

EXECUTIVE SUMMARY

Potential failure to meet Colorado River compact requirements is a big issue that must be addressed but cannot be solved by demand management alone. If a demand management program is implemented, it should support participation from the range of geographic areas and water using sectors that benefit from use of the Colorado River while avoiding disproportionate impacts. Although this study focused on potential effects from reductions in agricultural consumptive use in Western Colorado under a temporary, voluntary and compensated program; that focus does not imply that Western Slope agriculture should bear a disproportionate share of the burden for demand management.

At the beginning of the study, stakeholder groups were organized in each of the four major river basins in Western Colorado. These groups included representatives with expertise in agriculture, agricultural support businesses, recreation and tourism, banking and finance, local government issues and other aspects of the local economies and communities. The study team met with each stakeholder group twice – during the late summer of 2019 and during the spring of 2020– to discuss data and data sources, assumptions and methodology, and preliminary study findings. Input from the stakeholders helped identify key issues and refine the study approach and results.

Agriculture is an important economic, cultural, and aesthetic component of Western Colorado. There are nearly 12,000 farms in Western Colorado covering a total of more than 5.7 million acres of land. Approximately 70 percent of Western Colorado farms have irrigation, and irrigated acreage constitutes about 12 percent of the region's total farm lands. Agricultural activity in Western Colorado directly provides approximately 13,600 jobs, which is about 3 percent of the total jobs in the region across all industries. The number of direct agricultural jobs in each basin ranges from 2,300 jobs in the Yampa/White Basin to 4,300 jobs in the Colorado Basin. Agricultural activity also supports numerous secondary jobs in supporting industries throughout Western Colorado,

A small portion of Western Colorado's crop farming activity takes place within the fruit farming sector—and even smaller portions in grain, vegetable, and greenhouse production—but crop farming in the region is primarily in grass hay and alfalfa production, which in turn is predominantly an input to cattle and horse ranching. Livestock production accounts for 64 percent of Western Colorado's annual \$750 million in agricultural output and 48 percent of the region's annual \$246 million in agricultural income.

The latest estimates for the Technical Update to the Water Plan indicate there are a total of approximately 771,000 irrigated acres across the four Western Colorado basins, and annual consumptive use of 1.5 million acre-feet (AF) of water per year on those acres. These numbers correspond to average consumptive use of about 2.0 AF per acre.

Demand management scenarios. Many aspects of demand management are yet to be defined. Developing an evaluation of the potential economic implications of demand management in Western Colorado that provides more than a basic qualitative assessment required some general assumptions regarding possible aspects of a demand management program. The BBC team worked with the WBWG to identify and develop two scenarios for a potential demand management program involving Western Colorado agricultural water users.

The “Moderate” demand management” scenario (Scenario 1) was based on the Demand Management Storage Agreement signed by the Upper Basin states in 2019. The Moderate scenario assumes 125,000 AF of consumptive use reductions would be obtained from a demand management program involving Western Colorado irrigators over a five-year period – or, put more simply, a 25,000 AF annual reduction in consumptive use from participating Western Colorado farms and ranches for five years. In effect, this scenario assumes about one in every 60 irrigated acres currently in hay or corn production across Western Colorado would be temporarily fallowed by participants in the demand management program.

