Dem	5	48966.00001	4	Exchange to direct diversion
56	Green Mtn Contract Dem	9	48966.00003	4	Exchange to direct diversion
57	Green Mtn Contract Dem	6	48966.00004	4	Exchange to direct diversion
58	Fish Instream Flow	5	99999.93006	27	Release to carrier with plan
59	Fish Instream Flow	9	99999.93006	27	Release to carrier with plan
60	Fish Instream Flow	6	99999.93006	27	Release to carrier with plan
61	Excess HUP Release	5	100000.00000	2	Release to direct diversion
62	Excess HUP Release	9	100000.00000	2	Release to direct diversion
63	Excess HUP Release	6	100000.00000	2	Release to direct diversion
64	Molina Tailrace (UWCD)	5	46673.99994	28	Exchange to carrier
65	Molina Tailrace (UWCD)	9	46673.99996	28	Exchange to carrier
66	Molina Tailrace (UWCD)	6	46673.99997	28	Exchange to carrier

Right #	Destination	Account or Carrier	Admin #	Right Type	Description
67	Plateau (Ute PL HG 2)	5	46673.99994	28	Exchange to carrier
68	Plateau (Ute PL HG 2)	9	46673.99996	28	Exchange to carrier
69	Plateau (Ute PL HG 2)	6	46673.99997	28	Exchange to carrier
70	Rapid Creek Pumping Plant (Ute Col. River)	5	46673.99994	27	Reservoir release to carrier
71	Rapid Creek Pumping Plant (Ute Col. River)	9	46673.99996	27	Reservoir release to carrier
72	Rapid Creek Pumping Plant (Ute Col. River)	6	46673.99997	27	Reservoir release to carrier

Operating rules 1 through 12 correspond with the rules outlined in Section 5.9.2 Green Mountain Reservoir Operations – C-BT Project Operations, above.

Operating rules 13 through 15 correspond with the rule outlined in Section 5.9.2 Green Mountain Reservoir Operations – Silt Project Operations, above.

Operating rules 16 through 39 correspond with the rules outlined in Section 5.9.2 Green Mountain Reservoir Operations – Historic Users Replacement Operations, above. Wolford Mountain Reservoir was not online when Green Mountain Reservoir was releasing to the Shoshone Call Flows, therefore this rule is not modeled.

Operating rules 39 through 57 correspond with the rules outlined in Section 5.9.2 Green Mountain Reservoir Operations – Contract Demands Operations, above. Operating rules 55 through 57 are *exchanges* to direct diversion while the corresponding operating rules at Green Mountain Reservoir are *releases* to direct diversion.

Operating rules 58 through 60 correspond with rule 4 outlined in Section 5.9.2 Green Mountain Reservoir Operations – 15-Mile Reach Fish Flows Operations.

Operating rules 61 through 63 release water from the replacement accounts, in March, to the Excess HUP Release node (5003668HU) so replacement water is released within the same administration year. These rules are on in the Historic and Baseline simulations.

Operating rules 64 through 72 were added to the Baseline dataset to better reflect the Ute operations. These rules provide Green Mountain protection to the Ute Water Conservancy District from Green Mountain Reservoir, Williams Fork and Wolford Mountain Reservoirs.

5.9.6. Williams Fork Reservoir and Moffat Tunnel

The city of Denver uses two facilities to draw water from the Upper Colorado River basin into the South Platte River basin: Moffat Tunnel and the Harold D. Roberts Tunnel (see Section 5.9.4). The city of Englewood developed the Englewood Cabin-Meadow Creek Project to divert water from the Fraser River basin and export it through the Moffat Tunnel to its facilities.

Two primary reservoirs are associated with the Moffat and Englewood systems. Williams Fork Reservoir stores water for exchange by the city of Denver and the Henderson Mine and Mill. This reservoir is located on the Williams Fork River, in District 51, and has a capacity of 96,822 acre-feet. Meadow Creek Reservoir stores water for Denver, Englewood, and the Vail Ditch Company on Meadow Creek, a tributary to the Fraser River, and has a capacity of 5,930 acre-feet.

Reservoir	Acct	Account Name	Capacity (acre-feet)
Williams Fork	1	Denver	99,765
Williams Fork	2	Henderson	2,200
Williams Fork	3	Temporary Fish	0
Williams Fork	4	Green Mountain Replacement 1	10,000
Williams Fork	5	Green Mountain Replacement 2	25,000
Meadow Creek	1	Denver / Englewood	4,780
Meadow Creek	2	Vail Ditch	850
Meadow Creek	3	Dead Pool	300

Eighty-four operating rules are used to simulate the operations associated with Williams Fork Reservoir and Moffat Tunnel. Operations are split below into six sections.

Meadow Creek Reservoir Operations

Rule #	Destination	Account or Carrier	Admin #	Rule Type	Description
1	Vail Irrigation Div. Sys.	2	31259.30134	2	Reservoir release to carrier
2	Hamilton-Cabin Creek Ditch	1	31259.30134	3	Release to direct diversion via pipeline
3	Moffat Summary Node	1	31259.30134	3	Release to direct diversion via pipeline
4	Reservoir to Target	All	99999.99999	9	Release to river by target

Operating rule 1 releases water from the Vail Ditch account in Meadow Creek Reservoir by exchange to the Vail Ditch Diversion System demand. The administration number was set just junior to the reservoir's first fill right. This rule is on in the Historic and Baseline simulations.

Operating rules 2 and 3 releases water from the Denver / Englewood account in Meadow Creek Reservoir to Moffat Tunnel Collection points. The administration numbers were set just junior to the reservoir's first fill right. These rules are on in the Historic and Baseline simulations.

Operating rule 4 releases water from all accounts proportionally to meet the end-of-month target values. The junior administration number ensures this is the last operating rule to fire at the reservoir. This rule is on in the Historic and Baseline simulations.

Fraser River Moffat Carrier Operations

Right #	Destination	Account or Carrier	Admin #	Right Type	Description
1	Moffat Summary Node	Jim Creek Collection	30870.26117	11	Carrier to diversion
2	Moffat Summary Node	Vasquez Creek Collection	30870.26117	11	Carrier to diversion
3	Moffat Summary Node	St. Louis Creek Collection	20676.16801	11	Carrier to diversion
4	Moffat Summary Node	St. Louis Creek Collection	30870.26117	11	Carrier to diversion
5	Moffat Summary Node	Ranch Creek Collection	30870.26117	11	Carrier to diversion
6	Moffat Summary Node	Gumlick (Jones Pass) Tunnel	30870.26117	11	Carrier to diversion
7	Moffat Summary Node	Englewood Ranch Crk Collection	31259.30133	11	Carrier to diversion

Operating rules 1 through 7 carry water from their respective tributaries to the Moffat Tunnel summary node. The administration numbers were set identical to the direct diversion rights of the carrier structures. The direct diversion rights are turned off through the use of these rules. These rules are off in the Historic and on in the Baseline simulations.

Williams Fork Reservoir Operations

Right #	Destination	Account or Carrier	Admin #	Right Type	Description
1	Henderson Mine	2	31359.00002	4	Exchange to direct diversion
2	Roberts Tunnel	1	35927.00006	4	Exchange to direct diversion
3	Dillon Reservoir	1	35927.00007	5	Release to river exch to storage
4	Jim Creek Collection	1	30870.26118	4	Exchange to direct diversion
5	Vasquez Creek Collection	1	30870.26118	4	Exchange to direct diversion
6	St. Louis Creek Collection	1	30870.26118	4	Exchange to direct diversion
7	Ranch Creek Collection	1	30870.26118	4	Exchange to direct diversion
8	Gumlick (Jones Pass) Tunnel	1	30870.26118	4	Exchange to direct diversion
9	Jim Creek Collection	1	30870.26118	7	Release to river exch to carrier
10	Vasquez Creek Collection	1	30870.26118	7	Release to river exch to carrier
11	St. Louis Creek Collection	1	20676.16802	7	Release to river exch to carrier
12	St. Louis Creek Collection	1	30870.26118	7	Release to river exch to carrier

13	Ranch Creek Collection	1	30870.26118	7	Release to river exch to carrier
14	Gumlick (Jones Pass) Tunnel	1	30870.26118	7	Release to river exch to carrier
15	Reservoir to Target	All	99999.99999	9	Release to river by target

Operating rule 1 releases water from the Henderson account in Williams Fork Reservoir in exchange to Henderson Mine and Mill demands. The administration number was set junior to the reservoirs first fill right. This rule is on in the Historic and Baseline simulations.

Operating rules 2 and 3 allow Roberts Tunnel and Dillon Reservoir, respectively, to divert or store water by exchange from Williams Fork Reservoir. These rules are part of the Blue River Decree operations and their administration numbers were set junior to the direct diversion and storage rights (see Section 5.9.18). These rules are on in the Historic and Baseline simulations.

Operating rules 4 through 8 release water from Williams Fork Reservoir in exchange for diversions at the collection points for the Moffat Tunnel. The administration numbers were set junior to the direct diversion rights of these structures. These rules are on in the Historic simulation and off in the Baseline simulation.

Operating rules 9 through 14 release water from Williams Fork Reservoir in exchange for diversions at the collection points for the Moffat Tunnel. The administration numbers were set junior to the direct diversion rights of these structures. These rules are tied back to operating rules 1 through 6 of Section 5.9.6 Williams Fork Reservoir and Moffat Tunnel – Fraser River Moffat Carrier Operations, above. These rules are off in the Historic simulation and on in the Baseline simulation.

Operating rule 15 releases water from all accounts proportionally to meet the end-of-month target values. The junior administration number ensures this is the last operating rule to fire at the reservoir. This rule is on in the Historic and Baseline simulations.

15-Mile Reach Fish Flow Operations

In 2013, the sequence of releases for the 15-Mile reach changed (see Section 5.9.19). In the Baseline simulation, Williams Fork Reservoir no longer releases for the 15-Mile reach. However, the following operating rules are included in the Historic simulation:

Right #	Destination	Account or Carrier	Admin #	Right Type	Description
1	Temporary Fish Account	1 to 3	99999.95000	6	Reservoir account book-over
2	Fish Instream Flow	3	99999.93002	2	Res. release to diversion, carrier or res.

Operating rule 1 transfers water from the Denver account to the Temporary Fish account. The administration number was set junior and operated on June 30th.

Operating rule 2 releases water from the Temporary Fish account to the USFWS fish flow demand in the 15-Mile reach. The administration number was set junior to the instream flow right and is part of the historical fish release sequence described below in Section 5.9.19. This rule operates in the months of August through October. These operating rule are on in the Historic simulation starting in 1997 and were removed from the Baseline simulation.

Denver Replacement Operations

Right #	Destination	Account or Carrier	Admin #	Right Type	Description
1	Denver Replacement 1 account	1 to 4	1.00019	34	Reservoir exchange with plan
2	Denver Replacement 1 account	1 to 4	1.00020	34	Reservoir exchange with plan
3	Denver Replacement 2 account	1 to 5	1.00023	34	Reservoir exchange with plan
4	Denver Replacement 2 account	1 to 5	1.00024	34	Reservoir exchange with plan
5	Denver Replacement 2 account	1 to 1	1.00032	34	Reservoir exchange with plan
6	Denver Replacement 2 account	1 to 1	1.00033	34	Reservoir exchange with plan

Operating rules 1 through 4 book-over water to the first Denver Replacement account from the Denver account. The administration numbers were set senior so that operations occur at the beginning of the August 1st time step. Water booked-over reduces Denver's out-of-priority obligations and are tied to the out-of-priority diversion and storage plans, 3604684PL and 3604512PL, respectively, for accounting of replacements. Operating rules 5 and 6 book-over water to the Denver Replacement Account from the Denver Replacement Account, increasing Denver's out of priority plan obligation by the remaining amount in Colorado Spring's out-of-priority plan. Water booked-over reduces Colorado Springs' out-of-priority obligations and are tied to the out-of-priority diversion and storage plans, 3603570PL and 3604683PL, respectively, for accounting of replacements, and subject to CSULimit obligations. The water booked-over into the Denver Replacement accounts is used to meet Green Mountain Reservoir obligations, as described below in the Green Mountain Operations from Alternate Replacement Pools section. The rules are on in the Historic and Baseline simulations.

Green Mountain Operations from Alternate Replacement Pools

Right #	Destination	Account or Carrier	Admin #	Right Type	Description
1	Granby Reservoir	4	31258.00006	5	Release to river exch to storage
2	Granby Reservoir	5	31258.00010	5	Release to river exch to storage
3	Willow Creek Reservoir	4	31258.00013	5	Release to river exch to storage

Right #	Destination	Account or Carrier	Admin #	Right Type	Description
4	Willow Creek Reservoir	5	31258.00016	5	Release to river exch to storage
5	Shadow Mtn/Grand Lake	4	31258.00020	5	Release to river exch to storage
6	Shadow Mtn/Grand Lake	5	31258.00023	5	Release to river exch to storage
7	Granby Reservoir	4, Willow Creek Feeder	31258.00027	7	Release to river exch to carrier
8	Granby Reservoir	5, Willow Creek Feeder	31258.00030	7	Release to river exch to carrier
9	Farmers Irrigation Co	4, Silt Pump Canal	39041.00002	2	Release to river to carrier
10	Farmers Irrigation Co	5, Silt Pump Canal	39041.00005	2	Release to river to carrier
11	Shoshone Call Flows	4	99999.89998	1	Release to instream flow dem
12	Shoshone Call Flows	5	99999.89999	1	Release to instream flow dem
13	Historic Users	4	48965.99995	10	Release to general replace dem
14	Historic Users	5	48965.99998	10	Release to general replace dem
15	Government Highline	4, Grand Valley Project	48965.99995	2	Release to river to carrier
16	Government Highline	5, Grand Valley Project	48965.99998	2	Release to river to carrier
17	OMID Irrigation	4, Grand Valley Project	48965.99995	2	Release to river to carrier
18	OMID Irrigation	5, Grand Valley Project	48965.99998	2	Release to river to carrier
19	OMID Pump	4, Grand Valley Project	48965.99995	2	Release to river to carrier
20	OMID Pump	5, Grand Valley Project	48965.99998	2	Release to river to carrier
21	Historic Users	4	46673.99995	10	Release to general replace dem
22	Historic Users	5	46673.99998	10	Release to general replace dem
23	Government Highline	4, Grand Valley Project	46673.99995	2	Release to river to carrier
24	Government Highline	5, Grand Valley Project	46673.99998	2	Release to river to carrier
25	OMID Irrigation	4, Grand Valley Project	46673.99995	2	Release to river to carrier
26	OMID Irrigation	5, Grand Valley Project	46673.99998	2	Release to river to carrier
27	OMID Pump	4, Grand Valley Project	46673.99995	2	Release to river to carrier
28	OMID Pump	5, Grand Valley Project	46673.99998	2	Release to river to carrier
29	Vail Valley Consolidated	4	42420.41368	4	Exchange to direct diversion
30	Vail Valley Consolidated	5	42420.41371	4	Exchange to direct diversion
31	Atkinson Ditch	4	49308.48662	4	Exchange to direct diversion
32	Atkinson Ditch	5	49308.48665	4	Exchange to direct diversion
33	Needham Ditch	4	46751.42643	4	Exchange to direct diversion
34	Needham Ditch	5	46751.42646	4	Exchange to direct diversion
35	Derby Diversion System	4	47481.12657	4	Exchange to direct diversion
36	Derby Diversion System	5	47481.12660	4	Exchange to direct diversion
37	Coon Creek Pipeline	4	46995.00002	4	Exchange to direct diversion

Right #	Destination	Account or Carrier	Admin #	Right Type	Description
38	Coon Creek Pipeline	5	46995.00005	4	Exchange to direct diversion
39	Green Mtn Contract Dem	4	48966.00002	4	Exchange to direct diversion
40	Green Mtn Contract Dem	5	48966.00005	4	Exchange to direct diversion
41	Fish Instream Flow	4	99999.93005	27	Release from plan
42	Fish Instream Flow	5	99999.93005	27	Release from plan
43	Excess HUP Release	4	100000.00000	2	Release to direct diversion
44	Excess HUP Release	5	100000.00000	2	Release to direct diversion
45	Molina Tailrace (UWCD)	4	46673.99995	28	Exchange to carrier
46	Molina Tailrace (UWCD)	5	46673.99998	28	Exchange to carrier
47	Plateau (Ute PL HG 2)	4	46673.99995	28	Exchange to carrier
48	Plateau (Ute PL HG 2)	5	46673.99998	28	Exchange to carrier
49	Rapid Creek Pumping Plant (Ute Col. River)	4	46673.99995	27	Reservoir release to carrier
50	Rapid Creek Pumping Plant (Ute Col. River)	5	46673.99998	27	Reservoir release to carrier

Operating rules 1 through 8 correspond with the rules outlined in Section 5.9.2 Green Mountain Reservoir Operations – C-BT Project Operations, above.

Operating rules 9 and 10 correspond with the rule outlined in Section 5.9.2 Green Mountain Reservoir Operations – Silt Project Operations, above.

Operating rules 11 through 28 correspond with the rules outlined in Section 5.9.2 Green Mountain Reservoir Operations – Historic Users Replacement Operations, above.

Operating rules 29 through 40 correspond with the rules outlined in Section 5.9.2 Green Mountain Reservoir Operations – Contract Demands Operations, above. Operating rules 39 and 40 are *exchanges* to direct diversions while the operating rules at Green Mountain Reservoir are *releases* to direct diversions.

Operating rules 41 and 42 correspond with the rule outlined in Section 5.9.2 Green Mountain Reservoir Operations – 15-Mile Reach Fish Flows Operations, above.

Operating rules 43 and 44 release water from the replacement accounts, in March, to the Excess HUP Release node (5103709HU) so replacement water is released within the same administration year. These rules are on in the Historic and Baseline simulations.

Operating rules 45 through 50 were added to the Baseline dataset to better reflect the Ute operations. These rules provide Green Mountain protection to the Ute Water

Conservancy District from Green Mountain Reservoir, Williams Fork and Wolford Mountain Reservoirs.

5.9.7. Fryingpan-Arkansas Project

The Fryingpan-Arkansas (Fry-Ark) Project diverts water from the Fryingpan River and Hunter Creek basins into the Arkansas River basin for use on the Front Range. Water is exported from the Upper Colorado River basin through the Charles H. Boustead Tunnel, which has a rated capacity of approximately 1,000 cubic feet per second. Because the project was completed in phases, it is modeled as two collection areas, Fryingpan and Hunter, and one replacement reservoir, Ruedi Reservoir. The Fryingpan collection area obtains water from tributaries to the Fryingpan River basin, including 100% of the North Side collection system and a significant portion of the South Side collection system (see Upper Colorado River Basin Information Report). The Hunter collection area diverts water from the Hunter Creek basin through the use of the Hunter Tunnel (approximately 300 cubic feet per second capacity), and a portion of the South Side collection system.

Fryingpan-Arkansas Project Operations

Right #	Destination	Account or Carrier	Admin #	Right Type	Description
1	Boustead Summary Node	Hunter Tunnel	39291.00001	11	Carrier to diversion
2	Boustead Summary Node	Boustead Tunnel	39291.00000	11	Carrier to diversion
3	Boustead Summary Node	Boustead Tunnel	48577.39291	11	Carrier to diversion

Operating rule 1 diverts water from the Hunter Creek collection area and carries it to the Boustead summary node. The administration number for this rule was set to the administration number of Hunter Creek's direct diversion right. The Hunter Creek collection area was not online until 1981.

Operating rules 2 and 3 divert water from the Fryingpan collection area and carry it to the Boustead summary node. The administration numbers for these rules were set to the administration numbers of Boustead Tunnel's direct diversion rights

All three of these rules are turned off in the Historic simulation because the demand is met by the direct diversion rights; however, they are turned on for the entire study period in the Baseline simulations.

5.9.8. Ruedi Reservoir

Ruedi Reservoir, in the Fryingpan River basin, has a capacity of 102,373 acre-feet. It provides replacement water for out-of-priority diversions for the Fry-Ark Project. In addition, it provides water for contract sales as well as instream flow demands in the 15-Mile Reach of the Colorado River below the Grand Valley Project.

Reservoir	Acct	Account Name	Capacity (acre-feet)
Ruedi	1	Round 1 & 2 Contract	30,263
Ruedi	2	Replacement	28,000
Ruedi	3	Unallocated / Dead Pool	28,698
Ruedi	4	CWCB Fish	5,413
Ruedi	5	Unallocated / 5,000 acre-feet	5,000
Ruedi	6	USFWS 5,000 acre-feet 4/5	5,000

Seventeen operating rules are used to simulate the operations associated with Ruedi Reservoir. Operations are split below into four sections.

Fryingpan-Arkansas Project Operations

Right #	Destination	Account or Carrier	Admin #	Right Type	Description
1	Hunter Tunnel	2	39291.00002	4	Exchange to direct diversion
2	Boustead Tunnel	2	48577.39292	4	Exchange to direct diversion
3	Boustead Summary Node	2, Hunter Tunnel	48577.39293	7	Release to river exch to carrier
4	Boustead Summary Node	2, Boustead Tunnel	48577.39292	7	Release to river exch to carrier
5	Boustead Summary Node	2, Boustead Tunnel	48577.39294	7	Release to river exch to carrier

Operating rules 1 and 2 release water from Ruedi's Replacement account in exchange for the out-of-priority diversions made at the Hunter Creek Tunnel and Boustead Tunnel. The administration numbers for these rules were set just junior to the direct diversion rights. Rule 1 is on from 1981 forward and rule 2 is on the entire study period in the Historic simulation. Both rules are off in the Baseline simulation.

Operating rules 3 through 5 release water from Ruedi's Replacement account in exchange for the out-of-priority diversions made at the Hunter Creek Tunnel and Boustead Tunnel carriers to the Boustead summary node. The administration numbers were set junior to the most junior direct diversion right for the two carrier structures. These rules are off in the Historic simulation and on the entire study period in the Baseline simulation.

15-Mile Reach Fish Flow Operations

Right #	Destination	Account or Carrier	Admin #	Right Type	Description
1	Fish Flow Diversion	5	99999.91001	2	Release to direct diversion
2	Fish Flow Diversion	4	99999.91002	2	Release to direct diversion
3	Fish Flow Diversion	6	99999.91003	2	Release to direct diversion

4	Fish Instream Flow	5	99999.93001	2	Release to direct diversion
5	Fish Instream Flow	4	99999.93004	2	Release to direct diversion
6	Fish Instream Flow	6	99999.93012	2	Release to direct diversion
7	Unallocated / 5,000 acre-feet account	6 to 5	99999.93013	6	Reservoir account book-over

Operating rules 1 through 3 release water from the Unallocated / 5,000 acre-feet, CWCB Fish, and USFWS 5,000 acre-feet 4/5 accounts in Ruedi Reservoir, respectively, to the Fish Flow diversion node. The administration numbers were set junior to the reservoir first fill right. These rules model the pre-1997 fish releases that were made from Ruedi Reservoir (see Section 5.9.19). These rules are on in the Historic and Baseline simulation; however, the demand is set to zero in the Baseline simulation.

Operating rules 4 through 6 release water from the Unallocated / 5,000 acre-feet, CWCB Fish, and USFWS 5,000 acre-feet 4/5 accounts in Ruedi Reservoir, respectively, to the 15-Mile reach diversion node. The administration numbers were set junior to the reservoir first fill right and are part of a release sequence from reservoirs throughout the basin in the Baseline simulation. Operating rule 7 transfers water from the USFWS 5,000 acre-feet 4/5 account to the Unallocated / 5,000 acre-feet account. The administration number was set junior and operates on March 31st.

As noted in Section 5.9.19, the release sequence changed after 2012. These specific rules operate August through October and are turned on the entire study period in the Baseline simulation.

Similar rules are in the Historic simulation to model fish releases from 1997-2012; however, they represent a different sequence of reservoir releases (see Section 5.9.19).

Contract Demands Operations

Right #	Destination	Account or Carrier	Admin #	Right Type	Description
1	Round 1 Municipal Demand	1	39291.00003	2	Release to direct diversion
2	Round 1 Industrial Demand	1	39291.00004	2	Release to direct diversion
3	Round 2 Municipal Demand	1	39291.00005	2	Release to direct diversion
4	Round 2 Industrial Demand	1	39291.00006	2	Release to direct diversion

Operating rules 1 through 4 releases water from the Round 1 & 2 Contract account in Ruedi Reservoir to aggregated contract demands. The administration numbers for these rules were set just junior to Ruedi Reservoir's first fill right. These rules are on in the Historic and Baseline simulations.

Other Operations

Right #	Destination	Account or Carrier	Admin #	Right Type	Description
1	Reservoir to Target	All	99999.99999	9	Release to river by target

Operating rule 1 releases water from all accounts proportionally to meet the end-of-month target values. The junior administration number ensures this is the last operating rule to fire at the reservoir. This rule is on in the Historic and Baseline simulations.

5.9.9. Grand Valley Operations

The Grand Valley Project (GVP) is modeled in the Upper Colorado Model as seven nodes to represent the various uses and return flows from the project's Government Highline Canal, Orchard Mesa Irrigation District (OMID) irrigation, OMID hydraulic pump, and the USA Power Plant. These structures receive water by a series of operational rules that pull water from the GVP roller dam (7200646), which is modeled as a carrier structure.

The Orchard Mesa Check (7200813CH) structure and the OMID Bypass (7200813BP) operate solely based on administration numbers. In general, if the Grand Valley Irrigation Canal's junior water right (admin. number 30895.23491) is the calling right, the Orchard Mesa Check operates by delivering the return flows from power diversions at the USA Power Plant and the OMID pump to the Grand Valley Irrigation Canal headgate (see Upper Colorado River Basin Information Report). If there is not a call at the Grand Valley Irrigation Canal, the return flows from the USA Power Plant and OMID hydraulic pump are delivered to the OMID Bypass structure and the water is returned downstream of the Grand Valley Irrigation Canal. These operations can occur without operating rules because the Orchard Mesa Check is a non-consumptive structure that is modeled junior to the OMID Bypass structure—which is modeled junior to the Grand Valley Irrigation Canal.

The following operating rules are used to model additional operations related to the Grand Valley Project:

Right #	Destination	Account or Carrier	Admin #	Right Type	Description
1	Government Highline Canal	GVP roller dam	22729.14519	11	Carrier to diversion
2	Government Highline Canal	GVP roller dam	22729.19544	11	Carrier to diversion
3	Government Highline Canal	GVP roller dam	22729.21241	11	Carrier to diversion
4	Government Highline Canal	GVP roller dam	30895.24988	11	Carrier to diversion
5	OMID Irrigation	GVP roller dam	22729.18536	11	Carrier to diversion
6	OMID Irrigation	GVP roller dam	22729.21116	11	Carrier to diversion
7	OMID Pump	GVP roller dam	22729.18536	11	Carrier to diversion

8	OMID Pump	GVP roller dam	22729.21116	11	Carrier to diversion
9	USA Power	GVP roller dam	30895.21241	11	Carrier to diversion
10	USA Power – Winter	GVP roller dam	30895.21241	45	Carrier to diversion
11	USA Power – Summer Senior	GVP roller dam	30895.21241	45	Carrier to diversion
12	USA Power – Summer Junior	GVP roller dam	100000.10000	45	Carrier to diversion

Operating rules 1 through 9 divert water from the GVP roller dam to the individual demands. The administration numbers were set equal to the direct diversion rights that divert at the GVP roller dam. See Section 2.4 Grand Valley Area Water Demand (Cameo Call) of the Upper Colorado River Basin Information Report for further details concerning this complex diversion system. Rules 1 through 9 are on in the Historic and Baseline simulations.

Rules 10, 11, and 12 reflect stipulations associated with the Orchard Mesa Check Case. Although the case has not yet been resolved, beginning in 1997, the USA Power Plant informally agreed that it would not divert more than 400 cubic feet per second during the irrigation season (April – October) but would continue to divert its full water right for 800 cubic feet per second during the non-irrigation season (November – March). Rules 11 and 12 turn on the associated water rights during the appropriate months. Rules 10 and 11 are on in both the Historic and Baseline simulations. Rule 12 is only on in the Historic simulation. Refer to the Upper Colorado River Basin Information Report for additional details regarding the Orchard Mesa Check Case.

5.9.10. Homestake Project

The Homestake Diversion Project exports water from Homestake Creek, a tributary of the Eagle River, into the Arkansas River basin for the cities of Colorado Springs and Aurora. This project has one reservoir, Homestake, one transmountain diversion with its own decree, Homestake Project Tunnel, and two modeled collection areas, the Missouri Tunnel system and the Homestake Reservoir system. Homestake Reservoir is the primary western slope storage facility for this project, storing water from Homestake Creek, Hunter Creek, and several neighboring tributaries. The Homestake Project Tunnel (300 cubic feet per second capacity) conveys water diverted under its direct flow and storage decrees to the Arkansas River basin. The Missouri Tunnel system (600 cubic feet per second capacity) conveys water from four nearby drainages to Homestake Reservoir. The Homestake Reservoir collection system includes the reservoir on Middle Fork Homestake Creek and a diversion from East Fork Homestake Creek.

Reservoir	Acct	Account Name	Capacity (acre-feet)
Homestake	1	Colorado Springs & Aurora	42,881
Homestake	2	Dead Pool	211
Homestake	3	Homestake Reservoir Green Mountain Replacement	21,440

Twenty-five operating rules are used to simulate the operations associated with the Homestake Project. Operations are split below into four sections.

Homestake Project Operations

Right #	Destination	Account or Carrier	Admin #	Right Type	Description
1	Homestake Reservoir	Missouri Tunnel	39650.37520	11	Carrier to reservoir

Operating rule 1 delivers water from the Missouri Tunnel collection system to Homestake Reservoir. The administration number was set equal to the direct diversion right of the Missouri Tunnel. This operating rule turns off the direct diversion right for the Missouri Tunnel and is used to limit the diversions at the Missouri Tunnel to times when Homestake Reservoir has a demand and there is physical supply at the Missouri Tunnel. This rule is on in the Historic and Baseline simulations.

Homestake Reservoir Operations

Right #	Destination	Account or Carrier	Admin #	Right Type	Description
1	Homestake Tunnel	1	39650.37521	2	Release to direct diversion
2	Reservoir to Target	All	99999.99999	9	Release to river by target

Operating rule 1 releases water from the Colorado Springs & Aurora account to the Homestake Tunnel. The administration number associated with this rule was set junior to the Homestake Tunnel direct diversion right and Missouri Tunnel operating rule (above). This rule is used to meet remaining Homestake Tunnel demands with releases from Homestake Reservoir. This rule is on in the Historic and Baseline simulations.

Operating rule 2 releases water from all accounts proportionally to meet the end-of-month target values. The junior administration number ensures this is the last operating rule to fire at the reservoir. This rule is on in the Historic and Baseline simulations.

Colorado Springs Replacement Operations

Right #	Destination	Account or Carrier	Admin #	Right Type	Description
1	Homestake Reservoir Green Mtn Replacement account	1 to 3	1.00044	34	Reservoir exch with plan
2	Homestake Reservoir Green Mtn Replacement account	1 to 3	1.00045	34	Reservoir exch with plan

Operating rules 1 and 2 book-over water to the Homestake Reservoir Green Mountain Replacement account from the Colorado Springs & Aurora account. The administration numbers were set senior so that operations occur at the beginning of the August 1st time step. Water booked-over reduces Colorado Springs' out-of-priority obligations and are tied to the out-of-priority diversion and storage plans, 3604683PLand 3603570PL, respectively. The water booked over into the Homestake Reservoir Green Mountain Replacement account is used to meet Green Mountain Reservoir obligations, as described below in the Green Mountain Operations from Alternate Replacement Pools section. These rules are on in the Historic simulation starting in 2012 and on for the entire study period of the Baseline simulation.

Green Mountain Operations from Alternate Replacement Pools

Right #	Destination	Account or Carrier	Admin #	Right Type	Description
1	Granby Reservoir	3	31258.00008	5	Release to river exch to storage
2	Willow Creek Reservoir	3	31258.00017	5	Release to river exch to storage
3	Shadow Mtn/Grand Lake	3	31258.00024	5	Release to river exch to storage
4	Granby Reservoir	3, Willow Creek Feed	31258.00031	7	Release to river exch to carrier
5	Farmers Irrigation Co	3, Silt Pump Canal	39041.00006	2	Release to river to carrier
6	Historic Users	3	46673.99999	10	Release to general repl demand
7	Government Highline	3, Grand Valley Proj	46673.99999	2	Release to river to carrier
8	OMID Irrigation	3, Grand Valley Proj	46673.99999	2	Release to river to carrier
9	OMID Pump	3, Grand Valley Proj	46673.99999	2	Release to river to carrier
10	Vail Valley Consolidated	3	42420.41372	4	Exchange to direct diversion
11	Atkinson Ditch	3	49308.48666	4	Exchange to direct diversion
12	Needham Ditch	3	46751.42647	4	Exchange to direct diversion
13	Derby Diversion System	3	47481.12661	4	Exchange to direct diversion
14	Coon Creek Pipeline	3	46995.00006	4	Exchange to direct diversion
15	Green Mtn Contract Dem	3	48966.00006	4	Exchange to direct diversion
16	Fish Instream Flow	3	99999.93007	27	Release to diversion
17	Excess HUP Release	3	100000.00000	2	Release to direct diversion
18	Molina Tailrace (UWCD)	3	46673.99998	28	Exchange to carrier
19	Molina Tailrace (UWCD)	3	46673.99995	28	Exchange to carrier
20	Colorado River (UWCD)	9	46673.99998	27	Exchange to carrier

Operating rules 1 through 17 are turned on in the Historic and Baseline simulations. In 2012, a decree that allows Colorado Springs' alternate replacement sources to Green Mountain Reservoir for operations under the Blue River Decree was finalized. Previously, agreements allow for Colorado Springs to use Wolford Mountain Reservoir as an alternate replacement source to Green Mountain Reservoir based on previous decrees that allow Denver the use of Wolford Mountain Reservoir as an alternate replacement source. These rules are turned on from 2012 forward in the Historic simulation and are turned on for the entire study period in the Baseline simulation.

Operating rules 1 through 4 correspond with the rules outlined in Section 5.9.2 Green Mountain Reservoir Operations – C-BT Project Operations, above.

Operating rule 5 corresponds with the rule outlined in Section 5.9.2 Green Mountain Reservoir Operations – Silt Project Operations, above.

Operating rules 6 through 9 correspond with the rules outlined in Section 5.9.2 Green Mountain Reservoir Operations – Historic Users Replacement Operations, above. Homestake Reservoir was not decreed as an alternate replacement source for Green Mountain Reservoir when releases were made to the Shoshone Call Flows and water rights that were senior to January 24, 1984; therefore, these rules are not modeled.

Operating rules 10 through 15 correspond with the rules outlined in Section 5.9.2 Green Mountain Reservoir Operations – Contract Demands Operations, above. Operating rule 15 allows *exchange* to direct diversions, while the operating rule at Green Mountain Reservoir allows *releases* to direct diversions.

Operating rule 16 corresponds with rule 4 outlined in Section 5.9.2 Green Mountain Reservoir Operations – 15-Mile Reach Fish Flows Operations, above.

Operating rule 17 releases water from the replacement accounts, in March, to the Excess HUP Release node (3704516HU) to ensure replacement water is released within the same administration year.

Operating rules 18 through 20 were added to the Baseline dataset to better reflect the Ute operations. These rules provide Green Mountain protection to the Ute Water Conservancy District from Green Mountain Reservoir, Williams Fork, Wolford Mountain Reservoirs, and potentially Homestake Reservoir.

5.9.11. Silt Project

The Silt Project was authorized in 1956 under the Colorado River Storage Project Act and provides supplemental water for irrigation use in the general vicinity of Rifle Creek. The two primary facilities of the project include Rifle Gap Reservoir on Rifle Creek and the Silt Pump Plant, located on the mainstem of the Colorado River. In addition, it uses existing facilities such as Grass Valley Canal, East Lateral, West Lateral, and Grass Valley Reservoir (a.k.a. Harvey Gap Reservoir), owned by the Farmers Irrigation Company.

Rifle Gap Reservoir stores water for the Davie Ditch and the facilities owned by the Farmers Irrigation Company (FIRCO). While most irrigated acreage is in the Rifle Creek basin and an unnamed basin containing the Grass Valley Reservoir, some of the water diverted from the Grass Valley Canal is used to irrigate lands in the adjacent Elk Creek basin. The three basins are tributary to the mainstem of the Colorado River. As briefly discussed above in Section 5.9.2 Green Mountain Reservoir Operations – Silt Project Operations, the Silt Project owns storage water in Green Mountain Reservoir, which provides supplemental water to the Silt Pump Plant to satisfy irrigation demands. In the Upper Colorado Model, the irrigated lands associated with this project are divided into the following three demands:

- Dry Elk Valley (3900563_I) receives water from East Rifle Creek diverted at the Grass Valley Canal headgate and water by exchange from Rifle Gap Reservoir
- Farmers Irrigation Company (3903505_I) irrigates lands downstream of Grass Valley Reservoir. Fifty-seven percent of the water diverted at the Grass Valley Canal headgate is used to meet this irrigation demand and fill the Grass Valley Reservoir. This irrigation demand is further met by water exchanged upstream from the Rifle Gap Reservoir and the Silt Pump located on the Colorado River mainstem.
- Davie Ditch (3900547) receives water from Rifle Creek and stored water in Rifle Gap Reservoir

Reservoir	Acct	Account Name	Capacity (acre-feet)
Rifle Gap	1	Silt Pool	12,168
Rifle Gap	2	Dead Pool	1,434
Grass Valley (a.k.a. Harvey Gap)	1	Farmers	5,920
Phantom Exchange Reservoir	1	Exchange	999999

The following operating rules are used to simulate the operations associated with the Silt Project:

Right #	Destination	Account or Carrier	Admin #	Right Type	Description
1	Silt Project Plan	Grass Valley Canal	15458.13715	26	Direct flow rights to acc. plan
2	Silt Project Plan	Grass Valley Canal	37503.15066	26	Direct flow rights to acc. plan
3	Dry Elk Plan & FIRCO Plan	Silt Project Plan	37503.15067	46	Split to multiple owners
4	Dry Elk Valley Irr	Dry Elk Plan	37503.15068	27	Accounting plan to demand
5	Grass Valley Res.	Dry Elk Plan	37503.15068	27	Accounting plan to demand
6	FIRCO Irr	FIRCO Plan	37503.15068	27	Accounting plan to demand
7	Grass Valley Res.	FIRCO Plan	37503.15068	27	Accounting plan to demand
8	Grass Valley Canal	Silt Project Plan	37503.15069	29	Spill accounting plan

Right #	Destination	Account or Carrier	Admin #	Right Type	Description
9	Grass Valley Canal	Dry Elk Plan	37503.15069	29	Spill accounting plan
10	Grass Valley Canal	FIRCO Plan	37503.15069	29	Spill accounting plan
11	FIRCO Irr	1, Grass Valley Res.	37503.35322	2	Reservoir to direct flow
12	Davie Ditch	1, Rifle Gap Res.	37503.36901	2	Reservoir to direct flow
13	Phantom Reservoir	1, Rifle Gap Res	37503.36902	5	Res. exchange to reservoir
14	Dry Elk Irr	Phantom Reservoir	37503.36903	2	Accounting plan to demand
15	FIRCO Irr	Phantom Reservoir	37503.36904	2	Accounting plan to demand
16	Grass Valley Res.	Phantom Reservoir	37503.36905	2	Accounting plan to demand
17	Rifle Gap Reservoir	Phantom Reservoir	37503.36906	2	Accounting plan to demand
18	Release to target	1, Rifle Gap Res	99999.99999	9	Reservoir release to target
19	FIRCO Irr	Silt Pump	39041.00000	11	Carrier to diversion

Operating rules 1 and 2 divert water at the Grass Valley Canal headgate and place it in an accounting plan. Operating rule 3 splits the water from the original accounting plan and places 43 percent into the Dry Elk accounting plan and 57 percent into the FIRCO accounting plan. The water in the Dry Elk accounting plan is used to meet the Dry Elk Valley irrigation demand and fill the Grass Valley Reservoir (operating rules 4 and 5). Similarly, operating rules 6 and 7 use the water in the FIRCO plan to meet the Grass Valley irrigation demand and to fill the Grass Valley Reservoir. Operating rules 4 through 7 have the same priority; therefore, the water in each plan is used to meet the respective irrigation demand prior to filling the reservoir. Operating rules 8 through 10 spill any excess water in the three accounting plans. Operating rule 11 releases water from Grass Valley Reservoir to meet the FIRCO irrigation demand. The administration number for this rule was set just junior to Grass Valley Reservoir’s junior storage right.

Operating rule 12 releases water from the Silt Pool account in Rifle Gap Reservoir to meet the Davie Ditch irrigation demand. The administration number for this rule was set just junior to Rifle Gap Reservoir’s first fill right.

Operating rule 13 exchanges water from Rifle Gap Reservoir to a non-existent reservoir (3903508_Ex) located above the Grass Valley headgate. Note, this reservoir (3903508_Ex) is only included for operational purposes and model constraints, and does not actually exists. The water exchanged to this reservoir is used to meet the Dry Elk Valley irrigation demand, the FIRCO irrigation demand, and fill the Grass Valley Reservoir—operating rules 14, 15, and 16. The administration numbers for these three rules are set just junior to the administration number used to release water from Rifle Gap Reservoir to meet the Davie Ditch irrigation demand.

Operating rule 17 releases any excess water from the non-existent reservoir back to Rifle Gap Reservoir. This ensures no water is stored in 3903508_Ex and all of the excess water from the is released to Rifle Gap reservoir.

Operating rule 18 releases water from all accounts proportionally in Rifle Gap Reservoir to meet end-of-month target values. The junior administration number ensures this is the last operating rule to fire at the reservoir.

Operating rule 19 diverts water at the Silt Pump Plant and delivers it to the Farmers Irrigation Company. The administration number was set equal to the direct diversion right of the Silt Pump Plant. Note, the irrigated acreage under the FIRCO system is first met by the Grass Valley Canal diversions, releases from Grass Valley Reservoir, water exchanged from Rifle Gap reservoir and lastly the Silt Pump.

All of these rules are on in the Historic and Baseline simulations.

5.9.12. Glenwood Springs Operations

The town of Glenwood Springs obtains the majority of its municipal water supply from surface diversions on Grizzly Creek via the Glenwood Water Co. System (WDID 5301051) and from No Name Creek, also through the Glenwood Water Co. System (WDID 5300585) - both of which are tributaries of the Upper Colorado River. In the Upper Colorado River Model, the demands for the town of Glenwood Springs are modeled at structure located on No Name Creek.

Right #	Destination	Account or Carrier	Admin #	Right Type	Description
1	5300585	5301051	20427.19858	11	Carrier to diversion
2	5300585	5301051	33023.31607	11	Carrier to diversion
3	5300585	5301051	19573.13680	11	Carrier to diversion

Operating rules 1 through 3 carry water from Grizzly Creek (WDID 5301051) to No Name Creek (WDID 5300585) to meet the town of Glenwood Springs municipal demand. The administration numbers were set equal to the direct diversion rights located at Structure 5301051. These rules are on in the Historic and Baseline simulations.

5.9.13. Owens Creek Ditch Transbasin

Divide Creek Highline Ditch (WDID 4500576) receives imported water from Clear Fork Feeder/Divide Creek Feeder (WDID 4004657) in Water Division 4 and from Owens Creek Ditch (WDID 7204721). Clear Fork Feeder/Divide Creek Feeder (WDID 4004657) is modeled as an import into Divide Creek and does not require additional operating rules. Owens Creek Ditch (WDID 7204721) is modeled as a diversion structure on Owens

Creek, tributary to Buzzard Creek, and requires two operating rules to model the deliveries to Divide Creek Highline Ditch.

Right #	Destination	Account or Carrier	Admin #	Right Type	Description
1	Divide Creek Highline Ditch	7204721 – Carrier 09089500 – Return	22995.20976	45	Carrier to diversion
2	Divide Creek Highline Ditch	7204721 – Carrier 09089500 – Return	23177.00000	45	Carrier to diversion

Operating rules 1 and 2 carry water from the Owens Creek Feeder to the Divide Creek Highline Ditch and shepherds the water to the point of diversion. The administration numbers for these rules were set equal to the direct diversion rights of Owens Creek Ditch. These rules are on in the Historic and Baseline simulations.

5.9.14. Ute Water Conservancy District Operations

The Ute Water Conservancy District (Ute WCD) is the largest rural water provider in the Upper Colorado River basin, with a service area that extends from near Cameo to the northwest including the town of Fruita. The service area includes most of the rural land on both sides of the Upper Colorado River, but excludes the towns of Palisade, Clifton, Whitewater and Grand Junction, which have their own municipal supplies. Raw water diversions for the Ute WCD are made through six main structures:

1. The Ute Pipeline Headgate No. 2 (WDID 7200920) on Plateau Creek
2. The Ute Pipeline Headgate No. 1 (7201487) diverting from the tailrace of the Molina Power Plant
3. The Mason Eddy Ditch (WDID 7200766) on Mesa Creek
4. The Coon Creek Pipeline (WDID 7201339)
5. Rapid Creek Pumping Plant (WDID 7201329_D) on the Colorado River
6. The Martin Crawford Ditch (7200764) on Rapid Creek.

Water is delivered from Plateau Creek and its tributaries to the Rapid Creek Ute Water Treatment Plant (72_UWCD) where it is treated and distributed to users.

Ute WCD stores and releases water from Jerry Creek Reservoir 1 and 2, operated and modeled as a single reservoir (7203961) with 8,623 acre-feet capacity.

Reservoir	Acct	Account Name	Capacity (acre-feet)
Jerry Creek Agg Res	1	Active	8,460

Twenty-two operating rules are used to simulate the operations associated with the Ute Water Conservancy District.

Right #	Destination	Account or Carrier	Admin #	Right Type	Description

1	Rapid Creek Ute WTP	Ute Pipeline Hdgt 1	38846.99999	11	Carrier to diversion
2	Rapid Creek Ute WTP	Ute Pipeline Hdgt 1	40013.39607	11	Carrier to diversion
3	Rapid Creek Ute WTP	Ute Pipeline Hdgt 2	38847.00000	11	Carrier to diversion
4	Rapid Creek Ute WTP	Ute Pipeline Hdgt 2	40013.39608	11	Carrier to diversion
5	Rapid Creek Ute WTP	Mason Eddy Ditch	12753.00000	14	Carrier w/ constrained demand
6	Rapid Creek Ute WTP	Mason Eddy Ditch	30895.12724	14	Carrier w/ constrained demand
7	Rapid Creek Ute WTP	Mason Eddy Ditch	30895.24260	14	Carrier w/ constrained demand
8	Rapid Creek Ute WTP	Mason Eddy Ditch	32811.00000	14	Carrier w/ constrained demand
9	Rapid Creek Ute WTP	Mason Eddy-Carver Ranch	46751.46599	14	Carrier w/ constrained demand
10	Rapid Creek Ute WTP	Coon Creek Pipeline	46995.00000	14	Carrier w/ constrained demand
11	Jerry Creek Agg. Res	Ute Pipeline Hdgt 2	1.00000	11	Carrier to reservoir
12	Jerry Creek Agg. Res	Ute Pipeline Hdgt 2	1.00001	11	Carrier to reservoir
13	Jerry Creek Agg. Res	Ute Pipeline Hdgt 2	38847.00000	11	Carrier to reservoir
14	Rapid Creek Ute WTP	Jerry Creek Reservoir	40013.39608	11	Carrier to diversion
15	Rapid Creek Ute WTP	Martin Crawford	48942.48333	14	Release to demand
16	Rapid Creek Ute WTP	Jerry Creek Reservoir	48942.48335	3	Release to demand
17	ColRiver Plan	Cameo Pipeline to Plan	41791.00000	24	Exchange
18	Rapid Creek Ute WTP	Cameo Pipeline to UWCD WTP	48942.48334	27	Plan release to carrier
19	Plan Spill	ColRiver Plan	48942.48335	29	Plan spill
20	Rapid Creek Ute WTP	Rapid Creek Pumping Plant	41791.00000	11	Carrier to diversion
21	Jerry Creek Aggreg Res	All	99999.99999	9	Release to target
22	Ute Pipeline Hdgt 2	Jerry Creek Aggreg Res	46995.00001	3	Release to demand

Since the last model update, these operating rules were changed to better reflect the Ute's operations. In general, operating rules 1 through 10 and 15 divert water from Plateau Creek and its tributaries and deliver it to the Rapid Creek Ute Water Treatment Plant. A Type 14 operating rule was implemented for Operating rules 5 through 10 and 15 constrain the diversions based on Baseline demands. The administration numbers were set equal to the direct diversion rights of the carrier structures. These rules are off in the Historic simulation because the demands are modeled at the carrier locations and turned on in the Baseline simulation.

Operating rules 11 through 14 fill Jerry Creek Aggregated Reservoir via a carrier. These rules differ from the Historic simulation. Operating rule 16 releases water from Jerry Creek Aggregated Reservoir to Rapid Creek Ute Water Treatment Plant. The administration number for the release from Jerry Creek Aggregated Reservoir was revised so this occurs after all other structures have diverted—including the release from the ColRivPlan. This rule is turned off in the Historical simulation, because the demands are modeled at the carrier locations.

Operating rule 17 diverts from the Colorado River, when in priority, and stores the water in an accounting plan. Due to water quality issues, the Colorado River mainstem water is preferably used after the Coon Creek pipeline, Carver Ranch pipeline, and Martin Crawford Ditch rights have been diverted, but before releases Jerry Creek Aggregated Reservoir occur (operating rule 18). Operating rule 19 spills any excess water in the plan back to the river at the end of each time step. These rules are only included and turned on in the Baseline simulation.

Operating rule 21 releases water from Jerry Creek Aggregated Reservoir to meet end-of-month target values. The junior administration number ensures this is the last operating rule to fire at the reservoir. This rule is on in the Historic and Baseline simulations.

Operating rule 22 releases water from Jerry Creek Aggregated Reservoir to meet a 920 acre-foot demand. This rule is only turned on in the Historic simulation.

5.9.15. Collbran Project and Vega Reservoir

The Collbran Project was built by the USBR between 1957 and 1962. The project provides supplemental irrigation water for diverters in the Plateau Creek basin and generates hydroelectric power through the Molina Power Plant. The primary features of this project are Vega Reservoir (7203844), the Southside Canal (7200879), and the Molina Power Plant (7200807). Vega Reservoir is the main storage facility for the project providing irrigation water and replacement water for out-of-priority diversions used to generate hydropower.

The Southside Canal originates from Vega Reservoir and crosses nine sub-basins of Plateau Creek. The canal has a 240 cubic feet per second capacity at the reservoir and a 50 cubic feet per second capacity by the time it reaches the final stream—Mesa Creek. This carrier ditch conveys water from Vega Reservoir to ditches downstream of the canal-stream crossing. In addition, the Southside Canal provides exchange water to diverters that cannot be served by the canal directly.

The Molina Power Plant is served by two carrier ditches, Bonham Branch Pipeline and Cottonwood Branch Pipeline, on Big and Cottonwood Creeks, respectively. As part of the Collbran Project, the USBR rehabilitated several small reservoirs on the Grand Mesa above Big Creek and Cottonwood Creek. This additional storage water supplemented the available water in Big and Cottonwood Creeks to satisfy the hydropower demand at the Molina Power Plant. In the Upper Colorado Model, the multiple reservoirs on the Grand Mesa are aggregated into two reservoirs—one at each of the headwaters of Big and Cottonwood Creeks. The Bonham Aggregated Reservoir (7203904AG) and Cottonwood Aggregated Reservoir (7204033AG) each have one active account to supply storage water to the Molina Power Plant.

Vega Reservoir stores water by natural streamflow and from feeder canals originating on Par— project irrigation and dead storage. The project irrigation pool provides water for irrigation use on the Plateau Creek tributaries, which are crossed by the Southside Canal.

Reservoir	Acct	Account Name	Capacity (acre-feet)
Vega	1	Project Irrigation	33,311
Vega	2	Dead Pool	820
Bonham Aggregated	1	Active	6,778
Cottonwood Aggregated	1	Active	3,812

Sixty-three operating rules are used to simulate the operations associated with the Collbran Project.

Right #	Destination	Account or Carrier	Admin #	Right Type	Description
1	Vega Reservoir	Leon Park Feeder Canal	37486.00000	11	Carrier to diversion
2	Vega Reservoir	Leon Park Feeder Canal	44194.43247	11	Carrier to diversion
3	Vega Reservoir	Park Creek Feeder Canal	30895.23492	11	Carrier to diversion
4	Vega Reservoir	Park Creek Feeder Canal	41500.00000	11	Carrier to diversion
5	Molina Power Plant	Bonham Branch Pipeline	37486.00000	11	Carrier to diversion
6	Molina Power Plant	Bonham Branch Pipeline	37486.00001	2	Release to river to carrier
7	Reservoir to target	N/A	99999.99999	9	Release to river by target
8	Molina Power Plant	Cottonwood Branch Pipeline	37486.00000	11	Carrier to diversion
9	Molina Power Plant	Cottonwood Branch Pipeline	37486.00001	2	Release to river to carrier
10	Reservoir to target	N/A	99999.99999	9	Release to river by target
11	Galbraith Ditch	Southside Canal	37486.00000	11	Carrier to diversion
12	Grove Cr Ditch Co No 1	Southside Canal	37486.00000	11	Carrier to diversion
13	Golden Age Ditch	Southside Canal	37486.00000	11	Carrier to diversion
14	Kiggins Goyn Ditch	Southside Canal	37486.00000	11	Carrier to diversion
15	Eakin-Smith Ditch	Southside Canal	37486.00000	11	Carrier to diversion
16	Bertholf Lanham Updike	Southside Canal	37486.00004	11	Carrier to diversion
17	Silver Gauge Ditch	Southside Canal	37486.00000	11	Carrier to diversion

Right #	Destination	Account or Carrier	Admin #	Right Type	Description
18	Wildcat Ditch (Big Cr)	Southside Canal	37486.00000	11	Carrier to diversion
19	Coakley Kiggins Ditch	Southside Canal	37486.00000	11	Carrier to diversion
20	Park View Ditch	Southside Canal	37486.00000	11	Carrier to diversion
21	Mormon Mesa Ditch	Southside Canal	37486.00000	11	Carrier to diversion
22	Pioneer of Plateau Ditch	Southside Canal	37486.00000	11	Carrier to diversion
23	Bull Creek Ditch	Southside Canal	37486.00000	11	Carrier to diversion
24	Mesa Creek Ditch	Southside Canal	37486.00000	11	Carrier to diversion
25	West Side Ditch	Southside Canal	37486.00000	11	Carrier to diversion
26	Arkansas Ditch	Southside Canal	37486.00000	11	Carrier to diversion
27	King Ditch	Southside Canal	37486.00000	11	Carrier to diversion
28	Galbraith Ditch	1, Southside Canal	37486.00004	2	Release to river to carrier
29	Grove Cr D. Co No 1	1, Southside Canal	37486.00004	2	Release to river to carrier
30	Golden Age Ditch	1, Southside Canal	37486.00004	2	Release to river to carrier
31	Kiggins Goyn Ditch	1, Southside Canal	37486.00004	2	Release to river to carrier
32	Eakin-Smith Ditch	1, Southside Canal	37486.00004	2	Release to river to carrier
33	Bertholf Lanham Updike	1, Southside Canal	37486.00004	2	Release to river to carrier
34	Silver Gauge Ditch	1, Southside Canal	37486.00004	2	Release to river to carrier
35	Wildcat Ditch (Big Cr)	1, Southside Canal	37486.00004	2	Release to river to carrier
36	Coakley Kiggins Ditch	1, Southside Canal	37486.00004	2	Release to river to carrier
37	Park View Ditch	1, Southside Canal	37486.00004	2	Release to river to carrier
38	Mormon Mesa Ditch	1, Southside Canal	37486.00004	2	Release to river to carrier
39	Pioneer of Plateau Ditch	1, Southside Canal	37486.00004	2	Release to river to carrier
40	Bull Creek Ditch	1, Southside Canal	37486.00004	2	Release to river to carrier
41	Mesa Creek Ditch	1, Southside Canal	37486.00004	2	Release to river to carrier
42	West Side Ditch	1, Southside Canal	37486.00004	2	Release to river to carrier
43	Arkansas Ditch	1, Southside Canal	37486.00004	2	Release to river to carrier
44	King Ditch	1, Southside Canal	37486.00004	2	Release to river to carrier
45	Mason Eddy D (Irr)	1, Southside Canal	37486.00004	2	Release to river to carrier
46	Bull Basin Highline D	1, Southside Canal	37486.00004	2	Release to river to carrier
47	RMG (Mel) Div Sys	1, Southside Canal	37486.00004	2	Release to river to carrier
48	Johnson And Stuart D	1, Southside Canal	37486.00004	2	Release to river to carrier
49	Parker Ditch	1, Southside Canal	37486.00004	2	Release to river to carrier
50	Davenport D (Cottnwd)	1, Southside Canal	37486.00004	2	Release to river to carrier
51	Palmer Ditch	1, Southside Canal	37486.00004	2	Release to river to carrier

Right #	Destination	Account or Carrier	Admin #	Right Type	Description
52	New Erie Canal	1	37486.00004	4	Exch to direct diversion
53	Plateau Abv Vega Agg	1	37486.00005	4	Exch to direct diversion
54	Plateau Bl Vega Agg	1, Southside Canal	37486.00005	2	Release to river to carrier
55	Salt Creek Agg	1, Southside Canal	37486.00005	2	Release to river to carrier
56	Upper Grove Creek Agg	1, Southside Canal	37486.00005	2	Release to river to carrier
57	Lower Grove Crk Agg	1, Southside Canal	37486.00005	2	Release to river to carrier
58	Big Creek Agg	1, Southside Canal	37486.00005	2	Release to river to carrier
59	Cottonwood Creek Agg	1, Southside Canal	37486.00005	2	Release to river to carrier
60	Bull Creek Agg	1, Southside Canal	37486.00005	2	Release to river to carrier
61	Coon Creek Agg	1, Southside Canal	37486.00005	2	Release to river to carrier
62	Mesa Creek Agg	1, Southside Canal	37486.00005	2	Release to river to carrier
63	Reservoir to target	All	99999.99999	9	Release to river by target

Operating rules 1 through 4 allow Vega Reservoir to pull water from the Leon Creek Feeder (7200746) and the Park Creek Ditch (7200820_D) to supplement the natural inflows into the reservoir. Both of these structures are carrier ditches and are subject to the 350 cubic feet per second capacity of the Leon Creek Feeder. The administration numbers were set equal to the direct diversion rights for the two structures. These rules are on in the Historic and Baseline simulations.

Operating rules 5 and 6 allow the Molina Power Plant to pull available streamflow on Big Creek from the Bonham Branch Pipeline and storage water from the Bonham Aggregated Reservoir, respectively. Both operations are subject to the 45 cubic feet per second capacity of the Bonham Branch Pipeline. The administration number for rule 5 was set equal to the direct diversion right for the Bonham Branch Pipeline, while rule 6 was set just junior. These rules are on in the Historic and Baseline simulations.

Operating rule 7 releases water from all accounts proportionally in Bonham Reservoir to meet end-of-month target values. The junior administration number ensures this is the last operating rule to fire at the reservoir. This rule is on in the Historic and Baseline simulations.

Operating rules 8 and 9 allow the Molina Power Plant to pull available streamflow on Cottonwood Creek from the Cottonwood Branch Pipeline and storage water from the Cottonwood Aggregated Reservoir, respectively. Both operations are subject to the 28 cubic feet per second capacity of the Cottonwood Branch pipeline. The administration number for rule 8 was set equal to the direct diversion right for the Cottonwood Branch Pipeline, while rule 9 was set just junior. These rules are on in the Historic and Baseline simulations.

Operating rule 10 releases water from all accounts proportionally in Cottonwood Reservoir to meet end-of-month target values. The junior administration number ensures this is the last operating rule to fire at the reservoir. This rule is on in the Historic and Baseline simulations.

Operating rules 11 through 27 divert direct flow water through Southside Canal to ditches on Plateau Creek tributaries. The administration number for these rules corresponds to Southside Canal's direct flow right. These rules are on in the Historic and Baseline simulations.

Operating rules 28 through 52 provide Vega Reservoir storage water to ditches served by Southside Canal. The administration number for these rules ensures their direct flow rights are used before their storage rights. Operating rules 28 through 45 are turned on in both the Historic and Baseline simulations. Operating rules 46 through 52 are turned on in the Historic simulation and turned off in the Baseline simulation.

Operating rule 53 provides water from Vega Reservoir, by exchange, to the aggregated irrigation structure with lands located on Plateau Creek above Vega Reservoir. The administration number was set junior to the structure's direct diversion rights. This rule supplements the structure's direct flow rights. This rule is on in the Historic and Baseline simulations.

Operating rules 54 through 62 carry water from Vega Reservoir through the Southside Canal to the aggregated irrigation structures located on the Plateau Creek tributaries. The administration numbers were set junior to the structures' direct diversion rights. This rule supplements the structures' direct flow rights. These rules are in the Historic and Baseline simulations.

Operating rule 63 releases water from Vega Reservoir to meet end-of-month target values. The junior administration number ensures this is the last operating rule to fire at the reservoir. This rule is on in the Historic and Baseline simulations.

5.9.16. Leon Creek Aggregated Reservoir Operations

Reservoirs on Leon Creek are aggregated into two reservoirs—one that stores and delivers water to the Leon Tunnel for use in the Gunnison Basin, and one that delivers water to irrigation demands on Leon Creek.

Reservoir	Acct	Account Name	Capacity (acre-feet)
Leon Lake Agg Reservoir	1	Active	2,904
Monument Agg Reservoir	1	Active	987

Five operating rules are used to simulate the operations associated with the Leon Lake and Monument Aggregated Reservoirs.

Right #	Destination	Account or Carrier	Admin #	Right Type	Description
1	Leon Tunnel	1 (Leon Lake Agg)	22995.18426	2	Release to direct diversion
2	Kiggins Salisbury Ditch	1 (Monument Agg)	37037.00001	2	Release to direct diversion
3	Leon Ditch	1 (Monument Agg)	32811.00001	2	Release to direct diversion
4	Leon Lake to Target	1	99999.99999	9	Release to river by target
5	Monument to Target	1	99999.99999	9	Release to river by target

Operating rule 1 releases water from Leon Lake Aggregate Reservoir directly to Leon Tunnel Canal. Operating rules 2 and 3 release water from Monument Aggregate Reservoir directly to Kiggins Salisbury Ditch, and Leon Ditch, respectively. The administration numbers for these rules were set just junior to the direct diversion rights for these structures. These rules are on in the Historic and Baseline simulations.

