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Upper Basin Demand Management Economic Study in Western Colorado

REVISED FINAL REPORT

Revised Final Report

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Upper Basin Demand Management Economic Study in Western Colorado

Prepared for
The Water Bank Work Group

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COLORADO RIVER DISTRICT
PROTECTING WESTERN COLORADO WATER SINCE 1937

Colorado River Water Bank Work Group

Upper Basin Demand Management Economic Study in Western Colorado

After significant stakeholder engagement and over a year in the making the Colorado River Water Bank Work Group (WBWG) presents the BBC Research Study "Upper Basin Demand Management Economic Study in Western Colorado." The WBWG is the outcome from an initial meeting in 2008 between the Colorado River District (CRD) and Southwestern Water Conservation District (SWCD) boards in which the two organizations met to discuss the potential impacts of a Colorado River Compact curtailment on the West Slope. Ultimately, this meeting led to the development of the WBWG in 2009 and currently consists of the CRD, SWCD, The Nature Conservancy (TNC), Tri-State Generation and Transmission (Tri-State), Uncompahgre Valley Water Users Association (UVWUA), Upper Gunnison River Water Conservancy District (UGWCD), and the Grand Valley Water Users Association (GVWUA). The State of Colorado also participates in the WBWG in an advisory role and has provided grants to the WBWG for specific projects and studies. Throughout the process we have engaged agricultural producers, Native American tribes in Colorado, and the Bureau of Reclamation when appropriate. The WBWG wants to investigate possible solutions that strike a balance between urban, agricultural, environmental and industrial needs and Colorado's Compact obligations under the Law of the River.

The WBWG's effort is aimed at avoiding long-term agricultural dry up and water supply disruptions for all Colorado River water users within the state, either by providing replacement sources for post compact "critical" water uses, or by exploring the use of a voluntary and compensated market approach to temporarily reduce consumptive uses of Colorado River Basin water in Colorado to avoid Compact curtailment. The collective concern is that without a well-defined, well-thought out evaluation of the possible options ahead of time, if we were to approach a Compact compliance situation, West Slope agriculture would be subject to buy-and-dry transactions fueled by investment interests or even involuntary forced sales to major front range utilities with junior water rights that permanently separate water from the land.

Over the last decade, the WBWG has commissioned numerous studies and investigations into the feasibility of compact compliance, water banking, agronomic responses to irrigation practices, and water pricing/valuation. The latest report "**Upper Basin Demand Management Economic Study in Western Colorado**" by BBC Research and Consulting delves into the potential economies of scale of implementing a Demand Management program in western Colorado. The BBC team worked with the WBWG and the agricultural community to identify and develop two scenarios for a potential demand management program involving Western Colorado agricultural water users. These two scenarios, "moderate and aggressive," establish some book ends to the

economic conversation with the 500,000 Acre Feet Upper Basin Storage account authorized through the Drought Contingency Plan legislation in Lake Powell and the other Colorado River Storage Act reservoirs on one end, and the 2,000,000 Acre Feet the Risk Study indicates will actually be needed to make a meaningful contribution to preventing or significantly delaying a Compact compliance event on the other end. It is important to note that this study only looks at the impacts of fallowing West Slope agriculture which, if a demand management program is created in Colorado, will only be one piece of the solution; for a demand management program to succeed water must be contributed from conserved consumptive use in all water use segments from all regions that consume the waters of the Colorado River. This study in no way implies what a demand management program should be, but rather what the potential economic impacts of such a program might be if implemented in a similar fashion.

The WBWG's diligent work over the last decade has resulted in numerous studies which provide valuable data about types of solutions available to preserve communities, agriculture, power production, and the ecological health of the river. While this study may be the last official WBWG project, the findings from all of the WBWG inquiries will lead to informed discussions about the next steps which will need to be answered prior to deciding whether implementation of a demand management program is feasible and desirable for water users in western Colorado. On behalf of the WBWG here is the BBC Research Study "Upper Basin Demand Management Economic Study in Western Colorado."

On behalf of the Colorado River District, we want to thank all of our partners for many, many hours of work and for their financial contributions that have made this project successful.

Sincerely,

The Colorado River District Team.

Disclaimer: The purpose of this report is to provide insight from an economic inquiry into the feasibility of voluntary, temporary and compensated demand management within western Colorado. It is not intended to represent the group's, or any of its individual members, endorsement of the implementation of a demand management program or the structure of such a program on Colorado's western slope or in Colorado as a whole.

Upper Basin Demand Management Economic Study in Western Colorado

The Colorado River Water Bank Work Group (WBWG) commissioned this study in 2019 as part of its examination of the possibility of a water demand management program in Western Colorado that includes voluntary, temporary, and compensated reductions in water use. Demand management (DM) is being evaluated in each of the Upper Colorado River Basin states due to concerns about risks of a future Colorado River Compact curtailment.

The study included two meetings with invited stakeholders in each of the four major Western Slope river basins to gather input and review results, and focused on three primary objectives:

1. Examine and document baseline economic conditions and trends in West Slope communities;

2. Estimate the magnitude of potential positive and negative secondary economic and social impacts on West Slope communities from voluntary, temporary, and compensated reductions in agricultural water use; and

3. Identify ideas for maximizing positive benefits and avoiding, minimizing, or mitigating negative impacts.

Demand management scenarios. Two hypothetical scenarios were developed to examine potential impacts on agriculture and agriculture-related businesses and communities. Although the study focused on consumptive use reductions from Western Colorado irrigators, an actual demand management program – if implemented – 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.

- "Moderate" DM assumed 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. About one in every 60 irrigated acres currently in hay or corn production across Western Colorado would be temporarily fallowed by participants under this scenario.
- "Aggressive" DM assumed 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. The proportion of acres fallowed for demand management could range from about one in eight currently irrigated acres (in the Yampa/White Basin) to about one in 18 acres in the Gunnison Basin.[1]

[1] The demand management scenarios are for illustration only, and do not imply endorsement of demand management or specific consumptive use reduction targets in any basin or across Western Colorado as a whole.

Key findings. Some highlights from the numerous metrics provided in the report.

- Annual payments to participating irrigators were projected to range from $194 to $263 per AF (approximately double those amounts per acre). Payment levels necessary to successfully enroll participants could vary from year to year and location to location.

- If the funding 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 provide a regional economic benefit that could help offset adverse impacts on local communities.

- Reduced production of forage crops is likely to require fewer purchases of agricultural inputs such as seed, fertilizer, custom labor, hauling and other services. An estimated 55 full and part-time agricultural support jobs could be eliminated under the Moderate DM scenario, 236 jobs under the Aggressive DM scenario.
- Overall, the projected secondary economic benefits from payment spending are comparable in scale to the projected negative secondary impacts from reduced production. But, the jobs that would be supported by local payment spending could well be different from the jobs currently supported by forage production.
- Based on historical correlations between hay production, hay prices and the Western Colorado livestock inventory, the Aggressive DM scenario could increase local hay prices by about 6 percent, and decrease the regional livestock inventory by about 2 percent. Potential price and livestock impacts under the Moderate DM scenario would be much smaller.

Uncertainties and limitations. The economic estimates in this study are based on publicly available information and basin-level average characteristics of farms and ranches in Western Colorado. Actual effects would likely differ from the estimates depending on the specific characteristics of participating farms and ranches. Other important uncertainties:

- The analysis included estimated multi-year impacts on grass hay yields from fallowing (ceasing irrigation) for a single year. No studies were identified that had evaluated effects on subsequent grass hay yields from more extended fallowing periods.
- 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.
- Stakeholders in each basin emphasized their concerns about potential impacts on return flows relied on by downstream irrigators and other users. This analysis assumes that return flow issues associated with DM will be resolved – either through avoiding these issues or effectively mitigating them.

Summary Comparison of Potential Economic Benefits and Adverse Impacts from Demand Management in Western Colorado

Moderate DM 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 -$417,000	$136,000 to -$351,000	$231,000 to -$211,000	$107,000 to -$186,000	$546,000 to -$1,165,000

Aggressive DM 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 -$1,473,000	$424,000 to -$1,105,000	$863,000 to -$791,000	$863,000 to -$1,509,000	$2,402,000 to -$4,878,000

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

**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.

****RHS impacts on secondary jobs reflects low share of lease spending in basin and adverse impacts including livestock effects.

Program design considerations. 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. Program design elements to help reduce adverse impacts on Western Colorado agricultural communities could include:

- Designing the program to widely spread participation and impacts among and within the four Western Colorado basins;
- Limiting the frequency and duration of participation to avoid demand management becoming an irrigated land retirement program;
- Providing the opportunity for participants to opt out under exceptionally dry conditions like 2002, 2012 and 2018 (if the program is based on multi-year contracts); and
- Offering opportunities for split season fallowing or other forms of deficit irrigation which could reduce impacts and costs.

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.

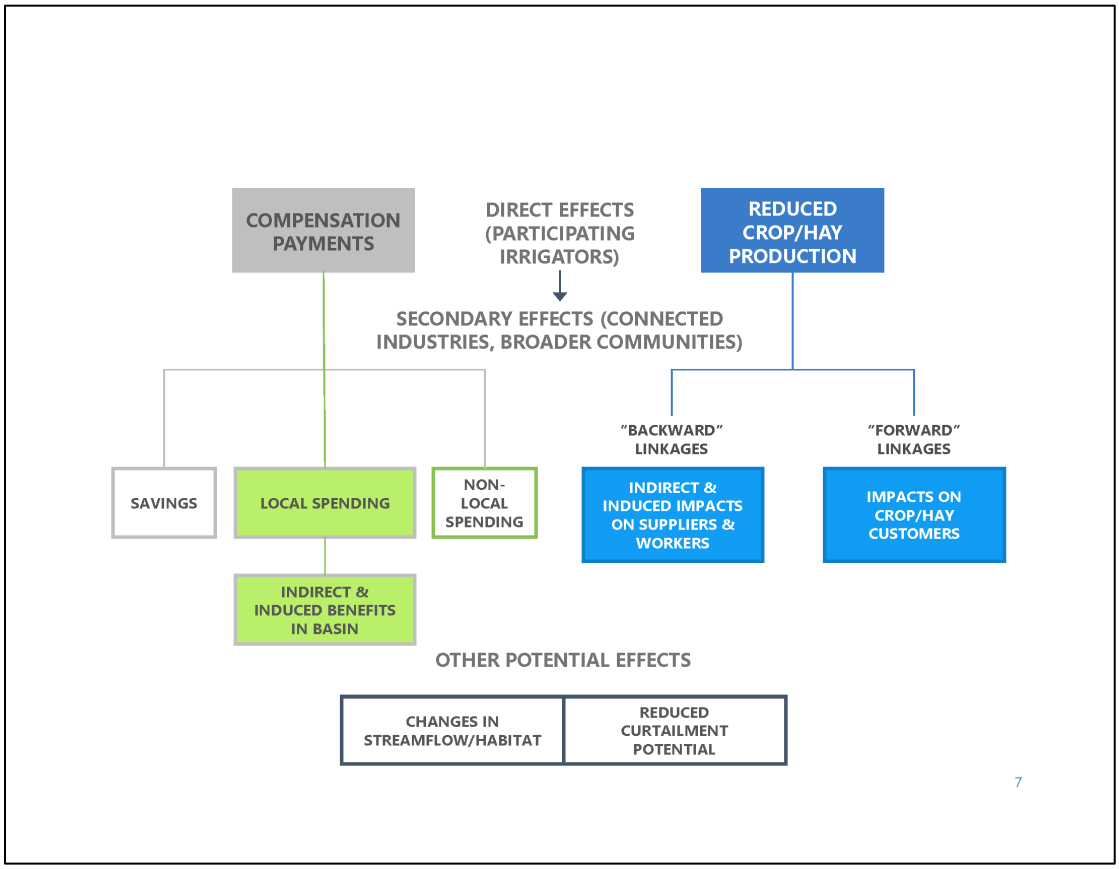
The "Aggressive" demand management scenario (Scenario 2) was designed to examine the potential effects from a larger or more geographically concentrated demand management program. This scenario examines an annual 25,000 AF reduction in consumptive use in each of the four major river basins, which could 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 and 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, fallowing 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 -$417,000	$136,000 to -$351,000	$231,000 to -$211,000	$107,000 to -$186,000	$546,000 to -$1,165,000

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 -$1,473,000	$424,000 to -$1,105,000	$863,000 to -$791,000	$863,000 to -$1,509,000	$2,402,000 to -$4,878,000

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.

SECTION 1.
Introduction

A consulting team led BBC Research & Consulting (BBC) was retained by the Water Bank Work Group (WBWG) in the Spring of 2019 to evaluate the potential economic effects from a water demand management program (demand management) in Western Colorado. Other members of the consulting team included ERO Resources Corporation, Headwaters Corporation, and experienced local facilitators in each of the four major Western Colorado river basins.[1] The study spanned the following 15 months and concluded with this report.

Overview and Context for Demand Management

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 time of this study, many aspects of a potential future demand management program are yet to be defined. There is agreement on the concepts that demand management would involve temporary, voluntary and compensated reductions in consumptive use to help ensure Colorado River compact compliance and help protect Colorado's water users from involuntary curtailment of the use of water supplies from the Colorado River system.[2] However, the scale and duration of a future demand management program have yet to be defined, as do critical implementation aspects such as funding, monitoring and measuring consumptive use reductions, shepherding conserved water and other elements of a potential program.

Study Purpose

The primary purpose of this study was to examine the potential secondary economic impacts of a demand management program in Western Colorado. Secondary impacts refers to the positive and negative effects beyond the direct effects on the farms and ranches that might voluntarily choose to participate in a demand management program – such as the impacts on suppliers of

[1] Meetings with stakeholders in the Yampa/White Basin were facilitated by Nicole Seltzer, meetings in the Colorado River Basin were facilitated by Hannah Holm, meetings in the Southwest Basin were facilitated by Stacy Beaugh, and meetings in the Gunnison River Basin were initially facilitated by Illene Roggensack and subsequently facilitated by Hannah Holm.

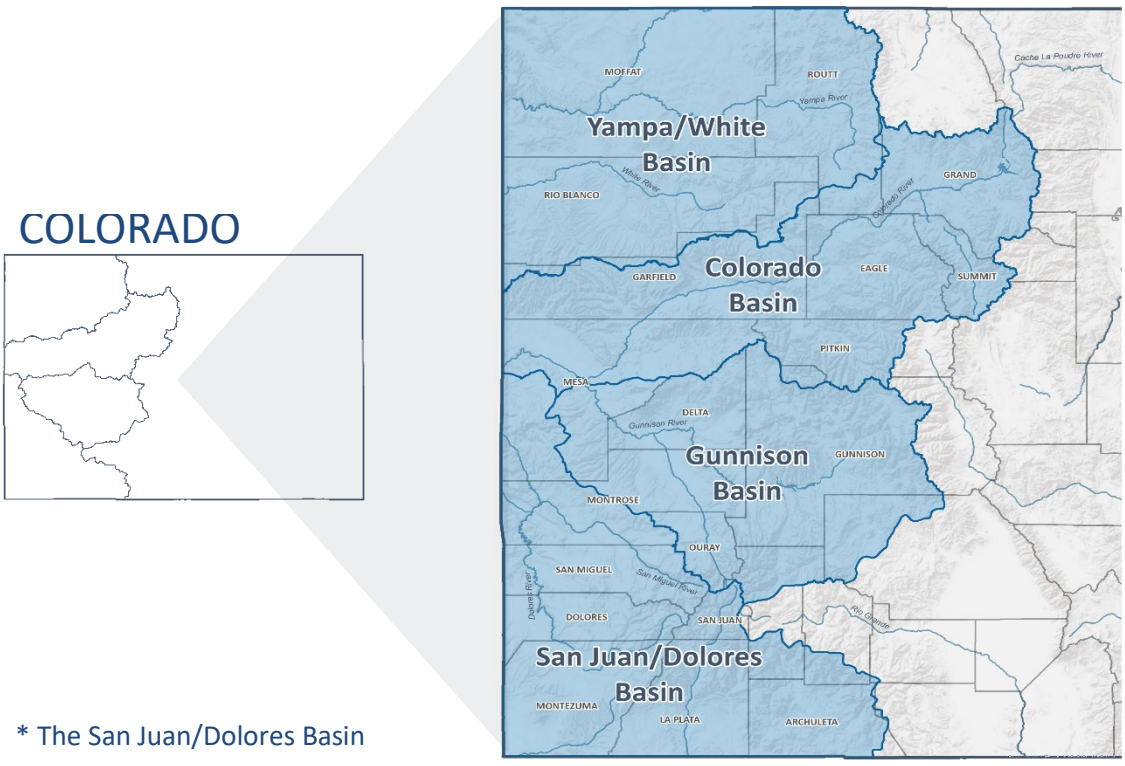
[2] Colorado Water Leaders Move Forward with Demand Management Investigation. Colorado Water Conservation Board Website. Downloaded June 4, 2020. https://cwcb.colorado.gov/news-article/colorado-water-leaders-move-forward-demand-management-investigation.

agricultural inputs and services, household goods and services, and the customers who normally would have purchased the production from the agricultural operations that choose to instead participate in demand management for at least a portion of their acreage. During the study, it became clear that it was also important to examine the direct effects on participating farms and ranches as well.

Additional purposes of the study were to identify potential aspects of a demand management program that could enhance the program's benefits in Western Colorado and reduce its adverse economic impacts. The study also considered potential impacts of demand management on the sustainability of agriculture, and agriculturally focused communities, in Western Colorado.

Figure 1-1 depicts the four basins that make up the study area for this analysis. As the figure indicates, the overall study area includes the entire Western Slope of Colorado. Given this large and diverse area, this study is a landscape level assessment of the potential economic effects of demand management at the basin-wide and regional levels. It is, not an evaluation of a fully developed program in a specific location. Consequently, this analysis is based on basin-wide averages in terms of cropping patterns, yields and other agricultural characteristics. However, as made clear in the discussions with the basin stakeholder groups, an actual demand management program would likely have to be customized or tailored to specific local circumstances to be successful.

Figure 1-1. Study area

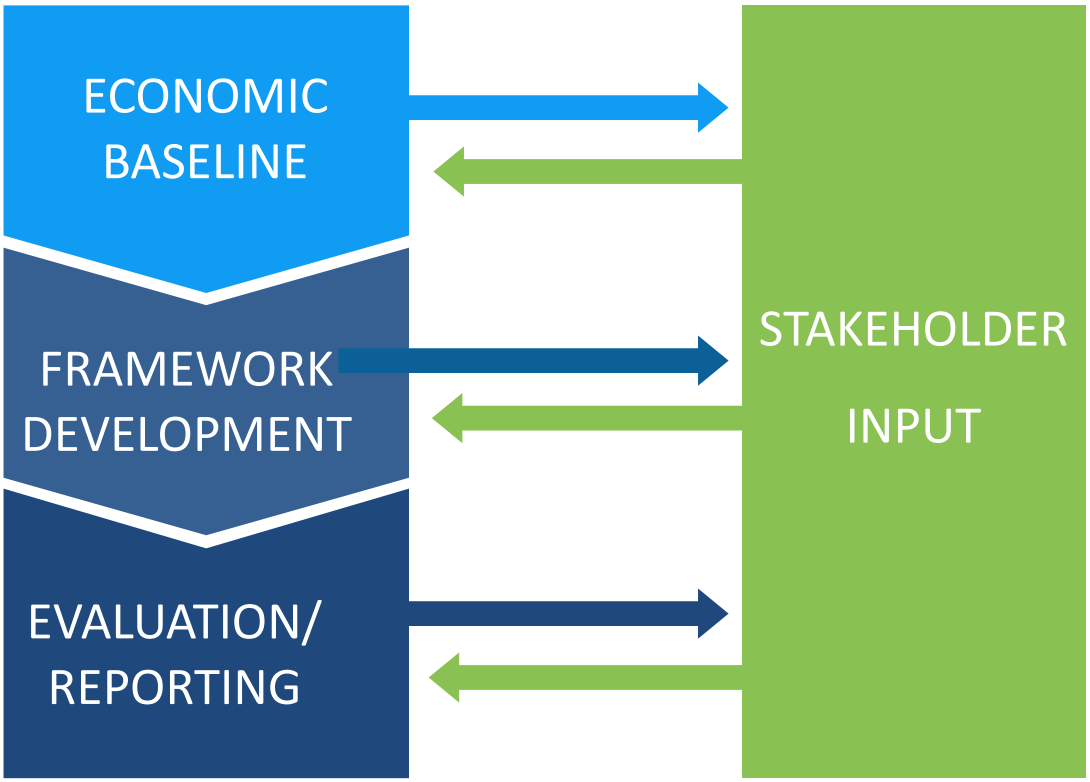


* The San Juan/Dolores Basin is referred to as the Southwest Basin in this study.

Study Process

Figure 1-2 provides a basic overview of the study process. There were four overall tasks in the study.

Figure 1-2. Overview of study process



Task 1 was the process of obtaining community review and input which continued throughout the study. During this task the study team worked with the WBWG to organize a process for obtaining community review and input. A stakeholder group was developed in each of the four major river basins in Western Colorado – the Colorado River Basin, the Gunnison Basin, the Southwest Basin[3] and the Yampa/White Basin. Selected individuals with experience and expertise representing agriculture, agricultural support businesses, recreation and tourism, banking and finance, local government issues and other aspects of the local economies and communities were invited to participate in each of the stakeholder groups. Appendix C provides a list of the members of each of the stakeholder groups.

[3] The Southwest Basin is sometimes referred to as the San Juan and Dolores River Basins.

The study team met with each of the stakeholder groups during August 2019 to review and discuss current economic and demographic conditions and baseline data for their basin and to preview the framework for evaluating economic effects of demand management. The study team met for a second time with each of the basin stakeholder groups during May 2020 to review the more fully developed framework for evaluation and discuss preliminary evaluation results for the two demand management scenarios.

The second task in the study was the examination and documentation of current economic and demographic conditions and recent trends in each of the four basins. The study team used publicly available data sources to develop a profile of economic baseline conditions in each basin, focusing on overall conditions and a more detailed examination of the agriculture-related and recreation and tourism-related components of the economy. As noted above, this baseline information was review with, and enhanced by, the community stakeholder groups.

Task 3 and Task 4 were the development of the framework for evaluating the potential effects of demand management and the application of that framework to evaluate demand management scenarios. An initial version of the framework and preliminary results from its application was provided to the project steering committee[4] at the end of October 2019. In response to steering committee comments, a revised version was provided to the committee and the full Water Bank Work Group in early December 2019. Additional comments were received on this second draft technical memorandum, and refinements to the framework and evaluation continued through the second round of stakeholder meetings in May 2020.

Organization of this Report

Following this introduction, the second section of this report summarizes current economic and demographic conditions (prior to the COVID-19 pandemic) in Western Colorado. More detailed information specific to each of the four basins is provided in Appendix A.

The third section of this report describes the demand management scenarios examined in this study and the fourth section provides detail regarding the framework for evaluating the scenarios. The fifth section discusses the potential economic benefits from demand management, while the sixth section discusses potential adverse economic impacts.

Section 7 compares the potential benefits and adverse impacts, discusses key uncertainties in the analysis, considers potential effects on agricultural and community sustainability and identifies some potential program design and implementation considerations that could reduce adverse impacts or increase benefits from demand management.

[4] The WBWG project steering committee was comprised of representatives of the Colorado River District, The Nature Conservancy, the Upper Gunnison River Water Conservancy District, the Southwest Water Conservancy District, Tri-State Generation and Transmission and JUB Engineers – representing the Grand Valley Water Users Association.

Three appendices are attached to this report. Appendix A provides the economic baseline reports for each of the individual basins. Appendix B provides the basin-specific crop budgets developed for use in this evaluation. Appendix C provides a list of the community stakeholders in each basin.

SECTION 2.
Current Economic and Demographic Conditions in Western Colorado and Recent Trends

Western Colorado comprises four major river basins covering nearly 38,000 square miles of the state. From north to south, these are the Yampa/White Basin, the Colorado River Basin, the Gunnison Basin, and the Southwest Basin. Snowpack in the basins' mountains is the main sources of water and the amount of runoff in each basin can fluctuate widely from year to year.

Geographic Setting

The Yampa/White Basin. The two primary rivers in the basin are the Yampa and the White. The Yampa River, located in the northern part of the basin, originates on the eastern slope of the Flat Tops Wilderness near the Town of Yampa and flows north for 25 miles, then west for 120 miles before passing into Utah. The largest communities in the Yampa sub-basin—Steamboat Springs and Craig—were founded on the Yampa River. The Yampa sub-basin includes nearly all of the lands and population of Moffat and Routt Counties.

The White River originates on the western slope of the Flat Tops Wilderness, east of the Town of Meeker, flowing east into Utah on a roughly parallel course to the Yampa. It is generally located between 40 and 60 miles south of the course of the Yampa River. The White River is entirely located within Rio Blanco County.

The Colorado Basin. The Colorado Basin is located across more than 9,800 square miles of Western Colorado and contains the headwaters of the Colorado River, one of the most important rivers in the Southwestern United States.

Within the basin is the mainstem of the Colorado River as well as many large and small tributaries, including the Blue River, the Snake River, the Swan River, the Piney River, the Eagle River, the Fryingpan River, the Crystal River, and more.

A substantial portion of the water originating in the Colorado Basin is diverted across the Continental Divide for use by cities, farms, ranches and other users on Colorado's Eastern Slope.

The Gunnison Basin. The Gunnison Basin is covers more than 8,000 square miles of Western Colorado and is bounded by the Continental Divide and Sawatch Range to the east, the Elk Range to the north, the San Juan mountains in the south, and the Uncompahgre Plateau to the west. The 164-mile-long Gunnison River is the basin's primary tributary to the Colorado River, and other rivers in the basin are tributaries of the Gunnison. The Gunnison River starts at the confluence of the Taylor and East Rivers in Gunnison County and runs into the Colorado River just south of the City of Grand Junction.

The Southwest Basin. The two primary rivers of the Southwest Basin—the San Juan and Dolores Rivers—are the basin's primary tributaries to the Colorado River. Other rivers in the basin are tributaries of the San Juan and Dolores Rivers.

The 383-mile-long San Juan River is a major tributary to the Colorado River, beginning in the San Juan Mountains northeast of Pagosa Springs and flowing southwest where it crosses the New Mexico state line before joining the Colorado River at Glen Canyon. It runs through a very dry and arid region of the Colorado Plateau and provides the only significant source of surface water for surrounding communities.

The headwaters of the 241-mile-long Dolores River are located high in the San Juan Mountains in Dolores County. From its source, the river flows southwest into McPhee Reservoir and then north through Dolores River Canyon before being joined by the San Miguel River, its main tributary. In dry years, the San Miguel can provide most of the Dolores's flow below their confluence due to the large number of agricultural diversions on the Dolores. The Dolores River flows into the Colorado River approximately 30 miles north of Moab, Utah.

Demographic Conditions and Trends

Historical and current population and growth trends

Between 2012 and 2017, the average total population in the four Western Colorado river basins was 574,607 (U.S. Census Bureau ACS 5-Year Estimates, 2012-2017). Western Colorado contains approximately 10 percent of the state's total residents (Figure 2-1).

Figure 2-1.
Population and Trends, Western Colorado River Basins, 1980 to 2017

	Basin				Western Colorado Total	State of Colorado
Metrics	Colorado River	Gunnison	Southwest	Yampa/ White		
2017 Population	314,266	105,800	109,906	44,635	574,607	5,609,445
Annual Growth Rates						
1980-2010	2.7%	1.6%	2.1%	1.0%	2.3%	1.9%
2010-2017	0.6%	0.3%	0.9%	0.2%	0.6%	1.5%

Source: U.S. Census Bureau 1980, 1990, 2000, & 2010; Colorado State Demography Office, 2019.

The population of Western Colorado grew at an average rate of 2.3% per year between 1980 and 2010 in comparison to an average population growth rate of 1.9% per year for the state as a whole. From 2010 to 2017, population growth in Western Colorado slowed to an average rate of 0.6% per year, while the state experienced an average population growth rate of 1.5%. Overall, population growth in Western Colorado has exhibited greater extremes than the state over the past four decades.

The average rate of population growth in the Colorado Basin was the highest amongst the basins in the region between 1980 and 2010, with an average annual growth rate of 2.7%. Population growth in the Colorado Basin was the driving force behind Western Colorado's total population growth during this time period, as the Colorado Basin contains the majority of the region's

population (e.g., 55% of Western Colorado's population in 2017) (U.S. Census Bureau ACS 5-Year Estimates, 2012-2017).

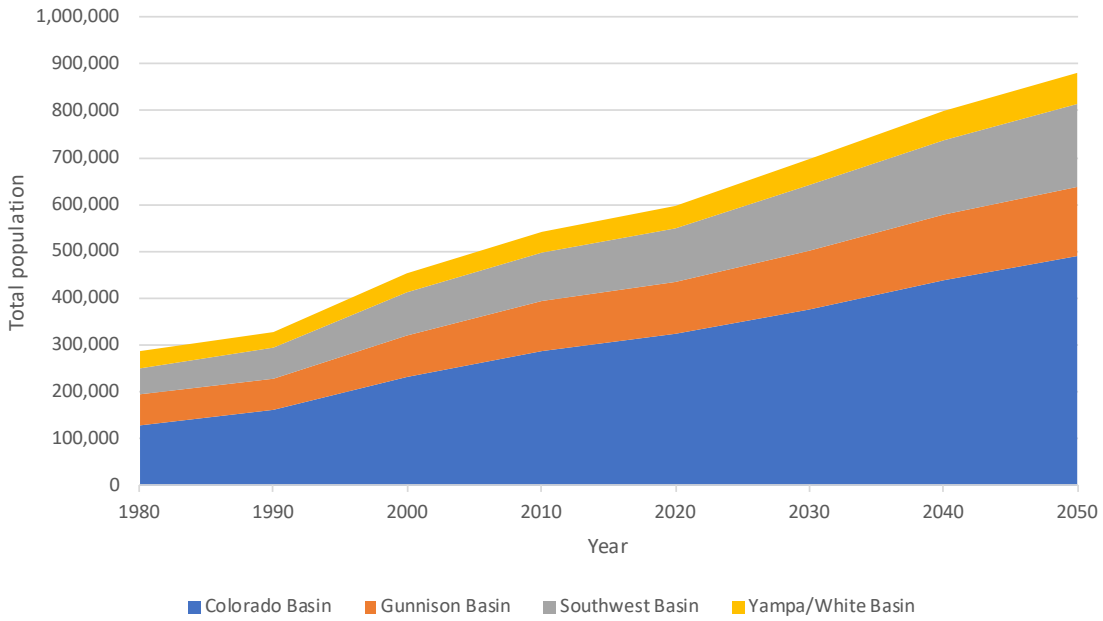
Between 2010 and 2017—the most recent year for which population estimates are available—the average rate of population growth in Western Colorado was 1.5%, and the Southwest Basin experienced the highest average annual growth rate (0.9%) of the basins in the region. Populations of the Yampa/White and Gunnison Basins were relatively static with respective annual average growth rates of 0.2% and 0.3% between 2010 and 2017.

As of 2017, the five most populous counties of Western Colorado were Mesa County (Colorado Basin – 136,700 residents), Garfield County (Colorado Basin – 59,200 residents), Eagle County (Colorado Basin – 54,700 residents), La Plata County (Southwest Basin – 55,600 residents), and Montrose County (Gunnison Basin – 41,800 residents) (U.S. Census Bureau ACS 5-Year Estimates, 2012-2017). These five counties comprise 61 percent of Western Colorado's population, with 39 percent of the region's population residing in the remaining 15 counties in Western Colorado.

Grand Junction—county seat of Mesa County in the Colorado Basin, and the most populous city in Western Colorado—has more than doubled in size since 1980, growing from approximately 28,000 residents in 1980 to an estimated 65,000 residents in 2017 (U.S. Census Bureau ACS 5-Year Estimates, 2012-2017). Montrose (Gunnison Basin – 19,400 residents) and Durango (Southwest Basin – 18.500 residents) are the two next-largest municipalities in Western Colorado. Of the 71 cities and towns in Western Colorado, 38 (54%) had fewer than 2,000 residents in 2017. Approximately 47 percent of the region's residents (270,600 residents) lived in unincorporated areas of Western Colorado in 2017.

Population projections. As shown in Figure 2-2, the population of Western Colorado is projected to grow by a total of 283,000 residents (47.3%) between 2020 and 2050 (Colorado State Demography Office, 2019).

Figure 2-2.
Population History and Projections, Western Colorado River Basins, 1980 to 2050



Source: U.S. Census Bureau 1980, 1990, 2000, & 2010; Colorado State Demography Office, 2019.

Approximately 58 percent of the region's future population growth is projected to occur in the Colorado Basin, with the Southwest Basin representing 22 percent of predicted population growth between 2020 and 2050 while the Gunnison and Yampa/White Basins constitute another 14 percent and 6 percent, respectively.

Economic Conditions and Trends

Employment and earnings. In 2017, there were 408,600 total jobs in Western Colorado. Approximately 57 percent of these jobs were located within the Colorado Basin (Figure 2-3). It should be noted that employment and earnings by industry is based only on the reported industry data totals for each county and basin. Approximately 16,000 jobs in Western Colorado were in nondisclosed employment sectors, and therefore are not represented in summary employment and earnings figures.

Between 2007 and 2017, the Colorado and Southwest Basins saw a net increase in number of jobs, while Gunnison and Yampa/White Basins experienced an overall decline in employment. Over this 10-year period, employment in Western Colorado increased by 9,095 jobs.

The three largest economic industries by employment in 2017 were government (12.1%), accommodation and food services (11.4%), and retail trade (9.9%) while the three largest economic industries by earnings were government (16.6%), construction (11.9%), and health care and social assistance (10.3%). Farm and ranch jobs comprised a little more than 3% of total employment in Western Colorado. Agriculture represents a relatively small proportion of jobs in the Colorado River Basin (1.5%), but a larger share of the jobs in each of the other basins –

ranging from 4.5% in the Southwest Basin to 5.2% in both the Gunnison Basin and the Yampa/White Basin (U.S. Bureau of Economic Analysis, 2017).

Earnings in the Colorado Basin represented 60 percent of the total $18.2 million in earnings across all industries in Western Colorado in 2017, followed by the Southwest Basin (17.8% of Western Colorado earnings), the Gunnison Basin (13.3%), and the Yampa/White Basin (8.7%).

Figure 2-3.
Total Employment and Key Sectors, Western Colorado River Basins, 2017

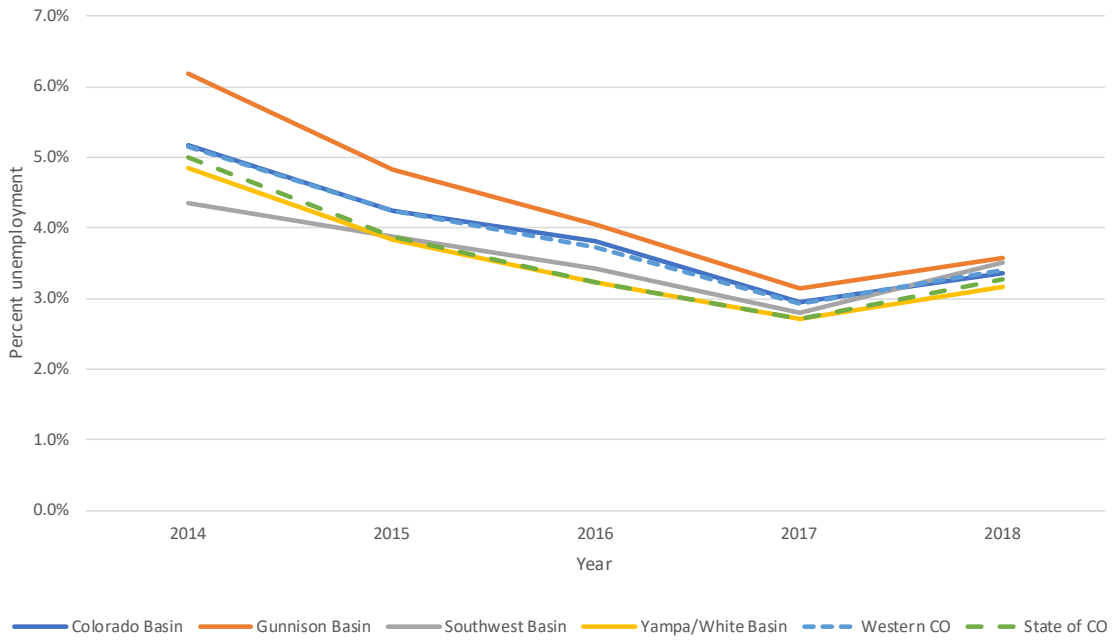
Metrics	Basin				Western Colorado Total
	Colorado River	Gunnison	Southwest	Yampa/ White	
2017 Total Jobs*	232,820	63,600	78,192	34,956	409,568
2007-17 Change	8,316	-282	3,619	-2,558	9,095
Agricultural Jobs**	4,289	3,642	3,323	2,309	13,563
Crops	1,367	1,061	1,169	335	3,932
Livestock	2,260	2,092	1,716	1,451	7,519
Other	662	489	438	523	2,112
Tourism Jobs***	54,000	6,900	7,000	7,500	75,400
Wildlife-related****	3,500	1,400	1,400	1,100	7,400
Water-related****	2,000	900	900	650	4,450

Source: *U.S. Bureau of Economic Analysis
**IMPLAN 2016
***Colorado State Demography Office
****Colorado Parks and Wildlife

In the tourism sector, approximately 10 percent of all tourism jobs in Western Colorado are supported by wildlife-related activities (e.g., hunting, fishing, and wildlife-watching) while another 6 percent are supported by water-related recreation (e.g., boating and swimming).

Unemployment. Unemployment rates in Western Colorado are near historically low levels and have dropped from 5.2% in 2014 to 3.4% in 2018 (Figure 2-4). Recent unemployment rates in Western Colorado are very similar to recent statewide unemployment rates, which were 5.0% in 2014 and 3.3% in 2018.

Figure 2-4.
Unemployment Rates, Western Colorado River Basins, 2014 to 2018

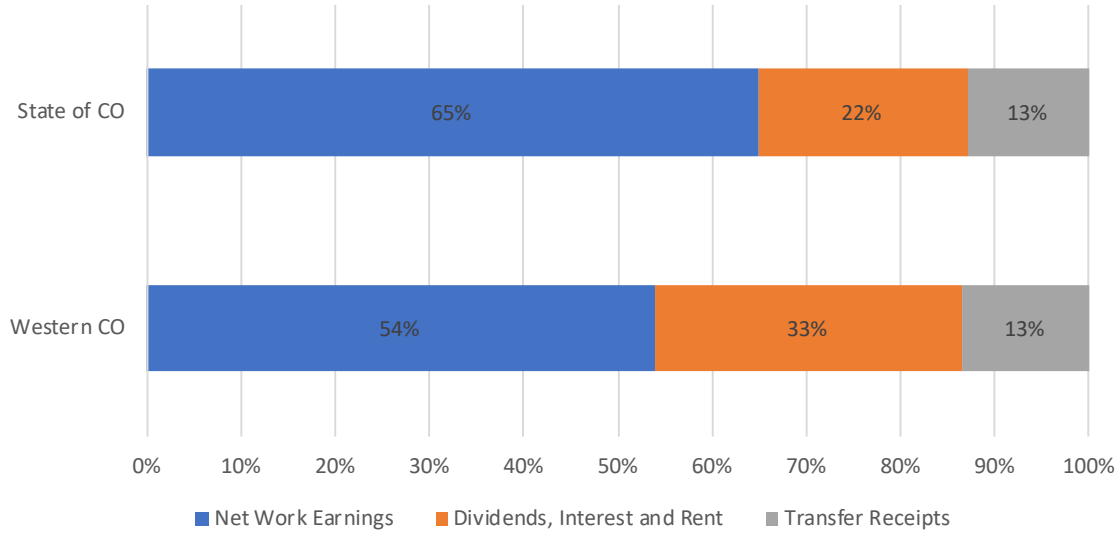


Source: Colorado State Demography Office.

Between 2014 and 2018, the Gunnison Basin had the highest unemployment rate of any basin in the region, with a high of 6.2% in 2014 and a low of 3.1% in 2017. Unemployment rates in the Colorado Basin were nearly identical to unemployment rates in the Western Colorado region between 2014 and 2018, and the Yampa/White Basin experienced unemployment rates nearly identical to statewide unemployment rates during the same period. The Southwest Basin saw the lowest unemployment rate of any Western Colorado basin in 2014 (4.3%). In 2018, the four basins of the region experienced unemployment rates within 0.4 percentage points of one another (3.2-3.6%).

Personal income. Most personal income in Western Colorado is from income earned through work (54%). Dividends, interest, and rent account for 33 percent of personal income, and transfer receipts, such as government social benefits, account for 13 percent. At the state level, a greater percentage of income is earned through work (65%) compared to the basin, while 22 percent is from dividends, interest, and rent and 13 percent is from transfer receipts (Figure 2-5).

Figure 2-5.
Sources of Personal Income, Western Colorado River Basins and State of Colorado, 2017



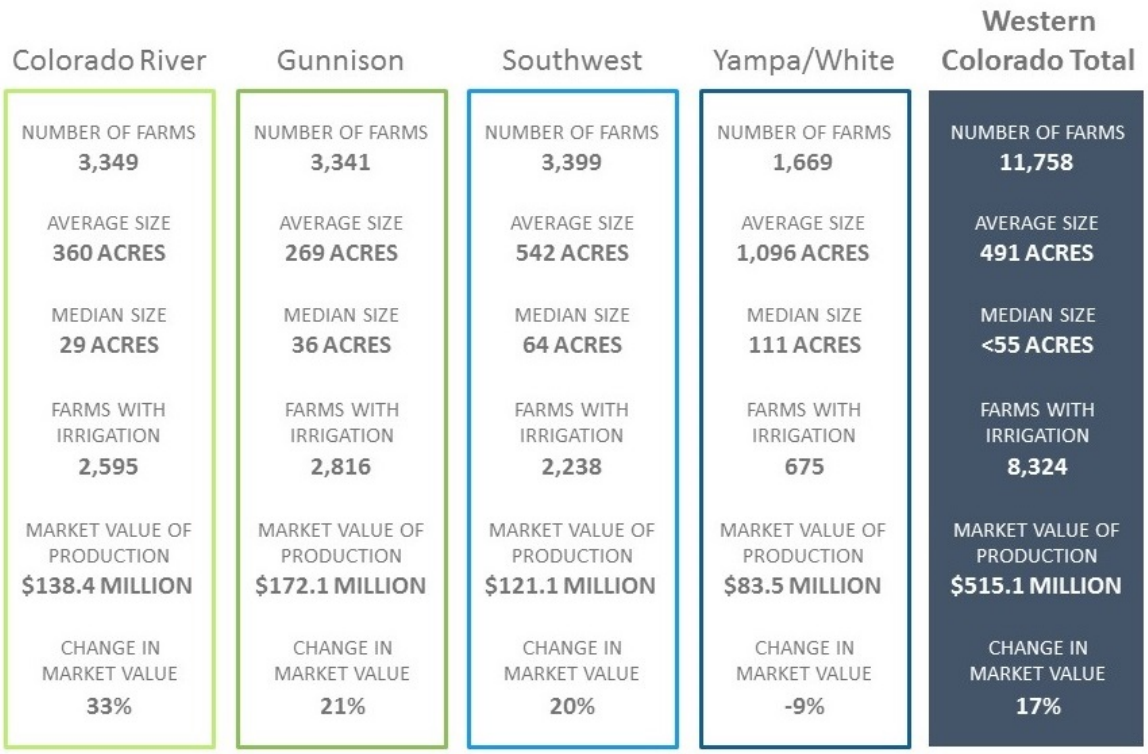
Source: U.S. Bureau of Economic Analysis.