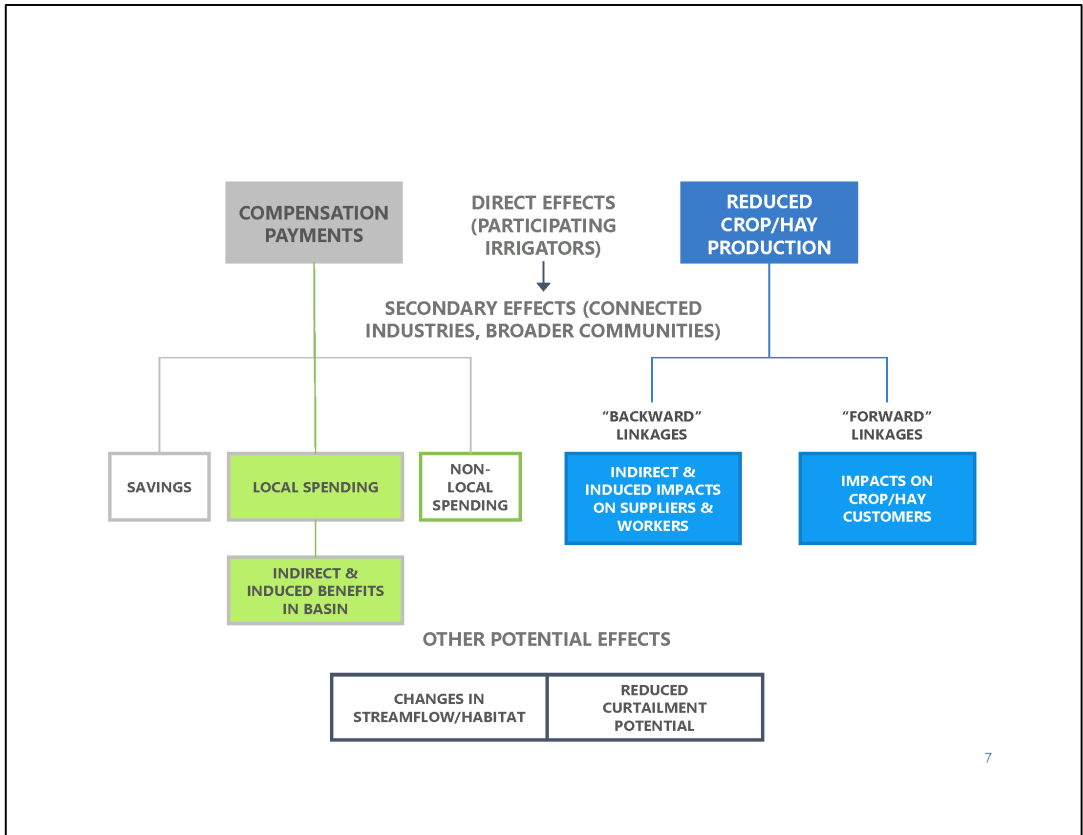
The “Aggressive” demand management scenario (Scenario 2) was designed to examine the potential effects from a larger or more geographically concentrated demand management program. This scenario examines an annual 25,000 AF reduction in consumptive use in each of the four major river basins, which could also correspond to a 100,000 AF annual reduction in consumptive use from irrigated agriculture across all of Western Colorado.¹ The Aggressive demand management scenario assumes that the proportion of acres fallowed for demand management could range from about one in eight acres (in the Yampa/White Basin) to about one in 18 acres in the Gunnison Basin.

Framework for evaluation. Figure ES-1 on the following page illustrates the overall structure for the economic analysis. The starting point for the analysis was to estimate the direct effects on participating irrigators under the two demand management scenarios. Those direct effects included the compensation or participation payments and the reduction in agricultural production. To estimate the potential level of compensation that could be required and the direct economic value of decreases in farm and ranch production, the study team developed simplified, basin-specific crop enterprise budgets for grass hay and alfalfa. The crop budget for the small proportion of each scenario’s acres planted in corn prior to temporary fallowing was based on regional Western Colorado crop budget due to data limitations at the county level.

Indirect and induced economic effects (also called secondary or “multiplier effects”) that could result from demand management were estimated using four basin-specific IMPLAN input-output models. The IMPLAN models were used to quantify the potential secondary economic benefits from the local spending of demand management participation payments, and the secondary economic impacts from reduced forage production, within each basin. The IMPLAN models were also used to help quantify the potential effects of demand management on livestock raising due to forward linkages from forage production,

¹ The WBWG is not endorsing the concept of equal sharing of consumptive use reduction among the four basins. The aggressive scenario is simply intended to provide information on the potential economic effects of larger scale consumptive use reductions in each basin.