Operating rules 4 and 5 releases water in Leon Lake Aggregated Reservoir and Monument Aggregate Reservoir to meet end-of-month target values. The junior administration numbers ensure these are the last operating rule to fire at the reservoir. These rules are on in the Historic and Baseline simulations.

5.9.17. Soil Moisture Operations

A type 22 operating rule is also used to allow soil moisture accounts for irrigation structures.

Right #	Destination	Account or Carrier	Admin #	Right Type	Description
1	Operate Soil Moisture	N/A	90000.00000	22	Soil moisture reservoir accounting

Operating rule 1 directs StateMod to consider soil moisture in the variable efficiency accounting. The administration number was set junior to allow for most operations at irrigation structures to occur. This operating rule allows structures with crop irrigation water requirements to store excess diverted water not required by the crops during the month of diversion in the soil reservoir zone. It also allows releases from the soil reservoir to meet unsatisfied demands if diversions are not adequate to meet crop irrigation water requirements during the month of diversion. This rule is on in the Historic and Baseline simulations.

5.9.18. Blue River Decree Operations

Consolidated Case Nos. 2782, 5016 and 5017 (the Blue River Decree). In this 1955 adjudication, the relative priorities of the storage rights and hydroelectric rights for Green Mountain Reservoir and the upstream rights at Dillon Reservoir and the Continental-Hoosier System (Colorado Springs) were specified as follows:

Continental Hoosier System	77 cfs	August 5, 1929
Green Mountain Reservoir	154,645 acre-feet	August 1, 1935
Green Mountain Hydro	1,726 cfs	August 1, 1935
Green Mountain Senior Refill	6,315 acre-feet	August 1, 1935
Montezuma Tunnel (Roberts Tunnel)	788 cfs	June 24, 1946
Dillon Reservoir	252,678 acre-feet	June 24, 1946
Continental-Hoosier System	400 cfs	May 13, 1948
Continental-Hoosier Storage	5,306 acre-feet	May 13, 1948

In this decree, Colorado Springs and Denver obtained the right to divert and store water at their upstream facilities on an out-of-priority basis against Green Mountain Reservoir's first fill right. Because the cities have storage in the upper Blue River basin, they were in a position to repay Green Mountain in the event Green Mountain Reservoir does not fill. This agreement allows out-of-priority upstream diversions against the senior storage decree at Green Mountain Reservoir. The cities have agreed to pay power interference charges to offset impacts, if any, to the Green Mountain Hydroelectric direct right.

When Denver incurs an obligation to repay Green Mountain Reservoir for water stored out-of-priority at Dillon Reservoir, provisions of the Blue River Decree, as more specifically described in a 1964 Stipulation and Agreement, allow Denver to replace the water owed by substituting releases from its Williams Fork Reservoir. In 1991, the agreements were again modified and allowed use of Wolford Mountain Reservoir as an additional source of substitution supply for water owed to Green Mountain Reservoir by Denver. These agreements also make reference to a requirement for Denver to maintain a pool of 1,000 acre-feet in Dillon Reservoir, which releases to Green Mountain Reservoir to the extent necessary to maintain flow in the Blue River below Dillon Dam at 50 cubic feet per second.

The Interim Policy was adopted by the State Engineer "to give water users certainty about administrative and accounting principles concerning Green Mountain Reservoir" and is, at the time of this update, the current administration of the Blue River Decree. The Interim Policy specifically outlines the components to the Paper Fill of Green Mountain Reservoir under its August 1, 1935, first fill right. The Paper Fill is defined to be met when 154,645 acre-feet is equal to the sum of:

1. Initial storage in Green Mountain Reservoir at the beginning of the administration year,
2. Stored water in Green Mountain Reservoir after the administration date,
3. Bypassed water in excess of 60 cubic feet per second or the demand of a downstream call senior to August 1, 1935,

4. Out-of-priority depletions from HUP and Contract beneficiaries upstream of Green Mountain Reservoir, and
5. Out-of-priority diversions and storage made by Denver and Colorado Springs.

After a paper fill has been met, Green Mountain Reservoir stores under the October 10, 1955 "exchange" right up to the amount of water stored and diverted out-of-priority to its 1935 storage right by Denver and Colorado Springs. According to Alan Martellaro, Division 5 Engineer, the Blue River Decree has been administered under the Interim Policy from 2003 to the time of this update (2013). Operations for out-of-priority depletions from HUP and Contract beneficiaries upstream of Green Mountain Reservoir are considered minor and are not explicitly modeled. Operations for the Interim Policy, detailed below, are used exclusively throughout the model simulations.

The Interim Policy is modeled to represent the current administration of the Blue River Decree. On April 1st, Green Mountain Reservoir is administered and the first fill volume is determined. The Paper Fill, under the Interim Policy, is satisfied when the administered first fill volume is equal to the sum of the:

1. Initial storage in Green Mountain Reservoir at the beginning of the administration year,
2. Stored water in Green Mountain Reservoir after the administration date,
3. Bypassed water in excess of 60 cubic feet per second or the demand of a downstream call senior to August 1, 1935, and
4. Out-of-priority diversions and storage made by Denver and Colorado Springs.

Once the Paper Fill has been reached, the 1935 priority storage water right is satisfied and can no longer call.

Below is an outline of the Blue River Decree operations through an administration year under the Interim Policy as modeled in the Upper Colorado River Model:

April 1st through July 31st Prior to a Paper Fill

Right #	Description	Account or Carrier	Admin #	Right Type	Plan Structure
1	Divert at Con-Hoosier - senior right	3604699	30184.29071	11	Carrier to a ditch
2	Green Mountain Reservoir Instream Flow	NA	31257.99994	*.ifr	
3	Divert at Con-Hoosier OOP - junior right	3604683	31257.99995	38	3604683PL
4	Store in Upper Blue Lakes OOP	NA	31257.99996	38	3603570PL
5	Dillon Reservoir Instream Flow	NA	31257.99997	*.ifr	
6	Divert at Roberts Tunnel OOP	NA	31257.99998	38	3604684PL
7	Store in Dillon OOP	NA	31257.99999	38	3604512PL
8	Store in Green Mountain - senior right	First 5	31258.00000	*.rer	

Operating rule 1 carries water from the Con-Hoosier collection node 3604699 to demand at the summary node 3604683SU. The administration number was set equal to the administration number of the direct diversion right associated with the carrier. This rule is turned on in the Historic and Baseline simulations.

Right 2 is the instream flow requirement below Green Mountain Reservoir—not an operating rule. The administration number was set senior to Green Mountain and the upstream out-of-priority operations. This right is on in the Historic and Baseline simulations.

Operating rule 3 simulates Colorado Springs' diversions through the Con-Hoosier Tunnel out-of-priority to Green Mountain Reservoir. The administration number was set senior to Green Mountain Reservoir's first fill right and is the first out-of-priority operation. Out-of-priority diversion accounting is simulated at plan structure 3604683PL. This rule is on in the Historic, and Baseline simulations with diversions limited to months of April through July.

Operating rule 4 simulates Colorado Springs' storage in Upper Blue Lakes out-of-priority to Green Mountain Reservoir. The administration number was set senior to Green Mountain Reservoir's first fill right and is the second out-of-priority operation. Out-of-priority storage from this rule is accounted for with the plan structure 3603570PL. This rule is on in the Historic, and Baseline simulations and storage was limited to the months of April through July.

Right 5 is the instream flow requirement below Dillon Reservoir—not an operating rule. The administration number was set senior to Green Mountain and Denver's out-of-priority operations. This right is on in the Historic and Baseline simulations.

Operating rule 6 simulates Denver's diversions through the Roberts Tunnel out-of-priority to Green Mountain Reservoir. The administration number was set senior to Green Mountain Reservoir's first fill right and is the third out-of-priority operation. Out-of-priority diversions from this rule are accounted for with plan structure 3604684PL. This rule is on in the Historic, and Baseline simulations and the diversions were limited to the months of April through July.

Operating rule 7 simulates Denver's storage in Dillon Reservoir out-of-priority to Green Mountain Reservoir. The administration number was set senior to Green Mountain Reservoir's first fill right and is the fourth and final out-of-priority operation. Out-of-priority storage from this rule is accounted for with plan structure 3604512PL. This rule is on in the Historic, and Baseline simulations and storage was limited to the months of April through July.

Right 8 is Green Mountain Reservoir's senior first fill right. The administration number was set by StateDMI and information located in HydroBase. This right is on in the Historic and simulation starting in 1943. The date is based on the first year diversions to storage occurred at Green Mountain Reservoir. The date is required due to accounting of bypassed water against the first fill right by setting the on/off switch for Green Mountain Reservoir to 3 in the *.res file. In the Baseline simulation, the right is on for the entire study period.

April 1st through July 31st after Paper Fill was met

Right #	Description	Account or Carrier	Admin #	Right Type	Plan Structure
1	Divert at Con-Hoosier - junior right	3604683	35927.00000	11	
2	Store in Upper Blue Lakes - original right	1	35927.00001	*.rer	
3	Release from Upper Blue Lakes to Con-Hoosier Tunnel Demand	1	35927.00002	3	
4	Release from Upper Blue Lakes to Con-Hoosier Tunnel Demand	2	35927.00003	3	
5	Divert at Roberts Tunnel - original right	NA	35927.00004	*.ddr	
6	Store in Dillon - modified original right	First 3	35927.00005	*.rer	
7	Exchange from Williams Fork to Roberts Tunnel	1	35927.00006	4	
8	Exchange from Williams Fork to Dillon	1	35927.00007	5	
9	Release from Dillon to Roberts Tunnel	1	35927.00008	2	
10	Release from Dillon to Roberts Tunnel	5	35927.00009	2	
11	Store in Green Mountain - 1955 Exchange Right	First 5	38628.00000	41	3604683PL 3603570PL 3604684PL 3604512PL
12	Store in Green Mountain - senior refill right	First 5	38628.00001	*.rer	
13	Store in Dillon - junior refill right	First 3	50038.49309	*.rer	
14	Store in Green Mountain - junior refill right	First 5	50403.49309	*.rer	
15	Store in Upper Blue Lakes – free river refill right	1	99999.99999	*.rer	

Rights 1 through 10 and 12 through 15 represent normal operations of diversions, storage, and exchanges in the Blue River Basin. Denver’s operations (rights 5 through 10) were set junior to Colorado Spring’s operations (rights 1 through 4) based on agreements between the two municipalities. Administration numbers were modified slightly to allow for the correct order of operation within each entity’s system.

Operating rule 11 simulates Green Mountain Reservoir’s 1955 Blue River Decree Exchange storage right. This operating rule allows Green Mountain to store, under a 1955 right, the amount of water that was diverted and stored out-of-priority to Green Mountain’s senior first fill right by Denver and Colorado Springs. When water is stored under this right, it reduces the out-of-priority obligation owed by Denver and Colorado Springs proportional to their out-of-priority operations. This rule operates after the out-of-priority operations are complete which allows for a pro-rata amount to be credited to each of the four out-of-priority plans. When the amount stored under this right equals out-of-priority operations by both cities, the right is satisfied.

August 1st Substitution Bill Repayment

Right #	Description	Account or Carrier	Admin #	Right Type	Plan Structure
1	Upper Blue lakes release 250 af to the river for West Slope use	1	1.00000	9	
2	Upper Blue lakes release 250 af to the river for West Slope use	2	1.00001	9	
3	Upper Blue release from OOP account to Dillon OOP account	2	1.00002	34	3603570PL 3604512PL
4	Upper Blue release from OOP account to Dillon OOP account	2	1.00003	34	3604683PL 3604512PL
5	Upper Blue release from OOP account to GM	2	1.00004	27	3603570PL
6	Upper Blue release from OOP account to GM	2	1.00005	27	3604683PL
7	Upper Blue release from C. Springs account to Dillon OOP account	1	1.00006	34	3603570PL 3604512PL
8	Upper Blue release from C. Springs account to Dillon OOP account	1	1.00007	34	3604683PL 3604512PL
9	Upper Blue release from C. Springs account to GM	1	1.00008	27	3603570PL
10	Upper Blue release from C. Springs account to GM	1	1.00009	27	3604683PL
11	Wolford transfer C. Springs account to C. Springs R account	7 to 9	1.00042	34	3604683PL
12	Wolford transfer C. Springs account to C. Springs R account	7 to 9	1.00043	34	3603570PL
13	Homestake transfer C. Springs & Aurora account to HR GMR account	1 to 3	1.00044	34	3604683PL
14	Homestake transfer C. Springs & Aurora account to HR GMR account	1 to 3	1.00045	34	3603570PL
15	Wolford transfer 250 af from West Slope account to Book-over account	1 to 8	1.00046	6	
16	Upper Blue transfer from OOP account to C. Springs account	2	1.00047	6	
17	Dillon transfer from OOP account to 1000 af account	5 to 4	1.00016	34	3604512PL
18	Wolford transfer from Denver account to Denver R1 account	2 to 5	1.00017	34	3604684PL
19	Wolford transfer from Denver account to Denver R1 account	2 to 5	1.00018	34	3604512PL
20	William Fork transfer from Denver account to WF GMR1 account	2 to 5	1.00019	34	3604684PL
21	William Fork transfer from Denver account to WF GMR1 account	2 to 5	1.00020	34	3604512PL
22	Wolford transfer from Denver account to Denver R2 account	2 to 6	1.00021	34	3604684PL
23	Wolford transfer from Denver account to Denver R2 account	2 to 6	1.00022	34	3604512PL

24	William Fork transfer from Denver account to WF GMR2 account	2 to 6	1.00023	34	3604684PL
25	William Fork transfer from Denver account to WF GMR2 account	2 to 6	1.00024	34	3604512PL
26	Dillon release from OOP account to Green Mountain	5	1.00025	27	3604684PL
27	Dillon release from OOP account to Green Mountain	5	1.00026	27	3604512PL
28	Dillon release from Denver account to Green Mountain	1	1.00027	27	3604684PL
29	Dillon release from Denver account to Green Mountain	1	1.00028	27	3604512PL
30	Dillon transfer remaining OOP water to Denver account	5 to 1	1.00029	6	
31	Wolford transfer Book-over account to C. Springs account	8 to 7	999999.9998	6	
32	Wolford transfer remaining Book-over account to West Slope account	8 to 1	999999.9999	6	

Operating rules 1, 2, 11, 12, 15, 16, 31, and 32 were incorporated in the model based on a May 15, 2003, *Memorandum of Agreement Regarding Colorado Springs Substitution Operations*. This agreement outlines the use of a 1,750 acre-feet pool in Wolford Mountain Reservoir, the transfer of 250 acre-feet per year from the West Slope pool to Colorado Spring's pool in Wolford Reservoir, and 250 acre-feet per year available in Upper Blue Lakes to West Slope users in the Blue River Basin. The agreement also outlines the use of the 1,750 acre-feet pool in Wolford Mountain Reservoir as an alternate replacement source to Green Mountain Reservoir operations. The 1,750 acre-feet account is used to replace out-of-priority operations by Colorado Springs in the Blue River Basin. These rules are on in the Historic and Baseline simulations.

Operating rules 13 and 14 transfer water from Colorado Spring's account to the Green Mountain Replacement account in Homestake Reservoir. At the time of this model update, Colorado Springs had recently decreed the alternate replacement sources to Green Mountain Reservoir. These rules are turned on in the Historic simulation starting in 2012 and are turned on for the entire study period for the Baseline simulation.

Operating rules 3 through 10 release water from the Upper Blue Reservoir to either Dillon or Green Mountain reservoirs to replace remaining out-of-priority obligations on August 1st. Releases to Dillon reservoir decrease Colorado Springs' out-of-priority obligation while increasing Denver's out-of-priority obligation. Releases to Green Mountain Reservoir reduce Colorado Springs' out-of-priority obligation. These operating rules are tied to either the out-of-priority diversion plan (3604683PL) or to the out-of-priority storage plan (3603570PL) for accounting of replacements. These rules are on in the Historic and Baseline simulations.

Operating rules 17 through 30 represent Denver's out-of-priority obligation replacement operations. Denver has the ability to repay out-of-priority obligations from three reservoirs - Dillon, Wolford Mountain, and Williams Fork. Wolford Mountain Reservoir and Williams Fork Reservoir each have two accounts to which Denver can transfer water for replacement. These accounts, and the order in which they are used, were established based on Denver's operations at the time of this model update. These rules are on in the Historic and Baseline simulations.

Replacement Reservoir Operations

Green Mountain Reservoir demands are met from alternate replacement accounts throughout the basin. In substitution years, when Denver and Colorado Springs make water available in reservoirs other than Green Mountain, releases are made from the alternate replacement accounts before Green Mountain Reservoir. As noted previously, Homestake Reservoir operations are included but turned off. The USBR provided the current release order from the different accounts in the basin as follows:

Release Order	Reservoir	Account
1	Wolford Mountain	Denver R1
2	Williams Fork	WF GMR1
3	Wolford Mountain	C. Springs R
4	Wolford Mountain	Denver R2
5	Williams Fork	WF GMR2
6	Homestake	HR GMR
7	Green Mountain	First 4 accounts

One hundred fifty-two operating rules are used to model Green Mountain Reservoir operations at the alternate replacement reservoirs. Some of Green Mountain Reservoir's operations are limited to specific time periods in the Historic simulation that do not overlap with the operational periods of some of the replacement reservoirs. For these cases (i.e., Shoshone Call Flows pre-1985 and Wolford Mountain Reservoir) operating rules were not developed for the replacement reservoir's account(s). See Section 5.9.2 for details on Green Mountain Reservoir release operations.

Right #	Destination	Account or Carrier	Admin #	Right Type	Reservoir Water is Released From
1	Granby Reservoir	5	31258.00005	5	Wolford Mountain
2	Granby Reservoir	4	31258.00006	5	Williams Fork
3	Granby Reservoir	9	31258.00007	5	Wolford Mountain
4	Granby Reservoir	3	31258.00008	5	Homestake
5	Granby Reservoir	6	31258.00009	5	Wolford Mountain
6	Granby Reservoir	5	31258.00010	5	Williams Fork
7	Granby Reservoir	2	31258.00011	5	Green Mountain
8	Willow Creek Reservoir	5	31258.00012	5	Wolford Mountain
9	Willow Creek Reservoir	4	31258.00013	5	Williams Fork

Right #	Destination	Account or Carrier	Admin #	Right Type	Reservoir Water is Released From
10	Willow Creek Reservoir	9	31258.00014	5	Wolford Mountain
11	Willow Creek Reservoir	6	31258.00015	5	Wolford Mountain
12	Willow Creek Reservoir	5	31258.00016	5	Williams Fork
13	Willow Creek Reservoir	3	31258.00017	5	Homestake
14	Willow Creek Reservoir	2	31258.00018	5	Green Mountain
15	Shadow Mountain/Grand Lake	5	31258.00019	5	Wolford Mountain
16	Shadow Mountain/Grand Lake	4	31258.00020	5	Williams Fork
17	Shadow Mountain/Grand Lake	9	31258.00021	5	Wolford Mountain
18	Shadow Mountain/Grand Lake	6	31258.00022	5	Wolford Mountain
19	Shadow Mountain/Grand Lake	5	31258.00023	5	Williams Fork
20	Shadow Mountain/Grand Lake	3	31258.00024	5	Homestake
21	Shadow Mountain/Grand Lake	2	31258.00025	5	Green Mountain
22	Granby Reservoir	5, Willow Creek Feeder	31258.00026	7	Wolford Mountain
23	Granby Reservoir	4, Willow Creek Feeder	31258.00027	7	Williams Fork
24	Granby Reservoir	9, Willow Creek Feeder	31258.00028	7	Wolford Mountain
25	Granby Reservoir	6, Willow Creek Feeder	31258.00029	7	Wolford Mountain
26	Granby Reservoir	5, Willow Creek Feeder	31258.00030	7	Williams Fork
27	Granby Reservoir	3, Willow Creek Feeder	31258.00031	7	Homestake
28	Granby Reservoir	2, Willow Creek Feeder	31258.00032	7	Green Mountain
29	Farmers Irrigation Company	5, Silt Pump Canal	39041.00001	2	Wolford Mountain
30	Farmers Irrigation Company	4, Silt Pump Canal	39041.00002	2	Williams Fork
31	Farmers Irrigation Company	9, Silt Pump Canal	39041.00003	2	Wolford Mountain
32	Farmers Irrigation Company	6, Silt Pump Canal	39041.00004	2	Wolford Mountain
33	Farmers Irrigation Company	5, Silt Pump Canal	39041.00005	2	Williams Fork
34	Farmers Irrigation Company	3, Silt Pump Canal	39041.00006	2	Homestake
35	Farmers Irrigation Company	4, Silt Pump Canal	39041.00007	2	Green Mountain
36	Vail Valley Consolidated	5	42420.41367	4	Wolford Mountain
37	Vail Valley Consolidated	4	42420.41368	4	Williams Fork
38	Vail Valley Consolidated	9	42420.41369	4	Wolford Mountain
39	Vail Valley Consolidated	6	42420.41370	4	Wolford Mountain
40	Vail Valley Consolidated	5	42420.41371	4	Williams Fork
41	Vail Valley Consolidated	3	42420.41372	4	Homestake
42	Vail Valley Consolidated	3	42420.41373	4	Green Mountain
43	Historic Users	5	46673.99994	10	Wolford Mountain

Right #	Destination	Account or Carrier	Admin #	Right Type	Reservoir Water is Released From
44	Government Highline	5, Grand Valley Project	46673.99994	27	Wolford Mountain
45	OMID Irrigation	5, Grand Valley Project	46673.99994	27	Wolford Mountain
46	OMID Pump	5, Grand Valley Project	46673.99994	27	Wolford Mountain
47	Historic Users	4	46673.99995	10	Williams Fork
48	Government Highline	4, Grand Valley Project	46673.99995	27	Williams Fork
49	OMID Irrigation	4, Grand Valley Project	46673.99995	27	Williams Fork
50	OMID Pump	4, Grand Valley Project	46673.99995	27	Williams Fork
51	Historic Users	9	46673.99996	10	Wolford Mountain
52	Government Highline	9, Grand Valley Project	46673.99996	27	Wolford Mountain
53	OMID Irrigation	9, Grand Valley Project	46673.99996	27	Wolford Mountain
54	OMID Pump	9, Grand Valley Project	46673.99996	27	Wolford Mountain
55	Historic Users	6	46673.99997	10	Wolford Mountain
56	Government Highline	6, Grand Valley Project	46673.99997	27	Wolford Mountain
57	OMID Irrigation	6, Grand Valley Project	46673.99997	27	Wolford Mountain
58	OMID Pump	6, Grand Valley Project	46673.99997	27	Wolford Mountain
59	Historic Users	5	46673.99998	10	Williams Fork
60	Government Highline	5, Grand Valley Project	46673.99998	27	Williams Fork
61	OMID Irrigation	5, Grand Valley Project	46673.99998	27	Williams Fork
62	OMID Pump	5, Grand Valley Project	46673.99998	27	Williams Fork
63	Historic Users	3	46673.99999	10	Homestake
64	Government Highline	3, Grand Valley Project	46673.99999	27	Homestake
65	OMID Irrigation	3, Grand Valley Project	46673.99999	27	Homestake
66	OMID Pump	3, Grand Valley Project	46673.99999	27	Homestake
67	Historic Users	1	46674.00000	10	Green Mountain
68	Government Highline	1, Grand Valley Project	46674.00000	27	Green Mountain
69	OMID Irrigation	1, Grand Valley Project	46674.00000	27	Green Mountain
70	OMID Pump	1, Grand Valley Project	46674.00000	27	Green Mountain
71	Needham Ditch	5	46751.42642	4	Wolford Mountain
72	Needham Ditch	4	46751.42643	4	Williams Fork
73	Needham Ditch	9	46751.42644	4	Wolford Mountain
74	Needham Ditch	6	46751.42645	4	Wolford Mountain
75	Needham Ditch	5	46751.42646	4	Williams Fork
76	Needham Ditch	3	46751.42647	4	Homestake
77	Needham Ditch	3	46751.42648	4	Green Mountain

Right #	Destination	Account or Carrier	Admin #	Right Type	Reservoir Water is Released From
78	Coon Creek Pipeline	5	46995.00001	4	Wolford Mountain
79	Coon Creek Pipeline	4	46995.00002	4	Williams Fork
80	Coon Creek Pipeline	9	46995.00003	4	Wolford Mountain
81	Coon Creek Pipeline	6	46995.00004	4	Wolford Mountain
82	Coon Creek Pipeline	5	46995.00005	4	Williams Fork
83	Coon Creek Pipeline	3	46995.00006	4	Homestake
84	Coon Creek Pipeline	3	46995.00007	4	Green Mountain
85	Derby Diversion System	5	47481.12656	4	Wolford Mountain
86	Derby Diversion System	4	47481.12657	4	Williams Fork
87	Derby Diversion System	9	47481.12658	4	Wolford Mountain
88	Derby Diversion System	6	47481.12659	4	Wolford Mountain
89	Derby Diversion System	5	47481.12660	4	Williams Fork
90	Derby Diversion System	3	47481.12661	4	Homestake
91	Derby Diversion System	3	47481.12662	4	Green Mountain
92	Historic Users	5	48965.99994	10	Wolford Mountain
93	Government Highline	5, Grand Valley Project	48965.99994	2	Wolford Mountain
94	OMID Irrigation	5, Grand Valley Project	48965.99994	2	Wolford Mountain
95	OMID Pump	5, Grand Valley Project	48965.99994	2	Wolford Mountain
96	Historic Users	4	48965.99995	10	Williams Fork
97	Government Highline	4, Grand Valley Project	48965.99995	2	Williams Fork
98	OMID Irrigation	4, Grand Valley Project	48965.99995	2	Williams Fork
99	OMID Pump	4, Grand Valley Project	48965.99995	2	Williams Fork
100	Historic Users	9	48965.99996	10	Wolford Mountain
101	Government Highline	9, Grand Valley Project	48965.99996	2	Wolford Mountain
102	OMID Irrigation	9, Grand Valley Project	48965.99996	2	Wolford Mountain
103	OMID Pump	9, Grand Valley Project	48965.99996	2	Wolford Mountain
104	Historic Users	6	48965.99997	10	Wolford Mountain
105	Government Highline	6, Grand Valley Project	48965.99997	2	Wolford Mountain
106	OMID Irrigation	6, Grand Valley Project	48965.99997	2	Wolford Mountain
107	OMID Pump	6, Grand Valley Project	48965.99997	2	Wolford Mountain
108	Historic Users	5	48965.99998	10	Williams Fork
109	Government Highline	5, Grand Valley Project	48965.99998	2	Williams Fork
110	OMID Irrigation	5, Grand Valley Project	48965.99998	2	Williams Fork
111	OMID Pump	5, Grand Valley Project	48965.99998	2	Williams Fork

Right #	Destination	Account or Carrier	Admin #	Right Type	Reservoir Water is Released From
112	Historic Users	1	48966.00000	10	Green Mountain
113	Government Highline	1, Grand Valley Project	48966.00000	2	Green Mountain
114	OMID Irrigation	1, Grand Valley Project	48966.00000	2	Green Mountain
115	OMID Pump	1, Grand Valley Project	48966.00000	2	Green Mountain
116	Green Mtn Contract Demand	5	48966.00001	4	Wolford Mountain
117	Green Mtn Contract Demand	4	48966.00002	4	Williams Fork
118	Green Mtn Contract Demand	9	48966.00003	4	Wolford Mountain
119	Green Mtn Contract Demand	6	48966.00004	4	Wolford Mountain
120	Green Mtn Contract Demand	5	48966.00005	4	Williams Fork
121	Green Mtn Contract Demand	3	48966.00006	4	Homestake
122	Green Mtn Contract Demand	3	48966.00007	2	Green Mountain
123	Atkinson Ditch	5	49308.48661	4	Wolford Mountain
124	Atkinson Ditch	4	49308.48662	4	Williams Fork
125	Atkinson Ditch	9	49308.48663	4	Wolford Mountain
126	Atkinson Ditch	6	49308.48664	4	Wolford Mountain
127	Atkinson Ditch	5	49308.48665	4	Williams Fork
128	Atkinson Ditch	3	49308.48666	4	Homestake
129	Atkinson Ditch	3	49308.48667	4	Green Mountain
130	Shoshone Call Flows	4	99999.89998	1	Williams Fork
131	Shoshone Call Flows	5	99999.89999	1	Williams Fork
132	Shoshone Call Flows	1	99999.90000	1	Green Mountain
134	Fish Instream Flow	4	99999.93005	27	Williams Fork
135	Fish Instream Flow	5	99999.93005	27	Williams Fork
136	Fish Instream Flow	5	99999.93006	27	Wolford Mountain
137	Fish Instream Flow	9	99999.93006	27	Wolford Mountain
138	Fish Instream Flow	6	99999.93006	27	Wolford Mountain
139	Fish Instream Flow	3	99999.93007	27	Homestake
140	Fish Instream Flow	1	99999.93008	2	Green Mountain

End of Year (March) Remaining Replacement Operations

Right #	Destination	Account or Carrier	Admin #	Right Type	Reservoir Water is Released From
1	Green Mountain Res	4	99999.00000	2	Dillon
2	Excess HUP Release	4	100000.00000	2	Dillon
3	Excess HUP Release	5	100000.00000	2	Wolford Mountain

4	Excess HUP Release	9	100000.00000	2	Wolford Mountain
5	Excess HUP Release	6	100000.00000	2	Wolford Mountain
6	Excess HUP Release	4	100000.00000	2	Williams Fork
7	Excess HUP Release	5	100000.00000	2	Williams Fork
8	Excess HUP Release	3	100000.00000	2	Homestake

Operating rules 1 through 8 release unused replacement water from alternate reservoir accounts based on USBR and Denver reservoir operations. Water owed to Green Mountain Reservoir due to out-of-priority operations is replaced within the same administration year and is not carried over in alternate replacement reservoirs. Operating rules one 1 through 8 are on in both the Historic and Baseline simulations.

End of Year (March 31st) Remaining Obligation Operations

Right #	Description	Account or Carrier	Admin #	Right Type	Plan Structure
1	Continental-Hoosier Plan Accounting Reset	NA	99999.99999	42	3604683PL
2	Upper Blue Lakes Plan Accounting Reset	NA	99999.99999	42	3603570PL
3	Roberts Tunnel Plan Accounting Reset	NA	99999.99999	42	3604684PL
4	Dillon Reservoir Plan Accounting Reset	NA	99999.99999	42	3604512PL

Operating rules 1 through 4 are used to reset accounting of out-of-priority operations every administration year. These rules are used to simplify the review of the plan accounting and to highlight years when the out-of-priority storage is not replaced. These rules are on in the Historic and Baseline simulations.

5.9.19. 15-Mile Reach Endangered Fish Flow Operations

The reach of the Upper Colorado River between the headgate of the Grand Valley Irrigation Canal (GVIC) and the confluence of the Upper Colorado River and the Gunnison River is often referred to as the 15-Mile Reach. This reach is considered a critical flow reach for the protection of endangered fish species because the river can be physically dried up at the GVIC headgate. The USFWS recommended flows for the months of August through October are 1,630 cubic feet per second, 1,240 cubic feet per second, and 810 cubic feet per second under wet, average, and dry hydrologic conditions. In 1997, the Recovery Implementation Program – Recovery Action Plan (RIPRAP) was developed and set aside storage within the Upper Colorado River Basin to be released to the 15-Mile Reach during times of low flows. Weekly phone conferences are held from August through October to determine the quantity and source of releases required to meet the fish demands. Although there is not a set sequence of reservoir releases, the USBR and CWCB provided the following general reservoir account and release order for modeling the Historic simulation:

General Fish Release Sequence Post-1997 through 2012			
Reservoir	**Acct**	**Account Name**	**Capacity (acre-feet)**
Ruedi	5	Unallocated / 5,000 acre-feet	5,000
Williams Fork	3	Temporary Fish	5,413
Wolford Mountain	4	Temporary Fish	5,413
Ruedi	4	CWCB Fish	10,825
HUP Surplus			
Wolford Mountain	5	Denver Replacement 1	5,000
Williams Fork	4	Green Mountain Replacement 1	10,000
Wolford Mountain	9	Colorado Springs Replacement	1,750
Wolford Mountain	6	Denver Replacement 2	20,610
Williams Fork	5	Green Mountain Replacement 2	25,000
Homestake	3	Homestake Reservoir Green Mountain Replacement	20,000
Green Mountain	1	Historic Users Pool	66,000
Ruedi	6	USFWS 5K 4/5	5,000
Wolford Mountain	3	Fish Account	6,000

Starting in 2013, the operations changed and the following sequence is used in the Baseline simulation:

General Fish Release Sequence Beginning in 2013			
Reservoir	**Acct**	**Account Name**	**Capacity (acre-feet)**
Granby	3	Fish Account	5,413
Ruedi	4	CWCB Fish	5,413
Wolford Mountain	3	Fish Account 1	3,000
Ruedi	5	Unallocated/5K	5,000
HUP Surplus			
Williams Fork	4	Green Mountain Replacement 1	10,000
Williams Fork	5	Green Mountain Replacement 2	25,000
Wolford Mountain	5	Denver Replacement 1	5,000
Wolford Mountain	9	Colorado Springs Replacement	1,750
Wolford Mountain	6	Denver Replacement 2	20,610
Homestake	3	Homestake Reservoir Green Mountain Replacement	20,000
Green Mountain	1	Historic Users Pool	66,000
Ruedi	6	USFWS 5K 4/5	5,000
Wolford Mountain	4	Fish Account 2	3,000

The primary difference between the Historic and Baseline simulations is that water is no longer released from the temporary fish accounts in Williams Fork and Wolford Mountain reservoirs in the Baseline simulation—instead water is released from Granby's fish account, and Wolford's fish account is split into two different permanent accounts that release water at different times. Note, the capacity of the fish accounts in Wolford and Ruedi differ between the two simulations.

Operational releases from Green Mountain's HUP account for 15-Mile Reach instream flows are determined based on an Operating Criteria Curve. If HUP storage is above the curve band, releases can be made from the HUP account to the 15-Mile reach while ensuring the HUP recipients' demand can continue to be met. If storage is below the curve band, fish releases are not made. StateMod does not currently have a feature to model operating curves or end-of-month targets for individual reservoir accounts.

Beyond supplementing low flows in the late summer through RIPRAP, the Recovery Program also investigated enhancing peak flows through the Coordinated Reservoir Operations Study (CROS). This study recommended participating reservoirs bypass legally storable water during a ten day period to allow enhanced peak flows in the 15-Mile Reach. This ten day period is determined based on prediction of the peak runoff through a coordinated effort of the Water Division 5 Engineer, U.S. Fish and Wildlife Service, and the National Weather Service. CROS operations are not specifically modeled due to the dynamic time period and StateMod forecasting limitations.

Eighteen operating rules were used to represent the releases to the 15-Mile Reach.

15-Mile Reach Endangered Fish Flow Operations

Right #	Destination	Account or Carrier	Admin #	Right Type	Reservoir (Account) Water is Released From
1	Fish Flow Diversion (7202003_M)	5	99999.91001	2	Ruedi
2	Fish Flow Diversion (7202003_M)	4	99999.91002	2	Ruedi
3	Fish Flow Diversion (7202003_M)	6	99999.91003	2	Ruedi
4	Fish Flow Diversion (7202003)	3	99999.93001	2	Granby
5	Fish Flow Diversion (7202003)	3	99999.93002	2	Ruedi (5413)
6	Fish Flow Diversion (7202003)	4	99999.93003	2	Wolford (Fish Account 1)
7	Fish Flow Diversion (7202003)	5	99999.93004	2	Ruedi (5K)
8	Fish Flow Diversion (7202003)	4	99999.93005	27	Williams Fork (HUP)
9	Fish Flow Diversion (7202003)	5	99999.93005	27	Williams Fork (HUP)
10	Fish Flow Diversion (7202003)	5	99999.93006	27	Wolford Mtn. (HUP)
11	Fish Flow Diversion (7202003)	9	99999.93006	27	Wolford Mtn. (HUP)
12	Fish Flow Diversion (7202003)	6	99999.93006	27	Wolford Mtn. (HUP)
13	Fish Flow Diversion (7202003)	3	99999.93007	27	Homestake Grn. Mtn. Replacement (HUP)
14	Fish Flow Diversion (7202003)	1	99999.93008	2	Green Mtn. (HUP)
15	Fish Flow Diversion (7202003)	6	99999.93009	2	Ruedi (5K 4/5)
16	Bookover	6 to 5	99999.93010	6	Ruedi
17	Fish Flow Diversion (7202003)	4	99999.93011	2	Wolford (Fish Account 2)
18	Bookover	1 to 3	99999.95000	6	Granby

Operating rules 1 through 3 releases water from the CWCB Fish, Unallocated / 5,000 acre-feet, and USFWS 5,000 acre-feet 4/5 accounts in Ruedi Reservoir, respectively, to the Fish Flow diversion node. The administration numbers were set junior to the reservoir first fill right. These rights were created to model the pre-1997 fish releases that were made exclusively from Ruedi Reservoir. Because the direct diversion right is set to a rate of zero cubic feet per second, the demand at the Fish Flow Diversion node determines when the rules operate and, therefore, the demand is only satisfied by the releases from these rules. These rules are turned on in the Historic and Baseline simulation; however, the demand is set to zero in the Baseline simulation.

Operating rules 4 through 18 release water from the reservoir accounts to the 15-Mile Reach Fish Diversion. The administration numbers were set junior to the reservoir's first fill rights and set to mimic the general sequence of current releases beginning in 2013. These rules are on in the Baseline simulation and are not included in the Historic Simulation. However, similar rules are turned on in the Historic simulation to model the post-1997 through 2012 fish releases and follow the general sequence provided in the "General Fish Release Sequence Post-1997 through 2012" table (above).

5.9.20. Eagle Park Reservoir

Eagle Park—located on the Eagle River—has a capacity of 3,418 acre-feet and is included in the model; however, the contract demands have not yet been included since they frequently change. The following operating rule releases water to meet end-of-month target values.

Right #	Destination	Account or Carrier	Admin #	Right Type	Description
1	Eagle Park Target	1	99999.99999	9	Release to river by target

The junior administration numbers ensure this is the last operating rule to fire at the reservoir. This rule is on in the Historic and Baseline simulations.

6. Baseline Results

The "Baseline" data set simulates current demands, current infrastructure and projects, and the current administrative environment, as though they had been in place throughout the modeled period. This section summarizes the state of the river as the Upper Colorado River Model characterizes it, under these assumptions.

6.1 Baseline Streamflows

Table 6.1 shows the average annual flow from the Baseline simulation for each gage, based on a 1909 through 2013 simulation period. In general, this value is lower than the historical average, because demand has risen and the development of storage has re-timed the supply so that more of the demand can be met. The second value in the table is the average annual available flow, as identified by the model. Available flow at a point is water that is not needed to satisfy instream flows or downstream diversion demand; it represents the water that could be diverted by a new water right. The available flow is always less than or the same as the total simulated flow.

The Baseline data set, and corresponding results, does not include any consideration for Colorado River Compact obligations, nor are conditional water rights represented in the Baseline data set. Variations of the Baseline data set could include conditional rights within the Upper Colorado River basin, and would likely result in less available flow than presented here.

Temporal variability of the historical and Baseline simulated flows is illustrated in

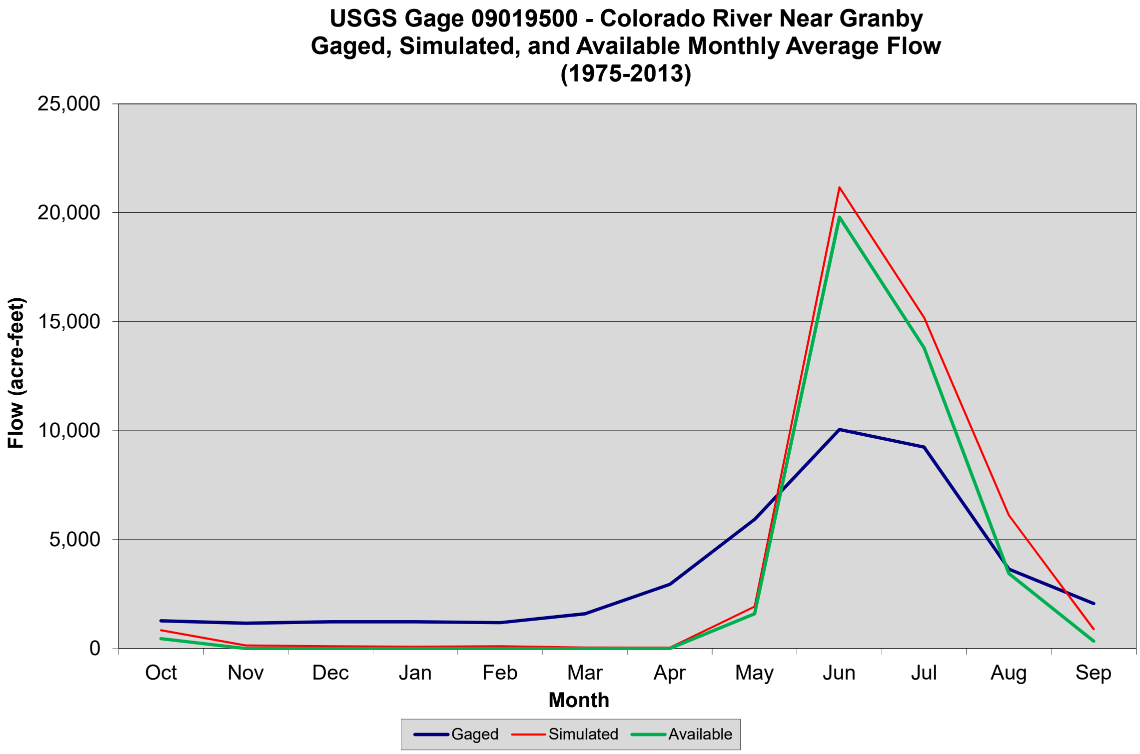


Figure 6.1 through Figure 6.14 for selected gages. Each figure shows two graphs: overlain hydrographs of historical gage flow, simulated gage flow, and simulated available flow for 1975 through 2013; and an average annual hydrograph based on the entire modeling period (1909 through 2013). The annual hydrograph is a plot of monthly average flow values, for the three parameters. The gages selected for these figures have a fairly complete record between 1975 and 2013.

Baseline flows are generally higher than historical flows during the irrigation season on tributaries with significant storage and on tributary gages upstream of senior diverters. This is, in part, due to increased reservoir releases and bypassed flow required to meet the higher Baseline demands. In addition, many of the reservoirs included in the Upper Colorado River Model came on-line during the simulation period. Their ability to re-regulate natural flow and provide supplemental water during the late irrigation season is not represented in the historical gage record for much of the study period, therefore not fully represented in the 1972 through 2013 graphs.

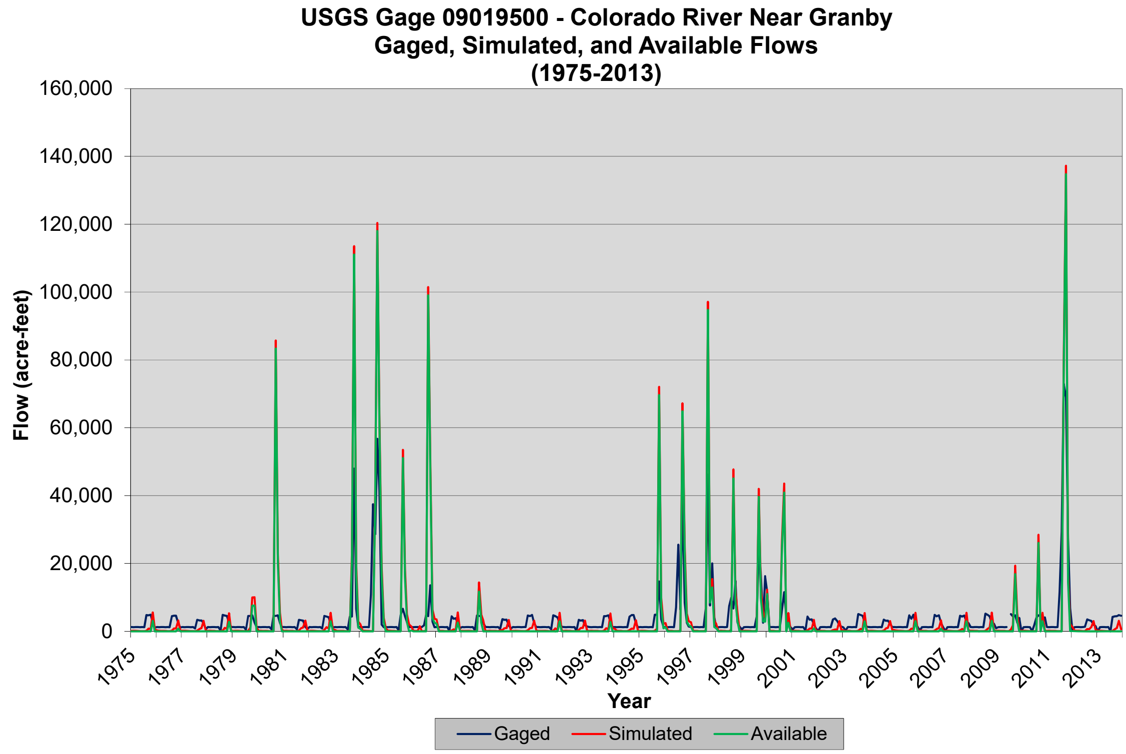
Table 6.1
Simulated and Available Baseline Average Annual Flows for Upper Colorado River Model Gages (1909-2013)

Gage ID	Gage Name	Simulated Flow (acre-feet)	Simulated Available Flow (acre-feet)
09010500	Colorado R Below Baker Gulch, Nr Grand Lake, CO.	50,276	13,625

Gage ID	Gage Name	Simulated Flow (acre-feet)	Simulated Available Flow (acre-feet)
09019500	Colorado River Near Granby	50,253	44,541
09021000	Willow Creek Below Willow Creek Reservoir	35,417	20,494
09024000	Fraser River at Winter Park	12,501	7,327
09025000	Vasquez Creek at Winter Park, CO.	18,757	11,359
09026500	St. Louis Creek Near Fraser, CO.	5,664	1,744
09032000	Ranch Creek Near Fraser, CO.	12,957	7,616
09032499	Meadow Creek Reservoir Inflow	7,058	860
09032500	Ranch Creek Near Tabernash, CO.	27,035	16,182
09033500	Strawberry Creek Near Granby, CO.	4,663	1,285
09034250	Colorado River at Windy Gap, Near Granby, CO.	174,067	11,3369
09034800	Little Muddy Creek Near Parshall, CO.	2,643	720
09034900	Bobtail Creek Near Jones Pass, CO.	7,711	2,687
09035500	Williams Fork Below Steelman Creek, CO.	15,093	5,199
09036000	Williams Fork River Near Leal, Co	75,042	19,057
09037500	Williams Fork River Near Parshall, Co	88,969	22,888
09038500	Williams Fork River Below Williams Fork Reservoir	101,123	66,721
09039000	Troublesome Creek Near Pearmont, CO.	23,349	7,223
09040000	East Fork Troublesome C Near Troublesome, CO.	20,524	18,060
09041000	Muddy Creek Near Kremmling, CO.	42,890	27,735
09041200	Red Dirt Creek Near Kremmling, CO.	13,952	4,035
09041500	Muddy Creek at Kremmling, CO.	68,061	59,166
09046600	Blue River Near Dillon, CO.	72,319	24,877
09047500	Snake River Near Montezuma, CO.	47,246	19,234
09050100	Tenmile Creek Below North Tenmile Creek at Frisco	78,663	30,458
09050700	Blue River Below Dillon Reservoir	153,114	59,327
09052800	Slate Creek at Upper Station, Near Dillon, CO.	19,157	4,858
09053500	Blue River Above Green Mountain Reservoir, CO.	257,697	73,836
09054000	Black Creek Below Black Lake, Near Dillon, CO.	23,118	10,259
09055300	Cataract Creek Near Kremmling, CO.	14,634	5,082
09057500	Blue River Below Green Mountain Reservoir	310,467	203,907
09058000	Colorado River Near Kremmling	742,344	518,054
09060500	Rock Creek Near Toponas, CO.	25,126	18,007
09060700	Egeria Creek Near Toponas, CO.	8,818	2,416
09063000	Eagle River at Red Cliff, CO.	33,036	24,809

Gage ID	Gage Name	Simulated Flow (acre-feet)	Simulated Available Flow (acre-feet)
09064000	Homestake Creek at Gold Park, CO.	17,521	9,346
09065100	Cross Creek Near Minturn	39,017	30,216
09065500	Gore Creek at Upper Station, Near Minturn, CO.	22,075	1,209
09067300	Alkali Creek Near Wolcott, CO.	2,149	2,056
09068000	Brush Creek Near Eagle, CO.	33,780	22,258
09069500	Gypsum Creek Near Gypsum, CO.	24,575	13,829
09070000	Eagle River Below Gypsum	424,011	336,939
09070500	Colorado River Near Dotsero	1,495,504	845,301
09071300	Grizzly Creek Near Glenwood Springs, CO.	9,065	7,866
09073400	Roaring Fork River Near Aspen	56,467	16,939
09074000	Hunter Creek Near Aspen	37,258	22,821
09074800	Castle Creek Above Aspen, CO.	30,769	21,362
09075700	Maroon Creek Above Aspen, CO.	47,776	32,231
09078600	Fryingpan River Near Thomasville	94,845	24,075
09080400	Fryingpan River Near Ruedi	122,921	63,983
09080800	West Sopris Creek Near Basalt, CO.	4,468	2,290
09081600	Crystal River Above Avalanche Creek Near Redstone	221,493	147,164
09082800	North Thompson Creek Near Carbondale, CO.	15,066	14660.18
09084000	Cattle Creek Near Carbondale, CO.	12,338	908
09084600	Fourmile Creek Near Glenwood Springs, CO.	7,351	4,371
09085000	Roaring Fork River at Glenwood Springs	876,772	756,134
09085100	Colorado River Below Glenwood Springs	2,455,074	1,562,916
09085200	Canyon Creek Above New Castle, CO.	37,375	33,180
09087500	Elk Creek at New Castle, CO.	69,421	62,942
09088000	Baldy Creek Near New Castle	3,887	2,764
09089500	West Divide Creek Near Raven	27,272	10,468
09090700	East Divide Creek Near Silt, CO.	10,787	6,788
09091500	East Rifle Creek Near Rifle, CO.	27,328	0
09092500	Beaver Creek Near Rifle	3,738	1,338
09092600	Battlement Creek Near Parachute	6,125	2,005
09093500	Parachute Creek at Parachute, CO.	22,727	21,903
09093700	Colorado River Near De Beque	2,607,517	1,592,631
09095000	Roan Creek Near De Beque, CO.	27,076	18,564
09095500	Colorado River Near Cameo	2,582,335	1,592,631

Gage ID	Gage Name	Simulated Flow (acre-feet)	Simulated Available Flow (acre-feet)
09096500	Plateau Creek Near Collbran, CO.	28,354	18,700
09097500	Buzzard Creek Near Collbran	38,276	34,503
09105000	Plateau Creek Near Cameo	149,465	131,787
09152500	Gunnison River Near Grand Junction	1,847,225	1,337,900
09163500	Colorado River Near Colorado-Utah State Line	4,339,264	4,339,264



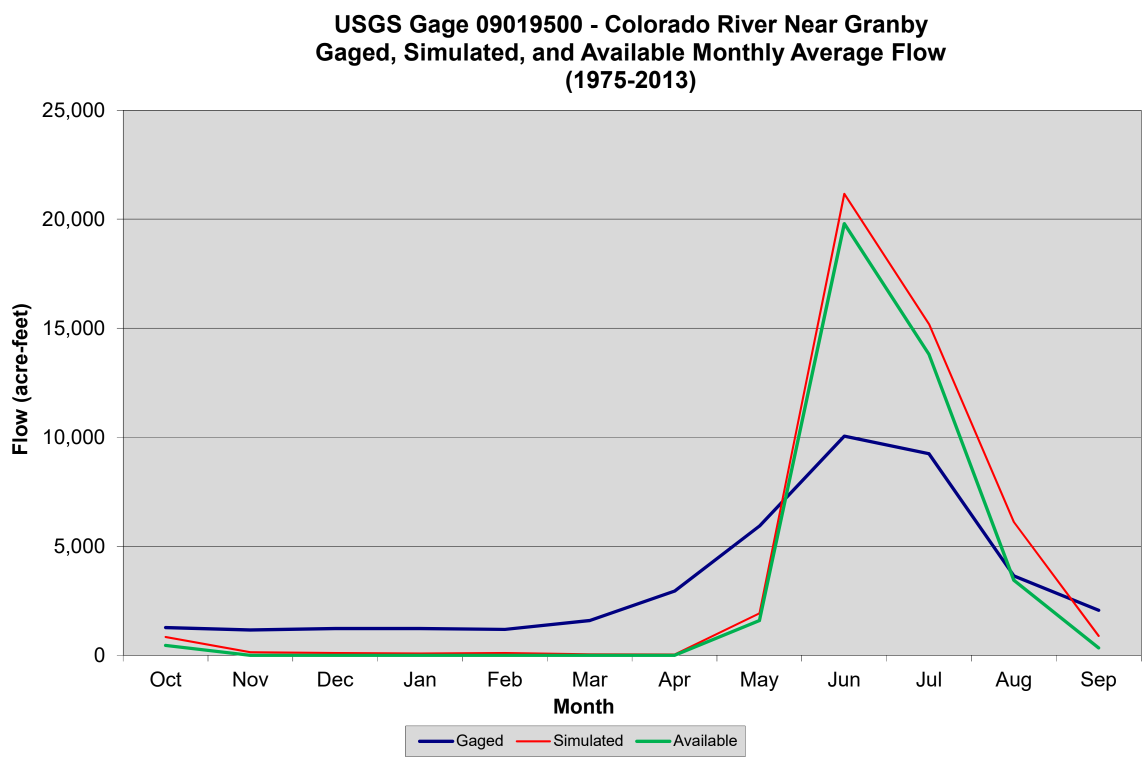
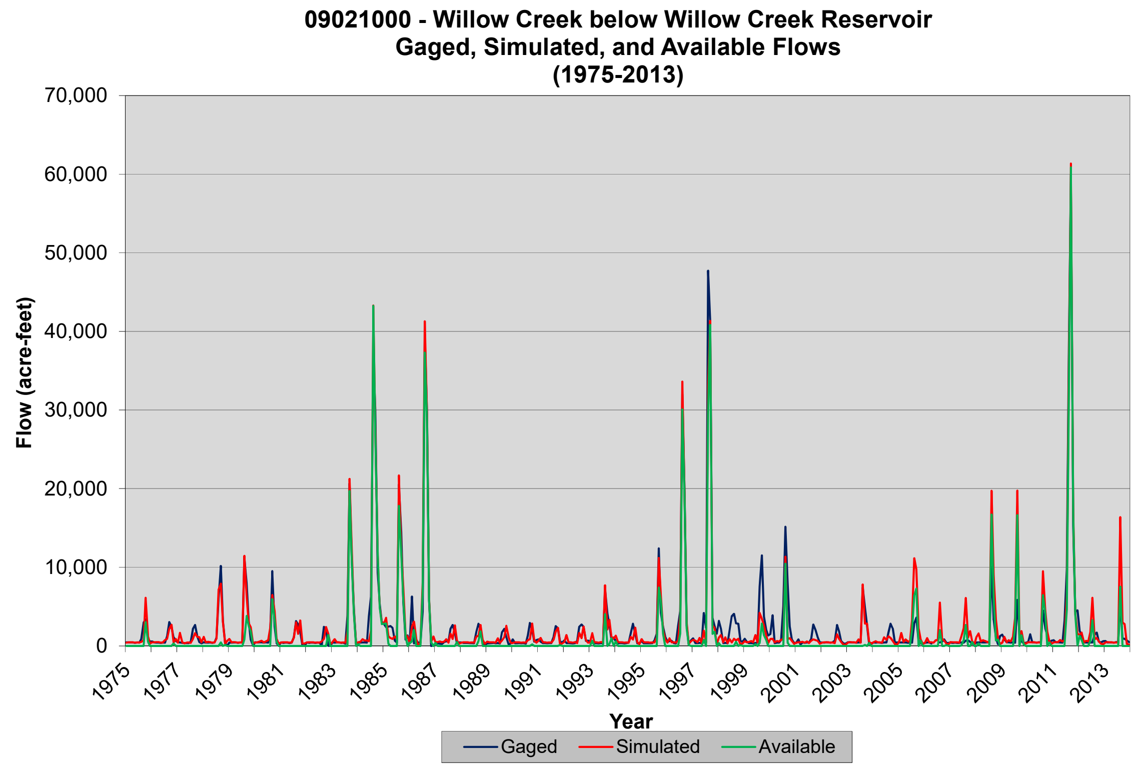


Figure 6.1 Baseline Results Colorado River near Granby



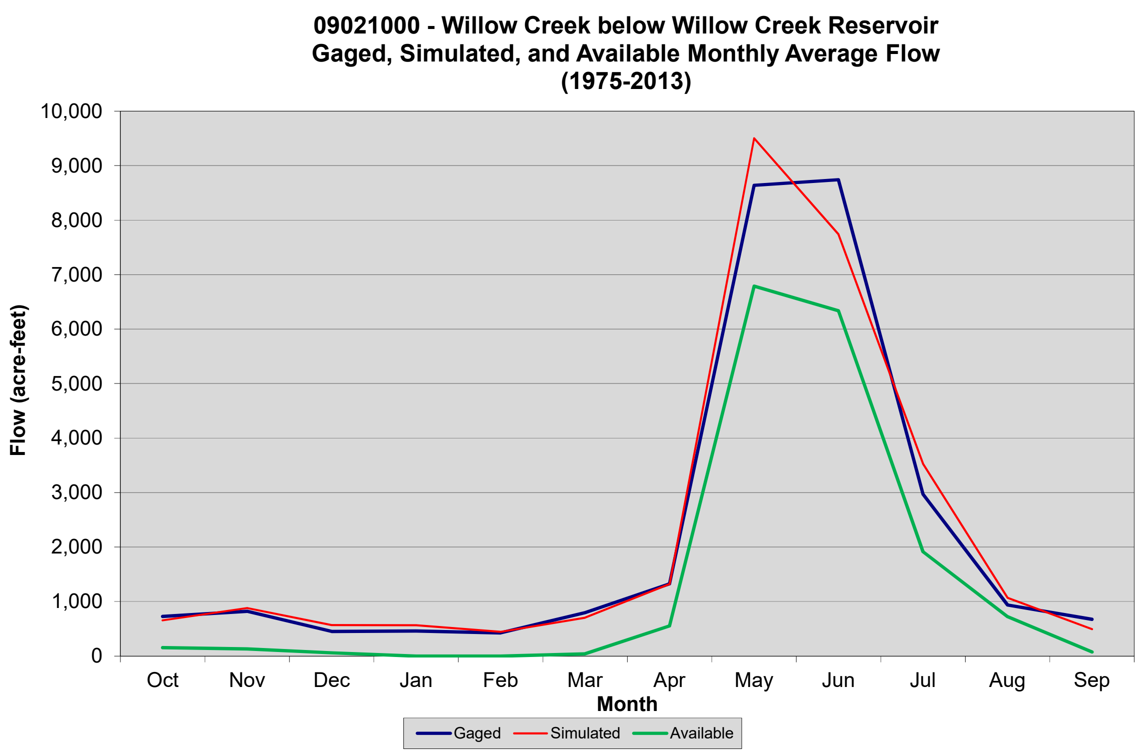
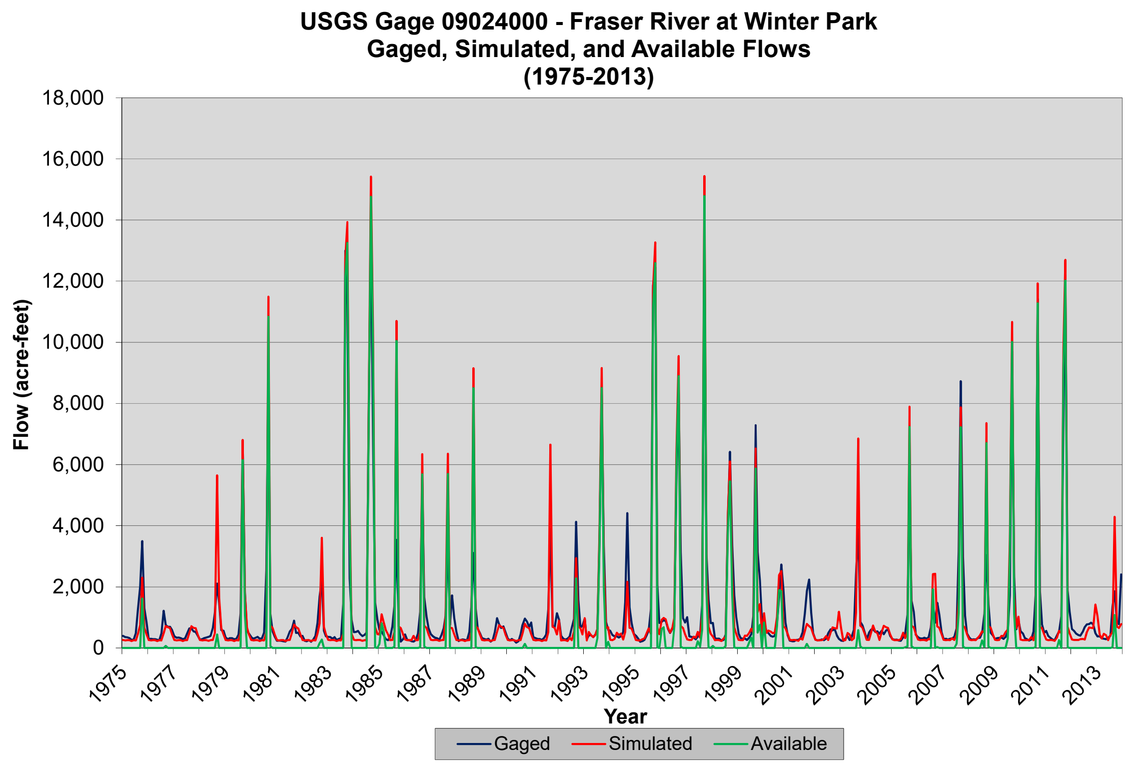


