WATER SUPPLY ALTERNATIVES SUMMARY

Phase 2 Assessment

January 2008 Draft

GrandRiver
Consulting Corporation

718 Cooper Ave.
Glenwood Springs, CO 81601
970-945-2237

A Project of the East Slope and West Slope
Water Users In Support of the Upper Colorado River
Endangered Fish Recovery Program

10825 WATER SUPPLY ALTERNATIVES SUMMARY

Phase 2 Assessment
January 2008 Draft

Prepared for:
East and West Slope Water Providers
Who divert water from the Colorado River Basin
With support from the
Colorado Water Conservation Board
Basin Roundtable Grant Program

Prepared by:
GRAND RIVER CONSULTING CORPORATION
Kerry Sundeen, Caroline Bradford, Maria Pastore, Dane Ensign

With considerable project team support from:

ECOLOGICAL RESOURCE CONSULTANTS
Heather Thompson

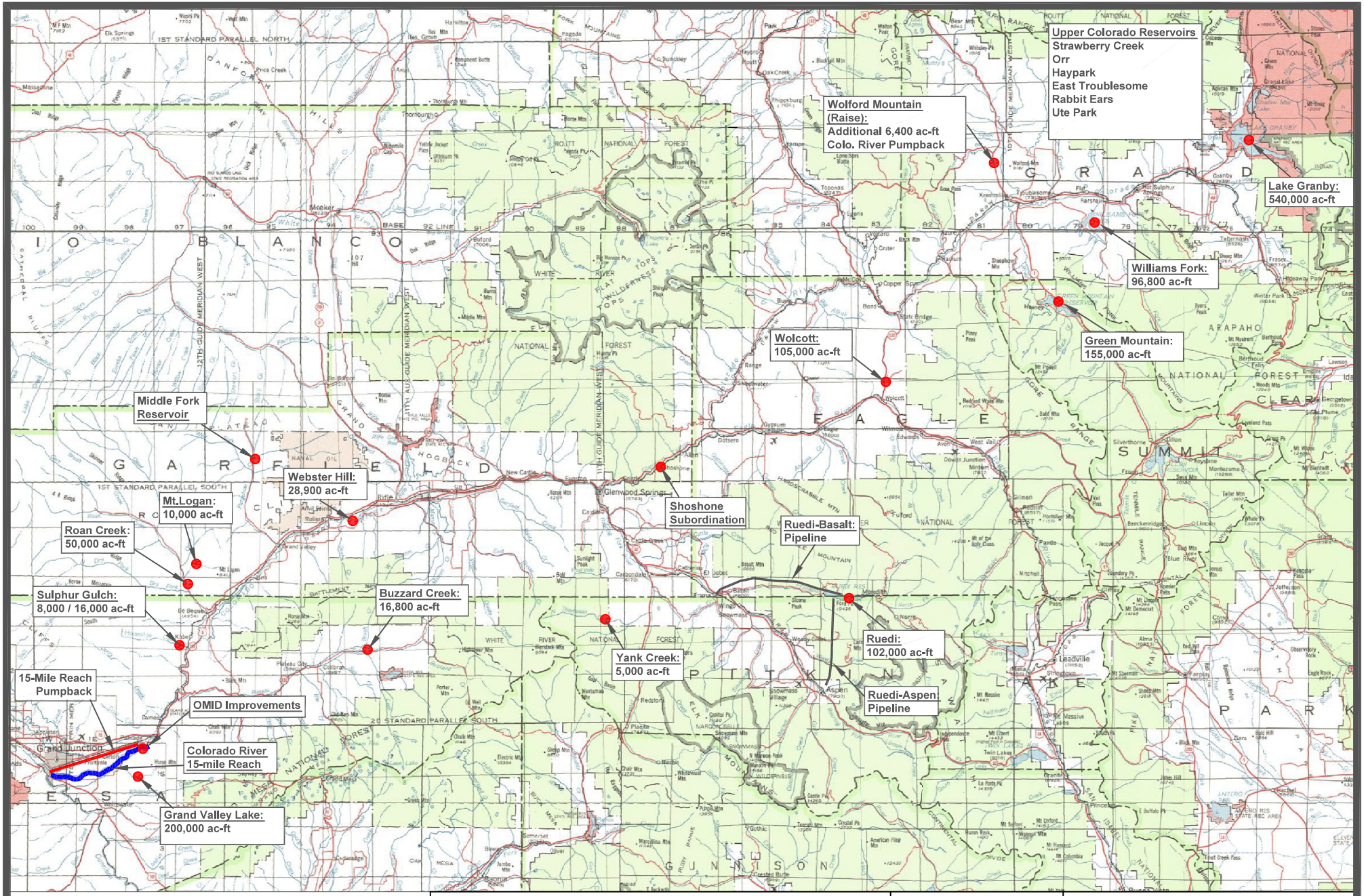
ERO RESOURCES
Steve Dougherty, Aleta Powers

GEI CONSULTANTS, INC.
Richard Westmore, John Harb, James Wright, Paul Eggers, Nick Miller

MILLER ECOLOGICAL
Bill Miller, Ph.D.

We would like to thank all the members of the
10825 Steering Committee for their time and generous commitment to the project.
For more information, please visit: www.grandriver.us/10825

TABLE OF CONTENTS



10825 Water Supply Study, Phase 2
Upper Colorado River Endangered Fish Recovery Program

GrandRiver Consulting Corporation

RECOVERY PROGRAM FACILITY LOCATION MAP

Project 071260 | January 2008 | Figure 1

DRAFT SUMMARY

10825 WATER SUPPLY STUDY

1.0 BACKGROUND

Four warm water fish species that inhabit the lower reaches of the Colorado River watershed in western Colorado have been listed as endangered under the federal Endangered Species Act. The four fish are the Colorado pikeminnow (aka squawfish), razorback sucker, humpback chub and the bonytail.

East Slope and West Slope water providers in the Upper Colorado Basin have committed to permanently supply 10,825 acre-feet of water per year (10825 Water) to assist with the recovery of the endangered fish. This water is supplied to the "15-Mile Reach" of the Colorado River near Grand Junction, most commonly during the July through October period. During this time of year the stream flow of the Colorado River within the 15-Mile Reach is substantially impacted by upstream water diversions, and the supplemental 10825 water is beneficial to the endangered fish.

The commitment to provide 10825 Water is divided equally between East Slope and West Slope water providers, with each responsible to supply 5,412.5 acre-feet per year on a permanent basis. Currently, the 10825 water is provided on a temporary and interim basis by Denver Water (from Williams Fork Reservoir) and by the Colorado River Water Conservation District (from Wolford Mountain Reservoir). The agreements to provide the temporary 10825 water supplies have drought provisions that allow reduced water deliveries during dry years.