Figure ES-1. Secondary impact analysis framework



Potential economic benefits. If a demand management program is implemented in Western Colorado, it is expected to involve voluntary and compensated reductions in consumptive irrigation use. The compensation payments would provide a direct benefit to participating farmers and ranchers, and could also produce secondary economic benefits within the region as those funds are spent on local goods and services. Based on the basin-specific crop enterprise budgets, generalized estimates of potential payment levels were developed for each of the basins. The estimated compensation required for irrigators to simply “break-even” ranged from \$136 to \$183 per AF of consumptive use across the basins, with an overall average for Western Colorado of \$164 per AF. Adding the projected 50% premium on “lost” net operating income, the projected participation payments ranged from \$194 to \$263 per AF. Participation payments per acre would likely be approximately double the payments per AF.

The potential level of compensation necessary for a successful demand management program could vary substantially simply due to variability in the crop mix and crop yields from location to location. Compensation requirements could also vary substantially from year to year depending on variations in hydrologic and weather conditions, crop prices, yields and other financial and market conditions. Apart from payments to participating irrigators, a demand management

program could also need to compensate the ditch companies serving the participants to offset lost revenues from reduced water assessments or duties, administrative costs, and other factors.

Apart from the direct financial effects on program participants, the participation payments under a demand management program could produce additional, secondary economic benefits in Western Colorado. Under the Moderate demand management scenario. The share of the participation payments spent locally is projected to support between 27 and 40 jobs (full and part-time) across Western Colorado, and between \$3.6 and \$5.5 million in annual regional output. Under the Aggressive scenario, the share of the participation payments spent locally is projected to support between 109 and 164 jobs (full and part-time) across Western Colorado, and between \$15 and \$23 million in annual regional output.

If the money to compensate participating irrigators in a demand management program comes from outside of Western Colorado, those payments – and the multiplier effects from the portion of the payments that is spent locally – would truly represent an economic benefit from a regional or basin standpoint. However, to the extent that those funds are raised within Western Colorado (for example from fees or taxes), the participation payments, and any secondary benefits associated with their spending, would not represent a net economic benefit to the region, but would simply redistribute funds already in the region away from their sources to participating irrigators.

Of course, the primary purpose of a demand management program would be to reduce the likelihood of the Upper Basin failing to meet Colorado River compact requirements and potentially facing an involuntary curtailment of at least a portion of its use of Colorado River water supplies. A demand management program can be considered akin to an insurance policy on a home or automobile. A “water bank” developed through an Upper Basin demand management program would provide another tool for water managers to use if needed, along with modified drought operations of Federally managed Colorado River basin storage facilities and other emergency measures.

From a recreation and environmental standpoint, a demand management program would likely have mixed effects. Increases in streamflow from reduced consumptive use would likely be beneficial. However, demand management could also reduce late season irrigation return flows which can be critical from an environmental and recreation standpoint. The reduction in irrigated acreage from demand management would also reduce forage and habitat for wildlife such as deer and elk.

Potential adverse economic impacts. Reducing irrigation consumptive use by farmers and ranchers participating in a demand management program in Western Colorado is likely to reduce crop production, particularly of forage crops including grass hay and alfalfa. Reduced crop production, in turn is likely to require fewer purchases of agricultural inputs such as seed, fertilizer, custom labor, hauling and other services. A decrease in forage crop production could, in turn, affect the livestock industry.

From the standpoint of Western Colorado as a whole, following acres to reduce consumptive use is projected to directly reduce annual hay and corn production by about \$6 million per year under Scenario 1, or by about \$23 million per year under Scenario 2. These “average year”

estimates are based on the value of mechanically harvested hay and corn and include the projected multi-year effects from fallowing grass hay.

Projected secondary impacts (indirect and induced effects) under the Moderate demand management scenario include about 55 full and part-time positions across Western Colorado, and about \$4.2 million in annual output and \$2.3 million in annual value-added. Combined with direct effects, changes in participating farm and ranch production under the Moderate demand management scenario are projected to reduce regional output by about \$10 million per year and regional value-added (including labor income and income of self-employed proprietors) by a little over \$5 million per year.

In total, reduced production on participating farms and ranches under the Aggressive demand management scenario is projected to reduce regional output by about \$40 million per year and regional value-added (including labor income and income of self-employed proprietors) by a little over \$21 million per year and affect about 500 jobs – though more than half of these affected jobs would occur on participating farms and ranches and likely would most consist of producers that chose to participate in demand management and would be compensated.