Figure 6.2 Baseline Results – Willow Creek below Willow Creek Reservoir



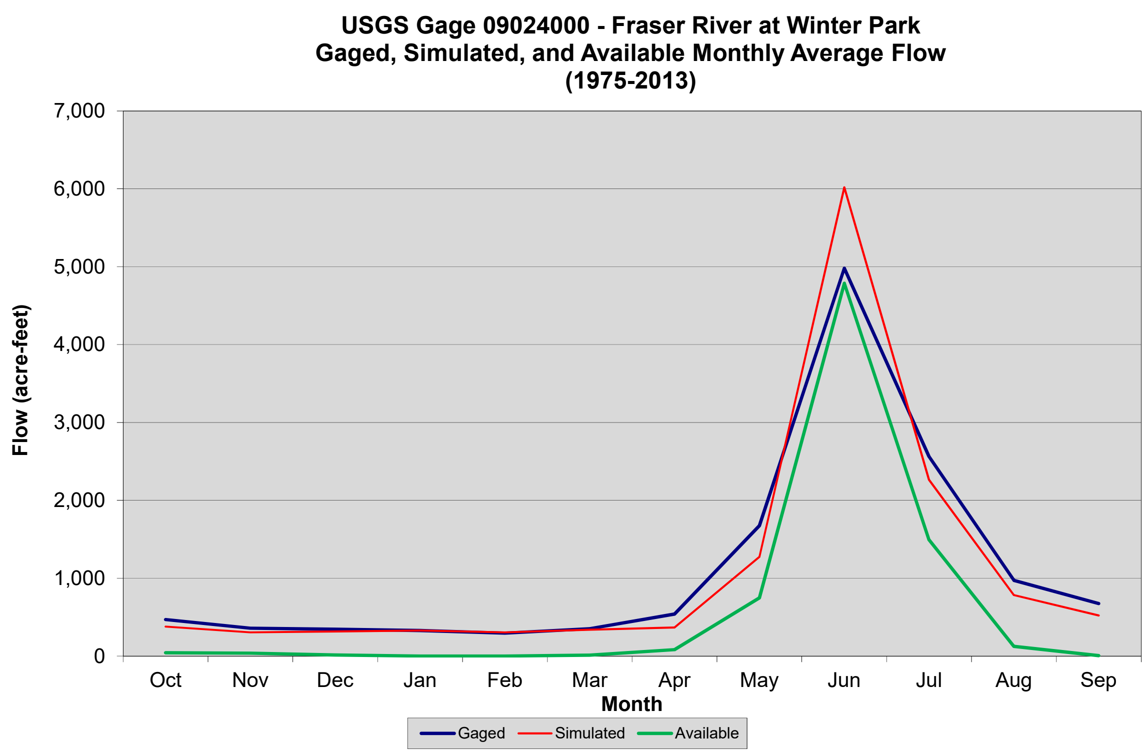
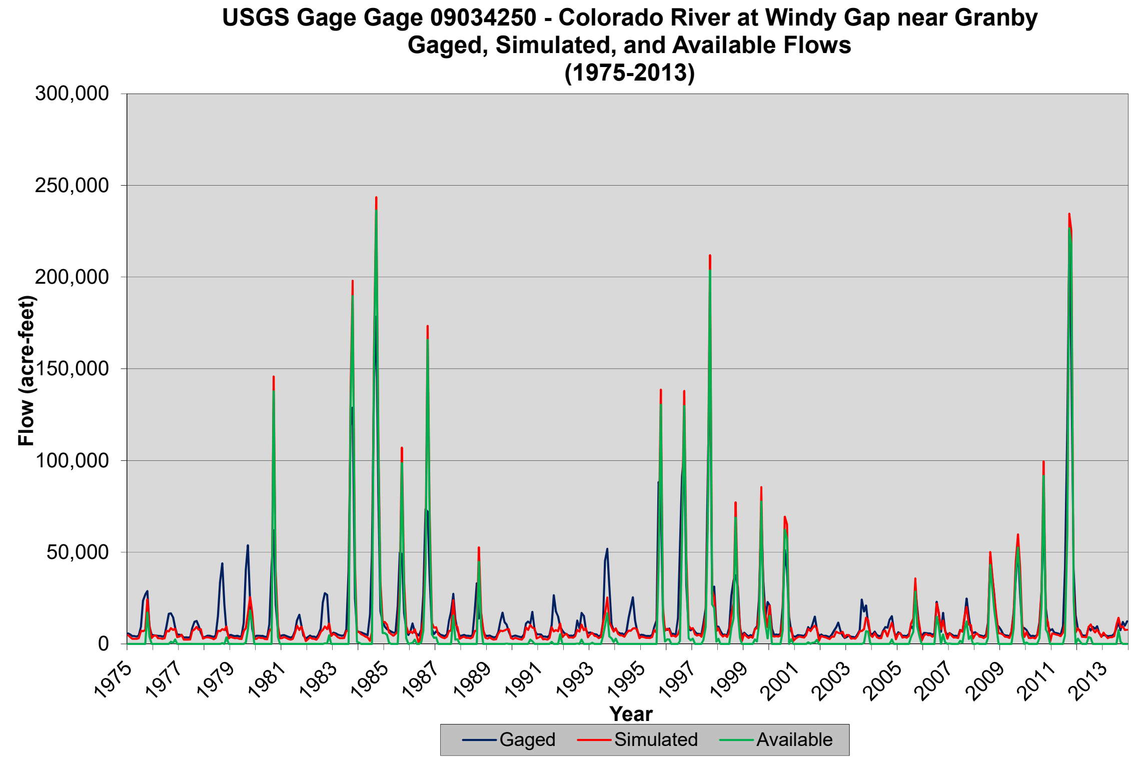


Figure 6.3 Baseline Results – Fraser River at Winter Park



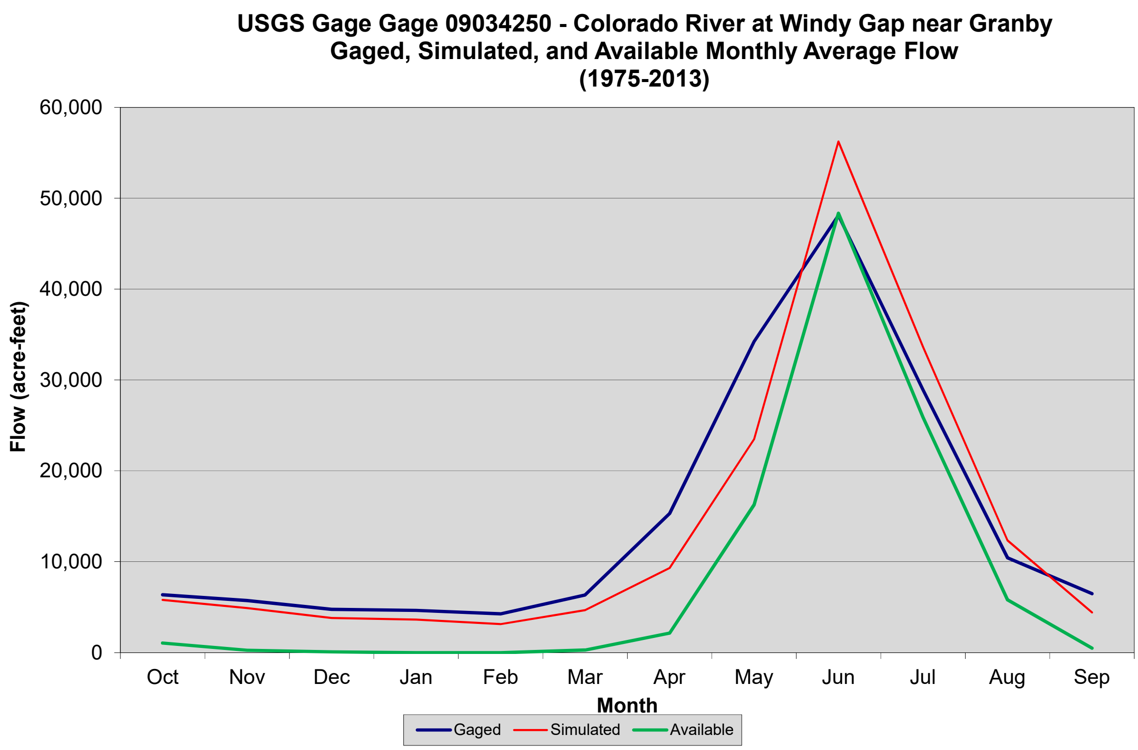
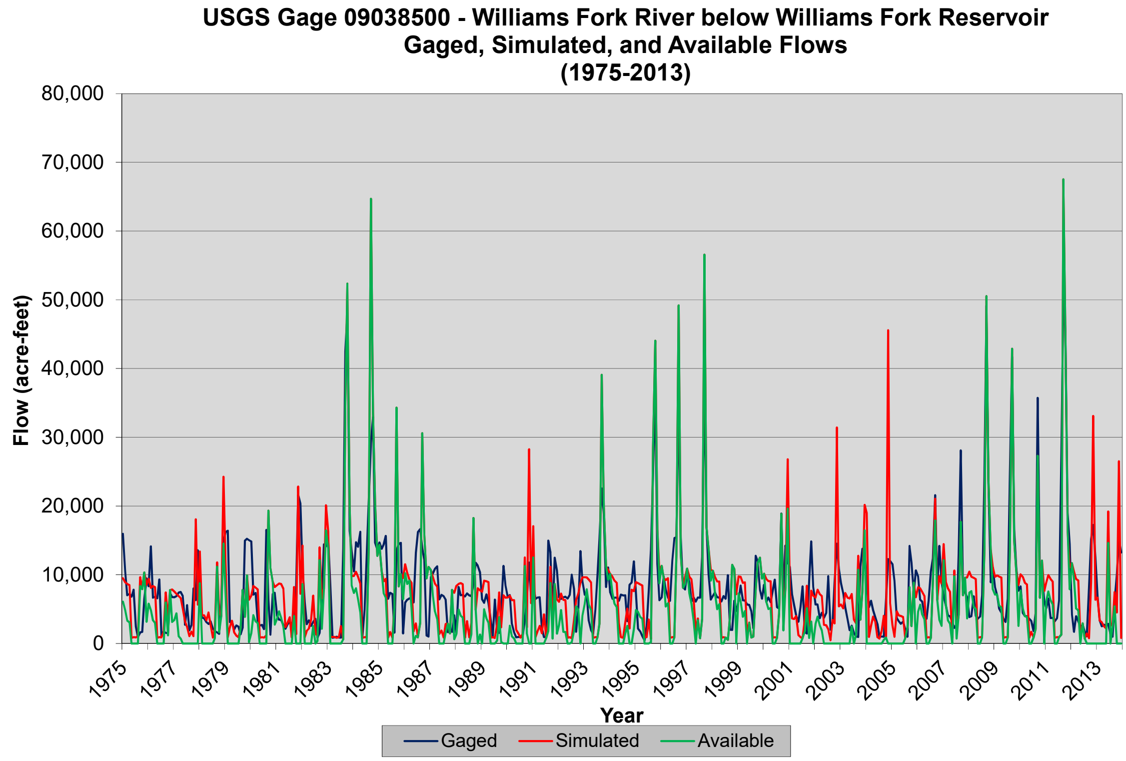


Figure 6.4 Baseline Results – Colorado River at Windy Gap, near Granby, CO



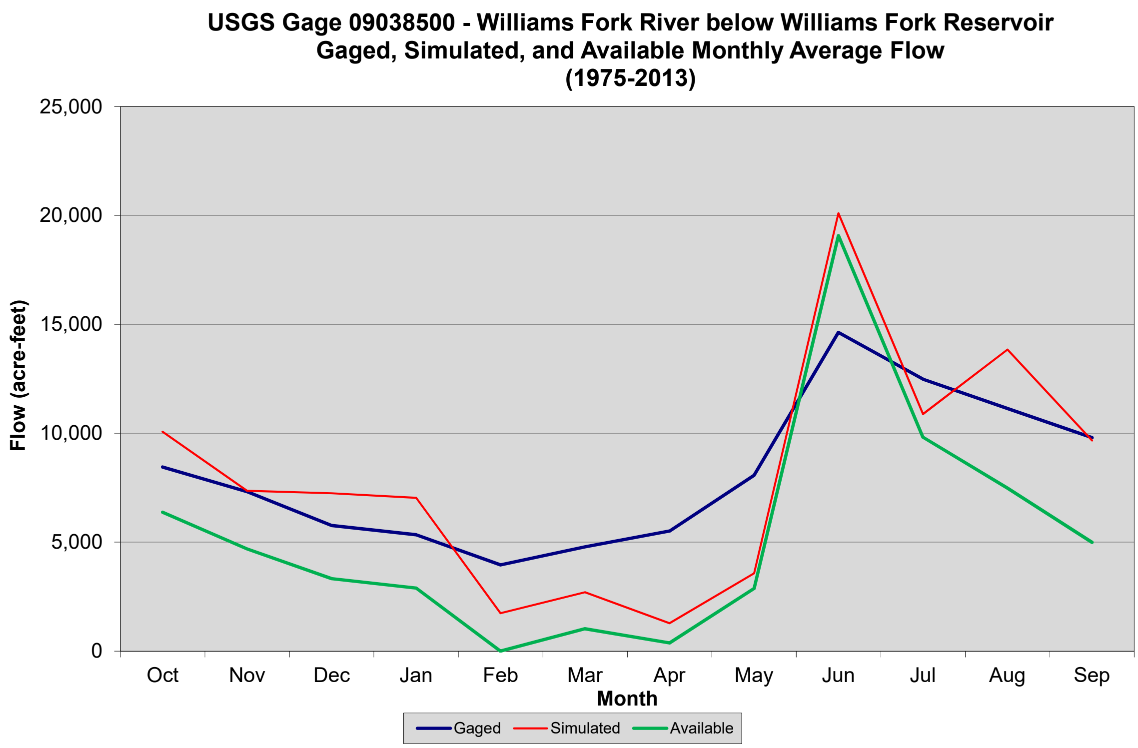
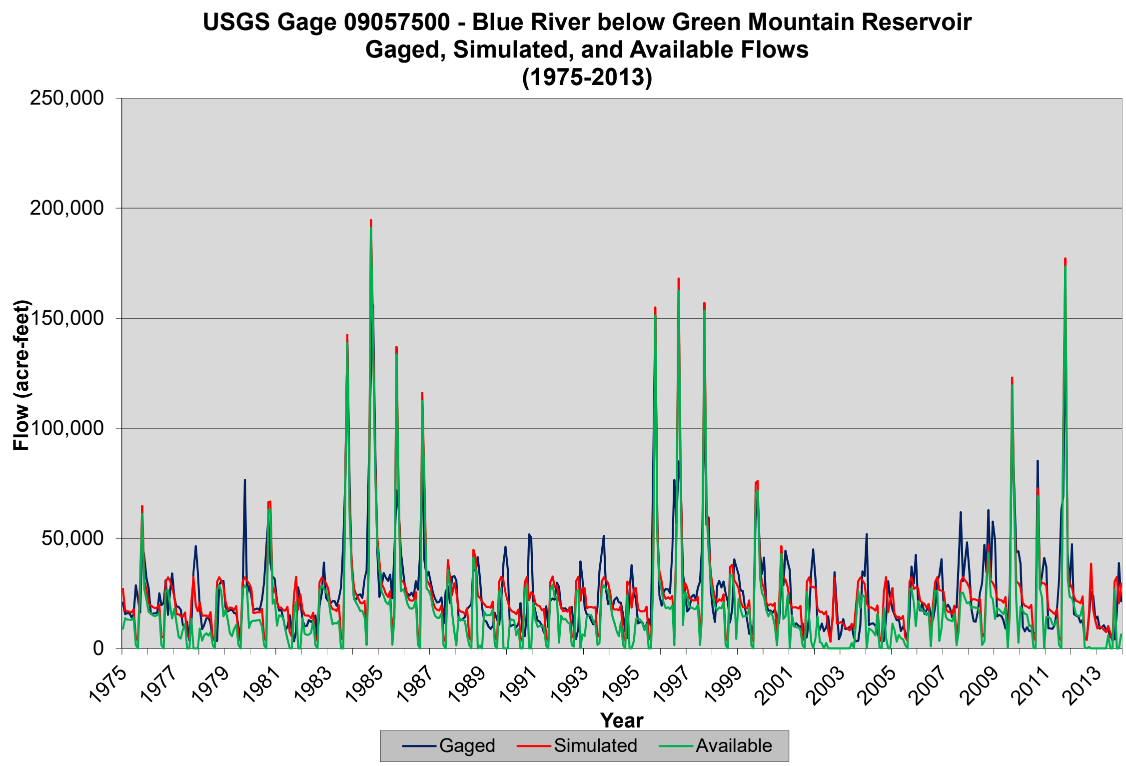


Figure 6.5 Baseline Results – Williams Fork River below Williams Fork Reservoir



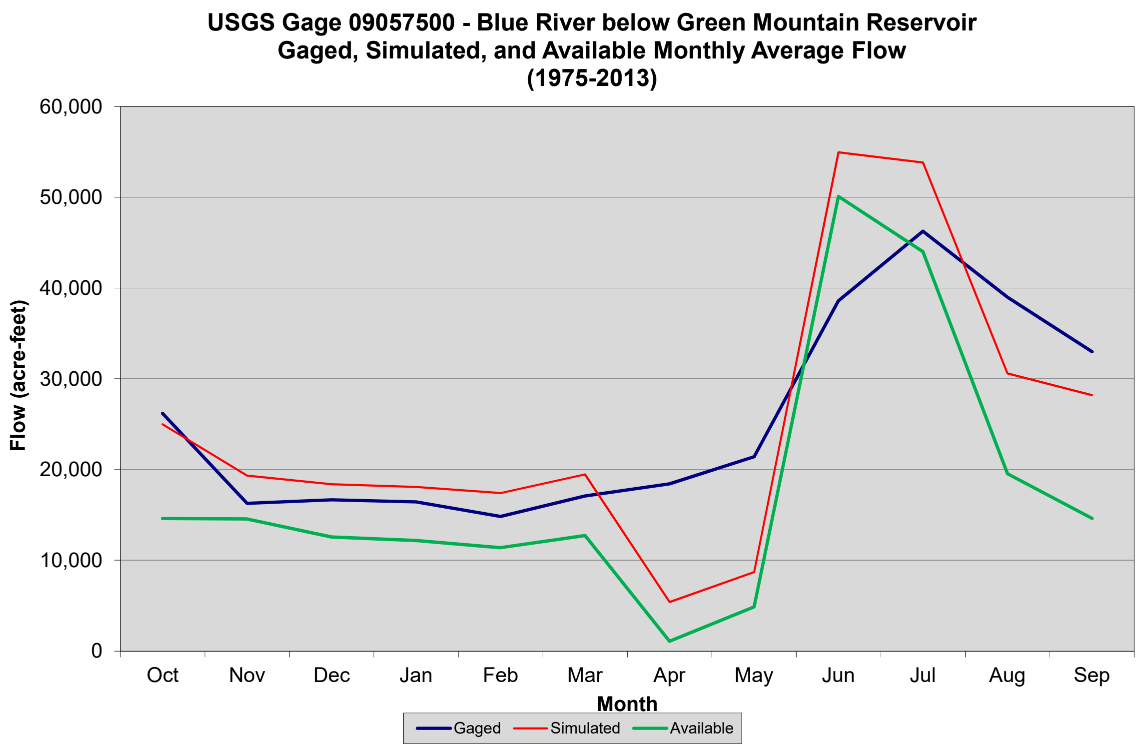
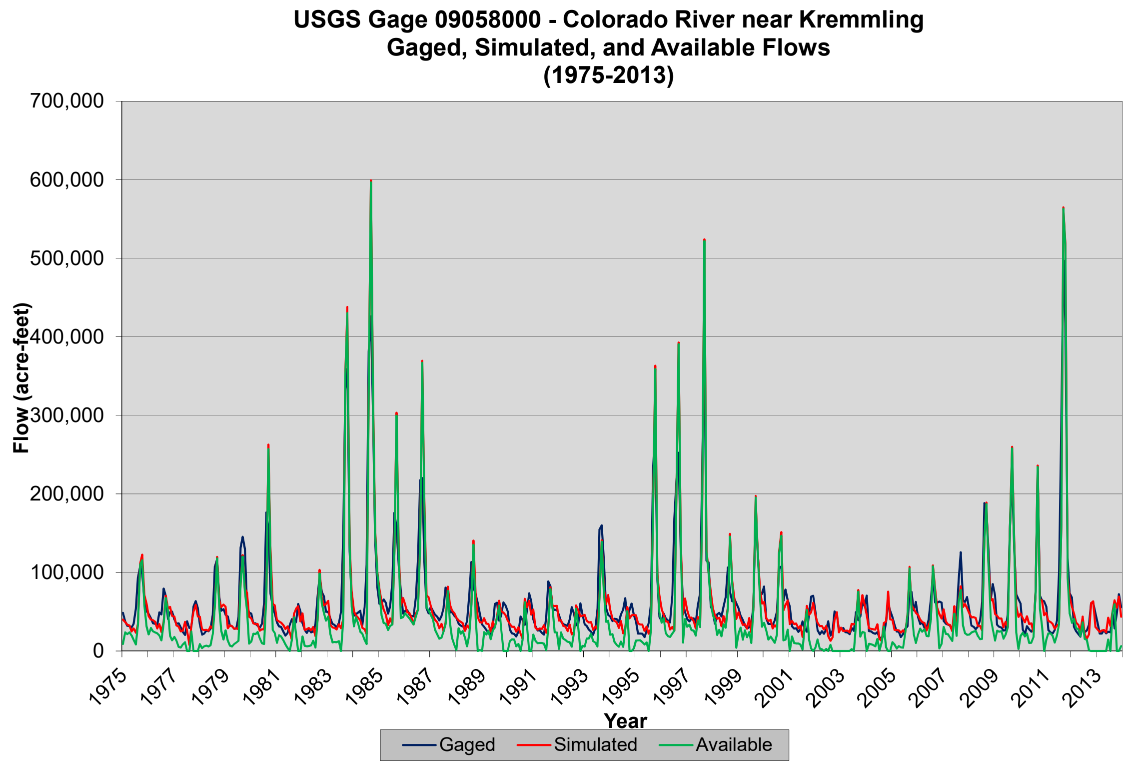


Figure 6.6 Baseline Results – Blue River below Green Mountain Reservoir



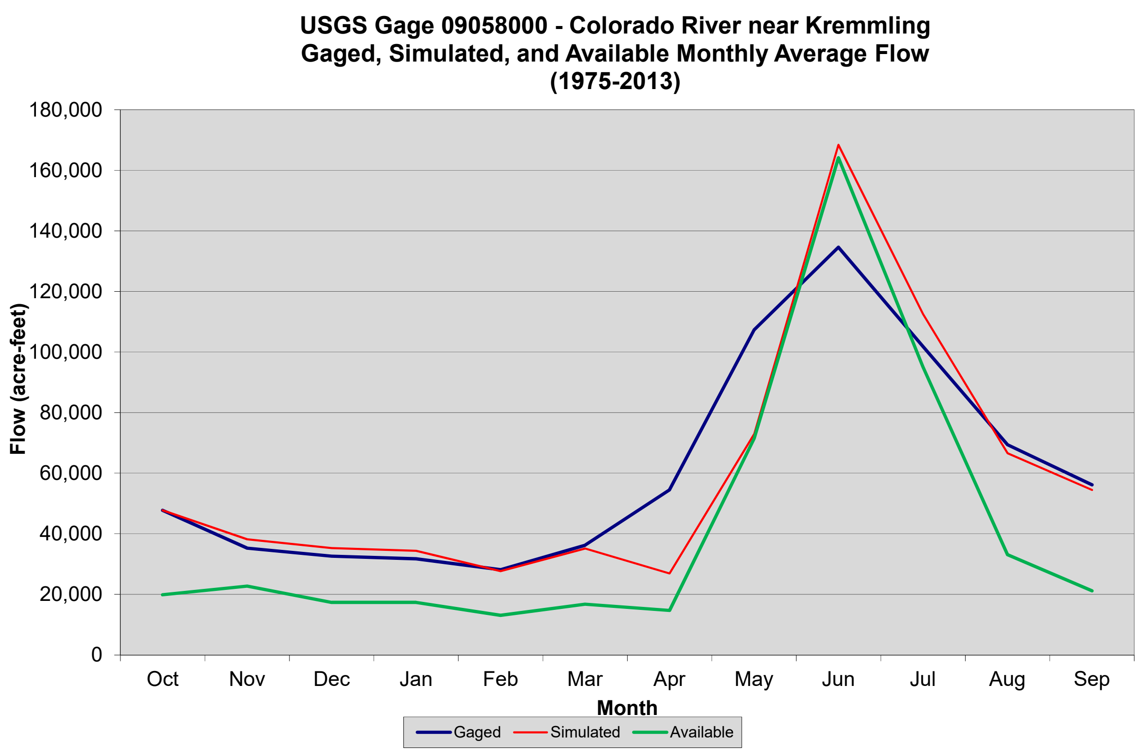
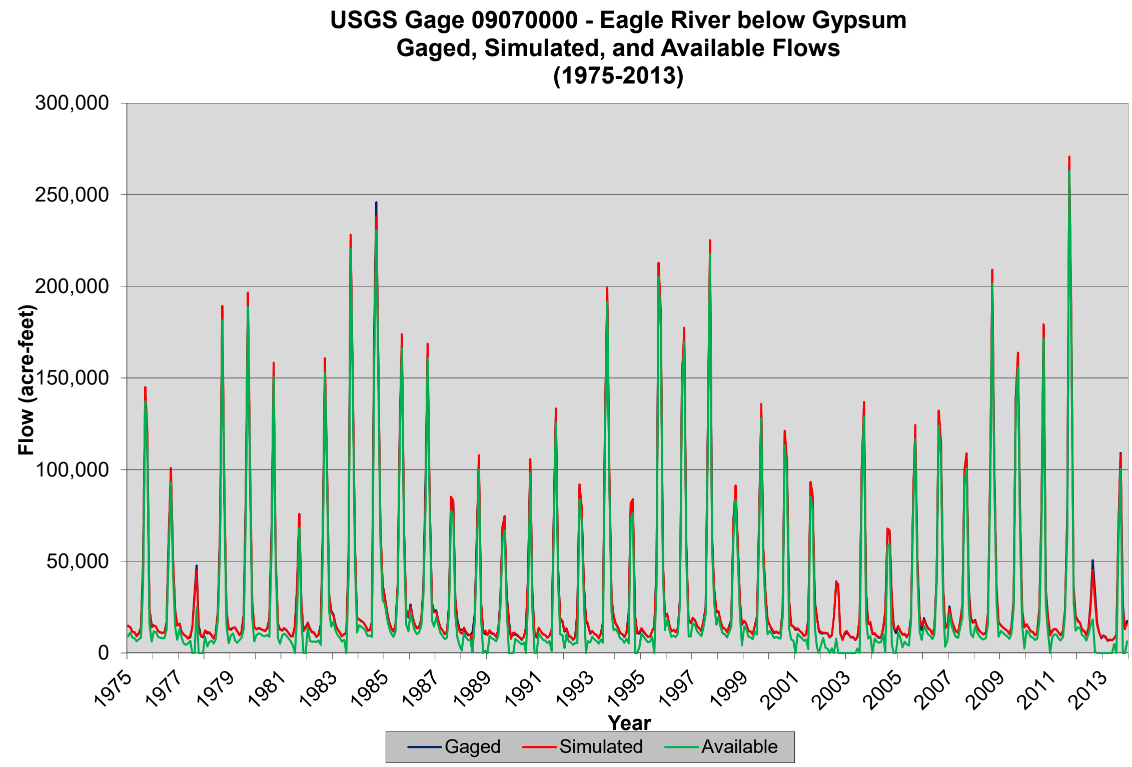


Figure 6.7 Baseline Results – Colorado River near Kremmling



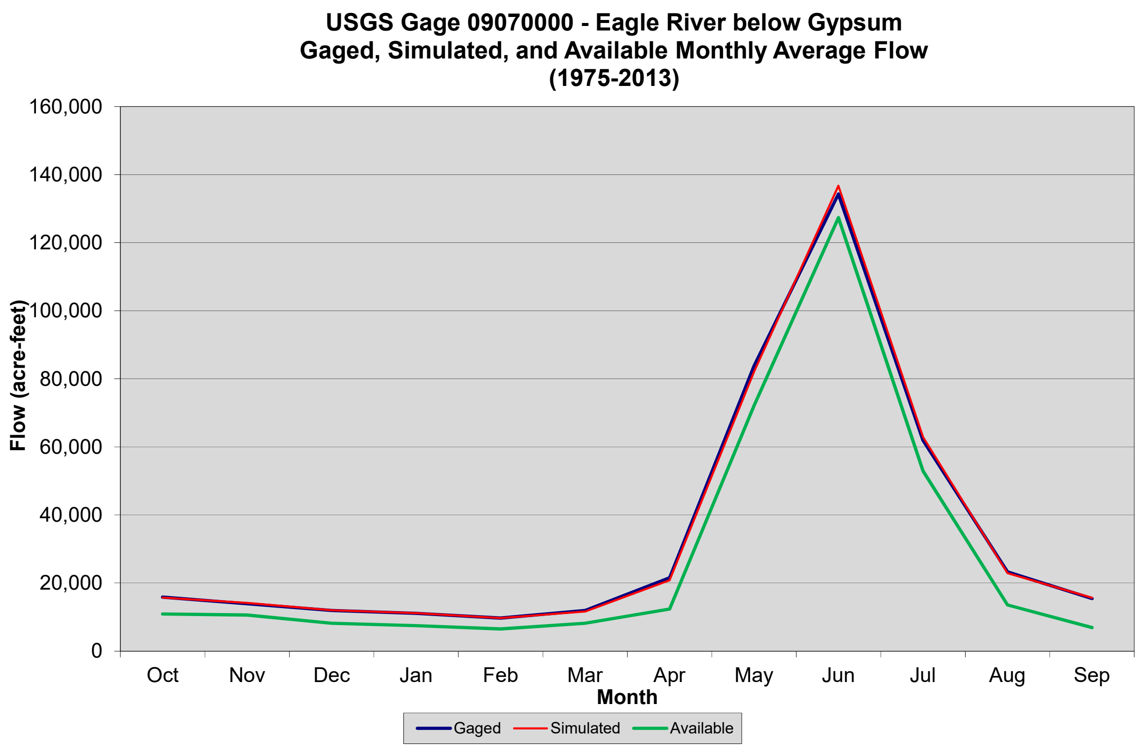
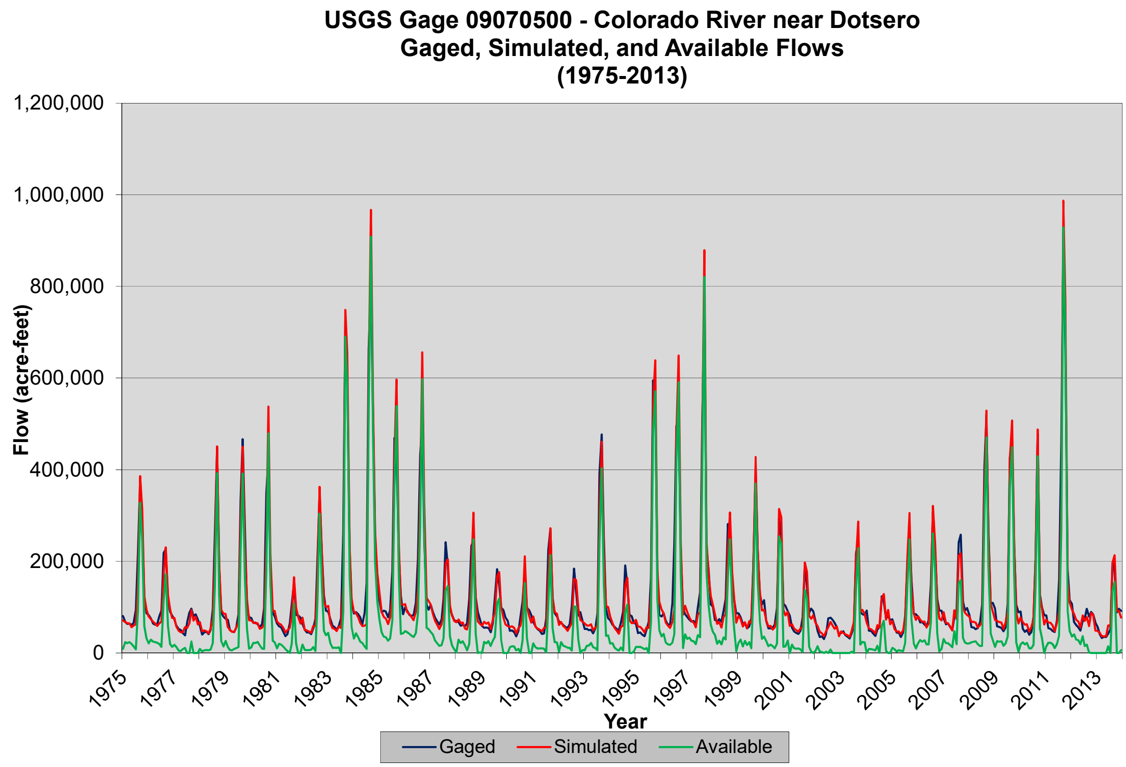


Figure 6.8 Baseline Results – Eagle River below Gypsum



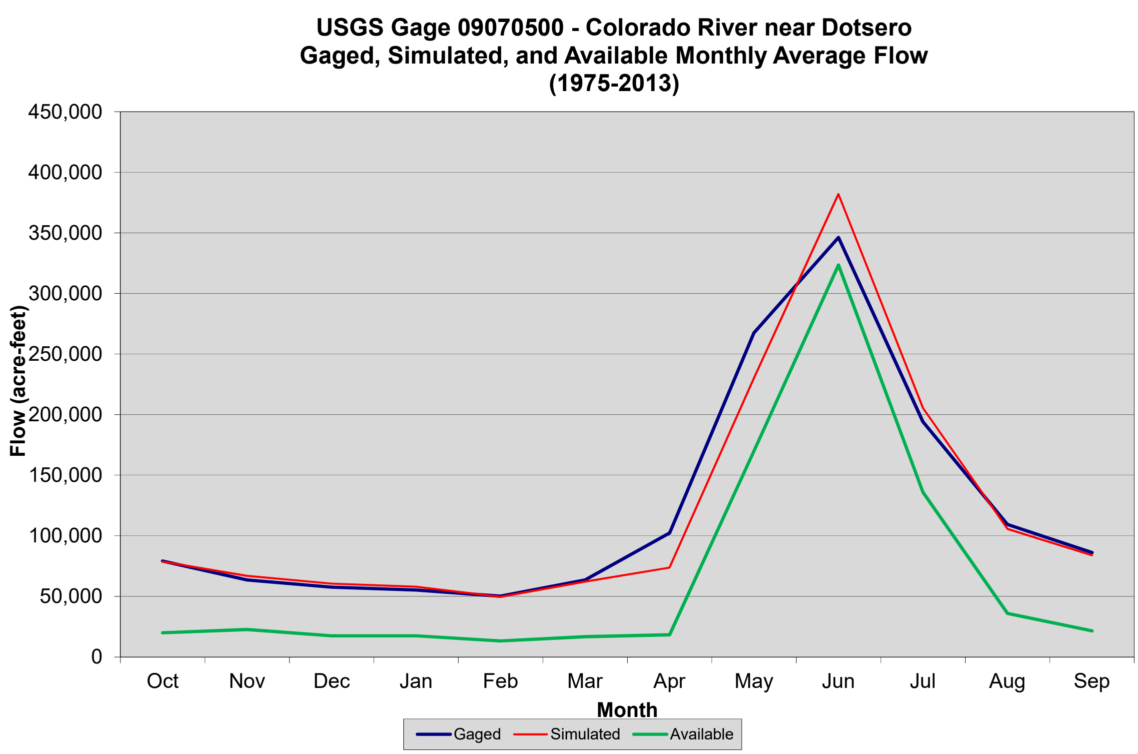
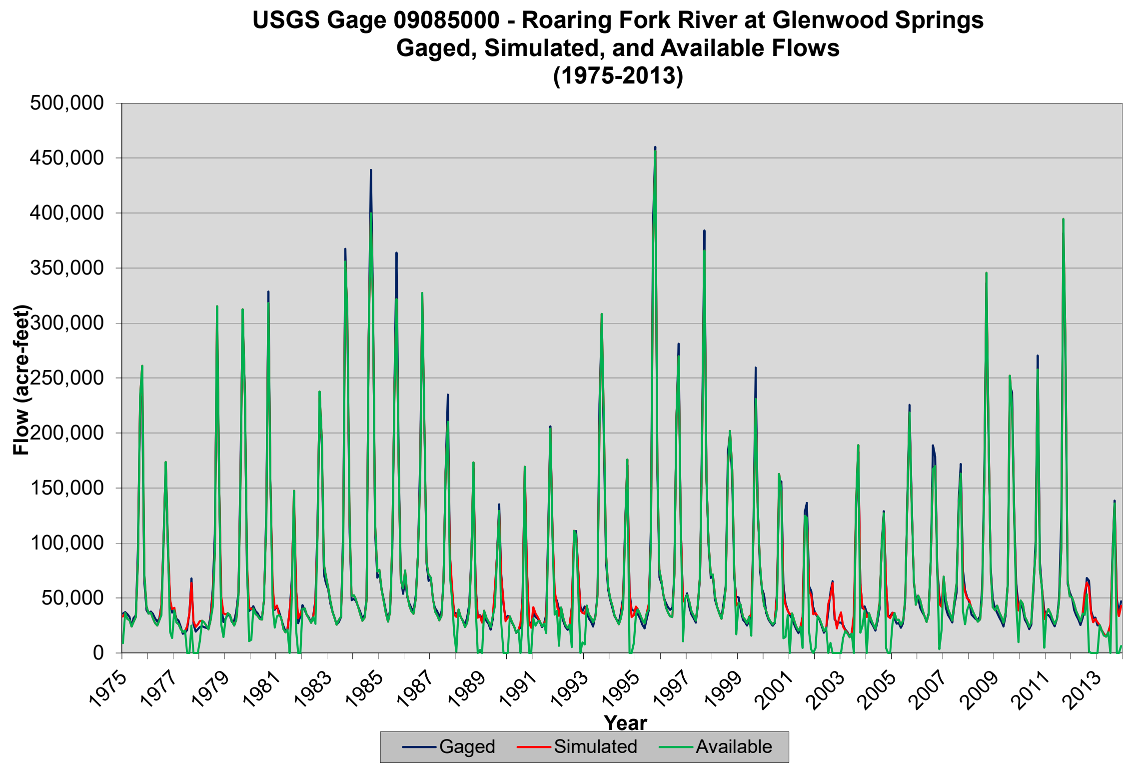


Figure 6.9 Baseline Results – Colorado River near Dotsero



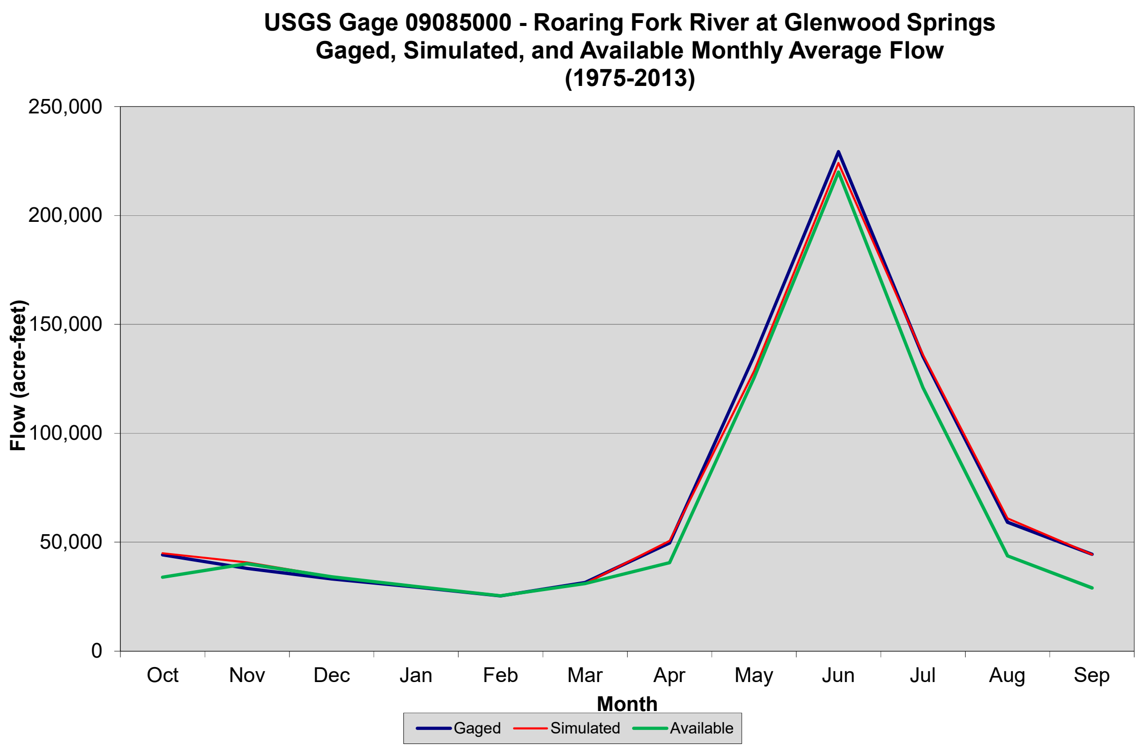
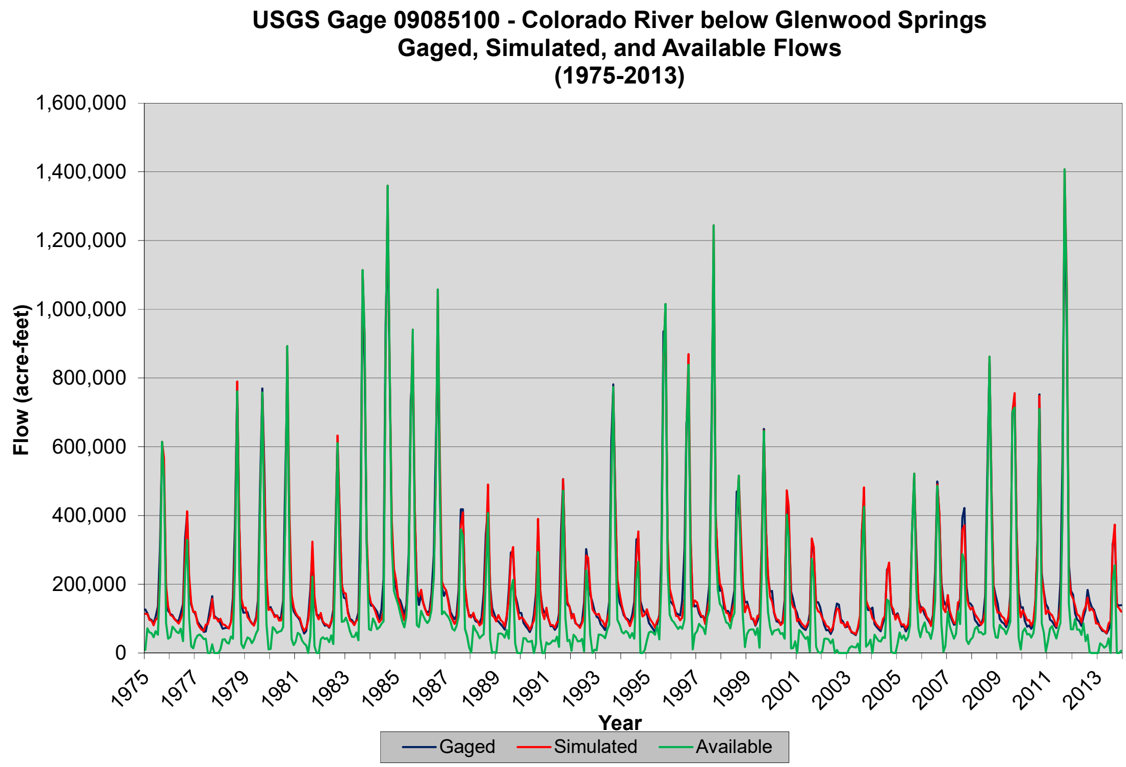


Figure 6.10 Baseline Results – Roaring Fork River at Glenwood Springs



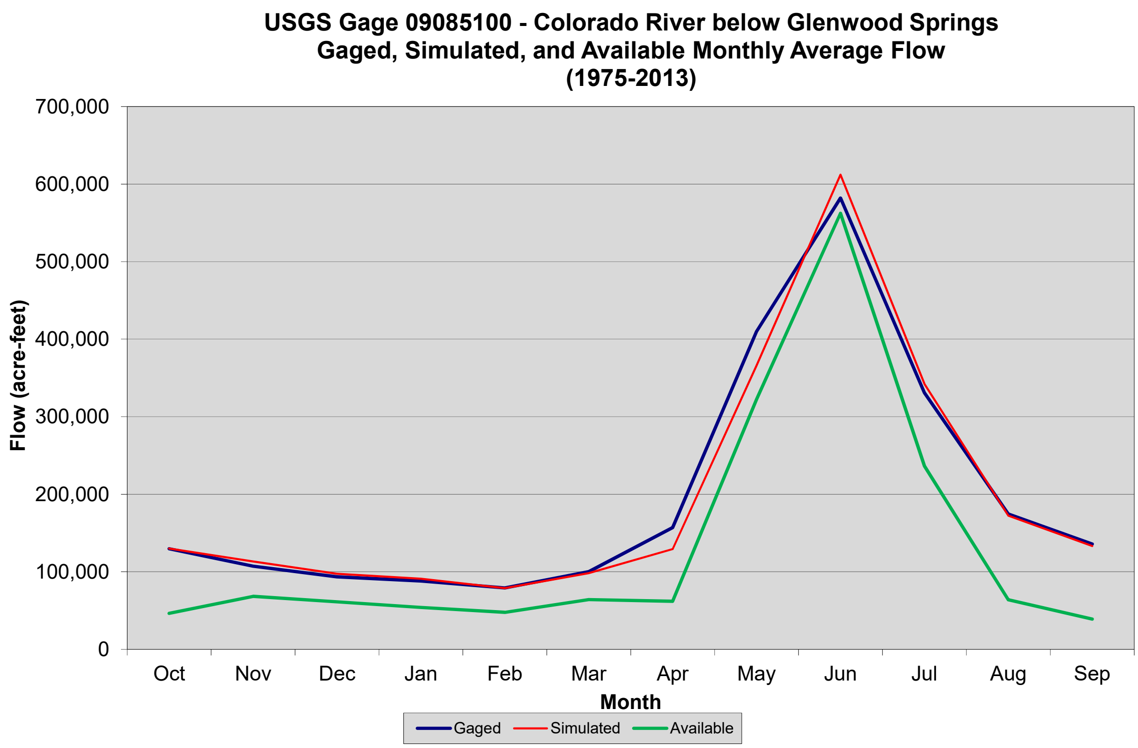
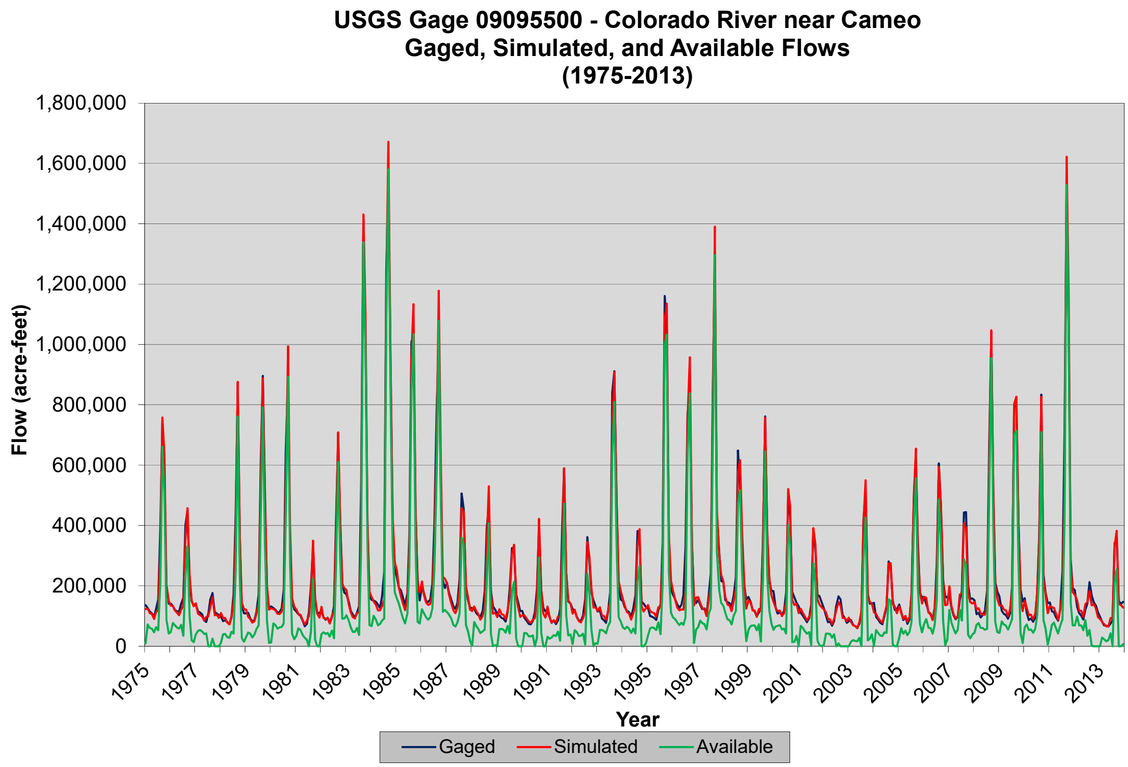


Figure 6.11 Baseline Results – Colorado River below Glenwood Springs



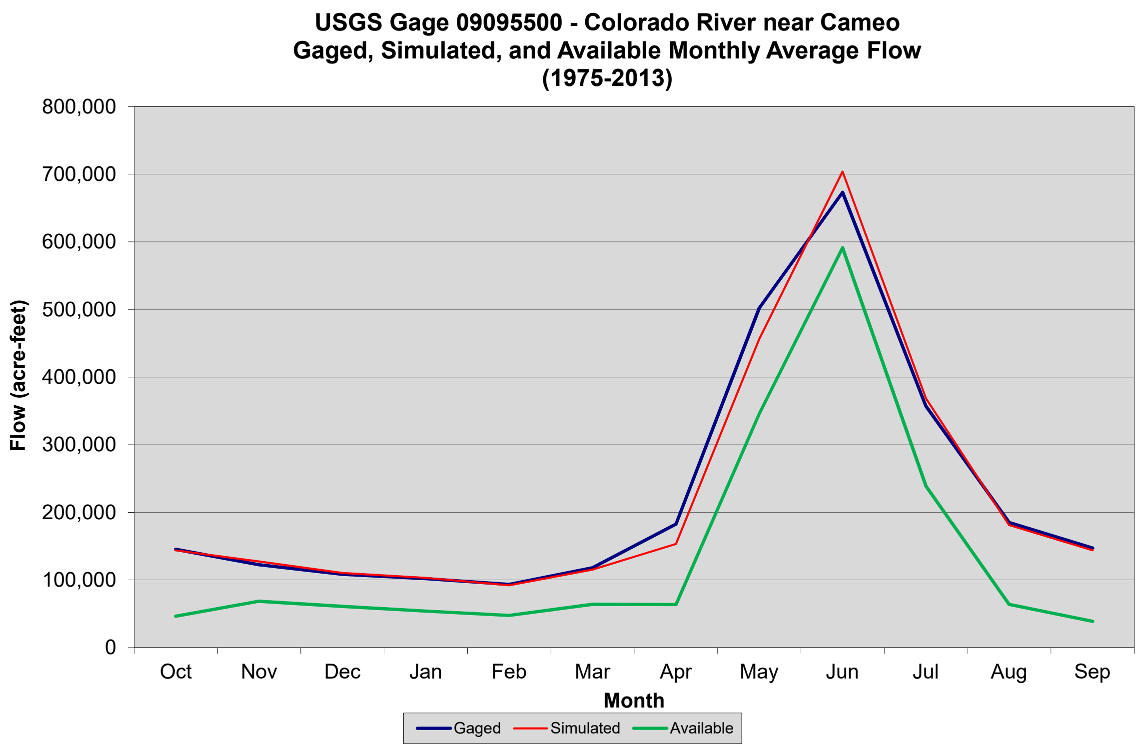
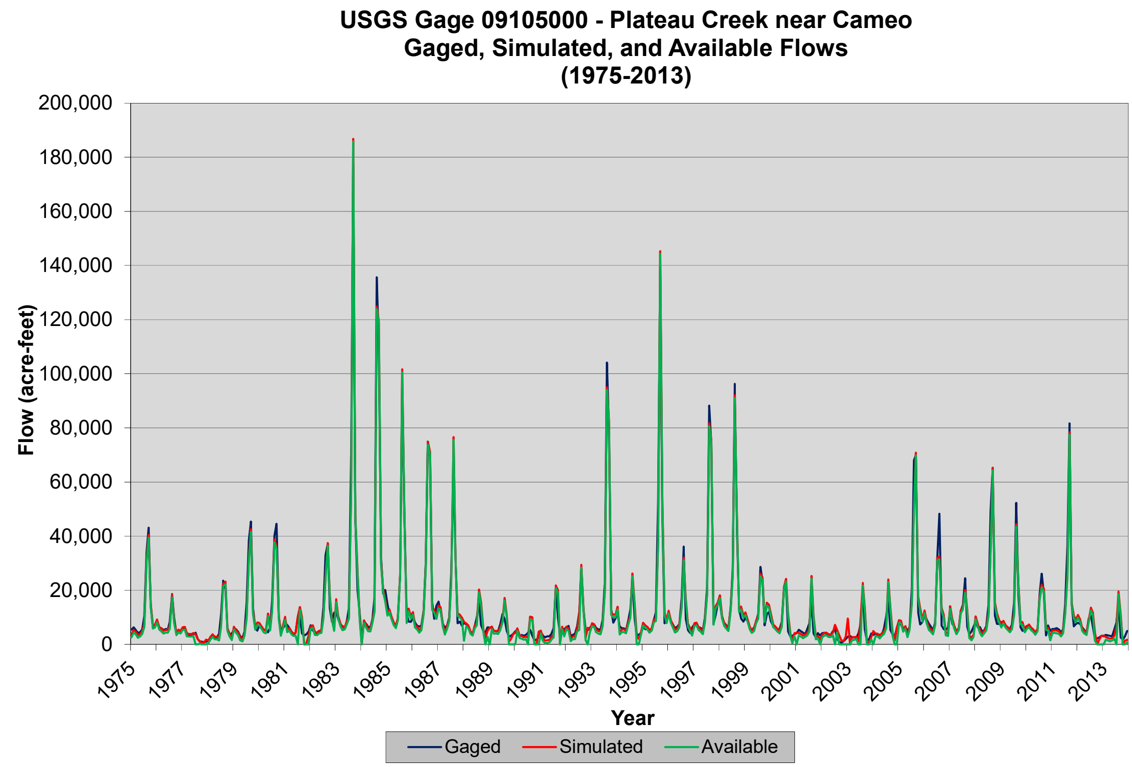


Figure 6.12 Baseline Results – Colorado River near Cameo



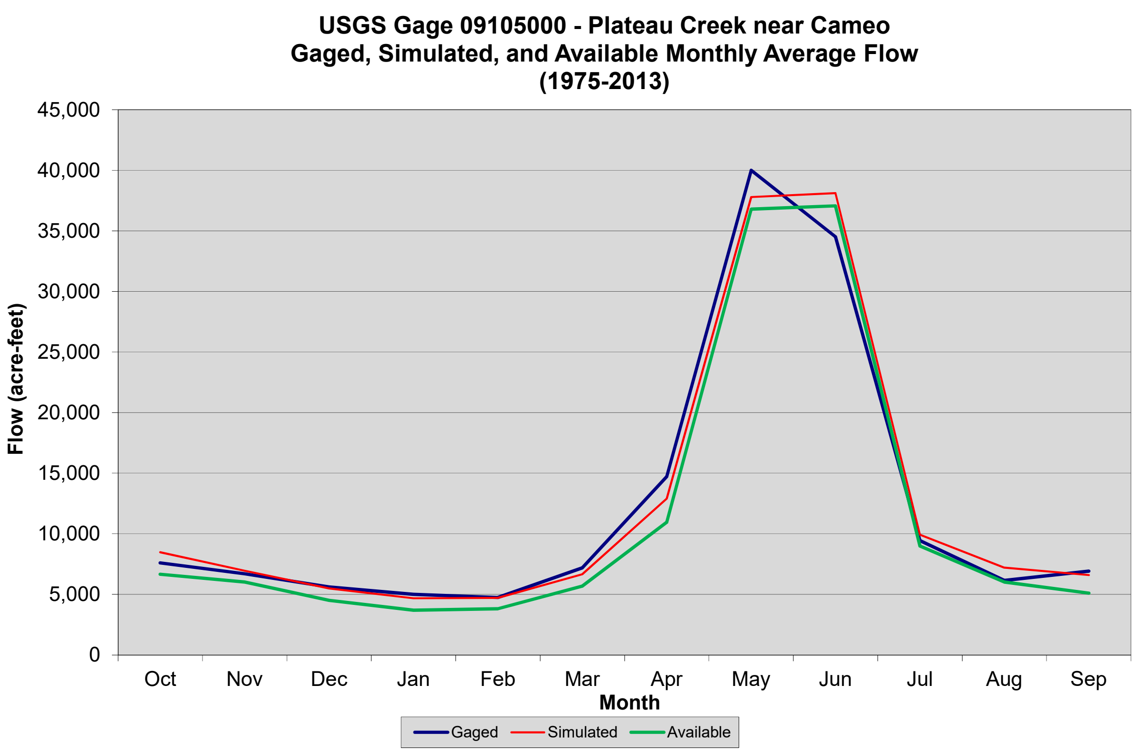
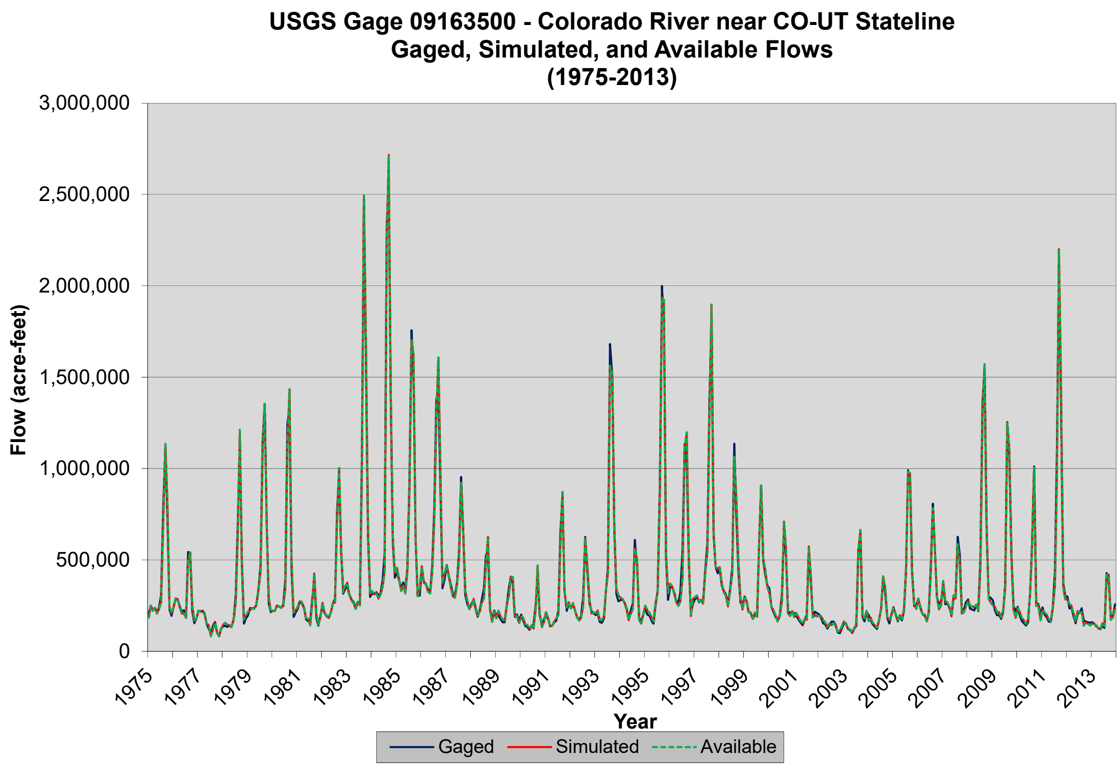


Figure 6.13 Baseline Results – Plateau Creek near Cameo



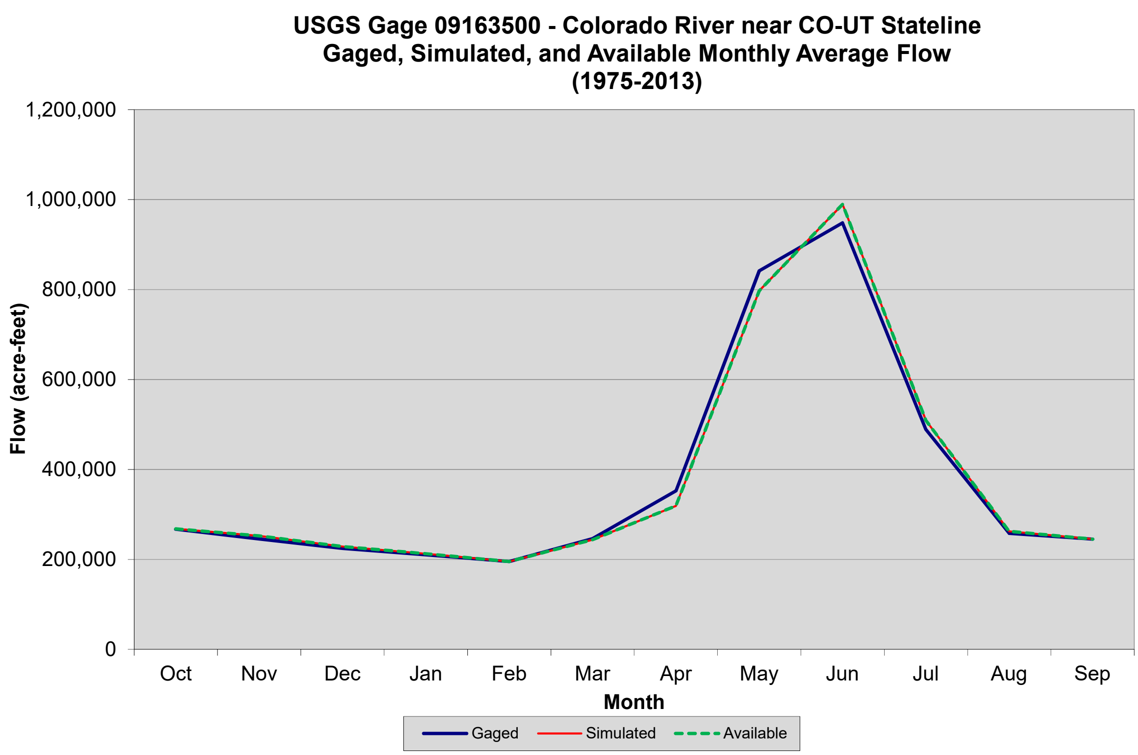


Figure 6.14 Baseline Results – Colorado River near Colorado-Utah State Line

7. Calibration

Calibration is the process of executing the model under historical conditions, and modifying estimated parameters to improve agreement between the model results and the historical record. This section describes the general approach taken in calibrating the Upper Colorado River Model. It describes specific areas of the basin that were revised during calibration, and it presents summaries comparing modeled results for 1975 through 2013 with historical values for the period.