The water providers must have permanent agreements in place that identify the permanent source of the 10825 water by December of 2009. Unlike the existing temporary 10825 agreements, the permanent agreements will require delivery of the 10825 Water in all years, including drought years.

1.1 STUDY PROCESS

A broad coalition of East and West Slope water providers agreed in early 2007 to cooperatively analyze and compare a wide range of alternatives that would meet their obligations to provide 10,825 acre feet of water to the 15-Mile Reach on a permanent basis. This report summarizes the second phase of an assessment that evaluates these alternatives.

Phase 1 of the alternatives assessment was a "preliminary screening" evaluation. A total of 15 potential 10825 facilities or alternatives that were identified in early 2007 were evaluated and compared at a reconnaissance level. After consideration of the Phase 1 study results, five of the initial concepts were determined by the 10825 Steering Committee to not warrant further study or consideration in the Phase 2 assessment.

This study provides information regarding the viability, environmental impacts, issues, and costs of potential 10825 Water supply alternatives and facilities. The specific facilities recommended for further analysis in the Phase 1 study have been assessed. Also, at the direction of the 10825 Steering Committee, additional elements and combinations of facilities that had not been considered in Phase 1 were added to the Phase 2 scope of study. In total, more than 20 alternatives, facilities (including structural and non-structural components), and combinations of facilities have been evaluated in this study. The location of each 10825 facility that has been evaluated is identified on the vicinity map in the front of this summary report.

Information from the Phase 2 Assessment is intended to facilitate the selection of a preferred alternative or group of alternatives that can be supported by both West Slope and East Slope water providers. A website with project notes, technical memoranda, engineering reports, and environmental reports that have been prepared by the study team is available at www.grandriver.us/10825. Background material on the Recovery Program and an extensive file reference library with material related to specific facilities is available to all interested parties via this project website.

1.2 OBJECTIVES FOR 10825 WATER SUPPLY ALTERNATIVES

The primary objectives of each 10825 Water supply alternatives are to:

- Permanently supply 10,825 acre feet of water during the late summer and fall months in all years, including dry years

- Not impair or reduce the water supply available to any West Slope or East Slope Water provider

Secondary considerations in the study included developing alternatives that would benefit and/or have minor negative impacts on the headwater streams in the Colorado River Basin. Some of the alternatives outlined in this report meet this secondary objective better than others.

A key component of the 10825 Water Supply Study process was that the preferred alternatives must be supported by the stakeholders in the study process. The most promising alternatives that meet BOTH the primary objectives AND the secondary considerations are most likely to have support by the stakeholders in this process.

1.3 PURPOSE AND NEED STATEMENT

The 10825 water supply alternatives must fulfill the obligation of the water providers who divert from the Colorado River (water providers) under Activity 1-A.5.e of the Recovery Implementation Program, Recovery Action Plan. Pursuant to this obligation, the water providers must permanently deliver 10,825 acre-feet of water in the summer and early fall to the 15-mile reach of the Colorado River to benefit the target fish species.

The alternatives must be practicable and capable of efficiently and effectively delivering the 10,825 acre-feet of water to the 15-mile reach in all years. An agreement for the permanent delivery of the water must be in place by December 20, 2009 and the project must be implemented by the date specified in this required agreement. The delivered water must be of sufficient quality to avoid adversely affecting the target fish species, irrigation or crop yields, municipal water treatment costs, or cause exceedances of existing water quality standards.

2.0 EVALUATION CRITERIA

Eleven evaluation criteria were developed pursuant to 404(b)(1) Guidelines, NEPA standards, and study guidelines of the members of the 10825 Steering Committee. The criteria are described in specific detail in the memorandum, *Screening Criteria*, which is available on the project website. The evaluation criteria are listed below in abbreviated form:

1. Amount of Water	Must be able to deliver at least 2,500 acre-feet per year (for new structural elements only)
2. Implementation Schedule	Must be capable of being agreed to by December 2009 by all necessary parties
3. Effective Delivery	Deliver water to the 15 Mile Reach within 72 hours
4. Efficient Delivery	Release water at rates between 50 and 250 cfs
5. Engineering Feasibility	Accomplished with existing technology
6. Land Use/Permitting	Feasible to obtain all appropriate permits
7. Institutional/Legal issues	Must be able to be resolved
8. Cost	Not greater than five times cost of acquiring similar amount of augmentation water in the 15 Mile Reach
9. Water Quality	Sufficient quality to avoid adverse affects
10. Benefit target fish species	Not diminish the opportunity for fish to recover
11. Stakeholder Consensus	Must be supported by stakeholders in the study

3.0 ELEMENTS SCREENED FROM FURTHER STUDY

Based upon study objectives, and upon the evaluation criteria, 17 facilities were screened from further investigation. The facilities screened from further study are listed below. Please note that two of these screened facilities (Roan Creek Reservoir and Wolcott Reservoir) were eliminated from further study because it is not likely that either project is capable of being agreed upon and supported by the Water Providers and other project participants by December 20, 2009. If developed in the future, either of these facilities may become viable sources of 10825 Water.

Prior to elimination from further consideration, conceptual-level designs and updated cost estimates were provided by GEI Consultants. This information was used to evaluate the 15 Mile Reach Pump back, Yank Creek Reservoir, Roan Creek Reservoir and Wolcott Reservoir in addition to the other facilities carried forward in the study. Detailed hydrology, aquatic impacts, environmental and permitting evaluations were not conducted for these screened out alternatives.

Facility	Evaluation Criteria Not Met
• 15 Mile Reach Pump back	Water Quality
• Mt. Logan Reservoir	Engineering Feasibility
• Yank Creek Reservoir	Minimum yield, engineering
• Pipeline from Ruedi to Basalt	Cost, permitting
• Pipeline/Tunnel Ruedi to Roaring Fork	Cost, permitting, engineering
• Webster Hill Reservoir	Schedule, target species, permitting
• Grand Valley Lake	Schedule, water quality, permitting
• Middle Fork Reservoir	Minimum yield
• Roan Creek Reservoir	Schedule
• Wolcott Reservoir	Schedule
• Shoshone Call Subordination	Yield, stakeholder consensus
• Upper Colorado Reservoirs (6)	Minimum yield

4.0 RECOVERY PROGRAM WATER RELEASE PRINCIPLES

In order to assess the impacts associated with potential 10825 Water supply alternatives, it is necessary to first estimate the timing and magnitude of 10825 Water releases. The following information was considered to identify specific study years and specific water release schedules.