Overall, the projected indirect and induced economic benefits from payment spending on regional output and value-added are comparable in scale to the projected negative secondary effects from reduced production. While the secondary benefits from payment spending may largely offset the negative secondary impacts from reduced production from a quantitative standpoint, it is important to note that this net effects comparison masks the underlying distribution of the economic benefits and costs. Although there would be some overlap among industries providing services to farm/ranch households, in many cases the jobs that would be supported by local payment spending are different from the jobs that are currently supported by forage production.

Potential effects on livestock production. If a demand management program leads to large reductions in forage production in Western Colorado, it could also impact local hay prices and livestock production. In part, effects on livestock production could depend on who participates in the program and how they adjust their operations. Prior research for the WBWG found that among high elevation sites that operate to support a cattle operation, the size of the cattle herd is directly tied to the amount of irrigated acreage. Alternatively, a number of the basin stakeholders noted that much of the hay in some of the basins is exported out of state, and in some cases to other countries. This appears to be particularly true among producers in the Southwest Basin and the Yampa/White Basin, and is supported by data from the basin-specific IMPLAN models. To the extent that participants in a demand management program would otherwise have exported their hay, the “forward linked” effects of demand management on the livestock industry within Western Colorado could be minimal.

In order to shed additional light on potential forward-linked impacts on the livestock industry, the study team examined historical correlations between hay production, hay prices and livestock inventories. Although correlation does not prove a causal relationship, on average a 10 percent reduction in hay production has correlated with an 8 percent increase in hay prices. Statistical analysis indicates that, on average, a 10 percent reduction in Western Colorado hay production has also correlated with a 3 percent decrease in cattle inventories during the

following year. Other factors, such as long-run national “cattle cycles” would likely continue to have more influence on cattle inventories and production than a demand management program.

Based on the historical correlations, the Moderate demand management scenario could result in slightly more than 0.5% reduction in livestock production, or a reduction in ranch output of about \$3 million per year across Western Colorado. The corresponding decrease in annual value-added and jobs on Western Colorado ranches is estimated at about \$700,00 and 17 FTE jobs. If livestock production declines, there would also be secondary (indirect and induced) impacts on Western Colorado’s economy. Under the Moderate demand management scenario, these secondary impacts are projected to include a nearly \$1.7 million annual reduction in output among firms and individuals who provide goods and services to Western Colorado ranches and their households, and a decline of about 21 full and part-time jobs.

The potential 2.2 percent reduction in livestock production under the Aggressive demand management scenario would correspond to larger forward linked impacts in each of the basins and across Western Colorado. The Aggressive demand management scenario could lead to a decline of \$13.4 million in annual ranch output and the loss of about 77 FTE ranch jobs. Including indirect and induced impacts, the total impact from reduced livestock production on annual output in Western Colorado could be about \$21 million per year, with a corresponding decrease in value-added of about \$6.6 million. About 95 part-time and full-time secondary jobs could be affected by reduced livestock production under the Aggressive demand management scenario.

Comparison of economic benefits relative to adverse impacts. Figure ES-2 provides a summary comparison of selected economic metrics for the Moderate demand management scenario. Figure ES-3 shows the same metrics for the Aggressive demand management scenario.

On-farm/ranch effects. The lower end of the range of potential annual reductions in production output in each basin and across Western Colorado indicates projected effects on farms and ranches that choose to participate in the demand management program, excluding any “forward-linked” impacts on livestock production. The higher end of the range includes potential annual reductions in the value of livestock sales. Likewise, the smaller decline in the on-farm/ranch jobs excludes potential effects on livestock producers – so these job estimates primarily reflect producers and their families who would be compensated through the participation payments (though some of these jobs may be hired workers). The larger declines in these metrics include potential decreases in output by livestock producers and potential on-farm (or ranch) reductions in jobs among these producers. All on-farm/ranch jobs are reported in FTEs.