7.1 Calibration Process

The Upper Colorado River Model was calibrated in a two-step process, based on the period 1975 through 2013. In the first step, demands were set to historical diversions, and reservoir levels were constrained to their historical levels. Reservoir storage was limited to the historical monthly content for each month. Reservoirs released water upon demand, but if the demand-driven operations left more water in a reservoir than it had historically, the model released enough water to the stream to achieve its historical end-of-month contents. In this step, the basic hydrology was assessed and baseflow distribution parameters and return flow characteristics were modified.

Reviewing the model run consisted of comparing simulated gage flows with historical flows, and determining where and why diversion shortages occurred. For example, a shortage might occur because a user’s water right was limiting. But it might also occur because water is physically unavailable or the water right is called out. In this typical calibration problem, there may be too little baseflow in a tributary reach to support historical levels of diversion in the model. Gains may not be modeled as entering the system until the next downstream gage, bypassing the shorted structures. Because the historical diversion and consumption did not occur, the model then overestimates flow at the downstream gage. Baseflow distribution parameters can be adjusted such that more water entered the system within the tributary, and typically, incremental inflow below the tributary is then reduced. The first step of calibration might also expose errors such as incorrect placement of a gage, or incorrect treatment of imports.

In the second step, reservoirs responded to demands and were permitted to seek the level required to meet the demands. Model results were again reviewed, this time focusing on the operations. For example, operating criteria in the form of monthly targets might be added for reservoirs that operate for un-modeled reasons such as flood control, hydropower generation, or winter maintenance. As another example, where reservoir history revealed that annual administration was not strictly observed, the annual administration feature was removed.

The model at the conclusion of the second step is considered the calibrated model. Note that the model is calibrated on a basin-wide level, concentrating on gage and reservoir locations. When using this model for future analyses involving smaller areas of the basin, it is recommended that further stream flow evaluations be conducted. A refined calibration will improve results of local analyses.

7.2 Historical Data Set

Calibration is based on supplying input that represents historical conditions, so that resulting gage and diversion values can be compared with historical records. This data set is referred to as the "Historic data set", and it is important to understand how it differs from the Baseline data set described in Section 5.

7.2.1. Demand File

A primary difference in data sets is the representation of demands (*.ddm). For calibration, both irrigation and non-irrigation demands were set to historical diversions; to the extent they were known. Gaps in the diversion records were filled using the automatic data filling algorithm described in Section 4.4.2. This demand reflects both limitations in the water supply and the vagaries of operations that cannot be predicted – headgate maintenance, dry-up periods, and so on.

Demands for irrigation multistructures and multiple node projects were placed at the point of diversion. For example, the demands for the Fraser River Diversion Project (Moffat Tunnel) demands, Fryingpan-Arkansas Project, and Ute Water Conservancy District were placed at the individual tributary nodes rather than the summary node for the Historic data set. In the Baseline data set, the combined demands are placed at the summary node, and operating rules drive the diversions from the individual headgates.

7.2.2. Direct Diversion Right File

In general, the direct diversion right file is the same between the Historical and Baseline data sets. However, in the Baseline data set, the water rights associated with the Mason and Eddy Ditch irrigation structure (7200766_I) were turned off since the associated rights have not been used for irrigation since 1984.

7.2.3. Irrigation Water Requirement File

Irrigation water requirement file (*.iwr) for the Historic data set is based on historical irrigated acreage, whereas the Baseline irrigation water requirement is based on the 2010 irrigated acreage. Differences occur at structures that came on-line during the study period, or significantly increased or decreased acreage during the study period.

7.2.4. Instream Flow Monthly Demand File

Instream flow monthly demand file (*.ifm) for the Historic data set demands are limited to historical periods of operation, whereas Baseline demands are set for the entire study period. Another difference between the Historic and Baseline data sets is the representation of the releases from Green Mountain to the Shoshone power plant. In the Historic data set prior to

1985, releases from Green Mountain Reservoir where made to the Shoshone Minimum Flow node (5300584P) when there was insufficient flow in the river to meet Shoshone's senior right's historical demands. In the Baseline data set the Shoshone Minimum Flow demand was set to zero, and releases are made to individual HUP recipients. See Section 5.9.2 for more information.

7.2.5. Reservoir Station File and Reservoir Target File

In the Historic data set, reservoirs are inactive prior to commencement of their historical operations. Initial contents in the reservoir file (*.res) were set to their historical end-of-month content in September, 1908, and storage targets (*.tar file) were set to zero until the reservoir historically began to fill. Reservoir rights are on for the entire study period with the exception of Green Mountain's rights, which are on from 1943 forward. The date was based on the first year diversions to storage occurred at Green Mountain Reservoir. The date was required due to accounting of bypassed water against the first fill right, in accordance with the Interim Policy and the Blue River Decree.

In the first calibration step, maximum storage targets were set to historical end-of-month contents. In the second calibration step maximum reservoir storage targets were set to capacity for reservoirs that operated primarily for agricultural and municipal purposes. Maximum targets were set to operational targets according to rule curves provided by USBR for Green Mountain, Ruedi, and Willow Creek reservoirs; Denver provided a rule curve for Williams Fork reservoir; and a rule curve was developed for the Continental Hoosier Upper Blue Lakes reservoir based on historical operations. If capacity of a reservoir changed midway through the study period, the Historic model accounts for the enlargement (not applicable in the Upper Colorado River Model).

In the Baseline data set initial reservoir storage was set to average end-of-month content, reservoir rights are on the entire study period, and maximum targets were set similar to the second calibration step for the entire study period.

7.2.6. Reservoir Right File

The reservoir right file (*.rer) contains data associated to each reservoir's water rights. In general, this file is the same for both the Historical and Baseline data sets; however, there are two differences between the data sets. For the Historical data set, the water rights associated with Green Mountain turn on in 1943 when the reservoir first came on-line. In the Baseline data set, these rights remain on for the entire study period.

Additionally, the water rights associated with Wolford Mountain reservoir differ between the Historical and Baseline data sets to reflect the historical 15-Mile Reach operations and the current operations that were implemented in 2013. See Section 5.9.19 for more detailed information.

7.2.7. Operational Rights File

The reservoir storage target file (*.tar) and the operating rules file (*.opr) work together to constrain reservoir operations in the first calibration step. The operational rights file includes rules to release water that remains in the reservoir above historical levels (specified in the target file) after demand-driven releases are made. In the second calibration step, release-to-target rules in the *.opr file remain on, but do not fire for most reservoirs, as targets were set to capacity. The exceptions are noted above in Section 7.2.5. Section 5.9 describes each operating rule used in the Baseline and Historic simulations.

Differences between the Baseline data set and the Historic data set are summarized in Table 7.1.

Table 7.1
Comparison of Baseline and Historical (Calibration) Files

Input File	Baseline Data Set	Historic Data Set
Diversion demand (*.ddm)	▪ Irrigation structures – "Calculated" demand for full supply, based on crop requirements and historical efficiency ▪ Non-irrigation structures – estimated current demand ▪ Demands placed on primary structures of multistructure systems and demands placed at use location for carrier systems	▪ Historical diversions ▪ Historical diversions for multistructures, Fraser River Diversion Project structures, Fryingpan-Arkansas Project structures, and Ute Water Conservancy District structures were set at individual diversion headgates
Direct diversion right (*.ddr)	▪ Mason and Eddy Ditch (720766_I) water rights for irrigation are turned off.	▪ Mason and Eddy Ditch (720766_I) water rights for irrigation are turned on.
Irrigation water requirement (*.iwr)	▪ Calculated using 2010 irrigated acreage	▪ Calculated using historical irrigated acreage
Instream flow monthly demand (*.ifm)	▪ Demands were set for the entire study period. Shoshone Minimum Flow demands were set to zero	▪ Demands were limited to historical operations, Shoshone Call Flows were set to Shoshone's senior right's historical operations prior to 1985
Reservoir station (*.res)	▪ Initial content = average end-of-month content	▪ Initial content = September 1908 end-of-month content, 0 if prior to construction
Reservoir target (*.tar)	▪ Current maximum capacity except reservoirs that release for flood control or hydropower generation	▪ First step – historical eom contents, 0 prior to construction ▪ Second step – historical maximum capacity except reservoirs that release for flood control or hydropower generation, 0 prior to construction
Reservoir rights (*.rer)	▪ Green Mountain Reservoir's first fill right on for the entire study period	▪ Green Mountain Reservoir's first fill right on from 1943 forward due to accounting for bypassed water under the Interim Policy administration of the Blue River Decree
Operational right (*.opr)	▪ Operating rules drive diversions to demand destination through multistructure and carrier structures ▪ Reservoir releases were made to irrigation structures to satisfy headgate demands only if crop irrigation water requirements were not met by other sources.	▪ Release-to-target operations allowed reservoirs to release to target contents ▪ Step 1 calibration, reservoir releases were made to irrigation structures to satisfy headgate demands regardless if crop irrigation water requirements were met.

7.3 Calibration Issues

This section describes areas of the model that were investigated in the various calibration efforts of the Upper Colorado River Model.

7.3.1. General Reservoir Enhancements

In previous model updates, reservoirs without refill rights were assigned a free river water right to store during high flow periods. Water stored during these periods still count towards the reservoirs' one-fill rules, if applicable. These free rights were assigned junior administration numbers of 99999.99999. Calibration was improved in wet years.

7.3.2. Aggregated Structures

Several revisions have taken place to aggregated structures throughout the modeling process. For this update, irrigated acreage assessments representing 2005 and 2010 were used as the basis for identifying structures that needed to be represented in the model. Aggregated structures were revised to include 100 percent of the irrigated acreage based on both the 2005 and 2010 assessments. The update also included the development of "no diversion" aggregates—groups of structures that have been assigned acreage but do not have current diversion records. "No diversion" aggregates are included in StateCU in order to capture 100 percent of irrigated acreage. However, they were not included in the StateMod modeling effort. Because the individual structures included in these aggregates do not have current diversion records, their effect on the stream cannot be accounted for in the development of natural flows. Therefore, it is appropriate that their diversions also not be included in simulation. The individual structures in the "no diversion" aggregates generally irrigate minimal acreage, often with spring water as a source. There is an assumption that the use will not change in future "what-if" modeling scenarios. For additional details on the development of aggregated structures, refer to the Upper Colorado River StateCU User's Manual 2015.

7.3.3. Baseflows

In previous model updates, significant effort was taken to accurately calculate baseflows at streamflow gages and then distribute the baseflow gains to upstream locations. Negative baseflows were calculated when too much water was "removed" or not enough water was "added" to historical streamflow gages. In the historical calibration simulation, this resulted in areas where simulated gage flows were high because negative baseflows were set to zero. The total amount of water in the system was not conserved. In areas where negative baseflows were calculated during the period of available diversion records, the amount of return flows that accrued upstream of a gage were revised. Overall, the amount of negative baseflows was reduced by more than 50 percent in the recent model update.

Most baseflow gains realized at stream gages were distributed to ungaged locations using the "gain approach," where the gain between gages was distributed upstream based on an area/precipitation pro ration. This approach did not work well for ungaged tributaries that have relatively small flow compared to the downstream gaged data. The "neighboring gage" approach distributes a percentage of actual baseflow (not gain) from a gaged location to upstream ungaged tributaries. Thirty-two baseflow nodes were assigned the "neighboring gage" approach during the recent model update. Many of these baseflow locations were tributary to Plateau Creek and the Roaring Fork. This reduced negative baseflows and resulted in better calibration of simulated versus historical diversions on the smaller ungaged tributaries.

7.3.4. Upper Mainstem

Additional Granby Reservoir end-of-month data not used in previous modeling efforts was identified. In addition, the USBR provided Willow Creek Reservoir operational data for the previously missing time period of 1983 through 2004. These additional data were included to estimate baseflows in the upper portion of the Colorado River basin. Overall calibration improved at Granby Reservoir, Willow Creek Reservoir, and downstream gages.

7.3.5. Blue River

In previous model updates, significant updates to StateMod were tested in the implementation of the Interim Policy of the Blue River Decree. Operations of the Interim Policy were updated based on meetings with Denver Water, USBR, and conversations with the Division Engineer. See Section 5.18 for details of the Blue River Decree, Interim Policy, and the associated operating rules.

Historical diversions at the Green Mountain Reservoir Hydropower Plant were included in the Historic simulation and improved the call regime on the Blue River. Specifically, the simulated end-of-month contents in Dillon Reservoir more closely matched historical contents.

The Hoagland Canal diverts water from Elliott Creek, Martin Creek, Deep Creek and several other tributaries to the Blue River. In Phase II, this canal was modeled as a multi-structure with the primary demand on Elliott Creek. Historical diversions at Hoagland Canal were assigned to carrier structures on Martin Creek (3600946) and Deep Creek (3601018) according to their water right. However, since several of the tributaries which contribute water to the canal were not modeled, the canal was shorted by a large amount in all simulations. Therefore, the canal "headgate" was moved onto the mainstem of the Blue River, below the location of all the contributing tributaries, and modeled as a diversion system. The historical records for the Hoagland Canal (3600662_D) were not disaggregated, and the secondary structures' water rights were assigned to 3600662_D.

Operating rules for Clinton Gulch Reservoir were added to the Upper Colorado River Model based on previous model documentation.

7.3.6. Silt Project

Silt Project operations were reviewed and updated. Demands for the two irrigation structures, Dry Elk Valley Irrigation (3900563_I) and Farmers Irrigation Company (3903505_I), were revised based on percent allocation provided by the operators, diversions through Grass Valley Canal (3900563), diversions through the Silt Pump Canal (3900663), and estimated releases from Grass Valley Reservoir (3903505). See Section 5.9.11 for operational enhancements.

7.3.7. Roaring Fork

Ruedi Reservoir was not operating correctly prior to calibration due to the account priority changes made during Task Order LR-2. In previous model updates, this was corrected by giving all accounts equal priorities for storage.

Previously, Hunter Creek (3801594) diversions were separated from the Boustead north and south collection system (3804625) diversions for the Historical simulation. A Boustead Summary node (3804625SU) was added above the Boustead north and south collection node to simulate the total Boustead Tunnel demand for the baseline scenario. Operating rules were added to deliver water from the Hunter node and the Boustead north and south collection system node to the summary node. The Hunter Creek water right was corrected to account for the sum of decrees for the multiple collection systems (No Name, Midway, and Hunter Creeks), and the Boustead Tunnel capacity was increased from 945 to 1,000 cfs to represent actual capacity.

7.3.8. Plateau Creek

The Phase II consumptive use analysis used a combination of climate data from the Grand Valley area (Grand Junction and Fruita) and the town of Collbran. The average annual rainfall for the two Grand Valley climate stations is approximately 9 inches; however, the station in Collbran averages 13.7 inches. There is also a large difference in average temperature between the stations. Structures in the Plateau Creek Basin were re-assigned this County-HUC, which resulted in more representative crop irrigation requirements.

In Phase II, only about one-half of the structures were tied to Vega's Project account. Based on information from the area water commissioners, additional explicit and aggregate structures were given operating rules to receive water from Vega's Project account. These structures are served by Southside Canal, either by releases from the canal directly, releases from the canal to the tributaries or, by exchange for structures above the canal.

In previous model updates, Leon Creek Aggregated Reservoir was added at the headwaters of Leon Creek to represent supplemental water to Leon Tunnel Canal (7204715). An operating rule with an administration number of 22995.18426 was added to allow 7204715 to receive water from this reservoir. This aggregated reservoir was made a baseflow node.

Additionally, in previous model updates, Hunter Creek Aggregated Reservoir (7203842) was added to the model and operating rules to allow the Kiggins Salisbury Ditch (7200730_D) and Leon Ditch (7200744) structures to receive water from the reservoir were added to the model.

The USBR provided daily data for the Vega Reservoir feeders and for releases to the South Side Canal and Galbraith Ditch for the period 1974 through 2002. This data was used to supplement records available in HydroBase.

Numerous aggregated structures (72_ADC056, 72_ADC057, 72_ADC059, 72_ADC060, 72_ADC061, 72_ADC062, and 72_ADC063) were moved from Plateau Creek to their respective tributaries. This change increased the demand on the Collbran Project, specifically Vega Reservoir via South Side Canal operations, and more closely represented the historical project operations.

Gages 09101500 (Bull Creek at Upper Station) and 09104000 (Coon Creek near Mesa) were changed from gage nodes to other baseflow nodes. These gages had relatively short periods of record that preceeded the calibration period. The filled stream flow data created calibration problems. The gage locations were left in the model as other nodes and are used to check baseflow distributions during calibration.

Ute Water Conservancy District diversion data and operations were updated based on conversations with District personnel and the Water Commissioner.

7.3.9. 15-Mile Reach Endangered Fish Flows

The 15-Mile reach demands and reservoir operations were added and revised based on meetings with the CWCB. Previously, the fish demand nodes had been modeled as instream flow structures. In this update, fish demand instream flows were consolidated into a fish demand diversion node. Because of the recovery project agreement to deliver reservoir water to the 15-Mile reach, discussed in Section 5.9.19, future depletions can occur without the fish demand calling for the water. Therefore, to assure that water available for future growth is accurately reflected, this demand does not have a water right and is only met from reservoir releases.

7.4 Calibration Results

Calibration of the Upper Colorado River Model is considered very good, with most streamflow gages deviating less than one percent from historical values on an average annual basis. Over half the diversion structures' shortages are at or below 2 percent on an annual basis, and the basin wide shortage is around 2 percent per year, on average. Simulated reservoir contents are representative of historical values.

7.4.1. Water Balance

Table 7.2 summarizes the water balance for the Upper Colorado River Model, for the calibration period (1975-2013). The following are observations based on the summary table:

- Stream water inflow to the basin averages nearly 5.6 million acre-feet per year, and stream water outflow averages 4.53 million acre-feet per year.
- Annual diversions amount to approximately 4.63 million acre-feet on average, indicating that there is extensive re-diversion of return flows in the basin.
- Approximately 1.02 million acre-feet per year are consumed.
- The column labeled "Inflow – Outflow" represents the net result of gain (inflow, return flows, and negative change in reservoir and soil moisture contents) less outflow terms (diversions, outflow, evaporation, and positive changes in storage), and indicates that the model correctly conserves mass.

Table 7.2
Average Annual Water Balance for Calibrated Upper Colorado River Model 1975-2013
(acre-feet/year)

Month	Stream Inflow	Return	From Soil Moisture	Total Inflow	Diversions	Resvr Evap	Stream Outflow	Resvr Change	To Soil Moisture	Soil Moisture Change	Total Outflow	Inflow - Outflow	CU
OCT	265,341	345,615	1,151	612,106	383,161	2,002	265,765	-39,973	2,252	-1,102	612,106	0	41,477
NOV	193,596	194,553	86	388,235	172,204	438	249,772	-34,265	904	-819	388,235	0	23,345
DEC	181,326	216,560	0	397,885	213,164	-983	227,835	-42,132	747	-747	397,885	0	30,128
JAN	175,544	201,068	0	376,612	208,820	-950	214,999	-46,258	569	-569	376,612	0	32,061
FEB	169,222	178,049	0	347,271	188,816	156	198,829	-40,529	451	-451	347,271	0	28,700
MAR	228,764	204,158	6,96	433,618	229,665	1,185	260,131	-58,058	680	17	433,618	0	33,796
APR	412,378	241,462	2,088	655,928	306,005	2,511	334,366	10,958	3,719	-1,631	655,928	0	47,174
MAY	1,181,163	356,876	3,651	1,541,690	551,432	5,923	816,287	164,398	11,555	-7,904	1,541,690	0	134,573
JUN	1,456,980	451,292	4,179	1,912,451	746,974	8,526	978,683	174,089	7,412	-3,233	1,912,450	1	235,220
JUL	726,129	438,599	9,203	1,173,932	653,054	8,021	500,932	2721	1,017	8,187	1,173,932	0	203,366
AUG	338,179	392,840	7,425	738,443	520,303	5,777	247,999	-43,060	1,088	6,337	738,443	0	131,138
SEP	268,041	379,778	3,556	651,375	456,154	3,726	237,985	-50,045	1,636	1,920	651,375	0	78,966
TOT	5,596,661	3,600,850	32,034	9,229,546	4,629,750	36,332	4,533,582	-2154	32,029	4	9,229,543	2	1,019,944

Note: Consumptive Use (CU) = Diversion (Divert) * Efficiency + Reservoir Evaporation (Evap)

7.4.2. Streamflow Calibration Results

Table 7.3 summarizes the annual average streamflow for water years 1975 through 2013, as estimated in the calibration run. It also shows average annual values of actual gage records for comparison. Both numbers are based only on years for which gage data are complete. Figure 7.1 through Figure 7.14 (at the end of this section) graphically present monthly streamflow estimated by the model compared to historical observations at key streamflow gages, in both time-series format and as scatter graphs. When only one line appears on the time-series graph, it indicates that the simulated and historical results are the same at the scale presented. The goodness of fit is indicated on the scatter plot by the equation for the “best fit” regression line relating simulated to gage values. A perfect fit would be indicated by an equation y = 1.000x.

Calibration based on streamflow simulation for gages is generally very good in terms of both annual volume and monthly pattern. Exceptions include gages below Granby, Green Mountain and Homestake reservoirs due to differences in current operations (as modeled) versus historical operations, hydropower operations, and other non-standard operations. Ranch Creek near Fraser and Vasquez Creek near Winter Park both have large deviations in terms of percentage but are a minor concern based on small total flow volume. Plateau Creek near Collbran deviated from historical gage information possibly due to limited gage data and inadequate understanding of operations. These exceptions do not significantly affect mainstem or major tributary calibration.

Simulation of streamflow on the mainstem of the Colorado River below Granby Reservoir and Willow Creek below Willow Creek Reservoir accurately model annual volume, but the monthly patterns vary from gaged. Calibration has improved in the upper portion of the basin due to a better understanding of the interactions between Willow Creek Reservoir and Feeder Canal, Windy Gap, and Granby Reservoir. However, the lack of gage data on Willow Creek and missing winter gage data on the mainstem of the Colorado River just below Granby Reservoir create unintended impacts on the system when simulating strictly based on operating criteria. Step 1 calibration results, when the reservoirs “release to target” of historical end-of-month contents, are also shown on Figure 7.1 and Figure 7.2.

Simulation of streamflows on Williams Fork below Williams Fork Reservoir and Blue River below Green Mountain Reservoir accurately model annual volume, but the monthly patterns vary from gaged. Williams Fork and Green Mountain Reservoirs are modeled using forecasting curves provided by the Denver Water Board and USBR that are intended to mimic hydropower and other operations. It is clear that the rule curves are used only as guidelines and decisions based on other factors drive actual operations. Because of the large volume of water stored and released from these reservoirs, relatively small deviations from historical reservoir operations result in large deviations in downstream flow. Additionally, the Blue River Decree is being simulated under the current administration outlined in the Interim Policy, which differs from historical administration. Step 1 calibration results—when the reservoirs “release to target"—shown in Figure 7.5 and Figure 7.6 further reinforce the conclusion regarding streamflow gages below these reservoirs.

Table 7.3
Historical and Simulated Average Annual Streamflow Volumes (1975-2013)
Calibration Run
(acre-feet/year)

Gage ID	Historical	Simulated	Historical -Simulated		Gage Name
			Volume	Percent	
09010500	46,878	46,878	0	0%	Colorado R Below Baker Gulch, Nr Grand Lake
09019500	41,849	40,030	1,819	4%	Colorado River Near Granby
09021000	27,492	28,048	-556	-2%	Willow Creek Below Willow Creek Reservoir
09024000	13,542	13,723	-181	-1%	Fraser River at Winter Park
09025000	11,122	14,443	-3,320	-30%	Vasquez Creek at Winter Park, CO.
09026500	15,676	15,703	-27	0%	St. Louis Creek Near Fraser, CO.
09032000	8,938	9,344	-406	-5%	Ranch Creek Near Fraser, CO.
09032499	7,570	7,570	0	0%	Meadow Creek Reservoir Inflow
09032500	20,648	22,928	-2,280	-11%	Ranch Creek Near Tabernash, CO.
09033500	Missing gage data during calibration period				Strawberry Creek Near Granby, CO.
09034250	175,638	177,839	-2,200	-1%	Colorado River at Windy Gap, Near Granby, CO.
09034800	Missing gage data during calibration period				Little Muddy Creek Near Parshall, CO.
09034900	7,544	7,544	0	0%	Bobtail Creek Near Jones Pass, CO.
09035500	13,972	14,043	-71	-1%	Williams Fork Below Steelman Creek, CO.
09036000	73,767	73,838	-71	0%	Williams Fork River Near Leal, Co
09037500	84,066	84,180	-115	0%	Williams Fork River Near Parshall, Co
09038500	97,264	97,038	226	0%	Williams Fork River bl Williams Fork Reservoir
09039000	22,364	22,711	-346	-2%	Troublesome Creek Near Pearmont, CO.
09040000	22,498	22,810	-312	-1%	East Fork Troublesome C Near Troublesome, CO.
09041000	49,395	50,845	-1,450	-3%	Muddy Creek Near Kremmling, CO.
09041200	Missing gage data during calibration period				Red Dirt Creek Near Kremmling, CO.
09041500	66,565	66,145	420	1%	Muddy Creek at Kremmling, CO.
09046600	69,503	69,364	139	0%	Blue River Near Dillon, CO.
09047500	45,154	45,159	-5	0%	Snake River Near Montezuma, CO.
09050100	75,129	75,221	-92	0%	Tenmile Creek Bl North Tenmile Creek at Frisco
09050700	146,064	147,125	-1,062	-1%	Blue River Below Dillon Reservoir
09052800	18,677	18,677	0	0%	Slate Creek at Upper Station, Near Dillon, CO.
09053500	312,567	322,421	-9,855	-3%	Blue River Above Green Mountain Reservoir, CO.
09054000	22,776	22,776	0	0%	Black Creek Below Black Lake, Near Dillon, CO.
09055300	14,558	14,558	0	0%	Cataract Creek Near Kremmling, CO.
09057500	304,217	302,692	1,525	1%	Blue River Below Green Mountain Reservoir
09058000	735,546	739,645	-4,099	-1%	Colorado River Near Kremmling
09060500	24,031	24,031	0	0%	Rock Creek Near Toponas, CO.
09060700	Missing gage data during calibration period				Egeria Creek Near Toponas, CO.
09063000	28,423	28,444	-21	0%	Eagle River at Red Cliff, CO.
09064000	20,352	20,258	94	0%	Homestake Creek at Gold Park, CO.

Gage ID	Historical	Simulated	Historical -Simulated		Gage Name
			Volume	Percent	
09065100	37,450	37,450	0	0%	Cross Creek Near Minturn
09065500	22,109	22,109	0	0%	Gore Creek at Upper Station, Near Minturn, CO.
09067300	Missing gage data during calibration period				Alkali Creek Near Wolcott, CO.
09068000	Missing gage data during calibration period				Brush Creek Near Eagle, CO.
09069500	Missing gage data during calibration period				Gypsum Creek Near Gypsum, CO.
09070000	414,477	414,126	352	0%	Eagle River Below Gypsum
09070500	1,474,478	1,478,971	-4,493	0%	Colorado River Near Dotsero
09071300	9,755	9,755	0	0%	Grizzly Creek Near Glenwood Springs, CO.
09073400	67,955	68,090	-134	0%	Roaring Fork River Near Aspen
09074000	29,607	29,644	-37	0%	Hunter Creek Near Aspen
09074800	31,675	31,675	0	0%	Castle Creek Above Aspen, CO.
09075700	50,076	50,076	0	0%	Maroon Creek Above Aspen, CO.
09078600	75,912	76,663	-751	-1%	Fryingpan River Near Thomasville
09080400	123,774	124,506	-731	-1%	Fryingpan River Near Ruedi
09080800	Missing gage data during calibration period				West Sopris Creek Near Basalt, CO.
09081600	215,584	215,584	0	0%	Crystal River Ab Avalanche Creek Near Redstone
09082800	10,923	10,923	0	0%	North Thompson Creek Near Carbondale, CO.
09084000	Missing gage data during calibration period				Cattle Creek Near Carbondale, CO.
09084600	Missing gage data during calibration period				Fourmile Creek Near Glenwood Springs, CO.
09085000	854,665	856,112	-1,447	0%	Roaring Fork River at Glenwood Springs
09085100	2,388,411	2,394,356	-5,945	0%	Colorado River Below Glenwood Springs
09085200	40,635	40,649	-14	0%	Canyon Creek Above New Castle, CO.
09087500	Missing gage data during calibration period				Elk Creek at New Castle, CO.
09088000	Missing gage data during calibration period				Baldy Creek Near New Castle
09089500	28,725	28,810	-85	0%	West Divide Creek Near Raven
09090700	Missing gage data during calibration period				East Divide Creek Near Silt, CO.
09091500	Missing gage data during calibration period				East Rifle Creek Near Rifle, CO.
09092500	3,591	3,591	0	0%	Beaver Creek Near Rifle
09092600	Missing gage data during calibration period				Battlement Creek Near Parachute
09093500	32,145	32,850	-705	-2%	Parachute Creek at Parachute, CO.
09093700	2,816,135	2,826,130	-9,994	0%	Colorado River Near De Beque
09094200	23,142	23,144	-3	0%	Roan Creek Near Clear Creek, Near De Beque
09095000	38,970	39,708	-738	-2%	Roan Creek Near De Beque, CO.
09095500	2,737,562	2,744,943	-7,380	0%	Colorado River Near Cameo
09096500	22,259	18,910	3,349	15%	Plateau Creek Near Collbran, CO.
09097500	30,447	31,203	-756	-2%	Buzzard Creek Near Collbran
09100500	Missing gage data during calibration period				Cottonwood Creek at Upper Sta, Near Molina
09104500	Missing gage data during calibration period				Mesa Creek Near Mesa, CO.
09105000	148,570	152,454	-3,884	-3%	Plateau Creek Near Cameo
09152500	1,794,354	1,794,352	1	0%	Gunnison River Near Grand Junction
09163500	4,522,322	4,533,583	-11,261	0%	Colorado River Near Colorado-Utah State Line

7.4.3. Diversion Calibration Results

Table 7.4 summarizes the average annual shortage for water years 1975 through 2013, by tributary or sub-basin in Colorado. Table 7.6 (at the end of this section) shows the average annual shortages for water years 1975 through 2013 by structure. On a basin-wide basis, average annual diversions differ from historical diversions by 1.6 percent in the calibration run. Note, the total diversions shown in Table 7.4 and Table 7.6 are not the same as total diversions shown in Table 7.2. Diversions in Table 7.2 include diverted amounts both at carriers and their destination.

- Aggregate nodes may be shorted if the associated structures historically re-diverted other aggregated structures' return flows.
- Aggregate nodes with senior water rights could preempt junior water rights that they could not physically call out due to the placement of the aggregate nodes on mainstem tributaries (See Appendix A).
- Diversions on smaller tributaries without historical streamflow records are often shorted because of a lack of understanding of hydrology.

Table 7.4
Historical and Simulated Average Annual Diversions by Sub-basin (1975-2013)
Calibration Run (acre-feet/year)

Water District - Sub-basin	Historical	Simulated	Historical minus Simulated	
			Volume	Percent
WD 51 – Upper Colorado/Fraser Rivers	405,444	396,956	8,488	2%
WD 50 – Muddy/Troublesome Creeks	79,572	75,628	3,945	5%
WD 36 – Blue River	172,994	168,858	4,136	2%
WD 52 & 53 – Piney/Cottonwood and Tribs North of the Colorado River	787,938	778,390	9,548	1%
WD 37 – Eagle River	113,814	112,848	965	1%
WD 38 – Roaring Fork River	457,974	448,878	9,095	2%
WD 39 – Rifle/Elk/Parachute Creeks	118,575	113,548	5,027	4%
WD 45 and 70 – Divide and Roan Creeks	162,525	155,344	7,181	5%
WD 72 – Lower Colorado River	1,206,002	1,193,508	12,493	1%

7.4.4. Reservoir Calibration Results

Figure 7.15 through

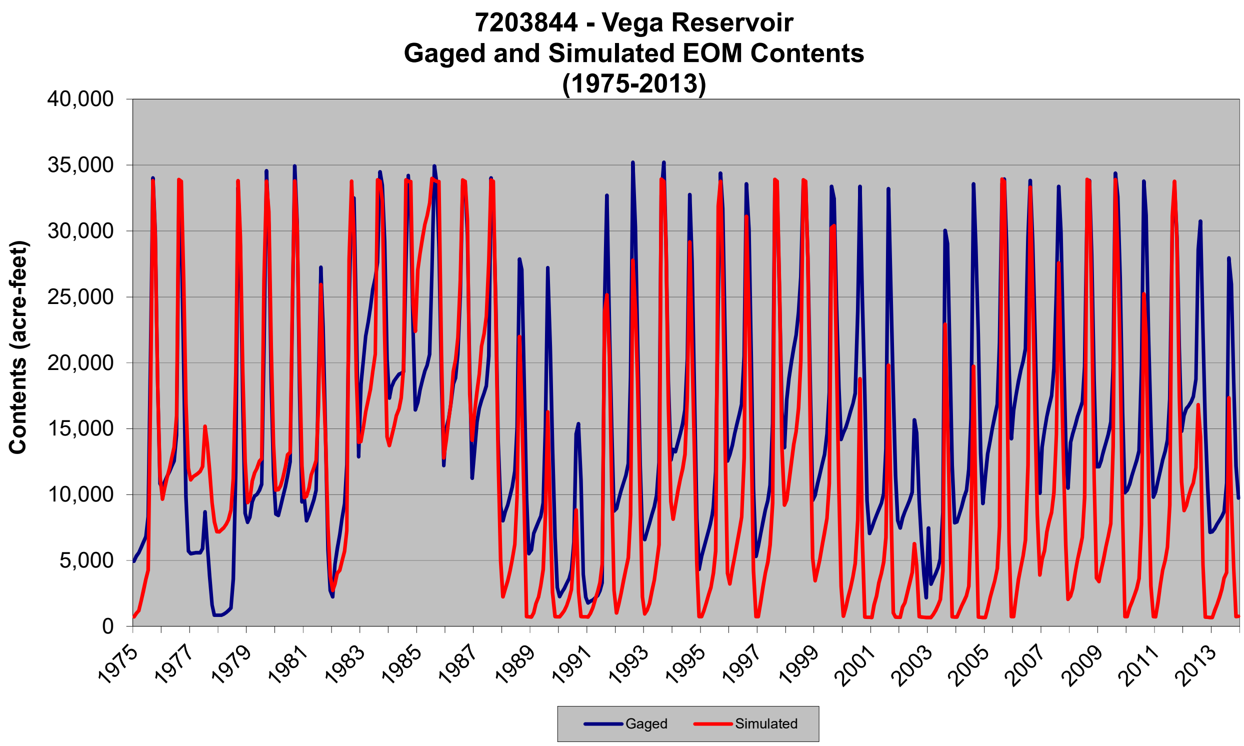


Figure 7.29 (located at the end of this chapter) illustrate reservoir end-of-month contents estimated by the model compared to historical observations at selected reservoirs. The following can be observed:

- Dillon Reservoir did not simulate historical EOM contents for the years 1983 through 1988. During this time, according to Denver Water, maintenance operations required a lower reservoir level; therefore, the flows were bypassed rather than stored.
- Rifle Gap Reservoir simulated end-of-month contents does not match historical estimated contents. A significant effort was made to understand Silt Project operations through discussions with water commissioners and project operators; however calibration of Rifle Gap Reservoir has not improved with additional efforts.
- Green Mountain, Ruedi, Williams Fork, and Willow Creek reservoirs operational targets appear to be general operating guidelines and do not explicitly mimic historical operations.

7.4.5. Consumptive Use Calibration Results

Crop consumptive use is estimated by StateMod and reported in the consumptive use summary file (*.xcu) for each diversion structure in the simulation. This file includes consumptive use for municipal and industrial diversions in addition to agricultural consumptive use. The crop consumptive use estimated by StateCU is reported in the water supply-limited summary file (*.wsl) for each agricultural diversion structure in the basin. Therefore, to provide a one-to-one comparison, only structures in the StateCU analysis are included in the comparison below.

Table 7.5 shows the comparison of StateCU estimated crop consumptive use compared to StateMod estimate of crop consumptive use for explicit structures, aggregate structures, and basin total. As shown, both explicit and aggregate structure consumptive use match StateCU results very well. Historical diversions are used by StateCU to estimate supply-limited (actual) consumptive use.

Table 7.5
Average Annual Crop Consumptive Use Comparison (1975-2013)

Comparison	StateCU Results (af/yr)	Calibration Run Results (af/yr)	% Difference
Explicit Structures	334,009	327,150	2.1%
Aggregate Structures	124,587	121,414	2.5%
Basin Total	458,596	448,564	2.2%

Table 7.6
Historical and Simulated Average Annual Diversions (1975-2013)
Calibration Run
(acre-feet/year)

WDID	Historical	Simulated	Historical - Simulated		Name
			Volume	Percent	
3600507	582	577	5	1%	ALBER DITCH
3600603	741	741	0	0%	ED WARD DITCH
3600606	0	0	0	0%	ELLIOTT CREEK FEEDER[1]
3600642	2,234	1,849	385	17%	MOUNTAIN CANAL
3600645	4,273	3,864	410	10%	GUTHRIE THOMAS DITCH
3600649_D	9,309	8,448	861	9%	HAMILTON DAVIDSON DITCH
3600658	723	673	50	7%	HIGHLINE DITCH
3600660	2,821	2,811	10	0%	HIGH MILLER DITCH
3600662_D	7,941	7,883	58	1%	HOAGLAND CANAL
3600671	2,228	2,085	143	6%	INDEPENDENT BLUE DITCH
3600687	1,279	1,160	119	9%	KIRKWOOD DITCH
3600709	6,189	6,021	168	3%	LOBACK DITCH
3600725	539	503	35	7%	MARY DITCH
3600728	1,021	1,003	19	2%	MAT NO 1 DITCH
3600729	1,207	1,183	24	2%	MAT NO 2 DITCH
3600734	1,064	964	100	9%	MCKAY DITCH
3600765	2,099	2,025	73	3%	PALMER-MCKINLEY DITCH
3600775	791	748	43	5%	PHARO DITCH

WDID	Historical	Simulated	Historical - Simulated		Name
			Volume	Percent	
3600776_D	5,326	4,923	403	8%	PHARO BAUER DITCH
3600780	1,139	1,069	70	6%	PLUNGER DITCH
3600784	853	850	3	0%	RANKIN NO 1 DITCH
3600796	1,496	1,468	28	2%	SAUMS DITCH
3600801	2,932	2,692	240	8%	SMITH DITCH
3600829	664	624	39	6%	STRAIGHT CREEK DITCH
3600832	640	628	12	2%	SUTTON NO 1 DITCH
3600841	1,513	1,440	74	5%	TENMILE DIVERSION NO 1
3600868_D	2,475	2,365	110	4%	WESTLAKE DITCH
3600881	0	0	0	0%	GREEN MTN HYDRO-ELEC [2]
3600908	437	366	71	16%	KEYSTONE SNOWLINE DITCH
3600989	0	0	0	0%	MAGGIE POND (SNOWMAKING) [5]
3601008	1,735	1,387	348	20%	BRECKENRIDGE PIPELINE
3601016	177	163	14	8%	COPPER MTN SNOWMAKING
3604512HU	0	0	0	0%	HUP Release Node [6]
3604626	565	559	6	1%	VIDLER TUNNEL WEST
3604683	0	0	0	0%	CON-HOOSIER SYS BLUE [1]
3604683SU	8,575	8,394	181	2%	CON HOOSIER SUMMARY
3604684	66,404	66,404	0	0%	BLUE RIVER DIVR PROJECT
3604685	103	103	0	0%	BOREAS NO 2 DITCH
3604699	0	0	0	0%	CON-HOOSIER TUNNEL [1]
36GMCON	0	0	0	0%	Grn Mtn Contract Dem [1]
36_ADC017	17,799	17,797	2	0%	UPPER BLUE RIVER
36_ADC018	9,347	9,347	0	0%	BLUE R ABV GRN MTN
36_ADC019	5,382	5,382	0	0%	BLUE R BL GREEN MTN
36_KeyMun	393	360	33	8%	KEYSTONE MUNICIPAL
3700519	1,541	1,349	191	12%	BRAGG NO 1 DITCH
3700539	3,755	3,755	0	0%	CHATFIELD BARTHOLOMEW D
3700545	1,382	1,318	65	5%	C K P DITCH
3700548	2,962	2,915	47	2%	C M STREMME GATES DITCH
3700560	1,775	1,646	129	7%	CREAMERY DITCH
3700561	3,030	3,030	0	0%	DAGGETT AND PARKER DITCH
3700571	2,169	2,084	85	4%	J M DODD DITCH
3700642	4,432	4,395	38	1%	HOLLINGSWORTH DITCH
3700655	1,921	1,921	0	0%	H O R DITCH
3700658	2,184	2,136	48	2%	HOWARD DITCH
3700686	1,876	1,876	0	0%	LOVE AND WHITE DITCH
3700694	2,550	2,542	8	0%	MATHEWS DITCH
3700708	1,812	1,808	4	0%	METCALF DITCH
3700723	1,054	1,049	5	0%	NEILSON SOUTH DITCH
3700743	2,932	2,847	85	3%	ONEILL AND HOLLAND DITCH
3700823	6,636	6,597	38	1%	STRATTON AND CO DITCH
3700830	1,640	1,599	41	3%	TERRELL AND FORD DITCH
3700843	1,210	1,210	0	0%	UPPER FROST DITCH

WDID	Historical	Simulated	Historical - Simulated		Name
			Volume	Percent	
3700848	3,978	3,912	66	2%	WARREN DITCH
3700857	2,368	2,341	27	1%	WILKINSON DITCH
3701146	0	0	0	0%	WOLCOTT PUMPING PIPE [5,7]
3704516HU	0	0	0	0%	HOMESTAKE HUP [6]
3704614	25,558	25,558	0	0%	HOMESTAKE PROJ TUNNEL
3704641	1,545	1,540	4	0%	COLUMBINE DITCH
3704642	1,026	1,011	15	1%	EWING DITCH
3704643	0	0	0	0%	HOMESTAKE PROJ COND [1]
3704648	2,626	2,624	3	0%	WARREN E WURTS DITCH
37VAILIRR	1,429	1,429	0	0%	VAIL VALLEY WATER
37VAILMUN	1,346	1,281	65	5%	VAIL VALLEY WATER-NO
37_ADC029	12,360	12,360	0	0%	EAGLE R ABV BRUSH CK
37_ADC030	10,750	10,750	0	0%	BRUSH CREEK
37_ADC031	5,967	5,967	0	0%	EAGLE R BL GYPSUM
3800516	1,548	1,116	432	28%	ATKINSON DITCH
3800528	8,505	8,433	71	1%	BASIN DITCH
3800545	1,649	1,585	63	4%	BORAM AND WHITE DITCH
3800547	3,772	3,752	20	1%	BOWLES AND HOLLAND DITCH
3800569	1,730	1,700	30	2%	C AND M DITCH
3800572	2,403	2,192	211	9%	CAPITOL FALLS DITCH
3800573	1,449	1,446	3	0%	CAPITOL PARK DITCH
3800574	7,234	7,118	116	2%	CARBONDALE DITCH
3800606	957	947	10	1%	COLLINS CREEK DITCH
3800618	4,989	4,948	42	1%	CRANE AND PEEBLES DITCH
3800639	1,420	1,284	137	10%	DESERT DITCH
3800651	10,042	9,992	50	0%	EAST MESA DITCH
3800659	2,304	2,291	12	1%	ELI CERISE DITCH
3800660	796	791	5	1%	ELK CREEK DITCH
3800663	5,645	5,530	115	2%	ELLA DITCH
3800667	439	367	72	16%	EUREKA NO 1 DITCH
3800688	808	808	0	0%	FOUR MILE DITCH
3800712	13,100	13,043	56	0%	GLENWOOD DITCH
3800715	6,601	6,539	61	1%	GRACE AND SHEHI DITCH
3800720	3,212	3,159	53	2%	GREEN MEADOW DITCH
3800740	5,151	5,108	43	1%	HARRIS & REED DITCH
3800749	2,944	2,828	117	4%	HERRICK DITCH
3800755	3,634	3,559	75	2%	HOLDEN DITCH
3800757	18,607	18,543	64	0%	HOME SUPPLY DITCH
3800798	1,250	1,235	14	1%	KELSO DITCH
3800800	4,314	4,216	98	2%	KESTER DITCH
3800822	274	199	75	27%	LIGNITE DITCH
3800838	1,404	1,382	22	2%	LOWER DITCH
3800840	11,236	11,153	84	1%	LOWLINE DITCH
3800854	4,143	4,029	114	3%	MAROON DITCH

WDID	Historical	Simulated	Historical - Simulated		Name
			Volume	Percent	
3800861	1,189	1,132	57	5%	MAURIN DITCH
3800869	4,914	4,914	0	0%	MIDLAND FLUME DITCH
3800879	755	750	6	1%	MONARCH DITCH
3800880_D	3,704	3,080	625	17%	MOUNT SOPRIS DITCH
3800881	6,106	4,697	1,409	23%	MOUNTAIN MEADOW DITCH
3800890	1,458	1,431	26	2%	MCKENZIE WILDCAT DITCH
3800893	1,673	1,442	231	14%	MCKOWN DITCH
3800902	2,534	2,442	92	4%	NEEDHAM DITCH
3800920	1,721	1,689	32	2%	OXFORD NO 1 DITCH
3800924	1,081	1,068	13	1%	PARADISE DITCH
3800925	3,046	3,044	2	0%	PARK DITCH
3800930	26,002	25,207	795	3%	PATERSON D JACOB EXT
3800939	2,702	2,698	4	0%	PIONEER DITCH
3800959	2,660	2,587	73	3%	RED ROCK BLUFF DITCH
3800966	4,049	3,979	70	2%	ROBERTSON DITCH
3800968	13,820	13,741	79	1%	ROBINSON DITCH
3800970	7,424	7,352	72	1%	ROCKFORD DITCH
3800981	6,811	6,793	18	0%	SALVATION DITCH
3800989	855	798	58	7%	SHIPPEE DITCH
3800994	906	782	124	14%	SLOSS DITCH
3800996	7,072	7,055	17	0%	SLOUGH D AND BANNING
3801012	2,732	2,701	31	1%	SNOWMASS DIVIDE DITCH
3801018	4,201	3,979	223	5%	SOUTHARD AND CAVANAUGH
3801038	13,149	13,076	73	1%	SWEET JESSUP CANAL
3801052	973	914	58	6%	CARBONDALE WTR SYS & PL
3801062	3,277	3,261	17	1%	UNION DITCH
3801066	357	357	1	0%	VAN CLEVE NO 1 DITCH
3801073	4,932	4,911	21	0%	WACO DITCH
3801078	4,861	4,474	387	8%	WALKER WONDER DITCH
3801082	3,043	2,537	506	17%	WEAVER AND LEONHARDY
3801096_D	2,022	1,968	53	3%	WILLIAMS NO 2 DITCH
3801101	2,001	1,973	28	1%	WILLOW CREEK DITCH
3801104	754	754	0	0%	WILLOW AND OWL DITCH
3801121	1,028	1,025	3	0%	ALEXIS ARBANEY DITCH
3801132	1,689	1,684	5	0%	WALTHEN DITCH
3801147	4,907	4,779	128	3%	KAISER AND SIEVERS DITCH
3801441	1,493	1,493	0	0%	E SNOWMASS BRUSH C PL
3801481	536	510	25	5%	VAN CLEVE-FISHER FDR D
3801594	10,310	10,274	37	0%	FRY ARK PR HUNTER TUNNEL
3801661	858	824	34	4%	SALVATION DITCH EXT
3801790	3,972	3,857	114	3%	RED MOUNTAIN EXT DITCH
3803713I1	0	0	0	0%	RUEDI RND 1 IND DEM [7]
3803713I2	0	0	0	0%	RUEDI_RND 2.IND DEMA [7]
3803713M1	0	0	0	0%	RUEDI RND 1 MUN DEM [7]

WDID	Historical	Simulated	Historical - Simulated		Name
			Volume	Percent	
3803713M2	0	0	0	0%	RUEDI RND 2 MUN DEM [7]
3803713M3	0	0	0	0%	RUEDI ADD'L DEMAND [7]
3804613	5,053	5,052	1	0%	IVANHOE RESERVOIR TUNNEL
3804617	40,780	40,645	134	0%	IND P TM DVR TUNNEL
3804625	41,286	40,536	750	2%	FRY ARK PR BOUSTEAD
3804625SU	0	0	0	0%	BOUSTEAD SUMMARY [8]
3804717	0	0	0	0%	WEST THREE MILE DITCH [1]
38_ADC033	9,772	9,772	0	0%	UPPER ROARING FORK
38_ADC034	15,399	15,377	22	0%	SNOWMASS CREEK
38_ADC035	5,427	5,427	0	0%	FRYING PAN RIVER
38_ADC036	7,785	7,785	0	0%	WEST SOPRIS CREEK
38_ADC037	19,977	19,598	379	2%	ROARING FK ABV CRYST
38_ADC038	6,322	6,322	0	0%	CRYSTAL CREEK
38_ADC039	5,713	5,713	0	0%	CATTLE CREEK
38_ADC040	1,327	1,327	0	0%	LOWER ROARING FORK
3900532	2,182	2,182	0	0%	CLOUGH NO 1 DITCH
3900537	1,318	1,159	159	12%	CORNELL DITCH
3900539	1,894	1,890	4	0%	CORYELL DITCH
3900540	1,244	907	337	27%	CORYELL JOINT STOCK IRR
3900546_D	891	446	445	50%	DAVENPORT DITCH
3900547	1,484	1,484	0	0%	DAVIE DITCH
3900548	1,936	1,928	8	0%	DEWEESE DITCH
3900562	1,766	673	1,093	62%	GRANLEE DITCH
3900563	14,449	18,652	-4,203	-29%	GRASS VALLEY CANAL [1]
3900563_I	0	0	0	0%	DRY ELK VALLEY IRR [9]
3900574	6,019	6,019	0	0%	GRAND TUNNEL DITCH
3900585	1,080	1,073	8	1%	HIBSCHLE BENBOW DITCH
3900590	1,666	646	1,020	61%	JANGLE DITCH
3900610	3,383	2,051	1,332	39%	LOW COST DITCH
3900612	16,053	16,053	0	0%	LOWER CACTUS VALLEY
3900635	1,570	785	785	50%	PARACHUTE DITCH
3900638	771	760	11	1%	PIERSON AND HARRIS DITCH
3900645	9,190	9,081	109	1%	RIFLE CREEK CANON DITCH
3900663	3,180	175	3,005	94%	SILT PUMP CANAL [1]
3900672	5,611	5,150	461	8%	THOMPKINS DITCH
3900687	11,382	11,288	93	1%	WARE AND HINDS DITCH
3900701	1,039	1,013	26	3%	RED ROCK DITCH
3900710	0	0	0	0%	DRAGERT PUMP PLNT & PL [1]
3900712	0	0	0	0%	EATON PUMP & PIPELINE [1]
3900728	0	0	0	0%	PUMPING PL UNION OIL [1]
3900825	6,792	6,630	162	2%	WILLIAMS CANAL
3900967	1,471	1,446	25	2%	RIFLE TOWN OF PUMP & PL
3900990	1,405	1,405	0	0%	WEST LAT RIFLE CR CR CANON
3903505_I	0	0	0	0%	FARMERS IRRIGATION CO [9]

WDID	Historical	Simulated	Historical - Simulated		Name
			Volume	Percent	
39_ADC041	14,789	14,641	147	1%	ELK CREEK
39_ADC045	6,009	6,009	0	0%	RIFLE CREEK
4200520	0	0	0	0%	GRAND JCT GUNNISON PL [10]
4200541	0	0	0	0%	REDLANDS POWER CANAL [10]
4200541_I	0	0	0	0%	REDLANDS POWER CANAL IRR [10]
4500514	2,589	2,432	157	6%	BATTLEMENT DITCH
4500572	255	252	3	1%	DOW DITCH
4500576_D	9,205	8,881	324	4%	DIVIDE CREEK HIGHLINE
4500584	1,869	1,523	346	19%	EAST DIVIDE CREEK DITCH
4500616	1,387	723	664	48%	H AND S DITCH
4500632_D	1,533	814	719	47%	HOLMES DITCH
4500635	630	599	31	5%	HUDSON & SULLIVAN DITCH
4500638	1,245	1,136	109	9%	HUNTLEY DITCH
4500648	168	160	8	5%	JOE TAYLOR DITCH
4500668	9,508	9,508	0	0%	LAST CHANCE DITCH
4500675	489	480	8	2%	LOUIS REYNOLDS DITCH
4500685	878	782	97	11%	MAMM CREEK DITCH
4500693_D	2,975	2,866	109	4%	MINEOTA DITCH
4500704	4,310	3,978	332	8%	MULTA-TRINA DITCH
4500705	890	801	89	10%	MURRAY AND YULE DITCH
4500725	4,270	4,052	217	5%	PORTER DITCH
4500743	5,246	5,246	0	0%	RISING SUN DITCH
4500749	424	411	13	3%	RODERICK DITCH
4500788	563	472	91	16%	SYKES AND ALVORD DITCH
4500790	2,195	2,010	185	8%	TALLMADGE AND GIBSON
4500793	1,650	1,555	95	6%	TAUGHENBAUGH DITCH
4500810	765	762	3	0%	WARD & REYNOLDS DITCH
4500818	1,593	1,542	51	3%	WEST DIVIDE CREEK DITCH
4500861	7,183	7,183	0	0%	LARKIN DITCH
4500969	27,116	27,103	13	0%	BLUESTONE VALLEY DITCH
45_ADC042	10,160	10,160	0	0%	COLO BL GARFIELD CK
45_ADC043	5,995	5,995	0	0%	COLO BL DIVIDE CK
45_ADC044	4,452	4,452	0	0%	COLO BL MAMM CK
45_ADC046	2,554	2,554	0	0%	COLO BL BEAVER CK
45_ADC047	4,868	4,868	0	0%	COLOR BL CACHE CK
45_ADC048	10,610	10,610	0	0%	COLO R NR DEBUQUE
5000517	836	816	20	2%	BECKER NO 3 DITCH
5000526	1,323	1,323	0	0%	BLICKLEY DITCH
5000539	1,007	1,006	0	0%	CLIFF DITCH
5000574	2,727	2,695	32	1%	HARDSCRABBLE DITCH
5000576	4,031	3,945	86	2%	HAYPARK CANAL HGT NO 1
5000582	1,508	1,459	49	3%	HERDE DITCH
5000585	835	835	1	0%	HOGBACK DITCH
5000593	5,579	5,215	364	7%	KIRTZ DITCH NO 2

WDID	Historical	Simulated	Historical - Simulated		Name
			Volume	Percent	
5000598	799	679	120	15%	LANDSLIDE DITCH
5000601	1,119	863	256	23%	MARTIN NO 1 DITCH
5000606	4,378	4,167	211	5%	MISSOURI DITCH
5000612	959	926	32	3%	MCELROY NO 1 DITCH
5000613	741	717	24	3%	MCELROY NO 2 DITCH
5000617	3,291	3,139	152	5%	MCMAHON DITCH
5000627	1,038	1,038	0	0%	PASS CREEK DITCH
5000628	1,100	786	314	29%	PICKERING DITCH
5000632	751	751	0	0%	PLEASANT VIEW DITCH
5000653_D	4,518	4,494	23	1%	TOM ENNIS DITCH
5000654	2,996	2,983	13	0%	TROUBLESOME DITCH
5000656	913	911	2	0%	TYLER DITCH
5000731	909	876	32	4%	CLIFF DITCH HGT NO 2
5000734_D	6,967	6,906	62	1%	DEBERARD DITCH
5000744	0	0	0	0%	NORTH MEADOW FEEDER [1]
5003668FR	0	0	0	0%	WOLFORD_FRASER_DEM [7]
5003668HU	0	0	0	0%	HUP RELEASE NODE [6]
5003668MK	0	0	0	0%	WOLFORD_MARKET_DEM [7]
5003668MP	0	0	0	0%	WOLFORD_MIDPARK_DEM [7]
50_ADC012	10,246	10,246	0	0%	TROUBLESOME CREEK
50_ADC013	4,850	2,867	1,983	41%	UPPER MUDDY CK
50_ADC014	6,259	6,202	57	1%	MUDDY CK ABV TYLER D
50_ADC015	2,618	2,614	3	0%	MUDDY CK ABV RED DIR
50_ADC016	2,870	2,869	1	0%	LOWER MUDDY CREEK
50_ADC020	4,403	4,295	108	2%	COLO BL KREMMLING
5100529_D	25,495	25,495	0	0%	BIG LAKE DITCH
5100546	5,743	5,684	59	1%	BUNTE HIGHLINE DITCH
5100585	3,372	3,339	33	1%	COFFEE MCQUEARY DITC
5100594	1,946	1,884	62	3%	CROOKED CREEK DITCH
5100629	1,814	1,763	51	3%	FARRIS SOUTH SIDE DITCH
5100639	0	0	0	0%	FRASER RIVER DIVERSION [1,8]
5100660	662	658	4	1%	GASKILL DITCH
5100686	1,202	1,132	71	6%	GRIFFITH DITCH
5100699	2,316	2,311	5	0%	HAMMOND NO 1 DITCH
5100700	678	678	0	0%	HAMMOND NO 2 DITCH
5100728	3,854	3,024	830	22%	HAMILTON-CABIN CR DITCH
5100763	8,280	8,153	128	2%	KINNEY BARRIGER DITCH
5100788	2,484	2,482	2	0%	LYMAN DITCH
5100810	2,576	2,451	125	5%	MUSGRAVE DITCH
5100826	1,167	986	181	16%	OSTRANDER DITCH
5100829	170	170	0	0%	PEAVEY NO 2 DITCH
5100831	980	971	9	1%	PETERSON DITCH NO 1
5100848	10,672	10,672	0	0%	RED TOP VALLEY DITCH
5100858	265	235	30	11%	ROCK CREEK DITCH

WDID	Historical	Simulated	Historical - Simulated		Name
			Volume	Percent	
5100876	1,620	977	643	40%	SCYBERT DITCH
5100880_D	2,319	2,301	18	1%	SELAK LARRABEE DITCH
5100883	1,712	1,703	10	1%	SHERIFF DITCH (156)
5100893	4,277	4,244	33	1%	SOPHRONIA DAY DITCH
5100924	2,341	1,516	825	35%	SYLVAN DITCH
5100934	991	940	51	5%	TRAIL CREEK DITCH
5100939	1,577	1,529	49	3%	UTE BILL NO 2 DITCH
5100941	4,531	4,432	99	2%	VAIL IRR SYS HGT NO
5100948	1,477	1,465	12	1%	WALDON HOLLOW DITCH
5100958	0	0	0	0%	CBT WILLOW CRK FEEDER [1]
5101070	1,632	1,520	112	7%	HENDERSON MINE WATER
5101148	1,222	1,183	40	3%	THOMPSON PUMP NO 1
5101149	1,425	1,379	46	3%	THOMPSON PUMP NO 2
5101231	2,413	1,862	551	23%	VAIL IRR SYS HGT NO
5101237	0	0	0	0%	WILLIAMS FRK PWR COND [1]
5101269	0	0	0	0%	FRASER RIVER DIVERSION - RANCH CREEK [1,8]
5101309_D	0	0	0	0%	FRASER RIVER DIVR - ST LOUIS CK [1,8]
5101310	0	0	0	0%	FRASER RIVER DIVERSION - VASQUEZ CREEK [1,8]
5103709HU	0	0	0	0%	WF HUP Release [6]
5104601	18,098	18,098	0	0%	GRAND RIVER DITCH
5104603	4,135	4,064	71	2%	WILLIAMS FORK TUNNEL
5104625	708	698	9	1%	BERTHOUD CANAL TUNNEL
5104634	233,602	233,602	0	0%	CBT ALVA B ADAMS TUNNEL
5104655	600	474	127	21%	MOFFAT WATER TUNNEL
5104700	0	0	0	0%	WINDY GAP PUMP PL CNL [1]
51_ADC001	6,001	5,922	78	1%	COLORADO RIVER NR GRANBY
51_ADC002	3,193	3,193	0	0%	WILLOW CREEK
51_ADC003	2,743	2,725	18	1%	RANCH CREEK
51_ADC004	3,753	3,726	27	1%	FRASER CROOKED CK
51_ADC005	6,614	6,614	0	0%	TENMILE CREEK
51_ADC006	3,683	3,672	11	0%	FRASER R AT GRANBY
51_ADC007	5,262	5,262	0	0%	COLO AT HOT SULPHUR
51_ADC008	4,003	4,003	0	0%	COLO ABV WILLIAMS FK
51_ADC009	3,299	3,299	0	0%	UPPER WILLIAMS FK
51_ADC010	2,904	2,897	7	0%	LOWER WILLIAMS FK
51_ADC011	5,634	5,634	0	0%	COLO ABV TROUBLESOME
5200559	889	840	50	6%	GUTZLER DITCH
5200572	694	659	35	5%	HOG EYE DITCH
5200658	1,208	947	261	22%	WILMOT DITCH
5200731	287	287	0	0%	NOTTINGHAM PUMP
52_ADC021	14,447	14,404	43	0%	BLACK TAIL/SHEEPHORN