4.1 STUDY YEARS

In their 1995 report entitled "Relationships between Flow and Rare Fish Habitat in the 15 Mile Reach of the Upper Colorado River", the U.S. Fish and Wildlife Service (USFWS) recommended 15 Mile Reach stream flow targets for four categories of years (Table 1). Dry years were defined as the driest 20 % of years, and wet years were defined as the wettest 25 % of years. Flow recommendations were also provided for above average years, and for below average years. In coordination with these recommendations, the four individual study years noted on Table 1 were selected for this evaluation.

Table 1

USFWS Summer and Fall Stream Flow Recommendations
15 Mile Reach

Year	% Exceedance	Flow Recommendation	Proposed 10825 Study Year
Dry	80 % to 100 %	810 cfs	1977
Below Average	50 % to 80 %	1,240 cfs	1988
Above Average	25 % to 50 %	1,630 cfs	1982
Wet	0 % to 25 %	1,630 cfs	1983

4.2 RELEASE SCHEDULES

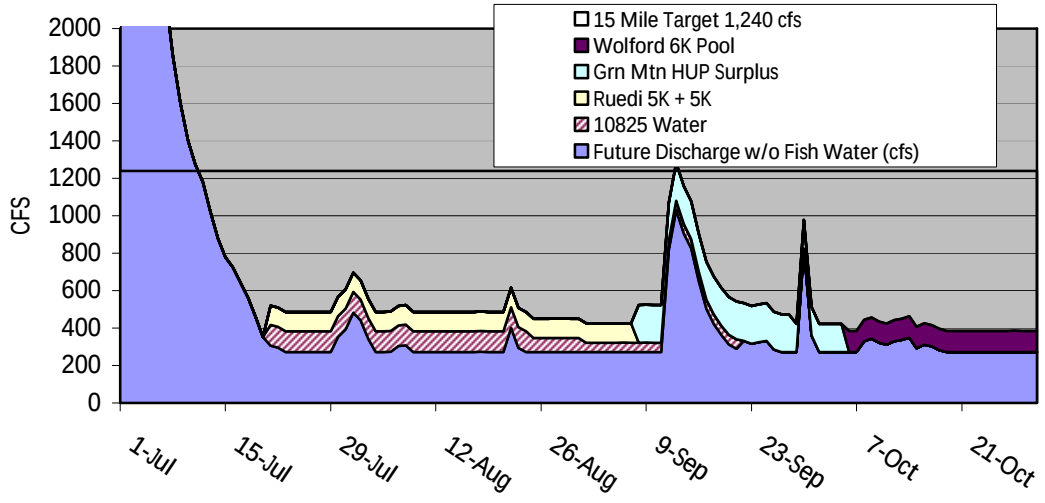
Recovery Program water is available from the four sources listed in Table 2. The total amount of water available to the Recovery Program varies by type of year, and is estimated to range from a low of 21,825 acre feet to a high of about 65,825 acre feet. These estimates in Table 2 do not reflect the existing contract for 10,825 acre feet of water from Ruedi Reservoir, as this contract expires in the year 2012.

Table 2 Recovery Program Water Sources						
Year	Study Year	10825 Water	Ruedi 5 + 5 Water	Grn Mtn HUP Surplus	Wolford Mtn Fish Pool	Total
Dry	1977	10,825 AF	5,000 AF	0 AF	6,000 AF	21,825 AF
Below Average	1988	10,825 AF	10,000 AF	15,000 AF	6,000 AF	41,825 AF
Above Average	1982	10,825 AF	10,000 AF	30,000 AF	0 AF	50,825 AF
Wet	1983	10,825 AF	10,000 AF	45,000 AF	0 AF	65,825 AF

In coordination with the USFWS, we have developed potential release schedules for each of the four study years. These release schedules are for the July through October period, and are based on the basic operational principles described in the memo *Release Schedules for 10825 Alternatives*, which is available on the project website. The operating/release principles are for use in this study only, and are based upon the experience and professional judgment of the USFWS and others.

The release schedule for the below average study year of 1988 is illustrated below. The release schedules used in this study are not binding, nor are they formalized in any specific agreement. (See related memo for other study years.) Please note that these release patterns benefit from hindsight, and that actual Recovery Program releases in the future may or may not occur in a manner consistent with the simulations and assumptions used in this study.

Figure 2
15 Mile Reach Streamflow (Below Avg 1988)



5.0 ALTERNATIVES STUDIED IN DETAIL

A total of 11 alternatives have been studied in detail in this Phase 2 Assessment. Based upon results of the Phase 1 Assessment, these alternatives were judged to most likely meet the evaluation criteria. The alternatives studied in detail are illustrated in Table 3 below. This table also illustrates the allocation of water yield for each alternative.

Two of these alternatives (Ruedi Reservoir and Sulphur Gulch Reservoir) are stand alone alternatives. The remaining nine alternatives are paired or synchronized alternatives.

TABLE 3

10825 WATER SUPPLY ALTERNATIVES STUDIED IN DETAIL
ALLOCATION OF WATER SUPPLY

	STAND ALONE ALTERNATIVES		SYNCHRONIZED ALTERNATIVES								
	Alt. A:	Alt. B:	Alt. C1:	Alt. C2:	Alt. C3:	Alt. C4:	Alt. C5:	Alt. C6:	Alt. C7:	Alt. C8:	Alt. C9:
Project Element	Ruedi Reservoir	Sulphur Gulch Reservoir 16K AF	Ruedi / Sulphur Gulch Reservoir 8K AF	Ruedi / Buzzard Creek Reservoir	Ruedi / Williams Fork Reservoir	Sulphur Gulch / Williams Fork Reservoir	Wolford Mtn / Ruedi Reservoir	Buzzard Ck / Wolford Mtn Reservoirs	Lake Granby / Ruedi Reservoir	Lake Granby / OMID Imprvmnt / Ruedi	Lake Granby / Sulphur Gulch Reservoir
Ruedi Reservoir	10,825 AF		5,412 AF (baseload release)	5,412 AF (baseload release)	8,125 AF most years 13,525 AF dry years		5,412 AF		8,125 AF	2,700 AF in all but dry yrs, 8,125 AF in dry yrs	
Sulphur Gulch Reservoir (16,000 AF)		10,825 AF				8,125 AF most years 13,525 AF dry years					8,125 AF
Sulphur Gulch Reservoir (8,000 AF)			5,412 AF (peaking release)								
Buzzard Creek Reservoir (16,800 AF)				5,412 AF (peaking release)				5,412 AF dry & below avg yrs 10,825 AF all other years			
Williams Fork Reservoir					2,700 AF if reservoir fills 0 AF dry years	2,700 AF if reservoir fills 0 AF dry years					
Wolford Mtn Pumpback & Reservoir Enlargement							5,412 AF				
Wolford Mtn Pumpback Only								5,412 AF dry & below avg years only			
Granby Reservoir									2,700 AF	2,700 AF	2,700 AF
OMID Water Management / Green Mtn HUP Surplus										5,412 AF in all but dry yrs, 0 AF in dry years	

6.0 GENERAL OBSERVATIONS: "A to Z"

Through the evaluation process, the study team has developed the following key observations. These observations are important for the 10825 Steering Committee to consider as this group evaluates specific alternatives to fulfill both the obligations of the Water Providers under the Programmatic Biological Opinion AND to support the broader goals of actually recovering the target fish species through the Upper Colorado River Endangered Fish Recovery Program. These observations also strongly influenced the identification of the most promising alternatives, which are presented later in this summary.