Personal income in Western Colorado accounts for approximately 10 percent ($30 billion) of total statewide personal income ($306 billion). Compared to the state, income from dividends, interest, and rent constitutes a larger portion of personal income in Western Colorado due to substantial wealth-related income in the Colorado Basin. Personal income in the Colorado Basin comprises 59 percent ($18 billion) of Western Colorado's total $30.3 billion in personal income. Within the Colorado Basin, dividends, interest, and rent account for 35 percent of personal income, primarily from Eagle, Garfield, and Pitkin Counties.

Agriculture in Western Colorado

Overview. Agriculture is an important economic, cultural, and aesthetic component of Western Colorado. There are nearly 12,000 farms in Western Colorado (Figure 2-6) covering a total of more than 5.7 million acres of land. The Southwest and Yampa/White Basins each contain approximately 1.8 million acres of farmland, while the Colorado Basin contains 1.2 million acres and the Gunnison Basin contains 900,000 acres (USDA Census of Agriculture, 2017).

Figure 2-6.
Agricultural Census Profiles, Western Colorado River Basins, 2017



Source: USDA Census of Agriculture, 2017.

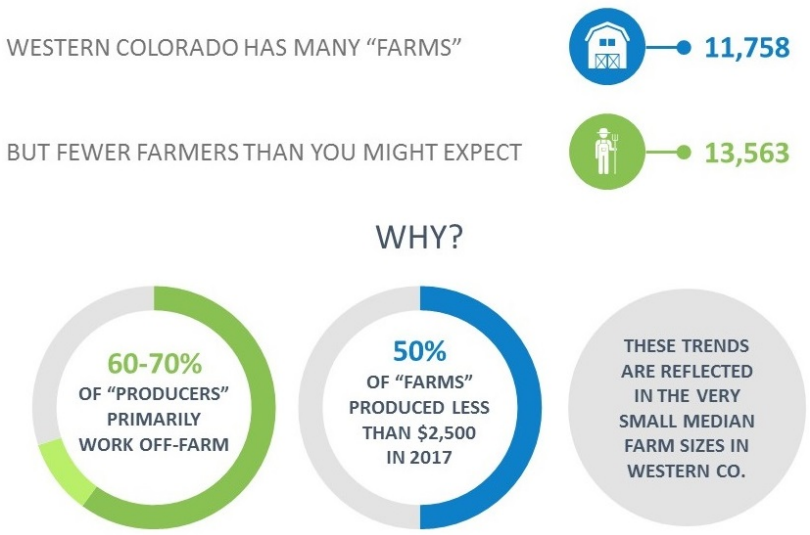
The average size of a farm in Western Colorado is 491 acres, although the median size is less than 55 acres. As of 2017, approximately 70 percent of Western Colorado farms utilized irrigation, and irrigated acreage constituted 12 percent of the region's total farm lands (USDA Census of Agriculture, 2017). Nearly one-quarter of farmland in the Gunnison Basin was irrigated in 2017—the highest proportion of any Western Colorado basin—compared to a low of five percent in the Yampa/White Basin.

Agricultural economy. Agricultural activity in Western Colorado provides approximately 13,600 jobs, which is about 3 percent of the total jobs in the region across all industries (U.S. Bureau of Economic Analysis, 2017). The number of agricultural jobs in each basin ranges from 2,300 jobs in the Yampa/White Basin to 4,300 jobs in the Colorado Basin.

The total number of agricultural jobs in the region can be considered small relative to the total number of farms. As shown in Figure 2-7. between 60 and 70 percent of agricultural producers primarily work off-farm, and half of Western Colorado farms had total annual sales of less than $2,500 in 2017.

Figure 2-7.
Agricultural Farms and Producers, Western Colorado, 2017

Source:
USDA Census of Agriculture, 2017.



Livestock production is an important component of the Western Colorado agricultural economy. Approximately 55 percent of agricultural jobs in Western Colorado are in the livestock sector (Figure 2-8).

Figure 2-8.
Agricultural Industry Economic Detail, Western Colorado River Basins, 2016

Agricultural Sector	Employment	Output (Receipts)	Income*	Production/ Import Taxes**	Total Value-Added (GRP)
Grain farming	287	$33,512,123	$4,395,285	-$488,347	$3,906,938
Vegetable and melon farming	157	$12,154,897	$6,645,023	$177,205	$6,822,228
Fruit farming	881	$49,365,958	$29,847,794	$1,538,546	$31,386,340
Greenhouse, nursery, and floriculture production	415	$31,489,059	$19,798,367	$208,877	$20,007,244
All other crop farming***	2,191	$69,556,677	$36,314,635	$547,065	$36,861,699
Total crop farming	**3,931**	**$196,078,714**	**$97,001,104**	**$1,983,346**	**$98,984,449**
Beef cattle ranching and farming, including feedlots****	6,475	$376,301,712	$71,005,640	$3,321,374	$74,327,014
Dairy cattle and milk production	315	$65,674,950	$17,865,704	$713,143	$18,578,847
Animal production, except cattle and poultry and eggs	729	$38,859,803	$21,241,246	$644,058	$21,885,304
Total livestock production	**7,519**	**$480,836,465**	**$110,112,590**	**$4,678,575**	**$114,791,165**
Commercial logging	159	$9,928,127	$3,251,246	$353,931	$3,605,177
Commercial fishing	0	$0	$0	$0	$0
Commercial hunting and trapping	294	$10,482,398	$5,060,259	$1,626,834	$6,687,093
Total forestry, hunting and fishing	**453**	**$20,410,525**	**$8,311,505**	**$1,980,765**	**$10,292,270**
Support activities for agriculture and forestry	**1,660**	**$52,353,927**	**$31,036,418**	**$1,238,905**	**$32,275,323**
Total direct agricultural activity	**13,563**	**$749,679,631**	**$246,461,617**	**$9,881,590**	**$256,343,207**

Note: *Income includes employee and proprietor earnings and property-related income.
**Includes sales and excise taxes, property taxes, special assessments and subsidies.
***Predominantly hay and alfalfa production.
****Includes dual purpose ranches/farms.

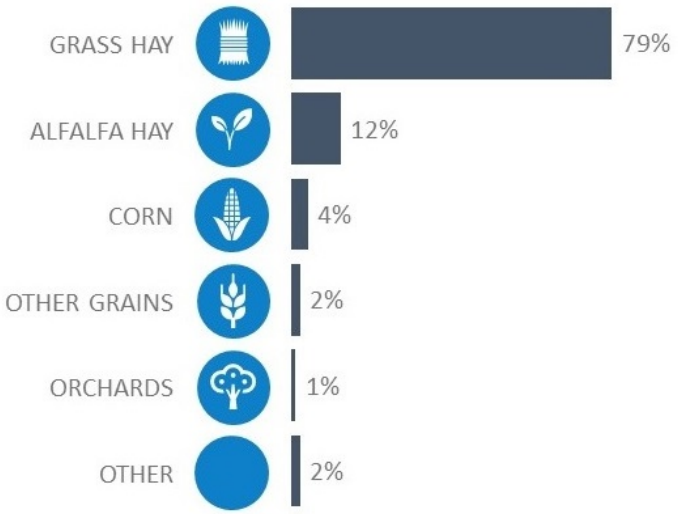
Source: IMPLAN, 2016.

Additionally, livestock production accounts for 64 percent of Western Colorado's total $750 million in agricultural output and 48 percent of the region's total $246 million in income. Within the region's livestock industry, 86 percent of jobs and 78 percent of output are in beef cattle ranching.

Crop farming is also a notable component of the Western Colorado's agricultural economy, representing 29 percent of agricultural jobs, 26 percent of output, and 39 percent of income. A small portion of Western Colorado's crop farming activity takes place within the fruit farming industry—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. Figure 2-9 shows cropping patterns by acreage in Western Colorado in 2015.

Figure 2-9.
Cropping Patterns,
Western Colorado, 2015

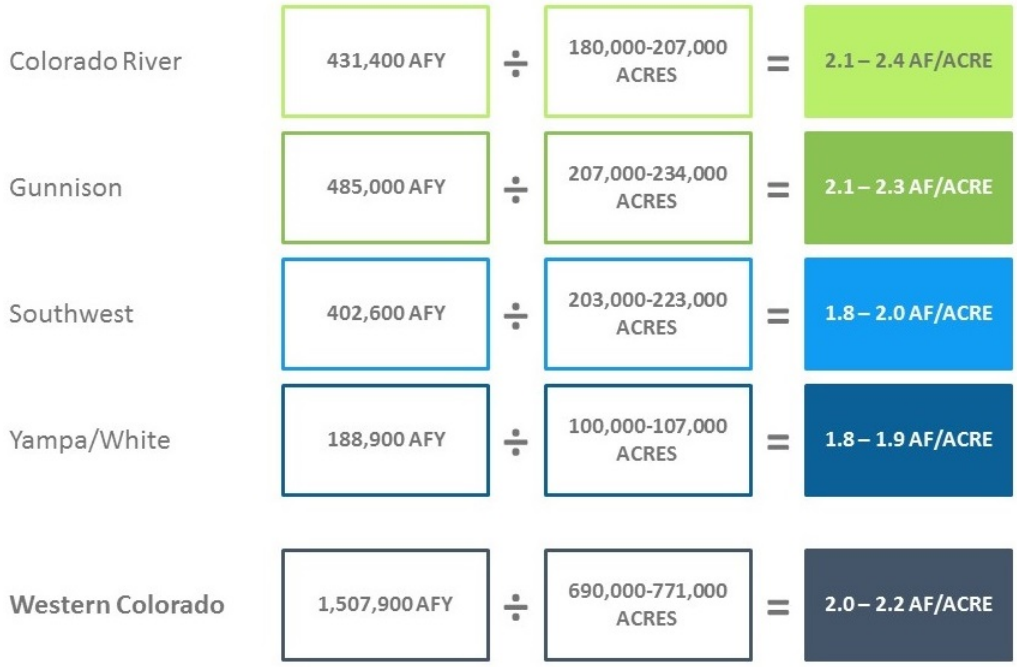
Source:
Colorado's Decision Support Systems
Historic Crop Analyses, 2015.



Agricultural water use. More than 95 percent of Western Colorado's average annual water diversions are used by agriculture (State Water Plan Technical Update, 2019). In 2017, approximately 71 percent of Western Colorado's farms were irrigated, with an average of 83 irrigated acres per irrigated farm.

Estimates of total irrigated land from the Census of Agriculture (690,000 acres in Western Colorado in 2017) differ somewhat from the more refined estimates developed for the Colorado Decision Support System (CDSS) and used in the Colorado Water Plan. The latest estimates for the Technical Update to the Water Plan indicate a total of approximately 771,000 irrigated acres across the four Western Colorado basins, and annual consumptive use of 1.5 million acre-feet per year on those acres (Figure 2-10). These numbers correspond to average consumptive use of about 2.0 acre-feet per acre (State Water Plan Technical Update, 2019).

Figure 2-10.
Agricultural Water Use and Irrigated Land, Western Colorado River Basins, 2019



Source: USDA Census of Agriculture, 2017 and State Water Plan Technical Update, 2019.

Tourism and Recreation Economy

The Western Colorado tourism and recreation economy depends on water to directly and indirectly support activities such as fishing, hunting, wildlife-watching, boating, swimming, and snow-making for ski resorts. The Colorado State Demography Office (SDO) estimates that tourism jobs constitute 82,000 (35%) of the 233,000 direct basic jobs in the basin (i.e., jobs that bring outside dollars into the community by selling goods or services). Within the basin, tourism supports a total of 122,500 direct and indirect jobs (i.e., jobs created as the result of goods and services sold by direct basic jobs).

The SDO definition of tourism includes resort activity (e.g., skiing, national parks, rafting), second home expenditures, and service employment and transportation jobs supported by visitation. Two-thirds of Western Colorado's direct basic tourism jobs are in the Colorado River Basin.

Further analysis from BBC using data from a 2017 study by the Colorado Department of Parks and Wildlife (CPW) finds that approximately 11,850 direct and indirect jobs in Western Colorado are supported by wildlife-related activity (7,400 jobs) and water-related recreation (4,450 jobs). Wildlife- and water-related recreation comprises only a small share of the tourism economies in the Colorado Basin (7%) due to the high level of resort activity and second home expenditures in the basin. It also comprises a relatively small part of the Southwest Basin tourism economy (11%). Wildlife- and water-related tourism jobs constitute a larger share of the tourism

economies in the Gunnison Basin (22%) and Yampa/White Basin (18%) than the two other basins of Western Colorado.

A recent study of the economic contributions from water-related outdoor recreation in Colorado estimated that over 25,000 total jobs are currently supported by these types of activities, but that estimate was based on a broader definition which included snow sports as well as camping, picnicking, and trail use near streams.[1]

[1] The Economic Contributions of Water-related Outdoor Recreation in Colorado. Business for Water Stewardship. February 28, 2020.

SECTION 3.
Demand Management Scenarios

As noted in Section 1, 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 requires some general assumptions regarding possible aspects of a demand management program.

Development of Demand Management Scenarios for this Study

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.

Scenario 1. The "Moderate" demand management" scenario was based on the Demand Management Storage Agreement (Agreement) signed by the Upper Basin states in 2019. The Agreement authorizes storage space in the Upper Colorado Storage Project Act Initial Units[1] for up to 500,000 acre-feet (AF) from an Upper Basin Demand Management Program to be used as a water bank to help assure compact compliance.[2]

Assuming that New Mexico, Utah and Wyoming would collectively contribute approximately 250,000 of the 500,000 AF based on their shares of Upper Basin consumptive use, Colorado's share would be approximately 250,000 AF. Since approximately one-half of Colorado's consumptive use of the Colorado River is accounted for by trans-mountain diversions to the Front Range, the proportionate contribution from Western Colorado could be about 125,000 AF. Although a portion of Western Colorado's consumptive use of Colorado River water is due to outdoor municipal use and industrial use, that portion is relatively small compared to consumptive use by irrigated agriculture.

For simplicity, the Moderate demand management scenario assumes a program designed to obtain 125,000 AF of consumptive use reductions from irrigated agricultural water users in Western Colorado. Recognizing that "*no Upper Basin Demand Management Program is likely to conserve enough water in any single year to help assure continued compliance with the Colorado River during extended drought conditions*"[3] Scenario 1 assumes the 125,000 AF of consumptive use reductions would be obtained from a demand management program operating 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. The Moderate Demand

[1] Blue Mesa, Crystal, and Morrow Point Reservoirs in Colorado, Flaming Gorge Reservoir in Utah/Wyoming, Navajo Reservoir in New Mexico and Lake Powell in Arizona.

[2] Agreement Regarding Storage at Colorado River Storage Project Act Reservoirs Under an Upper Basin Demand Management Program. U.S. Bureau of Reclamation, 2019. https://www.usbr.gov/dcp/docs/final/Attachment-A2-Drought-Managment-Storage-Agreement-Final.pdf

[3] Ibid.

Management scenario further assumes that each of the four major Western Colorado river basins would contribute to those 25,000 AF annual reductions based on their proportionate shares of the region's total irrigation consumptive use. Based on the irrigation consumptive use estimates from the 2109 Technical Update to the Water Plan[4], the annual reductions in irrigation consumptive use under Scenario 1 would be approximately:

- Colorado River Basin 7.150 AFY
- Gunnison Basin 8,040 AFY
- Southwest Basin 6,680 AFY
- Yampa/White Basin 3,130 AFY

Scenario 2. The "Aggressive" demand management scenario was designed to examine the potential effects from a larger or more geographically concentrated demand management program. The 500,000 acre-foot Agreement will expire at the end of 2025, though any water held in the account would continue to be available for drought contingency use. Hydrologic analysis conducted as part of the Risk Study indicates that a one to two million acre-foot water bank might be required to make a substantial impact on maintaining compact compliance under extended drought conditions.

With these considerations in mind, the Aggressive demand management scenario examines an annual 25,000 AF reduction in consumptive use in each of the four major river basins.[5] In aggregate, the effects from this scenario could also be indicative of the potential impacts from a 100,000 acre-foot annual reduction in consumptive use from irrigated agriculture across all of Western Colorado.

For purposes of this study, the study team made several other assumptions that apply to both scenarios:

- ***Full fallowing, or complete cessation of irrigation on participating acres.*** Full fallowing has historically the most common approach among programs involving temporary leases of agricultural water supplies, although some of the recent system conservation pilot projects for demand management have also incorporated other strategies such as split season fallowing or deficit irrigation. The potential economic implications of these alternative strategies are discussed in Section 7 of this report.

[4] Consumptive use based on reported annual irrigation water requirements net of annual consumptive use gaps from Volume 1 of the Technical Update to the Water Plan (July 2019).

[5] 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.

- ***Rotational fallowing.*** While many of the secondary economic impacts from fallowing the same acreage over multiple years may be generally similar to the impacts from fallowing different acres each year, a complicating factor is the extended effects on grass hay yields following fallowing, as described in Section 6 of this report. Since agronomic studies on behalf of the WBWG have quantified the changes in grass hay yield following a single year without irrigation, but no studies have quantified the longer-term effects of fallowing grass hay for multiple years, the economic estimates in this report are most directly applicable to a rotational fallowing strategy.

- ***No injury to other water users.*** One of the most frequent issues raised by the stakeholders during both the initial meetings and the second round of meetings was concern about potential effects from demand management on irrigation return flows relied on by other farmers and ranchers or for public water supply systems. While this is without a doubt a very serious concern, its is also very specific to individual irrigators and ditches and is not possible to evaluate at a basin-wide or regional level. This study assumes that these issues would have to be mitigated or avoided for a farmer or rancher to be legally allowed to participate in a demand management program.

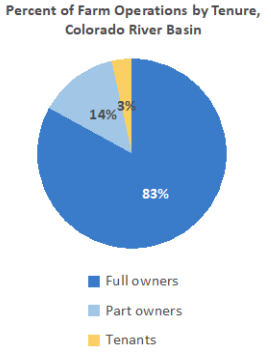
Who Might Participate in a Demand Management Program?

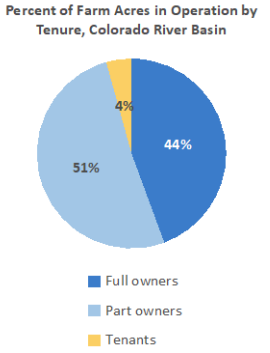
Other characteristics of Western Colorado agriculture are important to further define the demand management scenarios and evaluate their potential effects.

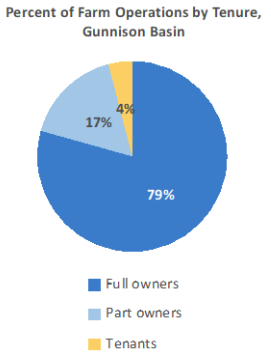
Farm and ranch characteristics. As shown in Section 2, there are over 8,300 farms and ranches with irrigation across Western Colorado. On average these operations are irrigating just over 90 acres, though the average number of irrigated acres per operation ranges from about 80 acres in the Colorado River Basin to almost 160 acres in the Yampa/White Basin. These averages are a bit misleading, however, because of the large number of small, part-time farms and ranches in each of the basins. Input from stakeholders during this study indicated that approximately 240 irrigated acres in hay production are required to support a full-time farmer, and approximately 250 cattle are required to support a full-time rancher.

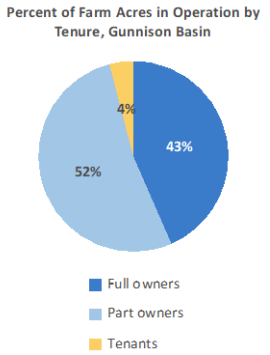
Other characteristics of Western Colorado's farms and ranches are also important in considering the potential economic effects from demand management. As shown in Figure 3-1, a very large majority of farms and ranches in each of the basins are family owner operated, based on either the number of operations or the total acreage by different ownership structures. This suggests that, for the most part, the benefits from payments to participate in a demand management program are likely to stay with the participating operations (rather than flowing to absentee landlords) and largely remain within Western Colorado. It also suggests that proprietor income from farms and ranches is also likely to be primarily spent locally rather than accruing to corporate owners in other regions or states.

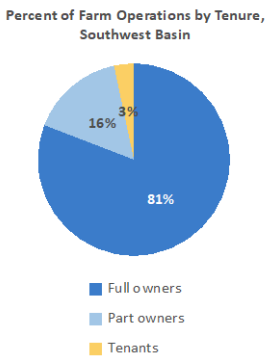
Figure 3-1. Farm and Ranch Ownership by Basin (2017 Census of Agriculture)

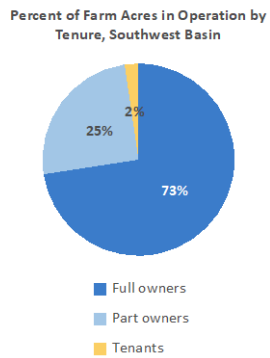


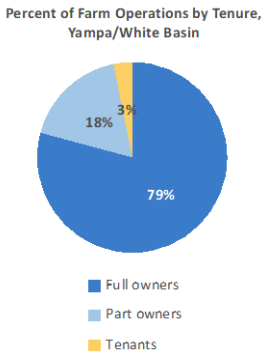


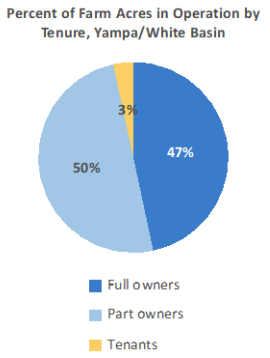






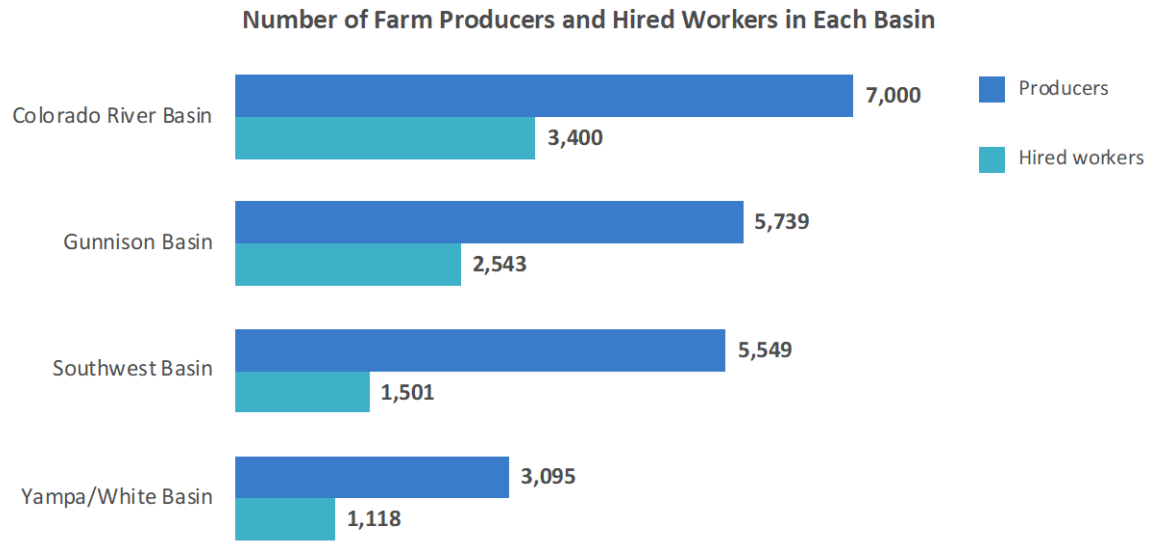






Farm and ranch owning families also account for most of the labor on Western Colorado farms and ranches. Figure 3-2 shows that about 1/3 of the labor on the region's agricultural operations is comprised of hired workers, while about 2/3 of the labor comes from "producers" who are in charge of making operational decisions and compensated out of farm and ranch income. In the context of a potential demand management program, where participants would in effect be paid to reduce production by fallowing some of their acres, some of these hired labor positions could be at risk.

Figure 3-2. Farm Producers and Hired Workers by Basin (2017 Census of Agriculture)



Most likely participants. As shown in Section 2, about 90 percent of the irrigated acres in Western Colorado are used to produce grass hay or alfalfa. The next largest crop in terms of irrigated acreage (at about 4 percent of irrigated acres) is corn. While orchards, vineyards and other crops are also grown on a fairly substantial number of irrigated acres in most of the basins (except the Yampa/White Basin), the economic and physical characteristics of these crops would appear to make them unlikely candidates for participation in demand management.

In essence, a demand management program in Western Colorado is likely to primarily involve acres currently growing hay, and to a lesser extent, corn. Based on the scale and geographic distribution of the scenarios defined earlier in this section, the irrigated cropping patterns in each basin, and the average consumptive water use per acre in each basin, Figure 3-3 depicts the assumed number of acres by crop type under each of the demand management scenarios.

Figure 3-3. Fallowing acreage assumptions by basin, crop type and scenario

Basin	Scenario 1: 25,000 AFY from Western Colorado				Scenario 2: 25,000 AFY from Individual Basins			
	Hay	Corn	Total	% of Irrigated Hay Acres	Hay	Corn	Total	% of Irrigated Hay Acres
Colorado	3,293	108	3,400	**1.7%**	11,617	379	11,996	**6.1%**
Gunnison	3,483	368	3,850	**1.8%**	10,910	1,151	12,061	**5.5%**
Southwest	3,675	25	3,700	**1.8%**	13,754	94	13,848	**6.9%**
Yampa/White	1,750	0	1,750	**1.6%**	14,161	0	14,161	**13.3%**
Western Colorado	12,200	500	12,700	**1.8%**	50,442	1,624	52,066	**7.3%**

In essence, the Moderate demand management scenario (Scenario 1) assumes about one in every 60 irrigated acres currently in hay or corn production across Western Colorado would be fallowed by participants in the demand management program. 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.

SECTION 4.
Framework for Evaluation

The third task in this study was to develop the framework for evaluating the potential economic effects in Western Colorado from demand management. The framework encompasses the overall structure of the analysis, the specific methodology, and the key assumptions and data sources used to estimate the economic effects.

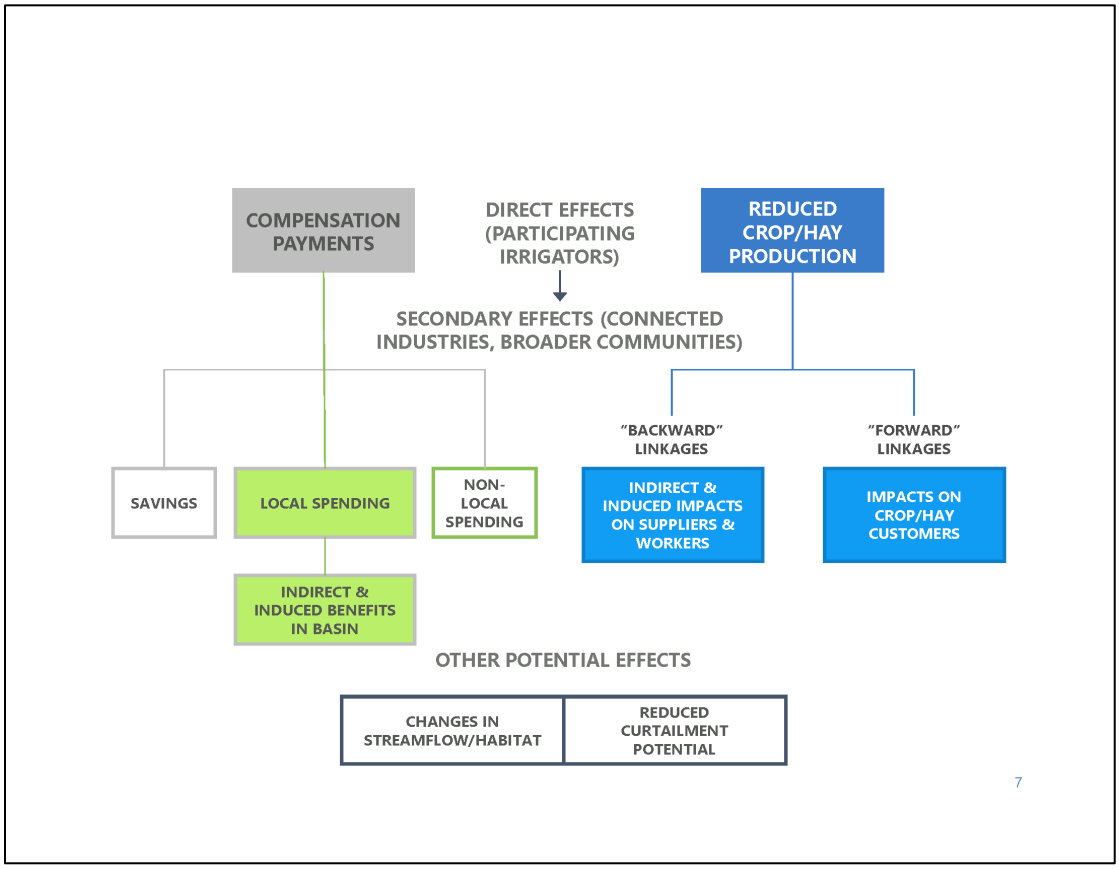
Overall Framework

Figure 4-1 on the following page illustrates the overall structure for the economic analysis.

Reading from top to bottom, the framework initially identifies the direct, on-farm/ranch effects from a potential demand management program, including the compensation payments to participants and the reduction in production on acres enrolled in the program. The framework then estimates the potential "secondary" economic effects arising from the direct effects. While the principal focus is on the financial effects on the participants and related suppliers and customers, the framework also includes consideration of other potential effects such as changes in streamflow and wildlife habitat arising from demand management and reductions in the probability of involuntary reductions in water use arising from failure to meet Colorado River compact requirements – thought these effects are more difficult to quantify.

The left-hand side of the flowchart depicts the potential economic benefits from a voluntary and compensated demand management program. Those benefits could arise from the payments to participating irrigators and the spending of a portion of those payments within their local basin and Western Colorado. The right-hand side depicts the potential adverse economic impacts from demand management. Adverse impacts could arise from reduced on-farm/ranch production, corresponding reductions in purchases of agricultural inputs and services (and potentially in the need for hired labor), and potential effects on local livestock production that relies on the production from operations that choose to participate in a demand management program.

Figure 4-1. Secondary impact analysis framework



Economic Metrics and Terminology. The potential economic effects from demand management were evaluated in terms of several different economic metrics.

- ***Output*** – In general, economic output as reported in this study is equivalent to annual gross receipts or sales (with the exception that output in retail or wholesale trade reflects gross sales minus the cost of the goods sold).

- ***Value-added*** – a broad measure of annual income which includes proprietor earnings (for example the earnings of self-employed farmers and ranchers) as well as wage or salary income and production-related taxes. In evaluating farm/ranch-related income, value-added is a better measure than wage and salary income.

- J***obs*** – As reported by the IMPLAN model (described later in this section), jobs include both full and part-time positions (including both wage and salary employment and self-employment). Many on-farm/ranch jobs are part-time. To make some of the study results easier to interpret, we converted on-farm/ranch jobs into full-time equivalents (FTE).

All effects measured in dollars (such as output and value-added as well as prices) were reported in terms of 2019 dollars.

Other economic terminology used in this analysis and report includes:

- ***Direct effects*** – the initial economic effect. In this analysis these effects are primarily on-farm or ranch effects on operations choosing to participate in a demand management program.

- ***Secondary effects*** – primarily "multiplier" effects resulting from the direct effects. These effects are further broken down into "indirect" and "induced" effects. In the context of this study, secondary effects also include potential effects from changes in streamflows.

- ***Indirect effects*** – effects on the businesses/industries that provide goods and services to directly affected industries. In this case, this includes farm and ranch suppliers and businesses that could benefit from local spending of participation payments.

- ***Induced effects*** – effects on the businesses/industries that provide household goods and services to directly and indirectly affected workers and their households.

- ***Backward linkages*** – effects on suppliers to directly affected operations and households, equivalent to indirect effects plus induced effects.

- ***Forward linkages*** – economic effects on the customers of directly affected operations, such as livestock operations, due to changes in availability or price for their inputs.

Methodology

As suggested by the framework flow chart shown in Figure 4-1, 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 payments (also referred to as participation payments) and the reduction in production.

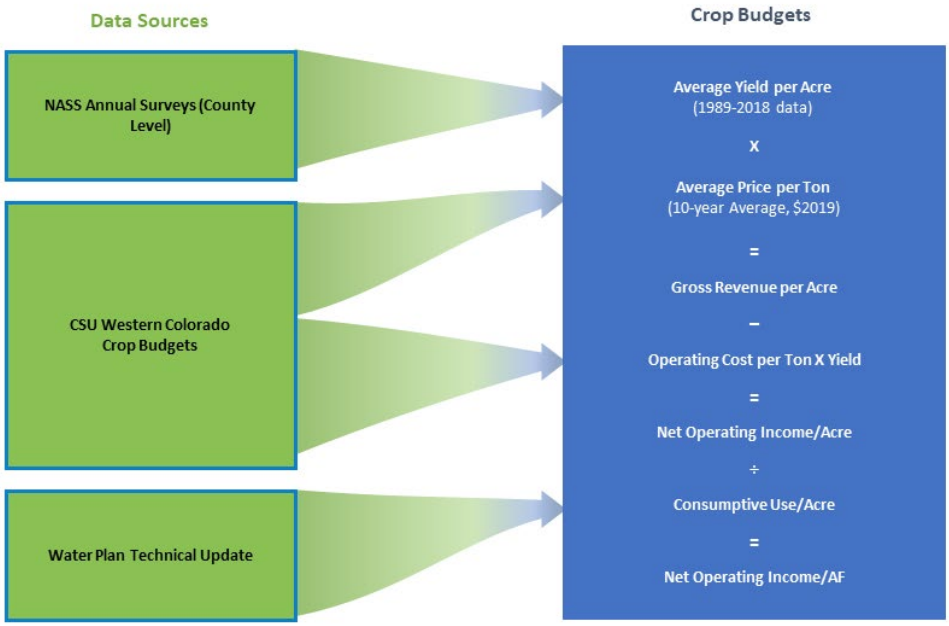
Development of Basin-specific Crop Budgets. To estimate the potential level of compensation that could be required for a demand management program (as described more fully in the following section of this report) and the direct economic value of decreases in farm and ranch production (described in Section 6), the study team developed simplified, basin-specific crop enterprise budgets for grass hay and alfalfa. Due to the lack of available data on corn production at the county level, a single regional crop budget was used for the acres planted in corn that were assumed to participate in the demand management scenarios.

The basin-specific crop budgets were developed from county level data regarding yields per acre from annual surveys conducted by the National Agricultural Statistics Service[1], price and operating expense data from Colorado State University's (CSU's) Western Colorado crop

[1] The NASS surveys have not distinguished between irrigated and non-irrigated yields since 2008. Although relatively few non-irrigated acres are included in the harvested acres in most counties, the reported NASS yields from 2009 forward were adjusted upward based on the relationship between yields on irrigated lands to yields on all harvested lands in each county from 1989-2008.

enterprise budgets, and water use data from the 2019 Technical Update to the Water Plan, as shown in Figure 4-2.

Figure 4-2. Development of basin-specific crop budgets



A key component of the simplified crop budgets was the average yield per acre. Every farm or ranch operation is unique and yields can vary considerably based on elevation, irrigation supply, soil quality, management and other factors. In general, however, variations in yield are strongly correlated with variations in consumptive water use, so yield per acre-foot may be similar between high yielding operations and lower yielding operations.

For purposes of this study, basin-wide average yields were used in the analysis. Figures 4-3 through 4-6 illustrate the average yields for grass hay and alfalfa in each of the four study basins. The stakeholder groups in each basin reviewed the average yield information and generally found it to be reasonable, though they also noted that the NASS yields may somewhat understate the economic value of hay acres because they reflect only the yield from the harvest cuttings, and do not include the value that some ranchers receive by grazing livestock on the "regrowth" on those acres after the final cutting. Consequently, both the required participation payments, and the secondary economic impacts could be understated in some cases.

Figure 4-3. Average yields in the Colorado River Basin

Average Grass Hay Yields:

- Eagle County: 1.5 tons/acre
- Garfield County: 1.9
- Grand County: 1.4
- Mesa County: 2.1
- Pitkin County: 1.5
- Summit County: 1.2
- **Basin Average: 1.6 tons/acre**

Average Alfalfa Yields:

- Eagle County: 2.3 tons/acre
- Garfield County: 2.6
- Grand County: 1.9
- Mesa County: 3.7
- Pitkin County: 2.0
- Summit County: N/A
- **Basin Average: 3.0 tons/acre**

Figure 4-4. Average yields in the Gunnison Basin

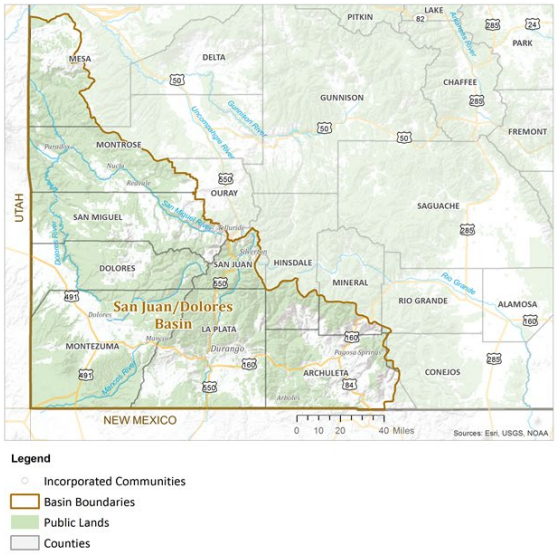
Average Grass Hay Yields:

- Delta County: 2.2 tons/acre
- Gunnison County: 1.5
- Montrose County: 2.3
- Ouray County: 1.8
- **Basin Average: 2.2 tons/acre**

Average Alfalfa Yields:

- Delta County: 3.2 tons/acre
- Gunnison County: 2.4
- Montrose County: 3.7
- Ouray County: 2.9
- **Basin Average: 3.2 tons/acre**

Figure 4-5. Average yields in the Southwest Basin



Average Grass Hay Yields:

- Archuleta County: 1.9 tons/acre
- Dolores County: 2.0
- La Plata County: 2.3
- Montezuma County: 2.3
- San Miguel County: 1.7
- **Basin Average: 2.0 tons/acre**

Average Alfalfa Yields:

- Archuleta County: 3.1 tons/acre
- Dolores County: 4.0
- La Plata County: 2.7
- Montezuma County: 3.8
- San Miguel County: 2.3
- **Basin Average: 3.3 tons/acre**

Figure 4-6. Average yields in the Yampa/White Basin

Average Grass Hay Yields:

- Rio Blanco County: 2.3 tons/acre
- Routt County: 1.9
- Moffat County: 2.0
- **Basin Average: 2.1 tons/acre**

Average Alfalfa Yields:

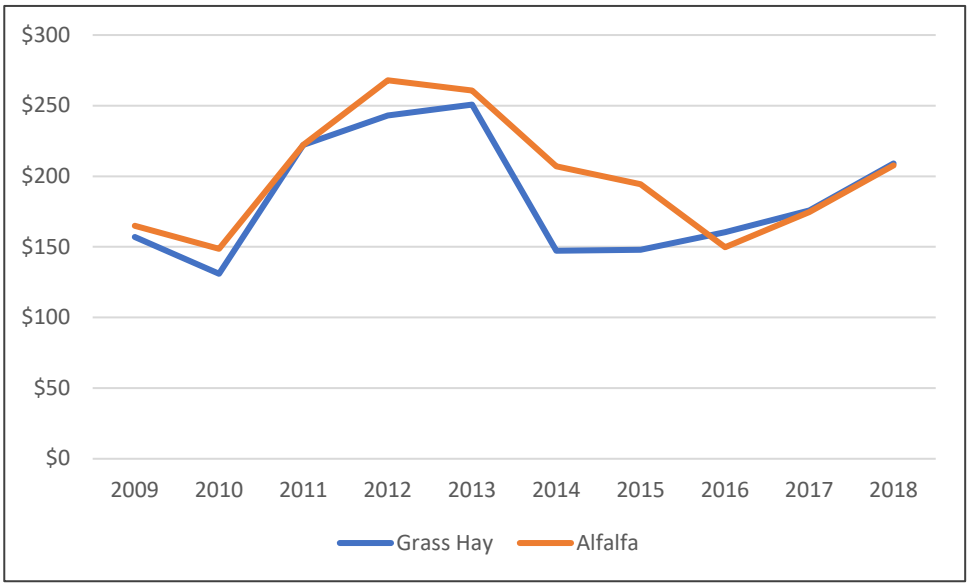
- Rio Blanco County: 2.7 tons/acre
- Routt County: 2.4
- Moffat County: 2.3
- **Basin Average: 2.4 tons/acre**

Another important component of the crop enterprise budgets was the average prices for grass hay and alfalfa. Annual average prices for Western Colorado were obtained from the crop enterprise budgets published by CSU. These prices are reflective of overall averages in Western Colorado, but hay prices can vary substantially based on quality. As noted by basin stakeholders, "horse hay" can sell for more than double the price of "cattle hay." The CSU hay prices were converted to 2019 dollars using the consumer price index inflation calculator provided by the

Bureau of Labor Statistics. Western Colorado-specific prices were not available for 2011-2013 for grass hay and 2012-2013 for alfalfa, so statewide averages were used for those years.

Figure 4-7 depicts the annual price per ton for grass hay and alfalfa from 2009 through 2018. The ten-year average prices (used in the subsequent analyses described in Sections 5 and 6) were $184 per ton for grass hay and $200 per ton for alfalfa. As shown in the figure, prices can vary considerably from year to year, with the highest prices typically occurring during dry years.

Figure 4-7. Western Colorado average price per ton for grass hay and alfalfa, 2009-2018 (2019 dollars)



The price and yield information from the crop budgets was used to estimate average revenues per acre by crop and basin. Revenue minus average operating expenses was used to estimate net operating income – before fixed costs such as debt service, returns to land and ownership. As described in the following report section, net operating income was a key component in estimating potential compensation levels by crop and basin.

Figure 4-8, on the following page, summarizes estimated net operating income per acre by basin and crop-type. The complete crop enterprise budgets used in the analysis are provided in Appendix B.