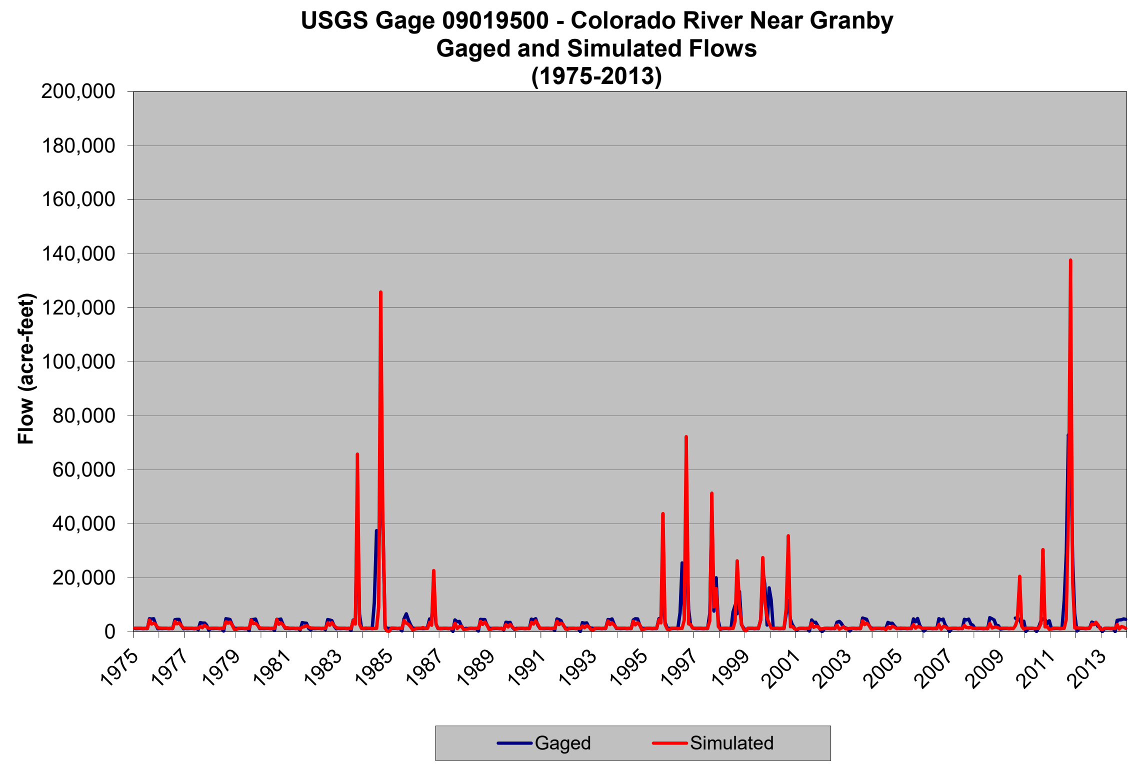
WDID	Historical	Simulated	Historical - Simulated		Name
			Volume	Percent	
52_ADC027	4,517	4,517	0	0%	COLO R ABV DERBY CK
5300555_D	8,511	8,325	186	2%	DERBY DITCH
5300584	689,383	684,036	5,347	1%	SHOSHONE POWER PLANT
5300585	4,761	4,739	21	0%	GLENWOOD L WTR CO SYS
5300621	660	469	191	29%	HIGHWATER DITCH
5300632	377	222	156	41%	HORSE MEADOWS DITCH
5300657	3,422	3,317	105	3%	KAYSER DITCH
5300678	2,127	2,121	6	0%	LION BASIN DITCH
5300767_D	2,462	1,310	1,151	47%	H M S RELOCATED DITCH
5300780	2,907	2,874	33	1%	ROGERS DITCH
5300783	444	199	244	55%	ROYAL FLUSH DITCH
5300800	4,296	4,291	4	0%	SOUTH DERBY DITCH
5300883	2,432	2,109	323	13%	WILSON AND DOLL DITCH
5301051	0	0	0	0%	GLENWOOD L WTR CO SYS [1]
5301082	332	139	193	58%	MACFARLANE DITCH
53_ADC022	2,332	1,710	622	27%	UPPER EGERIA CK
53_ADC023	2,285	1,973	312	14%	KING CREEK
53_ADC024	4,409	4,035	374	8%	EGERIA CK ABV TOPONA
53_ADC025	2,492	2,484	8	0%	TOPONAS CREEK
53_ADC026	5,614	5,614	0	0%	COLO ABV ALKALI CANY
53_ADC028	9,657	9,657	0	0%	DERBY CREEK
53_ADC032	16,994	16,994	0	0%	COLO R ABV GLENWOOD
7000520	0	0	0	0%	CITIES SERVICE PLAN [1]
7000521	3,107	2,751	355	11%	CLEAR CREEK DITCH
7000530	3,127	2,975	153	5%	CREEK AND NEWMAN DIT
7000550	1,648	1,209	438	27%	H V C AND S DITCH
7000558	0	0	0	0%	KOBE CANAL [1]
7000571	487	349	138	28%	NEW HOBO DITCH
7000580	5,505	5,325	181	3%	RESERVOIR DITCH
7000583_D	2,524	2,472	53	2%	ROAN CREEK NO 2 DITCH
7000584	1,749	1,724	25	1%	ROAN CREEK NO 3 DITCH
7000596	1,115	1,017	98	9%	UPPER ROAN CREEK DITCH
70FD1	0	0	0	0%	FUTURE DEPLETION_#1 [7]
70FD2	0	0	0	0%	FUTURE DEPLETION #2 [7]
70_ADC049	12,665	10,590	2,076	16%	UPPER ROAN CREEK
70_ADC050	3,021	3,021	0	0%	COLORADO R NR CAMEO
7200512_D	1,943	1,943	0	0%	ARBOGAST PUMPING PLA
7200514	1,561	1,490	71	5%	ARKANSAS DITCH
7200533	2,837	2,544	292	10%	BERTHOLF LANHAM UPDIKE D
7200542	8,060	9,294	-1,234	-15%	BONHAM BRANCH PL [3]
7200557	430	416	14	3%	BULL BASIN HIGHLINE D
7200558	3,513	2,971	542	15%	BULL CREEK DITCH
7200574	1,824	1,650	174	10%	COAKLEY KIGGINS DITCH
7200580	1,249	1,073	177	14%	COOK DITCH

WDID	Historical	Simulated	Historical - Simulated		Name
			Volume	Percent	
7200583	5,823	4,104	1,719	30%	COTTONWOOD BRANCH PL [3]
7200607	714	693	20	3%	EAKIN-SMITH DITCH
7200616	1,321	1,287	34	3%	NEW ERIE CANAL
7200628	1,313	1,274	40	3%	GALBRAITH DITCH
7200643	1,269	1,200	69	5%	GOLDEN AGE DITCH
7200644	2,238	2,189	49	2%	GRAND JCT COLO R PL
7200645	260,127	259,617	509	0%	GRAND VALLEY CANAL
7200646	781,643	781,934	-291	0%	GRAND VALLEY PROJECT [1,4]
7200646_I	0	0	0	0%	GVP _GRAND VALLEY PJ [9]
7200649	1,754	1,645	109	6%	GROVE CR DITCH CO NO
7200652	376	376	0	0%	GUNDERSON CARTER DITCH
7200703	4,586	4,391	195	4%	HOOSIER DITCH
7200721	753	678	75	10%	JOHNSON AND STUART DITCH
7200729	1,502	1,459	43	3%	KIGGINS GOYN DITCH
7200730_D	1,667	1,661	6	0%	KIGGINS SALISBURY DITCH
7200731	2,899	2,541	358	12%	KING DITCH
7200744	368	368	0	0%	LEON DITCH
7200746	0	0	0	0%	LEON PARK FEEDER CNL [1]
7200764	0	0	0	0%	MARTIN CRAWFORD DITCH [5]
7200764_I	91	90	0	0%	MARTIN CRAWFORD (UWCD)
7200766	0	0	0	0%	MASON EDDY DITCH [5]
7200766_I	334	320	14	4%	MASON EDDY DITCH – I
7200784	5,854	5,590	264	5%	MESA CREEK DITCH
7200799	5,991	5,194	797	13%	MORMON MESA DITCH
7200807	0	0	0	0%	MOLINA POWER PLANT [3]
7200813	0	0	0	0%	ORCHARD MESA IR DV SYS [4]
7200813BP	0	0	0	0%	GVP OMID BYPASS [4]
7200813CH	0	0	0	0%	GVP ORCH MESA CHECK [4]
7200813PP	0	0	0	0%	GVP OMID MECH PUMP [4,1]
7200813PW	0	0	0	0%	GVP _USA POWER PLANT [4,5]
7200816	845	845	0	0%	PALISADE TOWN PL (RAPID)
7200818	4,115	3,403	712	17%	PALMER DITCH
7200820_D	0	0	0	0%	PARK CREEK DITCH [1]
7200821	1,597	1,505	92	6%	PARKER DITCH
7200823	1,497	1,183	314	21%	PARK VIEW DITCH
7200831	2,045	1,720	325	16%	PIONEER OF PLATEAU D
7200852_D	1,105	364	741	67%	RMG DITCH
7200870	3,722	3,373	349	9%	SILVER GAUGE DITCH
7200879	0	0	0	0%	SOUTHSIDE CANAL [1]
7200911	1,207	551	656	54%	TEMS DITCH
7200920	7,722	7,800	-78	-1%	UTE PIPELINE HGT NO 2
7200933	2,846	2,582	263	9%	WEST SIDE DITCH
7200938	4,596	4,118	477	10%	WILDCAT DITCH (BIG CR)
7201233	1,452	1,414	38	3%	UPPER HIGHT DITCH

WDID	Historical	Simulated	Historical - Simulated		Name
			Volume	Percent	
7201329_D	423	390	33	8%	RAPID CREEK PUMPING
7201330	0	0	0	0%	COLORADO R PUMPING P [1]
7201334	880	584	296	34%	CARVER RANCH PIPELINE
7201339	118	45	73	62%	COON CREEK PIPELINE
7201478	0	0	0	0%	GETTY PIPELINE ALT P [1]
7201487	0	534	-534	0%	UTE PIPELINE HGT NO_DIV
7201523	0	0	0	0%	PACIFIC OIL CO PL NO [1]
7201574	335	302	33	10%	CRUM-JOHNSON LATERAL
7202003	0	0	0	0%	MIN FLOW COLORADO R [11]
7202003_M	0	0	0	0%	CO 15-MILE FISH REACH [11]
7204715	1,583	1,583	0	0%	LEON TUNNEL CANAL
7204721	0	0	0	0%	OWENS CREEK DITCH [1]
72_ADC051	1,568	1,531	37	2%	PLATEAU ABV VEGA
72_ADC052	4,014	4,007	7	0%	PLATEAU CK BL VEGA
72_ADC053	6,125	6,065	60	1%	SALT CREEK
72_ADC054	3,100	3,020	80	3%	UPPER BUZZARD CREEK
72_ADC055	4,417	4,417	0	0%	PLATEAU CK BL BUZZARD
72_ADC056	2,931	2,610	321	11%	UPPER GROVE CREEK
72_ADC057	3,832	3,485	347	9%	LOWER GROVE CREEK
72_ADC058	2,987	2,964	23	1%	KIMBALL CREEK
72_ADC059	5,703	5,011	692	12%	BIG CREEK
72_ADC060	7,256	5,931	1,324	18%	COTTONWOOD CREEK
72_ADC061	1,905	1,657	248	13%	BULL CREEK
72_ADC062	3,581	3,255	326	9%	COON CREEK
72_ADC063	3,075	2,712	363	12%	MESA CREEK
72_ADC064	1,570	1,165	406	26%	PLATEAU CK NR CAMEO
72_ADC065	9,206	9,206	0	0%	COLORADO RIVER NR ST
72_AMC001	0	0	0	0%	COLORADORNR [5,7]
72_GJMun	6,603	6,353	250	4%	GRAN GRAND JCT MUNIC
72_UWCD	0	0	0	0%	RAPI UTE WATER TREAT [5]
ChevDem	0	0	0	0%	CHEVRON DEMAND NODE [5,7]
MoffatBF	0	0	0	0%	MOFFAT BASEFLOWS [12]
Basin Total	**3,504,836**	**3,448,075**	**56,761**	**1.6%**	

1) Carrier Structures or Reservoir Feeders
2) Hydropower
3) Molina Power Plant is operated with the demand at the power plant (7200807) but historical diversions were recorded at the two carrier structures (7200542 and 7200583) therefore, historical diversions and simulated diversions are shown at the carrier structures
4) OMID Check, Bypass and Pump are non-consumptive and re-divert returns from the USA Power Plant
5) Municipal/Industrial
6) Demand nodes that allow for release of excess HUP water
7) Future Modeling Node (no demand in Baseline dataset)
8) Basin Export
9) Secondary Structure of a Multi-Structure Irrigation System

10) Gunnison Basin Import
11) Fish demand node or instream flow requirement
12) Node used in baseflow generation diversion to Moffat Tunnel from Meadow Creek Reservoir



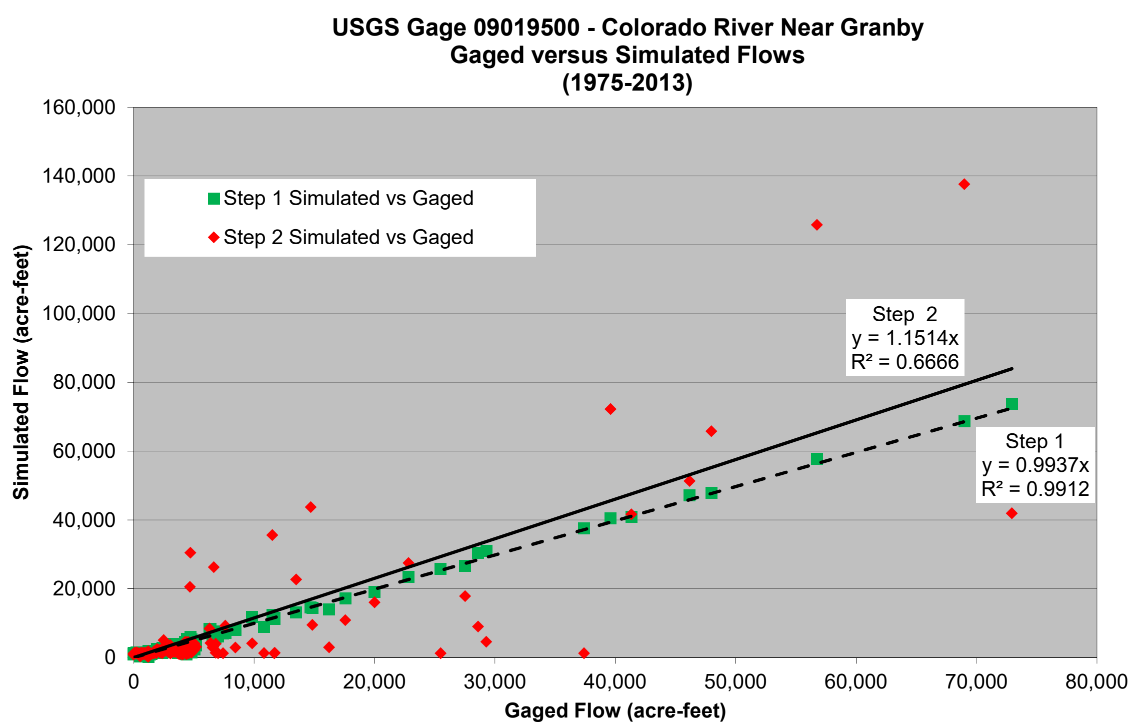
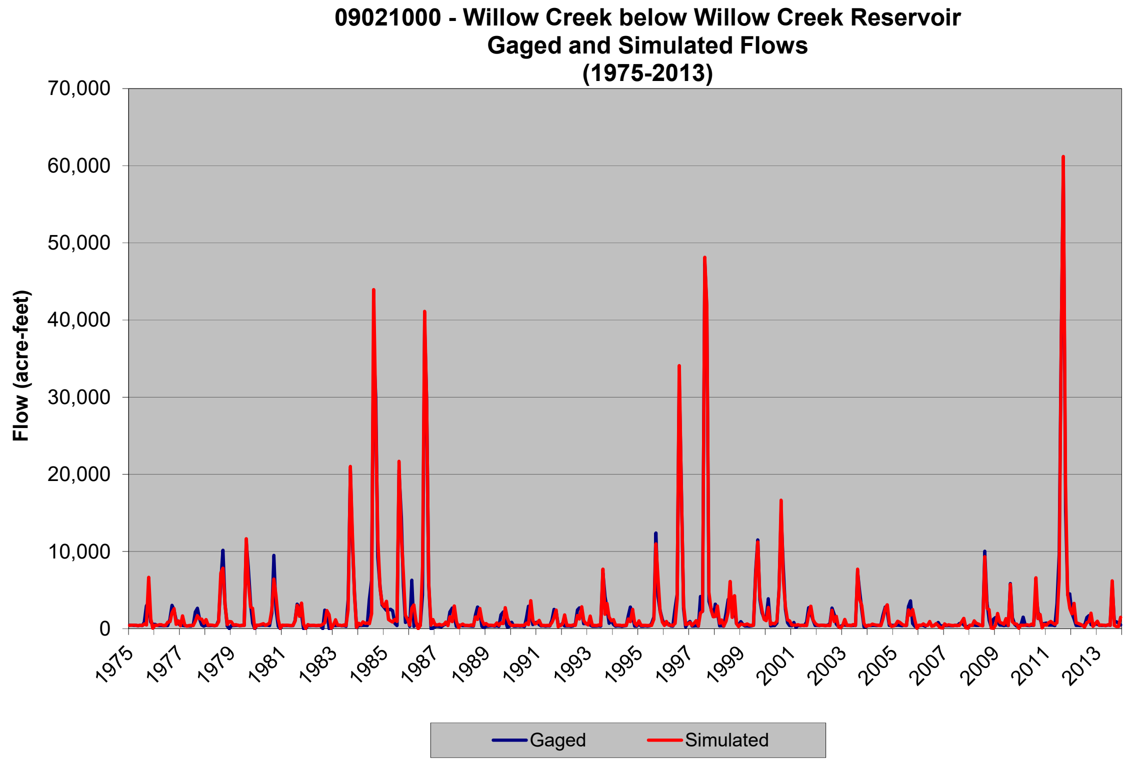


Figure 7.1 Streamflow Calibration – Colorado River near Granby



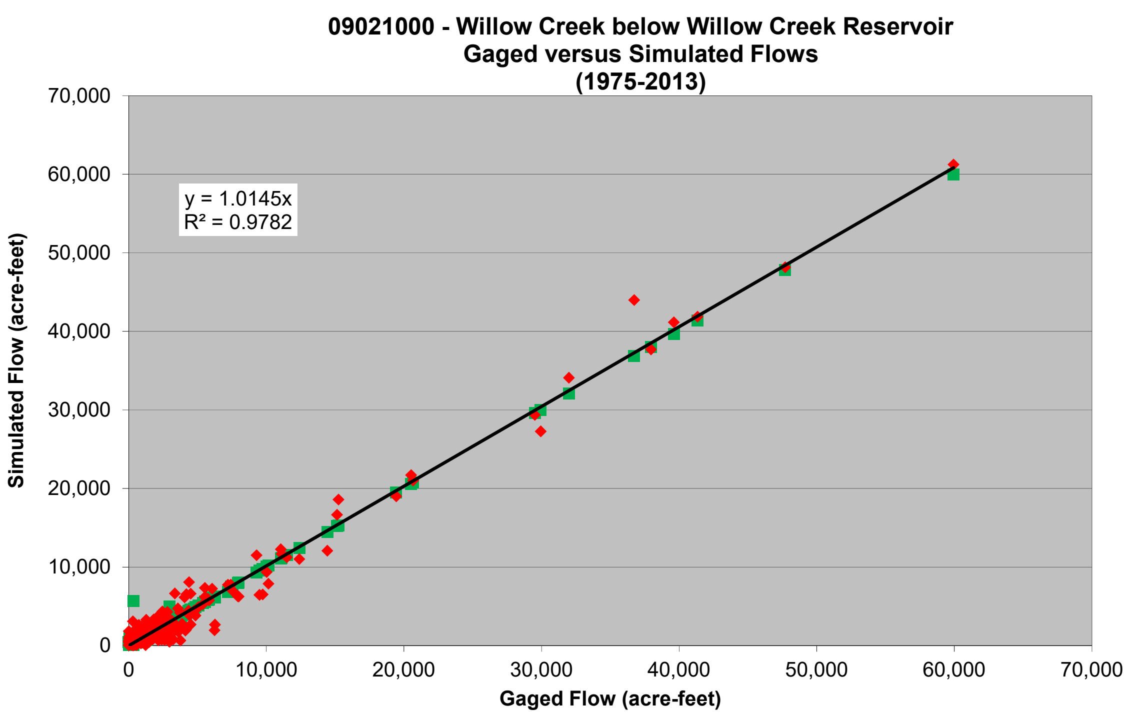
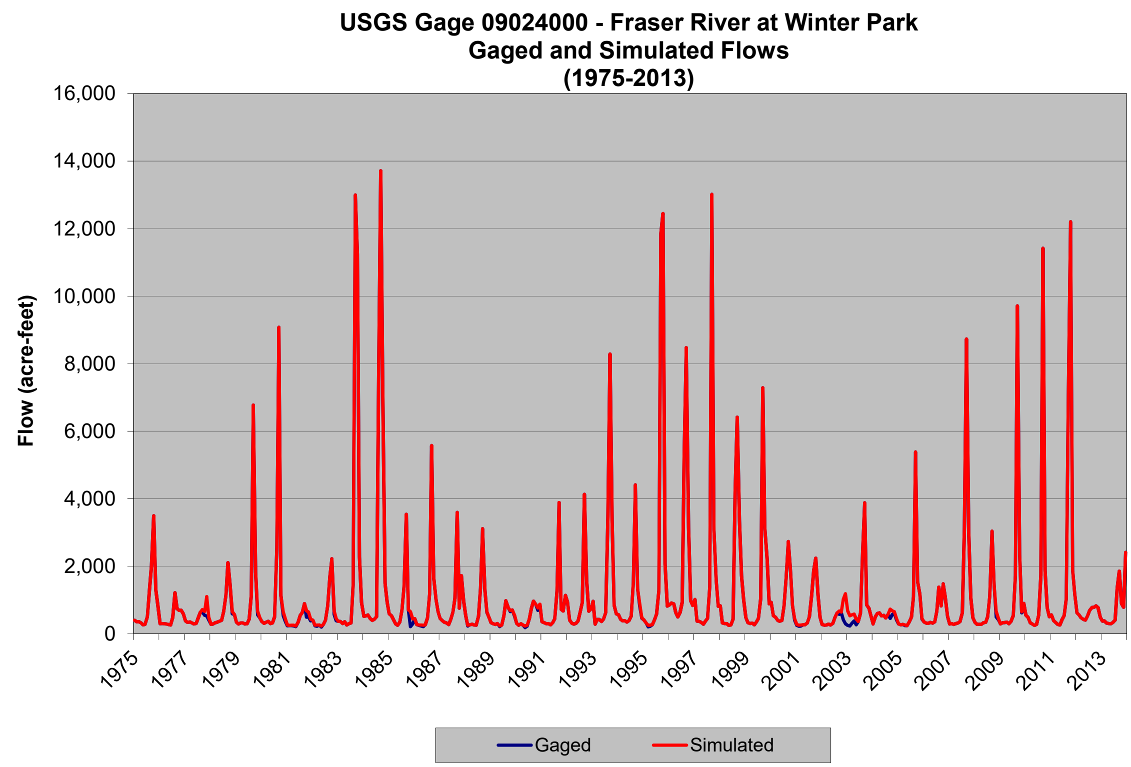


Figure 7.2 Streamflow Calibration – Willow Creek below Willow Creek Reservoir



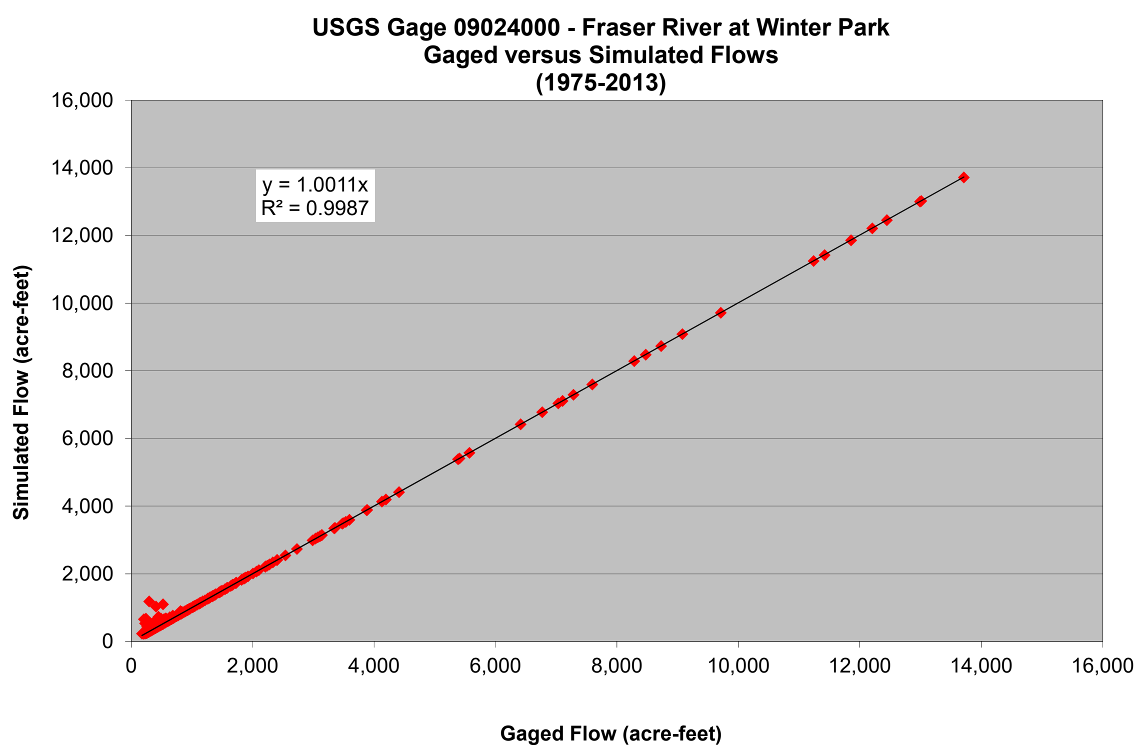
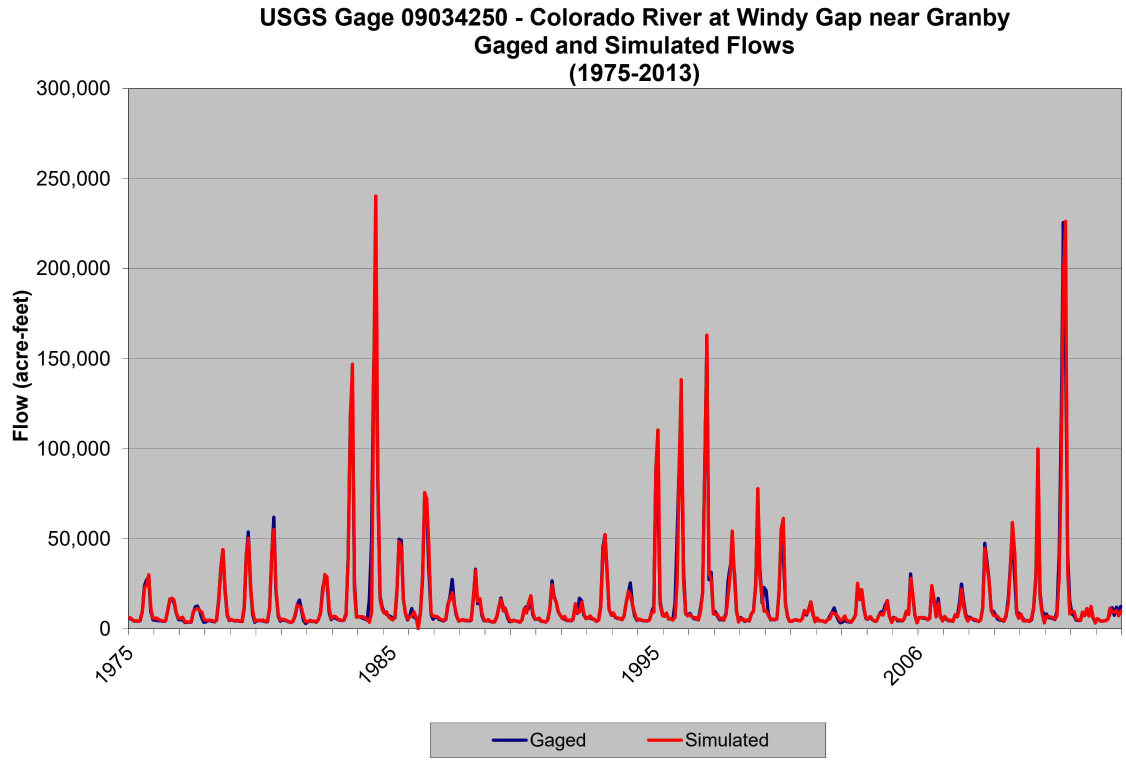


Figure 7.3 Streamflow Calibration – Fraser River at Winter Park



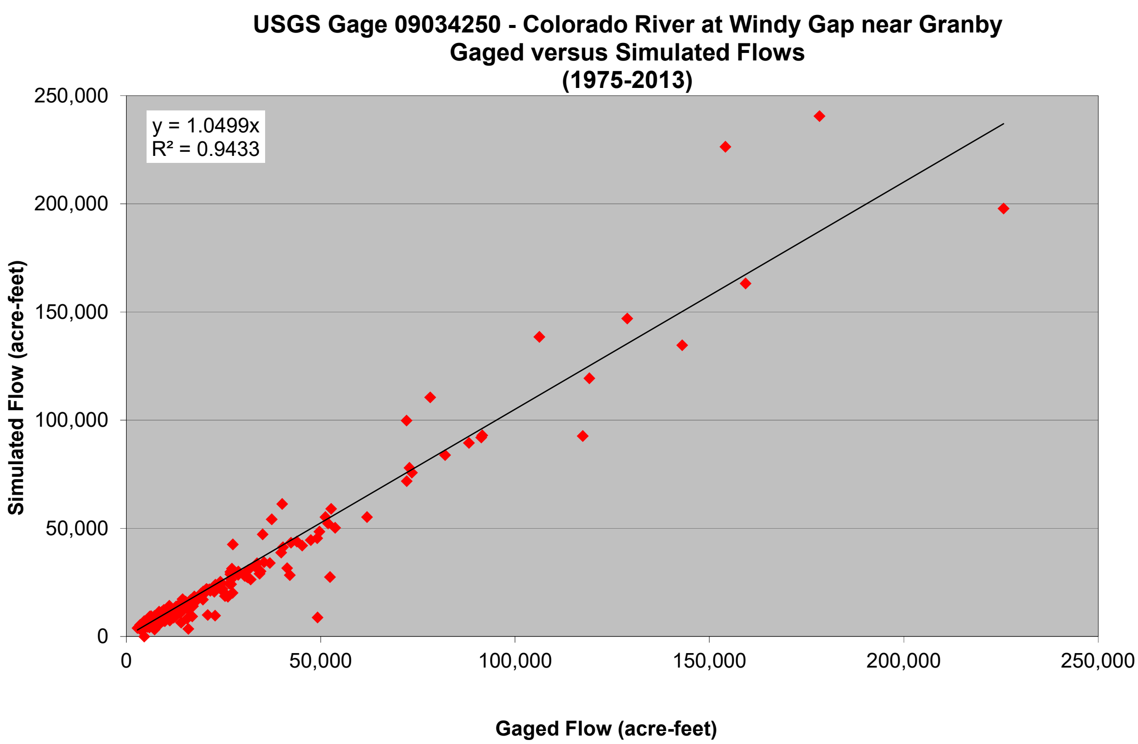
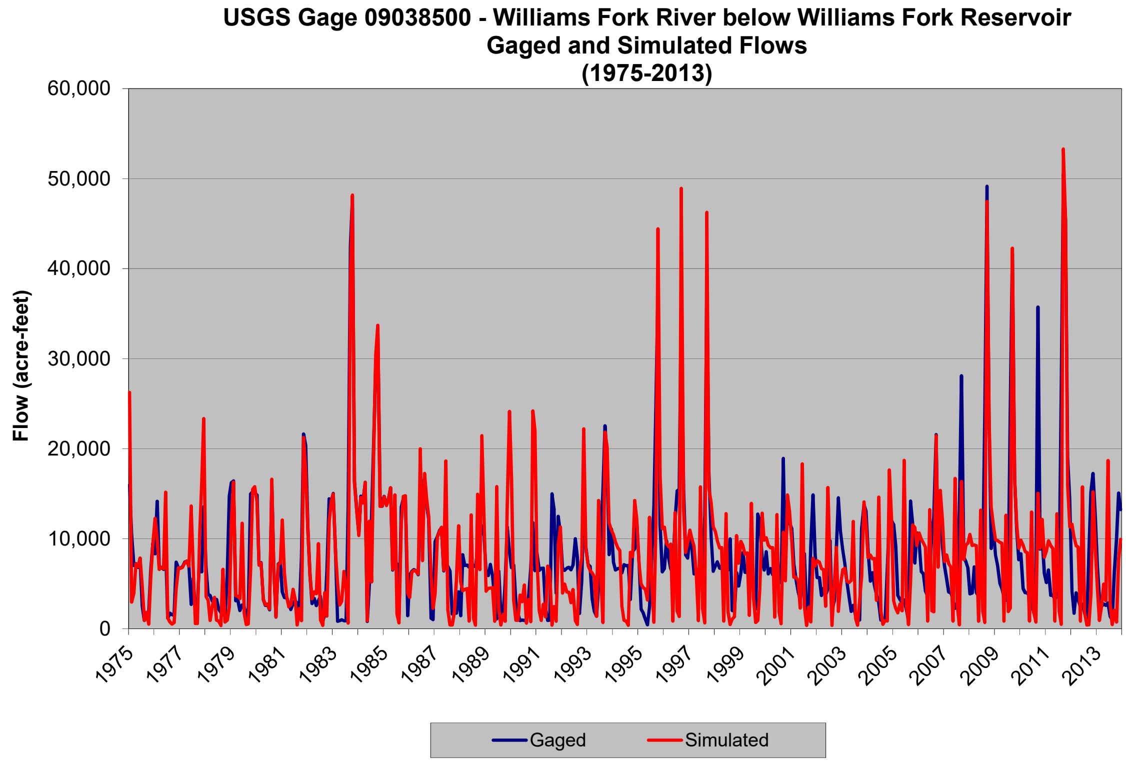


Figure 7.4 Streamflow Calibration – Colorado River at Windy Gap, near Granby, CO.



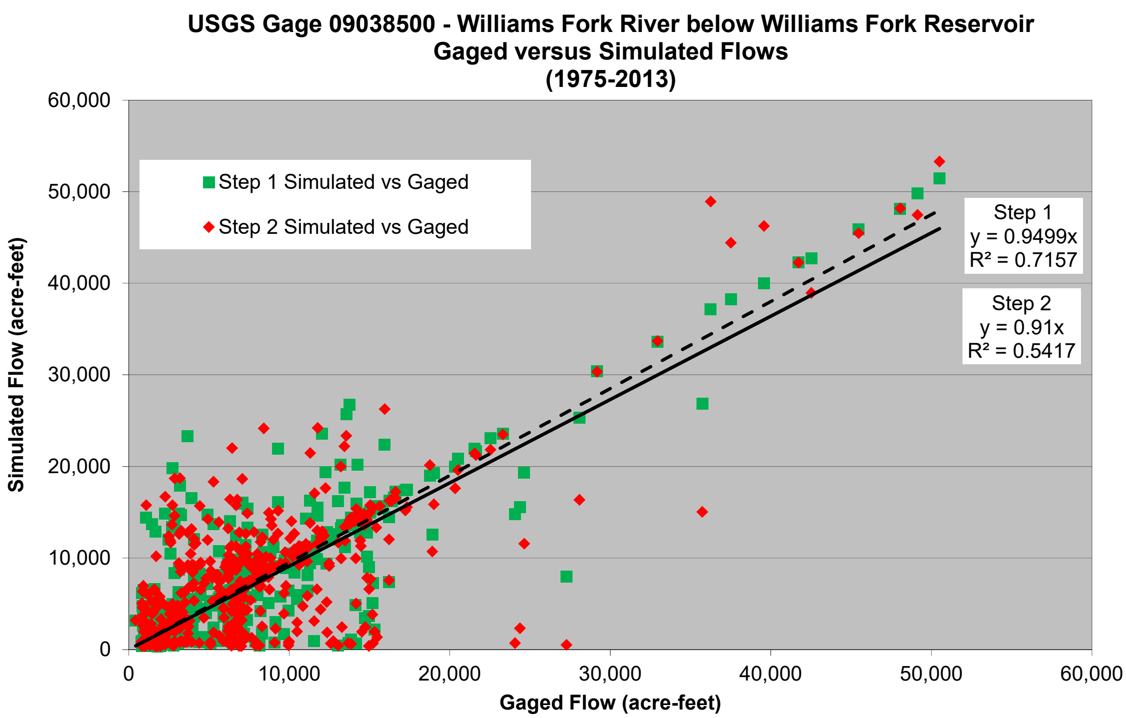
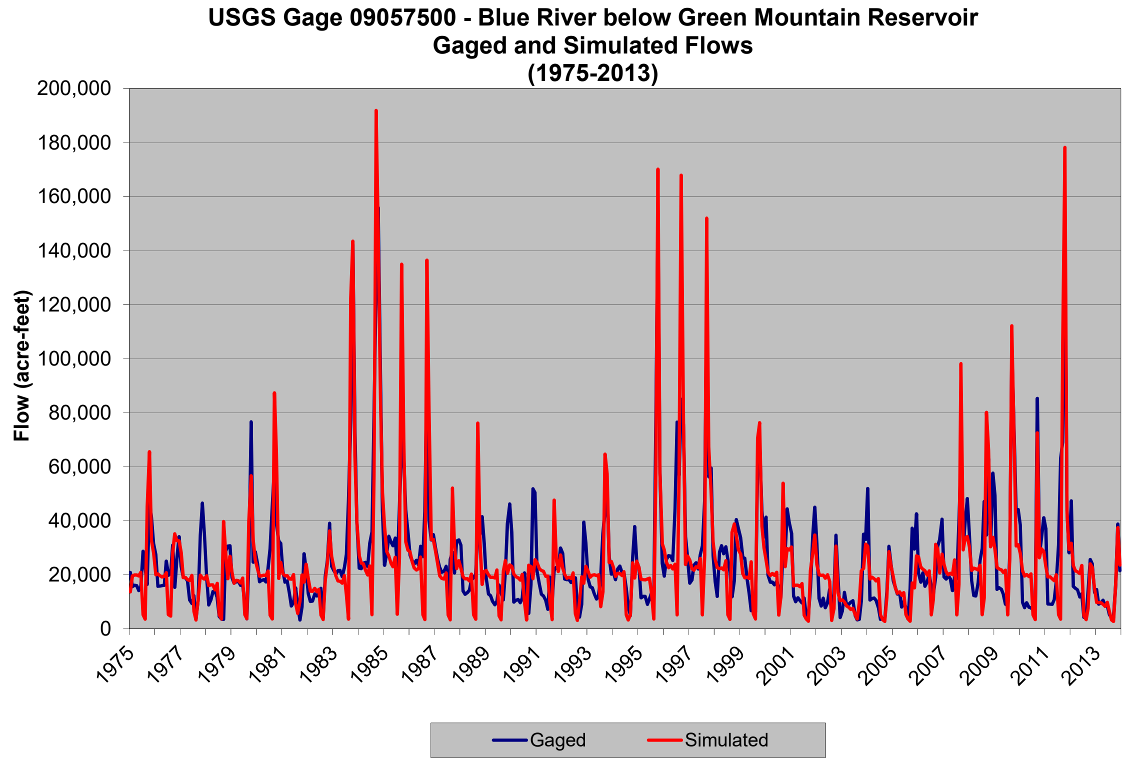


Figure 7.5 Streamflow Calibration – Williams Fork River below Williams Fork Res.



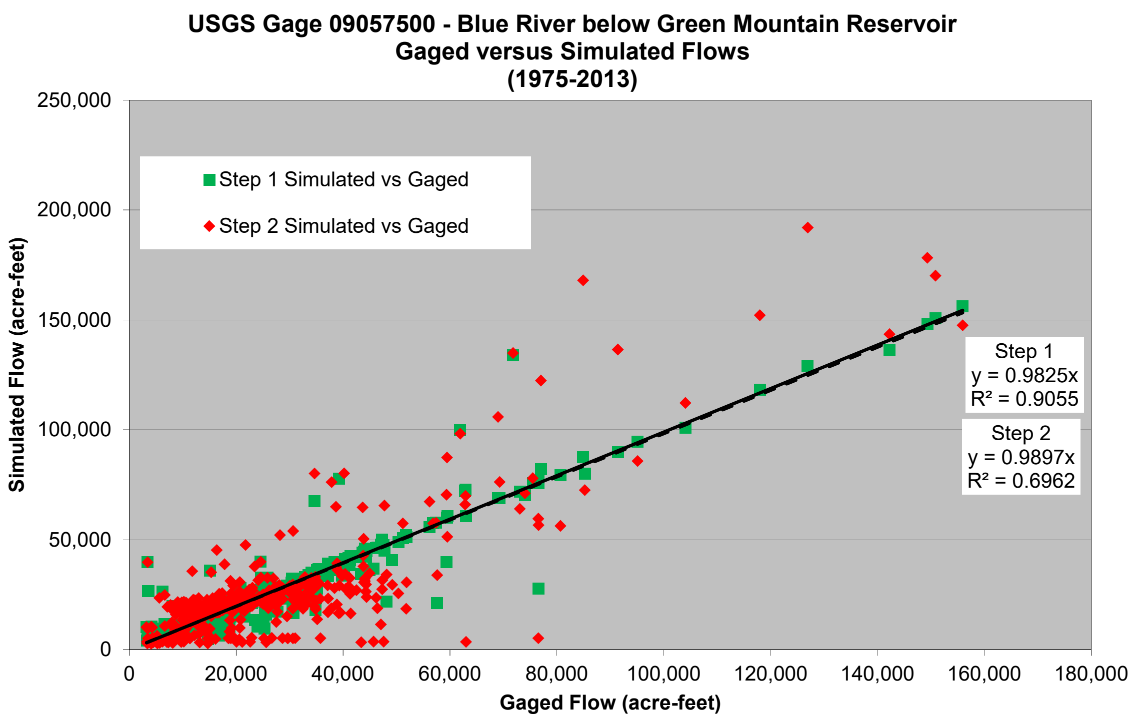
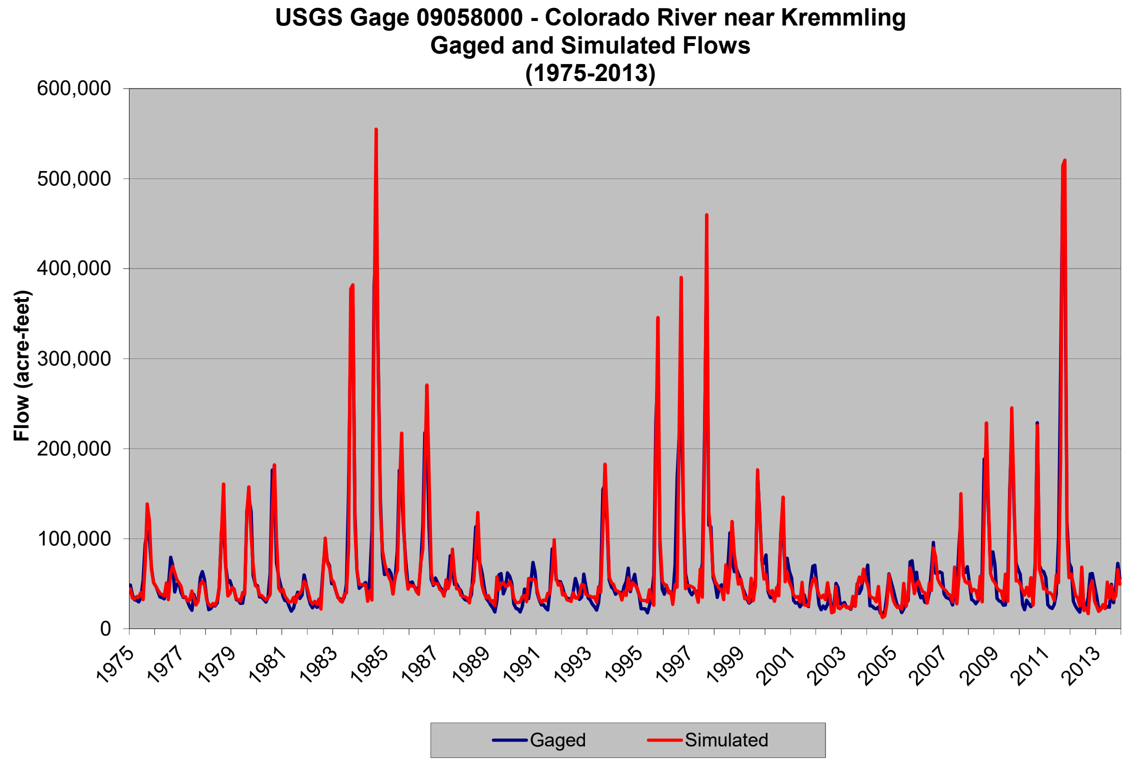


Figure 7.6 Streamflow Calibration – Blue River below Green Mountain Reservoir



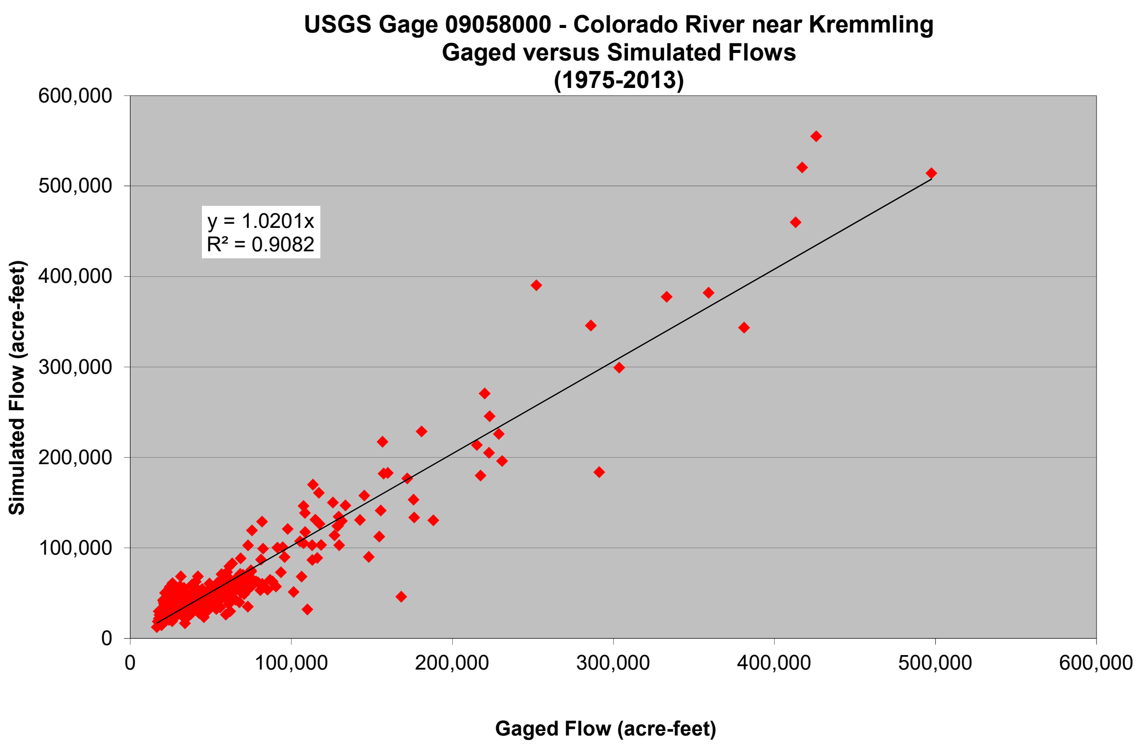
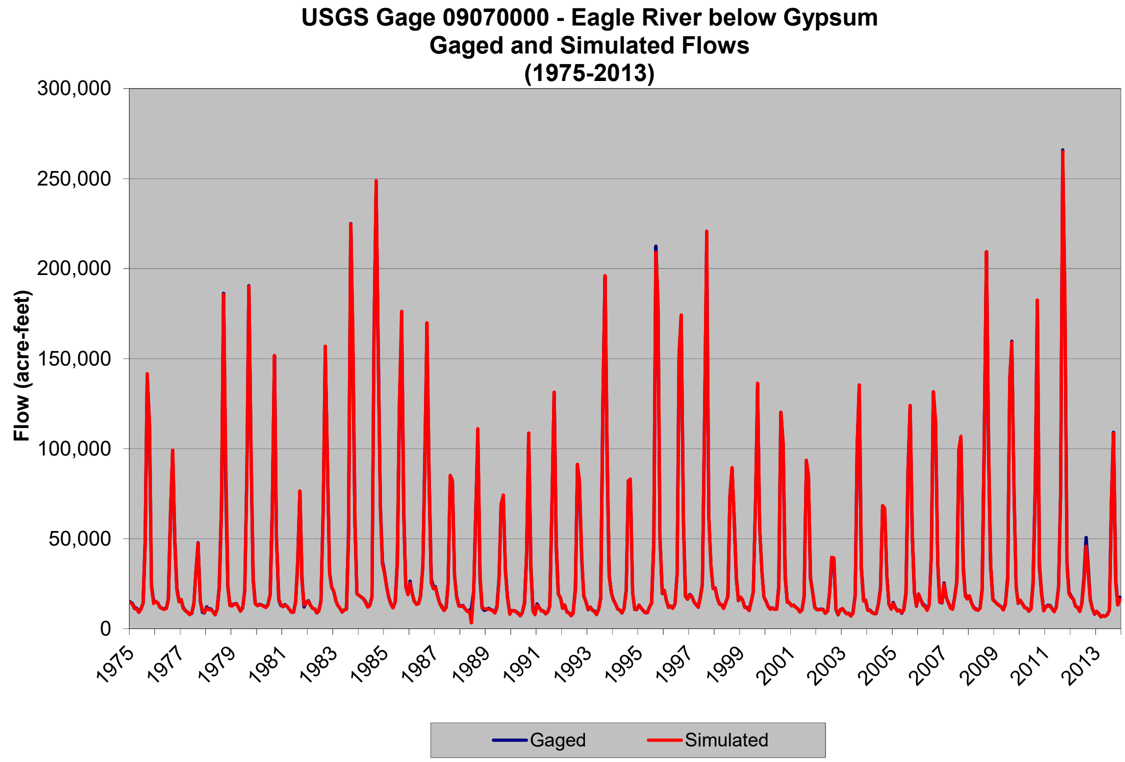


Figure 7.7 Streamflow Calibration – Colorado River near Kremmling



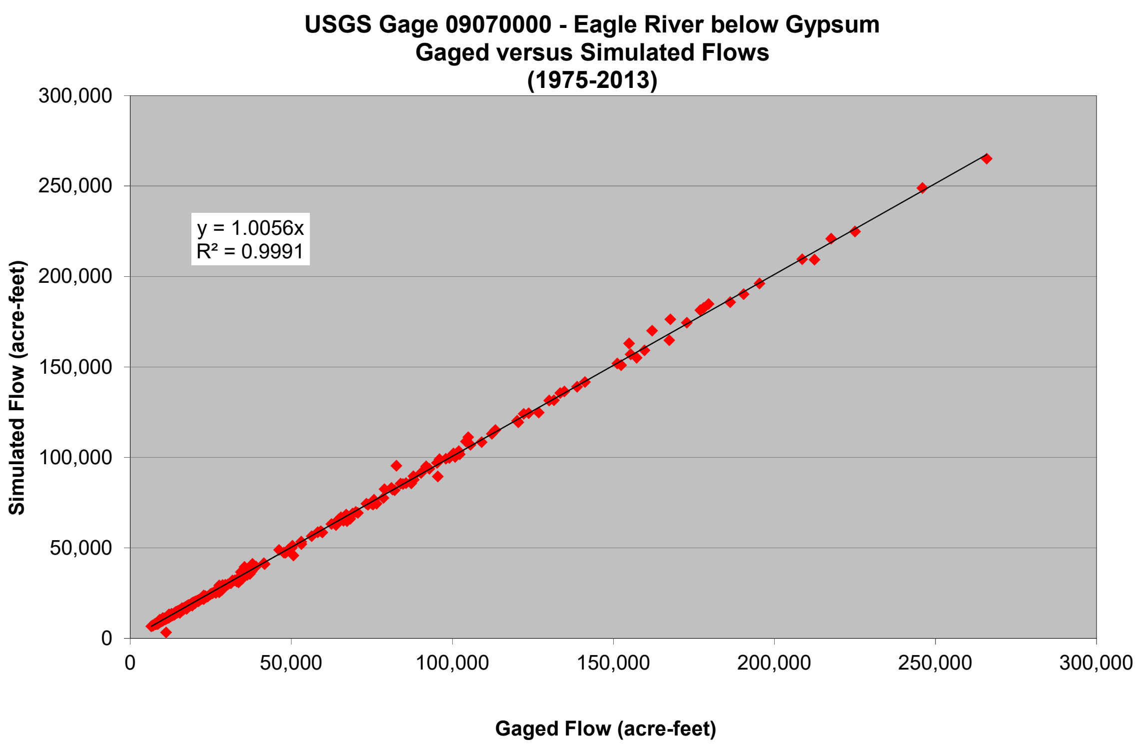
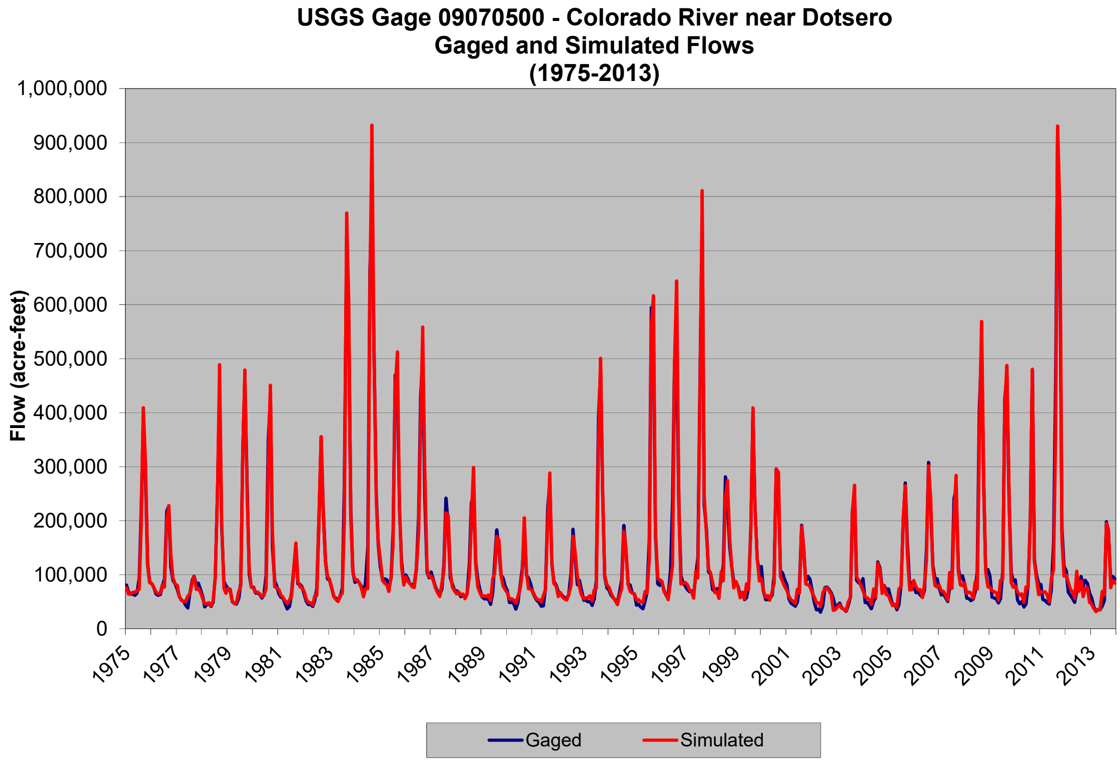


Figure 7.8 Streamflow Calibration – Eagle River below Gypsum



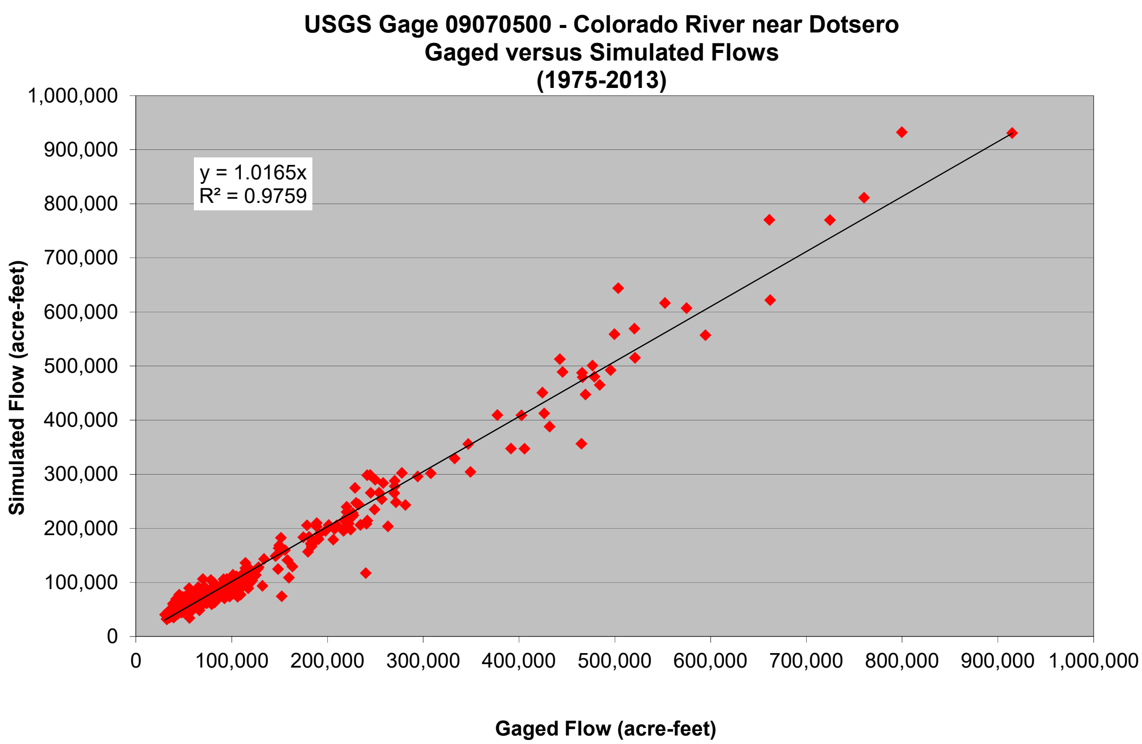
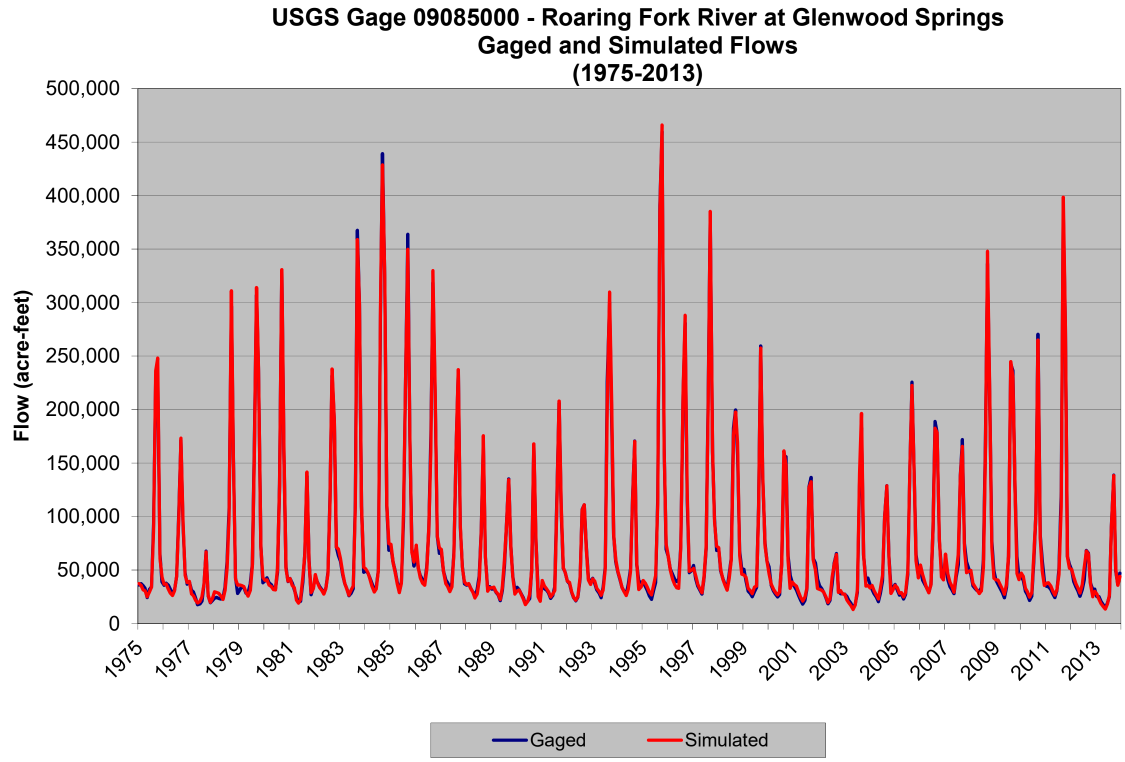