6.1 BENEFIT TO THE ENDANGERED FISH RECOVERY PROGRAM

a) Six alternatives are recommended as most promising in this report. Each of these alternatives would benefit the 15 Mile Reach by providing 10,825 acre feet of water per year.

b) The water sources available to the Recovery Program (Green Mtn. Reservoir surplus, Ruedi Reservoir 5 & 5 water, Wolford Mtn fish pool, and 10825 Water) will not increase stream flow in the 15 Mile Reach to the point that the USFWS target flow prescriptions are met in dry years, or even in below average years. While minimum dry year targets call for 810 cfs (1,240 cfs in below average years) in the 15 Mile Reach, the release of all the available Recovery Program water will maintain a flow of less than half of the targets (about 400 to 500 cfs) in drier years.

c) It is important to efficiently manage and coordinate releases of the 10825 Water along with all other Recovery Program sources of water, in order to maintain as consistent a flow as possible in the 15 Mile Reach, especially in drier than average years when flow targets will not be met.

d) The completion of fish passage improvements at the Price-Stubb dam will provide the endangered fish with new access to lengthy segments of the Colorado River that have relatively high stream flow throughout the year. When all of the related fish passage elements that have been put in place on the Colorado River are operational, they will have a positive impact on the potential recovery of the endangered fish. The provision of 10825 Water, while important, may have less impact on the recovery of the fish than other Recovery Program elements such as the fish passage improvements.

e) Releases of 10825 Water from alternatives that utilize Sulphur Gulch Reservoir would provide the most benefit to the 15 Mile Reach and to the Recovery Program, as long as appropriate operational and design criteria are implemented. This facility is close to the 15 Mile Reach, and reservoir releases can be timed in response to fluctuating stream flow of the Colorado River. The flexibility in release patterns associated with Sulphur Gulch Reservoir would maximize the effectiveness of the limited water supplies available to the

Recovery Program. However as outlined above, the 10825 Water may be of relatively minor importance compared to other elements of the Recovery Program, and all of alternatives recommended herein would supply 10,825 acre feet of water to the 15 Mile Reach in a timely manner.

6.2 TIMING OF 10825 RELEASES

f) Recovery Program water demands commonly occur from July through October when minimum flow targets in the 15 Mile Reach are not met.

g) Under existing operating conditions, 10825 Water will provide the most benefit to the endangered fish if all or a substantial portion of the water can be released in July and August, prior to the time that Green Mountain Reservoir HUP surplus water becomes available to use in September and October. Because the HUP Surplus provides over ½ to ¾ of all the Recovery Program water available in most years, it's important to spread HUP water out over the longest period possible. The 10825 Water and the Ruedi Reservoir "5 & 5" Water are the primary Recovery Program water sources available in July and August. The demand for additional Recovery Program water supplies (including 10825 Water) is often reduced by the time any Green Mountain surplus is available, which occurs commonly in early September.

h) If the Green Mountain HUP surplus declaration could occur earlier in the year, 10825 Water releases could be spread out over the July through October period which could maintain a consistent flow rate from all facilities to the 15-Mile Reach. This would result in smaller instantaneous releases of the 10825 Water, and would reduce negative impacts that may be associated with releases of this water from headwater facilities.

i) A tool or process to forecast probable stream flow conditions in the 15 Mile Reach would allow the more efficient delivery of all sources of Recovery Program water, including the 10825 Water. This process could be used to (1) forecast flow targets for the 15 Mile Reach (i.e. dry or wet year targets) and (2) forecast the amount of Green Mountain surplus water that may become available. The existing process for evaluating these issues is necessarily conservative, and as a result, all of the available Recovery Program water is often not used, or is released in a less than optimum schedule.

6.3 COLORADO RIVER – HEADWATER IMPACTS

j) The only headwater reach of the Colorado River that would markedly benefit from the release of 10825 Water is the Colorado River from Lake Granby to Troublesome Creek. Because the geometry of the river channel is small, the addition of 10825 Water would

significantly improve aquatic conditions. Tens of cfs of water can make a substantial difference in this narrow segment of the Colorado River headwater.

k) The release of 10825 Water from Williams Fork, Wolford Mountain, or Green Mountain reservoirs will not markedly improve aquatic conditions of the upper Colorado River. The use of these reservoirs has less affect on the upper Colorado River than we initially anticipated. The release of Recovery Program water will either have no significant impact, or a negative impact to aquatic life and recreation. Because the channel of the Colorado River below the confluence with the Blue River is large, and because stream flow is naturally greater at this downstream location, the release of 10825 Water does not substantially alter aquatic conditions in this reach of the river.

l) The viability of Granby Reservoir as a source of 10825 Water is not known at this time.

6.4 FRYINGPAN RIVER / RUEDI RESERVOIR

m) Recovery Program releases from Ruedi Reservoir will degrade aquatic conditions and recreation use of the Fryingpan River. The relative magnitude of the adverse impact will vary depending upon the amount of 10825 Water, the specific release schedule, and natural hydrologic conditions that vary a lot between dry and wet years.

n) The economic benefits associated with sport fishing on the Fryingpan River are substantial. A perception may exist that any impact to the Fryingpan River will be unacceptable from aquatic conditions, recreation and economic perspectives. However, if a portion or even all of the 10825 Water is supplied from Ruedi Reservoir, the Fryingpan River below the reservoir will remain a very productive fishery with significant economic benefits.

o) If all Recovery Program releases from Ruedi Reservoir, including "5 & 5" and 10825 Water, can be spread out over the July to October period (i.e. potentially make the Green Mountain Reservoir surplus declaration earlier), any adverse impacts to the Fryingpan River will be reduced.

p) In the near-term, impacts associated with 10825 Water releases from Ruedi Reservoir would be similar to the existing impacts associated with the release of the "2012 Recovery Program Water". The largest change in stream flow of the Fryingpan River, and the largest impacts to aquatic conditions and recreation, will occur at some point in the future as the West Slope demand for contracted water from Ruedi Reservoir increases. As contract releases increase in the future, the incremental impact of 10825 Water releases from Ruedi Reservoir will be more significant.

q) The release of 10825 Water from Ruedi Reservoir will not substantially affect aquatic conditions or recreation of the Roaring Fork River below Basalt. Because the channel of the Roaring Fork River below the confluence with the Fryingpan River is large, and because

stream flow is naturally greater at this downstream location, the release of 10825 Water does not substantially alter aquatic conditions in this reach of the river.

r) The delivery of any 10825 Water from Ruedi Reservoir will reduce the future marketable yield from this reservoir. It is not known when or if a demand will occur for all marketable water that is available from Ruedi Reservoir.