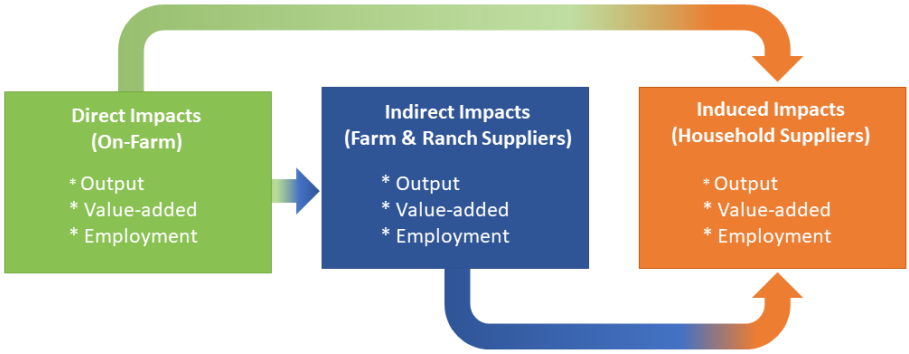
As mentioned earlier, the lack of available county-level yield data for acres planted in corn necessitated the use of a single, regional crop budget based on the crop enterprise budgets for Western Colorado published by CSU. Over the period of 2008-2018, the average yield per acre for irrigated corn was 179 bushels, the average price per bushel in 2019 dollars was $4.33 and the average net operating income per acre was $230 in 2019 dollars.

Figure 4-8. Estimated 10-year average net operating income per irrigated acre (2019 dollars)

	Colorado	Gunnison	Southwest	Yampa/ White
Grass Hay				
Average	$176	$254	$229	$236
Maximum	$290	$406	$386	$347
Minimum	$70	$93	$87	$87
Alfalfa				
Average	$351	$378	$383	$264
Maximum	$465	$605	$494	$443
Minimum	$182	$226	$215	$169

IMPLAN Modeling. The indirect and induced economic effects ("multiplier effects") that could result from demand management were estimated using four basin-specific IMPLAN input-output models as illustrated in Figure 4-9.

Figure 4-9. IMPLAN modeling



IMPLAN is a widely used, customizable regional economic modeling system originally developed by the U.S. Forest Service. IMPLAN incorporates county-level data and input-output tables to estimate transactions among industries and institutions. The model breaks the economy down into 536 sectors, including 19 agricultural sectors. The basin IMPLAN models used in this study were constructed using county-level data for 2016.

The direct effects from changes in the production of forage crops due to demand management primarily would occur in Sectors 10 "Other Crop Farming" which is nearly entirely hay farming and Sector 11 beef cattle ranching and farming which includes dual purpose farms and ranches. The default expenditure patterns for those industries (based on national averages) were adjusted based on the CSU crop enterprise budgets and other sources including cow-calf production costs for the Basin and Range region reported by USDA's Economic Research Service. The industry purchasing patterns for Sector 2 "Grain Farming" which includes corn production were not adjusted. IMPLAN sectors 10 and 11 were also modified to internalize proprietor income for those agricultural sectors.

Prior studies have found that IMPLAN can underestimate induced effects from changes in agricultural output because it assumes that proprietor income is leaked away from the region.[2] While that assumption is reasonable for industries dominated by publicly-owned companies, it is not appropriate in the case of Western Colorado agriculture where most farms and ranches are family owned and operated (as shown in Section 3).

The IMPLAN models were also used to help quantify the potential effects of demand management due to forward linkages from forage production, Initial effects were estimated based on potential percentage changes in output in the livestock sectors. These changes were then used to estimate corresponding indirect and induced effects from the forward linkages.

Finally, the IMPLAN model was also used to quantify the potential secondary economic benefits from the local spending of demand management participation payments within each basin, as described in more detail in the following section.

[2] IMPLAN Understates Agricultural Input-Output Multipliers: An Application to Potential Agricultural/Green Industry Drought Impacts in Colorado. John R. McKean and William P. Spencer. Journal of Agribusiness 21,2(Fall 2003).

SECTION 5.
Potential Economic Benefits from a Demand Management Program

As noted in Section 1, 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.

There are other potential economic benefits from a demand management program in Western Colorado as discussed towards the end of this section. Potential adverse economic effects are evaluated in Section 6.

Potential Payments and Financial Benefits to Demand Management Participants

A voluntary demand management program would need to provide sufficient compensation to be financially attractive to participants and induce them to change from their familiar operating practices on the lands they would enroll in the program. A prior literature review regarding secondary impacts for the WBWG found that participation payments always exceeded the loss in profit on lands participating in temporary water leasing programs.[1]

The BBC study team has previously worked in active, temporary water leasing programs in South Texas, Nebraska and the Lower Arkansas Valley in Colorado. In our experience, the premium required for a successful program is typically around 50% of decrease in net operating income that the participants experience due to the decrease in production on the lands involved in the program.

In addition to covering decreases in net operating income and providing an incentive to participate through a financial premium as just described, the participation payments would also need to pay for any direct costs associated with fallowing. Such costs could involve weed and pest control, preventing "thatching" in grass hay fields, and other management activities on the participating lands. A survey of participants in the Conserved Consumptive Use Pilot Program (CCUPP) involving the Grand Valley Water Users Association (GVWUA) indicated the annual direct costs for fallowing participating acres averaged between $50 and $100 per acre.[2] For purposes of this evaluation, we assumed an average fallowing cost of $75 per acre for acres planted in alfalfa and corn. Little information is available concerning the direct costs associated

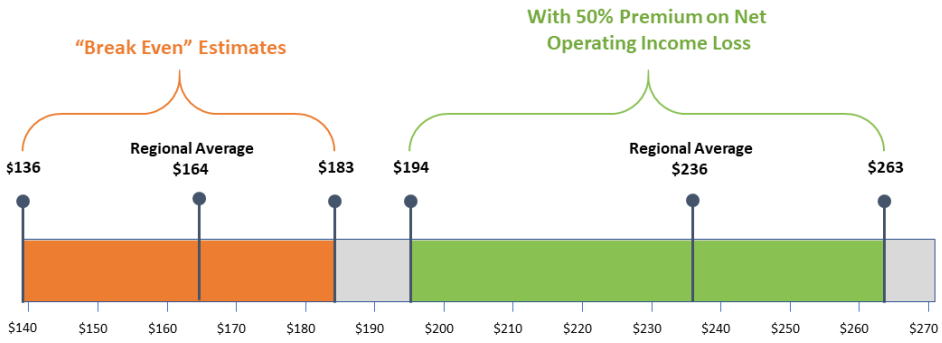
[1] Secondary Economic Impacts & Mitigation Strategies. WestWater Research, February 22, 2018.

[2] Grand Valley Water Users Association: Conserved Consumptive Use Pilot Projects, Final Report. JUB Engineers. May 2019.

with fallowing grass hay, though some cost is expected.[3] For this analysis, we have assumed $35 per acre for fallow management on participating grass hay acres.

Potential payment levels. Based on the basin-specific crop enterprise budgets described in the preceding section (and provided in Appendix A), generalized estimates of potential payment levels were developed for each of the basins. These estimates reflected the assumed crop mix on participating acres (shown in Figure 3-3) and differences in the average crop yields from basin to basin. As illustrated in Figure 5-1, the estimated compensation required for irrigators to simply "break-even" based on the direct fallowing costs and the estimated decreases in net operating income due to reduce production 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. Given typical consumptive use of about 2 AF per acre, average participation payments per acre would be approximately double the payments per AF.

Figure 5-1. Estimated ranges of participation payments per acre-foot of consumptive use



The projected average level of compensation to irrigators across Western Colorado as a whole ($236 per acre-foot of conserved consumptive use) is in the same general range as the actual compensation paid during the CCUPP in Mesa County of $228 per acre-foot in 2017 and $225 per acre-foot in 2018.[4] However, as indicated by the range of projected payments across the four basins shown in Figure 5-1, the potential level of compensation necessary for a successful

[3] Challenges in Prospective Temporary Fallowing of Irrigated Agriculture in the Upper Colorado River Basin. Environmental Defense Fund. December, 2011.

[4] Calculated based on JUB Engineers, 2019. https://www.coloradomesa.edu/water-center/grand-valley-water-banking-discussion.html.

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. The variability in net operating income for grass hay and alfalfa producers was illustrated in Figure 4-8 in the preceding section of this report. Finally, the required compensation levels could also vary depending on the method used to establish the compensation amounts. If compensation is established based on a "reverse auction" approach, such as was used to initially establish the temporary water leasing program in the Edwards Aquifer region of South Texas during the 1990s, the program could attract irrigators whose operations are less profitable than the basin-wide averages used in this analysis and potentially pay a lower level of compensation.

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. These compensation requirements would likely vary considerably based on specific local conditions, and they are not included in this analysis. As a point of reference, however, approximately 30 percent of the total compensation paid during the CCUPP was paid to the GVWUA.[5]

Potential Financial Benefits for Participants. To further illustrate the basic farm-level economics of a demand management program, Figure 5-2 depicts the potential financial benefits of enrolling 100 acres in the program for a hypothetical alfalfa producer in the Southwest Basin.

Under normal operations, in an average year, the producer would realize gross revenues of $66,000 from the 100 acres they plan to enroll in the demand management program, after subtracting variable operating costs of $27,000 to plant, ,manage and harvest their crop, the net operating income (prior to fixed costs) on those acres would be $39,000.

If those 100 acres are enrolled in a demand management program, the producer would be paid $64,750 by the program. After subtracting fallow management costs of $7,500, the participating acres would produce $57,250 in net income for the producer (again before subtracting the fixed costs of the operation). Consequently, the hypothetical producer would be $18,250 better off from their participation in the program.

[5] Ibid.

Figure 5-2. Hypothetical farm/ranch-level economics of fallowing 100 acres of alfalfa in the Southwest Basin

Financial Components	Normal Operation	Fallow Year
Lease Payment ($350 x 185AF)	$0	$64,750
Fallow Mgmt Cost ($75 * 100 acres)	$0	-$7,500
Harvest Revenue (330 tons x $200/ton)	$66,000	$0
Operating Expenses (100 acres x $270/acre)	-$27,000	$0
Net Operating Income	$39,000	$0
Bottom Line	**$39,000**	**$57,250**

The farm level economics of "fallowing" grass hay (ceasing irrigation on grass haylands or irrigated pastures) are somewhat more complicated. Anecdotal information from ranchers indicates that removing irrigation from grass hayfields or pastures not only impacts the yield of those acres during the fallow year, but also reduces their yield after the irrigation is resumed on those acres. Side by side agronomic studies on sample plots conducted for the WBWG confirmed this effect, determining that grass hay yields declined by approximately 70 percent during the year without irrigation and the fields continued to yield about 50 percent less than normal during the year immediately following the resumption of irrigation.[6] This multi-year impact was incorporated in the estimates of potential payments to irrigators described earlier, and in the other estimates of the potential financial and economic effects of demand management throughout this study. While the agronomic study indicated that yields returned to within 10 percent of normal by the second year after fallowing, some ranchers believe these effects could be more long lasting. Lingering effects from fallowing grass hay for more than a single year have not been examined to date, and further research studies regarding these issues would be helpful in reducing uncertainty regarding the on-farm effects from fallowing.

Figure 5-3 illustrates the projected annual financial effects of participating in a demand management program for a hypothetical producer from the Yampa/White Basin who enrolls 100 acres of irrigated grass hay meadows in the program. Under normal operations, the grass hay land would produce gross revenues of almost $38,000 per year. After subtracting variable operating expenses, the net operating income (before fixed costs) from those acres would be about $24,425 per year. During the year in which the grass haylands are enrolled in the demand

[6] Agronomic Responses to Partial and Full Season Fallowing of Alfalfa and Grass Hayfields. Update 2015 & 2016. Power Point presentations. Dr. Joe Brummer. Colorado State University.

management program, the hypothetical producer would receive a participation payment of $46,800. The remaining 30 percent[7] of normal yield from the participating acres during that year would produce another $11,378 in income for the producer. After subtracting the reduced operating costs associated with the lands enrolled in the program of $4,020 and the estimated fallow management costs of $3,500 the producer would realize a "bottom-line" before fixed expenses of the operation of $50,628 – about $26,000 more than under normal operations. However, a portion of this financial benefit would be eroded during the year after the grass haylands were "fallowed" when the producers net income (again before fixed costs) would be reduced by about $12,000 relative to normal operations. Over the two years including the fallow year and the following year, the combined net income (before fixed costs) for the hypothetical grass hay producer enrolled in the demand management program would be about $63,000. Under normal operations, the producers net income over that two-year period would have been about $49,000.

Figure 5-3. Hypothetical farm/ranch-level economics of "fallowing" 100 acres of grass hay in the Yampa/White Basin

Financial Components	Normal Operation	Fallow Year	Recovery Year
Lease Payment ($260 x 180AF)	$0	$46,800	$0
Fallow Mgmt Cost ($35 * 100 acres)	$0	-$3,500	$0
Harvest Revenue (205 tons x $185/ton)	$37,925	*30% yield* $11,378	*50% yield* $18,963
Operating Expenses (100 acres x $135/acre)	-$13,500	-$4,050	-$6,750
Net Operating Income	$24,425	$7,328	$12,213
Bottom Line	**$24,425**	**$50,628**	**$12,213**

Aggregate financial benefits for participants under the demand management scenarios. Figure 5-4 depicts the projected aggregate financial benefits and costs for participants under the Moderate demand management scenario designed to reduced consumptive use by Western Colorado irrigators by 25,000 acre-feet per year (as defined in Section 3 of this report). Across Western Colorado as a whole, participation or lease payments to participants are projected to total approximately $29 million over a five-year program duration. The net benefit to program

[7] Based on Agronomic Responses to Partial and Full Season Fallowing of Alfalfa and Grass Hayfields. Update 2015 & 2016. Power Point presentations. Dr. Joe Brummer. Colorado State University.

participants over that 5-year duration is projected to be approximately $9 million after subtracting the reduction in their net operating income and their direct management costs from fallowing.

Figure 5-4. Projected aggregate financial effects on participants from the Moderate demand management scenario

	Year 1	Year 2	Year 3	Year 4	Year 5	Residual Grass Hay Impact	Cumulative
Colorado River Basin							
Lease Revenue	$1,375,000	$1,375,000	$1,375,000	$1,375,000	$1,375,000		$6,875,000
Fallowing Cost	-$151,000	-$151,000	-$151,000	-$151,000	-$151,000		-$755,000
NOI Loss	-$585,000	-$815,000	-$815,000	-$815,000	-$815,000	-$230,000	-$4,075,000
Net Benefit	$639,000	$409,000	$409,000	$409,000	$409,000	-$230,000	$2,045,000
Gunnison Basin							
Lease Revenue	$1,917,000	$1,917,000	$1,917,000	$1,917,000	$1,917,000		$9,585,000
Fallowing Cost	-$162,000	-$162,000	-$162,000	-$162,000	-$162,000		-$810,000
NOI Loss	-$767,000	-$1,169,000	-$1,169,000	-$1,169,000	-$1,169,000	-$402,000	-$5,845,000
Net Benefit	$988,000	$586,000	$586,000	$586,000	$586,000	-$402,000	$2,930,000
Southwest Basin							
Lease Revenue	$1,756,000	$1,756,000	$1,756,000	$1,756,000	$1,756,000		$8,780,000
Fallowing Cost	-$151,000	-$151,000	-$151,000	-$151,000	-$151,000		-$755,000
NOI Loss	-$708,000	-$1,070,000	-$1,070,000	-$1,070,000	-$1,070,000	-$363,000	-$5,351,000
Net Benefit	$897,000	$535,000	$535,000	$535,000	$535,000	-$363,000	$2,674,000
Southwest Basin							
Lease Revenue	$806,000	$806,000	$806,000	$806,000	$806,000		$4,030,000
Fallowing Cost	-$66,000	-$66,000	-$66,000	-$66,000	-$66,000		-$330,000
NOI Loss	-$302,000	-$493,000	-$493,000	-$493,000	-$493,000	-$191,000	-$2,465,000
Net Benefit	$438,000	$247,000	$247,000	$247,000	$247,000	-$191,000	$1,235,000
Western CO Totals							
Lease Revenue	$5,854,000	$5,854,000	$5,854,000	$5,854,000	$5,854,000	$0	$29,270,000
Fallowing Cost	-$530,000	-$530,000	-$530,000	-$530,000	-$530,000	$0	-$2,650,000
NOI Loss	-$2,362,000	-$3,547,000	-$3,547,000	-$3,547,000	-$3,547,000	-$1,186,000	-$17,736,000
Net Benefit	$2,962,000	$1,777,000	$1,777,000	$1,777,000	$1,777,000	-$1,186,000	$8,884,000

Figure 5-5 depicts the projected financial effects on participants under the Aggressive demand management scenario. Over the same five-year program duration, total participation or lease payments to participants across Western Colorado under this larger scale scenario are projected to be approximately $120 million. The potential net financial benefit to participants is projected to be about $36 million.

Figure 5-5. Projected aggregate financial effects on participants from the Aggressive demand management scenario

	Year 1	Year 2	Year 3	Year 4	Year 5	Residual Grass Hay Impact	Cumulative
Colorado River Basin							
Lease Revenue	$4,851,000	$4,851,000	$4,851,000	$4,851,000	$4,851,000		$24,255,000
Fallowing Cost	-$531,000	-$531,000	-$531,000	-$531,000	-$531,000		-$2,655,000
NOI Loss	-$2,065,000	-$2,876,000	-$2,876,000	-$2,876,000	-$2,876,000	-$811,000	-$14,380,000
Net Benefit	$2,255,000	$1,444,000	$1,444,000	$1,444,000	$1,444,000	-$811,000	$7,220,000
Gunnison Basin							
Lease Revenue	$6,005,000	$6,005,000	$6,005,000	$6,005,000	$6,005,000		$30,025,000
Fallowing Cost	-$508,000	-$508,000	-$508,000	-$508,000	-$508,000		-$2,540,000
NOI Loss	-$2,403,000	-$3,663,000	-$3,663,000	-$3,663,000	-$3,663,000	-$1,260,000	-$18,315,000
Net Benefit	$3,094,000	$1,834,000	$1,834,000	$1,834,000	$1,834,000	-$1,260,000	$9,170,000
Southwest Basin							
Lease Revenue	$6,573,000	$6,573,000	$6,573,000	$6,573,000	$6,573,000		$32,865,000
Fallowing Cost	-$564,000	-$564,000	-$564,000	-$564,000	-$564,000		-$2,820,000
NOI Loss	-$2,649,000	-$4,007,000	-$4,007,000	-$4,007,000	-$4,007,000	-$1,358,000	-$20,035,000
Net Benefit	$3,360,000	$2,002,000	$2,002,000	$2,002,000	$2,002,000	-$1,358,000	$10,010,000
Southwest Basin							
Lease Revenue	$6,524,000	$6,524,000	$6,524,000	$6,524,000	$6,524,000		$32,620,000
Fallowing Cost	-$537,000	-$537,000	-$537,000	-$537,000	-$537,000		-$2,685,000
NOI Loss	-$2,442,000	-$3,990,000	-$3,990,000	-$3,990,000	-$3,990,000	-$1,548,000	-$19,950,000
Net Benefit	$3,545,000	$1,997,000	$1,997,000	$1,997,000	$1,997,000	-$1,548,000	$9,985,000
Western CO Totals							
Lease Revenue	$23,953,000	$23,953,000	$23,953,000	$23,953,000	$23,953,000	$0	$119,765,000
Fallowing Cost	-$2,140,000	-$2,140,000	-$2,140,000	-$2,140,000	-$2,140,000	$0	-$10,700,000
NOI Loss	-$9,559,000	-$14,536,000	-$14,536,000	-$14,536,000	-$14,536,000	-$4,977,000	-$72,680,000
Net Benefit	$12,254,000	$7,277,000	$7,277,000	$7,277,000	$7,277,000	-$4,977,000	$36,385,000

Potential Secondary Economic Benefits from a Demand Management Program

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. In evaluating these potential regional benefits, there are three primary considerations:

- How program participants spend the money they receive from the program;
- How much of that spending occurs locally (within their basin or Western Colorado as a whole); and
- Where the funding for the participation payments comes from.

How participants might use the funds they receive from a demand management program. The payments that participants receive from a demand management program would likely be taxed as ordinary operating income. Recent analysis of national farm income tax data by the USDA's Economic Research Service indicates an average federal tax rate of a little less than 14 percent

for medium sized family farms.[8] (USDA, ERS, June 2018). Adding Colorado's state income tax rate, BBC has assumed an average overall income tax rate of about 18 percent on participation revenues.

Prior surveys of participants in the CCUPP involving the GVWUA, participants in the long-standing Palo Verde Irrigation District water leasing program in California, and famers and ranchers involved in other programs such as the Federal Agricultural Conservation Easement Program have found that participants primarily spend their program revenues on improving their operation's financial condition by paying down debt or increasing savings, investing in improving their operation by spending money on farm/ranch infrastructure or equipment, and on paying for household consumption that would have been funded out of operating income on the participating acres.[9]

For purposes of this evaluation, we have assumed that approximately 47 percent of after tax revenues from participating in a demand management program would be spent on farm improvements[10], 33 percent would be spent on debt service and investment[11], and the remaining 20 percent would be spent on household consumption. Sensitivity analyses using different proportions of payment spending among these categories did not indicate substantially different secondary economic effects.

The extent to which the payments from participating in a demand management program create benefits beyond the farmers and ranchers who receive them also depends on how much of the money is spent locally. Past studies of the PVID leasing program have found that between 60 and 90 percent of the payments were spent locally. This range is consistent with the past experience in the Lower Arkansas Valley with the dry year option program sponsored by Aurora after the 2002 drought and expectations concerning future spending from the planned Super Ditch Program. We have assumed that same range of local spending in this evaluation.

Figure 5-6 depicts the projected range of annual secondary (indirect and induced) economic benefits from local spending of participation payments 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.

[8] Estimated Effects of the Tax Cuts and Jobs Act on Farms and Farm Households. James M. Williamson and Siraj G. Bawa. USDA Economic Research Service. June 2018.

[9] JUB Engineers 2019; Estimated Economic Impact of Federal Agricultural Conservation Easement Programs (ACEP) on Colorado, 2009-2017. Andrew Seidl, Ryan Swartzentruber, Rebecca Hill. Agricultura and Resource Economics, Colorado State University. July 2018.

[10] Allocated between IMPLAN sectors 62 (Maintenance and repairs); 395 (Wholesale trade); 396 (Retail automotive); 445 (Commercial and industrial machinery) and 504 (Auto repairs).

[11] Allocated between IMPLAN sectors 433 (Monetary authorities) and 434 (Non-depository lenders).

Figure 5-6. Moderate demand management scenario – Potential annual secondary economic benefits in Western Colorado from participation payment spending

	Share Spent within Basin	
	60% Local	90% Local
Colorado River Basin		
Output	$892,000	$1,338,000
Value-added	$477,000	$716,000
Jobs	6.4	9.6
Gunnison Basin		
Output	$1,131,000	$1,697,000
Value-added	$536,000	$804,000
Jobs	9.0	13.6
Southwest Basin		
Output	$1,116,000	$1,674,000
Value-added	$604,000	$906,000
Jobs	7.9	11.8
Yampa/White Basin		
Output	$500,000	$750,000
Value-added	$260,000	$390,000
Jobs	3.5	5.3
Western CO Totals		
Output	$3,639,000	$5,459,000
Value-added	$1,877,000	$2,816,000
Jobs	26.8	40.3

Figure 5-7 provides comparable information for the Aggressive demand management 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 under this larger scale demand management scenario.

Figure 5-7. Aggressive demand management scenario – Potential annual secondary economic benefits in Western Colorado from participation payment spending

	Share Spent within Basin	
	60% Local	90% Local
Colorado River Basin		
Output	$3,146,000	$4,719,000
Value-added	$1,683,000	$2,525,000
Jobs	22.5	33.8
Gunnison Basin		
Output	$3,542,000	$5,313,000
Value-added	$1,679,000	$2,519,000
Jobs	28.3	42.5
Southwest Basin		
Output	$4,176,000	$6,264,000
Value-added	$2,260,000	$3,390,000
Jobs	29.4	44.2
Yampa/White Basin		
Output	$4,042,000	$6,063,000
Value-added	$2,104,000	$3,156,000
Jobs	28.7	43.1
Western CO Totals		
Output	$14,906,000	$22,359,000
Value-added	$7,726,000	$11,590,000
Jobs	109.0	163.5

A final important consideration regarding the regional benefits from the participation payments is the source of those funds. If the money to compensate participating irrigators in a demand management program comes from outside of Western Colorado, those payments – and the multiplier effects on the portion of the payments that is spent locally – would truly represent an economic benefit from a regional 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. Instead, those payments would redistribute funds already in the region from the funding sources to participating irrigators.

Other Potential Economic Benefits

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. The ongoing Risk Study which is evaluating the hydrologic aspects of this issue has demonstrated that there is a great deal of uncertainty regarding future hydrology and other factors which makes it impossible to reliably estimate the probability of failing to meet the compact. Consequently, it is also not possible to quantify this benefit from a demand management program. However, three aspects of this issue are important to consider:

- Under a demand management program, participating farmers and ranchers would be compensated for reducing consumptive use. Under a curtailment, consumptive use reductions would not be compensated.

- A demand management program can be considered akin to an insurance policy on a home or automobile. No one can accurately assess their personal likelihood of an accident, but we nonetheless value having insurance against a serious, bad outcome; and

- 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.

A demand management program that reduces consumptive use must also, by definition, ultimately result in an increase in streamflows in at least portions of the Colorado River system. Relative to the annual flows of Western Colorado's major rivers – as measured near the state border, the potential annual flow increases from a demand management program would be relatively small – as shown in the simplified hydrologic analysis shown in Figure 5-8. Any environmental benefits — or benefits in terms of boating, angling or other recreational uses — would be highly dependent on the specific locations where the consumptive use reductions occur and the timing of any additional flows related to demand management.

Figure 5-8. Simplified hydrologic analysis of potential increases in annual river flows due to demand management

	Water Plan Technical Update Flow Tool		Scenario 1		Scenario 2		
Basin/Location	Baseline Median Annual Flow (AFY)	Baseline Mean August Monthly Flow (AFM)	Flow Increase (AFY)*	Percent Change	Flow Increase (AFY)*	Percent Change	Notes
Colorado Basin							
Colorado River near Cameo	2,581,000	181,000	7,150	0.3%	25,000	1.0%	
Colorado River near State Line	4,079,000	234,000	15,200	0.4%	50,000	1.2%	Includes CU savings in Gunnison Basin
Gunnison Basin							
Gunnison River near Grand Junction	1,560,000	86,000	8,050	0.5%	25,000	1.6%	
Southwest Basin							
Dolores River at Dolores	276,000	13,000	3,325	1.2%	12,500	4.5%	½ of CU savings in SW Basin
Animas River near Cedar Hill NM	626,000	40,000	3,325	0.5%	12,500	2.0%	½ of CU savings in SW Basin
Yampa/White Basin							
Yampa River at Deer Lodge Park	1,524,000	19,000	1,575	0.1%	12,500	0.8%	½ of CU savings in Yampa/White
White River below Meeker	477,000	23,000	1,575	0.3%	12,500	2.6%	½ of CU savings in Yampa/White

* Annual flow increases assume all consumptive use reductions occur above these gages.

All flow increases assume immediate and successful shepherding of consumptive use savings to state line, and do not consider evaporative losses.

From a recreation and environmental standpoint, a demand management program would likely have mixed effects. Increases in streamflow, such as those indicated in Figure 5-8 would likely be beneficial. However, demand management could also reduce late season irrigation return flows which can also be critical from and 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.

A final potential economic benefit from a demand management program, also related to the potential increase in streamflow, is hydropower production. The Western Area Power Administration, which markets power generated by Federal hydroelectric facilities in Colorado and other states downstream, provides inexpensive power to preference customers throughout the region. During drought conditions, when these hydroelectric facilities do not generate as much electricity, WAPA must purchase more power from other facilities such as fossil-fuel fired coal and gas generating stations. Those replacement power purchases, in turn, increase WAPA's costs and result in higher costs for its customers.

WAPA has numerous preference customers in Western Colorado, including:

- The cities of Aspen and Glenwood Springs, as well as the Grand Valley Electric Cooperative and Holy Cross Energy in the Colorado River Basin;
- The cities of Delta and Gunnison in the Gunnison Basin;
- The Ute Mountain Ute Tribe and the Southern Ute Tribe in the Southwest Basin; and
- The Town of Oak Creek and the Yampa Valley Electric Association in the Yampa/White Basin.[12]

Federal revenues from hydropower production also provide important funding for the operations and maintenance (and project repayment) of U.S. Bureau of Reclamation projects and for the Salinity Control Program, which has produced substantial economic benefits for downstream irrigators and agricultural communities and other water users.[13]

[12] Western Area Power Administration web-site. Customer list downloaded April 2020. https://www.wapa.gov/About/Pages/customers.aspx

[13] http://www.coloradoriversalinity.org/docs/Upper%20Basin%20Benefits%20Report%20-%20final.pdf

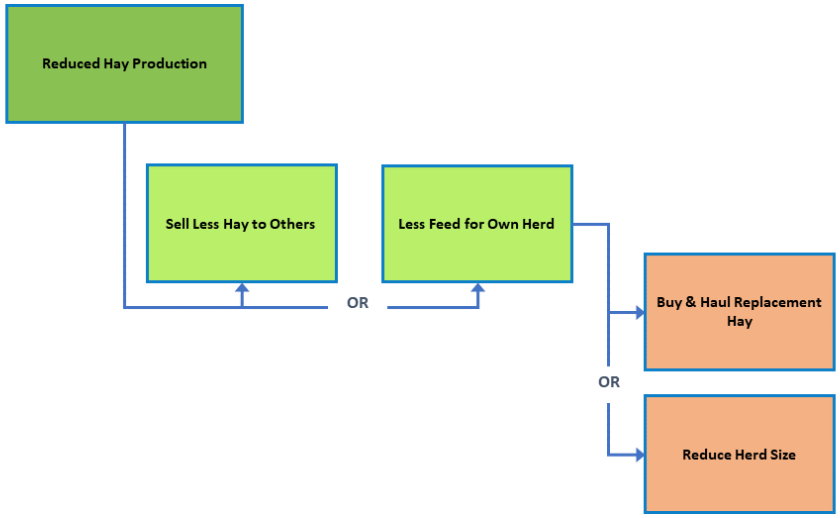
SECTION 6.
Potential Adverse Economic Effects from a Demand Management Program

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 which is the largest components of Western Colorado agriculture in terms of economic output and employment – as shown in Figure 2-8.

Potential Economic Impacts from Reduced Production

Changes in forage production could affect Western Colorado agriculture in a number of different ways, depending on what types of producers choose to participate in a demand management program, and the corresponding changes they make to their operations. Figure 6-1 depicts a simplified illustration of the potential ramifications of reducing hay production for participants in a demand management program, and some of the strategies they might use to adjust to growing less hay.

Figure 6-1. Simplified illustration of range of potential direct effects from reducing hay production



Potential direct impacts on farm/ranch revenues. The potential monetary value of reductions in crop production under the two demand management scenarios can be estimated based on the number of acres projected to be involved in a demand management program and the mix of crops grown on those acres (as shown previously in Figure 3-3), and the long-term average yields and prices for those crops (described in Section 4).

Figure 6-2 shows the projected annual reduction in farm/ranch production revenues for participating operations under the Moderate demand management scenario (Scenario 1) and the Aggressive demand management scenario (Scenario 2). From the standpoint of Western Colorado as a whole, fallowing 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 estimates are based on the value of mechanically harvested hay and corn (since hay production on grazing acres is not directly priced) and include the projected multi-year effects from fallowing grass hay discussed in the preceding section.

Figure 6-2. Estimated reduction in annual farm/ranch production revenues from fallowing participating acres

Basin	Per Acre	Per Acre-Foot	Scenario Totals (Millions of $2019)	
			Scenario 1	Scenario 2
Colorado River Basin	-$404	-$194	-$1.4	-$4.8
Gunnison Basin	-$463	-$223	-$1.8	-$5.6
Southwest Basin	-$465	-$257	-$1.7	-$6.5
Yampa/White Basin	-$443	-$251	-$0.8	-$6.3
Western Colorado	**-$406**	**-$207**	**-$5.7**	**-$23.2**

- Including residual impacts on grass hay yields and revenues after fallowing.
- Based on value of harvested acres.
- Does not include offsetting payments to participating irrigators.

The estimates shown in Figure 6-2 are based on long-term averages for crop yields and prices. Due to variability in prices and yields, as described in Section 4, the effects of demand management on the value of production for participating acres could be substantially greater during years with high prices (typically during dry conditions) or lower during years with low prices (typically during wet conditions).

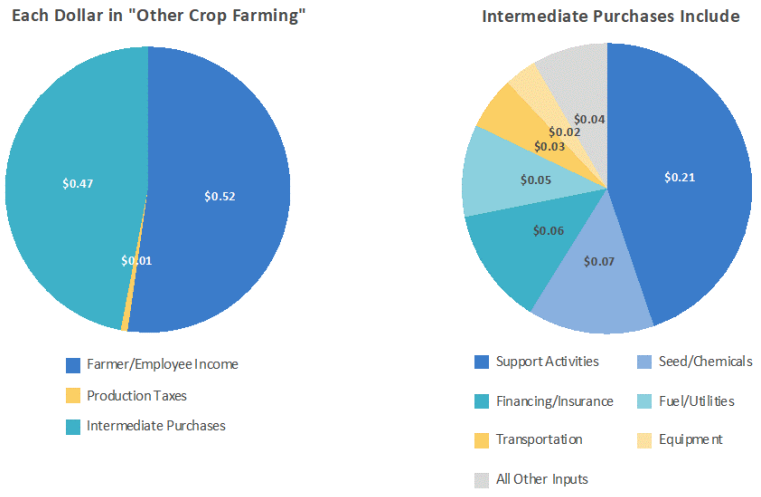
The reductions in revenues from production shown in Figure 6-2 do not reflect the estimated payments that farmers and ranchers would receive for their participation in a demand

management program. Potential economic benefits and adverse impacts are compared in the final section of this report (Section 7).

Potential secondary impacts from reduced production – backward linkages. Estimating the potential economic impacts of reduced forage production on the businesses and workers who provide goods and services to farm and ranch operations and their households involves tracing flows of money through the local economies where demand management could occur. As described in Section 4, this was accomplished using the IMPLAN models constructed for each of the four Western Slope basins.

Figure 6-3 depicts the ways in which each dollar of revenues from hay farming is spent. This breakdown is based on the production functions in IMPLAN Sector 10, termed "other crop farming" as adjusted by the study team based on the Western Colorado crop enterprise budgets produced by CSU. As shown in the left pie chart, about 53 cents of every dollar in revenues goes to farmer and employee income and about one cent of each dollar goes to "production taxes" – primarily property taxes. The remaining 47 cents is spent on intermediate goods and services used in the production process. The right pie chart provides more detail on the purchases of intermediate goods and services. The largest component of these expenditures — 21 cents from each dollar of revenue — is spent on agricultural services, primarily custom labor. The next largest components are purchases of seeds and chemicals, followed by financing and insurance costs.

Figure 6-3. Breakdown of expenditures from each dollar in revenues from hay farming



Based on IMPLAN modeling of the projected average annual impacts on participating farm/ranch revenues under the Moderate demand management scenario, Figure 6-4 shows projected annual direct and secondary impacts on employment, value-added and output in Western Colorado resulting from "backward linkages".

Figure 6-4. Projected impacts from reduced production under the Moderate demand management scenario (backward linked effects)

	Direct	Secondary Impacts Indirect	Secondary Impacts Induced	Total Impact
Colorado River Basin				
Output	-$1,374,000	-$516,000	-$605,000	-$2,495,000
Value-added	-$693,000	-$294,000	-$350,000	-$1,337,000
Jobs	-17.0 *	-8.3	-4.6	-29.9
Gunnison Basin				
Output	-$1,780,000	-$629,000	-$604,000	-$3,013,000
Value-added	-$824,000	-$355,000	-$313,000	-$1,492,000
Jobs	-19.3 *	-10.4	-5.4	-35.1
Southwest Basin				
Output	-$1,725,000	-$506,000	-$762,000	-$2,993,000
Value-added	-$1,021,000	-$258,000	-$417,000	-$1,696,000
Jobs	-18.5 *	-9.5	-6.2	-34.2
Yampa/White Basin				
Output	-$783,000	-$289,000	-$290,000	-$1,362,000
Value-added	-$415,000	-$117,000	-$166,000	-$698,000
Jobs	-8.8 *	-8.0	-2.2	-18.9
Western CO Totals				
Output	-$5,662,000	-$1,940,000	-$2,261,000	-$9,863,000
Value-added	-$2,953,000	-$1,024,000	-$1,246,000	-$5,223,000
Jobs	-63.5 *	-36.2	-18.4	-118.1

Note: *Direct employment impacts were converted to FTEs. Expressed as a mix of full-time and part-time on-farm positions, the regional direct employment impacts were estimated to include 146 jobs.

On participating farms and ranches (direct effects), annual output is projected to decline by $5.7 million and value-added is projected to decline by about $3 million. These estimates correspond to about 64 direct on-farm jobs on an FTE basis[1]. It is important to recognize that most of these direct, on-farm employment and value-added impacts would occur among voluntary participants in a demand management program who would be compensated through the participation payments (as described in Section 5). However, these direct impacts could also include on-farm hired labor positions (as discussed in Section 3) that might be at risk under a demand management program.[2]

[1] As originally reported by IMPLAN (prior to conversion to FTE positions by the study team), direct on-farm employment impacts were estimated at about 146 full and part-time jobs.

[2] Wage and salary workers directly employed by participating farms and ranches are included in the estimated direct employment effects. Contract providers of custom labor services are included in the secondary impact estimates.

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.

Figure 6-5 provides comparable data for the larger Aggressive demand management scenario.

Figure 6-5. Projected impacts from reduced production under the Aggressive demand management scenario (backward linked effects)

		Secondary Impacts		Total
	Direct	Indirect	Induced	Impact
Colorado River Basin				
Output	-$4,847,000	-$1,820,000	-$2,133,000	-$8,800,000
Value-added	-$2,445,000	-$1,039,000	-$1,234,000	-$4,718,000
Jobs	-60.0	-29.2	-16.2	-105.5
Gunnison Basin				
Output	-$5,574,000	-$1,969,000	-$1,891,000	-$9,434,000
Value-added	-$2,581,000	-$1,113,000	-$982,000	-$4,676,000
Jobs	-60.3	-32.6	-17.0	-109.9
Southwest Basin				
Output	-$6,458,000	-$1,895,000	-$2,853,000	-$11,206,000
Value-added	-$3,821,000	-$966,000	-$1,561,000	-$6,348,000
Jobs	-69.2	-35.5	-23.2	-127.8
Yampa/White Basin				
Output	-$6,334,000	-$2,336,000	-$2,348,000	-$11,018,000
Value-added	-$3,358,000	-$949,000	-$1,344,000	-$5,651,000
Jobs	-70.8	-64.8	-17.4	-153.0
Western CO Totals				
Output	-$23,213,000	-$8,020,000	-$9,225,000	-$40,458,000
Value-added	-$12,205,000	-$4,067,000	-$5,121,000	-$21,393,000
Jobs	-260.3 *	-162.1	-73.9	-496.3

Note: *Direct employment impacts were converted to FTEs. Expressed as a mix of full-time and part-time on-farm positions, the regional direct employment impacts were estimated to include 604 jobs.

The Aggressive demand management scenario is projected to directly affect about 260 full-time equivalent on-farm positions (mostly compensated producers) and reduce average annual production-related output and value-added by about $23 million and $12 million, respectively. Projected average annual secondary impacts (indirect and induced effects) under the Aggressive

demand management scenario include about 236 full and part-time positions across Western Colorado, and about $17.3 million in annual output and $9.2 million in annual value-added.

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 mostly consist of producers that chose to participate in demand management and would be compensated as described in Section 5.

Potential Impacts 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 (as discussed earlier in this section). During Phase 2 of the Colorado River Water Bank Feasibility Study in 2013, the consultants (MWH) noted that "for 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 … any reduction in grass/alfalfa yield impacts the size and quality of the herd."[3]

At the other end of the spectrum, during the initial round of stakeholder meetings for this study, a number of participants commented 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. Data from the basin level IMPLAN models also suggests extensive hay exports from those basins, as shown in Figure 6-6.

[3] Colorado River Water Bank Feasibility Study. Phase 2. Final Draft Report. MWH, March 2013.

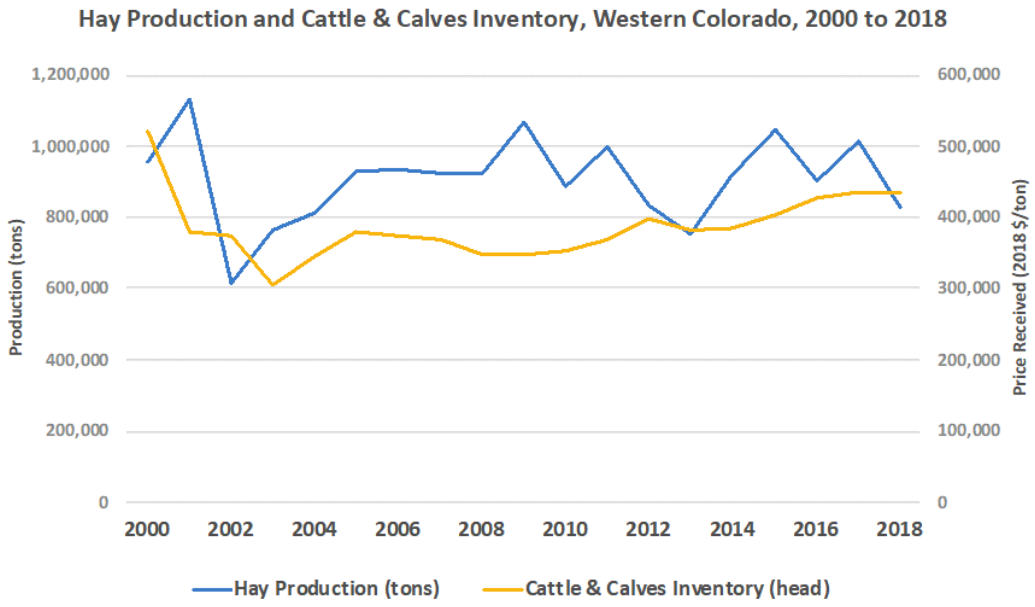
Figure 6-6. Estimates of Hay Exports and Imports by Basin from the IMPLAN models

Basin	Estimated Proportion of Supply Exported		Estimated Proportion of Demand Imported
	International	Domestic	
Colorado River	11%	19%	22%
Gunnison	12%	22%	14%
Southwest	12%	62%	11%
Yampa/White	12%	51%	12%
Western CO Total	12%	41%	16%

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. However, stakeholders also noted that the hay producers who commonly export their production have developed those customer relationships over time, and could be unwilling to risk losing those relationships to participate in a demand management program.