Figure 7.9 Streamflow Calibration – Colorado River near Dotsero



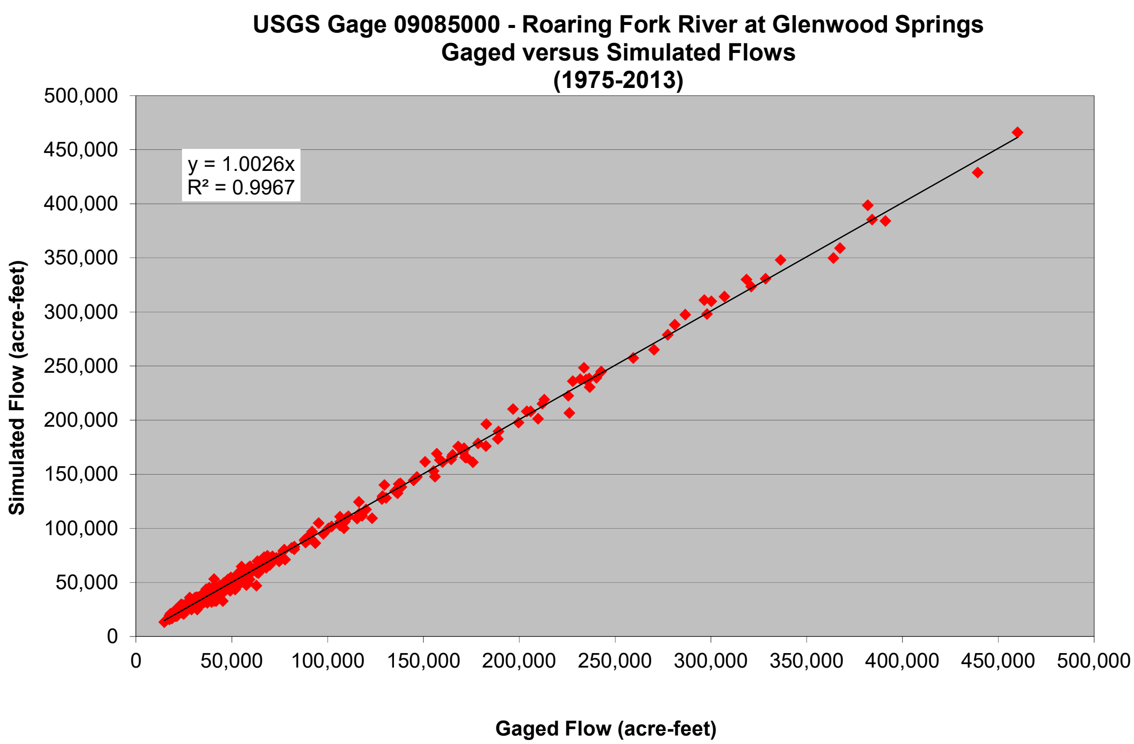
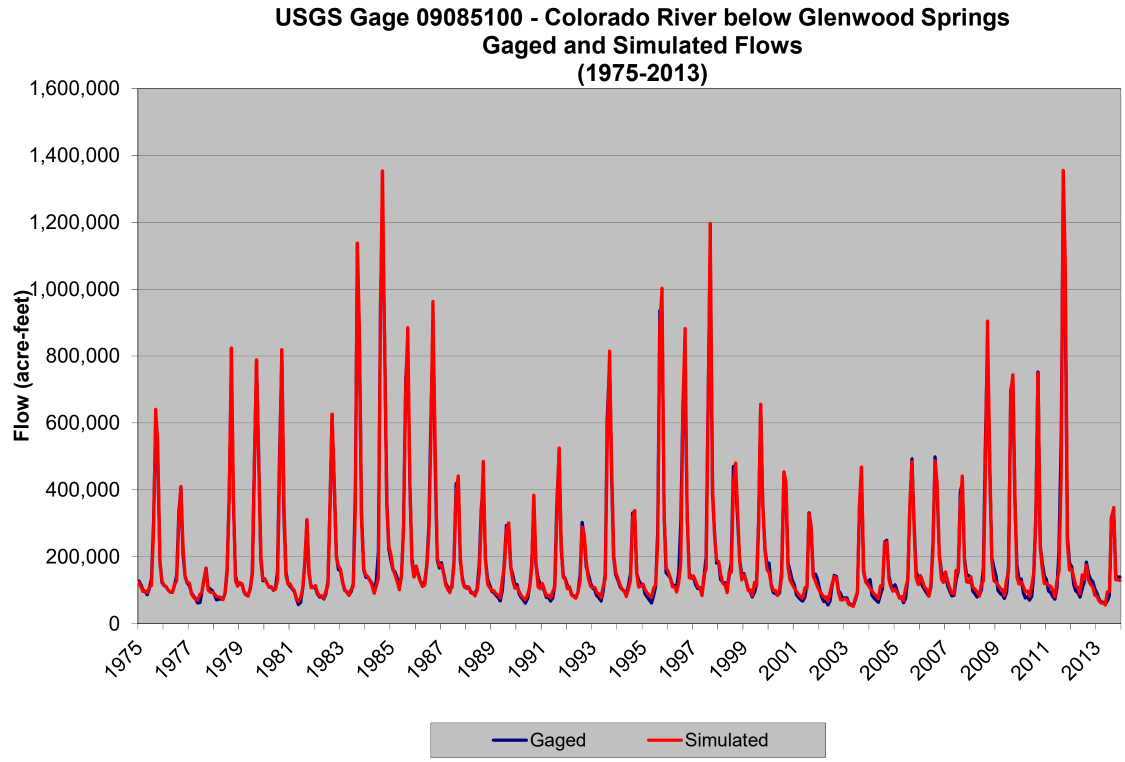


Figure 7.10 Streamflow Calibration – Roaring Fork River at Glenwood Springs



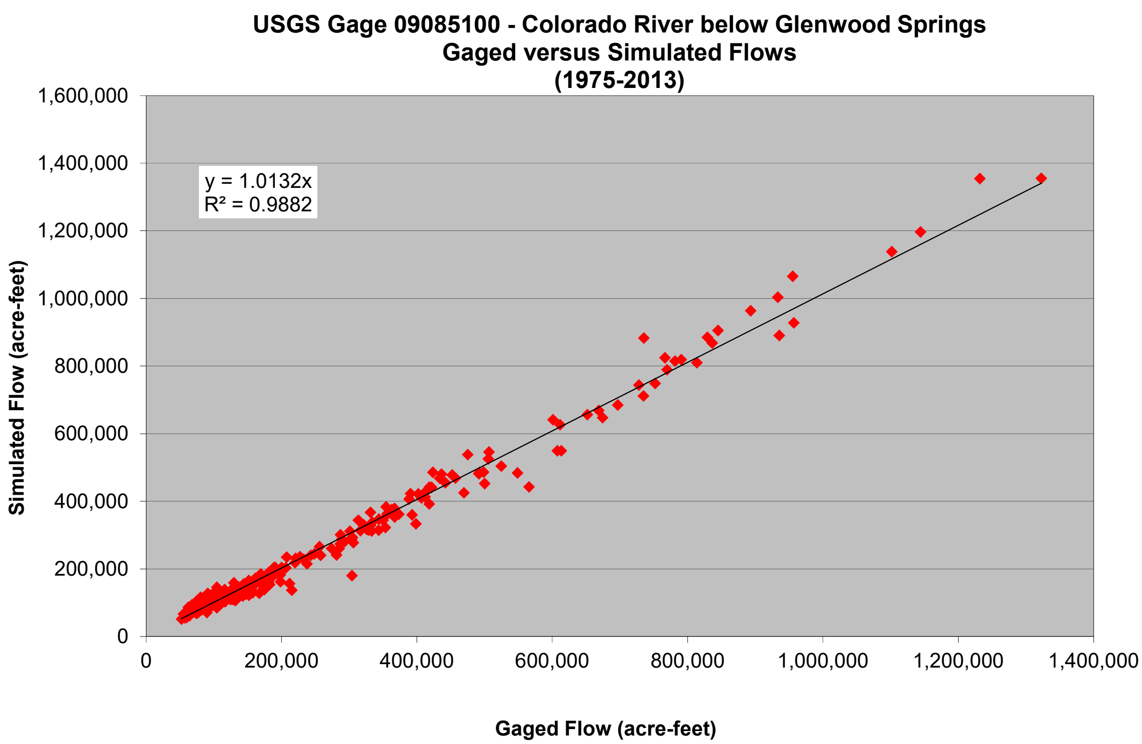
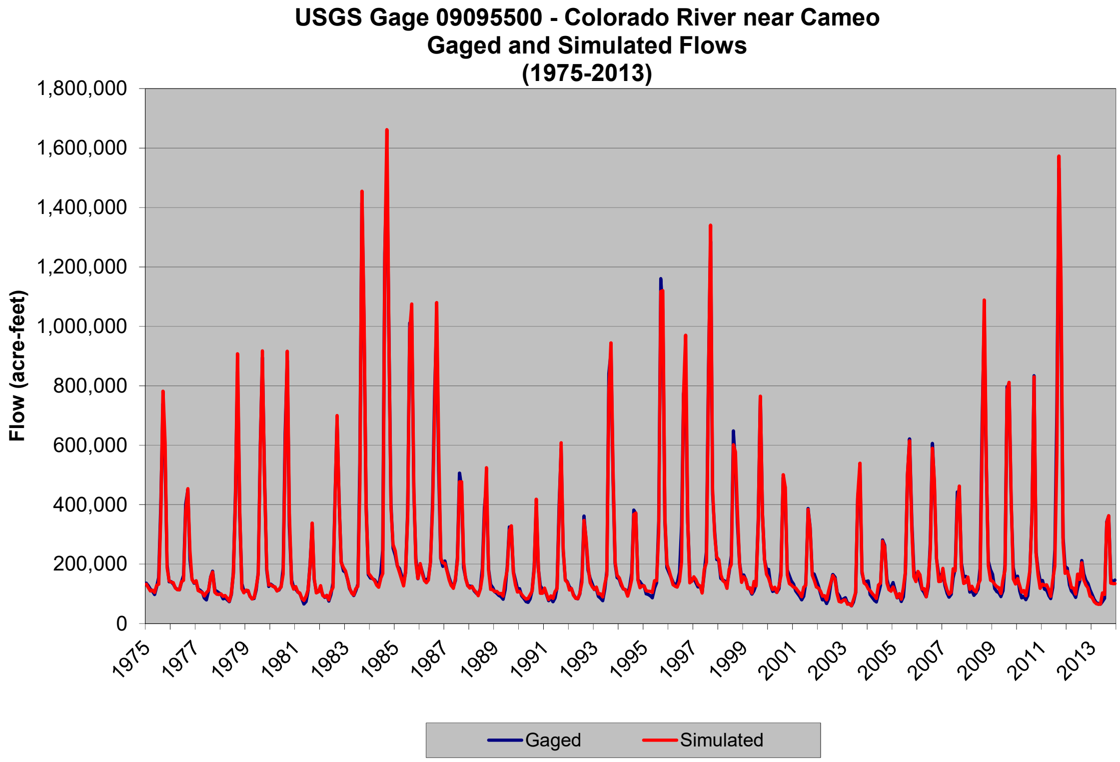


Figure 7.11 Streamflow Calibration – Colorado River below Glenwood Springs



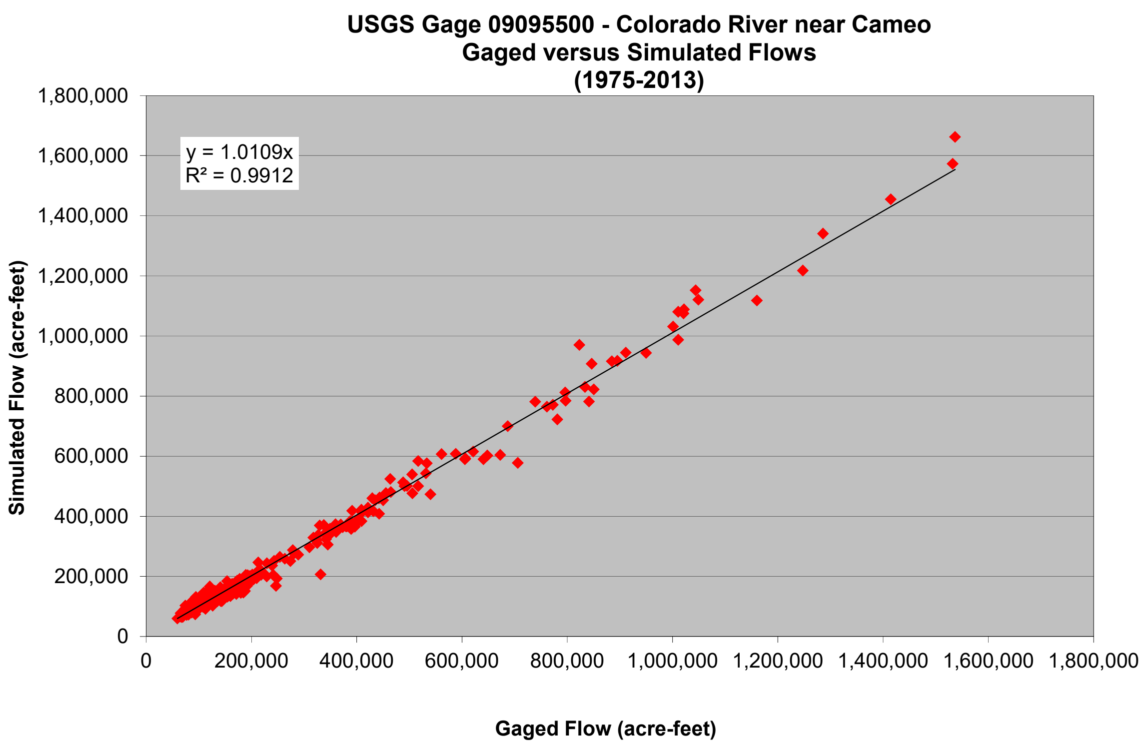
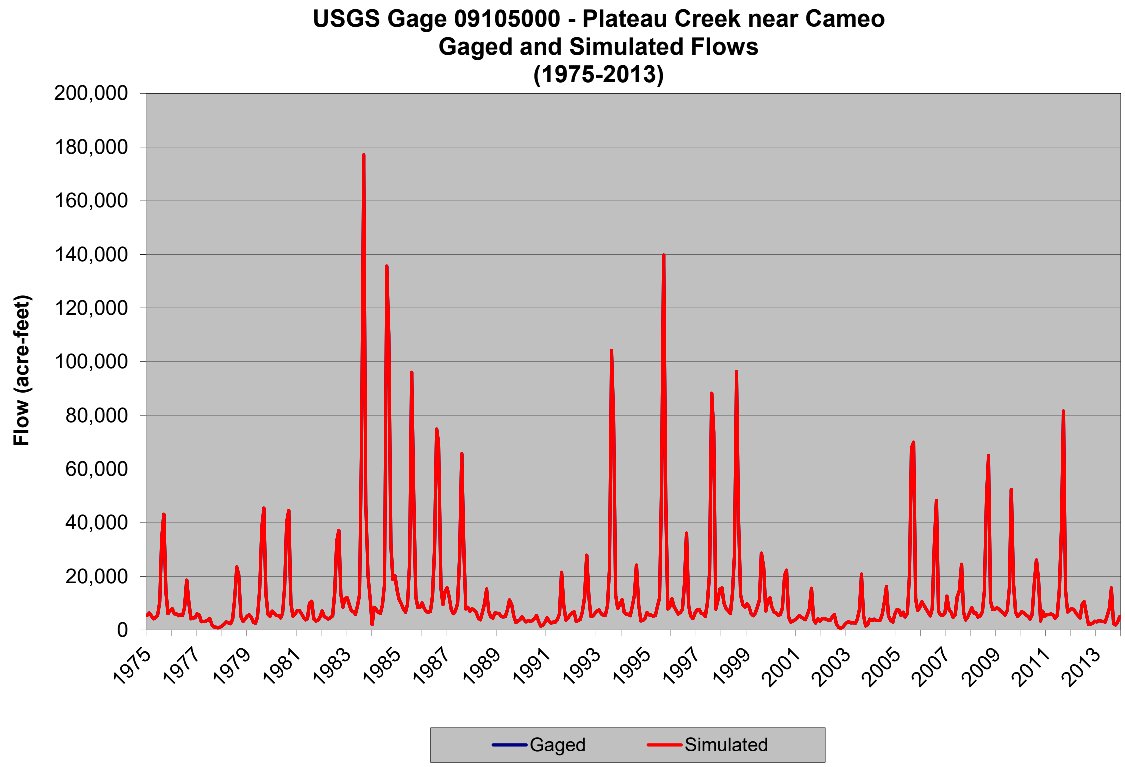


Figure 7.12 Streamflow Calibration – Colorado River near Cameo



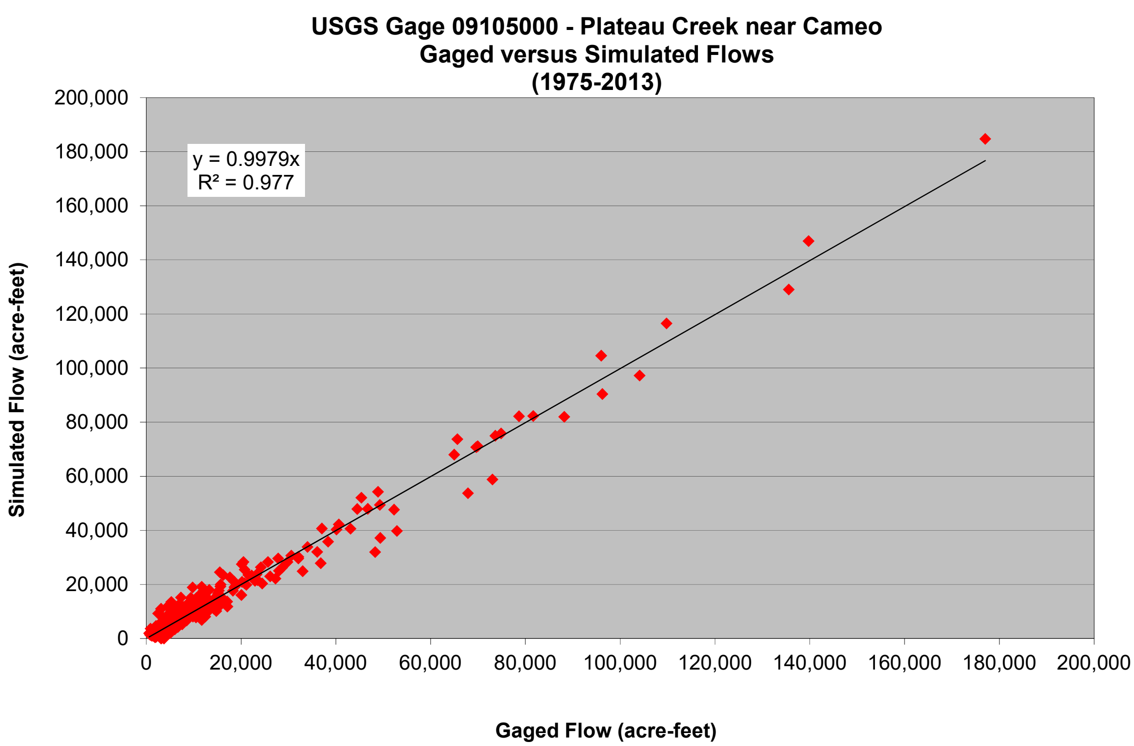
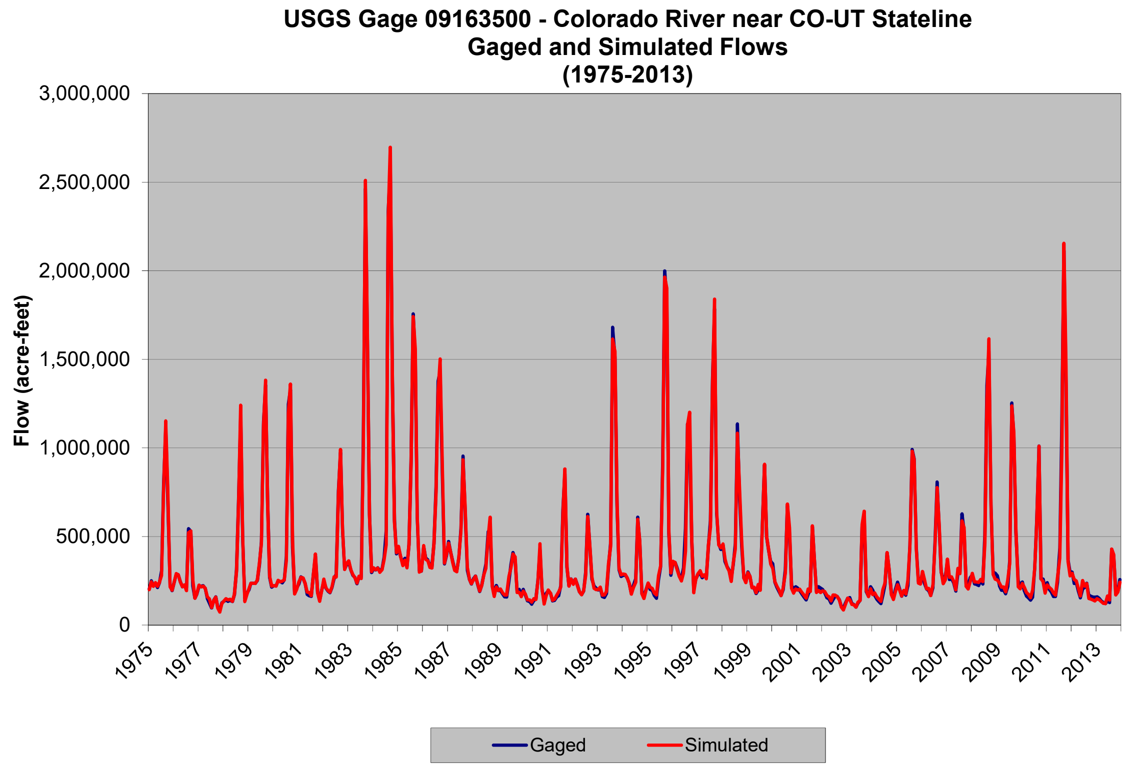


Figure 7.13 Streamflow Calibration – Plateau Creek nar Cameo



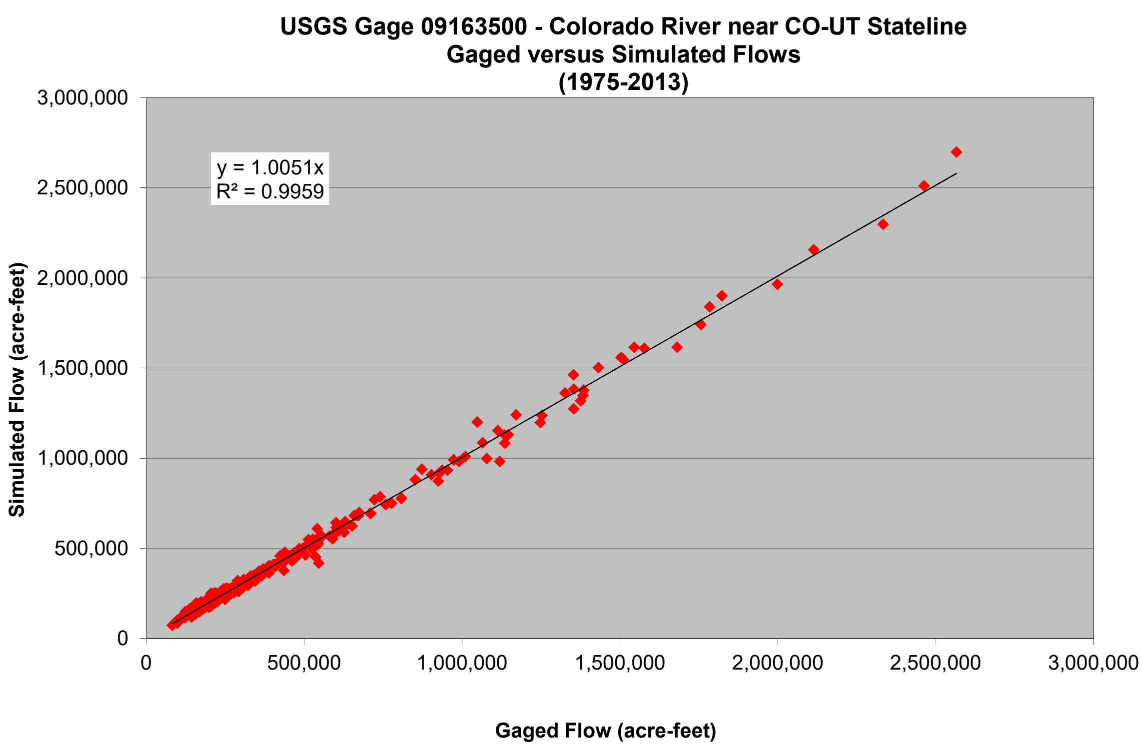


Figure 7.14 Streamflow Calibration – Colorado River near Colorado-Utah State Line

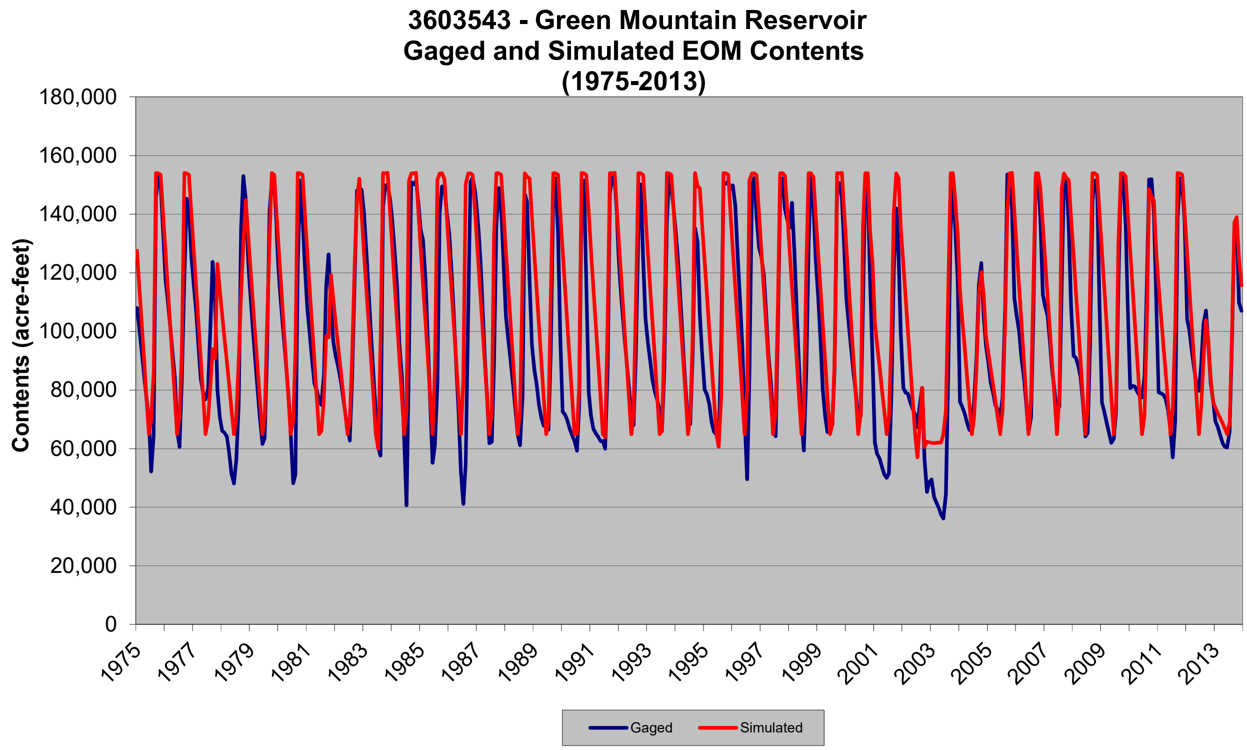


Figure 7.15 Reservoir Calibration – Green Mountain Reservoir

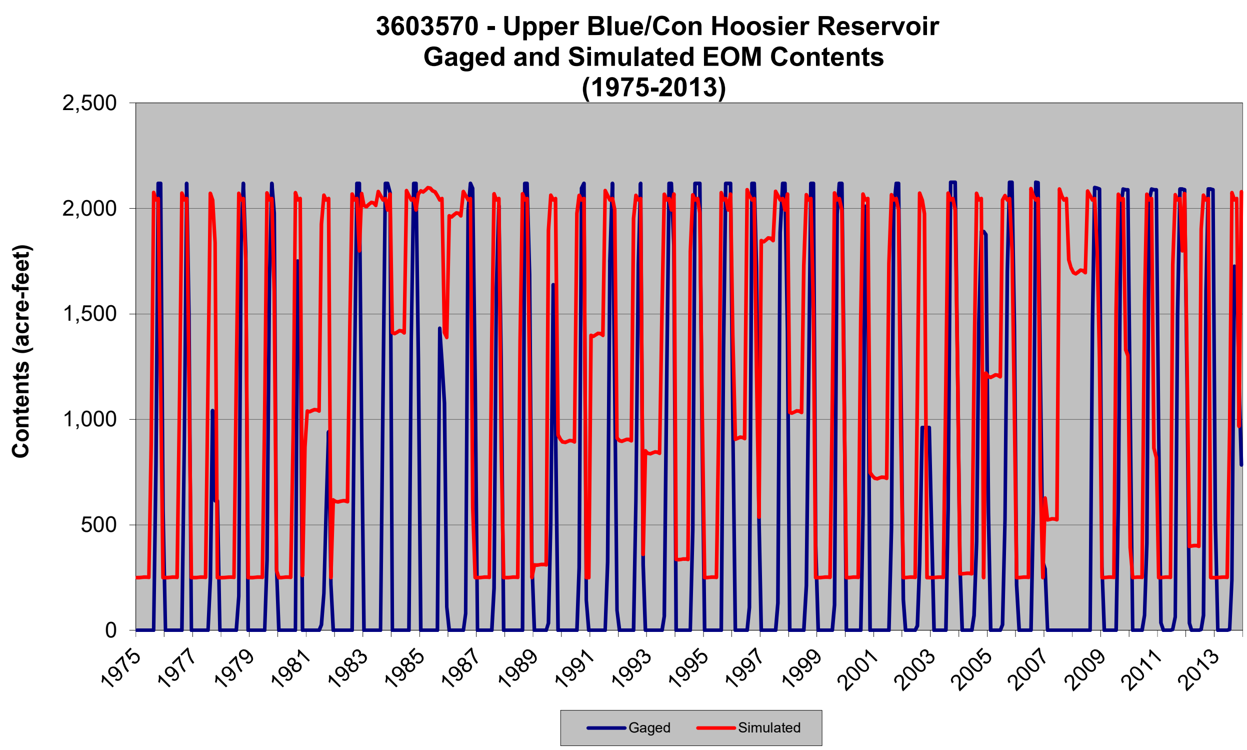


Figure 7.16 Reservoir Calibration – Upper Blue Reservoir (ConHoosier)

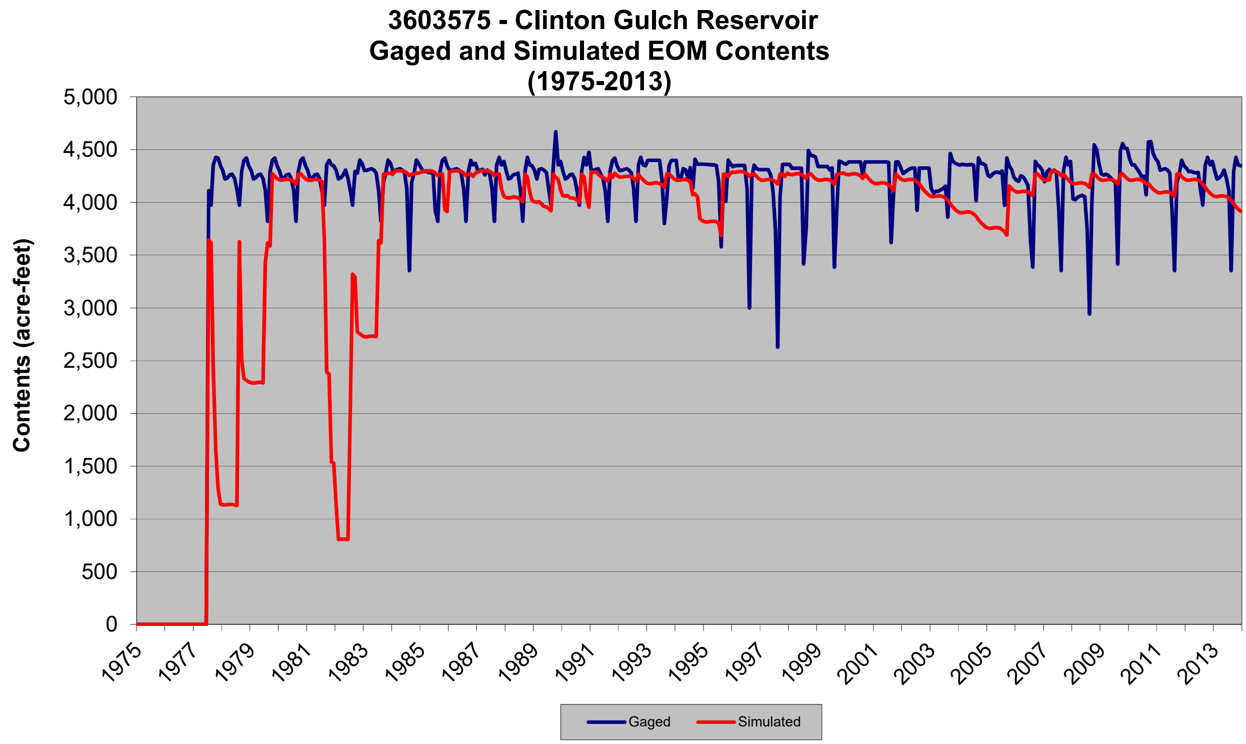


Figure 7.17 Reservoir Calibration – Clinton Gulch Reservoir

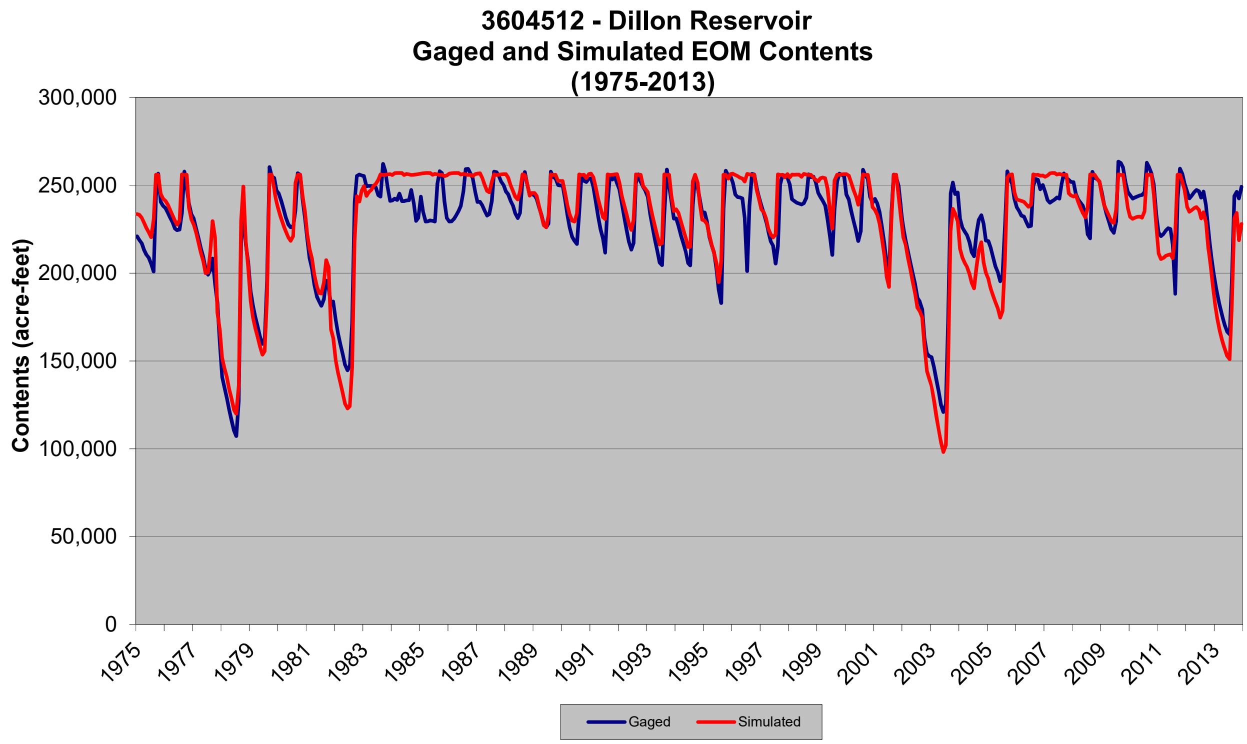


Figure 7.18 Reservoir Calibration – Dillon Reservoir

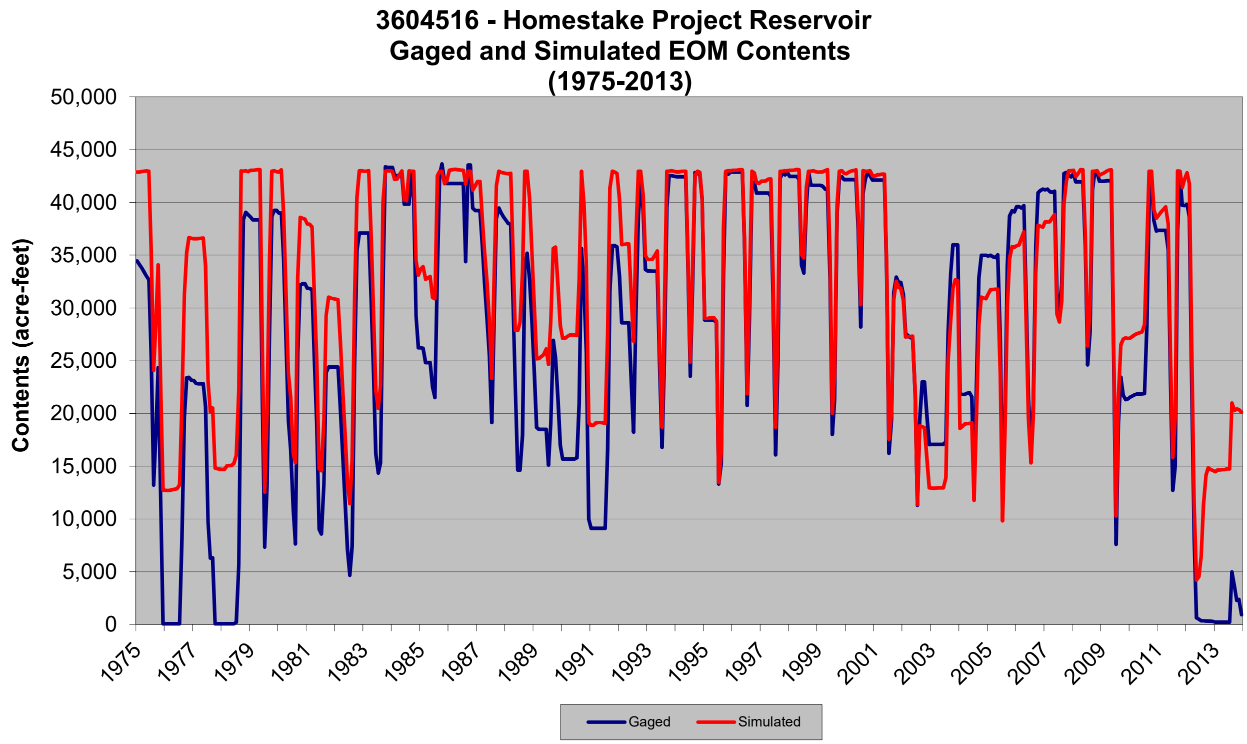


Figure 7.19 Reservoir Calibration – Homestake Project Reservoir

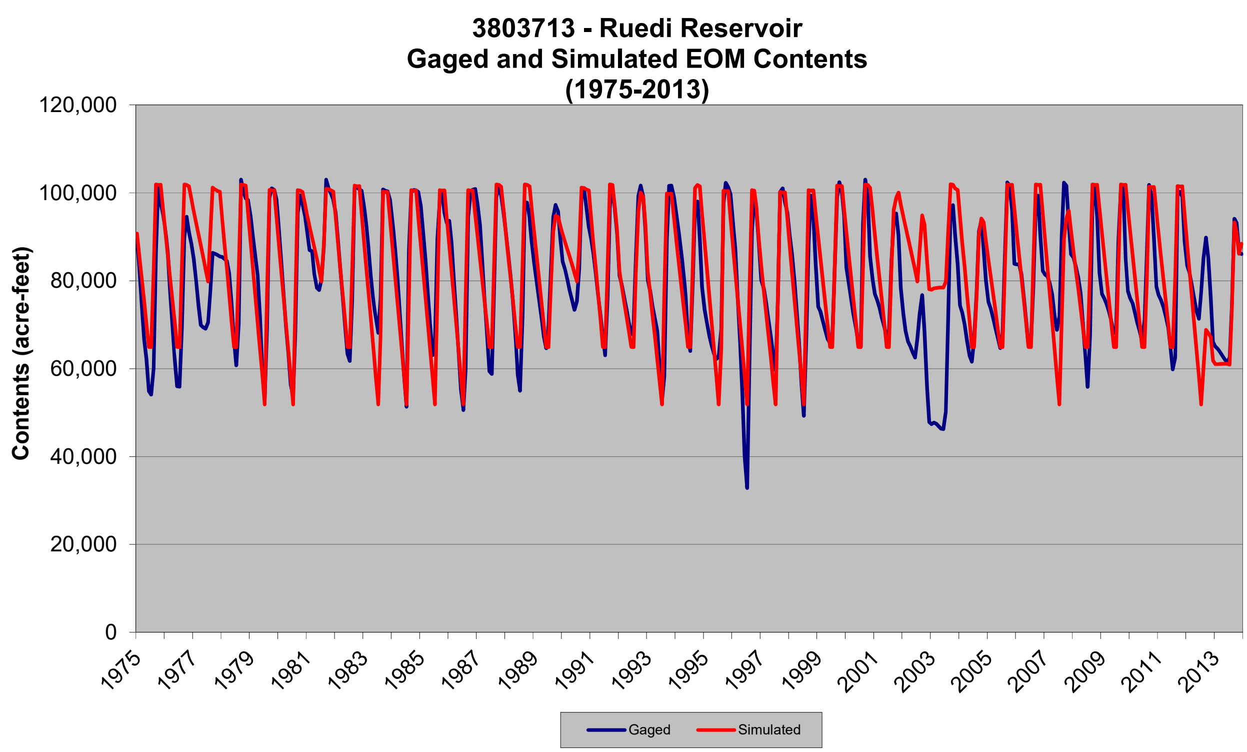


Figure 7.20 Reservoir Calibration – Ruedi Reservoir

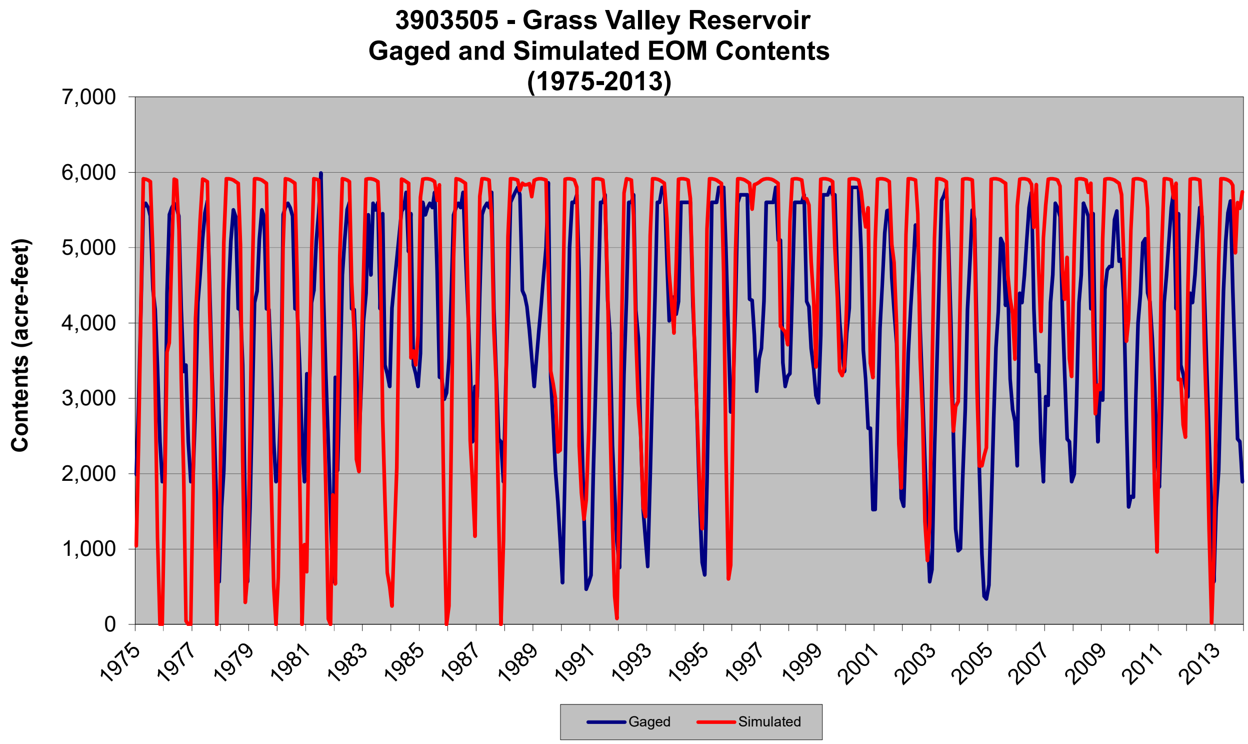


Figure 7.21 Reservoir Calibration – Grass Valley Reservoir

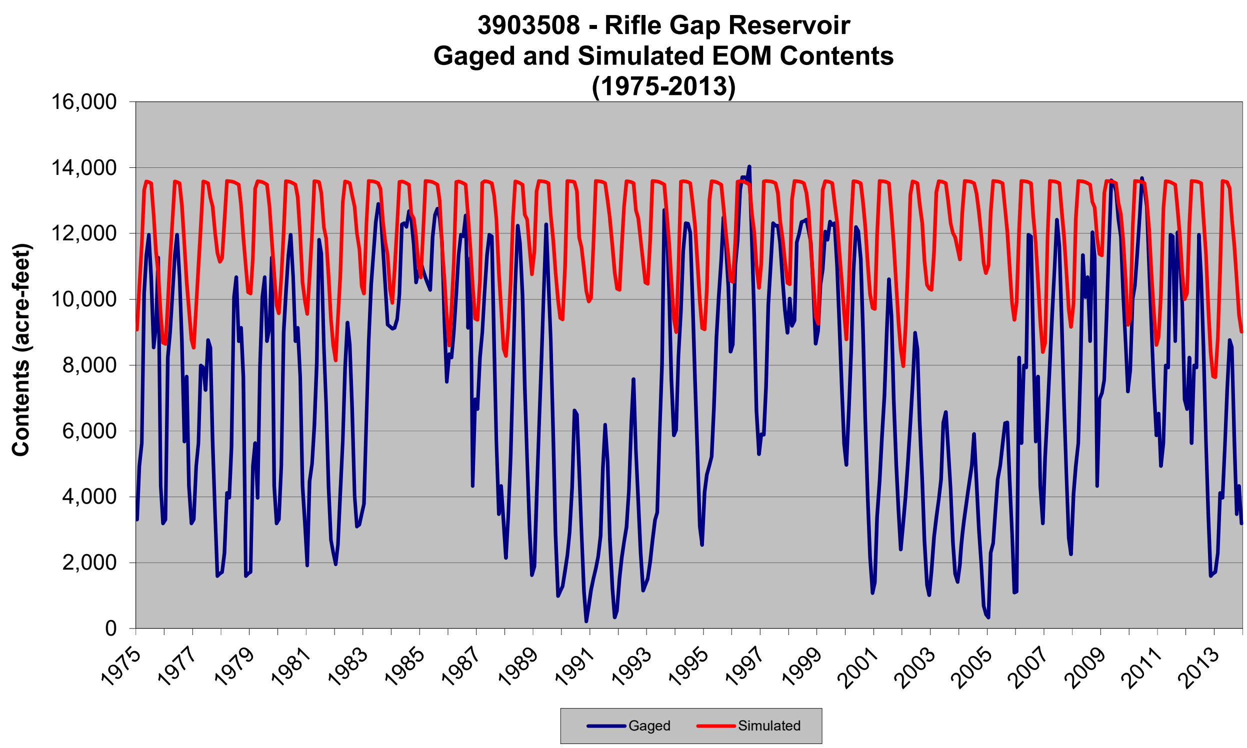


Figure 7.22 Reservoir Calibration – Rifle Gap Reservoir

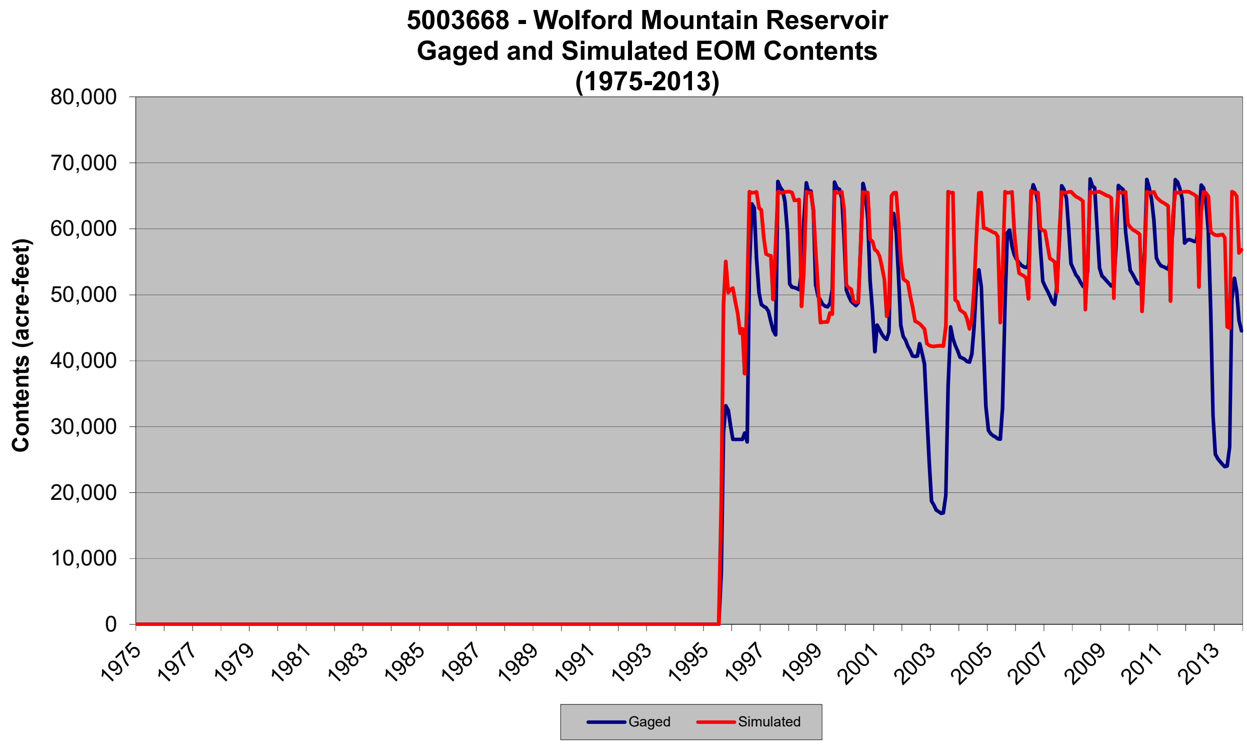


Figure 7.23 Reservoir Calibration – Wolford Mountain Reservoir

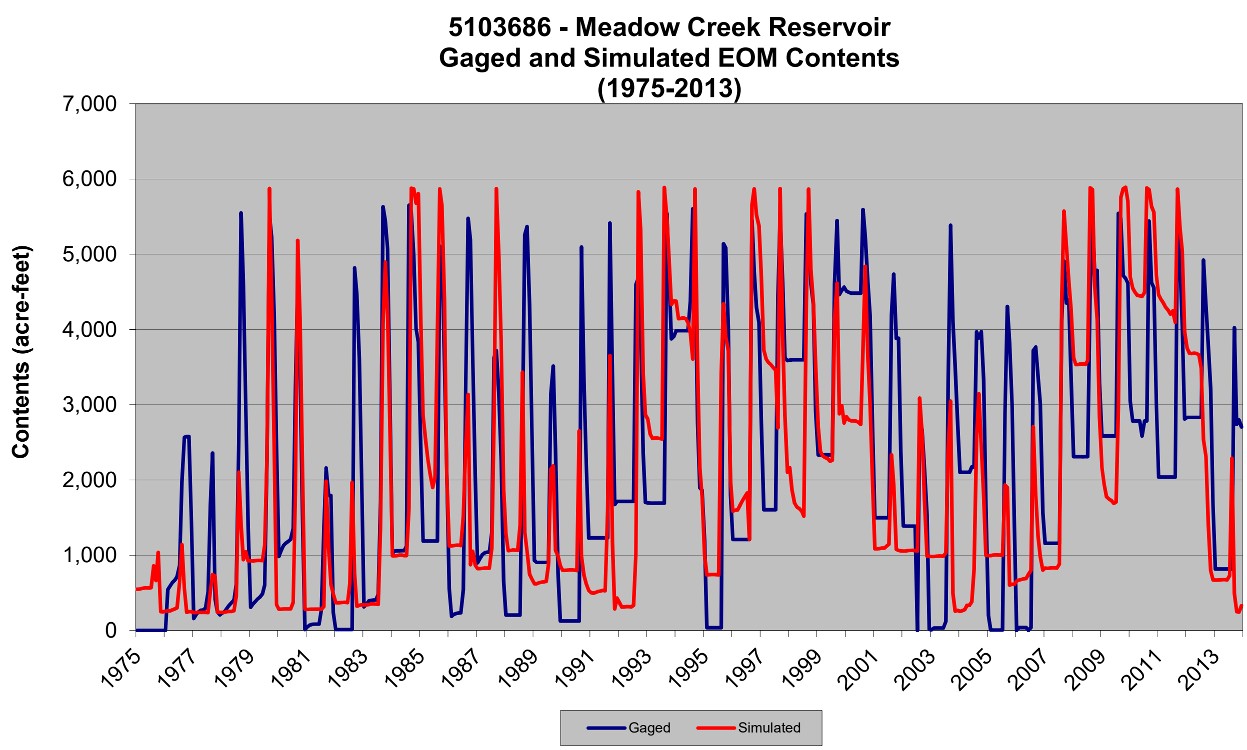


Figure 7.24 Reservoir Calibration – Meadow Creek Reservoir

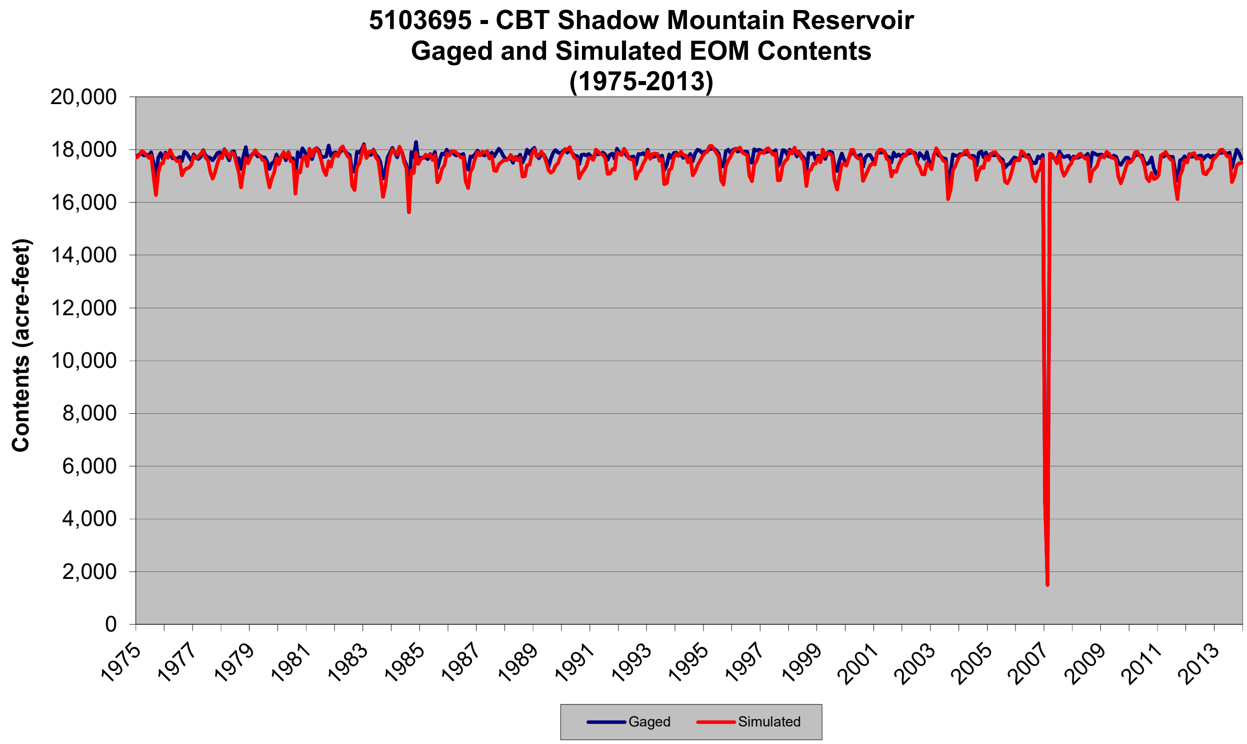


Figure 7.25 Reservoir Calibration – CBT Shadow Mtn Grand Lake

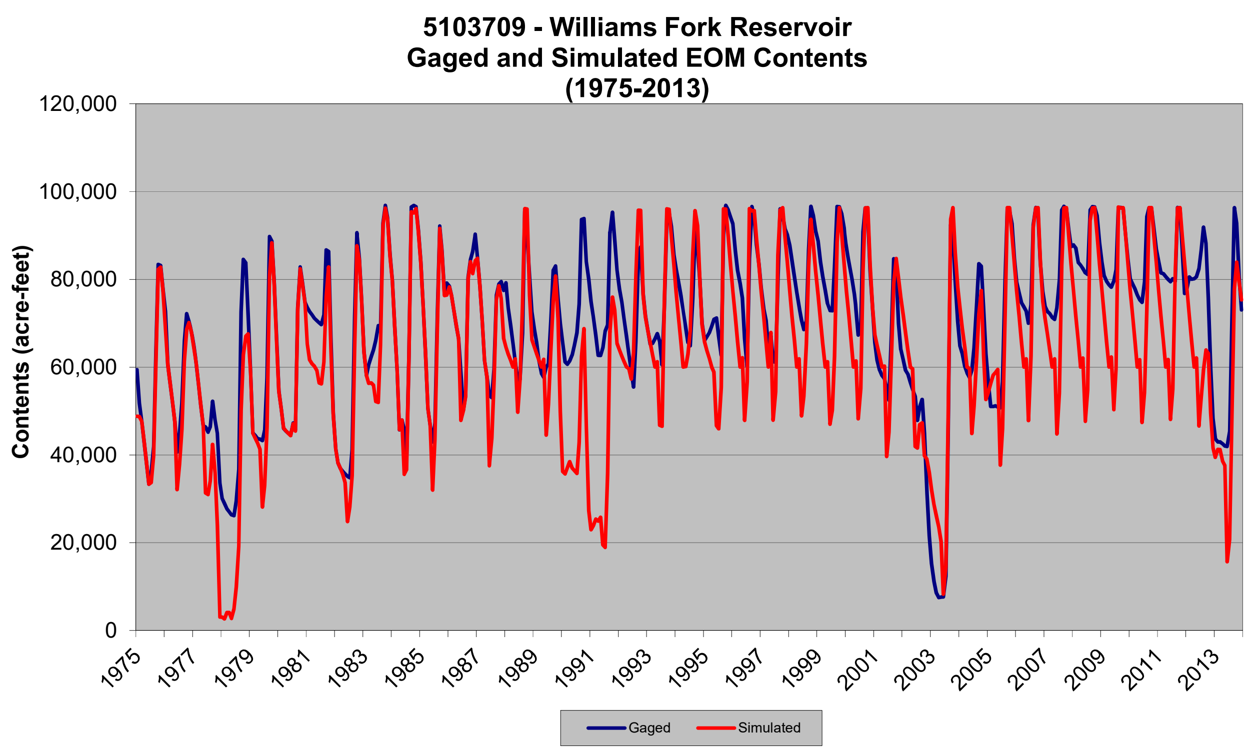


Figure 7.26 Reservoir Calibration – Williams Fork Reservoir

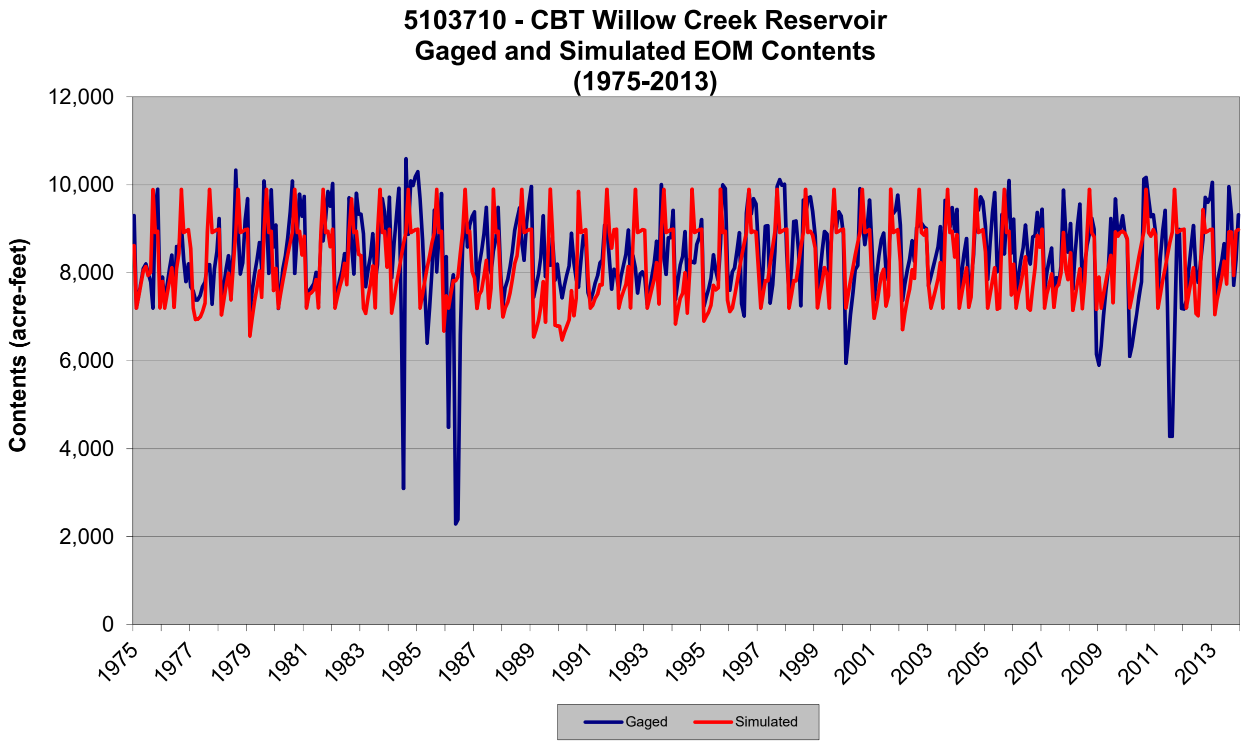


Figure 7.27 Reservoir Calibration – CBT Willow Creek Res

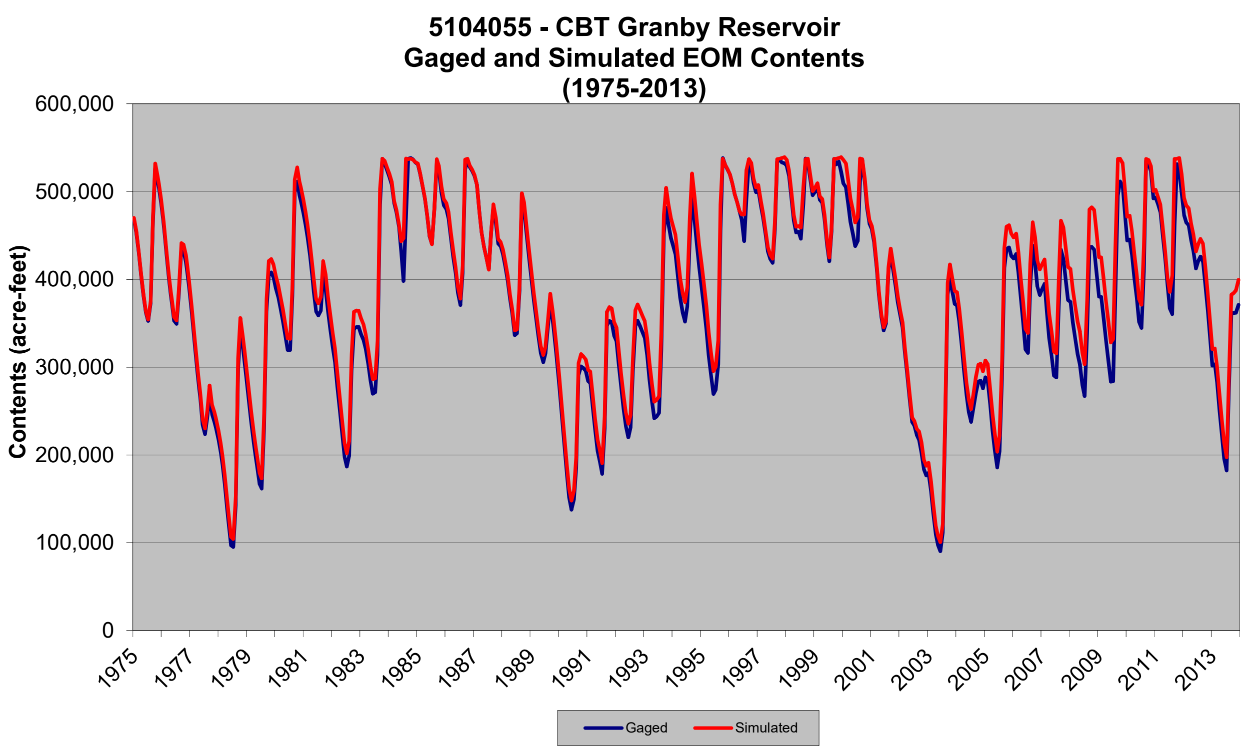


Figure 7.28 Reservoir Calibration – CBT Granby Reservoir

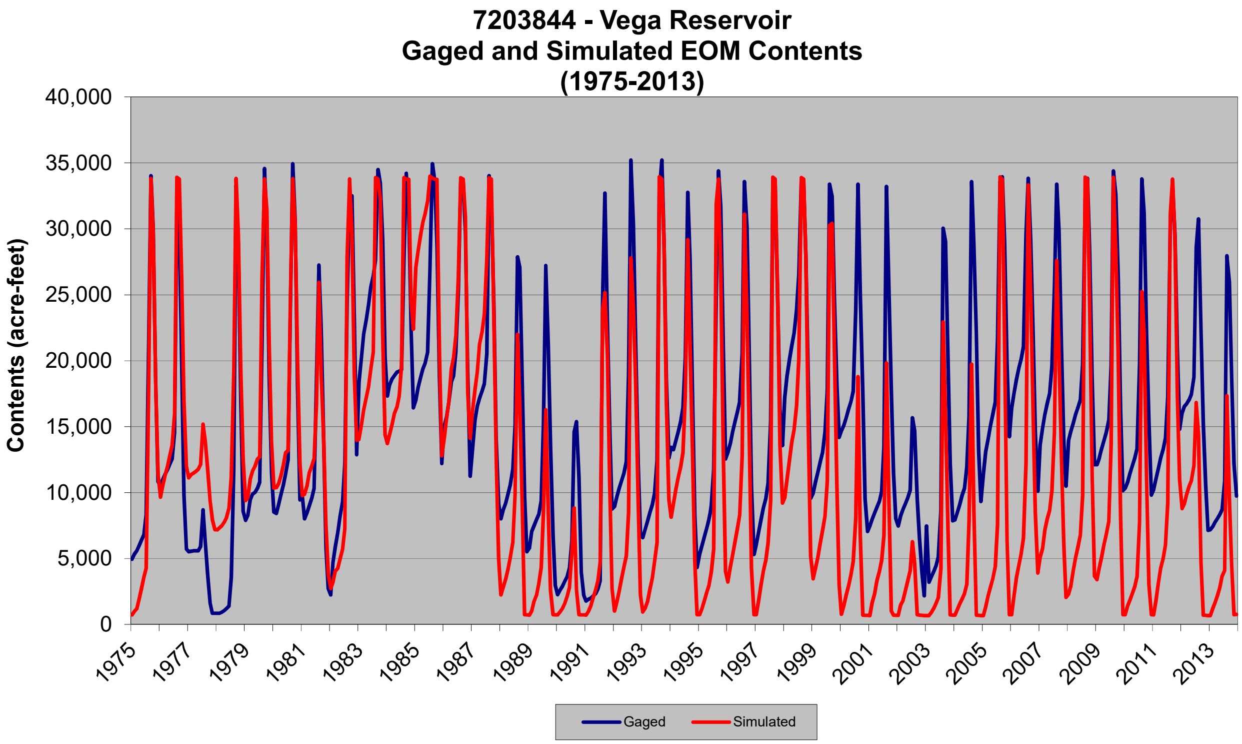


Figure 7.29 Reservoir Calibration – Vega Reservoir

Appendix A

Aggregation of Irrigation Diversion Structures

A-1: Colorado River Basin Aggregated Irrigation Structures
A-2: Identification of Associated Structures

A-1: Colorado River Basin Aggregated Irrigation Structures

Introduction

The original CDSS StateMod and StateCU modeling efforts were based on the 1993 irrigated acreage coverage developed during initial CRDSS efforts. Irrigated acreage assessments representing 2005 and 2010 have now been completed for the western slope basins. A portion of the 2005 and 2010 acreage was tied to structures that did not have identified acreage in the 1993 coverage, and, consequently, are not currently represented in the CDSS models. As part of this task, aggregate and diversion system structure lists for the western slope basins were revised to include 100 percent of the irrigated acreage based on both the 2005 and 2010 assessments. The update also included identification of associated structures and the development of “no diversion” aggregates—groups of structures that have been assigned acreage but do not have current diversion records.