6.5 OMID IMPROVEMENTS

s) OMID improvements could provide a substantial supply of water to the Recovery Program at a relatively low cost. The recent CalPoly study shows that savings of 17,000 acre-feet may occur in all years as a result of the improvements. Secondary benefits to OMID shareholders would also be large.

t) The value of the OMID improvements to the Recovery Program will be greatest if a Green Mountain Reservoir surplus can be declared earlier in the year. Otherwise, OMID water may become available for use later in the summer (September or after) when the demand for additional Recovery Program water is reduced. Even with the improvements and associated water savings in all years, no additional water may be available to the Recovery Program in critically dry years, as declaration of a surplus is not likely.

u) The OMID improvements would substantially change irrigation management practices of the District. It is not known how the Orchard Mesa Irrigation District board and staff might incorporate such significant changes in their operations.

6.6 SULPHUR GULCH RESERVOIR

v) The negative environmental impacts associated with the construction of Sulphur Gulch Reservoir are judged to be small. These minor negative impacts may be more than offset by benefits that accrue to headwater areas if 10825 Water is <u>not</u> released at upstream sites (i.e. Ruedi Reservoir).

w) Of any of the structural alternatives that would require a Section 404 permit, Sulphur Gulch Reservoir is likely to be the Least Environmentally Damaging Preferred Alternative (LEDPA).

x) The potential for introduction of non-native fish species and other potential negative impacts on the endangered fish from Sulphur Gulch Reservoir can be minimized with proper design and operational considerations.

6.7 WATER QUALITY

y) Several West Slope stakeholders have been concerned with potential water quality impacts that may be associated with the operation of Sulphur Gulch Reservoir. In a recent Water Court settlement, the water right applicants for the reservoir agreed to implement certain operational criteria to minimize any potential for water quality degradation. In return, the concerned West Slope stakeholders agreed "not to raise and to not encourage others to raise, any issues related to the salinity of and total dissolved solids in water to be diverted and stored in and released from the Sulphur Gulch Reservoir in any applicable permitting processes for the Sulphur Gulch Reservoir…and pumping plant and pipeline." No substantial water quality impacts have been identified that are associated with the proposed Sulphur Gulch Reservoir as long as the project is operated in accordance with the terms of the settlement.

z) Adverse water quality impacts are not anticipated with any of the other 10825 alternatives that have been assessed.

6.8 CONCLUDING OBSERVATIONS

The most viable 10825 Water supply alternatives would utilize a combination of some or all of the following facilities:

- Lake Granby
- OMID Improvements
- Ruedi Reservoir
- Sulphur Gulch Reservoir

Buzzard Creek Reservoir, Williams Fork Reservoir, and Wolford Mountain Reservoir improvements should be eliminated from consideration, along with the other facilities that were previously eliminated from consideration in this study.

7.0 PAIRED ALTERNATIVES NOT RECOMMENDED FOR FURTHER CONSIDERATION

An application of the evaluation criteria to all of the alternatives that have been studied in detailed is presented in Table 4 at the end of this summary. Alternative cost estimates are summarized in Table 5. Please note that cost was not a determining factor in identifying those alternatives not recommended for further consideration. Economic assumptions associated with each of the individual facilities are described in the memo, *Unit Cost Estimates 10825 Water Supply Alternatives,* which is available on the project website.

After significant detailed review and analysis, the following five alternatives are not recommended for further consideration, as illustrated on Table 4.

- Ruedi Reservoir paired with Buzzard Creek Reservoir (C2)
- Ruedi Reservoir paired with Williams Fork Reservoir (C3)
- Sulphur Gulch Reservoir paired with Williams Fork (C4)
- Wolford Mnt. Reservoir Expansion & Pump paired with Ruedi Reservoir (C5)
- Wolford Mnt. Reservoir Pump paired with Buzzard Creek Reservoir (C6)

Each of these five alternatives is described in more detail in memoranda that are available on the project website. A brief description and evaluation of each of the alternatives not recommended for additional consideration is presented below.

7.1 RUEDI RESERVOIR PAIRED WITH BUZZARD CREEK RESERVOIR (Alternative C2)

This alternative provides 5,412 acre-feet of water from Ruedi Reservoir with 5,412 acre-feet of water from Buzzard Creek Reservoir in each and every year. This alternative is not recommended for further consideration primarily due to the more significant wetland impacts of Buzzard Creek Reservoir when compared to other structural alternatives. This element would likely not be the Least Environmentally Damaging Practicable Alternative (LEDPA) when compared to other alternatives.

7.2 RUEDI RESERVOIR PAIRED WITH WILLIAMS FORK RESERVOIR (Alternative C3)

This alternative would provide different amounts of water from Ruedi and Williams Fork Reservoirs from year to year, depending upon whether it was a drier than average or wetter than average year. In above average and wet years, 2,700 acre feet of water would be released from Williams Fork Reservoir and 8,125 acre feet of water would be released from Ruedi Reservoir. In dry and below average years, all 10825 Water would be supplied from Ruedi

Reservoir, along with the release of an additional 2,700 acre feet to compensate Denver Water for past releases from Williams Fork Reservoir.

While this alternative meets all of the primary objectives of the study, it does not meet secondary considerations. In below average and dry years, Ruedi Reservoir would release 13,525 acre-feet of water. These increased releases will have the most adverse impacts to the Fryingpan River of any alternative studied. Further, water currently released from Williams Fork Reservoir would be released from Ruedi Reservoir in these drier than average years, resulting in lower stream flows in the upper Colorado River than would otherwise exist. This alternative is not recommended for further consideration.

7.3 SULPHUR GULCH PAIRED WITH WILLIAMS FORK RESERVOIR (Alternative C4)

This alternative would provide different amounts of water from Sulphur Gulch and Williams Fork Reservoirs from year to year, depending upon whether it was a drier than average, or wetter than average year. It would operate the same as Alternative C3, only with Sulphur Gulch releases instead of Ruedi Reservoir releases.