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. Figure 6-7 shows statewide hay production and hay prices (in 2018 dollars) from 2000 through 2018. Statewide data were used in this analysis because a complete set of prices were available throughout the past two decades. The inverse correlation between hay production and prices is visibly evident from the figure and was also confirmed by analysis of the statistical relationships between the two metrics. 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.

Figure 6-8. Western Colorado correlations between hay production and cattle inventories, 2000-2018



While the effects of a demand management program on Western Colorado livestock production are obviously uncertain, the historical relationships between hay production, prices and the cattle inventory suggest the effects of the demand management scenarios could include an increase in hay prices and a decline in livestock production. Figure 6-9 highlights those potential effects.

Figure 6-7. Statewide correlation between hay production and price, 2000-2018

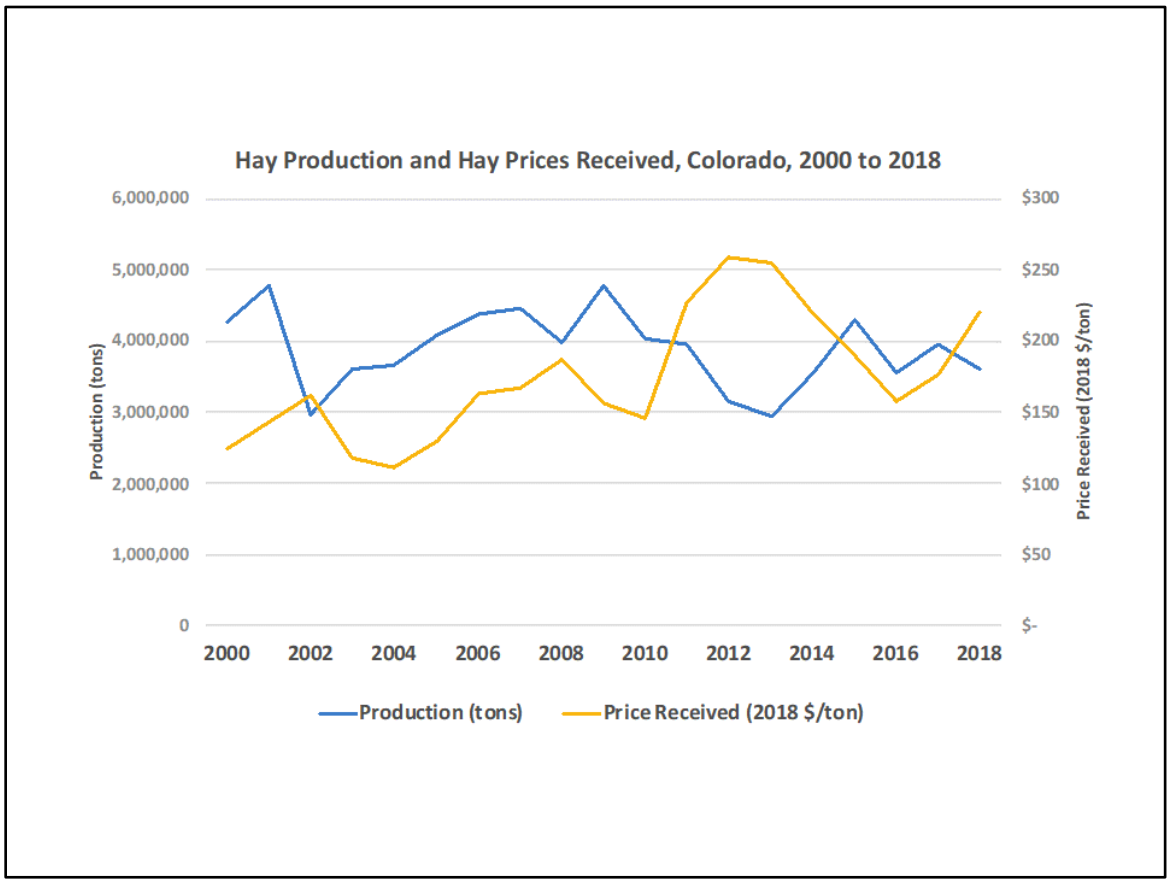


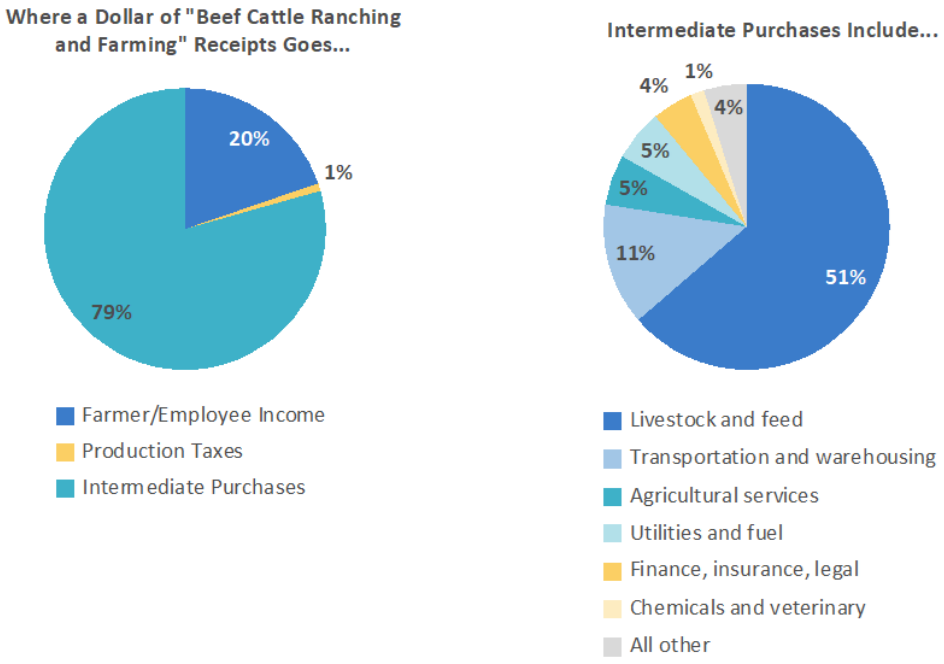
Figure 6-8 shows hay production and the livestock inventory in Western Colorado from 2000 through 2018. Although the correlation between these metrics is not as visually clear as in the previous chart showing production and prices – and cattle inventories are influenced by longer-term cattle cycles and other factors – statistical analysis shows that, on average, a 10 percent reduction in Western Colorado hay production has correlated with a 3 percent decrease in cattle inventories during the following year.

Figure 6-9. Potential changes in Western Colorado hay prices and livestock inventories under the demand management scenarios

	Scenario 1	Scenario 2
Decrease in Irrigated Forage	-1.8%	-7.3%
Potential Hay Price Impact	+1.4%	+5.8%
Potential Impact on Livestock Inventory	-0.5%	-2.2%

Potential economic effects from reduced livestock production. The basin-specific IMPLAN models were again used to estimate the potential economic effects of reductions in livestock production resulting from the demand management scenarios. Figure 6-10 depicts the initial financial flows from each dollar in cattle ranching from those models, which were customized based on CSU livestock enterprise budgets for Western Colorado and cow-calf production costs for the Basin and Range region reported by USDA's Economic Research Service. As shown in Figure 6-10, 79 cents of every dollar in cattle ranching revenues goes towards the purchase of intermediate goods and services. The largest components of these expenditures are purchases of feed and livestock from other ranchers.

Figure 6-10. Breakdown of expenditures from each dollar in revenues from cattle ranching



The slightly more than 0.5% potential reduction in livestock production under the Moderate demand management scenario (shown earlier in Figure 6-9) could correspond to a direct 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, respectively, as shown in Figure 6-11.

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 (see Figure 6-11).

Figure 6-11. Potential additional annual impacts from the Moderate demand scenario resulting from changes in livestock production (forward linkages)

		Secondary Impacts		Total
	Direct	Indirect	Induced	Impact
Colorado River Basin				
Output	-$836,000	-$335,000	-$166,000	-$1,337,000
Value-added	-$209,000	-$154,000	-$96,000	-$459,000
Jobs	-4.8	-4.9	-1.2	-10.9
Gunnison Basin				
Output	-$951,000	-$324,000	-$166,000	-$1,441,000
Value-added	-$220,000	-$133,000	-$86,000	-$439,000
Jobs	-5.4	-4.8	-1.5	-11.8
Southwest Basin				
Output	-$549,000	-$213,000	-$98,000	-$860,000
Value-added	-$129,000	-$86,000	-$54,000	-$269,000
Jobs	-3.1	-3.6	-0.8	-7.5
Yampa/White Basin				
Output	-$672,000	-$263,000	-$115,000	-$1,050,000
Value-added	-$158,000	-$97,000	-$66,000	-$321,000
Jobs	-3.8	-3.7	-0.9	-8.4
Western CO Totals				
Output	-$3,008,000	-$1,135,000	-$545,000	-$4,688,000
Value-added	-$716,000	-$470,000	-$302,000	-$1,488,000
Jobs	-17.2 *	-17.0	-4.4	-38.6

*Direct employment impacts were converted to FTEs. Expressed as a mix of full-time and part-time on-farm positions, the regional direct employment impacts were estimated to include about 47 jobs.

The potential 2.2 percent reduction in livestock production under the Aggressive demand management scenario would correspond to larger forward linked impacts on each of the basins and Western Colorado. As shown in Figure 6-12, 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 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.

Figure 6-12. Potential additional annual impacts from the Aggressive demand scenario resulting from changes in livestock production (forward linkages)

		Secondary Impacts		Total
	Direct	Indirect	Induced	Impact
Colorado River Basin				
Output	-$2,948,000	-$1,181,000	-$584,000	-$4,713,000
Value-added	-$736,000	-$545,000	-$338,000	-$1,619,000
Jobs	-16.8	-17.4	-4.3	-38.5
Gunnison Basin				
Output	-$2,978,000	-$1,014,000	-$520,000	-$4,512,000
Value-added	-$690,000	-$418,000	-$271,000	-$1,379,000
Jobs	-17.0	-15.2	-4.7	-36.9
Southwest Basin				
Output	-$2,057,000	-$797,000	-$369,000	-$3,223,000
Value-added	-$483,000	-$322,000	-$202,000	-$1,007,000
Jobs	-11.8	-13.3	-3.0	-28.1
Yampa/White Basin				
Output	-$5,441,000	-$2,129,000	-$929,000	-$8,499,000
Value-added	-$1,276,000	-$788,000	-$532,000	-$2,596,000
Jobs	-31.1	-30.0	-7.0	-68.1
Western CO Totals				
Output	-$13,424,000	-$5,121,000	-$2,402,000	-$20,947,000
Value-added	-$3,185,000	-$2,073,000	-$1,343,000	-$6,601,000
Jobs	-76.7 *	-75.9	-19.0	-171.6

*Direct employment impacts were converted to FTEs. Expressed as a mix of full-time and part-time on-farm positions, the regional direct employment impacts were estimated to include about 200 jobs.

Other Possible Adverse Impacts from Demand Management

Agriculture is a vital component of Western Colorado's aesthetic and cultural landscape, and the total value of agricultural land is not fully captured by the market value of agricultural output. There are few studies of the non-market values of agricultural land, but they show that active agricultural landscapes can provide amenities such as aesthetic value[4], cultural and heritage value[5], property value[6], and even spiritual value.[7] These non-market values accrue to local residents as well as visitors and tourists.

[4] Cline and Seidl, 2009. Wood et al., 2000. Crook, 1999.

[5] Ellingson and Seidl, 2009. Olsson and Roenningen, 1999.

Within Colorado, research indicates that working landscapes are important for tourism:

- A 2009 study derived winter tourists' valuation of Gunnison County's ranch land and found that conversion of all ranch land to other land uses (e.g., residential or commercial development) would decrease visitation and negatively impact the Gunnison County economy by up to $14.5 million and 350 jobs annually.[8]

- In Routt County, conversion of ranch land around Steamboat Springs to urban uses would cause 54 percent of visitors to reduce spending and trip length. Average expenditures would decrease by $100 per person per day, and average trip length would decrease by 2.3 days.[9]

- A Chaffee County study found that a decrease in ranch land in favor of urban uses led to a small loss in tourist consumer surplus (e.g., a 50% decrease in working landscape area resulted in a 9% loss in consumer surplus).[10]

- The connection between irrigated agriculture and cultural values is also reflected in the emphasis that Coloradans—including the state's urban residents—placed on maintaining water availability for Colorado's farms and ranches in a statewide survey of perceptions and values related to water.[11]

Nearly all existing research examines the aesthetic value of ranch land in comparison to total conversion to urban or industrial uses. There are no studies of the impacts of converting irrigated agricultural land to fallowed land, but we can draw informed conclusions from the existing literature in order to qualitatively estimate the secondary economic effects of the demand management program on Western Colorado's aesthetic values:

- In comparison to total conversion to urban development, the aesthetic change of irrigated agriculture to fallowed agriculture is less dramatic and likely to have a smaller impact on aesthetic value for residents and tourists.

- The effect of dispersed and temporary fallowing across private agricultural lands in the Upper Basin would likely have a smaller impact on aesthetic value than intensive or contiguous fallowing concentrated in a single area.

- The potential magnitude of the aesthetic impact of fallowing depends on the visibility of fallowed lands and their proximity to high-traffic roads, second homes, or urban centers where resident and tourist activity is concentrated.

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[6] Vanslembrouck et al., 2005.

[7] Groenfeldt, 2005.

[8] Orens and Seidl, 2009.

[9] Ellingson and Seidl, 2009.

[10] Cline and Seidl, 2009.

[11] CWCB, 2013.

- Cumulatively, participation in a demand management program involving temporary rotational fallowing of the scale examined in the Moderate demand scenario would likely have relatively minimal aesthetic impact on tourism and property values across the entire Upper Basin. More substantial localized impacts could be felt in specific locations or communities, particularly under larger scale demand management like the Aggressive scenario.

SECTION 7.
Benefit/Impact Comparison and Economic Sustainability

In some respects, it is challenging to compare the potential benefits and potential adverse impacts from demand management in Western Colorado. As discussed in the preceding sections, there is considerable nuance in both the benefit estimates and the impact estimates. Often the parties that could benefit from a demand management program differ from those who could be adversely affected.

Comparison of Potential Secondary Impacts from Reduced Production with Potential Secondary Benefits from Participation Payment Spending

Figure 7-1 compares the projected secondary benefits from participants' local spending of their participation payments (described in Section 5) to the projected secondary impacts from reduced production (backward linked effects).

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 effects from reduced production. The direction of the net effects depends on the share of the participation payments that is spent locally within the basins.

Reduced production is projected to lead to a larger decline in the number of secondary jobs across Western Colorado than the additional secondary jobs supported by payment spending. That result reflects the higher average income (value-added) per job supported by participation payment spending than the average income per secondary job supported by production.[1] In part, this is likely because there are more part-time jobs in agricultural services and other production support industries than in the industries, such as the finance industry, that would be supported by participation payment spending.

[1] Based on the data shown in Figure 7-2, each million dollars in secondary value-added tied to agricultural production supports about 24 full and part-time jobs. Each million dollars in secondary value-added tied to participation payment spending supports about 14 full and part-time jobs.

Figure 7-1. Comparison of secondary benefits from payment spending with secondary impacts from reduced projection (backward linked effects) under the Moderate demand management scenario

	Payment Spending		Reduced	Net Effect	
	60% local	90% local	Production	60% local	90% local
Colorado River Basin					
Output	$892,000	$1,338,000	-$1,121,000	-$229,000	$217,000
Value-added	$477,000	$716,000	-$644,000	-$167,000	$72,000
Jobs	6.4	9.6	-12.9	-6.5	-3.3
Gunnison Basin					
Output	$1,131,000	$1,697,000	-$1,233,000	-$102,000	$464,000
Value-added	$536,000	$804,000	-$668,000	-$132,000	$136,000
Jobs	9.0	13.6	-15.8	-6.8	-2.3
Southwest Basin					
Output	$1,116,000	$1,674,000	-$1,268,000	-$152,000	$406,000
Value-added	$604,000	$906,000	-$675,000	-$71,000	$231,000
Jobs	7.9	11.8	-15.7	-7.8	-3.9
Yampa/White Basin					
Output	$500,000	$750,000	-$579,000	-$79,000	$171,000
Value-added	$260,000	$390,000	-$283,000	-$23,000	$107,000
Jobs	3.5	5.3	-10.2	-6.6	-4.8
Western CO Totals					
Output	$3,639,000	$5,459,000	-$4,201,000	-$562,000	$1,258,000
Value-added	$1,877,000	$2,816,000	-$2,270,000	-$393,000	$546,000
Jobs	26.8	40.3	-54.6	-27.7	-14.3

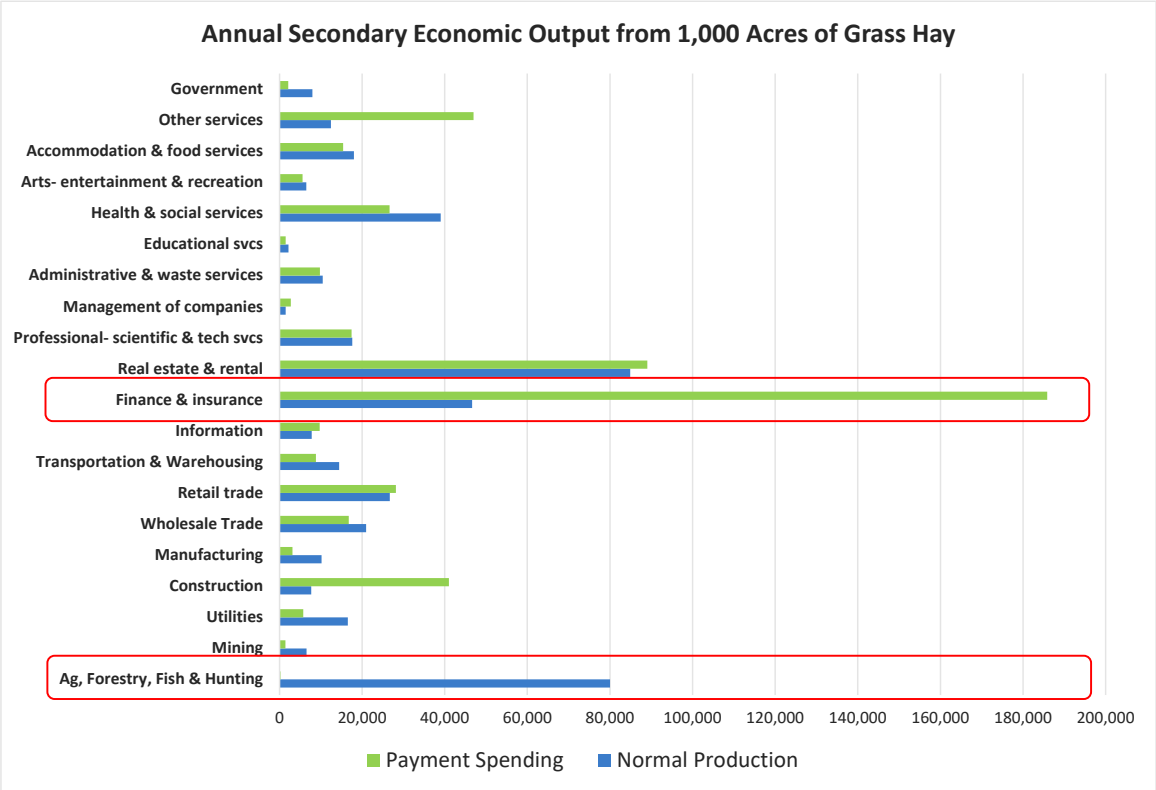
Figure 7-2 provides comparable data for the Aggressive demand management scenario. Like the results for the Moderate scenario, projected secondary effects on output and value-added from local payment spending are comparable to projected adverse secondary economic effects from reduced production. Also similar to the results for the Moderate demand management scenario, the net secondary effect on jobs is projected to be negative.

Figure 7-2. Comparison of secondary benefits from payment spending with secondary impacts from reduced projection (backward linked effects) under the Aggressive demand management scenario

	Payment Spending		Reduced	Net Effect	
	60% local	90% local	Production	60% local	90% local
Colorado River Basin					
Output	$3,146,000	$4,719,000	-$3,953,000	-$807,000	$766,000
Value-added	$1,683,000	$2,525,000	-$2,273,000	-$590,000	$252,000
Jobs	22.5	33.8	-45.5	-23.0	-11.7
Gunnison Basin					
Output	$3,542,000	$5,313,000	-$3,860,000	-$318,000	$1,453,000
Value-added	$1,679,000	$2,519,000	-$2,095,000	-$416,000	$424,000
Jobs	28.3	42.5	-49.6	-21.3	-7.1
Southwest Basin					
Output	$4,176,000	$6,264,000	-$4,748,000	-$572,000	$1,516,000
Value-added	$2,260,000	$3,390,000	-$2,527,000	-$267,000	$863,000
Jobs	29.4	44.2	-58.6	-29.2	-14.4
Yampa/White Basin					
Output	$4,042,000	$6,063,000	-$4,684,000	-$642,000	$1,379,000
Value-added	$2,104,000	$3,156,000	-$2,293,000	-$189,000	$863,000
Jobs	28.7	43.1	-82.2	-53.5	-39.1
Western CO Totals					
Output	$14,906,000	$22,359,000	-$17,245,000	-$2,339,000	$5,114,000
Value-added	$7,726,000	$11,590,000	-$9,188,000	-$1,462,000	$2,402,000
Jobs	109.0	163.5	-235.9	-126.9	-72.4

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 the net effects mask 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 supported by forage production. Some of these differences are evident from Figure 7-3 which compares the distribution of secondary benefits from payment spending with the secondary benefits from normal grass hay production across industries.

Figure 7-3. Industries supported by payment spending compared to normal hay production



Summary Benefit vs. Adverse Impact Comparisons

Given that both Section 6 (benefits) and Section 7 (adverse impacts) include numerous metrics, a simple summary comparison of some of the key quantitative estimates is useful in interpreting the results of this analysis.

Moderate demand management scenario. Figure 7-4 provides a summary comparison of selected economic metrics for the Moderate 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.

Figure 7-4 also reports 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 Figure 7-4 initially summarizes 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 uncertain. 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 7-4. 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 -$417,000	$136,000 to -$351,000	$231,000 to -$211,000	$107,000 to -$186,000	$546,000 to -$1,165,000

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.

Aggressive demand management scenario. Figure 7-5 provides a similar comparison for the Aggressive demand management scenario. Although the estimates are substantially larger, they can be interpreted in the same fashion as just described for the Moderate demand management scenario.

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. 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 (as described earlier).

Although the Aggressive demand management scenario is projected to result in a net loss of secondary (off-farm/ranch) jobs, the net change in secondary income (value-added) could be positive or negative. This result reflects the higher incomes per secondary job associated with the spending of the lease payments, compared to the average income per secondary job associated with farm and ranch production.

Figure 7-5. 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 -$1,473,000	$424,000 to -$1,105,000	$863,000 to -$791,000	$863,000 to -$1,509,000	$2,402,000 to -$4,878,000

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.

Broader context. It is also useful to consider the summary results for the two hypothetical demand management scenarios evaluated in this study in the broader context of the overall agricultural sector and regional economy – summarized in Section 2, with individual basin detail in Appendix A.

Moderate demand management scenario. As shown in Figure 7-5, the moderate demand scenario would fallow about 1 in every 60 acres currently in irrigated forage production. It could reduce annual agricultural output (including other agricultural sectors such as fruit farming and greenhouse and nursery production) by between 0.8 and 1.3 percent, with the higher figure including potential impacts on livestock production. However, based on the projected payments to demand management participants under this scenario, net on-farm income (value-added) would be projected to increase by about 1.1 to 1.4 percent. The projected maximum decrease in farm and ranch-related employment – including on-farm/ranch jobs (which would mostly be the compensated participants in the program) and secondary jobs tied to production – would be less than 0.1 percent of the approximately 409,000 total jobs in Western Colorado.[2]

[2] For purposes of this comparison, affected on-farm jobs were counted in terms of full and part-time positions for comparability to baseline employment estimates shown in Section 2 and Appendix A. The number of combined full and part-time farm and ranch jobs is considerably larger than the number of FTE jobs.

Aggressive demand management scenario. The aggressive demand scenario would fallow about 1 in every 15 acres currently in irrigated forage production in Western Colorado. It could reduce annual agricultural output by between 3.4 and 5.4 percent, again including potential impacts on livestock production in the higher figure. As in the Moderate scenario, projected payments to demand management participants are expected to be larger than the decrease in production-related income and net on-farm income would be projected to increase by between 4.1 and 5.7 percent. Under this scenario, the projected maximum decrease in farm and ranch-related employment – including on-farm/ranch jobs and secondary jobs tied to production – would be almost 0.3 percent of the approximately 409,000 total jobs in Western Colorado.[3] However, the majority of these jobs would be producers that chose to participate in the program (and who would be compensated). This maximum production-related impact estimate also does not count the jobs projected to be supported by local spending of the compensation payments.

Other important considerations. In seeking to summarize and compare the potential economic benefits and adverse impacts from demand management in Western Colorado, it is also important to reiterate the substantial concerns voiced by the stakeholders in each basin regarding impacts on return flows that are relied on by downstream irrigators and other users. As noted in Section 3, 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.

In considering the net effects from demand management in Western Colorado – as summarized in the preceding tables – we again note the importance of where the funding for demand management payments comes from (as stated in Section 5). While the net effects on participating irrigators, and the net secondary effects on support businesses and workers, could be the same regardless of the source of funding, the net effects from a regional economic standpoint would differ if some or all of the funding is raised within Western Colorado. In that case, the regional economic assessment would also have to consider the adverse economic impacts of raising the funds for the program – such as the economic cost of new taxes or fees on Western Colorado residents and businesses.

Alternative Impact Possibilities and Key Uncertainties

As discussed near the beginning of Section 6, the economic impacts of demand management in Western Colorado could vary depending on what types of farming/ranching operations choose to participate and how they modify their operations to adjust to reduced irrigation. The impacts could also vary depending on the options for reducing consumptive use through the demand management program.

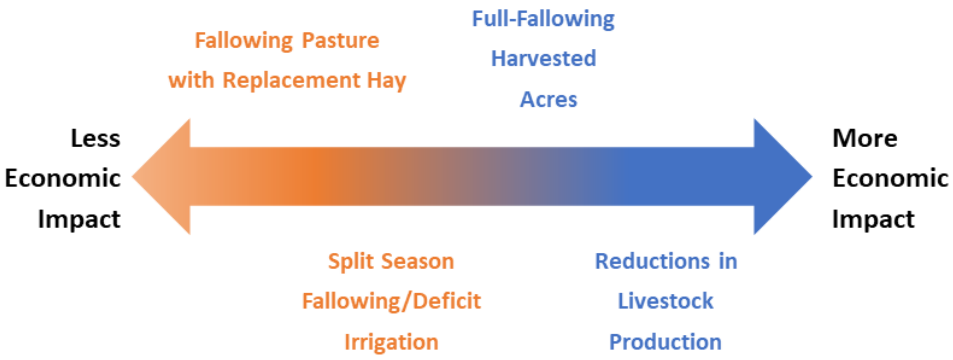
The evaluation described in this report assumes full fallowing of participating acres and is largely quantified based on reductions in mechanically harvested hay and corn. However, a

[3] See preceding footnote.

demand management program could also allow for or encourage "split season fallowing" or other forms of deficit irrigation. The program might also attract ranchers willing to fallow irrigated grazing lands, as well as operators fallowing mechanically harvested haylands.

Figure 7-6 provides a conceptual illustration of some of the alternative strategies and effects depending on program options, who participates and how they modify their operations. 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 alternatives such as split season fallowing. The latter 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). Split season fallowing was an option to participants in the CCUPP with the GVWUA, and was popular and well subscribed in that pilot project, but would likely require more participants (or at least more enrolled acreage) in a demand management program to achieve the same amount of consumptive use reductions as full fallowing.

Figure 7-6. Alternative impact possibilities



One of the potential participation strategies that could have substantially lower secondary economic impacts than full fallowing of harvested acres would be fallowing irrigated pasture and replacing the reduced forage with hay purchased from others (potentially from outside the region). In theory, this strategy could allow participating ranchers to maintain the same livestock herd and consequently have little or no impact on ranch output or livestock support industries. In practice, we are dubious that this approach would be financially viable unless participation payments per acre-foot are substantially higher than estimated in Section 5 given the potentially expensive hauling that could be required if local hay markets are already being tightened by demand management participation. Ranchers also have concerns about the quality of replacement hay, the potential introduction of new weeds into their operations and other aspects of replacing the hay they are accustomed to growing.

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. Undeniably, the potential development of a demand management program could add another complication to some of the pressures already facing agriculture within the region. Further, agriculture has traditionally been a source of economic continuity and stability in Western Colorado, which is particularly important given the declines in the energy-sector that have been experienced by the region over the past 10 to 12 years (as noted by basin stakeholders).

As described in the recent Technical Update for the Water Plan, Western Colorado agriculture faces continuing pressure from urbanization of farm lands. About 34,000 acres of irrigated farm land in Western Colorado are projected to be redeveloped for urban uses by 2050, with most of that acreage located in the Colorado and Gunnison Basins.[4]

Climate change is also likely to adversely affect irrigated agriculture in Western Colorado. The "In-between" and "Hot and Dry" scenarios developed for the recent Technical Update anticipate that Colorado's irrigation water requirements in 2050 will be 20 to 35 percent greater (respectively) than they were during the 1950 to 2013 period. The Technical Update also notes that "climate simulations … generally show a greater summer warming effect in basins at higher elevations, therefore the West Slope factors are generally greater than those developed for the East Slope basins."[5]

From the standpoint of participating irrigators, a demand management program could actually enhance the sustainability of their operations. Such a program would provide another, voluntary option for farmers and ranchers and might help hedge against market and climate risks. If participants spend portions of their participation payments on reducing debt and upgrading farms and ranches, the funding could enhance the economic and financial resilience of their operations.

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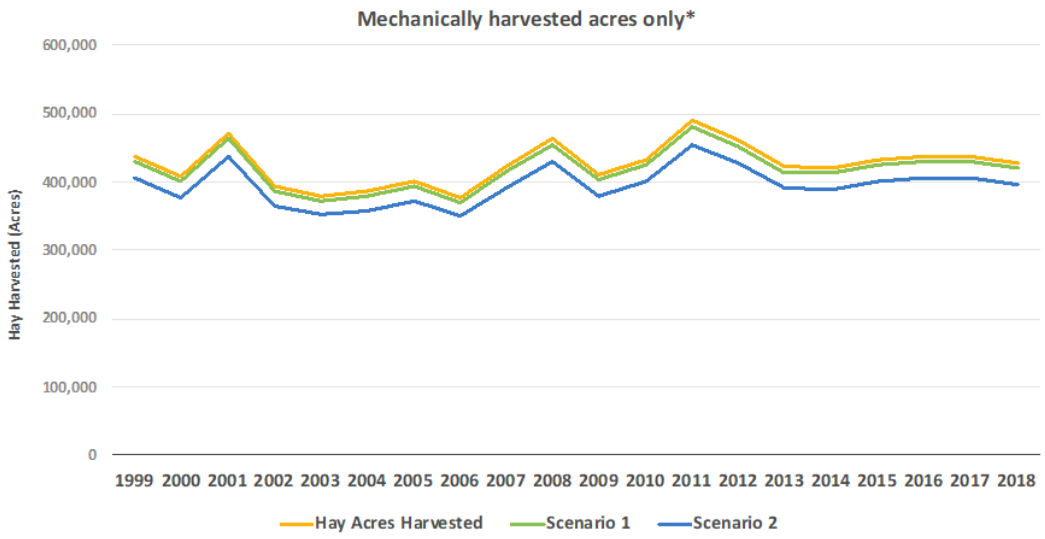
[4] Analysis and Technical Update to the Colorado Water Plan. Colorado Water Conservation Board. Department of Natural Resources. July 2019.

[5] Ibid.

The greater concern in regard to sustainability is the potential impacts of demand management on the businesses that supply farms and ranches (secondary impacts) and potential impacts on livestock producers. In the context of regional sustainability, it is useful to consider demand management in the context of historical variability in the number of hay acres that are harvested in Western Colorado.

Historical variability in hay acres harvested. Figure 7-7 depicts the number of acres of hay harvested in Western Colorado by year over the past two decades. The figure also shows how the number of acres harvested might have been different if either the Moderate or the Aggressive demand management scenarios had been in effect during this time. Note that the alternative harvested acre scenarios (minus 1.6 percent under the Moderate DM scenario, minus 6.4 percent under the Aggressive DM scenario) assume a comparable level of participation among irrigated grazing lands. If only harvested acres were enrolled in the demand management program, the reductions in regional harvested acres would be one and a half times as large as shown in the figure.

Figure 7-7. Historical hay acres harvested in W. Colorado and simulated changes under the demand management scenarios



Over five-year spans, comparable to the assumed duration of the demand management scenarios in this study, the average number of harvested acres has ranged from 415,000 acres/year to 452,000 acres – or minus 4 percent from the mean to plus 5 percent from the mean. As shown in the figure, the change in the number of acres harvested under Scenario 1 (Moderate demand

management) would be basically within the "noise" of normal variability. Scenario 2 (Aggressive demand management) would have a more perceptible impact on the overall number of hay acres harvested in Western Colorado, and – potentially – on the business that support hay production or depend on regional hay production, such as the livestock industry.

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. Prior research by members of the study team in the Lower Arkansas Valley has identified the characteristics of the communities most vulnerable to reductions in agricultural production, including small size, distance from larger communities and lack of economic diversity. 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, Dolores County or Archuleta County, for example.

Potential program design considerations. From the standpoint of Western Colorado as a whole, we believe that 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.

Appendix A.

Socioeconomic Baseline Reports by Basin

Colorado River Basin

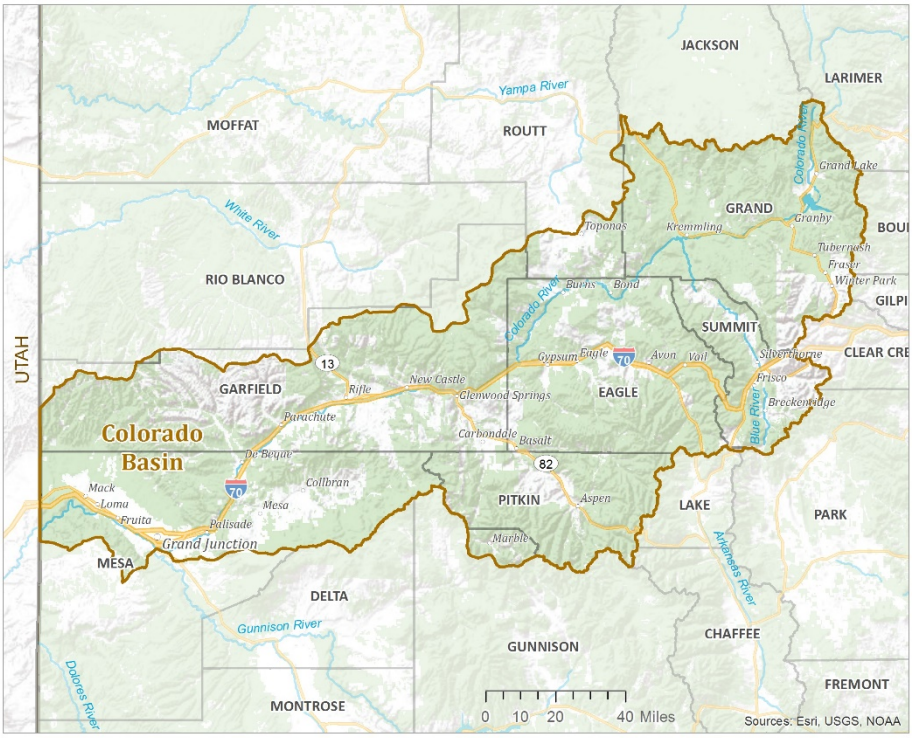
Geography

The Colorado River Basin is located across more than 9,800 square miles of western Colorado (Figure A-1). The basin covers an area that contains both high elevation alpine landscapes and arid, lower-altitude deserts. The basin contains the headwaters of the Colorado River, one of the most important rivers in the Southwestern United States. Snowpack in the basin's high mountains are the main sources of water for the basin's various tributaries to the Colorado and as a result, the amount of water in the basin can fluctuate widely from year to year. The basin also plays an important role in meeting interstate water compacts between Colorado and other western states as more than 70 percent of the basin's flows are committed to downstream users. The basin, as defined for Colorado water planning purposes, consists of seven separate regions.

Figure A-1. The Colorado Basin

Source:

BBC Research & Consulting.



Grand County. Grand County contains the headwaters of the 32-mile-long Fraser River, which drains the Middle Park basin on the western side of the Continental Divide. The Fraser flows through Winter Park, Fraser, and Tabernash before joining the Colorado River just west of

Granby. The Fraser is a popular river for fishing due to its high diversity of trout species. Grand County is also where the headwaters of the Colorado River begin near La Poudre Pass. From there the Colorado flows southwest into Grand Lake, the largest natural lake in Colorado.

Summit County. Summit County contains several tributaries of the Colorado River, including the Blue River; the Snake River; and the Swan River. The 65-mile-long Blue River begins in the Tenmile Range, south of the town of Breckenridge. From there, the Blue flows north through Dillion and Green Mountain reservoirs before joining the Colorado River near the town of Kremmling. The Snake and Swan rivers are small tributaries of the Blue that drain parts of the Front Range mountains just east of Keystone Resort.

State Bridge. The State Bridge region is located north of the Town of Vail and contains the Gore Mountain Range. The Piney River is the region's primary tributary to the Colorado and drains the northern part of the Gore Range in the Eagle Nest Wilderness. From its headwaters, the Piney flows northwest for about 28 miles before flowing into the Colorado.

Eagle. The Eagle region contains the 61-mile-long Eagle River and the 19-mile-long Gore Creek. The headwaters of the Eagle River are located in the a few miles north of the City of Leadville. From its headwaters, the Eagle flows through Minturn, Avon, Eagle and Gypsum before flowing into the Colorado River near Dotsero. The Eagle is popular with boaters since most of its reach is navigable by small watercraft. Gore Creek is a tributary of the Eagle that begins in the Gore Range east of Vail. It flows through Vail and joins the Eagle River about 3 miles west of the town. Parts of Gore Creek are Gold Medal fisheries, but the creek was listed as impaired in 2011 due to low numbers of macroinvertebrates.

Middle Colorado. This region contains the mainstem of the Colorado River from the Eagle/Garfield County line near the beginning of Glenwood Canyon and goes until the confluence of Roan Creek near the town of De Beque. The region contains many small tributaries of the Colorado, but notably the Colorado is the only major river contained in the region.

Roaring Fork. The Roaring Fork region contains the 70-mile-long Roaring Fork River; the 42-mile-long Fryingpan River; and the 40-mile-long Crystal River. The Roaring Fork River begins near Independence Pass in the Sawatch Range. The river flows northwest from its headwaters through the Roaring Fork Valley and the towns of Apsen, Basalt, and Carbondale before flowing into the Colorado River at Glenwood Springs. It is popular with boaters and fisherman. It is also an important water supply for several communities on the Front Range that divert some of the rivers flow to the Twin Lake Reservoir through the Twin Lakes Tunnel. The Frying Pan River is a tributary of the Roaring Fork that begins on the western flanks of Mount Massive, the State's second-tallest peak. It flows northwest into Ruedi Reservoir before flowing into the Roaring Fork near the town of Basalt. The Crystal River drains a section of the western Elk Mountains. From its headwaters it flows through the Crystal River Canyon and a steep mountain valley before flowing into the Roaring Fork near Carbondale.

Grand Valley. The Grand Valley Region contains the lower reaches of the Gunnison River and Plateau Creek. Plateau Creek is a 50-mile-long tributary of the Colorado. The creek drains Plateau Valley, which is located on the north side of Grand Mesa, the largest mesa in the world. It flows into the Colorado River approximately 15 miles east of Grand Junction.

Demographic Conditions and Trends

Historical and current population

The estimated total population in the Colorado Basin in 2017 was 314,266 (Colorado State Demography Office, 2017). The basin's population grew at an average of 2.7% per year between 1980 and 2010 (Figure A-2). Between 2010 and 2017, population growth in the basin slowed to an average rate of 0.6% per year. Consistent with the approach used in the Colorado Water Plan, 90 percent of the population of Mesa County was apportioned to the Colorado River Basin, while 10 percent of the county's population was attributed to the Gunnison River Basin.

Figure A-2.
Population and Trends, Colorado Basin Counties and Municipalities, 1980 to 2017

						1980-2010 Avg. Annual Growth		2010-2017 Avg. Annual Growth	
Location	1980	1990	2000	2010	2017	Residents	Pct. Change	Residents	Pct. Change
Eagle County	13,320	21,928	41,659	52,197	54,662	1,296	4.7%	352	0.7%
Avon	640	1,798	5,561	6,447	6,587	194	8.0%	20	0.3%
Basalt	529	1,128	2,681	3,857	3,189	111	6.8%	-95	-2.7%
Eagle	950	1,580	3,032	6,508	6,849	185	6.6%	49	0.7%
Gypsum	743	1,750	3,654	6,477	7,195	191	7.5%	103	1.5%
Minturn	1,060	1,066	1,068	1,027	1,056	-1	-0.1%	4	0.4%
Red Cliff	409	297	289	267	280	-5	-1.4%	2	0.7%
Vail	3,555	3,659	4,531	5,305	5,495	58	1.3%	27	0.5%
Unincorporated	5,434	10,650	20,843	22,309	24,011	563	4.8%	243	1.1%
Garfield County	22,514	29,974	43,791	56,389	59,167	1,129	3.1%	397	0.7%
Carbondale	2,084	3,004	5,196	6,427	6,826	145	3.8%	57	0.9%
Glenwood Springs	4,637	6,561	7,736	9,614	9,977	166	2.5%	52	0.5%
New Castle	563	679	1,984	4,518	4,821	132	7.2%	43	0.9%
Parachute	338	658	1,006	1,085	1,109	25	4.0%	3	0.3%
Rifle	3,215	4,636	6,784	9,172	9,465	199	3.6%	42	0.5%
Silt	923	1,095	1,740	2,930	3,121	67	3.9%	27	0.9%
Unincorporated	10,754	13,341	19,345	22,643	23,848	396	2.5%	172	0.7%
Grand County	7,475	7,966	12,442	14,843	15,297	246	2.3%	65	0.4%
Fraser	470	575	575	1,224	1,269	25	3.2%	6	0.5%
Granby	963	966	1,525	1,864	2,081	30	2.2%	31	1.6%
Grand Lake	382	259	447	471	499	3	0.7%	4	0.8%
Hot Sulphur Springs	405	347	521	663	702	9	1.7%	6	0.8%
Kremmling	1,296	1,166	1,578	1,444	1,526	5	0.4%	12	0.8%
Winter Park	480	528	662	999	1,038	17	2.5%	6	0.5%
Unincorporated	3,479	4,125	7,134	8,178	8,182	157	2.9%	1	0.0%
Mesa County*	73,377	83,831	104,630	132,051	136,710	1,956	2.0%	666	0.5%
Collbran	344	228	388	708	695	12	2.4%	-2	-0.3%
De Beque	279	257	451	504	494	8	2.0%	-1	-0.3%
Fruita	2,810	4,045	6,478	12,646	12,913	328	5.1%	38	0.3%
Grand Junction	27,956	29,034	41,986	58,566	65,224	1,020	2.5%	951	1.6%
Palisade	1,551	1,871	2,579	2,692	2,716	38	1.9%	3	0.1%
Unincorporated	48,590	57,710	64,373	71,607	69,858	767	1.3%	-250	-0.4%
Pitkin County	10,338	12,661	14,872	17,148	17,875	227	1.7%	104	0.6%
Aspen	3,678	5,049	5,914	6,658	6,879	99	2.0%	32	0.5%
Basalt	529	1,128	2,681	3,857	3,189	111	6.8%	-95	-2.7%
Snowmass Village	999	1,449	1,822	2,826	2,903	61	3.5%	11	0.4%
Unincorporated	5,132	5,035	4,455	3,807	4,904	-44	-1.0%	157	3.7%
Summit County	8,848	12,881	23,548	27,994	30,555	638	3.9%	366	1.3%
Blue River	230	440	685	849	918	21	4.4%	10	1.1%
Breckenridge	818	1,285	2,408	4,540	4,900	124	5.9%	51	1.1%
Dillon	337	553	802	904	960	19	3.3%	8	0.9%
Frisco	1,221	1,601	2,443	2,683	3,123	49	2.7%	63	2.2%
Montezuma	17	60	42	65	67	2	4.6%	0	0.4%
Silverthorne	989	1,768	3,196	3,887	4,639	97	4.7%	107	2.6%
Unincorporated	5,236	7,174	13,972	15,066	15,948	328	3.6%	126	0.8%
Basin Total	**135,872**	**169,241**	**240,942**	**300,622**	**314,266**	**5,492**	**2.7%**	**1,949**	**0.6%**

Note: *Mesa County data are apportioned between Colorado and Gunnison Basins.