The methodology for identifying associated structures is described more in-depth in **Section A-2** of this appendix. In general, associated structures—which divert to irrigate a common parcel of land—were updated to more accurately model combined acreage, diversions, and demands. These updates include the integration of the 2005 irrigated acreage, the 2010 irrigated acreage, as well as verification based on diversion comments and water right transaction comments. In StateCU, the modeling focus is on the irrigated parcels of land. Therefore, all associated structures are handled in the same way. The acreage is assigned to a single primary node, which can be supplied by diversions from any of the associated structures. In StateMod, there are two types of associated structures. Diversion systems represent structures located on the same tributary that irrigate common land. Diversions systems combine acreage, headgate demands, and water rights; StateMod treats them as a single structure. In contrast, multi-structure systems represent structures located on different tributaries that irrigate common land. Multi-structure systems have the combined acreage and demand assigned to a primary structure; however, the water rights are represented at each individual structure, and the model meets the demand from each structure when their water right is in priority.

“No diversion” aggregates are included in StateCU in order to capture 100 percent of irrigated acreage. However, they were not included in the StateMod modeling effort. Because the individual structures included in these aggregates do not have current diversion records, their effect on the stream cannot be accounted for in the development of natural flows. Therefore, it is appropriate that their diversions also not be included in simulation. The individual structures in the “no diversion” aggregates generally irrigate minimal acreage, often with spring water as a source. There is an assumption that the use will not change in future “what-if” modeling scenarios.

Approach

The following approach was used to update the aggregated structures in the Colorado River Basin.

1. Identify structures assigned irrigated acreage in either the 2005 or 2010 CDSS acreage coverages.

2. Identify Key structures represented explicitly in the model. The process for determining key structures is outlined in **Section 4** of the report.
3. Identify Key structures that should be represented as diversion systems or multi-structures, based on their association with other structures as outlined in **Section A-2** of this appendix.
4. Aggregate remaining irrigation structures identified in either the 2005 or 2010 irrigated acreage coverages based on the aggregate spatial boundaries shown in Figure A-1. The boundaries were developed during previous Colorado River Basin modeling effort to general group structures by tributaries with combined acreage less than 2,200.
5. Further split the aggregations based on structures with and without current diversions during the period 2000 through 2012.

Results

Table A-1 indicates the number of structures in the aggregation and the total the 2005 and 2010 aggregated acreage. All of the individual structures in the aggregates have recent diversion records.

Table A-1: Colorado River Basin Aggregation Summary

Aggregation ID	Aggregation Name	Number of Structures	2005 Acres	2010 Acres
36_ADC017	Upper Blue River	52	1,356	1,331
36_ADC018	Blue River abv Green Mountain Rsvr	18	739	737
36_ADC019	Blue River bl Green Mountain Rsvr	22	1,302	1,102
37_ADC029	Eagle River abv Brush Creek	26	1,376	1,365
37_ADC030	Brush Creek	24	873	874
37_ADC031	Eagle River bl Gypsum	19	922	792
38_ADC033	Upper Roaring Fork	17	650	638
38_ADC034	Snowmass Creek	20	1,297	1,288
38_ADC035	Frying Pan River	13	363	276
38_ADC036	West Sopris Creek	16	651	654
38_ADC037	Roaring Fork abv Crystal	17	1,052	1,002
38_ADC038	Crystal River	13	924	918
38_ADC039	Cattle Creek	21	1,175	1,012
38_ADC040	Lower Roaring Fork	7	310	265
39_ADC041	Elk Creek	24	1,071	970
39_ADC045	Rifle Creek	19	807	488
45_ADC042	Colorado River bl Garfield Creek	32	1,500	1,223
45_ADC043	Colorado River bl Divide Creek	31	2,022	1,088
45_ADC044	Colorado R bl Mamm Creek	17	1,949	1,462
45_ADC046	Colorado River bl Beaver Creek	17	924	591
45_ADC047	Colorado River bl Cache Creek	23	1,561	851
45_ADC048	Colorado River nr De Beque	33	2,313	848
50_ADC012	Troublesome Creek	29	2,498	2,481
50_ADC013	Upper Muddy Creek	16	1,997	1,474
50_ADC014	Muddy Creek abv Tyler Ditch	21	1,252	1,168

Aggregation ID	Aggregation Name	Number of Structures	2005 Acres	2010 Acres
50_ADC015	Muddy Creek abv Red Dirt Creek	9	932	835
50_ADC016	Lower Muddy Creek	14	751	733
50_ADC020	Colorado River bl Kremmling	8	923	828
51_ADC001	Colorado River nr Granby	12	881	874
51_ADC002	Willow Creek	9	967	841
51_ADC003	Ranch Creek	6	876	839
51_ADC004	Fraser River bl Crooked Creek	10	743	743
51_ADC005	Tenmile Creek	27	2,018	1,971
51_ADC006	Fraser River at Granby	11	554	549
51_ADC007	Colorado River abv Hot Sulphur Springs	16	548	497
51_ADC008	Colorado River abv Williams Fork	17	825	764
51_ADC009	Upper Williams Fork	12	953	779
51_ADC010	Lower Williams Fork	16	975	984
51_ADC011	Colorado River abv Troublesome Creek	14	768	758
52_ADC021	Black Tail & Sheephorn Creek	57	1,706	1,614
52_ADC027	Colorado River abv Derby Creek	17	919	979
53_ADC022	Upper Egeria Creek	9	930	941
53_ADC023	King Creek	8	1,133	1,244
53_ADC024	Egeria Creek abv Toponas Creek	9	828	937
53_ADC025	Toponas Creek	10	554	554
53_ADC026	Colorado River abv Alkali Canyon	22	526	540
53_ADC028	Derby Creek	21	1,751	1,735
53_ADC032	Colorado River abv Glenwood Springs	62	1,844	1,863
70_ADC049	Upper Roan Creek	33	2,070	1,571
70_ADC050	Colorado River nr Cameo	18	1,011	785
72_ADC051	Plateau Creek abv Vega Rsvr	7	450	445
72_ADC052	Plateau Creek bl Vega Rsvr	6	910	891
72_ADC053	Salt Creek	16	1,135	1,077
72_ADC054	Upper Buzzard Creek	14	680	531
72_ADC055	Plateau Creek bl Buzzard Creek	17	1,216	1,159
72_ADC056	Upper Grove Creek	10	646	659
72_ADC057	Lower Grove Creek	7	901	682
72_ADC058	Kimball Creek	7	425	350
72_ADC059	Big Creek	26	1,218	1,109
72_ADC060	Cottonwood Creek	10	1,470	1,465
72_ADC061	Bull Creek	8	352	332
72_ADC062	Coon Creek	13	837	771
72_ADC063	Mesa Creek	10	911	871
72_ADC064	Plateau Creek	9	136	57
72_ADC065	Colorado River nr State Line	28	1,499	1,025

Table A-2 shows the number of structures in the “no diversions” (AND) aggregates and the total 2005 and 2010 acreage. None of the individual structures in the aggregates have recent diversion records.

Table A-2: No Diversion Aggregation Summary

Aggregation ID	Aggregation Name	# of Structures	2005 Acres	2010 Acres
36_AND017	Upper Blue River	7	255	259
36_AND019	Blue River bl Green Mountain Rsvr	1	272	271
37_AND029	Eagle River abv Brush Creek	4	114	163
37_AND030	Brush Creek	2	123	123
37_AND031	Eagle River bl Gypsum	1	20	20
38_AND035	Frying Pan River	9	226	258
38_AND037	Roaring Fork abv Crystal	6	672	530
38_AND038	Crystal River	9	435	120
38_AND036	West Sopris Creek	5	212	212
38_AND033	Upper Roaring Fork	6	127	121
38_AND040	Lower Roaring Fork	5	606	454
38_AND034	Snowmass Creek	2	103	103
38_AND039	Cattle Creek	4	356	250
39_AND041	Elk Creek	6	209	190
39_AND045	Rifle Creek	8	209	95
45_AND042	Colorado River bl Garfield Creek	10	136	128
45_AND044	Colorado R bl Mamm Creek	2	81	44
45_AND048	Colorado River nr De Beque	5	289	127
45_AND043	Colorado River bl Divide Creek	2	28	25
45_AND046	Colorado River bl Beaver Creek	1	15	9
50_AND016	Lower Muddy Creek	1	67	67
50_AND014	Muddy Creek abv Tyler Ditch	1	96	101
51_AND003	Ranch Creek	1	147	147
51_AND005	Tenmile Creek	2	100	63
51_AND006	Fraser River at Granby	4	140	140
51_AND004	Fraser River bl Crooked Creek	2	67	67
51_AND001	Colorado River nr Granby	2	75	75
51_AND010	Lower Williams Fork	1	44	44
53_AND032	Colorado River abv Glenwood Springs	5	43	43
52_AND021	Black Tail & Sheephorn Creek	8	120	90
53_AND028	Derby Creek	4	379	380
53_AND023	King Creek	1	24	24
53_AND026	Colorado River abv Alkali Canyon	2	28	32
53_AND025	Toponas Creek	1	53	73
50_AND020	Colorado River bl Kremmling	1	32	32
70_AND049	Upper Roan Creek	2	27	14
70_AND050	Colorado River nr Cameo	2	44	19

Aggregation ID	Aggregation Name	# of Structures	2005 Acres	2010 Acres
72_AND063	Mesa Creek	4	156	138
72_AND054	Upper Buzzard Creek	1	79	88
72_AND058	Kimball Creek	1	55	14
72_AND062	Coon Creek	4	106	107
72_AND056	Upper Grove Creek	1	19	19
72_AND065	Colorado River nr State Line	2	87	58
72_AND053	Salt Creek	1	12	12
72_AND051	Plateau Creek abv Vega Rsvr	2	38	38
72_AND061	Bull Creek	2	28	28
72_AND052	Plateau Creek bl Vega Rsvr	1	46	46
45_AND047	Colorado River bl Cache Creek	2	34	0

Table A-3 indicates the structures in the diversion systems and multi-structures.

Table A-3: Diversion System and Multi-Structure Summary

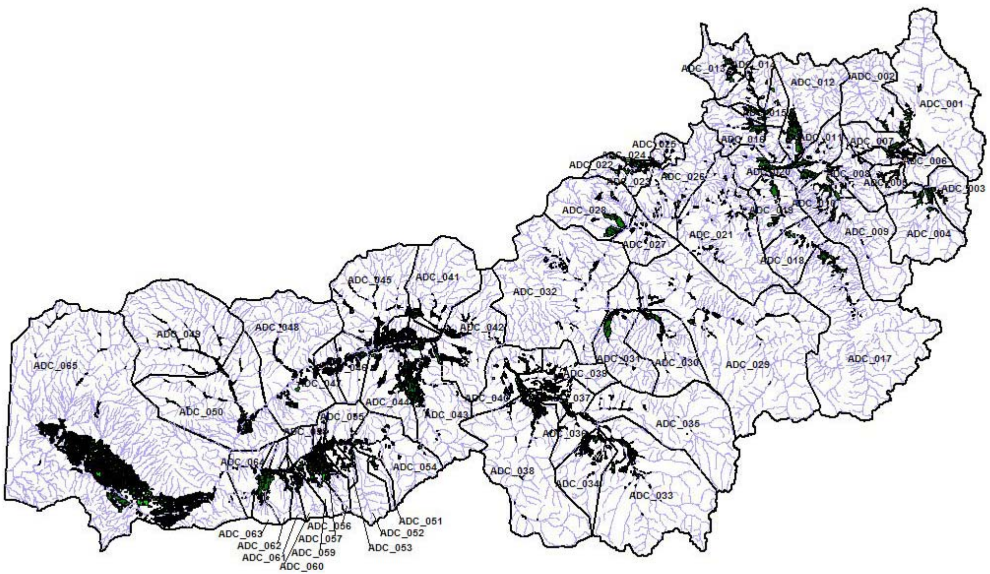
Diversion System ID	Diversion System Name	WDID
3600649_D HAMILTON DAVIDSON DIVSYS	HAMILTON DAVIDSON DITCH	3600649
	BRUSH CREEK DITCH	3600541
	UTE CREEK NO 1	3600849
	UTE CREEK NO 2	3600850
	UTE CREEK NO 3	3600851
	SLATE CREEK DITCH	3600800
	HIGHLINE DITCH (SLATE CR)	3600659
5100529_D BIG LAKE DIVSYS	BIG LAKE DITCH	5100529
	COBERLY BROTHERS DITCH	5100584
7200512_D ARBOGAST PUMP DIVSYS	ARBOGAST PUMPING PLANT 3	7200512
	ARBOGAST PUMPING PLANT	7201072
7200852_D RMG DIVSYS	R M G DITCH	7200852
	BUCKHORN DITCH	7200555
5000653_D TOM ENNIS DIVSYS	TOM ENNIS DITCH	5000653
	TOM ENNIS DITCH HGT NO 3	5000741
	TOM ENNIS DITCH HGT NO 2	5000756
4500576_D DIVIDE CREEK HIGHLINE DIVSYS	DIVIDE CREEK HIGHLINE D	4500576
	WILSON DITCH	4500828
4500693_D MINEOTA DIVSYS	MINEOTA DITCH	4500693
	ED CONNER DITCH	4500585
	DRY HOLLOW DITCH	4500574
7200730_D KIGGINS SALISBURY DIVSYS	KIGGINS SALISBURY DITCH	7200730
	OAK GLEN DITCH	7200810
7000583_D	ROAN CREEK NO 2 DITCH	7000583

Diversion System ID	Diversion System Name	WDID
ROAN CREEK NO 2 DIVSYS	BUMGARDNER WW DITCH	7000507
5300767_D HMS RELOCATED DIVSYS	H M S RELOCATED DITCH	5300767
	H M S DITCH	5301059
5100880_D SELAK LARRABEE DITCH DIVSYS	SELAK LARRABEE DITCH	5100880
	SELAK SUPPLEMENTAL DITCH	5100922
4500632_D HOLMES DIVSYS	HOLMES DITCH	4500632
	COTTONWOOD GULCH DITCH	4500558
3900546_D DAVENPORT DIVSYS	DAVENPORT DITCH	3900546
	SPRING DITCH	3900666
3801096_D WILLIAMS NO 2 DIVSYS	WILLIAMS NO 2 DITCH	3801096
	WILLIAMS NO 1 D CAP CR	3801095
3600776_D PHARO BAUER DIVSYS	PHARO BAUER DITCH	3600776
	PHARO BAUER NO 1 DITCH	3600777
3600868_D WESTLAKE DIVSYS	WESTLAKE DITCH	3600868
	CATARACT CREEK NO 2	3600555
3600662_D HOAGLAND DIVSYS	HOAGLAND CANAL (ELLIOT)	3600662
	HOAGLAND CANAL (BENTON)	3600946
	HOAGLAND CANAL (DEEP CR)	3601018
	HOAGLAND CANAL (MARTIN)	3601047
	HOAGLAND CANAL (SMITH)	3601020
	HOAGLAND CANAL (SPRING)	3601019
	HOAGLAND CANAL (SPRUCE)	3600945
	HOAGLAND CANAL (N SPRING)	3601048
	HOAGLAND CANAL (N SPRUCE)	3601049
3800880_D MT. SOPRIS DIVSYS	MOUNT SOPRIS DITCH	3800880
	MOUNT SOPRIS D PRINCE CR	3801633
5000734_D DEBERARD DIVSYS	DEBERARD DITCH	5000734
	DEBERARD DITCH OVFLW SYS	5000548
5300555_D DERBY DIVSYS	DERBY DITCH	5300555
	CABIN CREEK DITCH	5300519
	CABIN CREEK DITCH	5300521
*5101309_D FRASER RIVER DIVR PROJ	FRASER RIVER DIVERSION PROJECT - ST LOUI	5101309
	CROOKED CREEK SUPPLY D	5100593
*7201329_D RAPID CREEK PP DIVSYS	RAPID CREEK PUMPNG PLANT	7201329
	UTE PUMPING STATION	7201235
*7200820_D PARK CREEK DIVSYS	PARK CREEK DITCH (VEGA)	7200820
	PARK CREEK DITCH (PARK)	7200819
5100941 VAIL IRR MULTI	VAIL IRR SYS HGT NO 2	5100941
	VAIL IRR SYS HGT NO 1	5101231
5300883 WILSON AND DOLL DITCH DIVSYS	WILSON AND DOLL DITCH	5300883
	NOTTINGHAM PUMP	5200731
3600801	SMITH DITCH	3600801

Diversion System ID	Diversion System Name	WDID
SMITH DITCH DIVSYS	SUTTON NO 1 DITCH	3600832
**Carrier structures (not included in CU analysis)*		

Figure A-1 shows the spatial boundaries of each aggregation. **Exhibit A**, attached, lists the diversion structures represented in each aggregate. **Exhibit B** lists the diversion structures represented in each no diversion aggregate. Both **Exhibit A** and **Exhibit B** provide a comparison of the 2005 and 2010 irrigated acreage assigned to each structure.

Figure A-1: Aggregate Structure Boundaries



Recommendations

As part of this modeling update, various lists have been developed for review and reconciliation by the Water Commissioner. The lists include:

- Structures tied to irrigated acreage that do not have current diversion records
- Structures tied to irrigated acreage that do not have water rights for irrigation
- Structures that have current diversion records coded as irrigation use, but do not have irrigated acreage in either 2005 or 2010
- Structures that have irrigation water rights, but do not have irrigated acreage in either 2005 or 2010
- More than one structure is assigned to the same irrigated parcel, however there was no indication that the structures serve the same acreage in either diversion comments or water rights transaction comments.

Exhibit A: Diversion Structures in each Aggregate

Aggregation ID	Structure Name	WDID	2005 Acres	2010 Acres
36_ADC017 UPPER BLUE RIVER	BOBO DITCH	3600535	17	0
	BROWN ACORN DITCH	3600540	87	87
	BUFFALO DITCH	3600542	36	36
	C M OMER DITCH	3600569	75	75
	COLUMBINE DITCH	3600571	7	7
	DOMESTIC SUPPLY DITCH	3600591	15	15
	DUSING NO 1 DITCH	3600597	10	10
	EMMET BRUSH CREEK NO 3 D	3600609	25	25
	EMMET BRUSH CREEK NO 1 D	3600611	25	25
	FAMINE CREEK DITCH	3600617	21	21
	GILBERT DITCH	3600637	5	5
	GOULD DITCH	3600640	14	14
	HERBERT DITCH	3600654	24	24
	J F R DITCH	3600678	15	15
	LINDSTROM NO 1 DITCH	3600705	183	183
	LINDSTROM NO 2 DITCH	3600706	45	45
	LUND BLUE RIVER DITCH	3600717	26	26
	MARSHALL NO 1 DITCH	3600720	9	9
	MARSHALL NO 2 DITCH	3600721	29	29
	MARSHALL NO 4 DITCH	3600723	4	4
	MARYLAND NO 1 DITCH	3600726	49	47
	MARYLAND NO 2 DITCH	3600727	112	112
	MIDDLE BARTON NO 1 DITCH	3600741	14	15
	MIDDLE BARTON NO 2 DITCH	3600742	4	0
	NORTH ACORN DITCH HDG 1	3600759	8	8
	N P TREMBLAY DITCH	3600761	4	4
	OLD WHETSTONE SHEEP CR D	3600763	15	15
	PASS CREEK NO 1 DITCH	3600766	28	28
	ROBERTS IRRIGATING DITCH	3600791	14	14
	RUTH DITCH	3600794	39	40
	SARAH DITCH	3600795	25	25
	SAWMILL DITCH	3600797	42	48
	SONDREGGER DITCH	3600810	8	8
	SONDREGGER NO 2 DITCH	3600811	5	5
	SONDREGGER NO 3 DITCH	3600812	23	23
	SONDREGGER NO 4 DITCH	3600813	8	8
	SOUTH ROCK CREEK DITCH	3600816	31	28
	SPERRY DITCH	3600818	25	25
	SPERRY F W DITCH	3600819	25	25

	SWANSON ORO GRANDE DITCH	3600838	38	35
	VENDETT DITCH	3600852	23	16
	VALIER NO 2 DITCH	3600856	9	11
	VIE DITCH	3600857	25	25
	WAHLSTROM NO 4 DITCH	3600861	7	10
	WAHLSTROM NO 5 DITCH	3600862	7	7
	WHATLEY NO 2 DITCH	3600872	4	4
	WHATLEY NO 3 DITCH	3600873	13	11
	WHATLEY NO 4 DITCH	3600874	5	5
	WHATLEY NO 5 DITCH	3600875	11	11
	GUETZ-RUMACK DITCH	3600987	14	14
	INDEPENDENT BLUE (ACORN)	3600991	43	43
	GIBERSON HIGHLINE DITCH	3601017	11	11
36_ADC018 BLUE RIVER ABV GREEN MOUNTAIN RSVR	BLACK CREEK DITCH	3600526	72	72
	CLANCEY DITCH	3600567	29	29
	CLEAR CREEK DITCH HDG 1	3600568	12	12
	COW CAMP DITCH	3600577	12	12
	GARDEN DITCH	3600633	10	10
	GUTHRIE BROS DITCH	3600644	25	25
	GUYSELMAN DITCH	3600646	133	133
	GUYSELMAN NO 2 DITCH	3600647	17	17
	KNORR NO 1 DITCH	3600689	7	6
	KUMNIG NO 1 DITCH	3600691	86	86
	KUMNIG KNORR DITCH	3600696	40	40
	LEE BROS BEAVER CR NO 1	3600699	43	43
	LILLIAN DITCH	3600702	33	33
	MCDONALD DITCH	3600733	134	134
	MILLER DITCH	3600745	8	8
	MILLER NO 2 DITCH	3600746	42	42
	OTTER CREEK NO 1 DITCH	3600764	7	6
	NEW KUMNIG DITCH	3600966	30	29
36_ADC019 BLUE RIVER BL GREEN MOUNTAIN RSVR	BEAVER CREEK NO 1 DITCH	3600514	28	28
	BELL DITCH	3600517	18	18
	BELLS BLUE RIVER DITCH	3600520	30	30
	BUMGARNER NO 1 DITCH	3600545	11	11
	BUMGARNER NO 2 DITCH	3600546	11	11
	DRY CREEK DITCH (HDG 1)	3600593	47	47
	DRY CREEK NO 2 DITCH	3600595	160	26
	DRY CREEK NO 3 DITCH	3600596	79	79
	GRIGGS DITCH	3600643	211	147
	HEIL NO 1 DITCH	3600651	33	33
	HEIL NO 2 DITCH	3600652	33	33

	HEIL NO 3 DITCH	3600653	66	66
	INTAKE DITCH	3600675	28	28
	NOONEN DITCH	3600758	26	26
	SMITH NO 1 DITCH	3600802	307	307
	SPRING CREEK NO 1 DITCH	3600820	4	4
	SPRING CREEK NO 2 DITCH	3600821	19	16
	SPRING CREEK NO 3 DITCH	3600822	32	32
	STAFFORD BLUE RIVER DITC	3600827	61	61
	STAFFORD GREEN MTN DITCH	3600828	46	46
	WILLIAMSON DITCH	3600876	41	41
	HIGH DITCH	3600903	11	11
37_ADC029 EAGLE RIVER ABV BRUSH CREEK	ALKALI DITCH	3700502	175	175
	ARMINDA DITCH	3700505	4	4
	CASTEEL DITCH	3700531	36	36
	CASTLE NO 1 DITCH	3700534	28	28
	CASTLE NO 2 DITCH	3700535	78	75
	COWEN DITCH	3700557	53	53
	A B DEGRAW DITCH	3700563	24	24
	F E W NO 2 DITCH	3700597	57	57
	F E W NO 4 DITCH	3700599	57	57
	GRAHAM DITCH	3700614	149	149
	HAWLEY AND REESE DITCH	3700632	60	60
	BERT HYDE DITCH	3700662	37	65
	MUDDY DITCH	3700721	50	50
	MUDDY CREEK DITCH	3700722	8	8
	NEILSON PUMP LINE DITCH	3700724	13	13
	SHERWOOD DITCH	3700801	25	25
	BERT SIDDELL DITCH	3700803	63	63
	SMITH & PALLISTER DITCH	3700809	7	7
	TOURVILLE NO 1 DITCH	3700833	24	24
	TOURVILLE NO 2 DITCH	3700834	18	18
	WELSH DITCH	3700853	14	14
	WILKINSON DITCH	3700858	41	41
	CASTLE DITCH	3700906	179	139
	VAIL GOLF COURSE DITCH	3701156	94	96
	PINEY VALLEY RANCH DITCH	3701243	9	9
	GROFF DITCH COTTONWD ENL	3701277	74	74
37_ADC030 BRUSH CREEK	BEECHER CREEK DITCH	3700509	5	0
	BEMIS DITCH	3700510	4	4
	CRANN DITCH	3700559	8	8
	DITCH NO 1 DITCH	3700566	12	12
	DITCH NO 2 DITCH	3700567	5	5

	DITCH NO 3 DITCH	3700568	26	26
	EAST FROST DITCH	3700585	81	81
	FROST DITCH	3700604	64	64
	HASHBERGER DITCH	3700628	21	21
	LAURA A HOCKETT DITCH	3700640	22	27
	HOLLINGSWORTH POTTER D	3700643	59	44
	HOLLINGSWORTH POTTER NO2	3700644	25	55
	J P O NO 1 DITCH	3700667	1	2
	J P O NO 2 DITCH	3700668	1	2
	LOVE FROST DITCH	3700685	40	40
	MCKENZIE DITCH	3700704	94	94
	OLESON DITCH	3700741	26	13
	BOB REID DITCH	3700776	51	51
	ROBERTSON DITCH	3700778	5	5
	RUSSELL DITCH	3700785	17	17
	SCHUMM NO 1 DITCH	3700793	73	73
	SQUIRES DITCH NO 1	3700818	17	16
	SQUIRE & HAMMOND DITCH	3700820	134	134
	ZARTMAN DITCH	3700871	81	81
37_ADC031 EAGLE RIVER BL GYPSUM	COLLINS NO 2 DITCH	3700550	14	14
	COOLEY L E NO 1 DITCH	3700551	1	2
	ERICKSON NO 1 DITCH	3700594	4	4
	ERICKSON NO 2 DITCH	3700595	10	10
	GRUNDELL BROS DITCH	3700620	11	11
	MCBRAYER DITCH	3700698	28	28
	MCBRAYER & FENNER DITCH	3700699	315	157
	MILLER DITCH	3700712	44	44
	MUCKEY DITCH	3700720	37	37
	NELSON DITCH	3700725	49	52
	PHILLIPS DITCH	3700761	244	244
	SCHUMM NO 2 DITCH	3700794	7	22
	CASPER SCHUMM DITCH	3700795	23	31
	SKIFF AND SCHLIFF DITCH	3700807	2	2
	SUNDELL DITCH NO 1	3700824	44	44
	Y & V DITCH NO 4	3700868	35	35
	BEST DITCH	3701111	5	5
	BEARD PUMP	3701236	8	10
	WILSON SWAMP DRAIN DITCH	3701280	42	42
38_ADC033 UPPER ROARING FORK	BRUSH CREEK DITCH	3800556	130	128
	CERISE DITCH	3800580	64	40
	CHRISTOPHER SOUTH DITCH	3800590	19	0
	DAVIGNON DITCH	3800627	14	14

	EVERGREEN DITCH	3800666	-999	46
	LAST CHANCE DITCH	3800813	50	50
	LEMOND DITCH	3800814	17	16
	MCPHERSON DITCH	3800895	27	27
	NELLIE BIRD DITCH	3800904	10	10
	WENGER DITCH	3801084	49	49
	WHEATLEY DITCH	3801090	38	14
	BIONAZ DITCH	3801109	25	25
	BIVERT DITCH	3801110	30	30
	JOTE SMITH DITCH	3801145	70	70
	HAYDEN PEAK DITCH NO 2	3801241	-999	12
	COLLINS CREEK DITCH EXT	3801485	25	25
	LITTLE WOODY DITCH	3801549	83	83
38_ADC034 SNOWMASS CREEK	BROWN DITCH	3800554	17	17
	FORKER DITCH	3800684	35	35
	HORGAN DITCH	3800761	88	88
	JACOBSON & SOLBERG DITCH	3800785	46	46
	STEWART NO 1 DITCH	3800788	4	0
	LIME CREEK DITCH	3800824	56	56
	LINDVIG DITCH	3800825	7	7
	LITTLE ELK DITCH	3800830	185	200
	LUTZ DITCH	3800844	6	6
	MCPHERSON NO 1 DITCH	3800896	61	61
	PERRY DITCH	3800937	12	12
	POWELL MCKENZIE DITCH	3800946	55	55
	ROWNAN & JACOBSON DITCH	3800974	46	46
	SANDY DITCH	3800984	58	58
	SNOWMASS DITCH	3801011	147	148
	STAATS HARMON DITCH	3801023	232	224
	TANDY DITCH	3801041	-999	13
	WALTER DITCH	3801079	155	155
	WILLIAMS NO 4 DITCH	3801098	76	47
	GEORGE DITCH	3801289	13	13
38_ADC035 FRYING PAN RIVER	ALVIN SLOSS DITCH	3800506	45	44
	BIGLOW DITCH NO 219	3800540	11	11
	DAN GERMAN DITCH	3800626	17	17
	DAVISON DITCH	3800629	20	20
	DESERT DITCH FRENCHMAN C	3800638	7	7
	DOWNEY DITCH NO 1	3800642	48	48
	EUREKA DITCH	3800668	72	0
	FRENCHMAN CREEK D NO 1	3800696	62	48
	JAKEMAN DITCH	3800782	12	12

	SMITH TONER CREEK D NO 2	3801009	12	12
	SPRING CREEK DITCH	3801020	11	11
	FRENCHMAN CREEK D NO 2	3801160	11	11
	JOUFLAS DITCH HGT 2	3801673	37	37
38_ADC036 WEST SOPRIS CREEK	BUCK PASTURE DITCH	3800558	13	13
	CERISE BROS NO 1 DITCH	3800583	30	30
	CERISE BROS NO 2 DITCH	3800584	25	25
	CERISE ARBANEY DITCH	3800585	3	3
	DAVIS DITCH	3800628	17	17
	EAST MESA DITCH SOPRIS C	3800652	15	15
	GOOD FRIEND DITCH	3800713	29	29
	HATCH DITCH	3800742	31	31
	HIGHLAND NO 2 DITCH	3800752	63	63
	JACOBS DITCH	3800780	82	82
	LIGHT AND LIGHT DITCH	3800820	29	29
	MILLER DITCH	3800873	19	19
	SOPRIS HIGHLINE DITCH	3801015	166	169
	SWEARINGEN DITCH	3801035	8	8
	KELEY DITCH	3801149	114	114
	DRY CREEK DITCH	3801271	6	6
38_ADC037 ROARING FORK ABV CRYSTAL	FLYNN DITCH	3800681	74	72
	GOULD DITCH	3800714	62	62
	GRANGE AND CERISE DITCH	3800716	89	89
	HARDING SPRING W W DITCH	3800731	71	28
	JOHN CERISE DITCH	3800784	8	3
	KELLEY DITCH	3800791	153	156
	KELLY POND & SPRING 2 D	3800795	122	122
	LYONS DITCH	3800846	53	53
	MIDDLE DITCH	3800868	82	82
	MCCARTHY WWD & UPPER EXT	3800885	9	9
	NORTHSIDE PIONEER DITCH	3800908	44	44
	NORTH SPRINGS	3800910	19	19
	OXFORD NO 2 DITCH	3800921	91	91
	PATTERSON AND CUMMINS D	3800931	93	91
	SMITH NO 1 DITCH	3801001	3	4
	SMITH NO 2 DITCH	3801002	15	15
	JOHN J DITCH	3801125	64	64
38_ADC038 CRYSTAL RIVER	BANE DITCH	3800521	136	136
	BANE & THOMAS DITCH	3800522	135	135
	CLOUD DITCH	3800600	10	10
	COLPITTS DITCH NO 1	3800607	25	20
	DOOLEY DITCH	3800640	16	16

	EDGERTON DITCH	3800655	79	79
	EDGERTON SPG & WASTE D	3800656	78	78
	GRAY DITCH	3800719	93	93
	HELMS DITCH	3800747	141	141
	LOST BASIN DITCH	3800835	140	140
	NORTHSIDE THOMPSON D	3800909	27	27
	THOMPSON DITCH	3801131	28	28
	TYBAR DITCH AND PIPELINE	3801511	16	14
38_ADC039 CATTLE CREEK	C AND L HIGHLINE DITCH	3800568	70	70
	COULTER WEST SIDE DITCH	3800613	123	123
	DELCON SPRING GULCH D	3800637	4	4
	FONDER DITCH	3800683	18	10
	H C AND L DITCH	3800725	65	65
	HEUSCHKEL AND CHAPMAN D	3800750	21	21
	MASON DITCH	3800860	19	16
	MCNULTY NO 2 DITCH	3800878	73	38
	MCNULTY DITCH	3800894	73	38
	PAT MCNULTY NO 1 DITCH	3800927	9	9
	PAT MCNULTY NO 2 DITCH	3800928	11	11
	PRIOR DITCH	3800949	76	76
	RALSTON NO 1 DITCH	3800953	72	72
	SHEAFFER DITCH	3800987	25	13
	STATON DITCH	3801027	54	14
	WEST HIGHLINE DITCH	3801088	93	93
	WATERS DITCH	3801133	24	24
	LAURENCE DITCH	3801134	258	227
	KEETON & EMISON DITCH	3801148	46	46
	FONDER DITCH NO 2	3801177	24	24
	KEETON & EMISON DITCH AP	3801867	18	18
38_ADC040 LOWER ROARING FORK	BUCK FARM DITCH	3800557	98	98
	DEARING DITCH	3800635	24	24
	GRISTY DITCH	3800724	2	2
	HARDWICK DITCH	3800732	133	96
	LIGNITE NO 2 DITCH	3800823	25	25
	LYNCH DITCH	3800845	21	21
	SMART AND GREEN DITCH	3800997	7	0
39_ADC041 ELK CREEK	BENSON PIERSON NELSON D	3900510	39	29
	C O & C P PIERSON	3900525	74	63
	CLINETOP DITCH NO 1	3900530	32	16
	CLINETOP DITCH	3900531	53	53
	CONNALLY DITCH	3900536	25	24
	EDWARD B JORDAN DITCH	3900556	6	6

	HARRIS NO 2 DITCH	3900579	2	2
	JENNINGS NO 1 DITCH	3900592	68	68
	JENNINGS NO 2 DITCH	3900593	57	46
	LARSON DITCH	3900603	9	9
	NEW HARRIS DITCH	3900626	16	5
	OAK GROVE DITCH	3900633	59	59
	RYDEN SPRING DITCH	3900654	16	14
	RYDEN NO 2 DITCH	3900655	7	0
	RYDEN NO 1 DITCH	3900656	118	118
	RED GLEN HIGHLINE DITCH	3900657	165	165
	SAINT NO 2 DITCH	3900661	140	124
	SAMPLE NO 1 DITCH	3900662	4	4
	TROUT DITCH	3900674	71	71
	W E DITCH	3900688	4	5
	WAGGONER DITCH	3900689	51	31
	WHITTINGHAM DITCH	3900693	36	38
	PARK DITCH	3900810	2	2
	HADLEY CONSOLIDATED D	3900934	16	16
39_ADC045 RIFLE CREEK	CLARK DITCH	3900529	27	26
	G E HARRIS DITCH	3900566	39	36
	G E HARRIS NO 2 DITCH	3900567	56	56
	HARRIS WASTE WATER DITCH	3900580	59	59
	HEINZE DITCH	3900582	23	15
	LAKE DITCH	3900602	-999	20
	MANNING DITCH	3900614	69	62
	MCKEAL NO 1 DITCH	3900616	95	31
	MULLEN DITCH	3900625	78	64
	NELSON DITCH	3900627	13	13
	PERRY SPRINGS & DITCH	3900637	2	0
	PIONEER DITCH	3900640	23	0
	RIFLE CREEK NO 1 DITCH	3900646	51	51
	STODDARD DITCH	3900667	9	9
	WISDOM DITCH	3900695	119	25
	YOUKER DITCH	3900699	3	3
	C W D DITCH	3900706	104	0
	MCKEAL NO 3 DITCH	3900723	31	13
	BELL COLLECTION DITCH	3900900	5	5
45_ADC042 COLORADO RIVER BL GARFIELD CREEK	BAXTER NO 2 DITCH	3900506	17	17
	BAXTER SP BR & WASTE W	3900507	46	46
	BUSTER NO 1 DITCH	3900521	1	2
	DALLS DITCH	3900545	105	105
	HERMITAGE DITCH	3900584	22	22

	KEYSER DITCH	3900601	16	16
	LEWIS NO 1 DITCH	3900608	9	9
	MINGS CHENOWETH WOLVERTO	3900618	25	25
	POSSUM CREEK DITCH	3900641	1	1
	POSSUM NO 1 DITCH	3900642	5	5
	REYNOLDS AND CAIN DITCH	3900659	22	23
	URQHART DITCH	3900680	19	19
	WARNER DITCH	3900690	4	5
	ROCK-N-PINES NO 1 DITCH	3900827	104	104
	BUD DITCH	4500530	78	80
	BUD NO 2 DITCH	4500531	56	57
	COOLEY NO 1 DITCH	4500554	17	17
	COOLEY NO 2 DITCH	4500555	33	33
	ENTERPRISE DITCH	4500593	121	0
	HARRINGTON DITCH	4500621	9	9
	LAKE DITCH	4500665	54	48
	MOORE DITCH	4500695	2	0
	STARBUCK DITCH	4500779	78	82
	STARBUCK AND PAXTON D	4500780	19	0
	WARD DOW & TAYLOR DITCH	4500809	48	43
	WILLIAMS DITCH NO 1	4500823	30	30
	WILLIAMS JOINT DITCH	4500826	46	49
	YOUNG AND HESS DITCH	4500834	45	45
	YULE AND COOLEY DITCH	4500836	150	143
	MICKLISH NO 2 DITCH	4500837	19	6
	DWIRE DITCH	4501055	50	50
	VULCAN DITCH	4504725	246	131
45_ADC043 COLORADO RIVER BL DIVIDE CREEK	PYEATT AND CLAVEL DITCH	3900644	9	9
	A F SOMMER DITCH NO 1	4500500	24	24
	A F SOMMER DITCH NO 2	4500501	-999	63
	BUNN DITCH NO 1	4500534	20	0
	BURNETT DITCH	4500535	23	23
	CABE AND SKIFF DITCH	4500536	5	6
	CLEAR CREEK DITCH	4500550	257	198
	CROOKED DITCH	4500561	13	6
	DAVIS DITCH	4500564	24	12
	EAST CORRAL CREEK DITCH	4500580	16	13
	HAHN AND OTTEN DITCH	4500618	33	5
	HIGHEST DITCH	4500628	34	34
	HODGSON NO 1 DITCH	4500630	14	3
	JOHNSON DITCH E DIVIDE	4500649	29	190
	JUNE CREEK DITCH	4500655	9	9

	KAMM AND DAVIS DITCH	4500656	919	0
	KING DITCH	4500660	41	38
	KING HEATHERLY DITCH	4500661	101	98
	J LARSON DITCH	4500666	10	10
	MOSQUITO DITCH	4500699	27	27
	PENNY IRR DITCH NO 1	4500719	161	147
	POLE CREEK DITCH	4500724	34	34
	PROBASCO WASTE WATER D	4500728	21	21
	SCHATZ DITCH	4500755	69	0
	STOBAUGH DITCH	4500782	20	26
	WEST CORRAL CREEK DITCH	4500816	8	9
	BUNN DITCH NO 2	4500843	34	34
	PORTER PUMP & DIVR D	4500846	18	0
	RENO DITCH NO 1	4500849	6	6
	OTTEN DITCH NO 1	4500940	4	4
	HALLS GULCH DITCH	4501144	38	38
45_ADC044 COLORADO R BL MAMM CREEK	COLEMAN DITCH	3900538	5	4
	STOBAUGH D PUMP	3900980	11	0
	BERNUDY DITCH	4500524	26	26
	BOULTON AND BANTA DITCH	4500528	178	142
	CHADWICK DITCH	4500544	34	0
	EMANUEL GANT DITCH	4500592	101	84
	HUNTER AND GANT DITCH	4500637	409	300
	JONATHAN GANT DITCH	4500653	56	56
	NUCKOLLS DITCH	4500710	366	320
	SLIDING DITCH	4500764	116	0
	UPPER MAMM CREEK DITCH	4500800	219	242
	NANCY SPRING NO 2	4500842	10	8
	BARBARA SPRING NO 1	4500885	10	8
	RAINBOW DITCH	4501079	53	25
	LAST RESORT D-DRY HOLLOW	4501127	335	245
	COUEY SPRING NO 1	4501135	15	0
	BANTA SPRING DITCH	4501146	4	0
45_ADC046 COLORADO RIVER BL BEAVER CREEK	LANGSTAFF DITCH	3900604	11	6
	BEAVER CREEK DITCH	4500518	7	7
	CLAUSEN DITCH	4500548	72	56
	DAME DITCH	4500562	54	54
	HANN DITCH	4500619	28	25
	HILL DITCH	4500629	122	16
	J A CLARK DITCH	4500641	94	52
	LEE DITCH	4500670	121	78
	OCONNOR DITCH	4500713	85	67

	RUSTLER DITCH	4500751	49	16
	SMITH DITCH	4500766	103	71
	SMITH AND NEVE DITCH	4500768	71	71
	YOUNG MACKAY & OCONNOR D	4500835	37	0
	ANDERSON INTERCEPTION D	4500870	4	4
	MCCARNES SPRING NO 2	4500925	6	6
	RANCHO TRES WELL NO 1	4505166	51	57
	HILLTOP FARM WELL NO 2	4505310	8	7
45_ADC047 COLORADO RIVER BL CACHE CREEK	MOSBY PUMP AND PL NO 2	3900789	44	0
	BERNKLAU DITCH	4500523	86	40
	CAMP BIRD DITCH	4500538	270	238
	CEADER DITCH	4500541	6	6
	DILLMAN DITCH	4500567	53	14
	GRAVES SPRINGS	4500611	16	16
	HUMMING BIRD DITCH	4500636	110	75
	IVY SPRINGS WASTE WTR D	4500640	11	12
	JAY BIRD DITCH	4500645	92	5
	MARTIN AND KENNEDY DITCH	4500689	442	218
	MOCKING BIRD DITCH	4500694	51	5
	OBRIEN AND BAUMGARTNER D	4500711	51	51
	OBRIEN FEEDER DITCH	4500712	17	0
	R AND A G ANDERSON DITCH	4500730	94	23
	SPRING CREEK DITCH	4500772	88	64
	FORSHEE GATHERING D NO 2	4500903	15	8
	SPRING DITCH NO 1	4500948	18	13
	SPRING DITCH NO 2	4500949	18	13
	SPRING DITCH NO 3	4500950	18	13
	MAHAFFEY GATHERING D NO1	4501072	17	7
	MAHAFFEY GATHERING D NO2	4501073	17	7
	CANARY BIRD (EAST)	4501133	19	14
	HILLTOP FARM WELL NO 1	4505309	8	7
45_ADC048 COLORADO RIVER NR DE BEQUE	BENSON AND BARNETT DITCH	3900509	38	38
	DAISY DITCH	3900544	25	18
	DIAMOND DITCH	3900549	7	2
	EVANS DITCH	3900558	15	0
	GARDEN GULCH NO 2 DITCH	3900565	14	14
	JENSEN DITCH	3900594	104	41
	MCKEAL NO 2 DITCH	3900617	96	0
	PURDY DITCH	3900643	9	9
	WOODTICK DITCH	3900698	160	0
	VAN HORN PUMP	3900989	13	0
	BAKER DITCH	4500511	60	60

	DOBEY DITCH	4500570	27	5
	EGBERT SPRING DITCH NO 1	4500588	39	0
	ESTELLA DITCH	4500595	96	0
	HEWITT AND MILBURN DITCH	4500625	104	82
	HOMESTAKE DITCH	4500633	134	71
	KNIGHT PUMP & PIPELINE	4500662	43	36
	LONE STAR DITCH	4500674	211	73
	MESA DITCH	4500691	189	191
	MUSCONETCONG DITCH	4500706	119	28
	NUMBER ONE DITCH	4500708	11	11
	OLD TRUSTY DITCH	4500714	491	0
	PETE AND BILL DITCH	4500721	4	0
	R F DITCH	4500732	9	4
	RIVERS DITCH	4500744	14	2
	SHUTT DITCH	4500758	13	5
	TANNEY NO 2 DITCH	4500792	40	40
	TENDERFOOT DITCH	4500796	63	63
	WANDERING JEW DITCH	4500808	119	32
	FORSHEE GATHERING D NO 1	4500902	15	8
	BAKER SPRINGS	4501048	9	3
	HAYWARD & WYATT ENLG	4501122	20	10
	LAVA DITCH	7200742	3	3
50_ADC012 TROUBLESOME CREEK	BECKER NO 1 DITCH	5000515	41	41
	BECKER NO 2 DITCH	5000516	120	120
	BECKER NO 4 DITCH	5000518	14	14
	BECKER NO 5 DITCH	5000519	34	34
	BIG SPRING DITCH	5000523	5	5
	CARLSON DITCH	5000530	123	123
	CHARLEY NO 2 DITCH	5000533	2	2
	CHRIS NO 1 DITCH	5000534	28	28
	CHRIS NO 2 DITCH	5000535	123	123
	EAST FORK DITCH	5000565	43	43
	KIRTZ DITCH NO 1	5000592	18	18
	KIRTZ DITCH NO 3	5000594	18	18
	MILLER SPRINGS DITCH	5000604	40	40
	MRS A KING DITCH	5000608	243	226
	MUNKERS DITCH	5000609	66	66
	PARADISE DITCH	5000625	16	16
	ROUND CREEK DITCH	5000639	1	1
	TOM ENNIS D (SERREL LAT)	5000644	48	48
	SIX DIAMOND DITCH	5000645	210	210
	STAR GULCH DITCH	5000649	31	31

	STAR GULCH DITCH NO 2	5000650	49	49
	WHEATLEY DITCH NO 1	5000661	109	109
	WHEATLEY DITCH NO 2	5000662	109	109
	WHEATLEY DITCH NO 3	5000663	109	109
	WHEATLEY DITCH NO 4	5000664	109	109
	ZWAHLEN NO 1 DITCH	5000667	171	171
	CLIFF DITCH HGT NO 3	5000732	366	366
	CLIFF D MID STUART DIVR2	5000733	36	36
	CLIFF D MID STUART DIVR1	5000742	214	214
50_ADC013 UPPER MUDDY CREEK	ALBERT CREEK DITCH	5000501	309	309
	ALBERT CREEK DITCH NO 3	5000503	297	297
	ALFRED ARGAHALIE DITCH	5000504	66	66
	ALFRED ARGAHALIE DITCH 3	5000505	232	257
	ALFRED ARGAHALIE DITCH 4	5000506	116	91
	D H RIGGLE DITCH NO 1	5000544	77	55
	D H RIGGLE DITCH NO 2	5000545	122	0
	DIAMOND CREEK DITCH	5000550	23	23
	MILK CREEK DITCH	5000603	161	0
	MCGEE DITCH	5000615	249	57
	P J MARTIN DITCH	5000624	196	171
	MARTIN OUTLET DITCH	5000674	11	11
	ALBERT CREEK DITCH NO 4	5000681	9	9
	BASIN DITCH	5000683	58	58
	COLBURN DITCH NO 1	5000687	27	27
	COLBURN DITCH NO 2	5000688	44	44
50_ADC014 MUDDY CREEK ABV TYLER DITCH	WEGGENMAN DITCH NO 2	5000659	35	35
	ADOLPH DITCH	5000500	54	54
	ANTON HEINI DITCH	5000511	71	71
	BADGER CREEK DITCH NO 1	5000513	24	24
	BADGER CREEK DITCH NO 2	5000514	40	0
	CARTER CREEK DITCH	5000531	83	83
	DUNNING DITCH	5000563	56	56
	DIETRICH DITCH NO 2	5000564	34	34
	HEINI AND OAKS DITCH	5000577	110	110
	HEINI DITCH NO 5	5000580	62	62
	HEINI DITCH NO 6	5000581	36	36
	HERMAN DITCH	5000583	36	36
	HILL CREEK DITCH	5000584	203	203
	LINDSEY CREEK DITCH	5000599	94	94
	MCBRIDE DITCH	5000610	30	30
	MCBRIDE NO 2 DITCH	5000611	7	7
	RITSCHARD DITCH	5000638	144	144

	TAILOR DITCH	5000652	58	14
	WEGGENMAN DITCH	5000658	25	25
	BADGER CREEK DITCH NO 3	5000682	15	15
	DUNNING DITCH NO 2	5000774	34	34
50_ADC015 MUDDY CREEK ABV RED DIRT CREEK	ANTELOPE DITCH	5000509	33	31
	ANTELOPE CREEK NO 2 DITC	5000510	106	106
	DIETRICH DITCH NO 2	5000552	151	58
	PINTO CREEK DITCH	5000631	282	282
	SHIP DITCH	5000677	12	11
	HEINI-KRAMER DITCH	5000678	30	30
	LEWIS EXTENSION DITCH	5000679	12	11
	SCHULER NO 2 DITCH	5000720	275	275
	SCHULER NO 3 DITCH	5000760	32	32
50_ADC016 LOWER MUDDY CREEK	ALBERT KEYES DITCH	5000507	103	103
	ARNOLD DITCH	5000512	59	59
	COLUMBINE DITCH	5000540	25	25
	CRAZY MANS DITCH	5000542	31	29
	HARRISON DITCH	5000575	52	52
	HAZEL CREEK DITCH	5000586	19	19
	INFANGER DITCH NO 2	5000589	210	195
	PINNEY DITCH NO 1	5000629	8	8
	PINNEY DITCH NO 2	5000630	59	59
	SCHWAB DITCH	5000641	38	38
	SMITH DITCH HGT 1	5000647	43	43
	RENO GRAVITY PIPELINE	5000711	18	18
	SMITH DITCH HGT 2	5000738	43	43
	SMITH DITCH HGT 3	5000739	43	43
50_ADC020 COLORADO RIVER BL KREMMLING	ENNIS PUMP DITCH SYSTEM	5000566	126	143
	T A ENGLE DITCH NO 1	5000651	34	34
	MCELROY STATE PUMP NO 1	5000755	272	160
	HOLDCROFT PUMP NO 1	5101274	76	76
	MARTIN PUMP NO 1 DITCH	5300694	114	114
	STRAWBERRY DITCH	5300816	28	28
	JONES OUTLET DITCH	5301068	137	137
	SIPHON DITCH	5301144	137	137
51_ADC001 COLORADO RIVER NR GRANBY	CHESTER DITCH	5100580	50	50
	GEORGE BUNTE NO 2 DITCH	5100663	48	48
	HANSCOME DITCH	5100703	222	222
	HARRY BUNTE DITCH	5100707	25	25
	KOERBER DITCH	5100768	188	188
	PINE DITCH	5100833	7	7
	RAEDEL DITCH	5100841	94	94

	SPITZER HIGHLINE DITCH	5100906	92	92
	BARR DITCH	5100974	8	8
	DIGOR DITCH	5101048	18	16
	PITCHER DITCH	5101120	60	60
	RED TOP VALLEY DITCH	5101315	70	64
51_ADC002 WILLOW CREEK	CURTIS DITCH -16	5100596	299	173
	JOHNSON DITCH	5100742	112	112
	MCQUEARY NO 1 DITCH	5100818	19	19
	MCQUEARY NO 2 DITCH	5100819	67	67
	RAY DITCH	5100847	77	77
	SHERIFF DITCH -24	5100921	67	67
	TERRELL NO 2 DITCH	5100930	121	121
	WILLOW DITCH -316	5100962	40	40
	DIAMOND BAR T NO 3 D	5100987	165	165
51_ADC003 RANCH CREEK	AXEL DITCH	5100513	63	63
	DIAMOND BAR TEE NO 2 D	5100606	165	165
	GRANITE DITCH	5100681	62	25
	HARTSHORN DITCH	5100708	64	64
	HURD CREEK DITCH	5100727	281	281
	KLEIN DITCH	5100767	242	242
51_ADC004 FRASER RIVER BL CROOKED CREEK	ALGER DITCH	5100504	64	64
	COZENS DITCH	5100592	119	119
	FOWLER DITCH	5100635	8	8
	GEHMAN AND JUST DITCH	5100661	144	143
	HAMMOND NO 3 DITCH	5100701	21	21
	INDEPENDENT DITCH	5100729	50	50
	POLE CREEK DITCH NO 2	5100836	42	42
	SKUNK CREEK DITCH	5100888	117	117
	TYRON DITCH	5100936	128	128
	SWANSON DITCH NO 1	5100971	50	50
51_ADC005 TENMILE CREEK	BECK DITCH	5100521	232	232
	BEHRENS DITCH	5100522	42	42
	BUTTON NO 1 DITCH	5100554	60	60
	BUTTON NO 2 DITCH	5100555	35	35
	BUTTON NO 3 DITCH	5100556	35	35
	BUTTON NO 4 DITCH	5100557	250	331
	BUTTON NO 6 DITCH	5100559	34	34
	BUTTON NO 7 DITCH	5100560	34	34
	BUTTON NO 8 DITCH	5100561	51	51
	CENTER DITCH	5100579	95	95
	COINE DITCH	5100586	124	124
	EGGER NO 1 DITCH	5100614	42	76

	EGGER NO 3 DITCH	5100616	64	64
	F W LINKE DITCH	5100650	42	29
	F W LINKE DITCH NO 2	5100651	44	82
	F W LINKE NO 3 DITCH	5100652	4	4
	HALKOWEIZ DITCH	5100693	74	74
	HOLWORTH NO 1 DITCH	5100696	22	22
	HOLWORTH NO 2 DITCH	5100697	22	22
	HERSHEY DITCH	5100710	95	95
	HOME DITCH	5100714	42	42
	LINKE NO 2 DITCH	5100779	89	89
	MCNERNY DITCH	5100815	218	30
	NINE MILE DITCH	5100820	165	165
	ROHRACKER NO 2 DITCH	5100863	41	41
	ROHRACKER NO 3 DITCH	5100864	41	41
	ROHRACKER NO 4 DITCH	5100865	22	22
51_ADC006 FRASER RIVER AT GRANBY	DEBERARD DITCH -150	5100602	202	197
	GEORGE SNIDER DITCH	5100665	25	25
	GRANBY NO 1 DITCH	5100677	66	66
	JAMES SNIDER DITCH	5100735	2	2
	MUELLER DITCH -31	5100806	2	2
	MUELLER DITCH -56	5100807	40	40
	SIMPSON DITCH	5100923	82	82
	FRONTIER DITCH	5101286	37	37
	WILLISS NO 1 DITCH	5101294	19	19
	BAYLIS DITCH NO. 1	5101347	40	40
	BAYLIS DITCH NO. 2	5101367	40	40
51_ADC007 COLORADO RIVER ABV HOT SULPHUR SPRINGS	ARTHUR G BLANEY D PL	5100512	34	34
	DENNIS DITCH	5100603	43	43
	HORN DITCH NO 2	5100718	62	31
	KINNEY DITCH	5100764	9	14
	LOVE GLESSNER DITCH	5100787	14	14
	MARIETTA DITCH	5100791	63	44
	MCQUEARY DITCH 42	5100817	57	48
	REINHARDT NO 1 DITCH	5100853	28	28
	REINHARDT NO 2 DITCH	5100854	28	28
	REINHARDT NO 3 DITCH	5100855	28	28
	WASATCH DITCH	5100950	53	53
	WILLOW DITCH -322	5100963	13	13
	ISLAND DITCH	5100986	23	28
	JACQUES DITCH NO 2	5101076	42	42
	MATHEW SHERIFF D NO 1	5101172	27	27
	COYOTE DITCH NO 2	5101329	23	23