While this alternative meets all of the primary objectives of the study, it does not meet secondary considerations. This alternative would decrease the amount of water in the Colorado River below the confluence with the Williams Fork by 2,700 acre feet in below average and dry years, when releases would instead be made from Sulphur Gulch. This coincides with the years that Williams Fork does not fill. This alternative is not recommended for further consideration because changes below Williams Fork Reservoir would either have neutral or negative impacts to aquatic conditions when compared to other proposed alternatives. It may also require the construction of a larger Sulphur Gulch Reservoir, in order to meet the increased dry year release demands.

7.4 WOLFORD RESERVOIR EXPANSION & PUMPBACK WITH RUEDI (Alternative C5)

This alternative would supply 5,412 acre-feet from an enlarged Wolford Mountain Reservoir and Ruedi Reservoir would supply the other 5,412 acre-feet in each and every year. The Wolford Mountain Reservoir enlargement would be filled by a pump station from the Colorado River.

This alternative is not recommended for further consideration for several reasons. First, the alternative cannot supply 5,412 acre feet in dry years such as 1977, without impacting the marketable yield of the reservoir. Second, this alternative is not recommended for further study because of the more significant wetland impacts of Wolford Mountain Reservoir when compared to other structural alternatives. As a result, this alternative does meet the primary objectives of the study. Any alternative that utilizes a Wolford Mountain enlargement would not likely be the Least Environmentally Damaging Practicable Alternative (LEDPA) when compared to Sulphur Gulch Reservoir or to non-structural alternatives.

7.5 WOLFORD RESERVOIR PUMP STATION PAIRED WITH BUZZARD CREEK (Alt. C6)

This alternative would supply all of the 10825 Water from Buzzard Creek Reservoir in above average years and in wet years. In below average and dry years, releases would be evenly split between Wolford Mountain Reservoir (5,412 AF) and Buzzard Creek Reservoir (5,412). In drier than average years, Buzzard Creek Reservoir does not provide adequate yield to supply 10,825 acre feet of water. This alternative was formulated to supplement the Buzzard Creek Reservoir shortfall with releases from Wolford Mountain Reservoir. A new Colorado River Pump station would be utilized to enhance the dry year yield of the existing Wolford Mountain Reservoir (no reservoir enlargement would occur).

This alternative is not recommended for further consideration for several reasons. First, the alternative cannot supply 5,412 acre feet from Wolford Mountain Reservoir in dry years such as 1977, without impacting the marketable yield of this reservoir. As a result, this alternative does meet the primary objectives of the study. Second, any alternative that involves the construction of Buzzard Creek Reservoir would not likely be the Least Environmentally Damaging Practicable Alternative (LEDPA) when compared to Sulphur Gulch Reservoir or to non-structural alternatives.

8.0 MOST PROMISING ALTERNATIVES

The following six alternatives have been preliminarily determined to be feasible, and to best meet the objectives and the evaluation criteria of the 10825 Water Supply Assessment:

- Ruedi Reservoir (Alternative A)
- Sulphur Gulch Reservoir (Alternative B)
- Sulphur Gulch & Ruedi Reservoirs (Alternative C1)
- Lake Granby & Ruedi Reservoirs (Alternative C7)
- Lake Granby, Ruedi Reservoir and OMID Improvements (Alternative C8)
- Lake Granby & Sulphur Gulch Reservoirs (Alternative C9)

Each of these alternatives is briefly summarized below. The alternatives all satisfy the primary study objectives of providing 10,825 acre feet of water without impairing the yield of water users. The evaluation criteria include secondary objectives regarding impacts to headwater streams, and regarding stakeholder consensus. Some of the most promising alternatives outlined below meet these secondary objectives better than others.

8.1 RUEDI RESERVOIR (Alternative A)

This alternative would release 10,825 acre-feet from the existing Ruedi Reservoir in all years. This non-structural alternative uses a single existing facility, and avoids environmental impacts associated with new reservoir construction. This option satisfies the primary objectives of the 10825 Water Supply Study.

Secondary objectives of the study are not completely satisfied this alternative. Releases from Ruedi Reservoir do not provide any benefits to the Colorado River below Lake Granby. In future years when contract water releases from Ruedi Reservoir increase, the concurrent release of 10825 Water from the reservoir will cause incremental negative impacts to recreation use and aquatic conditions of the Fryingpan River. However, even with ALL of the 10825 Water released from Ruedi Reservoir, the Fryingpan River will continue to be an excellent fishery resource. With the release of 10825 acre feet of Recovery Program water, the Fryingpan River may be slightly more difficult to access for several weeks each summer. This alternative does not significantly alter aquatic conditions of the Roaring Fork River below Basalt.

Releases from Ruedi Reservoir, as analyzed in this study, would typically occur prior to September 1st in order to complement late summer Recovery Program releases from the Green Mountain Reservoir HUP surplus and from the Wolford Mountain Reservoir fish pool. With the

development of additional forecasting procedures, it may be possible to release Green Mountain Reservoir HUP surplus water earlier in the summer. This would allow releases from Ruedi Reservoir to be spread-out over a longer period of time, which would decrease any negative impacts associated with this alternative.

8.2 SULPHUR GULCH RESERVOIR (Alternative B)

This alternative provides releases of 10,825 acre-feet from a 16,000 acre-foot Sulphur Gulch Reservoir in all years. This structural option is the closest to the 15 Mile Reach, is simple to manage, and will most efficiently provide water to the 15 Mile Reach. Potential negative impacts to the endangered fish can be minimized or eliminated with proper design and operational considerations. Sulphur Gulch Reservoir would likely be the Least Environmentally Damaging Practicable Alternative (LEDPA) of all of the new reservoirs considered in this study.

Secondary objectives of the study are partially met with this alternative. While releases from Sulphur Gulch do not provide any new benefits to the Colorado River below Lake Granby, releases from Sulphur Gulch Reservoir do not create any new negative impacts in the Fryingpan River, the Roaring Fork River, or the upper Colorado River.

Several West Slope stakeholders have been concerned with potential water quality impacts that may be associated with the operation of Sulphur Gulch Reservoir. In a recent Water Court settlement, the water right applicants for the reservoir agreed to implement certain operational criteria to minimize any potential for water quality degradation. In return, the concerned West Slope stakeholders agreed "not to raise and to not encourage others to raise, any issues related to the salinity of and total dissolved solids in water to be diverted and stored in and released from the Sulphur Gulch Reservoir in any applicable permitting processes for the Sulphur Gulch Reservoir…and pumping plant and pipeline." No substantial water quality impacts are associated with the proposed Sulphur Gulch Reservoir assuming the project is operated in accordance with the terms of the settlement.

Water from Sulphur Gulch Reservoir can be effectively integrated into the overall Recovery Program. This alternative can release water at anytime during the summer and fall months, and will complement late summer (typically September and October) releases from the Green Mountain Reservoir HUP and from the Wolford Mountain Reservoir fish pool.