Source: U.S. Census Bureau 1980, 1990, 2000, & 2010; Colorado State Demography Office, 2019.

The average rate of population growth in Eagle County was the highest amongst the counties in the basin between 1980 and 2010, with an average annual growth rate of 4.7%. The highest rate of population growth in Eagle County was observed in Avon—which grew from 1,800 residents in 1990 to 5,500 residents in 2000, more than tripling in size in ten years—and in the unincorporated areas of the county, which grew from 10,700 residents in 1990 to 20,800 residents in 2000.

Summit County and Garfield County had respective average annual population growth rates of 3.9% and 3.1% between 1980 and 2010. As in Eagle County, the greatest population growth in Summit County during that 30-year period occurred between 1990 and 2000, during which time the population increased from 12,900 to 23,500. In Garfield County, population increased from 30,000 residents in 1990 to 56,400 residents in 2010.

Grand Junction—county seat of Mesa County and the most populous city in the Colorado Basin—more than doubled in size between 1980 and 2010, growing from approximately 28,000 residents to 58,600 residents.

Since 2010, population growth in the Colorado Basin has slowed in comparison to the previous 30-year period, with an average annual growth rate of 0.6%. Summit County has exhibited the highest average annual population growth rate since 2010 (1.3%), and none of the counties in the basin has experienced a net loss of population.

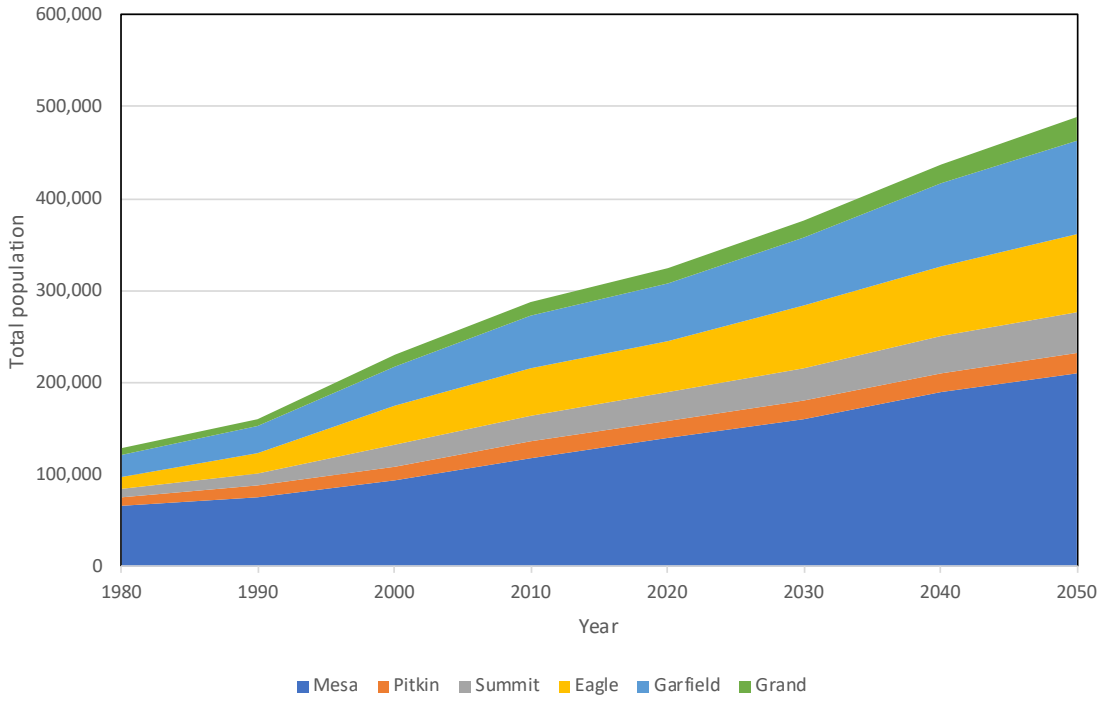
As of 2017, the most populous counties of the basin were Mesa County (136,700 residents), Garfield County (59,200 residents), and Eagle County (54,700 residents) (U.S. Census Bureau ACS 5-Year Estimates, 2012-2017). The largest municipalities in the basin were Grand Junction (65,200 residents), Fruita (13,000 residents), Glenwood Springs (10,000 residents), and Rifle (9,500 residents). Nine of the 33 cities and towns in the basin had total populations between 4,000 and 10,000 residents, and 16 towns had fewer than 3,000 residents.

Population in the unincorporated areas of each basin county comprise a substantial portion of each county's total population, ranging from a high of 53 percent in Grand County to a low of 27 percent in Pitkin County (Colorado State Demography Office, 2019).

Population projections

As shown in Figure A-3, the population in the Colorado Basin is projected to grow by a total of 150,000 residents between 2020 and 2050 (Colorado State Demography Office, 2019). With the exception of Pitkin County, the population of each county is projected to grow by between 44 and 63 percent between 2020 and 2050.

Figure A-3.
Population History and Projections, Colorado Basin Counties, 1980 to 2050



Note: *Mesa County data are apportioned between Colorado and Gunnison Basins.

Source: U.S. Census Bureau 1980, 1990, 2000, & 2010; Colorado State Demography Office, 2019.

Approximately 85 percent of the basin's future population growth is projected to occur in three counties. Mesa County's population growth is projected to account for 43 percent of the basin's total growth through 2050, with Garfield and Eagle Counties comprising another 24 percent and 18 percent, respectively.

Demographic characteristics

Generally, the demographic characteristics of the basin are similar to the state as a whole, with a few notable exceptions. Relative to the state of Colorado, the Colorado Basin has a smaller proportion of minority residents, with 23 percent of residents identifying as a race other than white compared to 31 percent for the state as a whole (Figure A-4).

Figure A-4. Demographic Characteristics, Colorado Basin, 2013 to 2017 Averages

Note:

Following Census-based definitions, individuals living in places with 2,500 residents or more are identified as the urban population.

Source:

U.S. Census Bureau American Community Survey (ACS), 2019.

	Basin Residents			State of
	Urban*	Rural*	Total	Colorado
Gender				
Female	49%	48%	49%	50%
Male	51%	52%	51%	50%
Age				
Under 18	22%	21%	22%	23%
18-64	64%	64%	64%	64%
65 and Over	14%	15%	14%	13%
Race/Ethnicity				
White, not Latino	75%	79%	77%	69%
Latino	20%	17%	19%	21%
Other Race	4%	3%	4%	10%
Educational Attainment (25 and older)				
High School Degree or Less	32%	36%	34%	31%
Some College/Associate Degree	30%	31%	30%	30%
Bachelors Degree or More	38%	33%	35%	39%
Individual Income (15 and older)				
Under $25,000	37%	37%	37%	35%
$25,000-$49,999	27%	27%	27%	24%
$50,000-$74,999	14%	14%	14%	14%
$75,000 or More	12%	13%	12%	15%
Unreported	*10%*	*9%*	*9%*	*12%*
People Living Below/Near Poverty Level				
Below 100% of Poverty Level	13%	11%	12%	12%
100 to 149% of Poverty Level	8%	8%	8%	8%

Residents of the basin have a slightly lower average educational attainment in comparison with the state, with 65 percent of Colorado Basin residents having some college education or a bachelor degree compared with 69 percent of all Colorado residents. Individual incomes in the Colorado Basin are also slightly lower compared to the state. Sixty-four percent of basin residents have an annual income of less than $50,000, compared to 59 percent of state residents. Still, poverty levels are comparable to the state as a whole, with 20 percent of residents living at or below 149 percent of poverty level.

Economic Conditions and Trends

Earnings by sector

In 2017, the Colorado Basin's four largest economic sectors based on work-related earnings were government (14.3%), construction (12.8%), health care and social assistance services (11.5%), and accommodation and food services (10.6%) (U.S. Bureau of Economic Analysis, 2017). Together, these four sectors account for about 50 percent of the basin's work-related earnings (Figure A-5). However, percentages of earnings by industry are based on comparison to total work earnings for each county. In some cases, earnings by sector are not disclosed at the county level in order to preserve data confidentiality for individual firms that comprise all or most of a particular sector. For example, the earnings data available for Eagle County account for 100 percent of the county's earnings total, while Grand County's data account for 89 percent of total earnings.

Figure A-5.
Work Earnings as a Percent of Total, Colorado Basin Counties, 2017

	Basin Counties						
Sector Earnings 2017	Eagle	Garfield	Grand	Mesa*	Pitkin	Summit	Basin
Farm Earnings	0.1%	0.2%	1.6%	0.4%	0.1%	0.0%	0.3%
Non-farm Earnings							
Forestry, fishing, and related activities	0.1%	0.1%	0.2%	0.2%	(D)	(D)	0.1% +
Mining, quarrying, and oil and gas extraction	0.1%	6.8%	0.8%	6.5%	(D)	(D)	3.3% +
Utilities	0.3%	2.1%	(D)	0.6%	(D)	(D)	0.6% +
Construction	14.7%	16.9%	15.0%	11.0%	6.2%	14.1%	12.8%
Manufacturing	0.8%	1.7%	1.7%	4.1%	0.6%	0.8%	2.1%
Wholesale trade	2.2%	2.7%	(D)	4.4%	(D)	(D)	2.4% +
Retail trade	7.7%	7.4%	7.4%	7.6%	5.2%	1.9%	6.6%
Transportation and warehousing	3.9%	3.7%	1.7%	4.5%	1.8%	1.9%	3.5%
Information	0.6%	0.4%	-0.8%	0.7%	0.8%	0.6%	0.6%
Finance and insurance	2.7%	2.6%	2.1%	4.8%	3.9%	2.7%	3.5%
Real estate and rental and leasing	4.7%	4.1%	5.2%	2.8%	11.5%	8.3%	5.3%
Professional, scientific, and technical services	6.2%	6.2%	(D)	4.7%	7.0%	6.9%	5.7% +
Management of companies and enterprises	0.4%	-0.1%	(D)	0.5%	0.9%	0.2%	0.4% +
Administrative and support and waste management	4.6%	3.9%	(D)	3.9%	5.0%	3.6%	4.0% +
and remediation services	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Educational services	1.1%	1.2%	0.2%	0.5%	2.0%	1.1%	1.0%
Health care and social assistance	12.4%	11.6%	3.0%	16.8%	2.4%	7.6%	11.5%
Arts, entertainment, and recreation	8.2%	1.5%	9.7%	0.6%	17.4%	5.3%	5.4%
Accommodation and food services	14.8%	5.1%	15.7%	4.3%	16.0%	20.1%	10.6%
Other services	4.8%	4.3%	5.6%	4.5%	4.1%	3.9%	4.4%
Government and government enterprises	9.4%	17.5%	19.8%	16.6%	13.9%	11.4%	14.3%
Total Reported Data	100.0%	100.0%	89.0%	100.0%	98.9%	90.4%	98.2%
Nondisclosed Percent of Work Income	0.0%	0.0%	11.0%	0.0%	1.1%	9.6%	1.8%

Note: *Mesa County data are apportioned between Colorado and Gunnison Basins.

+Due to non-disclosure for some sectors and counties, these basin-wide totals are potentially understated.

Source: U.S. Bureau of Economic Analysis, 2017.

Work-related earnings in individual counties exhibit a few noteworthy differences from the basin-wide earnings profile. For example, arts, entertainment, and recreation is Pitkin County's largest industry by earnings (17.4%), and is the fourth-largest sector by earnings in Grand County (9.7%). While accommodation and food services is a substantial sector in nearly all counties in the basin, it comprises more than 20 percent of Summit County's work-related earnings, making it the largest source of work earnings in the county by a wide margin.

Retail trade is the fourth-largest sector by earnings in Mesa County (7.6%) and Garfield County (7.4%). Real estate, rental, and leasing is the fourth-largest sector by earnings in Pitkin County (11.5%) and Summit County (8.3%). Lastly, the mining industry (including oil and gas)—which was a major source of earnings in portions of the Colorado River Basin as recently as ten years ago—remains most substantial in Garfield (6.8%) and Mesa (6.5%) Counties, and is less than one percent of total earnings for the other counties in the basin with disclosed earnings income from mining.

Employment by sector

As shown in Figure A-6, more than one-third of total employment in the Colorado Basin is concentrated in accommodation and food services (13.8%), government (10.6%), and retail trade (9.9%) (U.S. Bureau of Economic Analysis, 2017). The accommodation and food services sector is particularly important to total employment in Summit County (24.5%), Pitkin County (18.7%), Grand County (18.7%), and Eagle County (17.0%).

Figure A-6.
Employment by Industry, Colorado Basin Counties, 2017

	Basin Counties							
Sector Employment 2017	Eagle	Garfield	Grand	Mesa*	Pitkin	Summit	Basin	Basin Employment Share
Farm Employment	209	765	264	2,029	117	69	3,453	1.48%
Non-farm Employment								
Forestry, fishing, and related activities	137	169	109	385	(D)	(D)	800 +	0.34% +
Mining, quarrying, and oil and gas extraction	515	1,599	105	3,332	(D)	(D)	5,551 +	2.38% +
Utilities	91	305	(D)	202	(D)	(D)	598 +	0.26% +
Construction	4,751	5,120	1,252	5,684	1,181	2,213	20,201	8.68%
Manufacturing	603	654	219	3,180	218	283	5,157	2.21%
Wholesale trade	582	810	(D)	2,454	(D)	(D)	3,846 +	1.65% +
Retail trade	4,264	3,791	916	9,084	1,598	3,381	23,034	9.89%
Transportation and warehousing	1,049	848	166	2,705	396	523	5,687	2.44%
Information	393	253	74	796	263	264	2,043	0.88%
Finance and insurance	1,862	1,222	337	3,686	1,286	837	9,230	3.96%
Real estate and rental and leasing	5,155	3,041	1,082	4,978	3,570	3,033	20,859	8.96%
Professional, scientific, and technical services	2,875	2,314	(D)	3,695	1,582	1,607	12,073 +	5.19% +
Management of companies and enterprises	311	239	(D)	234	209	91	1,084 +	0.47% +
Administrative and support and waste management and remediation services	2,947	2,052	(D)	3,848	1,321	1,438	11,606 +	4.98% +
Educational services	754	754	71	836	521	415	3,351	1.44%
Health care and social assistance	2,782	3,249	343	10,485	611	415	17,885	7.68%
Arts, entertainment, and recreation	4,350	1,152	1,249	1,718	2,835	1,981	13,285	5.71%
Accommodation and food services	8,112	3,437	2,157	6,419	4,642	7,274	32,041	13.76%
Other services	2,623	2,058	601	4,410	1,530	1,354	12,576	5.40%
Government and government enterprises	3,435	5,366	1,390	9,401	2,402	2,612	24,606	10.57%
Total Employment	47,800	39,198	11,520	88,682	24,829	29,659	232,820	98.34%
Nondisclosed Employment Sectors	0	0	1,185	0	547	1,869	3,601	1.66%

Note: *Mesa County data are apportioned between Colorado and Gunnison Basins.

+Due to non-disclosure for some sectors and counties, these basin-wide totals are potentially understated.

Source: U.S. Bureau of Economic Analysis, 2017.

The construction industry also provides a substantial amount of employment in Garfield County (13.1%), Grand County (10.9%), and Eagle County (9.9%), and the real estate, rental, and leasing sector supplies significant employment in Pitkin County (14.4%), Eagle County (10.8%), and Summit County (10.2%).

Employment trends

Between 2007 and 2017, total employment in the Colorado Basin increased by approximately 8,300 jobs (3.7%). During that time, large job losses in the construction industry (-7,400 jobs) were offset by an increase in the number of jobs in health care and social assistance services (+3,467 jobs), government (+3,338 jobs), and accommodation and food services (+2,974 jobs) (Figure A-7). In total, every county in the Colorado Basin saw a net increase in jobs between 2007 and 2017 with the exception of Garfield County (-736 jobs). The greatest net employment increases occurred in Eagle County (+3,258 jobs) and Summit County (+3,220 jobs).

Figure A-7.
Employment Changes by Industry, Colorado Basin Counties, 2007 to 2017

	Basin Counties						
Job Changes by Sector, 2007-2017	Eagle	Garfield	Grand	Mesa*	Pitkin	Summit	Basin
Farm Employment	28	27	18	353	27	15	468
Non-farm Employment							
Forestry, fishing, and related activities		-26		83			
Mining, quarrying, and oil and gas extraction		-1,047		21			
Utilities	19	92		-8			
Construction	-2,063	-1,677	-482	-2,223	-577	-390	-7,412
Manufacturing	119	93	88	-156	8		
Wholesale trade	47	-162		23			
Retail trade	265	-651	-237	-523	-283	152	-1,277
Transportation and warehousing	297	-425	5	-240	33	135	-195
Information	-155	-64	-10	-256	-70	-3	-558
Finance and insurance	505	83	71	291	522	78	1,550
Real estate and rental and leasing	388	201	-65	509	319	270	1,622
Professional, scientific, and technical services	136	-41		-302	-104	143	
Management of companies and enterprises	105	56		106	127	11	
Administrative and support and waste management and remediation services	471	299		-249	-699	83	
Educational services	409	320	23	314	134	222	1,422
Health care and social assistance	620	789	37	1,760	39	222	3,467
Arts, entertainment, and recreation	464	260	156	12	486	603	1,981
Accommodation and food services	810	267	299	529	539	530	2,974
Other services	-52	22	117	7	9	166	269
Government and government enterprises	551	848	125	978	477	359	3,338
Total Employment	3,258	-736	121	1,192	1,170	3,220	8,316
Nondisclosed Employment Sectors	-358	0	774	0	183	341	940

Note: *Mesa County data are apportioned between Colorado and Gunnison Basins.

Source: U.S. Bureau of Economic Analysis, 217.

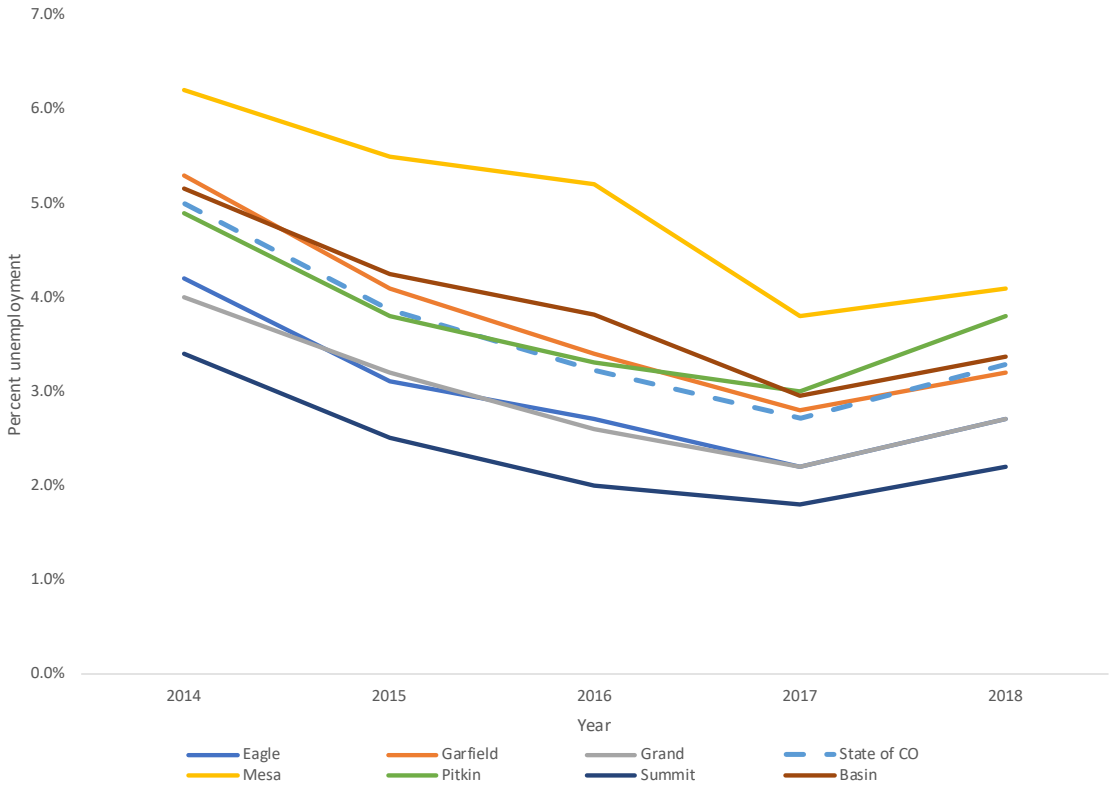
The loss of construction jobs was largest in Mesa, Eagle, and Garfield Counties, although job losses in the sector impacted every county in the basin. Many counties also experienced job losses in the retail trade sector between 2007 and 2017, although the majority of losses occurred in Garfield and Mesa Counties. Garfield County also lost more than 1,000 mining jobs during that time.

The largest increases in employment occurred in the health care and social assistance sector in Mesa County (+1,760 jobs) as well as Garfield and Eagle Counties. Job growth also occurred in the government and accommodation and food services sectors in all counties in the basin.

Unemployment

Unemployment rates in the Colorado Basin are near historically low levels and have dropped from 5.2% in 2014 to 3.4% in 2018 (Figure A-8). This basin-wide trend is very similar to the state-wide trend in unemployment rates over the same time period, with rates that are slightly higher than the state.

Figure A-8.
Unemployment Rates, Colorado Basin Counties, 2014 to 2018



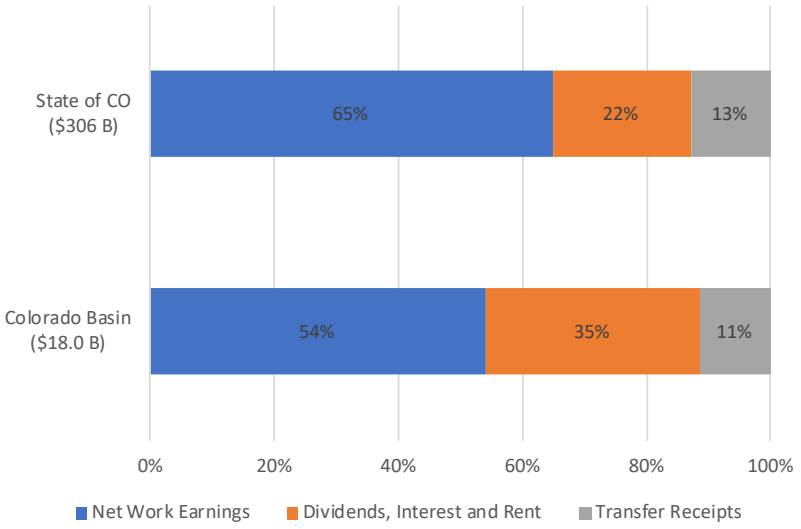
Source: Colorado State Demography Office.

The unemployment rates of the counties in the basin also follow this trend, but exhibit varied rates of unemployment. Between 2014 and 2018, Summit County had the lowest unemployment rate of the six basin counties in each year, from a high of 3.4% in 2014 to a low of 1.8% in 2017. Mesa County unemployment rates were consistently the highest in the basin, with a high of 6.2% in 2014 and a low of 3.8% in 2017. Of the remaining counties in the basin, Eagle and Grand Counties both experienced unemployment rates below the basin and state averages, while Garfield and Pitkin Counties have seen unemployment rates similar to the overall basin and state.

Personal income

Most personal income in the Colorado Basin is from income earned through work (54%). Dividends, interest, and rent account for 35 percent of personal income, and transfer receipts, such as government social benefits, account for 11 percent. At the state level, a greater percentage of income is earned through work (65%) compared to the basin, while 22 percent is from dividends, interest, and rent and 13 percent is from transfer receipts (Figure A-9).

Figure ?-?.
Sources of Personal Income, Colorado Basin and State of Colorado, 2017



Source: U.S. Bureau of Economic Analysis.

Compared to the state, income from dividends, interest, and rent constitutes a larger portion of personal income in the Colorado Basin due to substantial wealth-related income in several counties, particularly Pitkin County. Dividends, interest, and rent account for more than 60 percent of personal income within Pitkin County and account for significant portions of personal income in Grand County (31%), Summit County (34%), Eagle County (36%), and Garfield County (38%).

Mesa County exhibits a mix of personal income sources that is quite different from the other counties of the basin, with dividends, interest, and rent comprising 20 percent of personal income while another 20 percent of income comes from transfer receipts. Personal income from transfer receipts in the other basin counties is between 4 and 13 percent.

Community-level economic indicators

Household income. Further economic details of individual cities and towns within the Colorado Basin are shown in Figures A-10 and A-11. Of the 32 cities and towns in the basin, Eagle has the highest median annual household income at $118,630, while Palisade has the lowest at $38,092. Twenty of the 32 municipalities in the basin have median annual household incomes between $50,000 and $75,000. After adjusting for inflation, median household incomes declined in 19 municipalities in the basin between 2012 and 2017 (ACS 5-Year Estimates, 2007-2012 & 2012-2017).

Figure A-10. Median Household Income, Colorado Basin Municipalities, 2017

Note:

*2012-2017 American Community Survey (ACS). Reflects average of data collected over five-year period. 5-year change based on comparisons to 2007-2012 ACS.

**Inflation-adjusted comparison.

Source:

U.S. Census Bureau American Community Survey (ACS), 2012-2017.

Median Household Income**	2017*	5-Year Chg.		2017*	5-Year Chg.
Aspen	$64,594	-17%	Grand Lake	$51,719	-7%
Avon	$61,791	31%	Gypsum	$89,464	-3%
Basalt	$73,490	-2%	Hot Sulphur Springs	$53,882	-41%
Blue River	$94,844	-1%	Kremmling	$46,429	-27%
Breckenridge	$76,774	25%	Minturn	$82,679	1%
Carbondale	$68,217	9%	Montezuma	$60,000	23%
Collbran	$48,594	-19%	New Castle	$87,345	23%
De Beque	$51,250	-29%	Palisade	$38,092	-17%
Dillon	$60,568	1%	Parachute	$41,429	-1%
Eagle	$118,630	42%	Red Cliff	$60,909	-11%
Fraser	$52,267	16%	Rifle	$61,696	5%
Frisco	$67,938	-16%	Silt	$56,764	2%
Fruita	$55,286	-17%	Silverthorne	$50,727	-37%
Glenwood Springs	$61,044	2%	Snowmass Village	$58,233	-29%
Granby	$58,281	-8%	Vail	$73,981	-4%
Grand Junction	$47,824	-8%	Winter Park	$79,375	15%

Employment. The total number of employed residents increased in 20 of the basin's 32 cities and towns between 2012 and 2017 (ACS 5-Year Estimates, 2007-2012 & 2012-2017). Grand Junction—the largest city in the basin—experienced a 3 percent increase in the total number of employed residents between 2012 and 2017 (Figure A-11).

The largest percentage declines in the number of employed residents occurred in Grand Lake, Granby, and Kremmling, each of which experienced a decline of 28 percent or greater.

Figure A-11. Total Employed Residents, Colorado Basin Municipalities, 2017

Note:

*2012-2017 American Community Survey (ACS). Reflects average of data collected over five-year period. 5-year change based on comparisons to 2007-2012 ACS.

Source:

U.S. Census Bureau American Community Survey (ACS), 2012-2017.

Total employment	2017*	5-Year Chg.		2017*	5-Year Chg.
Aspen	4,574	12%	Grand Lake	124	-44%
Avon	4,093	11%	Gypsum	4,500	19%
Basalt	2,482	5%	Hot Sulphur Springs	459	-11%
Blue River	468	-16%	Kremmling	768	-28%
Breckenridge	3,317	8%	Minturn	835	34%
Carbondale	3,611	6%	Montezuma	49	-2%
Collbran	308	-4%	New Castle	2,729	21%
De Beque	213	24%	Palisade	1,216	-11%
Dillon	566	27%	Parachute	506	-8%
Eagle	3,624	-3%	Red Cliff	180	1%
Fraser	1,152	66%	Rifle	4,600	-3%
Frisco	1,901	4%	Silt	1,706	24%
Fruita	5,800	-7%	Silverthorne	2,698	10%
Glenwood Springs	5,639	0%	Snowmass Village	2,161	19%
Granby	1,151	-30%	Vail	3,868	6%
Grand Junction	28,367	3%	Winter Park	518	17%

Agricultural Conditions and Trends

The largest component of the agricultural economy of the Colorado Basin is livestock production. Including forestry, hunting, fishing, and agricultural support activities, agricultural activity directly provides approximately 4,300 jobs in the basin. Fifty-three percent (2,260 jobs) of these agricultural jobs are in livestock production, which constitutes 59 percent of the basin's agricultural output (Figure A-12). The large majority of the basin's livestock jobs are in beef cattle ranching.

Figure A-12.
Agricultural Industry Economic Detail, Colorado Basin, 2016

Agricultural Sector	Employment	Output (Receipts)	Income*	Production/ Import Taxes**	Total Value-Added (GRP)
Grain farming	60	$5,392,411	$707,242	-$78,580	$628,662
Vegetable and melon farming	38	$3,055,588	$1,670,475	$44,547	$1,715,022
Fruit farming	428	$26,486,320	$16,014,238	$825,476	$16,839,715
Greenhouse, nursery, and floriculture production	263	$19,442,650	$12,219,951	$128,969	$12,348,920
All other crop farming***	577	$19,036,441	$9,935,388	$152,548	$10,087,936
Total crop farming	**1,367**	**$73,413,410**	**$40,547,295**	**$1,072,961**	**$41,620,256**
Beef cattle ranching and farming, including feedlots****	1,903	$100,061,005	$18,883,402	$883,174	$19,766,577
Dairy cattle and milk production	93	$22,067,436	$6,005,926	$239,623	$6,245,549
Animal production, except cattle and poultry and eggs	264	$14,586,667	$8,043,901	$242,128	$8,286,028
Total livestock production	**2,260**	**$136,715,108**	**$32,933,229**	**$1,364,925**	**$34,298,154**
Commercial logging	54	$3,437,598	$1,171,471	$120,132	$1,291,603
Commercial fishing	0	$0	$0	$0	$0
Commercial hunting and trapping	70	$3,549,312	$2,261,427	$388,561	$2,649,988
Total forestry, hunting and fishing	**124**	**$6,986,909**	**$3,432,898**	**$508,693**	**$3,941,591**
Support activities for agriculture and forestry	**538**	**$19,210,022**	**$12,297,359**	**$401,551**	**$12,698,910**
Total direct agricultural activity	**4,289**	**$236,325,450**	**$89,210,781**	**$3,348,130**	**$92,558,911**

Note: *Income includes employee and proprietor earnings and property-related income.

**Includes sales and excise taxes, property taxes, special assessments and subsidies.

***Predominantly hay and alfalfa production.

****Includes dual purpose ranches/farms.

Source: IMPLAN, 2016.

Crop farming is also a significant component of the basin's agricultural economy, representing 32 percent of agricultural jobs and 31 percent of output. Jobs in crop farming are primarily in fruit farming and hay/alfalfa production, which is predominantly an input to cattle and horse ranching (IMPLAN, 2016).

Farm characteristics

According to the latest Census of Agriculture in 2017, there were 1.2 million acres of land in farms in the Colorado Basin (Figure A-13). Approximately 11 percent of farmland acres (134,000 acres) were harvested and 15 percent (180,000 acres) were under irrigation. Approximately 107,000 irrigated acres were harvested in 2017, and 64,000 irrigated acres were maintained as pastureland.

Figure A-13.
Agricultural Census Trends, Colorado Basin, 2007 to 2017

Note:

*Harvested cropland in Routt County was undisclosed in 2012. Routt County acreage estimated based on average of 2007 and 2017 reports.

**BLS inflation calculator, based on July values.

Source:

USDA Census of Agriculture, 2007, 2012, & 2017.

Metrics	2007	2012	2017
Number of Farms	2,542	2,928	3,349
Median Size of Farms (acres)	48	37	29
Average Size of Farms (acres)	410	353	360
Farms with Irrigation	1,965	2,257	2,595
Land in Farms (acres)	1,042,419	1,034,440	1,204,873
Harvested Cropland (acres)	113,222	119,376	133,961
Irrigated Land (acres)	169,915	144,626	179,646
Market Value ($000s)			
Crops	$34,887	$44,546 *	$52,446
Livestock	$53,663	$71,463	$85,910
Total	$88,550	$116,009	$138,357
Inflation-adjusted Market Value in $2017**	$104,064	$123,944	$138,357

In 2017, approximately 77 percent of the basin's 3,350 farms were irrigated, with an average of 70 irrigated acres per irrigated farm. Median farm size in the basin in 2017 was 29 acres, exhibiting a 40 percent decline since 2007 (USDA Census of Agriculture, 2007 & 2017).

In 2017, 53 percent of farms in the basin had total annual sales of less than $2,500, while 11 percent of farms had annual sales of more than $50,000. However, total farm receipts have increased over the last several years. After adjusting for inflation, farm receipts in 2017 were approximately 12 percent higher than in 2012 and 33 percent higher than in 2007.

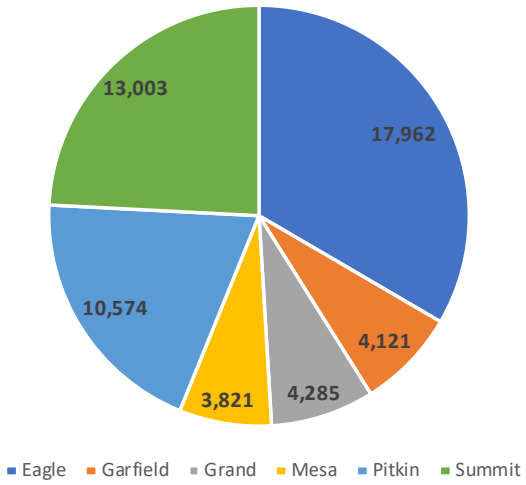
Estimates of total irrigated land from the Census of Agriculture differ somewhat from the more refined estimates developed for the Colorado Decision Support System (CDSS) and used in the Colorado Water Plan. The latest estimates for the Technical Update to the Water Plan indicate a total of approximately 207,000 irrigated acres in the Colorado Basin, and annual consumptive use of 431,400 acre-feet per year on those acres. These numbers correspond to average consumptive use of about 2.1 acre-feet per acre (State Water Plan Technical Update, 2019).

Tourism and Recreation Economy

The Colorado Basin tourism and recreation economy depends on water to directly and indirectly support activities such as fishing, hunting, wildlife-watching, boating, swimming, and snowmaking for the basin's ski resorts. The Colorado State Demography Office (SDO) estimates that tourism jobs constitute 40 percent (54,000 jobs) of direct basic jobs in the basin (i.e., jobs that bring outside dollars into the community by selling goods or services) (Figure A-14).

Figure A-14.
Estimated Direct Tourism Jobs, Colorado Basin Counties, 2018

Source:
Colorado State Demography Office, 2019.



Within the basin, tourism supports a total of 81,000 direct and indirect jobs (i.e., jobs created as the result of goods and services sold by direct basic jobs).

The SDO definition of tourism includes resort activity (e.g., skiing, national parks, rafting), second home expenditures, and service employment and transportation jobs supported by visitation. The majority of direct basic tourism jobs are in Eagle County (33.4%), Summit County (24.2%), and Pitkin County (19.7%).

Further analysis from BBC using data from a 2017 study by the Colorado Department of Parks and Wildlife (CPW) finds that approximately 5,500 direct and indirect jobs in the Colorado Basin are supported by wildlife-related activity (3,500 jobs) and water-related recreation (2,000 jobs). A large proportion of wildlife- and water-related tourism jobs are located in Mesa County (37% of the basin total). Wildlife- and water-related recreation comprises only a small share of the tourism economies in Eagle, Pitkin, and Summit Counties due to the high level of resort activity and second home expenditures in those areas of the basin.

Gunnison River Basin

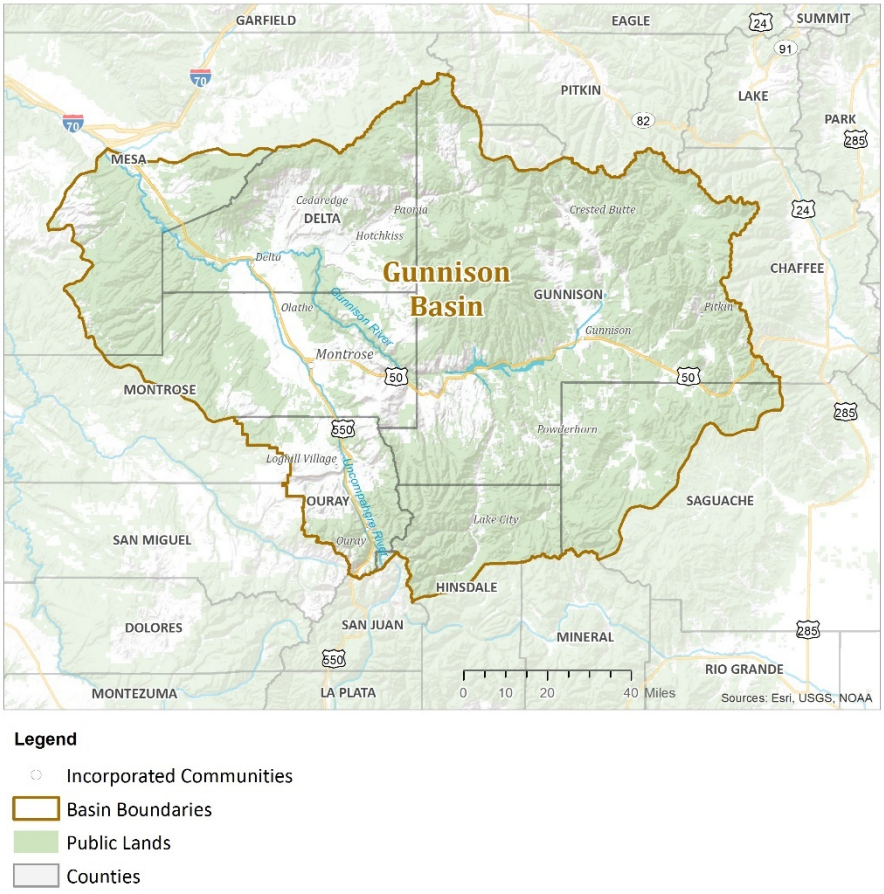
Geography

The Gunnison River Basin is located across more than 8,000 square miles of western Colorado. It is bounded by the Continental Divide and Sawatch Range to the east, the Elk Range to the north, the San Juan mountains in the south, and the Uncompahgre Plateau to the west (Figure A-15). The basin, as defined for Colorado water planning purposes, consists of seven separate river sub-basins. However, the Gunnison River is the basin's primary tributary to the Colorado River. Other rivers in the basin are tributaries of the Gunnison.

Figure A-15. The Gunnison Basin

Source:

BBC Research & Consulting, 2019.



Gunnison River. The Gunnison River is the primary river system of the Gunnison River Basin and the largest tributary of the Colorado River in Colorado. It extends approximately 164 miles from its start at the confluence of the Taylor and East Rivers in Gunnison County until it runs into the Colorado River just south of the City of Grand Junction. West of the City of Gunnison, the river flows into the Blue Mesa Reservoir, the largest lake in Colorado. The river flows out of Blue Mesa Reservoir and into the Black Canyon of the Gunnison, one of the deepest canyons in the world. Below the Black Canyon, the river receives flows from the North Fork River before flowing

through the City of Delta. Below Delta, the river receives additional flows from the Uncompahgre River and Kannah Creek before eventually flowing into the Colorado.

North Fork. The North Fork of the Gunnison River is a 33-mile-long river that drains the part of the southwestern section of the Elk Mountains west of the town of Delta. It flows out of the Elk Mountains and through the Towns of Somerset, Paonia, and Hotchkiss before flowing into the Gunnison River downstream of the Black Canyon.

Uncompahgre River (Upper and Lower). The 121-mile-long Uncompahgre River begins at Lake Como in San Juan County. From there, the river flows north through the Towns of Ouray, Ridgway, Montrose, and Olathe before flowing into the Gunnison River in the City of Delta. The river forms the Uncompahgre Gorge and the Ridgway Reservoir.

East and Slate. The East and Slate Rivers are relatively short rivers (38 and 24 miles long, respectively) that begin in the southern part of the Elk Mountains before flowing south toward the City of Gunnison. At their confluence, the two rivers merge to become the East River, which flows south to the City of Gunnison to a confluence with the Taylor River and forms the Gunnison River. The Slate River's location near the Town of Crested Butte has made it a popular river for recreational uses.

Lake Fork and Cimarron. The Lake Fork is a 65-mile-long tributary of the Gunnison River that beings at Sloan Lake in the San Juan Mountains in Hinsdale County. The river flows through Lake San Cristobal and Lake City before flowing into the Gunnison River at Blue Mesa Reservoir. The Cimarron is a 22-mile-long river that flows into the Gunnison River near Curecanti National Recreation Area near Cimarron, Colorado.

Tomichi Creek. The 72-mile-long Tomichi Creek begins northwest of Monarch Pass where it flows southwest until it reaches the Town of Sargents. From there, the creek flows in a northwest direction towards its confluence with the Gunnison River just west of the City of Gunnison.

