

# PHASE II UPPER COLORADO RIVER STUDY EXECUTIVE SUMMARY

## *I. Introduction*

The Upper Colorado River Basin Study (UPCO) was initiated in 1998 to identify and investigate water quantity and quality issues in the Study Area consisting of Grand and Summit Counties<sup>1</sup>. The primary goal of Phase II of UPCO was to develop the information and analytical tools necessary to understand existing hydrology and water quality conditions in the study area and how increased water diversions may impact those conditions. This information was meant to support discussions and negotiations between the stakeholders as they seek solutions to current and future water supply, reservoir level, instream flow, and water quality issues. Participants in the study were Grand and Summit Counties, Colorado River Water Conservation District (River District), Middle Park Water Conservancy District (Middle Park), Northwest Colorado Council of Government's Water Quality and Quantity Committee (QQ), Northern Colorado Water Conservancy District (Northern), Denver Water (Denver) and Colorado Springs. The principal components of the Phase II study were: 1) compilation and analysis of water resources and water supply data for Summit and Grand Counties; 2) expansion of Denver's hydrologic and water rights model (Platte and Colorado Simulation Model, PACSM) to represent individual West Slope water supply systems; 3) development of a data management and display tool to support the analysis of impacts associated with existing and future water supply and demand scenarios; and, 4) identification of issues to be addressed in Phase III, the solutions phase, of the study.

The study analyzed existing and future conditions based on the 1947-1991 hydrologic record. That is, the model used natural or "undepleted" stream flows for those years and accounted for the operation of water rights and demands to predict quantity and timing of water supplies, the depleted stream flows, and reservoir levels under various assumptions for the demands. The 1947-1991 period includes wet, dry and average years but does not include any years that are comparable to drought conditions as severe as what occurred during 2002 when streamflows in certain areas were the lowest ever recorded. Impacts created by the 2002 drought are discussed in more detail on page viii of this Executive Summary.

The UPCO evaluations indicate a need for additional water supplies in Grand and Summit Counties for existing and future municipal demands as well as instream flows to support the area's recreational uses and maintain low-flow levels used to determine waste load allocations for wastewater treatment plants. The key to developing solutions and addressing impacts is cooperation among the UPCO partners as future water projects are planned.

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<sup>1</sup> Phase I of UPCO was the development of the Scope of Work for Phase II. Phase III, to be initiated in mid-2003, involves a collaborative effort by the participating parties to seek solutions to the issues identified in the Phase II study report.

## II. Water Needs

### Upper Colorado River In-Basin Water Needs

Water demands in Grand and Summit Counties will grow as the area continues to be a destination resort and important recreation and tourism center for Colorado. Likewise, Denver Water and the Northern Water Colorado Conservancy District are also planning to further develop their existing water supplies, which are diverted from the study area for use on the Front Range, as their populations continue to grow. The UPCO study quantified current and future water demands. The following provides an overview:

Water Provider (1)	Current Demands( acre-feet per year) (2)	Future Demands (acre-feet per year) (3)	Comments (4)
Grand County	3,100	14,200	Approximately 70% of future demands are in the Fraser River Basin.
Summit County	8,000	17,900	Approximately 25% of future demands are in the Upper Blue River area above Dillon. The remaining future demands are primarily in the Silverthorne, Eagles Nest, and Mesa Cortina areas.
Denver Water	285,000	386,000	Please see below for more detail.
Northern	247,800	Up to 271,700	Additional diversions by the Windy Gap project.

Notes:

- 1) For Summit and Grand Counties, the amounts shown in this table include all of the major water providers but do not include dispersed domestic usage in unincorporated areas not served by major providers.
- 2) Current demands are based upon the year 2000. Approximately one-half of Denver's current water supply is derived from East Slope sources in the South Platte River Basin.
- 3) Future demands for Grand and Summit Counties are based upon estimated buildout conditions. Denver's future demand is for their near-term (future baseline) planning horizon (2030) and their estimated buildout demand is 450,000 acre-feet per year.
- 4) Water Demands for Colorado Springs are not included because no increases in water diversions from the Study Area are planned.