Figures ES-2 and ES-3 also report the projected aggregate annual payments to participants under the Moderate demand management scenario. Those payment totals are compared to the projected decrease in on-farm/ranch value-added (income) due to reduced production. In all cases, the payment totals are projected to exceed the loss of income on participating acres – indicating that participants are projected to benefit financially from a demand management program. Even when reductions in income from reduced livestock production are included (which produces the smaller numbers in the “Payments vs. on-farm value-added” ranges), the overall net effect of the program on farm and ranch income is projected to be positive.

Secondary effects. The secondary effects comparison in Figures ES-2 and ES-3 initially summarize the projected range of jobs that could be supported by local spending of a portion of the demand management participation payments. The lower estimate is based on 60 percent of the payments being spent locally, while the higher benefit estimate assumes 90 percent is spent locally. These secondary (indirect and induced) job benefits are then compared to the projected reduction in secondary jobs from decreased farm and ranch production. The higher end of that range includes the potential secondary job impacts from reductions in livestock production.

The projected net change in secondary jobs is always negative, in part because average compensation among the secondary jobs in agricultural support industries is lower than the average compensation among the secondary jobs that would be supported by local spending of the participation payments (as discussed previously). The comparison of effects on secondary income (value-added) is more ambiguous. If a high proportion (90 percent) of the participation payments is spent locally, and livestock production is not affected by the program, the net effect on secondary (indirect and induced) income is projected to be positive. Alternatively, if a lower proportion (60 percent) of the participation payments is spent locally and livestock production is impacted by the program, the net change in secondary value-added is projected to be negative.

Figure ES-2. Summary comparison of benefits and adverse impacts for the Moderate demand management scenario

	River Basin				
	Colorado River	Gunnison	Southwest	Yampa/White	Western Colorado
Participating Acres	3,400	3,850	3,700	1,750	12,700
Percent of Irrigated	1-in-60	1-in-60	1-in-60	1-in-60	1-in-60
On-Farm/Ranch Effects					
Decrease in Production Output*	-\$1,374,000 to -\$2,210,000	-\$1,780,000 to -\$2,731,000	-\$1,725,000 to -\$2,274,000	-\$783,000 to -\$1,455,000	-\$5,662,000 to -\$8,670,000
Reduced On-Farm/Ranch Jobs**	-17 to -22	-19 to -25	-19 to -22	-9 to -13	-64 to -81
Annual DM Payments	\$1,375,000	\$1,917,000	\$1,756,000	\$806,000	\$5,854,000
Payments vs. On-farm Value-added (net)*	\$682,000 to \$473,000	\$1,093,000 to \$873,000	\$735,000 to \$606,000	\$391,000 to \$233,000	\$2,901,000 to \$2,185,000
Secondary Effects					
Increased Jobs from Payment Spending***	6 to 10	9 to 14	8 to 12	4 to 5	27 to 40
Decreased Jobs tied to Production*	-13 to -19	-16 to -22	-16 to -20	-10 to -15	-55 to -76
Net change in Secondary Jobs****	-3 to -13	-2 to -13	-4 to -12	-5 to -11	-14 to -49
Value-added****	\$72,000 to -\$167,000	\$136,000 to -\$132,000	\$231,000 to -\$71,000	\$107,000 to -\$23,000	\$546,000 to -\$393,000

Notes: *Right-hand side (RHS) impact estimates include potential effects on livestock activity.

**On-farm employment is FTEs. Left-hand side (LHS) estimate is jobs on participating operations only (who would be compensated).

RHS estimates include potential livestock effects.

***Low end of range if 60% spent locally, high end if 90% spent locally.

****RHS impacts on secondary jobs and value-added reflect low share of lease spending in basin and adverse impacts including livestock effects.

Although the findings for the Aggressive demand management scenario are similar to the Moderate scenario, but on a larger scale, the number of decreased jobs stands out under this scenario – shown in Figure ES-3. In particular, the difference between the low end of the range for on-farm/ranch job decreases and the high end of that range reflects the estimated number of on-ranch livestock jobs projected to be lost (337-260 = 77 jobs across Western Colorado). In

addition, the large number of secondary jobs projected to be lost due to decreases in production (236 to 331 jobs) is also notable, because the partly offsetting number of secondary jobs that might be added due to local spending of the participation payments may often be in different industries.