8.3 SULPHUR GULCH RESERVOIR PAIRED WITH RUEDI RESERVOIR (Alternative C1)

This alternative pairs new reservoir construction at Sulphur Gulch with the existing Ruedi Reservoir. A total of 5,412 acre feet would be delivered from each reservoir to meet the primary objectives of the 10825 Water Supply Study. Water released from Ruedi Reservoir would be "base loaded", or released at a relatively constant rate to reduce potential impacts to

the Fryingpan River. Releases from Sulphur Gulch Reservoir would fluctuate more, in order to optimize flow conditions in the 15 Mile Reach.

Secondary objectives of the study are partially met with this alternative. Releases from Ruedi Reservoir do not provide any benefits to the Colorado River below Lake Granby. However, with the release of 5,412 acre feet from Ruedi Reservoir in a base-load schedule, the potential for impacts to the Fryingpan River are reduced. With half of the 10825 Water released from Ruedi Reservoir, the Frying Pan River will continue to be an excellent fishery resource that may be slightly more difficult to access.

As with Alternative A, releases from Ruedi Reservoir would typically occur prior to September 1st, in order to complement late summer Recovery Program releases from the Green Mountain Reservoir HUP surplus and from the Wolford Mountain Reservoir fish pool. Any operational procedures that would allow the release Green Mountain Reservoir HUP surplus water earlier in the summer, would also allow releases from Ruedi Reservoir to be spread-out over a longer period of time. This extended release period would decrease any negative impacts associated with this alternative.

8.4 LAKE GRANBY PARIED WITH RUEDI RESERVOIR (Alternative C7)

This alternative pairs releases from two existing reservoirs. Lake Granby releases of 2,700 acre feet would occur in the late summer of each year. The remaining 8,125 acre feet of Recovery Program water would be released from Ruedi Reservoir. This is a non-structural alternative, however the viability of Lake Granby as a source of 10825 Water is not known at this time.

This alternative provides substantial secondary benefits. The annual release of 2,700 acre feet from Lake Granby would significantly improve the aquatic resources of the upper Colorado River, particularly from Lake Granby downstream to Troublesome Creek. In future years when contract water releases from Ruedi Reservoir increase, the concurrent release of 8,125 acre feet from the reservoir will cause incremental negative impacts to recreation use and aquatic habitat of the Fryingpan River. However, the Fryingpan River will continue to be an excellent fishery resource. With the release of 8,125 acre feet of Recovery Program water, the Fryingpan River may be slightly more difficult to access for several weeks each summer.

Any operational procedures that would allow the release Green Mountain Reservoir HUP surplus water earlier in the summer, would also allow releases from Ruedi Reservoir to be spread-out over a longer period of time. This extended release period would decrease any negative impacts associated with this alternative.

8.5 LAKE GRANBY AND RUEDI RESERVOIR PAIRED WITH OMID IMPROVEMENTS (C8)

In this alternative, releases from three existing reservoirs provide the 10825 Water:

a) Lake Granby would supply releases of 2,700 acre-feet in all years.

b) Green Mountain Reservoir HUP surplus water available to the Recovery Program would increase with efficiency improvements to the Orchard Mesa Irrigation District (OMID) irrigation system. For purposes of this study, and based upon the January 2008 report by California Polytechnic State University, we have assumed that at least 5,412 acre feet of additional Green Mountain Reservoir water would be available in almost every year. During infrequent critically dry years (such as 1977 and 2002), the OMID improvements may not provide any water, as a Green Mountain HUP surplus may not occur in these years.

c) Ruedi Reservoir would provide the balance of the 10825 Water. A total of 2,700 acre feet of water would be released in almost every year. During infrequent dry years such as 1977 and 2002, a total of 8,125 acre feet of Ruedi water would be released.

This alternative would not construct any new reservoirs or diversion facilities. The only structural facilities would be associated with irrigation efficiency improvements to the OMID system. Any alternative using OMID water may be predicated upon the implementation of forecasting and operational procedures to allow the release of Green Mountain Reservoir HUP surplus water earlier in the year. If Green Mountain HUP surplus is only available late in the year, this alternative may not provide adequate 10825 Water in July and August.

This alternative meets both primary and some of the secondary objectives of the study. Lake Granby releases will substantially improve aquatic habitat in the upper Colorado River. Also, the reduced releases from Ruedi Reservoir will minimize the potential for adverse effects to the Fryingpan River (more than any other alternative involving Ruedi Reservoir) for several reasons.

First, Ruedi releases will only exceed 2,700 acre feet per year in critically dry years. In these very dry years when up to 8,125 acre feet of water will be released, the native runoff in the Fryingpan River is already reduced, and additional releases from storage do not commonly cause the flow of the river to exceed 300 cfs. Second, the increased releases will occur infrequently (perhaps less than 10 % of the years) and will not result in sustained impacts to the Fryingpan fishery.

It should be noted that neither the viability of Lake Granby as a source of 10825 Water, or the implementation plan for OMID improvements are known at this time.

8.6 LAKE GRANBY PAIRED WITH SULPHUR GULCH RESERVOIR (Alternative C9)

This alternative pairs releases from existing Lake Granby with new construction of Sulphur Gulch Reservoir. This alternative meets both the primary and secondary objectives of the 10825 Water Supply Study. Lake Granby releases of 2,700 acre feet would occur in the late summer of each year. The remaining 8,125 acre feet of Recovery Program water would be released from Sulphur Gulch Reservoir. The Sulphur Gulch releases will efficiently provide water to the 15 Mile Reach, and may be varied to provide maximum benefit to the 15 Mile Reach.

Releases of 2,700 acre feet from Lake Granby would significantly improve the aquatic resources of the Upper Colorado River in the segment from Lake Granby down to below Hot Sulphur Springs. The potential for negative aquatic impacts to the Fryingpan and Roaring Fork rivers are completely avoided in this alternative as no additional water for the Recovery Program is released from Ruedi Reservoir.

The viability of Lake Granby as a source of 10825 Water is not known at this time. The institutional and legal issues associated with this facility are currently being explored by the Lake Granby stakeholders.

9.0 RECOMMENDATIONS

By December of 2009, Water Providers on both the West Slope and East Slope of Colorado are required to select an alternative, and have a signed agreement with the USFWS, that will permanently provide a total of 10,825 acre-feet of water to the 15 Mile Reach. It is possible that the Programmatic Biological Opinion (PBO) for the Upper Colorado River Endangered Fish Recovery Program could be reopened if such an agreement is not reached. This is a prospect that all of the participants in this study would like to avoid.

Six water supply alternatives have been identified that meet the primary objectives and the primary evaluation criteria that have been established for this study (Table 4), with the possible exception of the "Stakeholder Consensus" evaluation criteria. Secondary objectives related to headwater benefits are better met by several of these six alternatives than others.