Demographic Conditions and Trends

Historical and current population

The estimated total population in the Gunnison Basin in 2017 was 105,800 (Colorado State Demography Office, 2019). The basin's population grew at an average of 1.6% per year between 1980 and 2010 (Figure A-16). Between 2010 and 2017, population growth in the basin slowed to an average rate of 0.3% per year. Consistent with the approach used in the Colorado Water Plan, 90 percent of the population of Mesa County was apportioned to the Colorado River Basin, while 10 percent of the county's population was attributed to the Gunnison Basin. Similarly, 90 percent of the population of Montrose County was apportioned to the Gunnison Basin, while 10 percent was attributed to the Southwest Basin.

Figure A-16.
Population and Trends, Gunnison Basin Counties and Municipalities, 1980 to 2017

						1980-2010 Avg. Annual Growth		2010-2017 Avg. Annual Growth	
Location	1980	1990	2000	2010	2017	Residents	Pct. Change	Residents	Pct. Change
Delta County	21,225	20,980	27,834	30,952	30,578	324	1.3%	-53	-0.2%
Cedaredge	1,184	1,380	1,854	2,253	2,229	36	2.2%	-3	-0.2%
Orchard City	1,914	2,218	2,880	3,119	3,103	40	1.6%	-2	-0.1%
Delta	3,931	3,789	6,400	8,915	8,888	166	2.8%	-4	0.0%
Hotchkiss	849	744	968	944	927	3	0.4%	-2	-0.3%
Paonia	1,425	1,403	1,497	1,451	1,433	1	0.1%	-3	-0.2%
Crawford	268	221	366	431	422	5	1.6%	-1	-0.3%
Unincorporated	11,654	11,225	13,869	13,839	13,576	73	0.6%	-38	-0.3%
Gunnison County	10,689	10,273	13,956	15,324	16,871	155	1.2%	221	1.4%
Crested Butte	959	878	1,529	1,487	1,656	18	1.5%	24	1.5%
Gunnison	5,785	4,636	5,409	5,854	6,443	2	0.0%	84	1.4%
Unincorporated	3,945	4,759	7,018	7,983	8,772	135	2.4%	113	1.4%
Hinsdale County	408	467	790	843	791	15	2.4%	-7	-0.9%
Lake City	206	223	375	408	377	7	2.3%	-4	-1.1%
Unincorporated	202	244	415	435	414	8	2.6%	-3	-0.7%
Mesa County*	8,153	9,315	11,626	14,672	15,190	217	2.0%	74	0.5%
Collbran	344	228	388	708	695	12	2.4%	-2	-0.3%
De Beque	279	257	451	504	494	8	2.0%	-1	-0.3%
Fruita	2,810	4,042	6,727	12,655	12,913	328	5.1%	37	0.3%
Grand Junction	27,956	29,034	41,986	58,566	65,224	1,020	2.5%	951	1.6%
Palisade	1,551	1,871	2,579	2,579	2,716	34	1.7%	20	0.7%
Unincorporated	48,590	57,713	64,124	71,711	69,858	771	1.3%	-265	-0.4%
Montrose County**	21,917	21,981	30,089	37,148	37,587	508	1.8%	63	0.2%
Montrose	8,722	8,854	12,344	19,132	19,401	347	2.7%	38	0.2%
Naturita	819	434	635	546	534	-9	-1.3%	-2	-0.3%
Nucla	1,027	656	734	711	714	-11	-1.2%	0	0.1%
Olathe	1,262	1,263	1,573	1,849	1,810	20	1.3%	-6	-0.3%
Unincorporated	12,522	13,216	18,146	19,038	19,304	217	1.4%	38	0.2%
Ouray County	1,925	2,295	3,742	4,436	4,783	84	2.8%	50	1.1%
Ouray	684	644	813	1,000	1,034	11	1.3%	5	0.5%
Ridgway	369	423	744	925	1,003	19	3.1%	11	1.2%
Unincorporated	872	1,228	2,185	2,511	2,746	55	3.6%	34	1.3%
Basin Total	**64,317**	**65,310**	**88,036**	**103,376**	**105,800**	**1,302**	**1.6%**	**346**	**0.3%**

Note: *Mesa County data are apportioned between Colorado and Gunnison Basins.

**Montrose County data are apportioned between Gunnison and Southwest Basins.

Source: U.S. Census Bureau, 1980, 1990, 2000, & 2010; Colorado State Demography Office, 2019.

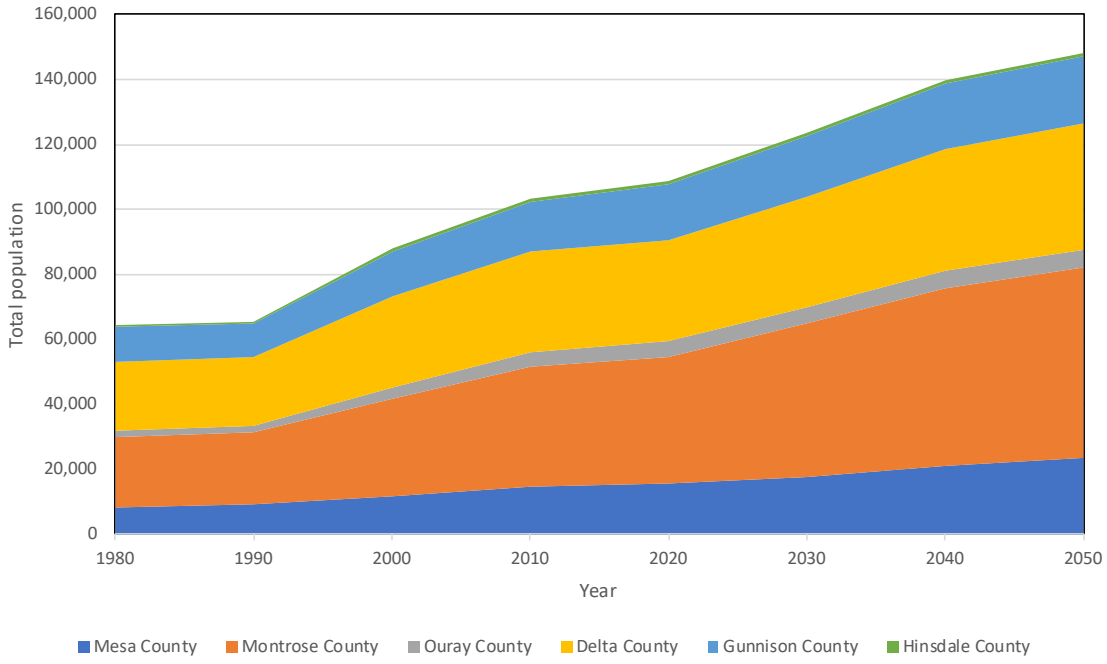
Ouray County experienced the highest average annual rate of population growth between 1980 and 2010 (2.8%) due to population growth in the town of Ridgway and the county's unincorporated areas. Hinsdale, Mesa, and Montrose Counties saw respective average annual growth rates of 2.4%, 2.0%, and 1.8% between 1980 and 2010. The average annual rate of population growth was slowest in Delta (1.3%) and Gunnison (1.2%) Counties.

Since 2010, population growth in the basin has slowed in comparison to the previous 30-year period. Delta and Hinsdale Counties experienced net population loss between 2010 and 2017. The highest average annual rate of population growth between 2010 and 2017 occurred in Gunnison County (1.4%). Crested Butte, Gunnison, and the unincorporated areas of Gunnison County have each experienced population increases at similar average annual rates (1.4-1.5%).

Population projections

As shown in Figure A-17, population in each Gunnison Basin county is projected increase between 2020 and 2050 (Colorado State Demography Office, 2019). The greatest proportion of growth in the basin is projected to occur in the parts of Montrose and Mesa Counties that fall within the basin. Both Montrose and Mesa Counties are projected to experience an average annual growth rate of 1.4% between 2020 and 2050.

Figure A-17.
Population History and Projections, Gunnison Basin Counties, 1980 to 2050



Note: *Mesa County data are apportioned between Colorado and Gunnison Basins.
**Montrose County data are apportioned between Gunnison and Southwest Basins.

Source: U.S. Census Bureau, 1980, 1990, 2000, & 2010; Colorado State Demography Office, 2019.

Population growth in Montrose County—the most populous area within the Gunnison Basin—is projected to account for 44 percent of the basin's total population growth between 2020 and 2050. The smallest change in population is forecast in Ouray County, which is projected to grow by approximately 600 residents between 2020 and 2050.

Demographic characteristics

Generally, the demographic characteristics of the basin are similar to the state as a whole, with a few exceptions. Relative to the state of Colorado, the Gunnison Basin has a smaller proportion of minority residents, with 83 percent of residents identifying as white compared to 69 percent in the state (Figure A-18).

Figure A-18. Demographic Characteristics, Gunnison Basin, 2013 to 2017 Averages

Note:

Following Census-based definitions, individuals living in places with 2,500 residents or more are identified as the urban population.

Source:

U.S. Census Bureau American Community Survey (ACS) 5-Year Estimates, 2012-2017.

	Basin Residents			State of
	Urban*	Rural*	Total	Colorado
Gender				
Female	51%	50%	50%	50%
Male	49%	50%	50%	50%
Age				
Under 18	21%	22%	21%	23%
18-64	61%	59%	60%	64%
65 and Over	18%	19%	19%	13%
Race/Ethnicity				
White, not Latino	79%	86%	83%	69%
Latino	19%	12%	15%	21%
Other Race	2%	1%	2%	10%
Educational Attainment (25 and older)				
High School Degree or Less	37%	41%	39%	31%
Some College/Associate Degree	34%	33%	33%	30%
Bachelors Degree or More	29%	26%	28%	39%
Individual Income (15 and older)				
Under $25,000	47%	41%	44%	35%
$25,000-$49,999	23%	25%	24%	24%
$50,000-$74,999	12%	12%	12%	14%
$75,000 or More	8%	10%	9%	15%
Unreported	*10%*	*11%*	*11%*	*12%*
People Living Below/Near Poverty Level				
Below 100% of Poverty Level	19%	14%	16%	12%
100 to 149% of Poverty Level	11%	10%	10%	8%

The average age of residents is slightly higher than the statewide average. Approximately 19 percent of basin residents are 65 years old or older compared to 13 percent for the state. The proportion of working age adults (aged 18-64) in the basin (60%) is smaller than the statewide average (64%).

Basin residents are slightly more likely to have ended their education with a high school degree or less, particularly outside of the urban areas of the basin. Thirty-nine percent of basin residents aged 25 and older have a high school degree or less, compared to 31 percent of statewide residents.

Individual incomes in the basin are lower than individual incomes for the state, with 44 percent of basin residents earning an annual income of less than $25,000 compared with 35 percent of statewide residents earning less than $25,000. Twenty-six percent of basin residents live at or below 149 percent of the poverty level, compared with 20 percent statewide.

Economic Conditions and Trends

Earnings by sector

In 2017, the Gunnison Basin's largest economic sectors based on work-related earnings were government (22.6%), construction (10.6%), retail trade (8.2%), and mining – including oil and gas (7.4%) (U.S. Bureau of Economic Analysis, 2017). The government sector accounts for approximately one-quarter of earnings in Delta, Gunnison, Hinsdale, and Montrose Counties (Figure A-19).

Figure A-19.
Work Earnings as a Percent of Total, Gunnison Basin Counties, 2017

	Basin Counties						
Sector Earnings 2017	Delta	Gunnison	Hinsdale	Mesa*	Montrose**	Ouray	Basin
Farm Earnings	2.7%	0.5%	2.5%	0.9%	1.6%	0.9%	1.5%
Non-farm Earnings							
Forestry, fishing, and related activities	1.0%	0.1%	(D)	0.2%	0.9%	(D)	0.6% +
Mining, quarrying, and oil and gas extraction	19.3%	7.2%	(D)	6.4%	0.9%	(D)	7.4% +
Utilities	0.7%	1.1%	-0.2%	0.6%	2.6%	(D)	1.4% +
Construction	7.9%	11.9%	15.1%	11.0%	10.4%	17.4%	10.6%
Manufacturing	4.0%	1.2%	1.6%	4.1%	7.5%	3.5%	4.6%
Wholesale trade	1.2%	0.9%	(D)	4.4%	3.5%	0.7%	2.4% +
Retail trade	8.3%	6.9%	(D)	7.6%	9.0%	9.8%	8.2% +
Transportation and warehousing	1.5%	3.9%	(D)	4.5%	3.1%	(D)	3.0% +
Information	0.9%	0.3%	(D)	0.7%	0.7%	0.4%	0.7% +
Finance and insurance	3.8%	2.1%	(D)	4.8%	2.6%	1.4%	3.0% +
Real estate and rental and leasing	0.2%	2.9%	(D)	2.8%	2.7%	6.5%	2.3% +
Professional, scientific, and technical services	3.5%	6.6%	(D)	4.7%	4.4%	9.2%	4.9% +
Management of companies and enterprises	(D)	(D)	(D)	0.5%	1.2%	0.9%	0.5% +
Administrative and support and waste management and remediation services	(D)	(D)	(D)	3.9%	3.3%	3.0%	1.9% +
Educational services	0.5%	0.6%	0.2%	0.5%	(D)	0.8%	0.4% +
Health care and social assistance	9.2%	3.9%	(D)	16.8%	(D)	4.5%	5.9% +
Arts, entertainment, and recreation	0.1%	8.2%	1.2%	0.6%	0.6%	2.1%	2.2%
Accommodation and food services	2.7%	8.5%	8.0%	4.3%	3.5%	12.1%	5.0%
Other services	5.1%	4.9%	5.9%	4.4%	5.7%	4.8%	5.1%
Government and government enterprises	25.3%	24.8%	27.7%	16.5%	22.8%	17.5%	22.6%
Total Reported Data	97.9%	96.7%	61.9%	100.0%	87.2%	95.4%	94.1%
Nondisclosed Percent of Work Income	2.1%	3.3%	38.1%	0.0%	12.8%	4.6%	5.9%

Note: *Mesa County data are apportioned between Colorado and Gunnison Basins.

**Montrose County data are apportioned between Gunnison and Southwest Basins.

+Due to non-disclosure for some sectors and counties, these basin-wide totals are potentially understated.

Source: U.S. Bureau of Economic Analysis, 2017.

Percentages of earnings by industry are based on comparison to total work earnings for each county. In some cases, earnings by sector are not disclosed at the county level, in order to preserve data confidentiality for individual firms that comprise all or most of a particular sector. For example, the earnings data available for Delta County accounts for more than 97 percent of the county's earnings total. Hinsdale County, however, has a greater incidence of nondisclosed work income and the earnings data available for the county represent only 62 percent of the county's total earnings for 2017.

Individual counties in the basin exhibit a few notable differences with respect to leading economic sectors by earnings. In Mesa County, the largest sector is health care and social assistance services (16.8%). This sector is also a primary contributor to total earnings in Delta County (9.2%). The third-largest sector in both Ouray and Gunnison Counties is accommodation and food services

(12.1% and 8.5%, respectively), and in Gunnison County this is closely followed by arts, entertainment, and recreation (8.2%).

Mining, quarrying, and oil and gas extraction is the second largest sector in Delta County, representing 19 percent of total earnings. Mining activity in Delta County comprises the majority share of basin-wide mining activity. Farm earnings are not a major component of earnings in the Gunnison Basin, representing less than 2 percent of total earnings.

Employment by sector

In 2017, there were 63,600 jobs across all disclosed employment sectors in the Gunnison Basin. The largest employment sectors were government (14.6%), retail trade (10.4%), construction (8.6%), and accommodation and food services (8.5%) (U.S. Bureau of Economic Analysis, 2017). Employment in these sectors is distributed across all basin counties, and these are the largest sectors by employment for each individual county (Figure A-20).

Figure A-20.
Employment by Industry, Gunnison Basin Counties, 2017

	Basin Counties							Basin
Sector Employment 2017	Delta	Gunnison	Hinsdale	Mesa*	Montrose**	Ouray	Basin	Employment Share
Farm Employment	1,410	302	34	507	930	147	3,330	5.2%
Non-farm Employment	14,003	13,514	563	8,615	20,030	3,545	60,270	
Forestry, fishing, and related activities	253	82	(D)	43	281	(D)	659	1.0% +
Mining, quarrying, and oil and gas extraction	322	498	(D)	370	251	(D)	1,441	2.3% +
Utilities	61	77	1	22	213	(D)	375	0.6% +
Construction	1,150	1,257	59	632	1,967	397	5,461	8.6%
Manufacturing	700	239	23	353	1,335	140	2,790	4.4%
Wholesale trade	164	107	(D)	273	510	22	1,076	1.7% +
Retail trade	1,711	1,270	(D)	1,009	2,373	277	6,641	10.4% +
Transportation and warehousing	170	205	(D)	301	600	(D)	1,276	2.0% +
Information	195	141	(D)	88	201	25	650	1.0% +
Finance and insurance	576	413	(D)	410	690	191	2,280	3.6% +
Real estate and rental and leasing	1,115	1,215	(D)	553	1,343	360	4,586	7.2% +
Professional, scientific, and technical services	665	835	(D)	411	947	282	3,139	4.9% +
Management of companies and enterprises	(D)	(D)	0	26	167	66	259	0.4% +
Administrative and support and waste management and remediation services	(D)	(D)	(D)	428	815	101	1,343	2.1% +
Educational services	112	181	9	93	(D)	48	443	0.7% +
Health care and social assistance	1,644	483	(D)	1,165	(D)	136	3,428	5.4% +
Arts, entertainment, and recreation	239	1,140	21	191	391	158	2,140	3.4%
Accommodation and food services	913	1,766	70	713	1,335	590	5,387	8.5%
Other services	932	776	29	490	1,289	177	3,693	5.8%
Government and government enterprises	2,525	2,282	99	1,045	2,958	406	9,315	14.6%
Total Employment	15,413	13,816	597	9,122	20,960	3,692	63,600	93.9%
Nondisclosed Employment Sectors	556	547	252	0	2,365	169	3,889	6.1%

Note: *Mesa County data are apportioned between Colorado and Gunnison Basins.

**Montrose County data are apportioned between Gunnison and Southwest Basins.

+Due to non-disclosure for some sectors and counties, these basin-wide totals are potentially understated.

Source: U.S. Bureau of Economic Analysis, 2017.

Delta and Mesa Counties additionally have a large proportion of employment in the health care and social assistance sector (10.7% and 12.8% of total county employment, respectively), and 9.8% of Ouray County's employment is in the real estate, rental, and leasing sector.

Government accounts for 14.6% of basin employment but 22.6% of basin earnings, whereas industries with lower median incomes—like retail trade (8.2% of earnings) and accommodation and food services (4.9% of earnings)—account for fewer earnings than jobs.

Agriculture constitutes 3,330 jobs (5.2%) of the basin's total employment and is a significant source of employment. Farm employment represents a larger share of total county employment in Delta County (9.1%) than in other counties in the basin.

Employment trends

As shown in Figure A-21, total employment was stable between 2007 and 2017, declining by 282 jobs (-0.4%). All counties saw declines in the construction industry, ranging from the loss of 208 jobs in Ouray County to 1,058 jobs in Montrose County.

Figure A-21.
Employment Changes by Industry, Gunnison Basin Counties, 2007 to 2017

	Basin Counties						
Job Changes by Sector, 2007-2017	Delta	Gunnison	Hinsdale	Mesa*	Montrose**	Ouray	Basin
Farm Employment	-18	53	11	88	-46	20	109
Non-farm Employment							
Forestry, fishing, and related activities	-52			9	23		
Mining, quarrying, and oil and gas extraction	-262			2	32		
Utilities	-11	12	0	-1	14		
Construction	-342	-414		-247	-1,058	-208	
Manufacturing	-109	73	5	-17	-86	78	-56
Wholesale trade	-177	12		3	-27	-4	
Retail trade	-156	38		-58	-302	-35	
Transportation and warehousing	-24	20		-27	-81		
Information	4	1		-28	-52	-9	
Finance and insurance	104	69		32	27	77	
Real estate and rental and leasing	363	192		57	-45	41	
Professional, scientific, and technical services	-41	151		-34	-151	33	
Management of companies and enterprises			0	12	128		
Administrative and support and waste management and remediation services				-28	-72		
Educational services		-39	8	35			
Health care and social assistance		50		196			
Arts, entertainment, and recreation	-10	229	4	1	-3	35	257
Accommodation and food services	53	90	16	59	42	41	301
Other services	-78	10		1	-106	-2	
Government and government enterprises	63	433	7	109	220	33	864
Total Employment	-310	700	-15	373	-1,253	311	-282
Nondisclosed Employment Sectors	383	-280	-66	210	288	211	746

Note: *Mesa County data are apportioned between Colorado and Gunnison Basins.

**Montrose County data are apportioned between Gunnison and Southwest Basins.

Basin-wide job changes are only calculated for sectors for which there are data for all counties.

Source: U.S. Bureau of Economic Analysis, 2007 & 2017.

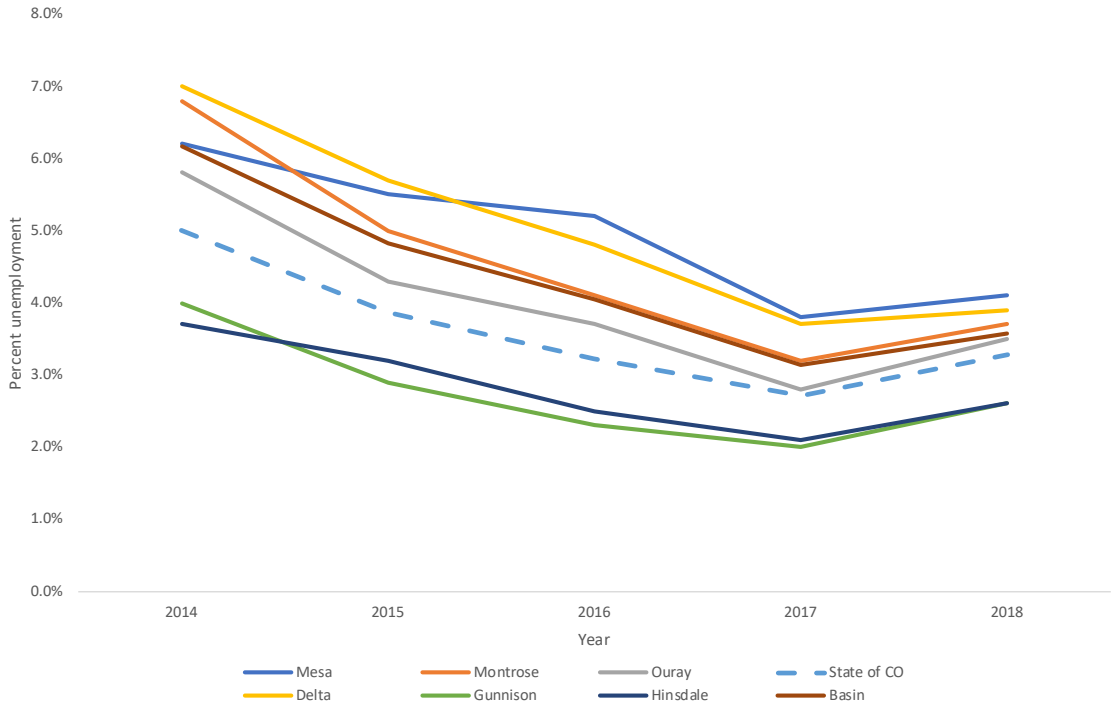
Employment in retail trade decreased, with Montrose and Delta Counties losing 302 and 156 retail jobs, respectively. However, these job losses were offset by substantial employment growth in other sectors, such as government, which grew by 864 jobs in the basin between 2007 and 2017.

Between 2007 and 2017, Montrose County experienced the largest net loss of jobs in the basin (-1,253 jobs), due in part to losses in construction, retail trade, and professional services. Gunnison County experienced the largest net gain (+700 jobs), due in part to employment growth in the government; arts, entertainment, and recreation; and real estate sectors.

Unemployment

Unemployment rates in the Gunnison Basin dropped steadily from 6.2% to 3.1% between 2014 and 2017 and then rose to 3.6% in 2018. This basin-wide trend is similar to the state-wide trend in unemployment rates over the same time period (Figure A-22), although the unemployment rate in the basin is consistently higher than the state.

Figure A-22.
Unemployment Rates, Gunnison Basin Counties, 2014 to 2018



Source: Colorado State Demography Office, 2019.

The basin-wide unemployment rate reflects a mix of very low unemployment in Gunnison and Hinsdale Counties (e.g., 2.6% in 2018) and somewhat higher unemployment rates in the other four counties in the basin (e.g., between 3.5% and 4.1% in 2018). Delta and Mesa Counties have had the highest unemployment rates of any basin counties since 2015.

Personal income

Total personal income in the Gunnison Basin in 2017 was approximately $4.3 billion, most of which is from income earned through work (53%). Dividends, interest, and rent account for 25 percent of personal income. Transfer receipts, such as government social benefits, account 21 percent (Figure A-23).

Figure A-23.
Sources of Personal Income, Gunnison Basin and State of Colorado, 2017

Source: U.S. Bureau of Economic Analysis, 2017.

At the state level, a greater percentage of income is earned through work (65%) compared to the basin, while 22 percent is from dividends, interest, and rent and 13 percent is from transfer receipts. Compared to the state, transfer receipts constitute a larger portion of personal income in the Gunnison Basin due to the amount of income from transfer receipts in Delta (26.3%) and Montrose (24.7%) Counties. In contrast, residents of Gunnison, Hinsdale, and Ouray Counties obtain a higher proportion of personal income from dividends, interest, and rent (33%, 45%, and 37%, respectively) than at the state level.

Community-level economic indicators

Household income. Figures A-24 and A-25 provide greater detail on the community-level economic characteristics of the Gunnison Basin. Of the 18 cities and towns in the basin, Marble and Crested Butte have the highest median annual household incomes at $79,000 and $67,000, respectively (Figure A-24).

Figure A-24.
Median Household Income, Gunnison Basin Municipalities, 2017

Median Household Income**	2017*	5-Year Chg.		2017*	5-Year Chg.
Cedaredge	$36,364	-4%	Mount Crested Butte	$53,654	-6%
Crawford	$28,958	-31%	Naturita	$33,750	-2%
Crested Butte	$67,279	14%	Nucla	$30,278	-43%
Delta	$38,708	-15%	Olathe	$31,375	-21%
Gunnison	$41,510	-3%	Orchard City	$37,500	-19%
Hotchkiss	$30,563	-21%	Ouray	$63,558	-9%
Lake City	$54,444	-3%	Paonia	$37,330	-36%
Marble	$78,750	48%	Pitkin	$59,250	61%
Montrose	$42,930	-14%	Ridgway	$43,438	-43%

Note:

*2012-2017 American Community Survey (ACS). Reflects average of data collected over 5-year period. 5-year change based on comparisons to 2007-2012 ACS.

**Inflation-adjusted comparison.

Source:

U.S. Census Bureau American Community Survey (ACS) 5-Year Estimates, 2012-2017.

Two-thirds of the cities and towns in the basin have median annual household incomes of less than $50,000. After adjusting for inflation, median household incomes declined in 15 out of 18 municipalities in the basin between 2012 and 2017 (ACS 5-Year Estimates, 2007-2012 & 2012-2017), with reductions ranging from -2 percent to -43 percent.

Employment. As shown in Figure A-25, the total number of employed residents declined in 11 of the 18 cities and towns in the Gunnison Basin between 2012 and 2017, with the largest percentage decline seen in Crawford (-72%) (ACS 5-Year Estimates, 2007-2012 & 2012-2017). Montrose—which accounted for 37 percent of the basin's total employed residents in 2017—maintained stable employment levels with a 1 percent increase in the total number of employed residents between 2012 and 2017.

Figure A-25.
Total Employed Residents, Gunnison Basin Municipalities, 2017

Total employment	2017*	5-Year Chg.		2017*	5-Year Chg.
Cedaredge	677	-22%	Mount Crested Butte	723	40%
Crawford	68	-72%	Naturita	211	47%
Crested Butte	856	-18%	Nucla	228	-10%
Delta	3,158	-14%	Olathe	673	-5%
Gunnison	3,888	16%	Orchard City	993	-18%
Hotchkiss	344	-21%	Ouray	428	-14%
Lake City	208	32%	Paonia	610	-7%
Marble	79	84%	Pitkin	46	667%
Montrose	7,966	1%	Ridgway	604	13%

Note:

*2012-2017 American Community Survey (ACS). Reflects average of data collected over 5-year period. 5-year change based on comparisons to 2007-2012 ACS.

Source:

U.S. Census Bureau American Community Survey (ACS) 5-Year Estimates, 2012-2017.

Agricultural Conditions and Trends

The largest component of the agricultural economy of the Gunnison Basin is livestock production, which constitutes 57 percent (2,092 jobs) of agricultural employment, 63 percent ($144 million) of agricultural output, and 44 percent ($32 million) of agricultural income in the basin (IMPLAN, 2016). Almost 87 percent of livestock jobs are in beef cattle ranching (Figure A-26).

Figure A-26.
Agricultural Industry Economic Detail, Gunnison Basin, 2016

Agricultural Sector	Employment	Output (Receipts)	Income*	Production/ Import Taxes**	Total Value-Added (GRP)
Grain farming	141	$17,481,630	$2,292,805	-$254,747	$2,038,058
Vegetable and melon farming	101	$8,147,369	$4,454,127	$118,780	$4,572,907
Fruit farming	360	$18,919,804	$11,439,349	$589,657	$12,029,006
Greenhouse, nursery, and floriculture production	75	$5,292,503	$3,324,828	$35,107	$3,359,935
All other crop farming***	384	$11,956,384	$6,248,430	$95,679	$6,344,109
Total crop farming	**1,061**	**$61,797,690**	**$27,759,539**	**$584,476**	**$28,344,015**
Beef cattle ranching and farming, including feedlots****	1,820	$110,319,130	$20,813,182	$973,716	$21,786,898
Dairy cattle and milk production	118	$25,959,187	$7,051,210	$281,882	$7,333,093
Animal production, except cattle and poultry and eggs	154	$7,765,792	$4,190,512	$128,906	$4,319,418
Total livestock production	**2,092**	**$144,044,108**	**$32,054,904**	**$1,384,505**	**$33,439,409**
Commercial logging	42	$2,987,291	$1,214,257	$93,875	$1,308,133
Commercial fishing	0	$0	$0	$0	$0
Commercial hunting and trapping	35	$1,578,666	$931,652	$194,784	$1,126,436
Total forestry, hunting and fishing	**77**	**$4,565,957**	**$2,145,909**	**$288,659**	**$2,434,569**
Support activities for agriculture and forestry	**412**	**$16,902,651**	**$11,617,696**	**$306,362**	**$11,924,057**
Total direct agricultural activity	**3,642**	**$227,310,407**	**$73,578,048**	**$2,564,001**	**$76,142,049**

Note: *Income includes employee and proprietor earnings and property-related income.

**Includes sales and excise taxes, property taxes, special assessments and subsidies.

***Predominantly hay and alfalfa production.

****Includes dual purpose ranches/farms.

Source: IMPLAN, 2016.

Fruit farming is a significant component of crop farming in the basin, representing approximately 34 percent of employment, 31 percent of output, and 41 percent of income in the crop farming sector. Employment in "other crop farming"—primarily hay and alfalfa production—accounts for a further 36 percent of crop farming employment. Output from grain farming constitutes another 28 percent of total crop output in the basin.

Farm characteristics

According to the latest Census of Agriculture in 2017, there were 900,000 acres of land in farms in the Gunnison Basin (Figure A-27). Approximately 16 percent (141,000 acres) were harvested and 23 percent (207,000 acres) were under irrigation. Approximately 126,000 irrigated acres were harvested in 2017, and 66,000 irrigated acres were maintained as pastureland.

Figure A-27.
Agricultural Census Trends, Gunnison Basin, 2007 to 2017

Note:

*Harvested cropland was undisclosed in 2012 in Hinsdale and Ouray Counties. Acreages estimated based on average of 2007 and 2017 reports.

**BLS inflation calculator, based on July values.

***Market values were undisclosed in 2017 in Hinsdale County. Market values based on average of 2007 and 2012 reports.

Source:

USDA Census of Agriculture, 2007, 2012, & 2017.

Metrics	2007	2012	2017
Number of Farms	2,723	2,871	3,341
Median Size of Farms (acres)	50	46	36
Average Size of Farms (acres)	303	293	269
Farms with Irrigation	2,244	2,345	2,816
Land in Farms (acres)	825,524	841,047	899,597
Harvested Cropland (acres)	130,269	137,723 *	141,467
Irrigated Land (acres)	192,391	178,124	206,711
Market Value ($000s)			
Crops	$44,926	$57,947	$58,735 ***
Livestock	$76,374	$104,964	$113,349 ***
Total	$121,300	$162,911	$172,084
Inflation-adjusted Market Value in $2017**	$142,552	$174,054	$172,084

In 2017, approximately 84 percent of the basin's 3,340 farms were irrigated, with an average of 73 irrigated acres per irrigating farm. Median farm size in the basin was 36 acres in 2017, a decline of 28 percent since 2007 (USDA Census of Agriculture, 2007 & 2017).

In 2017, 50 percent of farms in the basin had total annual sales of less than $2,500, while 13 percent of farms had annual sales of more than $50,000. However, after adjusting for inflation, total farm receipts in 2017 were approximately equivalent to 2012 and about 21 percent higher than in 2007.

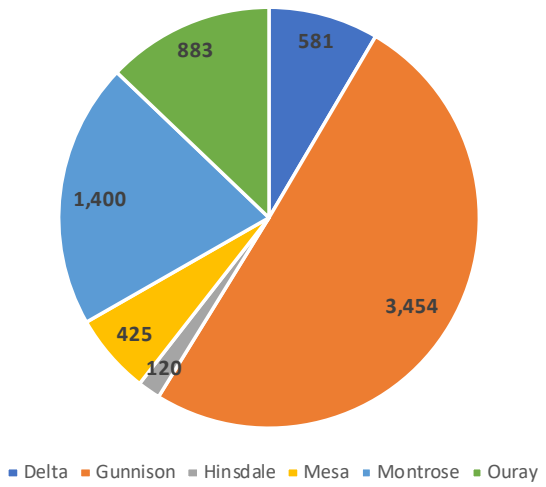
Estimates of total irrigated land of the Census of Agriculture differ somewhat from the more refined estimates developed for the Colorado Decision Support System (CDSS) and used in the Colorado Water Plan. The latest estimates for the Technical Update to the Water Plan indicate a total of approximately 234,000 irrigated acres in the Gunnison Basin, and annual consumptive use of 485,000 acre-feet per year on those acres. These numbers correspond to average consumptive use of about 2.1 acre-feet per acre (State Water Plan Technical Update, 2019).

Tourism and Recreation Economy

The Gunnison Basin tourism and recreation economy depends on water to directly and indirectly support activities such as fishing, hunting, wildlife-watching, boating, and swimming. The Colorado State Demography Office (SDO) estimates that tourism jobs constitute approximately 20 percent (6,900 jobs) of direct basic jobs in the basin (i.e., jobs that bring outside dollars into the community by selling goods or services) (Figure A-28).

Figure A-28.
Estimated Direct Tourism Jobs, Gunnison Basin Counties, 2018

Source:
Colorado State Demography Office, 2019.



Within the basin, tourism supports a total of 10,500 direct and indirect jobs (i.e., jobs created as the result of goods and services sold by direct basic jobs).

The SDO definition of tourism includes resort activity (e.g., skiing, national parks, rafting), second home expenditures, and service employment and transportation jobs supported by visitation. Half of the basin's direct basic tourism jobs are in Gunnison County and another 20 percent are in Montrose County.

Further analysis from BBC using data from a 2017 study by the Colorado Department of Parks and Wildlife (CPW) finds that approximately 2,300 direct and indirect jobs in the Gunnison Basin are supported by wildlife-related activity (1,400 jobs) and water-related recreation (900 jobs). These types of recreation correspond to approximately 22 percent of the basin's total tourism-related economic activity. Wildlife- and water-related recreation comprise a large share of the tourism-related economy in Delta and Montrose Counties, but a small share in Gunnison and Ouray Counties.

Southwest River Basin

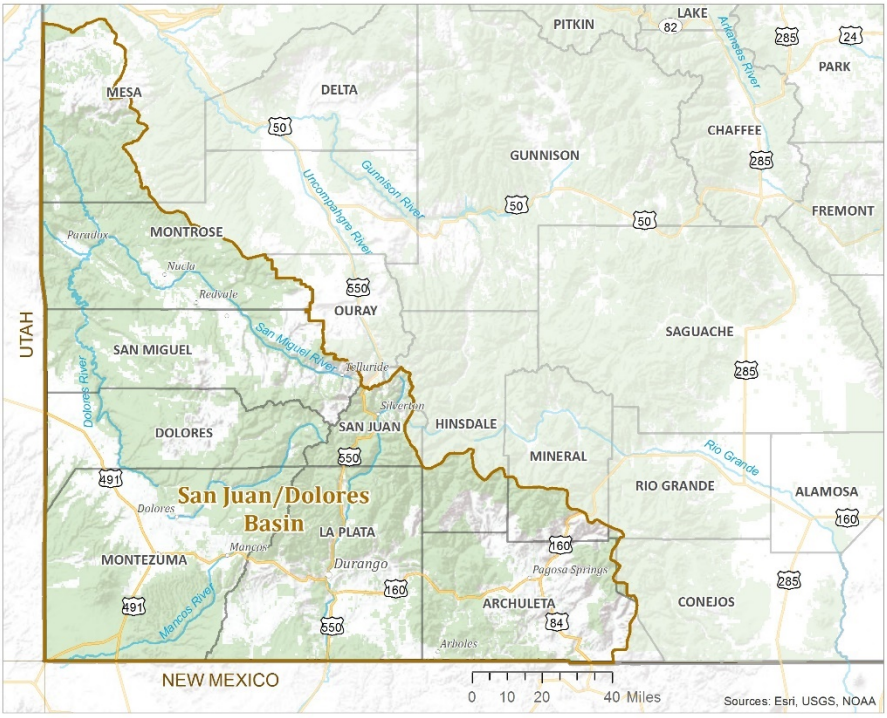
Geography

The Southwest Basin is shown in Figure A-29. As defined for Colorado water planning purposes, the basin consists of nine separate river sub-basins. However, the San Juan and Dolores Rivers are the basin's primary tributaries to the Colorado River. Other rivers in the basin are tributaries of the San Juan and Dolores Rivers.

Figure A-29. The Southwest Basin

Source:

BBC Research & Consulting, 2019.



San Juan. The 383-mile-long San Juan River is one of the major tributaries to the Colorado River and provides the primary drainage for the Four Corners region. The river begins in the San Juan Mountains northeast of the Town of Pagosa Springs. From there it flows southwest where it crosses the New Mexico state line before joining the Colorado River at Glen Canyon. It runs through a very dry and arid region of the Colorado Plateau and provides the only significant source of surface water for surrounding communities. The river is an important source of irrigation water for the Navajo Nation. The river's historic terminus was inundated when the Bureau of Reclamation began filling Lake Powell in 1963.

The Animas. The 126-mile-long Animas River is a major tributary of the San Juan River. The headwaters of the Animas are located north of the town of Silverton in the San Juan Mountains. The river flows south through remote mountain landscapes before passing through the City of Durango, 60 miles north of its confluence with the San Juan River in the City of Farmington, New Mexico. The Animas is a popular river for rafting, kayaking, and fishing and also provides water for irrigation and municipal supplies.

The Piedra. The 40-mile-long Piedra River is a tributary of the San Juan River. It begins in the San Juan Mountains approximately 40 miles north of the Town of Pagosa Springs. It flows through a series of isolated canyons until it joins the San Juan River at Navajo Lake.

The Pine (Los Pinos). The Los Pinos River is a tributary of the San Juan River that originates near Weminuche Pass and flows into Vallecito Reservoir.

The La Plata. The 70-mile-long La Plata River is a tributary of the San Juan River. Its headwaters are located in the La Plata Mountains northwest of the City of Durango. From there it flows south and joins the San Juan River just outside of Farmington, New Mexico.

The Mancos. The 85-mile-long Mancos River, a tributary of the San Juan River, begins in the La Plata Mountains northwest of the City of Durango. Beginning at its source, the river flows north before turning west and then south as it flows through the Town of Mancos in Montezuma County. From there it continues to flow southwest before joining the San Juan River in the Four Corners region of New Mexico.

McElmo Creek. The 70-mile-long McElmo Creek is a tributary of the San Juan River. The river's headwaters are just east of the Town of Cortez in Montezuma County.

The Dolores. The 241-mile-long Dolores River is a tributary of the Colorado River, which drains a large area of the Colorado Plateau. It was explored as early as 1765 by Spanish explorers from Santa Fe. The river's headwaters are located high in the San Juan Mountains east of the Town of Rico in Dolores County. From its source, it flows southwest into McPhee Reservoir, which was created to provide a source of irrigation water for local agricultural operations. Below the reservoir, the river flows north through Dolores River Canyon before being joined by the San Miguel River, its main tributary. In dry years, the San Miguel can provide most of the Dolores's flow below their confluence due to the large number of agricultural diversions on the Dolores. The river flows into the Colorado River approximately 30 miles north of Moab, Utah.

The San Miguel. The San Miguel River is an 81-mile-long tributary of the Dolores River. The river's headwaters are located high in the San Juan Mountains near the Town of Telluride. The river flows northwest from its headwaters through the Uncompahgre Plateau and the Towns of Placerville and Nucla in San Miguel County and Montrose County, respectively, before joining the Dolores River near the Utah state line. The lower sections of the river are popular with recreationists due to the variety of moderate river runs. It also provides water for agricultural operations along its reach.

Demographic Conditions and Trends

Historical and current population

The estimated total population in the Southwest Basin in 2017 was 109,906 (Colorado State Demography Office, 2019). The basin's population grew at an average rate of 2.1% per year between 1980 and 2010 (Figure A-30). Between 2010 and 2017, average population growth in the basin slowed to rate of 0.9% per year. Consistent with the approach used in the Colorado Water Plan, 90 percent of the population of Montrose County was apportioned to the Gunnison Basin, while 10 percent was attributed to the Southwest Basin.