### In-basin Instream and Recreational Water Needs

The UPCO study also compiled information regarding instream flow water rights, water levels necessary for water-based-recreational activities, and wastewater treatment plant discharges. This information was used to evaluate the impact on stream flow and lake levels, and goes beyond just the municipal and domestic water demands of the study area.

The study incorporated the following types of information for purposes of evaluation of impacts:

- Colorado Water Conservation Board (CWCB) instream-flow water rights
- Minimum and optimum fish flows
- Low, high and optimum kayaking flows
- Low, high and optimum rafting flows
- Reservoir levels necessary for boat ramps and marinas
- Wastewater treatment plant 1-day and 30-day, 3-year low flows

The CWCB instream-flow rights are of interest because they limit junior water diversions and represent the minimum flows necessary to protect the environment to a reasonable degree subject to water availability. The modeling explicitly accounted for these instream-flow water rights.

The fish, kayaking, and rafting flows and reservoir levels are guidelines that the study established based on information from CDOW and local, established guides and businesses. The flows and reservoir levels represent what the recreation and in-basin communities believe is important to sustain a quality recreational experience. The wastewater treatment plant information provides an indication of potential water quality impacts in streams below wastewater treatment plants. Wastewater treatment facilities' discharge permits depend on certain minimum stream flows for determining the quality and quantity of the wastewater that can be discharged to the stream. If stream flows drop too low, then wastewater treatment plants may be required to provide additional treatment, forcing expensive treatment plant modifications.

### **Denver Water Needs**

Under the PACSM scenarios evaluated in Phase II, at full use of the existing system the average annual Roberts Tunnel diversions will increase by about 64% from 70,500 acre-feet of existing demand to 115,400 acre-feet. This increase will occur as demand in the Denver Water service area grows without building new facilities. In addition to the 64%, if the next project on line were a North System supply with a firm yield of 15,000 acre-feet, diversions from Summit County would increase by 3% to 118,600 acre-feet. If the next project on line were a South System supply, the diversions from Summit County would increase by an additional 7% to 123,400 acre-feet.

Similarly, at full use of the existing system the average Moffat Tunnel diversions will increase by about 6% from 63,600 acre-feet of existing demand to 67,400 acre-feet. Again, this increase will occur as demand increases without building any new facilities. If the next project on line is a North System supply with a firm yield of 15,000 acre-feet, diversions would increase from Grand County by 9% to 73,600 acre-feet, while a South System supply would increase diversions by 8% to 72,600 acre-feet.

### **Northern Colorado Water Conservancy District Water Needs**

The Colorado-Big Thompson/Windy Gap system is designed to collect up to an average of 310,000 acre-feet of water from the Upper Colorado River for conveyance through the Alva B. Adams Tunnel to the East Slope for supplemental irrigation and municipal water supply purposes. Under existing demands CB-T and Windy Gap diversions from the West Slope average about 247,800 acre-feet per year. Under future demands, average annual diversions are expected to increase by about 10% up to 271,700 acre-feet.

### **III. Study Results**

Phase II of the UPCO study represents the most comprehensive water planning and hydrologic evaluation to-date for the headwaters of the Colorado River. The primary results of this phase of the UPCO study are detailed quantifications of water supplies, stream flows, and reservoir levels for various locations in Grand and Summit Counties. The results of the modeling are voluminous, containing daily data for 45 years at nearly 40 locations for several separate model “runs.”

The data display tool provides a means to compare various water supply and planning options. Four water supply and demand “scenarios” were modeled:

1. Existing Demand with Existing Supply
2. Full Use Demand of Existing Supply
3. Full Use with 15,000 acre-feet of New North System Supply including full use of Windy Gap
4. Full Use with 15,000 acre-feet of New South System Supply including full use of Windy Gap

The evaluation entailed reviewing the model output for locations of interest and comparing the current conditions with future conditions to discern where and when water shortages are likely to occur. The table below summarizes the estimated water supply shortages for water providers in Grand and Summit Counties.