In general, we believe that the assumptions incorporated in this analysis – full fallowing of harvested acres and potential reductions in livestock production – could result in larger economic impacts than alternative strategies for reducing consumptive use such as split season fallowing. This alternative approach is a form of deficit irrigation that effectively increases the crop production efficiency from irrigation – meaning that the reduction in yield (in percentage terms) should be less than the reduction in consumptive use (also in percentage terms).

Throughout this study, stakeholders in each basin emphasized their concerns about potential impacts on return flows that are relied on by downstream irrigators and other users. This analysis assumes that return flow issues associated with demand management will be resolved – either through avoiding these issues or effectively mitigating them. If those issues cannot be avoided or mitigated, the adverse economic impacts from demand management could be substantially greater than the estimates described in this report.

Figure ES-3. Summary comparison of benefits and adverse impacts for the Aggressive demand management scenario

	River Basin				
	Colorado River	Gunnison	Southwest	Yampa/White	Western Colorado
Participating Acres	12,000	12,100	13,800	14,200	52,100
Percent of Irrigated	1-in-17	1-in-19	1-in-16	1-in-8	1-in-15
On-Farm/Ranch Effects					
Decrease in Production Output*	-\$4,847,000 to -\$7,795,000	-\$5,574,000 to -\$8,552,000	-\$6,458,000 to -\$8,515,000	-\$6,334,000 to -\$11,775,000	-\$23,213,000 to -\$36,637,000
Reduced On-Farm/Ranch Jobs**	-60 to -77	-60 to -77	-69 to -81	-71 to -102	-260 to -337
Annual DM Payments	\$4,851,000	\$6,005,000	\$6,573,000	\$6,524,000	\$23,953,000
Payments vs. On-farm Value-added (net)*	\$2,406,000 to \$1,670,000	\$3,424,000 to \$2,734,000	\$2,752,000 to \$2,269,000	\$3,166,000 to \$1,890,000	\$11,748,000 to \$8,563,000
Secondary Effects					
Increased Jobs from Payment Spending***	23 to 34	28 to 43	29 to 44	29 to 43	109 to 164
Decreased Jobs tied to Production*	-45 to -67	-50 to -70	-59 to -75	-82 to -119	-236 to -331
Net change in Secondary Jobs****	-12 to -45	-7 to -41	-14 to -46	-39 to -90	-72 to -222
Value-added****	\$252,000 to -\$590,000	\$424,000 to -\$416,000	\$863,000 to -\$267,000	\$863,000 to -\$189,000	\$2,402,000 to -\$1,462,000

Notes: *Right-hand side (RHS) impact estimates include potential effects on livestock activity.

**On-farm employment is FTEs. Left-hand side (LHS) estimate is jobs on participating operations only (who would be compensated).

RHS estimates include potential livestock effects.

***Low end of range if 60% spent locally, high end if 90% spent locally.

****RHS impacts on secondary jobs and value-added reflect low share of lease spending in basin and adverse impacts including livestock effects.

Economic sustainability and program design considerations. During this study, the WBWG has raised the question of where a tipping point might be for Western Colorado agriculture and its agriculturally-focused communities. From the standpoint of sustainability, there could be more reason for concern at the local, community level, than at the regional level across Western

Colorado. The bottom line is that the location and concentration of reductions in agricultural production matters. Even under the smaller, Moderate demand management scenario, the total number of acres assumed to be fallowed across Western Colorado (about 12,700 acres) would be more than the total number of irrigated acres in Eagle County or Dolores County, for example.

From the standpoint of Western Colorado as a whole, a demand management program involving up to four to five percent of the irrigated forage acres in Western Colorado (about 30,000 acres or 60,000 acre-feet per year) would be within the range of historical variability in hay production and could be economically manageable if:

- Participation and impacts were widely distributed among and within the four Western Colorado basins;
- Frequency and duration of participation was limited to avoid demand management becoming an irrigated land retirement program;
- The program provided the opportunity for participants to opt out under exceptionally dry conditions like 2002, 2012 and 2018; and
- The program offered opportunities for split season fallowing or other forms of deficit irrigation which could reduce impacts and costs.