An important evaluation criterion for the 10825 Water Supply Study is that any preferred alternatives should be supported by the project stakeholders. We recommend that the 10825 stakeholders evaluate whether stakeholder consensus can be obtained for any of these alternatives, or for a variation of these alternatives. Alternatives which satisfy BOTH the primary and the secondary (headwater) evaluation criteria are most likely to gain broad stakeholder support.

It may not be appropriate to finalize this "draft" Phase 2 Assessment until the possibility of stakeholder consensus has been explored. If broad support can be successfully obtained for one or more alternatives, the Phase 2 Assessment can be finalized to provide support for the NEPA process associated with any preferred alternatives.

Table 4

APPLICATION OF EVALUATION CRITERIA
10825 WATER SUPPLY ALTERNATIVES

	STAND ALONE ALTERNATIVES		SYNCHRONIZED ALTERNATIVES									
	Alternative A: Ruedi Reservoir	**Alternative B: Sulphur Gulch Reservoir (16K AF)**	**Alternative C1: Ruedi & Sulphur Gulch Reservoirs (8K AF)**	**Alternative C2: Ruedi & Buzzard Creek Reservoirs**	**Alternative C3: Ruedi & Williams Fork Reservoirs**	**Alternative C4: Sulphur Gulch & Williams Fk Reservoirs**	**Alternative C5: Ruedi & Wolford Mountain Reservoirs**	**Alternative C6: Buzzard Creek & Wolford Mountain Reservoirs**	**Alternative C7: Granby & Ruedi Reservoirs**	**Alternative C8: Granby & OMID/ Green Mtn / Ruedi Reservoirs**	**Alternative C9: Granby & Sulphur Gulch Reservoirs**	**Alternative C10: tbd by group**
MEETS STUDY OBJECTIVES	**YES**	**YES**	**YES**	**NO**	**NO**	**NO**	**NO**	**NO**	**YES**	**YES**	**YES**	
WATER SUPPLY	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	
SCHEDULE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	
EFFECTIVE DELIVERY	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	
EFFICIENT DELIVERY	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	
ENGINEERING FEASIBILITY	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	
LIKELY SECURE ALL LAND USE PERMITS	YES	TBD	TBD	NO	YES	TBD	NO	NO	YES	YES	YES	
PRELIMINARY LEDPA DETERMINATION	N/A	TBD	TBD	Not the LEDPA	N/A	Not the LEDPA	Not the LEDPA	Not the LEDPA	N/A	N/A	Likely the LEDPA	
INSTITUTIONAL / LEGAL	YES	YES	YES	YES	YES	YES	YES	YES	Granby TBD	Granby TBD	Granby TBD	
COST	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	
WATER QUALITY	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	
BENEFIT TO TARGET FISH	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	
STAKEHOLDER CONSENSUS	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	YES
MEETS SECONDARY STUDY OBJECTIVES FOR AQUATIC HEALTH												
Colo. Above Hot Sulphur Springs	Neutral	Neutral	Neutral	Neutral	Neutral	Neutral	Neutral	Neutral	Positive Impacts	Positive Impacts	Positive Impacts	
Colo. Near Kremmling	Neutral	Neutral	Neutral	Neutral	Negative in drier years	Negative in drier years	Neutral	Neutral	Neutral	Neutral	Neutral	
Fryingpan River / Roaring Fork	Negative Impacts in Fryingpan & Roaring Fork	Neutral	Negative Impacts in Fryingpan	Negative Impacts in Fryingpan	Negative Impacts in Fryingpan	Neutral	Neutral	Negative Impacts in Fryingpan	Negative Impacts in Fryingpan	Neutral or slightly negative impacts in Fryingpan	Neutral	
15-Mile Reach	Neutral	Quick response to conditions in 15 Mile Reach	Quick response to conditions in 15 Mile Reach	Neutral	Neutral	Quick response to conditions in 15 Mile Reach	Neutral	Neutral	Neutral	Neutral	Quick response to conditions in 15 mile reach	

Table 5

COST ESTIMATES

10825 WATER SUPPLY ALTERNATIVES

	STAND ALONE ALTERNATIVES		SYNCHRONIZED ALTERNATIVES											
	Alternative A: Ruedi Reservoir	Alternative B: Sulphur Gulch Reservoir (16,000 AF)	Alternative C1: Ruedi & Sulphur Gulch Reservoir (8,000 AF)	Alternative C2: Ruedi & Buzzard Creek Reservoirs	Alternative C3: Ruedi & Williams Fork Reservoirs	Alternative C4: Sulphur Gulch & Williams Fk Reservoirs	Alternative C5: Ruedi & Wolford Mountain Reservoirs	Alternative C6: Buzzard Ck & Wolford Mountain Reservoirs	Alternative C7: Lake Granby & Ruedi Reservoir		Alternative C8: Lake Granby, OMID Improvements & Ruedi Reservoir		Alternative C9: Lake Granby & Sulphur Gulch Reservoir	
									Low Estimate	High Estimate	Low Estimate	High Estimate	Low Estimate	High Estimate
Capital Cost	$16,287,762	$43,200,000	$40,843,129	$30,268,129	$20,350,256	$43,200,000	$39,623,112	$47,200,000	$12,225,200	$52,725,200	$19,825,200	$67,925,200	$43,200,000	$83,700,000
Annualized Capital Cost	$1,120,686	$2,972,393	$2,810,227	$2,082,610	$1,400,207	$2,972,393	$2,726,284	$3,247,614	$841,160	$3,627,778	$1,364,081	$4,673,620	$2,972,393	$5,759,011
Annual Operation & Maintenance	$46,006	$150,000	$173,001	$98,001	$57,481	$150,000	$123,001	$175,000	$34,531	$46,006	$204,531	$386,006	$150,000	$161,475
Annual Pumping Cost	$0	$184,875	$92,250	$0	$0	$144,375	$126,000	$84,000	$0	$0	$0	$0	$144,375	$144,375
Total Annualized Cost	$1,166,692	$3,307,268	$3,075,478	$2,180,611	$1,457,689	$3,266,768	$2,975,285	$3,506,614	$875,691	$3,673,784	$1,568,612	$5,059,626	$3,266,768	$6,064,861
Present Value per Acre Foot	$1,566	$4,440	$4,130	$2,928	$1,957	$4,386	$3,995	$4,708	$1,176	$4,932	$2,106	$6,793	$4,386	$8,143
Annualized Cost per Acre Foot	**$108**	**$306**	**$284**	**$201**	**$135**	**$302**	**$275**	**$324**	**$81**	**$339**	**$145**	**$467**	**$302**	**$560**