Figure A-30.
Population and Trends, Southwest Basin Counties and Municipalities, 1980 to 2017

						1980-2010 Avg. Annual Growth		2010-2017 Avg. Annual Growth	
Location	1980	1990	2000	2010	2017	Residents	Pct. Change	Residents	Pct. Change
Archuleta County	3,664	5,345	9,898	12,084	13,316	281	4.1%	176	1.4%
Pagosa Springs	1,331	1,207	1,591	1,727	1,937	13	0.9%	30	1.7%
Unincorporated	2,333	4,138	8,307	10,357	11,379	267	5.1%	146	1.4%
Dolores County	1,658	1,504	1,844	2,064	2,040	14	0.7%	-3	-0.2%
Dove Creek	826	643	698	735	722	-3	-0.4%	-2	-0.3%
Rico	76	92	205	265	263	6	4.3%	0	-0.1%
Unincorporated	756	769	941	1,064	1,055	10	1.1%	-1	-0.1%
La Plata County	27,195	32,284	43,941	51,334	55,619	805	2.1%	612	1.2%
Bayfield	724	1,090	1,549	2,333	2,702	54	4.0%	53	2.1%
Durango	11,649	12,430	13,922	16,887	18,518	175	1.2%	233	1.3%
Ignacio	667	720	669	697	725	1	0.1%	4	0.6%
Unincorporated	14,155	18,044	27,801	31,417	33,674	575	2.7%	322	1.0%
Montezuma County	16,510	18,672	23,830	25,535	26,074	301	1.5%	77	0.3%
Cortez	7,095	7,284	7,977	8,482	8,699	46	0.6%	31	0.4%
Dolores	1,658	1,504	1,844	936	962	-24	-1.9%	4	0.4%
Mancos	870	842	1,119	1,336	1,410	16	1.4%	11	0.8%
Unincorporated	6,887	9,042	12,890	14,781	15,003	263	2.6%	32	0.2%
Montrose County*	2,435	2,442	3,343	4,128	4,176	56	1.8%	7	0.2%
Montrose	8,722	8,854	12,344	19,132	19,401	347	2.7%	38	0.2%
Naturita	819	434	635	546	534	-9	-1.3%	-2	-0.3%
Nucla	1,027	656	734	711	714	-11	-1.2%	0	0.1%
Olathe	1,263	1,573	1,573	1,849	1,810	20	1.3%	-6	-0.3%
Unincorporated	12,521	12,906	18,146	19,038	19,304	217	1.4%	38	0.2%
San Juan County	833	745	558	699	714	-4	-0.6%	2	0.3%
Silverton	794	716	531	637	649	-5	-0.7%	2	0.3%
Unincorporated	39	29	27	62	65	1	1.6%	0	0.7%
San Miguel County	3,192	3,653	6,594	7,359	7,967	139	2.8%	87	1.1%
Mountain Village	0	0	978	1,320	1,394	44	-	11	0.8%
Norwood	478	429	438	518	560	1	0.3%	6	1.1%
Ophir	38	69	113	159	192	4	4.9%	5	2.7%
Sawpit	41	36	25	40	44	0	-0.1%	1	1.4%
Telluride	1,047	1,309	2,221	2,325	2,527	43	2.7%	29	1.2%
Unincorporated	1,588	1,810	2,819	2,997	3,250	47	2.1%	36	1.2%
Basin Total	**55,487**	**64,645**	**90,008**	**103,203**	**109,906**	**1,591**	**2.1%**	**958**	**0.9%**

Note: *Montrose County data are apportioned between Gunnison and Southwest Basins.

Source: U.S. Census Bureau, 1980, 1990, 2000, & 2010; Colorado State Demography Office, 2019.

Archuleta County experienced the highest average annual rate of population growth between 1980 and 2010 (4.1%) due to population growth in the county's unincorporated areas. San Miguel and La Plata Counties saw respective average annual growth rates of 2.8% and 2.1% between 1980 and 2010, driven by population growth rates in Telluride (2.7%) and Bayfield (4.0%). In the

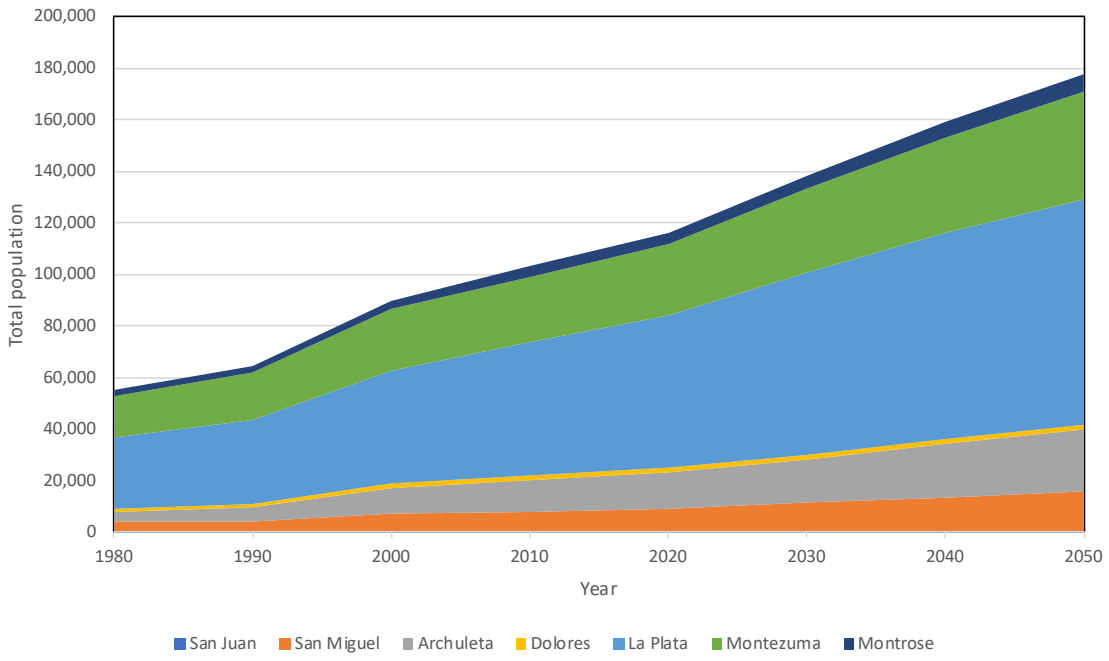
basin, the average annual rate of population growth was slowest in San Juan (-0.6%) and Dolores (0.7%) Counties.

Since 2010, population growth in the basin has slowed in comparison to the previous 30-year period. Dolores County experienced net population loss between 2010 and 2017. The highest average annual rate of population growth between 2010 and 2017 occurred in Archuleta County (1.4%). Durango—county seat of La Plata County and the most populous city in the Southwest Basin—grew by 233 residents between 2010 and 2017, with an average annual growth rate of 1.3%.

Population projections

As shown in Figure A-31, total population in the Southwest Basin is projected to grow by a total of 62,000 residents between 2020 and 2050 (Colorado State Demography Office, 2019). Approximately 46 percent of the basin's population growth between 2020 and 2050 is projected to occur in La Plata County.

Figure A-31.
Population History and Projections, Southwest Basin Counties, 1980 to 2050



Note: *Montrose County data are apportioned between Gunnison and Southwest Basins.

Source: U.S. Census Bureau, 1980, 1990, 2000, & 2010; Colorado State Demography Office, 2019.

Population growth is not projected to occur across all counties in the basin. Dolores and San Juan Counties are projected to experience net population loss, with overall growth rates of -1.7% and -0.9%, respectively, between 2020 and 2050. However, these two counties combined represent only 2.5% of the basin's total population. Each other county in the basin is projected to grow by between 48 and 76 percent between 2020 and 2050.

Demographic characteristics

The demographic characteristics of the basin are similar to the state as a whole, with a few notable exceptions. Relative to the state of Colorado, the Southwest Basin has a smaller proportion of minority residents, with 23 percent of residents identifying as a race other than white compared to 31 percent for the state as a whole (Figure A-32).

Figure A-32. Demographic Characteristics, Southwest Basin, 2013 to 2017 Averages

Note:

Following Census-based definitions, individuals living in places with 2,500 residents or more are identified as the urban population.

Source:

U.S. Census Bureau American Community Survey (ACS) 5-Year Estimates, 2012-2017.

	Basin Residents			State of
	Urban*	Rural*	Total	Colorado
Gender				
Female	51%	50%	50%	50%
Male	49%	50%	50%	50%
Age				
Under 18	20%	21%	21%	23%
18-64	67%	59%	61%	64%
65 and Over	12%	20%	19%	13%
Race/Ethnicity				
White, not Latino	76%	78%	78%	69%
Latino	13%	16%	15%	21%
Other Race	12%	6%	7%	10%
Educational Attainment (25 and older)				
High School Degree or Less	25%	36%	34%	31%
Some College/Associate Degree	31%	32%	32%	30%
Bachelors Degree or More	44%	32%	35%	39%
Individual Income (15 and older)				
Under $25,000	40%	42%	41%	35%
$25,000-$49,999	27%	26%	26%	24%
$50,000-$74,999	13%	13%	13%	14%
$75,000 or More	11%	10%	10%	15%
Unreported	*9%*	*9%*	*9%*	*12%*
People Living Below/Near Poverty Level				
Below 100% of Poverty Level	14%	13%	14%	12%
100 to 149% of Poverty Level	11%	10%	10%	8%

The average age of residents is slightly higher than the statewide average. Approximately 19 percent of basin residents are 65 years old or older compared to 13 percent for the state. The proportion of working age adults (aged 18-64) in the basin (61%) is smaller than the statewide average (64%).

Basin residents are slightly more likely to have ended their education with a high school degree or less, particularly outside of the urban areas of the basin. Thirty-four percent of basin residents aged 25 and older have a high school degree or less, compared to 31 percent of statewide residents.

Individual incomes in the basin are lower than individual incomes for the state, with 41 percent of basin residents earning an annual income of less than $25,000 compared with 35 percent of statewide residents earning less than $25,000. Twenty-four percent of basin residents live at or below 149 percent of the poverty level, compared with 20 percent statewide.

Economic Conditions and Trends

Earnings by sector

In 2017, the Southwest Basin's largest economic sectors based on work-related earnings were government (20.0%), health care and social assistance services (11.7%), and construction (11.0%) (U.S. Bureau of Economic Analysis, 2017). The government sector was the largest single source of earnings in six out of seven basin counties in 2017, representing from 19.5% of earnings in La Plata County to 35.6% of earnings in Dolores County (Figure A-33). Percentages of earnings by industry are based on comparison to total work earnings for each county. In some cases, earnings by sector are not disclosed at the county level, in order to preserve data confidentiality for individual firms that comprise all or most of a particular sector. For example, the earnings data available for Archuleta County account for more than 96 percent of the county's earnings total, while Dolores County's reported data account for only 51 percent of its earnings total.

Figure A-33.
Work Earnings as a Percent of Total, Southwest Basin Counties, 2017

	Basin Counties							
Sector Earnings 2017	Archuleta	Dolores	La Plata	Montezuma	Montrose*	San Juan	San Miguel	Basin
Farm Earnings	2.5%	5.0%	0.1%	0.7%	6.0%	0.0%	0.5%	0.7%
Non-farm Earnings								
Forestry, fishing, and related activities	0.4%	(D)	(D)	0.6%	0.9%	1.2%	(D)	0.2% +
Mining, quarrying, and oil and gas extraction	1.0%	(D)	3.7%	4.9%	0.9%	1.3%	(D)	3.1% +
Utilities	(D)	-0.1%	0.8%	1.6%	2.5%	-0.1%	0.2%	0.8% +
Construction	17.5%	(D)	10.4%	7.6%	10.0%	(D)	15.4%	11.0% +
Manufacturing	1.8%	(D)	2.3%	3.7%	7.2%	(D)	2.2%	2.6% +
Wholesale trade	(D)	(D)	2.2%	2.7%	3.3%	(D)	1.3%	2.0% +
Retail trade	11.2%	6.7%	6.5%	9.9%	8.6%	18.6%	6.0%	7.5%
Transportation and warehousing	1.2%	(D)	8.7%	3.2%	3.0%	(D)	4.1%	6.3% +
Information	-0.2%	(D)	1.3%	0.4%	0.7%	(D)	-0.1%	0.8% +
Finance and insurance	3.2%	(D)	5.4%	2.5%	2.5%	(D)	1.8%	4.1% +
Real estate and rental and leasing	4.5%	(D)	3.3%	1.9%	2.6%	(D)	5.8%	3.4% +
Professional, scientific, and technical services	6.9%	1.7%	7.7%	3.2%	4.2%	2.3%	6.8%	6.6%
Management of companies and enterprises	0.3%	0.0%	(D)	0.8%	1.2%	0.0%	0.4%	0.2% +
Administrative and support and waste management and remediation services	3.5%	2.1%	2.6%	0.7%	3.2%	(D)	5.0%	2.7% +
Educational services	0.7%	(D)	1.1%	1.3%	(D)	(D)	1.6%	1.1% +
Health care and social assistance	6.2%	(D)	13.7%	16.5%	(D)	(D)	3.9%	11.7% +
Arts, entertainment, and recreation	0.9%	(D)	1.5%	1.3%	0.6%	(D)	(D)	1.2% +
Accommodation and food services	7.9%	(D)	4.8%	5.0%	3.4%	(D)	(D)	4.4% +
Other services	7.8%	(D)	3.7%	4.8%	5.4%	5.3%	5.5%	4.5% +
Government and government enterprises	19.7%	35.6%	19.5%	26.8%	21.8%	20.1%	12.5%	20.0%
Total Reported Data	96.9%	51.1%	99.3%	100.0%	87.8%	48.8%	72.8%	94.9%
Nondisclosed Percent of Work Income	3.1%	48.9%	0.7%	0.0%	12.2%	51.2%	27.2%	5.1%

Note: *Montrose County data are apportioned between Gunnison and Southwest Basins.

+Due to non-disclosure for some sectors and counties, these basin-wide totals are potentially understated.

Source: U.S. Bureau of Economic Analysis, 2017.

In contrast to the other counties in the basin, the largest sector by earnings in San Miguel County is construction (15.4%) rather than government (12.5%). Retail trade is the fourth-largest source of work earnings in the basin and constitutes more than 10 percent of earnings in Archuleta County (11.2%) and San Juan County (18.6%). Neither the mining sector (0.2%) nor the agricultural sector (0.7%) contribute substantially to work earnings in the Southwest Basin.

Employment by sector

In 2017, there were 78,200 jobs across all disclosed employment sectors in the Southwest Basin (Figure A-34). The largest employment sectors were government (14.2%), retail trade (10.1%), health care and social assistance services (9.0%), and construction (8.5%) (U.S. Bureau of Economic Analysis, 2017).

Figure A-34.
Employment by Industry, Southwest Basin Counties, 2017

	Basin Counties								Basin Employment
Sector Employment 2017	Archuleta	Dolores	La Plata	Montezuma	Montrose*	San Juan	San Miguel	Basin	Share
Farm Employment	361	274	1,184	1,149	398	0	144	3,510	4.5%
Non-farm Employment									
Forestry, fishing, and related activities	102	(D)	(D)	154	31	8	(D)	295	0.4% +
Mining, quarrying, and oil and gas extraction	185	(D)	1,484	462	28	24	(D)	2,183	2.8% +
Utilities	(D)	1	167	107	24	1	25	325	0.4% +
Construction	1,022	(D)	3,703	872	219	(D)	803	6,619	8.5% +
Manufacturing	205	(D)	1,037	519	148	(D)	196	2,105	2.7% +
Wholesale trade	(D)	(D)	748	272	57	(D)	40	1,117	1.4% +
Retail trade	1,041	90	4,098	1,703	264	75	617	7,888	10.1%
Transportation and warehousing	80	(D)	856	278	67	(D)	89	1,370	1.8% +
Information	81	(D)	558	82	22	(D)	76	819	1.0% +
Finance and insurance	294	(D)	1,953	477	77	(D)	341	3,142	4.0% +
Real estate and rental and leasing	852	(D)	2,728	642	149	(D)	1,251	5,622	7.2% +
Professional, scientific, and technical services	464	25	2,637	611	105	19	598	4,459	5.7%
Management of companies and enterprises	72	0	(D)	136	19	1	90	318	0.4% +
Administrative and support and waste management and remediation services	338	21	1,494	308	91	(D)	437	2,689	3.4% +
Educational services	101	(D)	673	278	(D)	(D)	194	1,246	1.6% +
Health care and social assistance	487	(D)	4,343	1,874	(D)	(D)	320	7,024	9.0% +
Arts, entertainment, and recreation	206	(D)	1,705	199	43	(D)	(D)	2,153	2.8% +
Accommodation and food services	902	(D)	3,673	1,210	148	(D)	(D)	5,933	7.6% +
Other services	716	(D)	1,894	810	143	25	593	4,181	5.3% +
Government and government enterprises	882	240	5,977	2,796	329	76	837	11,137	14.2%
Total Employment	8,495	1,138	41,283	14,939	2,624	624	9,089	78,192	91.8%
Nondisclosed Employment Sectors	104	487	371	0	0	395	2,438	6,423	8.2%

Note: *Montrose County data are apportioned between Gunnison and Southwest Basins

+Due to non-disclosure for some sectors and counties, these basin-wide totals are potentially understated.

Source: U.S. Bureau of Economic Analysis, 2017.

The accommodation and food services sector also provides a substantial amount of employment in Archuleta (10.6%), La Plata (8.9%), and Montezuma (8.1%) Counties. Additionally, the real estate, rental, and leasing sector supplies significant employment in Archuleta County (10.0%) and San Miguel County (13.8%). Agriculture constitutes 3,510 jobs (4.5%) of the basin's total employment. The greatest number of agricultural jobs was in La Plata County (1,184 jobs) and Montezuma County (1,149 jobs).

Employment trends

Between 2007 and 2017, total employment in the Southwest Basin increased by approximately 3,600 jobs (4.8%). During that time, all counties in the basin experienced job losses in the construction industry (Figure A-35). However, basin-wide job losses were offset by employment growth, particularly in health care and social assistance services; mining; finance and insurance; and real estate, rental, and leasing.

Figure A-35.
Employment Changes by Industry, Southwest Basin Counties, 2007 to 2017

Job Changes by Sector, 2007-2017	Basin Counties							Basin
	Archuleta	Dolores	La Plata	Montezuma	Montrose*	San Juan	San Miguel	
Farm Employment	63	-19	44	-7	33	0	9	123
Non-farm Employment								
Forestry, fishing, and related activities				11	3	-1		
Mining, quarrying, and oil and gas extraction	82		447	281	4			
Utilities		0	38	5	2	-2	10	
Construction	-348		-958	-568	-118		-537	
Manufacturing	72		238	-46	-10		35	
Wholesale trade			-46	44	-3		3	
Retail trade	10	-2	-119	8	-34		11	
Transportation and warehousing	16		20	-5	-9		4	
Information	-21		-56	-59	-6		-76	
Finance and insurance	17		376	70	3		113	
Real estate and rental and leasing	-91		380	-5	-5		216	
Professional, scientific, and technical services	-12	-34	6	-48	-17		32	
Management of companies and enterprises		0			14	1	59	
Administrative and support and waste management and remediation services		-12	-217		-8		106	
Educational services			234	215			58	
Health care and social assistance			1,050	486			61	
Arts, entertainment, and recreation	-7		431	-12	0			
Accommodation and food services	66		149	67	5			
Other services	45		148	36	-12		41	
Government and government enterprises	207	41	258	-361	24	2	-1	170
Total Employment	323	-11	2,513	114	-88	97	671	3,619
Nondisclosed Employment Sectors	224	15	90	2	46	97	527	3,326

Note: *Montrose County data are apportioned between Gunnison and Southwest Basins.

Basin-wide job changes are only calculated for sectors for which there are data for all counties.

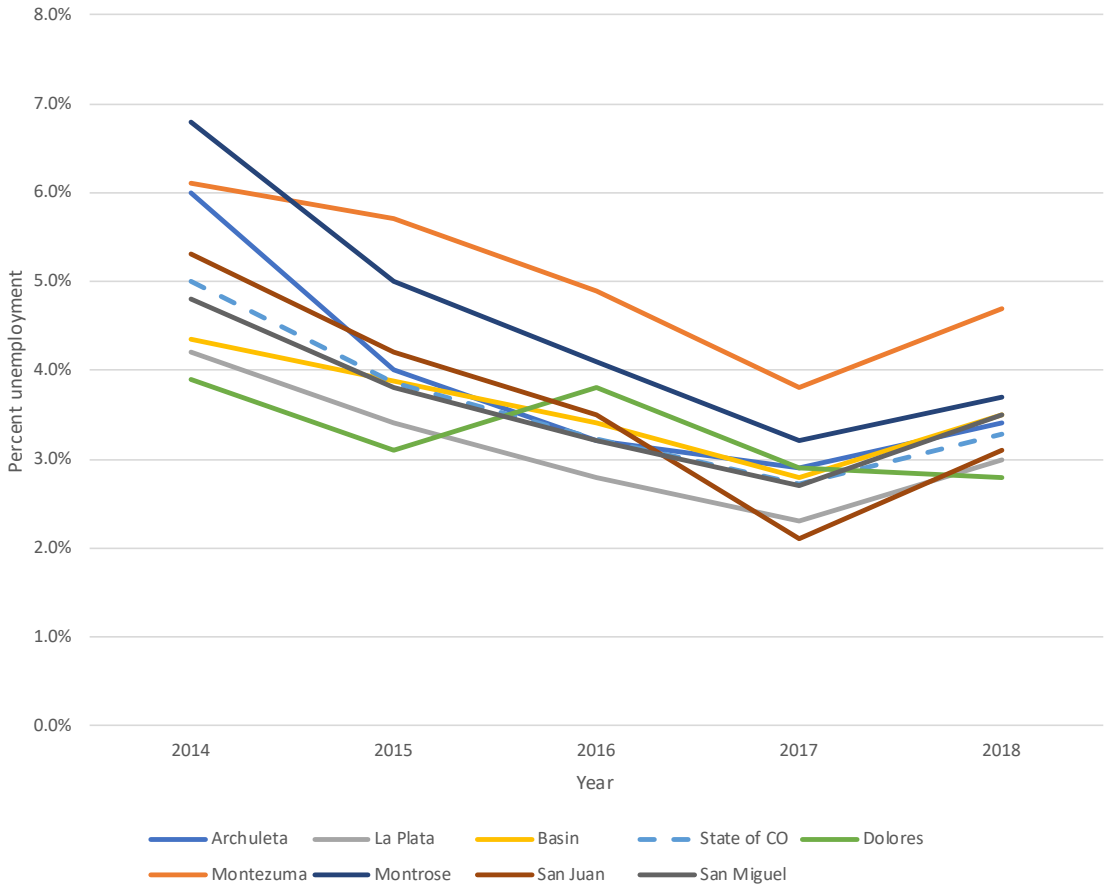
Source: U.S. Bureau of Economic Analysis, 2007 & 2017.

The greatest net employment growth occurred in La Plata County (+2,513 jobs). Employment increases in the county can be primarily attributed to the health care and social assistance (+1,050 jobs); mining (+447 jobs); and arts, entertainment, and recreation sectors (+431 jobs).

Unemployment

Unemployment rates in the Southwest Basin dropped steadily from 4.3% to 2.8% between 2014 and 2017 and then rose to 3.5% in 2018. This basin-wide trend is similar to the state-wide trend in unemployment rates over the same time period (Figure A-36). With the exception of Dolores County, the counties of the basin generally follow this trend. However, each county in the basin exhibits varying rates of unemployment.

Figure A-36.
Unemployment Rates, Southwest Basin Counties, 2014 to 2018



Source: Colorado State Demography Office, 2019.

La Plata County consistently experienced unemployment rates lower than the average basin and state unemployment rates between 2014 and 2018 (e.g., 2.3% in 2017 compared to 2.8% in the basin and 2.7% in the state). Dolores County had the lowest unemployment rates of any county in the basin in 2014 (3.9%) and 2015 (3.1%), while San Juan County had the lowest rate in 2017 (2.1%).

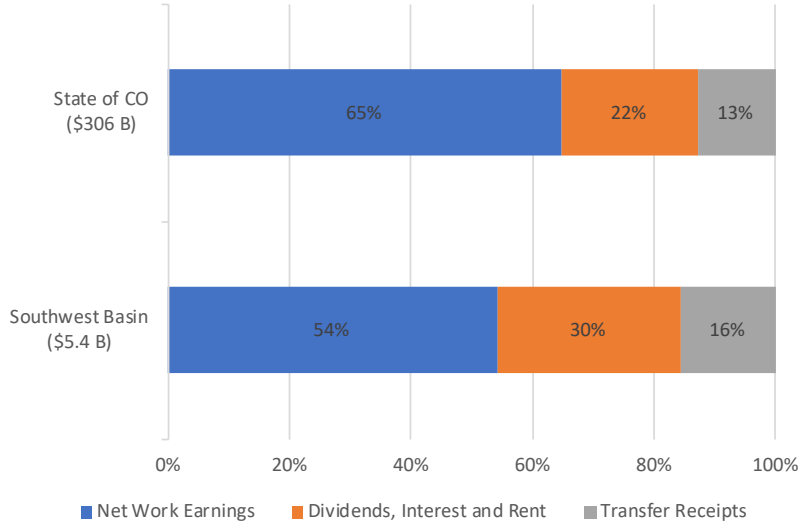
Montezuma County had the highest rate of unemployment in the basin between 2015 (5.7%) and 2018 (4.7%). Montrose County has also consistently had unemployment rates above the basin and state averages, ranging from a high of 6.8% in 2014 to a low of 3.2% in 2017. Archuleta and

San Miguel Counties experienced unemployment rates most similar to the basin and state averages out of any counties in the basin, particularly from 2015 to 2018.

Personal income

The majority of personal income in the Southwest Basin is from income earned through work (53%). Dividends, interest, and rent account for 30 percent of personal income, and transfer receipts account for 16 percent. At the state level, a greater percentage of income is earned through work (65%) compared to the basin, while 22 percent is from dividends, interest, and rent and 13 percent is from transfer receipts (Figure A-37).

Figure A-37.
Sources of Personal Income, Southwest Basin and State of Colorado, 2017



Source: U.S. Bureau of Economic Analysis, 2017.

Compared to the state, income from dividends, interest, and rent constitutes a larger portion of personal income in the Southwest Basin due to wealth-related income in La Plata and San Miguel Counties. La Plata County personal income accounts for 54 percent of total personal income in the basin, and dividends, interest, and rent within La Plata County account for 30 percent of personal income within the county. The total amount of personal income in San Miguel County—with the county seat of Telluride—is much smaller, but 41 percent of personal income in that county comes from dividends, interest, and rent. In Archuleta, Dolores, Montezuma, and Montrose Counties approximately one-quarter of personal income comes from transfer receipts compared to 13 percent at the state level.

Community-level economic indicators

Household income. There are 16 cities and towns in the Southwest Basin with household income data available. Half of these municipalities have median annual household incomes below $45,000. Telluride and Ophir have the highest median annual household incomes at $65,000 and $67,000, respectively (Figure A-38). After adjusting for inflation, median household incomes declined in nine out of 16 municipalities in the basin between 2012 and 2017 (ACS 5-Year Estimates, 2007-2012 & 2012-2017). Dolores, however, saw a 65 percent increase in median household income during the same period.

Figure A-38.
Median Household Income, Southwest Basin Municipalities, 2017

Note:

*2012-2017 American Community Survey (ACS). Reflects average of data collected over 5-year period. 5-year change based on comparisons to 2007-2012 ACS.

**Inflation-adjusted comparison.

Source:

U.S. Census Bureau American Community Survey (ACS) 5-Year Estimates, 2012-2017.

Median Household Income**	2017*	5-Year Chg.		2017*	5-Year Chg.
Bayfield	$59,185	-7%	Norwood	$50,917	7%
Cortez	$40,183	-8%	Nucla	$30,278	-43%
Dolores	$52,404	65%	Ophir	$66,875	-33%
Dove Creek	$44,167	18%	Pagosa Springs	$30,469	-29%
Durango	$60,521	4%	Rico	$36,875	-37%
Ignacio	$56,667	2%	Sawpit	-	-
Mancos	$39,417	-2%	Silverton	$45,917	13%
Mountain Village	$44,342	3%	Telluride	$65,313	-7%
Naturita	$33,750	-2%			

Employment. As shown in Figure A-39, the total number of employed residents increased in 11 of the 17 cities and towns in the Southwest Basin between 2012 and 2017, with the greatest increases seen in Naturita (+47%), Bayfield (+42%), and Mancos (+16%) (ACS 5-Year Estimates, 2007-2012 & 2012-2017). Employment in Durango—the most populous city in the basin—remained stable with a 1 percent increase in the total number of employed residents between 2012 and 2017. Large percentage reductions in the number of employed residents occurred in Silverton (-42%), Sawpit (-40%), and Rico (-37%).

Figure A-39.
Total Employed Residents, Southwest Basin Municipalities, 2017

Note:

*2012-2017 American Community Survey (ACS). Reflects average of data collected over 5-year period. 5-year change based on comparisons to 2007-2012 ACS.

Source:

U.S. Census Bureau American Community Survey (ACS) 5-Year Estimates, 2012-2017.

Total employment	2017*	5-Year Chg.		2017*	5-Year Chg.
Bayfield	1,428	42%	Norwood	354	10%
Cortez	3,819	8%	Nucla	228	-10%
Dolores	526	3%	Ophir	110	12%
Dove Creek	270	2%	Pagosa Springs	894	31%
Durango	10,043	1%	Rico	94	-37%
Ignacio	441	-1%	Sawpit	28	-40%
Mancos	813	32%	Silverton	264	-42%
Mountain Village	993	16%	Telluride	1,265	-20%
Naturita	211	47%			

Agricultural Conditions and Trends

Livestock production is a large part of the Southwest Basin agricultural economy, comprising 52 percent of the basin's 3,323 agricultural jobs; 58 percent of agricultural output; and 39 percent of agricultural income (IMPLAN, 2016). The large majority of the basin's livestock jobs are in beef cattle ranching (Figure A-40).

Figure A-40.
Agricultural Industry Economic Detail, Southwest Basin, 2016

Agricultural Sector	Employment	Output (Receipts)	Income*	Production/ Import Taxes**	Total Value-Added (GRP)
Grain farming	77	$9,046,593	$1,186,506	-$131,829	$1,054,677
Vegetable and melon farming	7	$460,128	$251,550	$6,708	$258,258
Fruit farming	89	$3,856,431	$2,331,687	$120,190	$2,451,877
Greenhouse, nursery, and floriculture production	67	$6,159,995	$3,880,261	$40,861	$3,921,123
All other crop farming***	929	$27,454,847	$14,324,502	$212,035	$14,536,537
Total crop farming	**1,169**	**$46,977,994**	**$21,974,507**	**$247,965**	**$22,222,472**
Beef cattle ranching and farming, including feedlots****	1,488	$68,081,688	$12,850,193	$600,913	$13,451,106
Dairy cattle and milk production	66	$8,824,163	$2,408,700	$95,819	$2,504,518
Animal production, except cattle and poultry and eggs	162	$6,347,240	$3,538,853	$105,359	$3,644,213
Total livestock production	**1,716**	**$83,253,092**	**$18,797,746**	**$802,092**	**$19,599,837**
Commercial logging	19	$1,584,818	$798,520	$41,673	$840,193
Commercial fishing	0	$0	$0	$0	$0
Commercial hunting and trapping	117	$3,828,194	$1,657,558	$650,581	$2,308,139
Total forestry, hunting and fishing	**136**	**$5,413,012**	**$2,456,078**	**$692,254**	**$3,148,332**
Support activities for agriculture and forestry	**302**	**$8,356,164**	**$4,480,007**	**$225,250**	**$4,705,257**
Total direct agricultural activity	**3,323**	**$144,000,262**	**$47,708,338**	**$1,967,561**	**$49,675,898**

Note: *Income includes employee and proprietor earnings and property-related income.

**Includes sales and excise taxes, property taxes, special assessments and subsidies.

***Predominantly hay and alfalfa production.

****Includes dual purpose ranches/farms.

Source: IMPLAN, 2016.

Eighty percent of crop farming employment in the Southwest Basin is "other crop farming," which is primarily hay and alfalfa production used as an input to livestock production. "Other crop farming" also accounts for 58 percent of crop output (receipts) and 65 percent of crop farming income. The entire crop farming sector accounts for 46 percent of the total agricultural income in the basin—slightly more than livestock production—but 35 percent of employment and 33 percent of output.

Farm characteristics

According to the latest Census of Agriculture, there were 1.8 million acres of land in farms in the Southwest Basin in 2017 (Figure A-41). Approximately 9 percent (174,000 acres) were harvested and 11 percent (203,000 acres) were under irrigation. Approximately 108,000 irrigated acres were harvested in 2017, and 77,000 irrigated acres were maintained as pastureland.

Figure A-41.
Agricultural Census Trends, Southwest Basin, 2007 to 2017

Note:

**BLS inflation calculator, based on July values.

Source:

USDA Census of Agriculture, 2007, 2012, & 2017.

Metrics	2007	2012	2017
Number of Farms	3,219	3,388	3,399
Median Size of Farms (acres)	79	69	64
Average Size of Farms (acres)	573	554	542
Farms with Irrigation	2,073	2,231	2,238
Land in Farms (acres)	1,844,604	1,876,100	1,842,476
Harvested Cropland (acres)	163,925	155,993	174,295
Irrigated Land (acres)	185,271	189,622	202,848
Market Value ($000s)			
Crops	$39,653	$56,582	$53,011
Livestock	$46,429	$71,674	$68,039
Total	$86,082	$127,722	$121,050
Inflation-adjusted Market Value in $2017**	$101,163	$136,458	$121,050

In 2017, approximately 66 percent of the basin's 3,400 farms were irrigated, with an average of 90 irrigated acres per irrigated farm. Median farm size in the basin in 2017 was 64 acres, a decline of approximately 20 percent since 2007 (USDA Census of Agriculture, 2007 & 2017).

In 2017, 48 percent of farms in the basin had total annual sales of less than $2,500, while 12 percent of farms had annual sales of more than $50,000. However, total farm receipts have increased since 2007. After adjusting for inflation, farm receipts in 2017 were approximately 20 percent higher than in 2007, although 12 percent lower than in 2012.

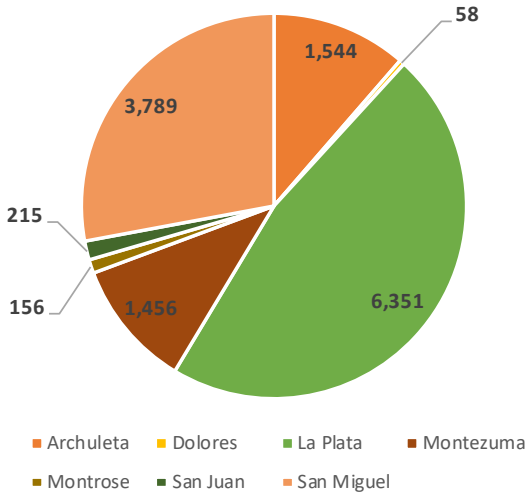
Estimates of total irrigated land of the Census of Agriculture differ somewhat from the more refined estimates developed for the Colorado Decision Support System (CDSS) and used in the Colorado Water Plan. The latest estimates for the Technical Update to the Water Plan indicate a total of approximately 223,000 irrigated acres in the Southwest Basin, and annual consumptive use of 402,600 acre-feet per year on those acres. These numbers correspond to average consumptive use of about 1.8 acre-feet per acre (State Water Plan Technical Update, 2019).

Tourism and Recreation Economy

The Southwest Basin tourism and recreation economy depends on water to directly and indirectly support activities such as fishing, hunting, wildlife-watching, boating, and swimming. The Colorado State Demography Office (SDO) estimates that tourism jobs constitute approximately 13,600 jobs in the Southwest Basin, or one-third of the basin's total direct basic jobs (i.e., jobs that bring outside dollars into the community by selling goods or services) (Figure A-42).

Figure A-42.
Estimated Direct Tourism Jobs, Southwest Basin Counties, 2018

Source:
Colorado State Demography Office, 2019.



Within the basin, tourism supports a total of 21,000 direct and indirect jobs (i.e., jobs created as the result of goods and services sold by direct basic jobs).

The SDO definition of tourism includes resort activity (e.g., skiing, national parks, rafting), second home expenditures, and service employment and transportation jobs supported by visitation. Nearly 50 percent of direct basic tourism jobs are in La Plata County, and another 28 percent are in San Miguel County.

Further analysis from BBC using data from a 2017 study by the Colorado Department of Parks and Wildlife (CPW) finds that approximately 2,300 direct and indirect jobs in the Southwest Basin are supported by wildlife-related activity (1,400 jobs) and water-related recreation (900 jobs). A larger proportion of wildlife- and water-related tourism jobs are located in La Plata County than in any other county in the basin (45% of the basin total).

Yampa/White River Basin

Geography

The Yampa/White Basin encompasses approximately 10,500 square miles of northwestern Colorado (Figure A-43). Just over one-third of the land area in the basin (3,695 square miles) is privately owned, while just under two-thirds of the basin's land area (6,845 square miles) is publicly owned. The two primary rivers in the basin are the Yampa and the White.

Figure A-43.
The Yampa/White Basin

Source:

BBC Research & Consulting, 2019.

The Yampa River, located in the northern part of the basin, originates on the eastern slope of the Flat Tops Wilderness near the Town of Yampa. The Yampa initially flows north for about 25 miles, then flows to the west for about 120 miles before passing into Utah. The largest communities in the Yampa sub-basin—Steamboat Springs and Craig—were founded on the Yampa River and today are connected by US Highway 40. The Yampa sub-basin includes nearly all of the lands and population of Moffat and Routt Counties.

The White River originates on the western slope of the Flat Tops Wilderness, east of the Town of Meeker. The White also flows eastward into Utah, on a roughly parallel course to the Yampa, and is generally located between 40 and 60 miles south of the course of the Yampa River. The White River is entirely located within Rio Blanco County and the two largest communities in that county,

Meeker and Rangely, are located on the White River. All of Rio Blanco County is located in the White River sub-basin.

Demographic Conditions and Trends

Historical and current population

The estimated total population in the Yampa/White Basin in 2017 was 44,635 (Colorado State Demography Office, 2019). The basin's population grew at an average of 1 percent per year between 1980 and 2010 (Figure A-44). From 2010 to 2017, population growth in the basin slowed to rate of 0.2% per year.

Figure A-44.
Population and Trends, Yampa/White Basin Counties and Municipalities, 1980 to 2017

						1980-2010 Avg. Annual Growth		2010-2017 Avg. Annual Growth	
Location	1980	1990	2000	2010	2017	Residents	Pct. Change	Residents	Pct. Change
Moffat County	13,133	11,357	13,184	13,795	13,112	22	0.2%	-98	-0.7%
Craig	8,133	8,091	9,189	9,464	8,953	44	0.5%	-73	-0.8%
Dinosaur	313	324	319	339	321	1	0.3%	-3	-0.8%
Unincorporated	4,687	2,942	3,676	3,992	3,838	-23	-0.5%	-22	-0.6%
Rio Blanco County	6,255	5,972	5,986	6,666	6,345	14	0.2%	-46	-0.7%
Meeker	2,356	2,098	2,242	2,475	2,228	4	0.2%	-35	-1.5%
Rangely	2,113	2,278	2,096	2,365	2,229	8	0.4%	-19	-0.8%
Unincorporated	1,786	1,596	1,648	1,826	1,888	1	0.1%	9	0.5%
Routt County	13,404	14,088	19,690	23,509	25,178	337	1.9%	238	1.0%
Hayden	1,720	1,444	1,634	1,810	1,925	3	0.2%	16	0.9%
Oak Creek	929	673	849	884	927	-2	-0.2%	6	0.7%
Steamboat Springs	5,098	6,695	9,815	12,088	12,950	233	2.9%	123	1.0%
Yampa	472	317	443	429	458	-1	-0.3%	4	0.9%
Unincorporated	5,185	4,959	6,949	8,298	8,918	104	1.6%	89	1.0%
Basin Total	**32,792**	**31,417**	**38,860**	**43,970**	**44,635**	**373**	**1.0%**	**95**	**0.2%**

Source: U.S. Census Bureau, 1980, 1990, 2000, & 2010; Colorado State Demography Office, 2019.

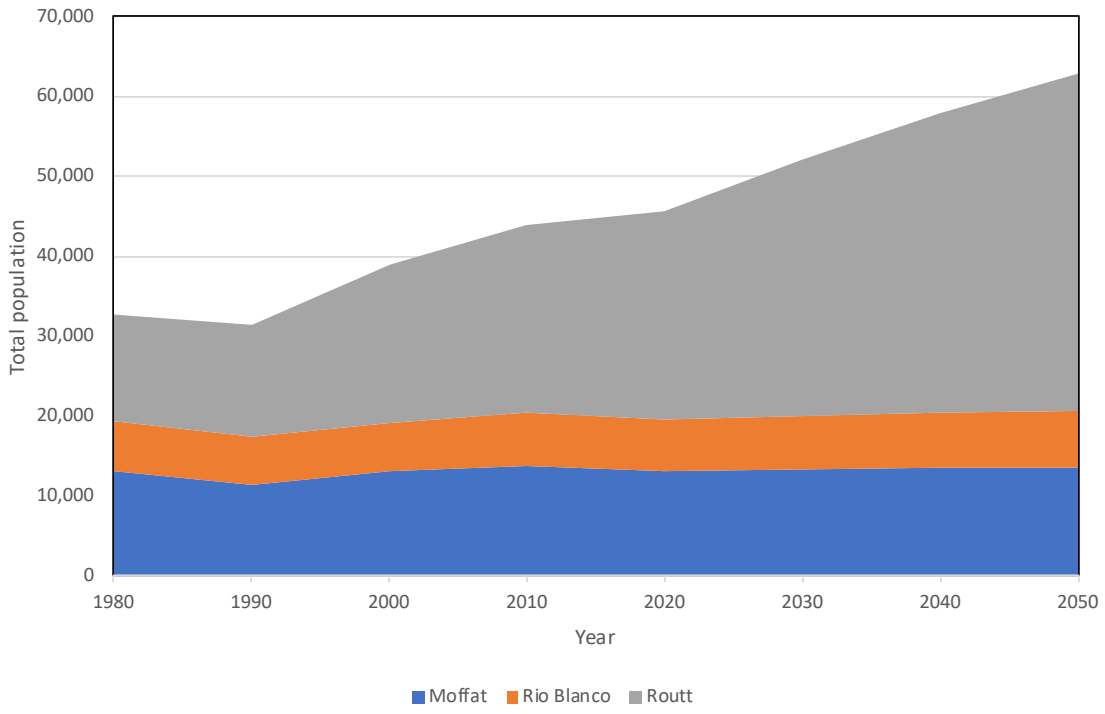
Routt County experienced the highest average annual population of any of the three counties of the basin between 1980 and 2010, mostly due to a substantial population increase in Steamboat Springs. In that 30-year period, the county's population grew at an average annual rate of 1.9%, and the city of Steamboat Springs more than doubled in size, growing from 5,100 residents to 12,100 residents. Since 2010, population growth in Routt County has slowed in comparison to the previous 30-year period, with an average annual growth rate of 1 percent.

Between 1980 and 2010, Moffat and Rio Blanco Counties experienced slower average annual population growth (0.2%) than Routt County. Populations of Moffat and Rio Blanco Counties have seen a net decline since 2010. In the City of Craig—the county seat and largest city of Moffat County—population declined by 5 percent between 2010 and 2017, from 9,464 to 8,953.

Population projections

As shown in Figure A-45, the population of Routt County is projected to increase between 2020 and 2050, while the populations of Moffat and Rio Blanco Counties are projected to stabilize (Colorado State Demography Office, 2019). From 2020 to 2050, Routt County's population is projected to grow from 25,000 residents to 42,000 residents, a total increase of 67 percent (1.6% annual average growth rate).