**Study Area Water Demands and Shortages**

Water Provider	Average Annual Water Demand (AF)		Average Annual Shortages Under Modeled Scenarios (AF)				
	Existing (yr. 2000)	Future Buildout	Existing Demand with Existing Supply	Full Use Demand of Existing Supply	Full Use with New N. System Supply	Full Use with New S. System Supply	Maximum Annual Shortage (AF)
<b>GRAND COUNTY</b>							
Columbine Lake WD	157	303	0	0	0	0	0
Town of Grand Lake	199	1,262	0	0	0	0	7
Hot Sulphur Springs <sup>(1)</sup>	116	1,667	0	41	41	41	44
Town of Kremmling <sup>(2)</sup>	441	888	0	18	18	18	18
Winter Park Rec. and W&S District (Indoor)	151	500	2	52	55	50	204
Winter Park Rec. (Snowmaking)	199	477	0	10	8	8	70 <sup>(3)</sup>
Grand County W&SD	687	3,711	1	977	996	973	1,903
Winter Park West W&SD	454	618	0	2	2	2	23
Town of Fraser <sup>(3)</sup>	309	1,326	0	8	8	8	27
Silver Creek Resort <sup>(4)</sup>	189	2,950	0	19	19	19	68
Town of Granby	230	465	0	0	0	0	5
<b>Grand County Totals</b>	<b>3,132</b>	<b>14,167</b>	<b>3</b>	<b>1,127</b>	<b>1,147</b>	<b>1,119</b>	<b>2,369</b>
<b>SUMMIT COUNTY</b>							
Arapahoe Basin Snowmaking <sup>(5)</sup>	0	351	0	133	133	133	330
Keystone-Montezuma Domestic	0	30	0	2	2	2	11
Keystone Snake River Snowmaking <sup>(6)</sup>	485	1,157	27	207	207	207	668 <sup>(7)</sup>
Keystone Gulch	0	78	0	11	11	11	2
Keystone Golf Course <sup>(7)</sup>	170	170	0	0	0	0	2
Keystone Ranch <sup>(8)</sup>	268	274	0	0	0	0	6
Snake River WD	555	1,903	1	35	35	35	239
East Dillon WD	290	623	1	11	11	11	106
Town of Breckenridge	2,062	3,355	0	0	0	0	0
Breckenridge Golf Course	176	365	7	12	12	6	88
Breckenridge Ski Resort	546	685	0	4	4	4	24
Copper Mountain W&SD	381	876	46	101	100	96	282
Copper Mountain Inc (outdoor and snowmaking)	500	689	6	13	12	12	99
Town of Frisco <sup>(9)</sup>	846	1,976	0	0	0	0	0
Dillon Valley Metro District	333	406	0	0	0	0	7
Town of Dillon	327	878	0	0	0	0	0
Buffalo Mountain / Mesa Cortina	296	755	0	0	0	0	0
Town of Silverthorne	465	2,298	0	0	0	0	0
Eagle's Nest	327	1,002	0	0	0	0	3
<b>Summit Totals</b>	<b>8,027</b>	<b>17,871</b>	<b>88</b>	<b>529</b>	<b>527</b>	<b>517</b>	<b>1,900</b>
<b>Totals of Both Counties</b>	<b>11,159</b>	<b>32,038</b>	<b>91</b>	<b>1,656</b>	<b>1,674</b>	<b>1,636</b>	<b>4,269</b>

- 1) Hot Sulphur will experience July shortages when 4 cfs demand exceeds 3.3 cfs right.
- 2) Shortages exist in some months when demand exceeds 1 cfs right. Based on Colorado River supplies.
- 3) December shortages.
- 4) December shortages.
- 5) Demands include domestic and snowmaking. Future snowmaking demand is 350 af/year.
- 6) This shortage can be eliminated by operation of the existing Montezuma shaft pumps
- 7) PASCN develops historical flows ending in 1991 - golf course irrigation began 1999.
- 8) Demands for domestic, commercial, golf course and greenbelt.
- 9) Shortage when the junior right using Dillon exchange cannot operate because Dillon has reached its minimum content in dry years.

As shown on the table, most water providers have sufficient water supplies to cover the current levels of demand (see page viii of this Executive Summary for discussion of 2002 drought impacts). However, under future conditions, nearly two-thirds of the providers are expected to have demands that exceed their current water rights and/or water availability. The largest shortages are predicted for the Fraser River upstream of Tabernash, the Blue River upstream of Dillon Reservoir, Snake River upstream of Dillon Reservoir and Tenmile Creek upstream of Dillon Reservoir.