51_ADC008 COLORADO RIVER ABV WILLIAMS FORK	AMELIA WILLIAMS DITCH	5100508	28	28
	BUTTON NO 5 DITCH	5100558	42	42
	BYERS DITCH NO 2	5100563	87	87
	BYERS NO 5 DITCH	5100566	43	43
	DOLLOFF DITCH	5100608	60	0
	JONES NO 3 DITCH	5100747	50	50
	LITTLE MUDDY DITCH	5100783	30	30
	RAUH NO 1 DITCH	5100845	28	28
	RAUH NO 2 DITCH	5100846	41	41
	REINI BROTHERS DITCH	5100856	144	144
	SMITH DITCH	5100889	18	18
	SMITH NO 2 DITCH	5100890	99	99
	STANLEY DITCH	5100903	19	19
	UTE BILL DITCH NO 1	5100938	32	32
	WILKINS DITCH	5100954	50	50
	WOOD NO 2 DITCH	5100966	36	36
	WOOD NO 3 DITCH	5100967	16	16
51_ADC009 UPPER WILLIAMS FORK	B W FIELDS MULE CR 1	5100514	35	35
	BARKER NO 1 DITCH	5100516	96	147
	BRINKER DITCH	5100539	10	10
	F A FIELD DITCH	5100624	105	105
	GERVENS NO 2 DITCH	5100667	39	39
	GUS BOHM DITCH	5100689	38	34
	JOHN SHORE NO 1 DITCH	5100741	138	0
	KEYSER DITCH	5100760	83	0
	LOST CREEK DITCH	5100786	161	161
	NORTH SKYLARK DITCH	5100823	43	43
	SCHOLL DITCH	5100875	72	72
	WILLIAMS DITCH -175	5100955	134	134
51_ADC010 LOWER WILLIAMS FORK	BATTLE CREEK DITCH NO 1	5100518	38	38
	BERG NO 1 DITCH	5100525	21	21
	BERG NO 2 DITCH	5100526	50	50
	BULL RUN DITCH NO 1	5100545	32	32
	COLE NO 1 DITCH	5100587	66	66
	COLE NO 2 DITCH	5100588	85	85
	DALE DITCH	5100600	59	59
	JESSMER DITCH	5100737	24	26
	LANGHOLEN NO 1 DITCH	5100769	28	28
	LANGHOLEN NO 2 DITCH	5100770	61	61
	LANGHOLEN NO 3 DITCH	5100771	28	28
	LONG GULCH DITCH	5100784	34	34
	OLSON NO 1 DITCH	5100824	29	29

	OLSON NO 2 DITCH	5100825	29	29
	ROHAN DITCH	5100860	148	148
	ROHAN NO 2 DITCH	5100861	48	48
	RORIC DITCH	5100866	29	29
	SHORE DITCH NO 2	5100885	68	68
	TYNDALL DITCH	5100937	46	52
	SHORE DITCH	5100972	51	51
51_ADC011 COLORADO RIVER ABV TROUBLESOME CREEK	ALEXANDER DITCH	5100503	36	36
	CARR DITCH	5100599	55	55
	FARRIS DITCH	5100628	37	37
	GIBBS DITCH	5100668	69	69
	HOME NO 1 DITCH	5100715	59	59
	HOME NO 2 DITCH	5100716	171	171
	REEDER CREEK DITCH	5100850	81	82
	REEDER CREEK NO 1 DITCH	5100851	18	18
	R WILLIAMS NO 2 DITCH	5100869	11	0
	ROCK CREEK DITCH ENLARGE	5100871	35	35
	SADDLE DITCH	5100872	112	112
	WALKER DITCH	5100949	13	13
	WEIMER DITCH	5100951	33	33
	WILLIAMS DITCH -247	5100956	39	39
52_ADC021 BLACK TAIL & SHEEPHORN CREEK	A A P DITCH	5200500	19	19
	ANGEHRN DITCH	5200505	13	13
	ASHLOCK DITCH	5200514	35	65
	ASHLOCK NO 2 DITCH HDG 1	5200515	5	17
	ASHLOCK NO 2 DITCH HDG 2	5200516	11	0
	ASPEN CREEK DITCH	5200517	33	33
	BOX CANYON NO 2 DITCH	5200524	72	0
	CABIN DITCH	5200530	24	24
	CASTLE DITCH	5200531	130	130
	COLE BLACK DITCH	5200539	39	39
	CONGER DITCH	5200540	21	21
	ERNEST SUTTON DITCH	5200545	19	19
	GIBSON NO 1 DITCH	5200551	5	5
	GIBSON NO 2 DITCH	5200552	5	5
	GUTZLER DITCH NO 3	5200561	29	33
	HARTMAN DITCH	5200563	53	53
	HARTMAN NO 2 DITCH	5200566	31	8
	JONES DITCH	5200583	89	89
	LAVA CREEK DITCH	5200587	5	6
	LAVA CREEK NO 2 DITCH	5200588	4	4
	LITTLE COTTONWOOD DITCH	5200589	11	24

	MILL DITCH	5200591	19	19
	MOOREHEAD DITCH	5200593	1	2
	MCPHEE DITCH	5200598	34	0
	MCPHEE DITCH (NO 2)	5200599	34	67
	OSAGE DITCH	5200607	17	18
	PERRY DITCH	5200608	9	12
	PEYTON DITCH	5200610	-999	6
	PINEY NO 1 DITCH	5200612	11	14
	ROCK CREEK DITCH	5200621	19	19
	RUNDELL DITCH	5200624	68	68
	RUSSELL NO 2 DITCH	5200627	33	33
	RUSSELL NO 4 DITCH	5200629	16	16
	SOUTH GOODSON DITCH	5200640	15	15
	SWITZER DITCH	5200648	37	37
	WINSLOW DITCH	5200660	17	17
	HINTON DITCH	5200692	3	3
	PINEY WLDLF AREA SP NO 2	5200702	6	0
	OSAGE DITCH HDG 2	5200741	17	18
	OSAGE DITCH HDG 3	5200742	17	18
	OSAGE DITCH HDG 4	5200743	32	32
	PINEY NO 1 DITCH HDG 2	5200745	20	20
	GUTZLER DITCH NO 3 HDG 2	5200869	29	33
	BAILEY MESA DITCH	5300508	54	66
	BLACKTAIL DITCH	5300513	53	56
	CHARLES B MCCOY DITCH	5300526	46	46
	HIGHLINE NO 2 DITCH	5300620	49	49
	HOYT DITCH	5300637	4	6
	MAUDLIN NO 1 DITCH	5300695	10	10
	MUGRAGE HOYT DITCH HGT 1	5300713	21	23
	MUGRAGE HOYT DITCH HGT 2	5300714	30	30
	O C MUGRAGE HGT 1 DITCH	5300749	3	4
	PURGATORY DITCH	5300758	50	51
	PURGATORY NO 2 DITCH	5300759	84	84
	TYLER DITCH	5300848	76	0
	WEST YARMANY DITCH	5300873	22	22
	YARMANY PARK DITCH	5300891	94	94
52_ADC027 COLORADO RIVER ABV DERBY CREEK	BRUNER NO 1 DITCH	5200526	40	45
	BRUNER NO 2 DITCH	5200527	29	34
	BRUNER NO 3 DITCH	5200528	12	19
	BUTTE CREEK DITCH	5200529	86	86
	CASTLE CREEK DITCH	5200532	75	75
	CASTLE PEAK DITCH	5200534	4	4

	CATAMOUNT NO 1 DITCH	5200536	39	39
	DRY PARK DITCH	5200544	265	285
	SCHLEGAL DITCH (ALKALI)	5200632	117	117
	SEVEN PINES DITCH	5200633	45	45
	WASTE DITCH	5200653	9	9
	JOSEPHENE NO 1 DITCH	5200665	3	5
	JOSEPHENE NO 2 DITCH	5200666	24	29
	ALBERTSON WRIGHT DITCH	5200729	45	45
	DEER PEN SPRING	5200730	10	18
	ROGERS NO 2 DITCH HDG 5	5200750	10	18
	HOOVER DITCH	5300627	106	106
53_ADC022 UPPER EGERIA CREEK	CLARK DITCH	5300532	42	47
	HALL DITCH	5300603	91	91
	JOHN THOMAS DITCH	5300648	325	332
	LONG PARK DITCH	5300682	87	87
	TABLE MESA DITCH	5300829	103	103
	WILLOW DITCH	5300879	112	112
	BRONCO NO 1 DITCH	5301019	39	39
	BRONCO NO 2 DITCH	5301020	39	39
	EGERIA BASIN DITCH & PL	5301160	91	91
53_ADC023 KING CREEK	BUFFALO HEAD DITCH	5300518	70	70
	GROVER CLEVELAND DITCH	5300596	87	87
	KAYSER WASTE WATER DITCH	5300660	-999	92
	MERRIMAN DITCH	5300702	160	160
	NELLIE BLY DITCH	5300729	276	374
	N G DITCH	5300732	81	81
	NUMBER 1 DITCH	5300735	153	152
	SUTTON NO 1 DITCH	5300825	305	228
53_ADC024 EGERIA CREEK ABV TOPONAS CREEK	ELK HEAD DITCH	5300571	-999	63
	KIER NO 2 DITCH	5300664	106	102
	QUAKER DITCH	5300760	79	83
	RAVENS NEST DITCH	5300763	214	255
	S D DITCH	5300791	93	105
	WILSON SEEP & WSTE DITCH	5300885	-999	45
	WOHLER GULCH DITCH	5300887	177	177
	STILLWATER DITCH	5304715	153	100
	OTTO GUMPRECHT WELL NO.1	5305000	6	6
53_ADC025 TOPONAS CREEK	COBERLY NO 1 DITCH	5300534	10	10
	IDLEWILD DITCH	5300639	29	29
	JONES NO 1 AND NO 2	5300653	65	65
	MCKEAN DITCH	5300722	69	69
	MCKEAN NO 2 DITCH	5300723	69	69

	TOPONAS ELLIOTT DITCH	5300835	48	48
	WILLOW DITCH	5300878	154	154
	COBERLY NO 2 DITCH	5301034	5	5
	MARY JEAN SEEPAGE D NO 1	5301083	29	29
	HIGHLAND DITCH NO 1	5301137	76	76
53_ADC026 COLORADO RIVER ABV ALKALI CANYON	WATER WHEEL DITCH	5200652	27	18
	DESERT DITCH	5300557	2	2
	ELK DITCH	5300569	10	10
	ELK CREEK DITCH	5300570	20	20
	GRIMES DITCH	5300592	19	49
	HORN CONSOLIDATED DITCH	5300628	91	93
	HORN NO 1 DITCH	5300629	14	18
	JOHANNBROER NO 1 DITCH	5300647	17	17
	JOLLY HOMESTEAD NO 1 D	5300649	11	0
	KIRBY DITCH	5300666	42	42
	KIRBY WASTE WATER DITCH	5300668	15	15
	LITTLE MESA DITCH	5300680	12	12
	MAXWELL DITCH	5300698	26	26
	MESA DITCH	5300703	26	26
	OAK KNOLL DITCH	5300746	13	13
	QUINLAN DITCH	5300761	24	31
	RUSSELL NO 2 DITCH	5300785	11	0
	TEPE DITCH	5300831	50	50
	WOHLER DITCH	5300886	65	65
	JOHANNBROER NO 2 DITCH	5301069	6	6
	WHITE COTTON DITCH	5301131	4	4
	FRANK GROH PUMP STATION	5301172	21	24
53_ADC028 DERBY CREEK	BAXTER DITCH	5300510	18	18
	BIG MESA DITCH	5300511	46	46
	CABIN CREEK BASIN DITCH	5300522	130	130
	CEDAR CREEK NO 2 DITCH	5300528	61	61
	CORRELL DITCH	5300539	62	58
	DAWSON DITCH	5300546	160	160
	DRY DITCH	5300559	18	18
	HOOPER DITCH	5300626	310	310
	LINK DITCH	5300677	18	18
	LITTLE DRY GULCH DITCH	5300679	123	123
	LUARK DITCH	5300683	19	25
	MERRIMAC DITCH	5300701	15	15
	OAK GROVE DITCH	5300745	295	290
	SANDERS DITCH	5300790	46	46
	SUNNYSIDE DITCH	5300820	81	81

	SUNNYSIDE ROBERTS DITCH	5300822	18	18
	TANNER DITCH	5300830	15	0
	WASTE WATER DITCH	5300869	41	43
	MERRIMAC II DITCH	5301014	15	15
	DOME RANCH DITCH HGT 1	5301039	130	130
	DOME RANCH DITCH HGT 2	5301040	130	130
53_ADC032 COLORADO RIVER ABV GLENWOOD SPRINGS	O H ANDERSON DITCH	3700503	25	25
	ALAMO DITCH	5200502	5	5
	ALLEN DITCH	5200503	6	9
	BAIR DITCH	5200518	2	2
	BARRIER DITCH	5200519	11	12
	DOLL DITCH	5200543	46	26
	EAST LATERAL DITCH	5200546	6	6
	MATHER DITCH	5200590	7	7
	PRUETT NO 1 DITCH	5200617	3	4
	SPRUCE CREEK NO 1 DITCH	5200643	15	16
	SPRUCE CREEK NO 2 DITCH	5200644	6	6
	SPRUCE CREEK NO 3 DITCH	5200645	10	10
	SPRUCE CREEK DITCH NO 5	5200647	3	3
	WISE DITCH	5200661	31	32
	POSEY DITCH	5200711	7	7
	KENNYS DITCH	5200720	12	11
	SCHULTZ PUMP 1A	5200721	2	2
	WOLTER PUMP	5200763	3	3
	ALLEN NO 1 DITCH	5300501	7	0
	ALLEN NO 2 DITCH	5300502	7	7
	ALLEN NO 3 DITCH	5300503	2	5
	CHOCKIE NORTH DITCH	5300529	3	3
	CHOCKIE SOUTH DITCH	5300530	6	6
	CYRUS NO 1 DITCH	5300542	48	48
	CYRUS NO 2 DITCH	5300543	4	4
	CYRUS NO 3 DITCH	5300544	4	4
	DEEP CREEK DITCH	5300549	87	75
	DEMPSEY NO 1 DITCH	5300553	21	21
	DEMPSEY NO 2 DITCH	5300554	22	22
	ED HULL NO 1 DITCH	5300566	6	6
	FREDRICK DITCH	5300579	80	80
	GANNON DITCH	5300580	9	17
	GODAT DITCH	5300586	10	10
	GRUNER NO 1 DITCH	5300597	6	6
	GRUNER NO 2 DITCH	5300598	9	9
	HACK NO 2 DITCH	5300600	11	11

	IDE DITCH	5300638	30	30
	KEEP DITCH	5300662	44	32
	MACHIN DITCH	5300687	19	19
	MALONEY NO 1 DITCH	5300688	11	31
	MALONEY NO 2 DITCH	5300689	4	4
	MALONEY NO 3 DITCH	5300690	71	66
	MEANA DITCH	5300700	10	10
	MIDDLE FORK MASON CR D	5300706	90	90
	MCKEEN NO 1 DITCH	5300726	16	16
	NORTH FORK MASON DITCH	5300744	90	90
	RIVER DITCH	5300772	71	71
	ROGERS DITCH	5300781	36	36
	SNODGRASS AND MANNERS D	5300798	85	117
	SOUTH FORK MASON DITCH	5300802	62	62
	STEPHENS DITCH	5300809	20	20
	TUCKER DITCH	5300838	22	22
	TUCKER NO 1 DITCH	5300839	3	3
	TUCKER NO 2 DITCH	5300840	3	3
	TUCKER PETERSON DITCH	5300842	17	26
	WILLOW CREEK NO 4 DITCH	5300881	79	67
	YOST DITCH	5300892	22	27
	CHOCKY JACKSON DITCH	5301032	16	16
	FOUR CREEK DITCH HGT 2	5301047	397	397
	LOWER ED HULL NO 2 DITCH	5301145	38	38
	FOSTER PUMP NO 1	5301149	45	45
	LUARK PUMP NO 1	5301159	4	6
70_ADC049 UPPER ROAN CREEK	ALTENBERN DITCH	7000500	31	31
	CALDWELL DITCH	7000510	50	50
	CANNON DITCH	7000511	153	141
	CANNON HIGHLINE DITCH	7000512	60	60
	CARLISLE DITCH	7000514	9	9
	CATARACT DITCH	7000516	185	0
	CAUGHMAN DITCH	7000517	86	70
	A V AND D DITCH ALT	7000526	40	40
	FLUME DITCH	7000538	95	87
	FRANKLIN D AND LATERAL	7000539	30	13
	FRANKLIN NO 1 DITCH	7000540	8	8
	FRANKLIN NO 2 DITCH	7000541	9	9
	FRASHIER DITCH	7000542	57	57
	GERRICKE DITCH	7000544	37	0
	GIBLER DITCH	7000545	54	50
	H SCOTT DITCH	7000549	28	28

	HIMEBAUGH DITCH	7000551	623	494
	HOAGLUND-FRASIER DITCH	7000555	67	67
	KIMBALL DITCH	7000556	53	53
	KREPS DITCH AND LATERAL	7000559	7	7
	LONG GULCH DITCH NO 1	7000561	17	0
	LONG GULCH DITCH NO 2	7000562	16	0
	LONGSETH NO 1 DITCH	7000563	19	4
	MEADOWS DITCH	7000568	10	10
	NEWTON DITCH	7000572	132	115
	OLLIS DITCH	7000573	21	21
	PARKES DITCH	7000578	2	0
	S L AND W DITCH	7000588	39	39
	SCOTT DITCH	7000589	27	2
	SIMMONS NO 2 DITCH	7000592	4	4
	VAN CLEAVE DITCH	7000597	74	74
	KAISER GULCH DITCH	7000628	20	20
	BOYD GULCH DITCH	7000639	8	8
70_ADC050 COLORADO RIVER NR CAMEO	ANDERSON AND HAYES DITCH	7000501	23	0
	ARMSTRONG DITCH	7000503	61	38
	BAKER AND BOWDISH DITCH	7000505	97	93
	BAKER CANNON DITCH	7000506	13	13
	CISSNA DITCH NO 2	7000519	29	27
	CONWELL DITCH	7000527	142	56
	COTTONWOOD DITCH	7000529	77	0
	DE LA MATYR DITCH	7000533	41	75
	DE LA MATYR & ANDERSON D	7000534	47	13
	DE LA MATYR GUNDERSON D	7000535	46	46
	DRY FORK DITCH	7000536	17	17
	GUNDERSON & GUNDERSON D	7000547	32	0
	HAYES DITCH (DRY FORK)	7000553	93	61
	LOVELESS DITCH	7000565	101	101
	OMUNDSON AND FROST DITCH	7000575	30	23
	ROTHSCHILD DITCH	7000587	69	129
	SMITH DITCH	7000593	48	48
	HIGH LONESOME AP NO 1	7000605	45	45
72_ADC051 PLATEAU CREEK ABV VEGA RSVR	BILLY DITCH	7200538	30	30
	ERIE CANAL	7200615	329	327
	VEGA DITCH	7200928	10	10
	WILSON DITCH	7200943	25	25
	ZEIGLE MEADOWS DITCH	7200953	20	19
	ZEIGEL SEEPAGE DITCH	7201252	18	17
	ZEIGEL SEEPAGE DITCH NO2	7201253	18	17

72_ADC052 PLATEAU CREEK BL VEGA RSVR	HARDSCRABBLE DITCH	7200662	297	296
	HIGHLINE DITCH (BUZZARD)	7200691	177	164
	LINWOOD DITCH	7200750	20	20
	LITTLE FINN IRRIGATING D	7200752	147	147
	PARKINSON DITCH	7200822	179	174
	ROSA DITCH	7200858	90	90
72_ADC053 SALT CREEK	BAILEY DITCH	7200522	83	71
	BLACKMAN DUNLAP CLARK D	7200540	240	232
	CEDAR DITCH	7200566	47	46
	CLIFTON DITCH	7200572	8	0
	DUNLAP NO 1 D (PLATEAU)	7200605	11	11
	JOHN A FITZPATRICK DITCH	7200619	14	14
	FRANCIS DITCH	7200622	18	13
	NORMAN F HILL DITCH A	7200694	94	94
	HILL JOHNSON DITCH	7200697	56	56
	JONES BROS DITCH	7200723	105	105
	KIGGINS DITCH	7200728	194	191
	PINES DITCH	7200830	17	17
	SALISBURY KIGGINS DITCH	7200863	129	107
	SUNNYSIDE NO 1 DITCH	7200902	11	11
	ELIZABETH TURNER DITCH	7200914	40	40
	LEWIS C WILLIAMS DITCH	7200944	68	68
72_ADC054 UPPER BUZZARD CREEK	ADVENT DITCH	7200502	91	91
	ALFALFA DITCH LATERAL	7200503	4	4
	CHENEY CREEK DITCH	7200569	111	111
	CO-OPERATIVE DITCH	7200582	117	117
	ELIZABETH DITCH HDG 1	7200614	50	49
	GEORGE GUNDERSON LUNVAL	7200653	4	4
	JORGEN GUNDERSON DITCH	7200654	4	4
	KLOSTERMAN DITCH	7200733	48	48
	LINN DITCH	7200749	43	0
	MIDDLETON MEADOWS DITCH	7200790	103	0
	VAN DEN HEUVEL DITCH	7200925	11	11
	WOODY DITCH	7200949	14	14
	BUZZARD CREEK DITCH	7201338	56	56
	GIPP DITCH	7201733	25	23
72_ADC055 PLATEAU CREEK BL BUZZARD CREEK	ACORN DITCH	7200501	47	14
	BROWN NO 1 DITCH	7200550	5	5
	CRANE DITCH	7200588	14	14
	DUNLAP DITCH (HAWXHURST)	7200604	149	144
	HAWXHURST DITCH	7200675	77	77
	LAST DOLLAR DITCH	7200739	64	64

	MATTINGLY DITCH	7200769	14	14
	MCCURRY DITCH	7200774	30	30
	MCCURRY HIGHLINE DITCH	7200775	197	199
	MIDLINE DITCH	7200791	297	295
	OAKLAND DITCH	7200811	144	144
	RED BLUFF DITCH	7200845	72	72
	SMALLEY DITCH	7200871	14	14
	SUPERIOR DITCH	7200906	14	14
	WHIZZER IRRIGATING DITCH	7200937	26	26
	DEER TRAIL DITCH	7201350	14	14
	SUPERIOR DITCH (SMALLEY)	7201457	37	17
72_ADC056 UPPER GROVE CREEK	N F GUTHRIE DITCH NO	7200655	18	6
	HARRIS DITCH (OAK CREEK)	7200665	-999	17
	KOCH DITCH	7200734	19	19
	LITTLE CREEK DITCH	7200751	128	128
	ROCKWELL DITCH	7200854	306	303
	SPRING CREEK DITCH GROVE	7200887	24	24
	SUNSET DITCH (GROVE CR)	7200904	11	11
	WALLACE DITCH (GROVE CR)	7200929	35	35
	NORRELL DITCH	7201181	26	26
	N F GUTHRIE DITCH NO	7201451	79	92
72_ADC057 LOWER GROVE CREEK	ANDERSON GULCH DITCH	7200505	104	18
	ATKINSON DITCH	7200515	57	51
	BERTHOLF FLEMING DITCH	7200532	184	188
	FITZPATRICK DITCH	7200617	148	110
	GILT EDGE DITCH	7200637	138	138
	MURRAY DITCH	7200805	115	72
	RED MOUNTAIN DITCH	7200846	156	105
72_ADC058 KIMBALL CREEK	ATWELL DITCH	7200516	87	79
	ATWELL WASTE SEEP DITCH	7200519	72	58
	BACON IRRIGATION DITCH	7200521	36	0
	JONES DITCH	7200722	107	104
	MCKEE DITCH	7200777	102	89
	HILL DITCH	7200956	15	15
	HODSON DITCH	7201443	4	4
72_ADC059 BIG CREEK	ANDERSON DITCH	7200504	29	30
	BARKER AND WEBER DITCH	7200525	48	48
	DAUMAN DITCH	7200594	18	18
	FITZPATRICK SPRING DITCH	7200618	10	10
	GIBSON DITCH (BIG CR)	7200633	11	12
	HANNAH DITCH	7200659	116	119
	HAWKINS DITCH	7200673	24	17

	ILES SPRING DITCH	7200711	6	2
	C D LUDE DITCH	7200757	176	147
	MASON GULCH DITCH	7200767	11	0
	MASQUATO DITCH	7200768	34	22
	PARROT DITCH	7200824	61	61
	PENSION DITCH	7200828	22	23
	R A PITTS SEEPAGE DITCH	7200835	51	51
	RYAN SPRING DITCH	7200861	7	7
	SHAW DITCH	7200865	47	37
	SILVER BELL DITCH	7200869	136	136
	STANDIFORD SPRING DITCH	7200891	15	15
	D & G PLATEAU DITCH	7201008	12	12
	D & G SPRINGS DITCH	7201033	7	0
	D & G SPRINGS DITCH	7201041	171	171
	NICHOLS DITCH	7201179	63	63
	WOODY-BROWN DITCH	7201249	6	6
	STODDART WW SEEPAGE D	7201388	94	53
	COAKLEY KIGGINS EXT D	7201417	27	27
	ED LONG DITCH	7201424	17	22
72_ADC060 COTTONWOOD CREEK	CROWN POINT DITCH	7200591	67	63
	DAVENPORT D (COTTNWD)	7200596	446	446
	HALL DITCH (COTTONWOOD)	7200656	148	145
	JULIA KRUH DITCH	7200735	6	6
	NICHOLS DITCH RES SYSTEM	7200809	26	27
	PLATEAU FLOUR MILL DITCH	7200838	46	40
	SHOTWELL DITCH	7200867	568	567
	SNIPES DITCH	7200877	77	92
	WINTERS OR WOLFE DITCH	7200945	64	58
	WOODRING SEEP WASTE D 1	7200946	22	22
72_ADC061 BULL CREEK	FREDERICK NO 2 DITCH	7200625	16	16
	JENKINS CROSS PHILLIPS 1	7200718	93	87
	LOST TIME DITCH	7200756	57	49
	RIESER DITCH	7200850	31	31
	SNIPES GULCH DITCH	7200878	44	45
	SPRING DITCH (BULL CR)	7200885	33	26
	STEELE DITCH	7200894	14	14
	STEWART DITCH (BULL CR)	7200895	64	64
72_ADC062 COON CREEK	BARNES DITCH	7200526	49	49
	CRAIG STEWART DITCH	7200587	58	58
	DINGMAN SP SEEPAGE DITCH	7200600	201	201
	HARKLEROAD DITCH	7200663	67	67
	HEELY DITCH NO 3 (PLAT)	7200682	15	15

	MCGEOCH DITCH	7200776	28	0
	MCKINNEY DITCH	7200779	74	74
	PIONEER EXTENSION DITCH	7200829	210	199
	SADDLE DITCH	7200862	30	0
	SPRING DITCH (COON CR)	7200882	27	29
	CRAIGS SPRING DITCH NO 2	7201404	3	3
	V P BYRAM DITCH NO	7201513	15	15
	SPRING DITCH (SPRING DRW)	7201522	60	61
72_ADC063 MESA CREEK	ATWELL SHORT LINE DITCH	7200518	41	41
	BROWN DITCH	7200549	14	14
	COON CREEK DITCH	7200581	51	52
	INDEPENDENT DITCH	7200712	460	459
	JACKSON DITCH (PLATEAU)	7200714	38	0
	MARINERS IRR DITCH	7200763	114	114
	SMITH DITCH (COON CR)	7200873	8	8
	SPURLOCK DITCH	7200889	41	42
	SUNSET DITCH (MESA CR)	7200903	100	98
	THISTLE SPRINGS DITCH	7200912	44	45
72_ADC064 PLATEAU CREEK	COPPOCK DITCH	7200584	8	8
	JACKSON D (WALLACE GU)	7200715	14	0
	MCQUEARY SHOEMAKER D HG1	7200782	55	0
	SHUEY DITCH	7200868	17	3
	TATE CREEK DITCH	7200909	6	24
	ERVEN DITCH	7201078	7	0
	LUCY ROGERS DITCH	7201151	3	3
	WILKINSON PUMP NO 1	7201392	8	0
	HARVEY NO 2 DITCH-HDGT 2	7201452	18	18
72_ADC065 COLORADO RIVER NR STATE LINE	COYLE RANCH DITCH	7200585	93	58
	CRESCENT DITCH	7200590	77	11
	DAVENPORT DITCH (E SALT)	7200595	160	150
	GAVIN CANAL DITCH	7200629	110	0
	GAVIN WASTE WATER DITCH	7200630	88	86
	GOFFREDI DITCH	7200641	4	0
	GRAPEVINE DITCH	7200647	22	12
	HOWARD SALT RIVER	7200705	52	46
	HURLBURT WASTE DITCH	7200709	26	26
	KELLEY DITCH	7200727	202	63
	KINNEY DITCH	7200732	24	8
	HUDSON DITCH & PUMP NO	7200738	2	2
	MCCABE DITCH	7200770	-999	11
	WILLIAM MILLER DITCH	7200792	25	12
	MONUMENT DITCH	7200798	24	8

	ROGERS DITCH	7200857	56	32
	SMITH DITCH (RAPID CR)	7200872	17	16
	SMITH STRUTHERS DITCH #1	7200875	19	19
	TAYLOR NO 1 DITCH	7200908	58	21
	UPPER SALT WASH DITCH	7200919	75	102
	WILLIAMS IRRIGATING D	7200941	53	26
	BRACH PUMP	7201024	123	115
	DUPONT PUMP	7201070	11	11
	H F MCCLAIN DITCH	7201107	43	61
	TALBOTT PIPELINE	7201225	28	28
	MOORLAND DITCH	7201299	12	12
	SMITH-HOLMES SPG WW HDGT	7201484	23	20
	HURLBURT DITCH PUMP	7201682	70	69

Exhibit B: Diversion Structures in each "No Diversion Records" Aggregate

Aggregation ID	Structure Name	WDID	2005 Acres	2010 Acres
36_AND017 UPPER BLUE RIVER	KEYSTONE DITCH (UPPER)	3600683	66.131	66.366
	SONDREGGER NO 5 DITCH	3600814	2.188	2.564
	WARD NO 3 DITCH HDG 1	3600864	0	2.656
	SWAN RIVER WATER SYSTEM	3601009	71.013	77.262
	GOLF SURFACE DIVERSION 1	3601093	69.888	70.459
	COPPER MTN WELL NO 1A	3605217	26.099	39.539
	MONTEZUMA TOWN PIPELINE	3600752	19.952	0
36_AND019 BLUE RIVER BL GREEN MOUNTAIN RSVR	SMITH NO 2 DITCH	3600803	271.615	271.451
37_AND029 EAGLE RIVER ABV BRUSH CREEK	BRETT DITCH	3700521	0	46.729
	NOTTINGHAM DITCH -76	3700732	9.514	9.514
	ROOT DITCH	3700779	31.041	32.506
	EAGLE-VAIL MUN WATER SYS	3701084	73.681	74.27
37_AND030 BRUSH CREEK	EAGLE TOWN OF GRAV SYS	3700583	101.508	101.508
	JOE GOODE NO 1 DITCH	3700610	21.267	21.267
37_AND031 EAGLE RIVER BL GYPSUM	GRUNDELL A F DITCH	3700619	20.375	20.375
38_AND033 UPPER ROARING FORK	DEANE FISH PONDS & DITCH	3800631	17.261	18.54
	GARDNER DITCH	3800911	34.774	34.774
	QUAKING ASPEN DITCH	3800951	11.078	11.078
	HAYDEN PEAK DITCH NO 1	3801238	0	19.372
	OGARA DITCH	3801870	37.501	37.501
	BRUSH CREEK PUMP NO 1	3801496	26.697	0
38_AND034 SNOWMASS CREEK	HUNTER DITCH	3800767	90.634	90.634
	PINNELL AND MCLAUGHLIN D	3800938	12.734	12.734
38_AND035 FRYING PAN RIVER	ALFRED SLOSS DITCH NO 1	3800502	14.999	14.999
	CLYDE DITCH	3800601	31.858	31.858
	HALL DITCH	3800727	0	17.955
	HYRUP DITCH	3800772	26.768	26.768
	SHEHI DITCH	3800988	76.622	76.622
	FRENCHMAN CREEK D NO 3	3801161	34.361	48.082
	FRANCES NISBET D NO 1	3801778	8.576	8.576
	FRANCES NISBET D NO 2	3801779	10.466	10.466
	JAKEMAN DITCH AP	3801909	22.764	22.764
38_AND036	DEAN DITCH	3800630	19.504	19.504

Aggregation ID	Structure Name	WDID	2005 Acres	2010 Acres
WEST SOPRIS CREEK	ETIENNE ARBANEY DITCH	3800664	7.687	7.794
	JACOBS NO 2 DITCH	3800781	31.928	31.928
	LIGHT DITCH	3800819	139.825	139.825
	BRUSH CREEK RNCH SPG NO2	3801583	13.075	13.075
38_AND037 ROARING FORK ABV CRYSTAL	BLUE CRK LATERAL DITCH	3800542	19.088	19.088
	FRIELER DITCH	3800697	25.046	24.747
	GEIGEL WASTE WATER DITCH	3800705	240.366	212.343
	WILLOW SPRINGS	3801399	30.424	30.93
	SPRING PARK RESERVOIR	3803744	294.753	243.042
	KELLY NO 3 DITCH	3800793	62.361	0
38_AND038 CRYSTAL RIVER	COAL CREEK DITCH	3800602	11.219	11.219
	PROSPECT DITCH	3800950	135.295	72.866
	VILLAGE FARM DITCH	3801069	12.693	12.693
	GUILFORD DITCH NO 1	3801295	7.895	7.743
	VORHIES CREEK DITCH HG 2	3801674	5.625	5.625
	PLANK SPRING & PIPELINE	3805651	10.142	10.142
	PRINCE DITCH	3800948	33.617	0
	SPRING GULCH DITCH	3801372	199.299	0
	EDGERTON RES FEEDER D	3801478	18.981	0
38_AND039 CATTLE CREEK	THOMAS MCNULTY COULTER D	3801046	151.002	128.072
	MARY MCLEAN DITCH HGT 2	3801652	121.542	121.542
	HAFF SPRINGS NO 1 & 2 D	3800726	53.733	0
	LAFAYETTE COX DITCH	3800807	29.736	0
38_AND040 LOWER ROARING FORK	FREEMONT DITCH	3800695	21.608	21.608
	KENDALL AND STRICKLETT D	3800799	385.245	344.457
	REYNOLDS DITCH	3800961	91.515	11.321
	WADDELL DITCH	3801074	77.045	77.045
	FRANK CHAPMAN DITCH	3800691	30.784	0
39_AND041 ELK CREEK	ALLEY SPRINGS NO 1 2 3	3900501	3.126	3.126
	JOHN ROLLETTO NO 1 DITCH	3900598	37.855	37.873
	TONY PERRY DITCH	3900673	3.86	3.86
	TONIOLLI DITCH	3900676	21.267	21.266
	PARK RESERVOIR	3903507	139.498	123.754
	ALLEY SPRING NO 4	3900500	3.878	0
39_AND045 RIFLE CREEK	BROWN DITCH	3900516	21.707	21.707
	CRYSTAL FALLS DITCH	3900543	23.375	23.375
	RIFLE FALLS DITCH	3900647	13.357	13.357
	RAYNARD DITCH	3900702	38.622	34.944
	JONES WELL NO 2	3905633	1.836	1.836
	BEANE SPRING PIPELINE	3900508	10.233	0

Aggregation ID	Structure Name	WDID	2005 Acres	2010 Acres
	HUBBARD DITCH	3900588	88.151	0
	HABLUTZEL PUMP	3900805	12.036	0
45_AND042 COLORADO RIVER BL GARFIELD CREEK	GILMORE DITCH	3900569	59.114	50.788
	JACKSON SPRING PIPELINE	3900591	19.781	22.396
	CANYON CREEK WELL NO 1	3905033	2.746	2.746
	CANYON CREEK WELL NO 2	3905647	2.746	2.746
	BELLODI NO 1 DITCH	4500521	13.192	13.192
	RINEBERGER & LAKE DITCH	4500740	17.744	17.744
	TALBOTT PUMP & PIPELINE	4500791	10.193	10.193
	DEBOY SPRING NO 1 & PL	4500893	7.844	7.844
	ROCK-N-PINES POND NO 8	3903618	1.156	0
	COOLEY NO 3 DITCH	4500556	1.651	0
45_AND043 COLORADO RIVER BL DIVIDE CREEK	MULTA-FLEXA DITCH	4500703	3.834	3.834
	GUTHERIDGE DITCH NO 2	4501095	24.185	21.491
45_AND044 COLORADO R BL MAMM CREEK	STOBAUGH DITCH	3900668	31.231	17.201
	BISHOP WELL	4505002	50.009	26.644
45_AND046 COLORADO RIVER BL BEAVER CREEK	SPENCER SPRINGS DITCH	4500771	15.231	8.789
45_AND047 COLORADO RIVER BL CACHE CREEK	CLOUGH NO 2 STOCKWATER D	3900534	1.316	0
	RULISON MILLER DITCH	3900653	32.901	0
45_AND048 COLORADO RIVER NR DE BEQUE	HAYWARD AND WYATT PL	4500623	101.671	92.604
	GARDNER DITCH	4500731	44.215	34.074
	STREIT BOTTOM DITCH	3900669	25.819	0
	MARLING DITCH	4500688	107.999	0
	SAM B WASSON WW D NO 1	4500756	9.099	0
50_AND014 MUDDY CREEK ABV TYLER DITCH	CARTER CREEK FEEDER D	5000770	96.007	100.57
50_AND016 LOWER MUDDY CREEK	CAMERON SP NO 1 2 3 4 D	5000537	66.791	66.791
50_AND020 COLORADO RIVER BL KREMMLING	WEST END NO 1 DITCH	5300870	32.011	32.011
51_AND001 COLORADO RIVER NR GRANBY	BUSSE PICKUP LATERAL NO1	5101032	54.775	54.775
	BUSSE PICKUP LATERAL NO2	5101033	19.739	19.739
51_AND003 RANCH CREEK	CABIN CREEK DITCH	5100568	147.358	147.331
51_AND004	SPRING BRANCH DITCH	5100899	54.997	54.997

Aggregation ID	Structure Name	WDID	2005 Acres	2010 Acres
FRASER RIVER BL CROOKED CREEK	SPRING BRANCH NO 2 DITCH	5100900	12.182	12.182
51_AND005 TENMILE CREEK	CROOKED DITCH	5100595	21.926	21.926
	WESTMAN NO 2 DITCH	5100953	77.823	40.824
51_AND006 FRASER RIVER AT GRANBY	DEBERARD DITCH	5100601	12.45	12.45
	STRAWBERRY DITCH NO 1	5100918	24.727	24.727
	GRAND ELK GOLF DIV NO. 1A	5101381	53.421	53.35
	GRAND ELK GOLF DIV NO. 2A	5101382	49.418	49.348
51_AND010 LOWER WILLIAMS FORK	SPACEK RESERVOIR	5103697	43.994	43.994
52_AND021 BLACK TAIL & SHEEPHORN CREEK	A P R NO 4 DITCH	5200511	23.492	23.492
	KUHN DITCH	5200667	0	7.43
	OSAGE DITCH HDG 5	5200744	17.008	22.981
	MAUDLIN NO 2 DITCH	5300696	10.44	10.44
	O C MUGRAGE DITCH	5300748	8.01	8.01
	ORNDOFF DIVR POINT NO 2	5301151	14.242	14.242
	HASTINGS SPRING	5305026	3	3
	GORE CANYON RANCH DITCH	5200685	43.475	0
53_AND023 KING CREEK	ELLIOTT NO 2 DITCH	5300573	24.304	24.304
53_AND025 TOPONAS CREEK	STRINE DITCH	5300817	53.311	72.595
53_AND026 COLORADO RIVER ABV ALKALI CANYON	HART NO 3 DITCH	5300607	21.46	21.46
	TOWERS DITCH	5300836	6.344	10.537
53_AND028 DERBY CREEK	CABIN CREEK NO 2 DITCH	5300520	123.378	123.378
	DOME RANCH DITCH	5300558	129.688	129.689
	ROGERS DITCH	5300779	123.378	123.378
	WURTSMITH SPRING PL	5300889	2.399	3.951
53_AND032 COLORADO RIVER ABV GLENWOOD SPRINGS	ANDERSON DITCH	5200504	8.419	8.419
	SMALLEY DITCH	5200638	2.844	2.844
	CRAGHEAD PUMP POINT 1	5200734	20.095	20.096
	INDIAN CAMP ALTERNATE POINT	5200765	9.69	9.69
	RILAND DITCH (HACK CR)	5300770	2.444	2.444
70_AND049 UPPER ROAN CREEK	BRIDGES DITCH	7000509	13.744	13.744
	A V AND D DITCH	7000635	13.08	0
70_AND050 COLORADO RIVER NR CAMEO	BOWEN WELL NO 1	7005001	12.747	5.739
	FINLEY RANCH PMP PLANT	7201080	30.842	13.587
72_AND051 PLATEAU CREEK ABV VEGA RSVR	ZEIGEL STOCK DITCH	7201254	17.857	17.216
	VEGA RESERVOIR	7203844	20.341	20.34

Aggregation ID	Structure Name	WDID	2005 Acres	2010 Acres
72_AND052 PLATEAU CREEK BL VEGA RSVR	VEGA RES (VEGA PROJ POOL)	7204906	46.215	46.419
72_AND053 SALT CREEK	LORIMOR SPRING	7201148	11.719	11.719
72_AND054 UPPER BUZZARD CREEK	FRED F CARNAHAN DITCH	7200565	79.072	87.605
72_AND056 UPPER GROVE CREEK	Y T RESERVOIR DITCH	7200951	18.901	18.9
72_AND058 KIMBALL CREEK	NEWMAN DITCH	7200808	54.816	14.442
72_AND061 BULL CREEK	BULL CREEK RES NO 5	7203894	14.5	14.5
	TWIN BASIN RESERVOIR	7203902	13.547	13.952
72_AND062 COON CREEK	PISEL DITCH	7200832	48.014	48.014
	PITTS HIGHLINE DITCH	7200834	13.825	13.83
	WELCH DITCH	7200932	6.304	6.304
	WILDCAT DITCH	7200939	37.615	38.503
72_AND063 MESA CREEK	ATWELL ENL IRR DITCH	7200517	27.318	27.317
	WEIMER DITCH	7200931	24.851	14.85
	DIEMOZ DITCH	7201060	10.288	10.288
	ATWELL DITCH	7201448	93.361	85.207
72_AND065 COLORADO RIVER NR STATE LINE	COLORADO R PUMP STA NO 1	7200981	25.698	25.699
	BROWN POND & PMP PLT	7201030	0	7.07
	ECHO LAKE RESERVOIR	7203920	53.363	25.524
	GILBERT WEBB DITCH	7200636	7.856	0

A-2: Identification of Associated Structures (Diversion Systems and Multi-structures)

Background

The previous CDSS Western Slope models include associated structures which divert to irrigate common parcels of land. These associations were primarily based on information provided directly during meetings with Water Commissioners, and were not based on information from the original 1993 irrigated acreage assessment. The original CDSS 1993 irrigated acreage assessment was based on the USBR identification of irrigated land enhanced with a water source (ditch identifier) that served that land. Many of the irrigated acreage parcels covered more than one ditch service area and, in lieu of spending significant time splitting the parcels by ditch service area, more than one ditch was assigned. For CDSS modeling purposes, the acreage was simply "split" and partially assigned to each ditch.

Introduction

For the recent 2005 and 2010 acreage assessments, there was significant effort spent trying to refine irrigated parcels based on the legal and physical ditch boundaries so, where possible, there was only one ditch assigned to each irrigated parcel in Divisions 5, 6, and 7. Division 4 efforts concentrated on a few areas, but not the entire basin. To model these ditches as accurately as possible, it is important to understand if the acreage that is still assigned to more than one ditch is actually irrigated by all assigned ditches in a comingled fashion or, alternatively, if the acreage should be "split" and the structures should be modeled as having no association. Ditches combined for modeling because the supplies are believed to be comingled are termed "associated structures" for the CDSS modeling effort.

Some associated structures can be identified based on the HydroBase water rights transaction table because they are decreed alternate points or exchange points, while others can be identified based on Water Commissioner accounting procedures, generally documented in their comments accessible through Hydrobase. In the models, associated structures are represented as diversion systems if the structures are located on the same tributary or multi-structure systems if they are located on different tributaries. As part of Task 3, the associated structures were updated to more accurately model the combined acreage, diversions, and demands. These updates include the integration of the 2005 irrigated acreage, the 2010 irrigated acreage, as well as verification of associated structures based on diversion comments and water right transaction comments.

Approach

The following steps were used to identify associated structures in Divisions 5, 6, and 7. Because the Division 4 parcels have not yet been refined to the ditch service level, no effort was made to determine additional associated structures. Note, however, the parcels that require additional refinement have been identified and provided to Division 4. These updates should be included with the next acreage assessment.

Updating the associated structures was a multi-step process that involved 1) identifying potential associated structures by integrating the 2005 and 2010 CDSS irrigated acreage, 2) verifying the associated structures using the diversion and water right transaction comments, and 3) making recommendations on how to best represent the associated structures in the CDSS Western Slope models.

1) *Develop an Associated Structure List Based on Revised 2005and 2010 CDSS Irrigated Acreage*

An initial associated structure list was developed by combining the CDSS revised 2005 and 2010 irrigated acreage. During this process the overlapping similarities between the two irrigated acreage coverages were integrated, resulting in a list of associated structures containing unique IDs. An illustrative example is presented below. In this example, the 2005 irrigated acreage coverage contains parcel A assigned to structures 1, 2, and 3; while the 2010 irrigate acreage coverage contains parcel B assigned to structures 2 and 4. Parcel A and B are integrated, resulting in an association comprised of structures 1, 2, 3, and 4.

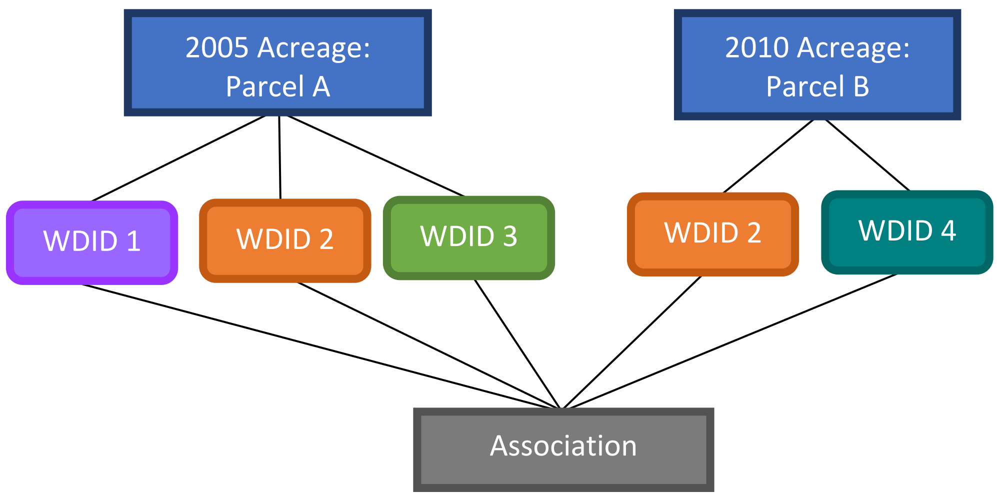


Figure A-2. Example of integrating the CDSS irrigated acreage coverage to identify associated structures.

2) *Verify the Associations Using Diversion and/or Water Right Transaction Comments*

Once a unique list of associated structures was developed, each association was verified using diversion comments and/or water right transaction comments. If the diversion comments and/or water right transaction comments could not verify structure associations, then unverified structures were removed from the list of associated structures (i.e., their diversions will not be treated as commingled). Types of verification included comments identifying structures as alternate points of diversion, points of exchange, acreage reported under alternative structure, same points of diversion, and water right transfers.

Below is an example of the verification methodology using the diversion and/or transaction comments for the association shown in step 1.

Table A-4. Example of Integrating the Diversion and Water Right Transaction Comments for Verification.

WDID	Verification Comment	Source	Verified?
1	Irrigates Y Ranch	Diversion Comment	N
2	Water right transferred to WDID 4	Transaction Comments	Y
3	Acreage is recorded under WDID 2	Diversion comments	Y
4	-	-	Y

Given this example, WDID 1 was not verified by the comments and, thus, not included in the final list of associated structures.

3) *Recommend a Modeling Approach for Representing Associated Structures in the CDSS Western Slope Models*

Using the refined associated structure list developed in step 2, recommendations on how to best represent the associated structures in the CDSS models were provided. These recommendations were based on the following criteria:

- If located on non-modeled tributaries, the associated structures were added to appropriate aggregates.
- Associated structures were explicitly modeled—either in diversion systems or multi-structure systems—if the net water rights for at least one structure in the association exceeded a specific threshold identified in previous modeling efforts. In general, the thresholds represent 75% of the net water rights and are listed in **Table A-5**.

Table A-5. Water Right Thresholds for Explicit Modeling

CDSS Model	Water Right Threshold (CFS)
Yampa	5
White	4.8
Upper Colorado	11
San Juan/Dolores	5/6.5

Structures located on the same tributary were modeled as diversion systems, while structures located on different tributaries were modeled as a multi-structure system. Note, diversions systems combine acreage, headgate demands, and water rights; and the model treats them as a single structure. Contrastingly, multi-structure systems have the combined acreage and demand assigned to a primary structure; however, the water rights are represented at each individual structure, and StateMod meets the demand from each structure when their water right is in priority. **Figure A-3** illustrates how a diversion system is modeled, while **Figure A-4** illustrates how a multi-structure system is modeled.

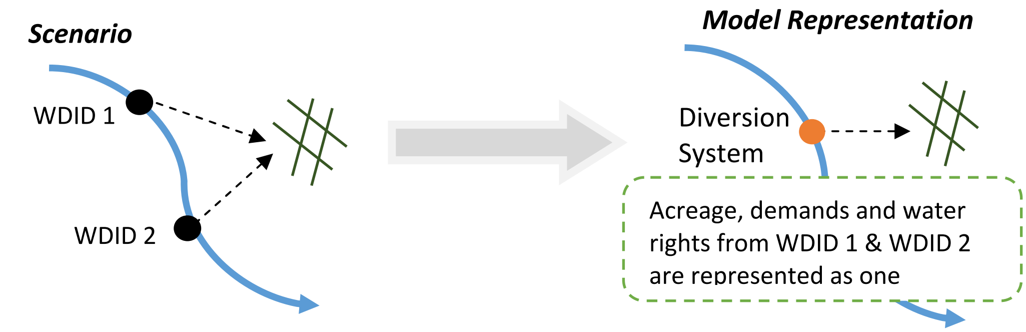


Figure A-3. Model Representation of a Diversion System.

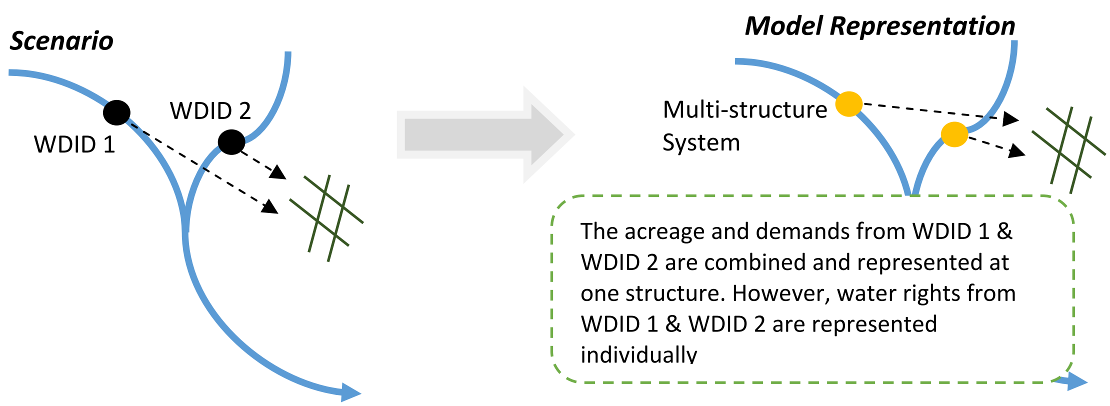


Figure A-4. Model Representation of a Multistructure System.

  - The structure with the most irrigated acreage—based on the 2005 and 2010 CDSS coverages—was selected as the modeled structure for each diversion system.
  - The structure with the greatest net water rights was selected as the primary structure for multi-structure systems.
- If none of the structures in an association exceeded the water right threshold identified in Table 2 and have contemporary diversion records, the structures were modeled in an aggregate.
- If all structures in an associated did not have diversion records, the structures were placed in a "no diversion" aggregate.

Appendix B

Aggregation of Non-Irrigation Structures

1. CDSS Memorandum 5.10
Colorado River Basin Aggregated Municipal and Industrial Use

2. CDSS Memorandum 5.11
Colorado River Basin Aggregated Reservoirs and Stock Ponds

Final
Memorandum

TO: File

FROM: Ray R. Bennett

SUBJECT: **Subtask 5.10 - Colorado River Basin Aggregated Municipal and Industrial Use**

Introduction

This memo describes the results of Sub task 5.10 Colorado River Basin Aggregated Municipal and Industrial Use. The objective of this task was as follows:

> *Aggregate municipal and industrial uses not explicitly modeled in Phase II to simulate their depletive effects in the basin.*

Approach and Results

Phase II Modeled M&I Use. Table 1 presents the 1975 to 1991 average annual Municipal and Industrial depletions modeled in Phase II. These were identified by evaluating Appendix C8.8, Municipal Diversions, of the Phase II Documentation, structures with no irrigated acreage, and structures with a non-agricultural return flow pattern. Note, transmountain diversions are not shown because they are modeled explicitly in the Phase II model. Also, hydropower and M&I carrier ditches (ID 3801170, 7200814, 7200920, 7201339, and 7200766) are not shown because they are non-consumptive.

Table 1

Phase II Explicitly Modeled M&I Consumptive Use (acre-feet)

Id	Name	Serving	Total
3600784	Rankin No 1	Dillon	89
3600908	Keystone Snowline Ditch	Keystone	43
3601008	Breckenridge Pipeline	Breckenridge	326
3601016	Copper Mt. Snowmaking	Copper Mt.	33
3700708	Metcalf Ditch	Upper Eagle	681
3800854	Maroon Ditch	Aspen	1,243
3800869	Midland Flume Ditch	Aspen	1,841
3801052	Carbondale Water System & PL	Carbondale	381
3900967	Rifle Town of Pump & PL	Rifle	483
4200520	Grand Junction Gunnison PL	Grand Jct.	501
5101070	Henderson Mine Water System	Industrial	1,887
5300585	Glenwood L Water Co. System	Glenwood Sp.	1,425
5301051	Glenwood L Water Co. System	Glenwood Sp.	113
7200644	Grand Junction Colo. R PL	Grand Jct.	551
7200816	Palisade Town Pipeline	Palisade	257
72_UWCD	Ute Water Treatment	Ute	1594
72_GJMun	Grand Junction Demands	Grand Jct.	2,680
37VAILIRR	Vail Valley Consolidated	Vail	715
37VAILMUN	Vail Valley Consolidated	Vail	123
36_KeyMun	Keystone Municipal	Keystone	99
Total			**15,065**

Phase II Consumptive Uses and Loss Estimates. Table 2 presents the categories and values of M&I consumptive use presented in the task memorandum 2.09-10, Non-Evapotranspiration (Other Uses) Consumptive Uses and Losses in the Colorado River Basin (01/21/97).

Table 2

Phase II Consumptive Use and Loss M&I Consumptive Use (acre-feet)

Category	Total
Municipal	8,481
Mineral	1,019
Livestock	1,462
Thermal	39
Total	**11,001**

Aggregated M&I Diversion. Based on the above, the Phase II model includes more M&I CU (**15,065 ac-ft**) than the data prepared for the Consumptive Uses and Losses report (**11,001 ac-ft**). This discrepancy might be attributed to the efficiency assigned to municipal users in the Phase II model (36%), the per capita use assigned to urban and rural users in the Consumptive Uses and Losses report (120 gal/person/day), etc. Because the amount of consumptive use is relatively small, no refinement of either estimate is proposed. Rather for Phase IIIa, it is recommended that one aggregated M&I demand be included at the bottom of the system for consistency with other basins and for potential use at a later date should the basic data be refined. As presented in **Table 3** below, for the Phase IIIa analysis, this aggregated M&I structure should be assigned an annual demand of 0 ac-ft/yr. and a water right of 0 cfs.

Table 3

Phase III Colorado River Aggregated M&I Consumptive Use Summary

Basin	Aggregated M&I ID	Depletive Demand AF/yr.	Water Right cfs
Colorado	72_AMC001	0	0

A monthly aggregated demand files with 0 ac-ft/yr was built in an editor using a StateMod format. It is named 72_AMC001.stm and is stored in the directory /crdss/tmp on cando.

Section D.5
Final

TO: File

FROM: Ray Alvarado

SUBJECT: **Subtask 5.11-Colorado River Basin Aggregate Reservoirs and Stock Ponds**

Introduction

This memorandum describes the approach and results obtained under Subtask 5.11, Aggregate Reservoirs and Stock Ponds. The objective of this task was as follows:

> *Aggregates and stock ponds not explicitly modeled in Phase II to allow simulation of effects of minor reservoirs and stock ponds in the basin.*

Approach and Results

Reservoirs and Stock Ponds: **Table 1** presents the net absolute storage rights that were modeled in Phase II, those to be added as aggregated reservoirs in Phase IIIa, and stock ponds to be added as aggregated stock ponds in Phase IIIa. The Phase II reservoir information was obtained from the Phase II reservoir rights file, *coloup.rer*. The absolute decree amount presented in **Table 1** for "Total Aggregated Reservoirs " was produced by running **watright** with command file *aggres.com* (see **Exhibit 1**). The storage presented in **Table 1** for the "Total Aggregated Stock Ponds" was taken from the year 2 Task Memorandum 2.09-10 "Consumptive Use Model Non-Irrigation (Other Uses) Consumptive Uses and Losses in the Upper Colorado River Basin" (11/26/96).

Table 1

Net Absolute Water Rights

Phase	Reservoir	Absolute Decree (af)	% Total
Phase II	GREEN MOUNTAIN RESERVOIRR	160,961	10%
Phase II	CLINTON GULCH RESERVOIR	4,250	<1%
Phase II	DILLON RESERVOIR	252,678	16%
Phase II	HOMESTAKE PROJ RESERVOIR	43,505	3%
Phase II	GRASS VALLEY RESERVOIR	6,889	<1%
Phase II	RIFLE GAP RESERVOIR	13,601	1%
Phase II	MEADOW CREEK RESERVOIR	5,100	<1%
Phase II	CBT SHADOW MTN GRAND L	19,669	1%
Phase II	WILLIAMS FORK RESERVOIR	187,274	12%
Phase II	CBT WILLOW CREEK RES	10,553	1%
Phase II	CBT GRANBY RESERVOIR	543,758	35%
Phase II	VEGA RESERVOIR	33,500	2%
Phase II	RUEDI RESERVOIR	102,369	7%
Phase II	WOLFORD MOUNTAIN RES	65,985	4%
Phase II	BONHAM AGGREGATED RES	6,778	<1%
Phase II	COTTONWOOD AGGREG RES	3,812	<1%
Phase II	CONT. HOOSIER RES	2,140	<1%
Subtotal		1,462,822	94%
Phase IIIa	Total Aggregated Reservoirs	92,505	6%
Phase IIIa	Total Aggregated Stock Ponds	2,661	<1%
Subtotal		94,766	6%
Total		**1,557,588**	**100%**

Number of Structures and Locations: Based on general location, the Phase IIIa reservoirs and stock ponds were incorporated into the model as 11 aggregated structures within each water district. Ten non-operational reservoirs were used to model the net absolute decreed storage. Storage was assigned to the ten nodes as shown in **Table 2**. One non-operational reservoir was used to model the stock ponds, also shown in **Table 3**.

Each aggregated reservoir and stock pond was assigned one account and an initial storage equal to their capacity. Each aggregated reservoir and stock pond was assumed to be 10 foot deep. Each aggregated reservoir and stock pond was assigned a 2 point area-capacity curve. The first curve point is zero capacity and zero area. The second point on the area-capacity table is total capacity with the area equal to the total capacity divided 10. The net evaporation station as described in Phase II Colorado River basin documentation (Section 4.3.2.1 “Estimation of Annual Net Evaporation") was assigned to each structure at 100 percent. All other parameters were left as the default to each structure.

Table 2
Non-operational Reservoirs

Model ID	Name	Capacity (AF)	Percent
36_ARC001	36_ARC001	8,702	9
37_ARC002	37_ARC002	6,671	7
38_ARC003	38_ARC003	13,074	14
39_ARC004	39_ARC004	2,236	2
45_ARC005	45_ARC005	2,054	2
50_ARC006	50_ARC006	11,481	12
51_ARC007	51_ARC007	8,480	9
52_ARC008	52_ARC008	821	1
53_ARC009	53_ARC009	8,389	9
72_ARC010	72_ARC010	30,597	33
	Total	92,505	100

Table 3
Non-operational Stock Pond

Model ID	Name	Capacity (AF)	Percent
72_ASC001	72_ACS_001	2,261	100
	Total	94,766	100

Target Contents, and End-of-Month Data: Each aggregate reservoir and stock pond was designed to maintain maximum volume, filling to account for evaporation losses,
The end-of-month data used in the baseflow calculations was set to the target values.

Water Rights: Water rights associated with each aggregated reservoir and stock pond were assigned an administration number equal to 1.