Figure A-45.
Population History and Projections, Yampa/White Basin Counties, 1980 to 2050



Source: U.S. Census Bureau, 1980, 1990, 2000, & 2010; Colorado State Demography Office, 2019.

Recent demographic trends in Routt County point to population increases caused by in-migration of older residents. Between 2000 and 2010, the median age of county residents increased from 35 to 39 years, and the proportion of residents aged 55 years or older grew from 12 percent to 23 percent (U.S. Census Bureau, 2000 & 2010). From 2000 to 2010, the number of residents aged 25-44 years was stagnant (7,182 compared to 7,145), even as the county grew by nearly 4,000 residents over the course of the decade (U.S. Census Bureau, 2000 & 2010).

Routt County's population growth is projected to account for 93 percent of the basin's total growth through 2050, with Moffat and Rio Blanco Counties comprising only 3 percent and 4 percent of total growth, respectively. Populations of Moffat and Rio Blanco Counties are projected to remain steady through 2050, with average annual growth rates of 0.1% in Moffat County and 0.3% in Rio Blanco County.

Demographic characteristics

The basin's demographic characteristics are shown in Figure A-46 and differ from the state of Colorado across certain metrics. Relative to the state of Colorado, the Yampa/White Basin has a smaller proportion of minority residents, with 13 percent of residents identifying as a race other than white compared to 31 percent for the state as a whole.

Figure A-46. Demographic Characteristics, Yampa/White Basin, 2013 to 2017 Averages

Note:

Following Census-based definitions, individuals living in places with 2,500 residents or more are identified as the urban population.

Source:

U.S. Census Bureau American Community Survey (ACS) 5-Year Estimates, 2012-2017.

	Basin Residents			State of
	Urban*	Rural*	Total	Colorado
Gender				
Female	48%	49%	48%	50%
Male	52%	51%	52%	50%
Age				
Under 18	21%	23%	22%	23%
18-64	68%	63%	65%	64%
65 and Over	12%	14%	13%	13%
Race/Ethnicity				
White, not Latino	84%	90%	87%	69%
Latino	13%	6%	10%	21%
Other Race	3%	3%	3%	10%
Educational Attainment (25 and older)				
High School Degree or Less	33%	35%	34%	31%
Some College/Associate Degree	26%	31%	28%	30%
Bachelors Degree or More	41%	34%	38%	39%
Individual Income (15 and older)				
Under $25,000	38%	37%	37%	35%
$25,000-$49,999	28%	25%	26%	24%
$50,000-$74,999	13%	14%	14%	14%
$75,000 or More	12%	14%	13%	15%
Unreported	*9%*	*10%*	*10%*	*12%*
People Living Below/Near Poverty Level				
Below 100% of Poverty Level	11%	10%	11%	12%
100 to 149% of Poverty Level	11%	6%	8%	8%

Residents of the basin have a slightly lower average educational attainment in comparison with the state, particularly outside of Steamboat Springs and Craig. Sixty-six percent of Yampa/White Basin residents have some college education or a bachelor degree, while 69 percent of Colorado residents have some college education or a bachelor degree. Individual incomes and poverty levels are comparable to the state as a whole.

Economic Conditions and Trends

Earnings by sector

In 2017, the basin's three largest sectors based on work-related earnings were government (16%), mining—including oil and gas (13%), and construction (10%) (Figure A-47). Percentages of earnings by industry are based on comparison to total work earnings for each county. In some cases, earnings by sector are not disclosed at the county level, in order to preserve data confidentiality for individual firms that comprise all or most of a particular sector. For example, the earnings data available for Rio Blanco and Routt Counties accounts for more than 95 percent of each county's earnings total. Moffat County, however, has a greater incidence of nondisclosed work income and the earnings data available for Moffat County only represent two-thirds of the county's total earnings for 2017.

Figure A-47. Work Earnings as a Percent of Total, Yampa/White Basin Counties, 2017

Note:

+Due to non-disclosure for some sectors and counties, these basin-wide totals are potentially understated.

Source:

U.S. Bureau of Economic Analysis, 2017.

	Basin Counties			
Sector Earnings 2017	Moffat	Rio Blanco	Routt	Basin
Farm Earnings	2.1%	3.6%	0.9%	1.5%
Non-farm Earnings				
Forestry, fishing, and related activities	0.4%	(D)	(D)	0.1% +
Mining, quarrying, and oil and gas extraction	14.9%	26.0%	10.3%	13.3%
Utilities	(D)	(D)	1.9%	1.3% +
Construction	5.9%	7.1%	11.8%	9.9%
Manufacturing	0.9%	1.4%	0.6%	0.8%
Wholesale trade	3.2%	(D)	2.9%	2.6% +
Retail trade	7.2%	3.0%	7.4%	6.8%
Transportation and warehousing	(D)	3.6%	2.5%	2.1% +
Information	0.8%	0.2%	-0.9%	-0.4%
Finance and insurance	2.3%	1.4%	2.1%	2.1%
Real estate and rental and leasing	1.1%	1.1%	6.3%	4.5%
Professional, scientific, and technical services	(D)	1.0%	7.1%	4.8% +
Management of companies and enterprises	(D)	0.0%	(D)	0.0% +
Administrative and support and waste management and remediation services	1.4%	4.4%	5.3%	4.3%
Educational services	(D)	0.0%	1.1%	0.7% +
Health care and social assistance	(D)	1.1%	9.2%	6.2% +
Arts, entertainment, and recreation	0.6%	0.8%	5.7%	4.0%
Accommodation and food services	2.9%	3.0%	7.9%	6.2%
Other services	3.8%	3.0%	5.3%	4.7%
Government and government enterprises	18.1%	34.6%	12.0%	16.2%
Total Reported Data	65.7%	95.3%	99.5%	91.5%
Nondisclosed Percent of Work Income	34.3%	4.7%	0.5%	8.5%

The government and mining sectors constitute larger percentages of earnings in Rio Blanco County compared with the other two counties in the basin (U.S. Bureau of Economic Analysis, 2017). In Rio Blanco County, government earnings represent more than one-third of county earnings, and mining sector earnings represent more than one-quarter of county earnings.

In contrast, work earnings in Routt County come from a more diverse range of industries. Routt County's five largest industries by earnings are government (12%), construction (12%), mining (10%), health care and social assistance (9%), and accommodation and food services (8%). Moffat County's five largest industries by earnings are government (18%), mining (15%), retail trade (7%), construction (6%), and other services (4%).

Employment by sector

Nearly one-third of total employment in the Yampa/White Basin is concentrated in government (13%), accommodation and food services (10%), and retail trade (9%) (U.S. Bureau of Economic Analysis, 2017) (Figure A-48).

Figure A-48.
Employment by Industry, Yampa/White Basin Counties, 2017

Sector Employment 2017	Basin Counties			Basin	Basin Employment Share
	Moffat	Rio Blanco	Routt		
Farm Employment	550	430	853	1,833	5.2%
Non-farm Employment					
Forestry, fishing, and related activities	137	(D)	(D)	137 +	0.4% +
Mining, quarrying, and oil and gas extraction	556	549	700	1,805	5.2%
Utilities	(D)	(D)	171	171 +	0.5% +
Construction	433	257	1,976	2,666	7.6%
Manufacturing	127	81	249	457	1.3%
Wholesale trade	220	(D)	428	648 +	1.9% +
Retail trade	874	271	2,002	3,147	9.0%
Transportation and warehousing	(D)	99	485	584	1.7% +
Information	67	17	181	265	0.8%
Finance and insurance	220	84	967	1,271	3.6%
Real estate and rental and leasing	270	175	2,440	2,885	8.3%
Professional, scientific, and technical services	(D)	112	1,395	1,507 +	4.3% +
Management of companies and enterprises	(D)	0	(D)	0 +	0.0% +
Administrative and support and waste management and remediation services	195	188	1,110	1,493	4.3%
Educational services	(D)	11	411	422 +	1.2% +
Health care and social assistance	(D)	89	1,690	1,779 +	5.1% +
Arts, entertainment, and recreation	154	89	1,963	2,206	6.3%
Accommodation and food services	512	249	2,634	3,395	9.7%
Other services	453	162	1,463	2,078	5.9%
Government and government enterprises	1,114	1,274	2,048	4,436	12.7%
Total Employment	7,233	4,305	23,418	34,956	94.9%
Nondisclosed Employment Sectors	1,351	168	252	1,771	5.1%

Note: + Due to non-disclosure for some sectors and counties, these basin-wide totals are potentially understated.

Source: U.S. Bureau of Economic Analysis, 2017.

The government sector is the largest single source of employment in Rio Blanco and Moffat Counties, comprising nearly one-third of the total jobs in Rio Blanco County and 15 percent in Moffat County. Government is a notable component of Routt County employment as well (9%). In Rio Blanco County, mining accounts for the second largest share of employment (13%). In Moffat County, retail trade (12%) and mining (8%) account for the second and third largest shares of employment, respectively.

Agriculture accounts for 1,833 jobs (5%) of the basin's total employment. Agriculture is a significant source of employment in the basin counties. Farm employment represents a larger share of total county employment in both Rio Blanco County (10%) and Moffat County (8%) than in Routt County (4%).

Routt County accounts for most of the substantial percentage of basin-wide jobs in accommodation and food services (10%), due to the concentration of restaurants and lodging amenities in Steamboat Springs. Overall, the economy of Routt County is more diverse than

Moffat or Rio Blanco Counties. In Routt County, a range of additional industries—each representing between 8% and 11% of jobs—contribute to the county-wide diversity of employment opportunities, including construction; retail trade; real estate and leasing; and arts, entertainment, and recreation.

Employment trends

As shown in Figure A-49, between 2007 and 2017 total employment in the basin declined by more than 2,500 jobs (7%). The decline was led by the loss of more than 3,970 jobs in construction, mining (including oil and gas), and retail trade. In comparison with other industries, the construction sectors of Routt and Rio Blanco Counties saw the largest job losses by a wide margin, with Routt County losing approximately 2,000 construction jobs and Rio Blanco losing 1,029. Rio Blanco County was also negatively affected by the loss of 400 jobs in mining.

Figure A-49. Employment Changes by Industry, Yampa/White Basin Counties, 2007 to 2017

Note: Basin-wide job changes are only calculated for sectors for which there are data for all counties.

Source:

U.S. Bureau of Economic Analysis, 2007 & 2017.

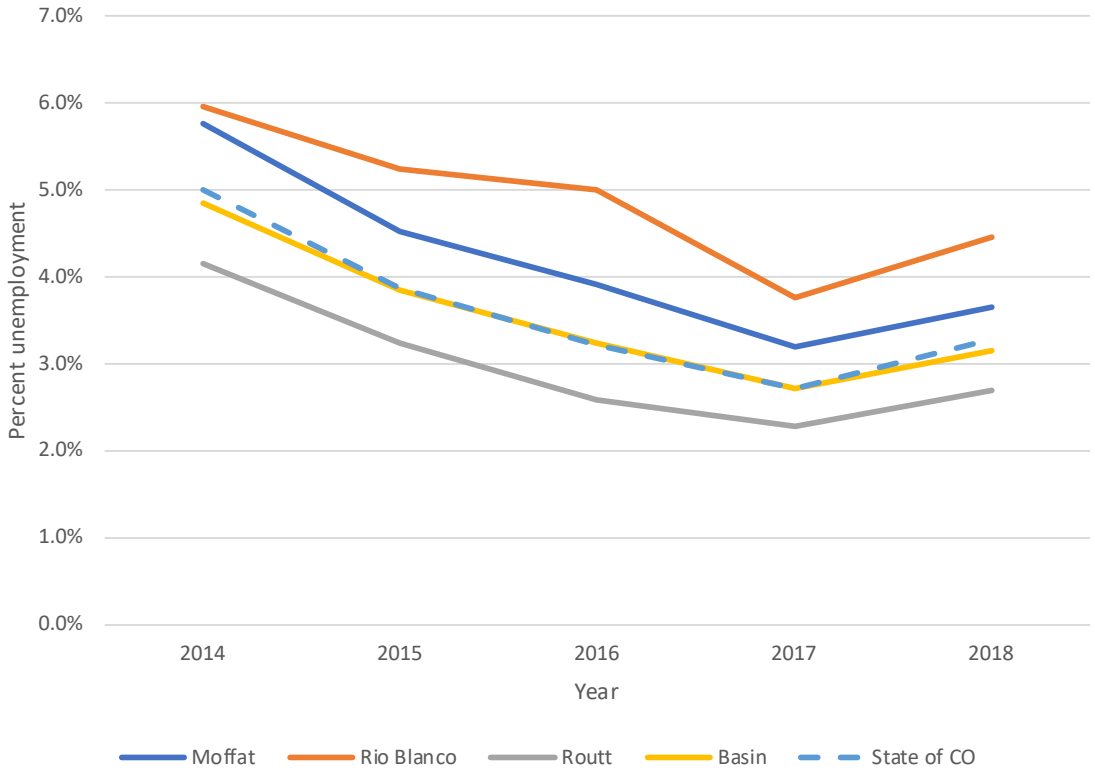
	Basin Counties			
Job Changes by Sector 2007-2017	Moffat	Rio Blanco	Routt	Basin
Farm Employment	19	91	195	305
Non-farm Employment				
Forestry, fishing, and related activities	-21			
Mining, quarrying, and oil and gas extraction	-152	-400		
Utilities				
Construction	-6	-1,029	-1,999	-3,034
Manufacturing	10	4	26	40
Wholesale trade	-64			
Retail trade	-124	-71	-197	-392
Transportation and warehousing		-85	37	
Information	14	-10	-73	-69
Finance and insurance	31	16	204	251
Real estate and rental and leasing	1	16	75	92
Professional, scientific, and technical services		-39	38	
Management of companies and enterprises		0		
Administrative and support and waste management and remediation services	-109	49	102	42
Educational services		0	124	
Health care and social assistance		-26	253	
Arts, entertainment, and recreation	2	14	459	475
Accommodation and food services	-33	-137	251	81
Other services	-61	-26	180	93
Government and government enterprises	-135	200	278	343
Total Employment	-688	-1,407	-463	-2,558
Nondisclosed Employment Sectors	-60	26	-416	-785

Despite the large loss of jobs in the construction sector, Routt County experienced the smallest net loss in employment, because the decline in construction jobs was partially offset by growth in other sectors, including arts, entertainment, and recreation; government; health care and social assistance; and accommodation and food services. Moffat and Rio Blanco Counties' job losses affected a variety of sectors, resulting in larger total losses.

Unemployment

Unemployment rates in the Yampa/White Basin dropped steadily from 4.9% to 2.7% between 2014 and 2017 and then rose to 3.3% in 2018. This basin-wide trend is nearly identical to the state-wide trend in unemployment rates over the same time period (Figure A-50).

Figure A-50.
Unemployment Rates, Yampa/White Basin Counties, 2014 to 2018



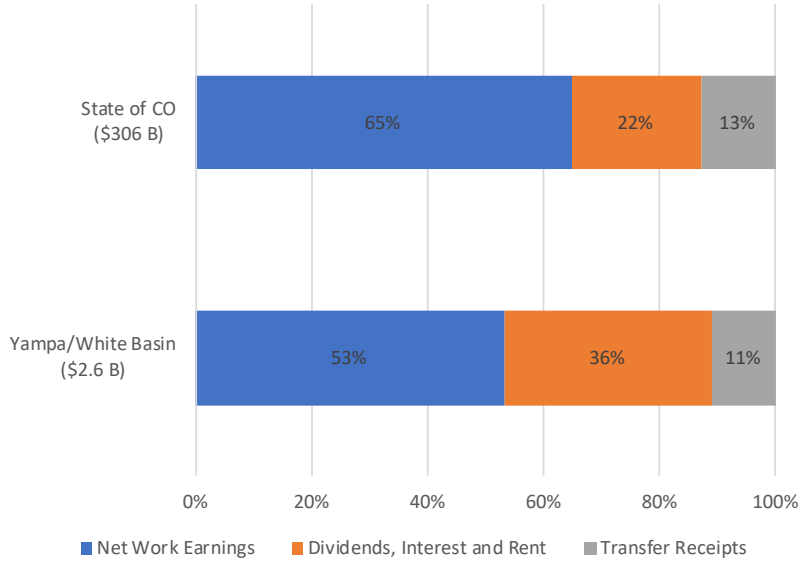
Source: Colorado State Demography Office, 2019.

The unemployment rate of three counties of the basin also follow this trend, but exhibit varied rates of unemployment. Between 2014 and 2018, Routt County had the lowest unemployment rate of the three counties in each year, from a high of 4.2% in 2014 to a low of 2.3% in 2017. Moffat County unemployment rates were higher than basin- and state-level unemployment rates, with a high of 5.8% in 2014 and a low of 3.2% in 2017. In any given year, Rio Blanco County saw the highest unemployment rate of any county in the basin, with a high of 6.0% in 2014 and a low of 3.8% in 2017.

Personal income

Most personal income in the Yampa/White Basin is from income earned through work (53%). Dividends, interest, and rent account for 36 percent of personal income, and transfer receipts, such as government social benefits, account for 11 percent. At the state level, a greater percentage of income is earned through work (65%) compared to the basin, while 22 percent is from dividends, interest, and rent and 13 percent is from transfer receipts (Figure A-51).

Figure A-51.
Sources of Personal Income, Yampa/White Basin and State of Colorado, 2017



Source: U.S. Bureau of Economic Analysis, 2017.

Compared to the state, income from dividends, interest, and rent constitutes a larger portion of personal income in the Yampa/White Basin due to the substantial wealth-related income in Routt County. In fact, Routt County personal income accounts for 70 percent of total personal income in the basin, and dividends, interest, and rent account for more than 43 percent of personal income within Routt County. The ratio of personal income sources in Moffat and Rio Blanco Counties is comparable to the state, with work earnings in each county comprising 62 percent of personal income, while dividends, interest, and rent account for 17 percent of personal income in Moffat County and 21 percent of personal income in Rio Blanco County.

Community-level economic indicators

Household income. Details of individual cities and towns within the Yampa/White Basin provide greater clarity on the community-level economic characteristics of the basin. Of the eight cities and towns in the basin, Rangely and Steamboat Springs have the highest median annual household incomes at $73,000 and $63,000, respectively (Figure A-52). After adjusting for inflation, median household incomes declined in all eight municipalities in the basin between 2012 and 2017 (ACS 5-Year Estimates, 2007-2012 & 2012-2017).

Figure A-52.
Median Household Income, Yampa/White Basin Municipalities, 2017

Note:

*2012-2017 American Community Survey (ACS). Reflects average of data collected over five year period. 5-year change based on comparisons to 2007-2012 ACS.

**Inflation-adjusted comparison.

Source:

U.S. Census Bureau American Community Survey (ACS) 5-Year Estimates, 2012-2017.

Median Household Income**	2017*	5-Year Chg.
Craig	$49,831	-7%
Dinosaur	$36,875	-5%
Hayden	$55,104	-8%
Meeker	$51,101	-7%
Oak Creek	$42,692	-14%
Rangely	$72,550	-6%
Steamboat Springs	$63,393	-10%
Yampa	$50,865	-19%

Employment. As shown in Figure A-53, the total number of employed residents declined in four of the eight cities and towns in the Yampa/White Basin between 2012 and 2017, with the largest decline seen in Hayden (-11%) (ACS 5-Year Estimates, 2007-2012 & 2012-2017). Steamboat Springs—which accounted for 29 percent of the basin's total employed residents in 2017—saw a 5 percent increase in the total number of employed residents between 2012 and 2017.

Figure A-53.
Total Employed Residents, Yampa/White Basin Municipalities, 2017

Note:

*2012-2017 American Community Survey (ACS). Reflects average of data collected over five year period. 5-year change based on comparisons to 2007-2012 ACS.

Source:

U.S. Census Bureau American Community Survey (ACS) 5-Year Estimates, 2012-2017.

Total employment	2017*	5-Year Chg.
Craig	4,387	-1%
Dinosaur	127	5%
Hayden	1,022	-11%
Meeker	1,173	1%
Oak Creek	518	-1%
Rangely	1,084	6%
Steamboat Springs	7,857	5%
Yampa	180	-5%

Agricultural Conditions and Trends

The largest component of the agricultural economy of the Yampa/White Basin is livestock production. Crop farming in the basin is predominantly an input to cattle and horse ranching. As shown in Figure A-54, 90 percent of employment and 80 percent of output in crop farming is in the category "other crop farming," which is primarily hay and alfalfa production that supports the ranching sector within the basin (IMPLAN, 2016).

Figure A-54.
Agricultural Industry Economic Detail, Yampa/White Basin, 2016

Agricultural Sector	Employment	Output (Receipts)	Income*	Production/ Import Taxes**	Total Value-Added (GRP)
Grain farming	9	$1,591,490	$208,732	-$23,192	$185,540
Vegetable and melon farming	11	$491,812	$268,871	$7,170	$276,041
Fruit farming	4	$103,402	$62,519	$3,223	$65,742
Greenhouse, nursery, and floriculture production	10	$593,911	$373,327	$3,940	$377,266
All other crop farming***	300	$11,109,004	$5,806,314	$86,803	$5,893,117
Total crop farming	**335**	**$13,889,619**	**$6,719,763**	**$77,944**	**$6,797,707**
Beef cattle ranching and farming, including feedlots****	1,264	$97,839,890	$18,458,863	$863,570	$19,322,433
Dairy cattle and milk production	39	$8,824,163	$2,399,868	$95,819	$2,495,687
Animal production, except cattle and poultry and eggs	149	$10,160,104	$5,467,980	$167,665	$5,635,645
Total livestock production	**1,452**	**$116,824,157**	**$26,326,711**	**$1,127,053**	**$27,453,765**
Commercial logging	44	$1,918,420	$66,998	$98,250	$165,248
Commercial fishing	0	$0	$0	$0	$0
Commercial hunting and trapping	71	$1,526,226	$209,621	$392,909	$602,530
Total forestry, hunting and fishing	**115**	**$3,444,646**	**$276,619**	**$491,159**	**$767,778**
Support activities for agriculture and forestry	**408**	**$7,885,090**	**$2,641,356**	**$305,743**	**$2,947,099**
Total direct agricultural activity	**2,309**	**$142,043,513**	**$35,964,450**	**$2,001,899**	**$37,966,349**

Note: *Income includes employee and proprietor earnings and property-related income.

**Includes sales and excise taxes, property taxes, special assessments and subsidies.

***Predominantly hay and alfalfa production.

****Includes dual purpose ranches/farms.

Source: IMPLAN, 2016.

Livestock production accounts for nearly 1,500 of the total 2,300 agricultural jobs (including forestry, hunting, and fishing) in the basin. More than 85 percent of livestock-related jobs are in cattle ranching (Figure A-54). Additionally, livestock production constitutes 82 percent of agricultural output and 73 percent of agricultural income in the Yampa/White Basin.

Farm characteristics

According to the latest Census of Agriculture, in 2017 there were 1.8 million acres of land in farms in the Yampa/White Basin (Figure A-55). Approximately 7 percent (126,000 acres) were harvested and 5 percent (100,000 acres) were under irrigation. Approximately 67,000 irrigated acres were harvested in 2017, and 30,000 irrigated acres were maintained as pastureland.

Figure A-55.
Agricultural Census Trends, Yampa/White Basin, 2007 to 2017

Metrics	2007	2012	2017
Number of Farms	1,398	1,604	1,669
Median Size of Farms (acres)	153	121	111
Average Size of Farms (acres)	1,256	1,278	1,096
Farms with Irrigation	562	586	675
Land in Farms (acres)	1,755,255	2,049,774	1,829,142
Harvested Cropland (acres)	127,674	109,152 *	125,687
Irrigated Land (acres)	94,991	95,739	100,010
Market Value ($000s)			
Crops	$10,064	$15,274	$11,747
Livestock	$67,918	$82,592	$71,789
Total	$77,982	$97,866	$83,536
Inflation-adjusted Market Value in $2017**	$91,644	$104,560	$83,536

Note:

*Harvested cropland in Routt County was undisclosed in 2012. Routt County acreage estimated based on average of 2007 and 2017 reports.

**BLS inflation calculator, based on July values.

Source:

USDA Census of Agriculture, 2007, 2012, & 2017.

In 2017, approximately 40 percent of the basin's 1,700 farms irrigated, with an average of 150 irrigated acres per irrigated farm. Median farm size in the basin was 111 acres in 2017, exhibiting a 27 percent decline since 2007 (USDA Census of Agriculture, 2007 & 2017).

In 2017, 49 percent of farms in the basin had total annual sales of less than $2,500, while 17 percent of farms had annual sales of more than $50,000. After adjusting for inflation, farm receipts in 2017 were approximately 20 percent lower than in 2012 and 9 percent lower than in 2007.

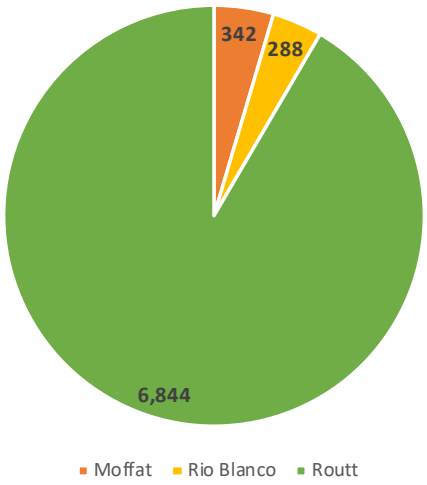
Estimates of total irrigated land of the Census of Agriculture differ somewhat from the more refined estimates developed for the Colorado Decision Support System (CDSS) and used in the Colorado Water Plan. The latest estimates for the Technical Update to the Water Plan indicate a total of approximately 107,000 irrigated acres in the Yampa/White Basin, and annual consumptive use of 188,900 acre-feet per year on those acres. These numbers correspond to average consumptive use of about 1.8 acre-feet per acre (State Water Plan Technical Update, 2019).

Tourism and Recreation Economy

The Yampa/White Basin tourism and recreation economy depends on water to directly and indirectly support activities such as fishing, hunting, wildlife-watching, boating, and swimming. The Colorado State Demography Office (SDO) estimates that tourism jobs constitute one-third (7,500 jobs) of direct basic jobs in the basin (i.e., jobs that bring outside dollars into the community by selling goods or services) (Figure A-56).

Figure A-56.
Estimated Direct Tourism Jobs, Yampa/White Basin Counties, 2018

Source:
Colorado State Demography Office, 2019.



Within the basin, tourism supports a total of 10,000 direct and indirect jobs (i.e., jobs created as the result of goods and services sold by direct basic jobs).

The SDO definition of tourism includes resort activity (e.g., skiing, national parks, rafting), second home expenditures, and service employment and transportation jobs supported by visitation. More than 90 percent of direct basic tourism jobs are in Routt County (Figure A-56) due to high levels of resort, real estate, and service employment, particularly in Steamboat Springs.

Further analysis from BBC using data from a 2017 study by the Colorado Department of Parks and Wildlife (CPW) finds that approximately 1,750 direct and indirect jobs in the Yampa/White Basin are supported by wildlife-related activity (1,100 jobs) and water-related recreation (650 jobs). A larger proportion of wildlife- and water-related tourism jobs are located in Moffat and Rio Blanco Counties than in Routt County, due to the concentration of resort activity in Routt County.

Appendix B.

Estimated Crop Enterprise Budgets by Basin

Colorado Basin
Grass Hay Yields, Revenue and Net Operating Income per Acre
(2019 Dollars)

Year	Average Yield (Tons/Acre)	Average Price per Ton	Gross Revenue per Acre	Operating Expense per Acre	Net Operating Income per Acre
2018	1.45	$209	$302	$121	$181
2017	1.46	$176	$256	$77	$179
2016	1.59	$161	$256	$79	$177
2015	1.89	$148	$280	$82	$198
2014	1.41	$147	$208	$82	$126
2013	1.59	$251	$399	$109	$290
2012	1.13	$243	$275	$78	$197
2011	1.22	$222	$270	$84	$187
2010	1.56	$131	$204	$134	$70
2009	2.41	$157	$378	$218	$160
2016-18 Avg.	1.50	$182	$271	$92	$179
10-Yr Avg.	1.57	$184	$283	$106	$176

Sources:
Yields from National Agricultural Statistics Service Annual Surveys.
Prices from CSU crop enterprise budgets, 2011-13 are statewide averages.
Operating expenses per acre estimated based on operating expenses per ton
from CSU crop enterprise budgets for Western Colorado.

Notes:
Operating expenses per ton in 2011-2013 based on average expenses per ton
from available CSU crop enterprise budgets from 2008-2018 -- crop enterprise budgets
unavailable for these years.

Colorado Basin
Alfalfa Hay Yields, Revenue and Net Operating Income per Acre
(2019 Dollars)

Year	Average Yield (Tons/Acre)	Average Price per Ton	Gross Revenue per Acre	Operating Expense per Acre	Net Operating Income per Acre
2018	3.41	$208	$709	$298	$411
2017	3.32	$175	$579	$295	$284
2016	2.58	$150	$387	$205	$182
2015	3.11	$194	$605	$251	$354
2014	3.05	$207	$631	$221	$410
2013	2.65	$261	$690	$225	$465
2012	2.44	$268	$653	$207	$446
2011	3.17	$222	$704	$247	$457
2010	2.62	$149	$390	$162	$229
2009	3.46	$165	$571	$302	$269
2016-18 Avg.	3.10	$177	$558	$266	$292
10-Yr Avg.	2.98	$200	$592	$241	$351

Sources:
Yields and prices from National Agricultural Statistics Service Annual Surveys.
Prices from CSU crop enterprise budgets, 2012-13 are statewide averages.
Operating expenses per acre estimated based on operating expenses per ton
from CSU crop enterprise budgets for Western Colorado.

Notes:
Operating expenses per ton in 2012-2013 based on average
of available CSU crop enterprise budgets from 2008-2018 -- crop enterprise budgets
unavailable for those years.

Gunnison Basin
Grass Hay Yields, Revenue and Net Operating Income per Acre
(2019 Dollars)

Year	Average Yield (Tons/Acre)	Average Price per Ton	Gross Revenue per Acre	Operating Expense per Acre	Net Operating Income per Acre
2018	2.40	$209	$502	$202	$301
2017	1.82	$176	$320	$96	$224
2016	1.97	$161	$316	$98	$218
2015	2.43	$148	$360	$106	$255
2014	2.44	$147	$359	$142	$217
2013	2.23	$251	$560	$153	*$406*
2012	1.87	$243	$455	$129	*$326*
2011	2.11	$222	$468	$145	*$323*
2010	2.06	$131	$270	$176	$93
2009	2.67	$157	$419	$241	$178
2016-18 Avg.	2.06	$182	$379	$132	$248
10-Yr Avg.	**2.20**	**$184**	**$403**	**$149**	**$254**

Sources:
Yields from National Agricultural Statistics Service Annual Surveys.
Prices from CSU crop enterprise budgets, 2011-13 are statewide averages.
Operating expenses per acre estimated based on operating expenses per ton
from CSU crop enterprise budgets for Western Colorado.

Notes:
Operating expenses per ton in 2011-2013 based on average expenses per ton
from available CSU crop enterprise budgets from 2008-2018 -- crop enterprise budgets
unavailable for these years.

Gunnison Basin
Alfalfa Hay Yields, Revenue and Net Operating Income per Acre
(2019 Dollars)

Year	Average Yield (Tons/Acre)	Average Price per Ton	Gross Revenue per Acre	Operating Expense per Acre	Net Operating Income per Acre
2018	2.94	$208	$610	$257	$353
2017	3.25	$175	$569	$290	$279
2016	3.20	$150	$480	$254	$226
2015	3.68	$194	$716	$296	$419
2014	3.05	$207	$632	$222	$411
2013	2.79	$261	$728	$237	$491
2012	3.31	$268	$886	$281	$605
2011	3.14	$222	$698	$245	$453
2010	3.01	$149	$447	$185	$262
2009	3.63	$165	$598	$317	$281
2016-18 Avg.	3.13	$177	$553	$267	$286
10-Yr Avg.	**3.20**	**$200**	**$636**	**$258**	**$378**

Sources:
Yields and prices from National Agricultural Statistics Service Annual Surveys.
Prices from CSU crop enterprise budgets, 2012-13 are statewide averages.
Operating expenses per acre estimated based on operating expenses per ton
from CSU crop enterprise budgets for Western Colorado.

Notes:
Operating expenses per ton in 2012-2013 based on average
of available CSU crop enterprise budgets from 2008-2018 -- crop enterprise budgets
unavailable for those years.

Southwest Basin
Grass Hay Yields, Revenue and Net Operating Income per Acre
(2019 Dollars)

Year	Average Yield (Tons/Acre)	Average Price per Ton	Gross Revenue per Acre	Operating Expense per Acre	Net Operating Income per Acre
2018	1.74	$209	$364	$146	$218
2017	2.58	$176	$454	$137	$317
2016	1.86	$161	$299	$92	$206
2015	2.65	$148	$392	$115	$277
2014	2.15	$147	$316	$125	$191
2013	1.04	$251	$261	$72	$189
2012	2.21	$243	$538	$152	$386
2011	1.74	$222	$387	$120	$267
2010	1.93	$131	$253	$166	$87
2009	2.29	$157	$360	$208	$153
2016-18 Avg.	2.06	$182	$372	$125	$247
10-Yr Avg.	2.02	$184	$362	$133	$229

Sources:
Yields from National Agricultural Statistics Service Annual Surveys.
Prices from CSU crop enterprise budgets, 2011-13 are statewide averages.
Operating expenses per acre estimated based on operating expenses per ton
from CSU crop enterprise budgets for Western Colorado.

Notes:
Operating expenses per ton in 2011-2013 based on average expenses per ton
from available CSU crop enterprise budgets from 2008-2018 -- crop enterprise budgets
unavailable for these years.

Southwest Basin
Alfalfa Hay Yields, Revenue and Net Operating Income per Acre
(2019 Dollars)

Year	Average Yield (Tons/Acre)	Average Price per Ton	Gross Revenue per Acre	Operating Expense per Acre	Net Operating Income per Acre
2018	2.85	$208	$592	$249	$343
2017	4.23	$175	$740	$377	$362
2016	3.05	$150	$457	$242	$215
2015	4.34	$194	$843	$349	$494
2014	3.52	$207	$729	$256	$473
2013	1.70	$261	$444	$145	$299
2012	3.63	$268	$973	$308	$664
2011	2.85	$222	$634	$222	$412
2010	3.16	$149	$470	$195	$276
2009	3.76	$165	$620	$328	$292
2016-18 Avg.	3.38	$177	$596	$290	$307
10-Yr Avg.	3.31	$200	$650	$267	$383

Sources:
Yields and prices from National Agricultural Statistics Service Annual Surveys.
Prices from CSU crop enterprise budgets, 2012-13 are statewide averages.
Operating expenses per acre estimated based on operating expenses per ton
from CSU crop enterprise budgets for Western Colorado.

Notes:
Operating expenses per ton in 2012-2013 based on average
of available CSU crop enterprise budgets from 2008-2018 -- crop enterprise budgets
unavailable for those years.

Yampa/White Basin
Grass Hay Yields, Revenue and Net Operating Income per Acre
(2019 Dollars)

Year	Average Yield (Tons/Acre)	Average Price per Ton	Gross Revenue per Acre	Operating Expense per Acre	Net Operating Income per Acre
2018	1.85	$209	$387	$155	$232
2017	2.12	$176	$373	$112	$261
2016	2.32	$161	$372	$115	$257
2015	2.18	$148	$323	$95	$228
2014	2.32	$147	$341	$135	$207
2013	1.91	$251	$478	$131	$347
2012	1.77	$243	$430	$122	$308
2011	1.85	$222	$411	$127	$284
2010	1.93	$131	$253	$166	$87
2009	2.24	$157	$352	$203	$150
2016-18 Avg.	2.10	$182	$378	$128	$250
10-Yr Avg.	2.05	$184	$372	$136	$236

Sources:
Yields from National Agricultural Statistics Service Annual Surveys.
Prices from CSU crop enterprise budgets, 2011-13 are statewide averages.
Operating expenses per acre estimated based on operating expenses per ton
from CSU crop enterprise budgets for Western Colorado.

Notes:
Operating expenses per ton in 2011-2013 based on average expenses per ton
from available CSU crop enterprise budgets from 2008-2018 -- crop enterprise budgets
unavailable for these years.

Yampa/White Basin
Alfalfa Hay Yields, Revenue and Net Operating Income per Acre
(2019 Dollars)

Year	Average Yield (Tons/Acre)	Average Price per Ton	Gross Revenue per Acre	Operating Expense per Acre	Net Operating Income per Acre
2018	1.59	$208	$330	$139	$191
2017	2.39	$175	$417	$213	$204
2016	2.40	$150	$359	$190	$169
2015	2.08	$194	$404	$167	$237
2014	2.06	$207	$427	$150	$278
2013	1.85	$261	$483	$157	$326
2012	NA				
2011	3.07	$222	$682	$239	$443
2010	2.69	$149	$400	$166	$234
2009	3.75	$165	$618	$327	$291
2016-18 Avg.	2.12	$177	$368	$180	$188
10-Yr Avg.	2.43	$192	$458	$194	$264

Sources:
Yields and prices from National Agricultural Statistics Service Annual Surveys.
Prices are statewide averages (no data available at the county level).
Operating expenses per acre estimated based on operating expenses per ton
from CSU crop enterprise budgets for Western Colorado.

Notes:
Operating expenses per ton in 2012-2013 based on average
of available CSU crop enterprise budgets from 2008-2018 -- crop enterprise budgets
unavailable for those years.

Western Colorado
Corn Yields, Revenue and Net Operating Income per Acre
(2019 Dollars)

Year	Yield/Acre (bushels)	Price (per bushel)	Gross Revenue per Acre	Operating Expense per Acre	Net Operating Income per Acre
2018	193	$3.59	$693	$562	$130
2017	145	$3.48	$505	$537	-$32
2016	174	$3.96	$689	$704	-$15
2015	190	$4.00	$759	$552	$207
2014	180	$4.03	$726	$551	$175
2013	NA	NA	NA	NA	NA
2012	NA	NA	NA	*NA*	*NA*
2011	NA	NA	NA	NA	NA
2010	200	$6.20	$1,239	$543	$696
2009	179	$4.58	$820	$474	$346
2008	172	$4.84	$830	$494	$336
2016-18 Avg.	171	$3.68	$629	$601	$28
10-Yr Avg.	179	$4.33	$783	$552	$230

Sources:
All data from CSU crop enterprise budgets for Western Colorado.

Appendix C.

Stakeholder Groups by Basin

Colorado River Basin Stakeholders

Name (First, Last)	Organization
Aaron Derwingson	Water Bank Work Group
Chris Trees	Water Bank Work Group
Dennis Davidson	NRCS (former)
Heather Tattersall Lewin	Roaring Fork Conservancy, Basalt
Ilana Moir	Colorado West Land Trust
John Stavney	Executive Director for Northwest Colorado Council of Governments
Ken Murphy	Glenwood Adventure Co
Kim Albertson	Rancher (McCoy), Grand Valley crop farmer, (GVWUA) Board member
Luke Gingerich	Grand Valley Water Users Association
Mel Rettig	Row Crop Farmer, Grand Valley
Mike Gardner	Terra Energy Partners and GVIC Board Member
Nicole Reed	Colorado West Land Trust
Sam Potter	West Divide Water Conservancy District
Tyler Hawkins	American Ag Credit

Gunnison River Basin Stakeholders

Name (First, Last; Affiliation)
Aaron Clay; retired attorney specializing in water law
Andy Spann; Spann Ranch, Upper Gunnison River Water Conservancy District
Austin Keiser; Grand Mesa Water Conservancy District
Cary Denison; Trout Unlimited
Chad Zummach; Vice President, Gunnison Branch - The Gunnison Bank and Trust
David Harold; Tuxedo Corn, Olathe
Elaine Brett; Founder of Western Colorado; Food and Ag Council and North Fork Area Food Systems expert
Jim Heneghan; Chief Power Supply Officer, DMEA
John Messner; Gunnison County Commissioner
Julie Nania; High Country Conservation Advocates
Kathleen Curry or Greg Peterson; Gunnison area ranchers, former operators of Tomichi Creek Natural Beef
Mark Voegeli; Director of Mountain Operations for Crested Butte Ski Resort/Vail Resorts
Mike Eytel; CRWCD- WBWG Rep from Colorado River District; Public Affairs Manager
Robbie Levalley; Delta County Administrator, Rancher
Sandy Head; Executive Director, Montrose
Sonja Chavez, WBWG, Upper Gunnison River Water Conservancy District, GM
Steve Shea; Uncompahgre Valley Water Users Association Board of Directors Chairman, Feedlot owner
Tom Kay; North Fork Organics, Delta Conservation District
Mark Roeber
John McClow; WBWG, Upper Gunnison River Water Conservancy District

Southwest Basin Stakeholders

Name (First, Last; Affiliation)
Al Pfister; retired USFS/Southwest Basin Roundtable
April Montgomery; Board Member – American Whitewater
Bob Witt; Board Member – Pine River Irrigation District
Bob Wright; American Ag Credit, Durango and Cortez office (retired)
Bruce Smart; Board Member – Dolores Water Conservancy District
Buck Skillen; Trout Unlimited and Animas Watershed Partnership
Carrie Padgett; Southwest Water Conservation District
Danny Decker; Farmer in Montezuma County
Don Schwindt; Southwest Water Conservation District
Duane Oliver; San Miguel Power Association
Elizabeth Howe; Mountain Capital Partners
Godwin Oliver; Farmer and Board Member, DWCD Board Member
Hilary Cooper, San Miguel County Commissioner
Justin Talbot; La Plata Electric Association
Kenny Heldman; Board member West End Economic Development Corporation, Southwest Roundtable, and producer
Blake Mamich (not Kevin Mallow) (Irrigation Division Head for the Southern Ute Tribe)
Phyllis Snyder; Farm Bureau Livestock Association
Ryan Unterriener (or other); Colorado Parks and Wildlife
Simon Martinez; Ute Mountain Utes
Zandon Bray; Lilylands Farm Bureau
Josh Dellinger; Empire Electric
Jude A. Schvenemeyer
Steve Harris; Harris Water Engineering

Yampa/White River Basin Stakeholders

Name (First, Last)
Al Vanden Brink; Rio Blanco Water Conservancy District
Hal Pearce; White River Valley Electric Cooperative
Andi Shaffner; Colorado Division of Water Resources (retired)
Callie Hendrickson; White River and Douglas Creek Conservation District
David Fleming; President, Yampa Valley Bank in Craig
Doug Monger; Routt County Commissioner
Geoff Blakeslee; The Nature Conservancy Yampa Valley Project Director
Jackie Brown, Water & Natural Resource Policy Advisor, Tri-State Generation and Transmission Assoc.
Marsha Daughenbaugh; Landowner/rancher on the Elk
Mike Camblin; Maybell Irrigation District
Nicole Seltzer, Facilitator, River Network
Shawn Welder; Meeker Hunting Outfitter
Todd Hagenbuch; Colorado State University Extension
Tom Kleinschnitz; Visit Moffat County