Even though the hydrologic model calculates volumes down to the acre-foot and flow rates to a fraction of a cubic foot per second, the numbers provided on the table above, and in the full report, should be considered as guidelines and not the exact value of the shortage or supply. It is most useful to consider the reported values as relatively “large” or “small” and use comparisons and common sense to get a feel for the size and likelihood of future supplies and shortages.

#### ***IV. PACSM Analysis Results***

##### **Grand County**

The analysis of PACSM results was divided into sub-basins.

**Fraser River Basin above and below the Town of Fraser:** Under the PACSM model, municipal and domestic water supplies were adequate for existing levels of water demand, but most water providers would experience shortages under future demand scenarios. Shortages would be most severe for the Grand County Water & Sanitation District, ranging from an annual minimum of 616 acre-feet to a maximum of 1,903 acre-feet and averaging 996 acre-feet. These shortages would occur primarily in the fall and winter months as a result of lack of physical supply and Denver’s upstream diversions and would coincide with periods when streamflow would be below the CWCB instream flows, fish minimum flows and wastewater treatment plant low-flows.

Water quality impacts related to Berthoud Pass, though not specifically examined in this study, emerged as issues. This includes water quality impacts related to winter sanding operations on Berthoud Pass and the potential for an accident of a truck carrying hazardous materials on Berthoud Pass. The latter could significantly affect water supply in the upper part of the Fraser River, as most providers divert directly from the Fraser with no alternative sources of supply.

**Colorado River Basin above the Fraser River confluence:** Municipal and domestic water supplies were adequate under both existing and future demands. Though Northern is required to bypass flows below Lake Granby to maintain minimum instream flow requirements, instream flows below Lake Granby will be below CWCB, fish minimum and fish optimum levels. However, due to data inadequacies, it is not clear exactly how often this would occur. The only time flows will be below CWCB levels is when inflows are less than the minimum flow. Lake levels in Lake Granby were not fully evaluated in the study but should be before entering the solutions phase as lake levels relate to marina operations.

**Colorado River below the Fraser River confluence:** The water supply systems for the Towns of Hot Sulphur Springs and Kremmling were adequate for existing demands but would experience shortages under all of the future demand scenarios. In addition, instream flows below Windy Gap were below CWCB, fish minimum, and kayak minimum levels under all scenarios. Low flows in the Colorado River below Windy Gap in the late summer and early fall often result in high water temperatures that adversely impact the trout fishery.

## **Summit County**

The PACSM results were divided into the following sub-basins:

**Blue River above Dillon Reservoir:** Municipal and domestic water supplies were adequate for existing and future water demand scenarios, but the Breckenridge Golf Course would experience shortages under all demand scenarios in most years during the spring and fall months. The potential for a collaborative arrangement involving in-basin water providers, Summit County and the City of Colorado Springs to develop additional storage in the Upper Blue River Basin emerges as a potential solution for further evaluation in Phase III.

**Tenmile Creek above Dillon Reservoir:** Copper Mountain Water & Sanitation District and the Copper Mountain Golf Course will experience frequent small water supply shortages under existing demands and occasional large shortages under future demands. Instream flows in Tenmile Creek below West Tenmile Creek were frequently below CWCB levels and occasionally below wastewater treatment plant low-flow levels under all demand scenarios.

**Snake River above Dillon Reservoir:** A-Basin and Keystone snowmaking, Keystone-domestic uses below Peru Creek, Keystone Gulch and the East Dillon Water District will experience water supply shortages under future demands. The water supply shortages in the Snake River Basin are due primarily to lack of adequate physical supply during the fall and winter months. At times, Keystone snowmaking shortages can be eliminated by pumping water from Denver's Montezuma shaft into the Snake River. Due to Robert's Tunnel maintenance and operational constraints, this water is not always available. An additional issue relating to reduced streamflows concerns levels of zinc, cadmium and copper in excess of aquatic life water quality standards and levels of manganese in excess of the domestic water supply standards due to acid mine drainage from the Peru Creek drainage.

**Dillon Reservoir and the Blue River below Dillon:** Under future demand conditions, PACSM results indicate significant increases in the frequency and duration of periods when Dillon reservoir would be below levels needed for normal operation of the Dillon and Frisco marinas. Streamflows in the Blue River below Dillon Reservoir under future demands would be at or above the 50 cfs CWCB instream flow that was determined using PHABSIM analysis, but frequently below the 55 cfs seasonal flow (10/1 – 4/30) identified by CDOW using the R-2 Cross Method. Streamflows in the Blue River below Dillon Reservoir under future demands would also frequently be below the rafting low-

flow levels and kayak low-flow levels. Reservoir levels during the summer recreation season and flows in the Blue River below Dillon are influenced primarily by water demands on the Denver System.

**Green Mountain Reservoir and the Blue River Below Green Mountain:** PACSM results indicated that flows in the Blue River below Green Mountain are usually above the CWCB and fish minimum levels under all scenarios. However, kayaking flows were below the minimum and optimum levels under current demands in all months except June and July and under future demands in all months except July.

## ***V. Impacts of 2002-2003 Drought***

As previously discussed, the 1947-1991 study period for the UPCO model includes a number of wet, average and dry years. The study period includes the 1954-56 and 1977 droughts, which have historically been used by water planners for estimating the “firm” yield of their water supplies. The participants of the study realize that the current 2002-2003 drought may present conditions even more severe than the past droughts. The participants also recognize that a number of conditions have occurred to-date during the 2002-2003 drought that may present unique new challenges which need to be considered in the future. These specific conditions include the following:

- ❑ Streamflows in certain areas of the Colorado River Basin and its tributaries were lower than in previous droughts.
- ❑ Problems occurred with Green Mountain Reservoir including exhausting the historic users pool (HUP) and the impact of the Heeney slide, which prevented full use of the reservoir’s available storage.
- ❑ Denver Water reduced its by-pass flows past their Moffat Collection System, significantly reducing streamflows in the Fraser River Basin.
- ❑ Due to agreements between water users and Excel Energy, there were changes in the administration of the Shoshone Call.
- ❑ Clinton Reservoir may fail to fill for a fourth consecutive year, causing shortages in the planned 3-year supply for certain shareholders.
- ❑ Denver Water has nearly exhausted its Williams Fork Reservoir supply and resorted to use of Dillon Reservoir to augment its Fraser River diversions.

The degree to which these problems affect the published yields and shortages in the UPCO study are not certain. However, the participants agree that these issues should be considered during the next phase (Phase III) of the study and evaluated for potential impacts on the future shortages and water requirements of the water users in the basin.

## ***VI. Next Steps***

Phase II of the UPCO Study has identified a number of issues and problems that warrant further study. The objectives for the next phase need to be identified and the role and organization of UPCO needs to be defined. This may involve formation of one of more



subgroups to address specific issues and problems. Tasks that could be addressed in Phase III of UPCO include the following activities:

- ❑ Providing a forum to develop possible solutions to some of the problems identified in the study.
- ❑ Providing information to in-basin water users and communities in their own planning efforts.
- ❑ Providing a forum to coordinate the review of water supply projects proposed by Denver and Northern.

Both Denver and Northern are in different stages of considering projects in the Study Area or that would affect the Study Area. Denver is currently involved in two projects. The South Metro Study is evaluating conjunctive use options in the South Metro area using Blue River water. This study will look to UPCO to assist in resolving issues and impacts as the study participants evaluate alternatives. Denver will initiate a National Environmental Policy Act (NEPA) review of a project for its North System. Denver has identified the need for the project but not a preferred alternative. Denver is working through the UPCO process with Grand County to include and address some of the impacts identified in UPCO. Denver's permitting agency will most likely be the Corps of Engineers. Northern is studying alternatives for a Windy Gap firming project. Northern will most likely initiate the NEPA process in the summer of 2003. The permitting agency will be the U.S. Bureau of Reclamation. Northern will continue to work through UPCO to get public input from Grand County during the NEPA process.

Some of the issues identified in UPCO are being addressed through the ongoing efforts of groups other than the UPCO Management Committee. Examples of these efforts include the Three Lakes Water Quality Study, the Snake River Task Force, two Blue River restoration projects – above and below Dillon Reservoir, and the French Gulch Remediation Opportunities Group. UPCO will work with and through existing groups where such efforts already exist.