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The Central Utah Project: Economic Impacts and Counterfactual

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The Central Utah Project (CUP) is an extensive network of diversions, dams, reservoirs, tunnels, and pipelines delivering a portion of Utah's allocation of Colorado River water to residents of Salt Lake, Utah, Wasatch, Duchesne, and Uintah counties. Federal appropriations began in 1958, under the direction of the U.S. Bureau of Reclamation, and the project has been managed by the Central Utah Water Conservancy District. Through 2017, a total of $2.5 billion had been spent or appropriated to build and administer the system. The CUP currently delivers 151,160 acre-feet of municipal and industrial water annually to Salt Lake, Utah, Wasatch, and Duchesne counties, supporting over 659,000 residents.

CUP Construction Economic Impacts

The Kem C. Gardner Policy Institute analyzed the broad economic impacts of the CUP on the Utah economy from 1960 to 2017. This section presents estimates of statewide economic impacts stemming from the federal portion of CUP construction spending, including the direct, indirect, and induced jobs provided by the construction of CUP shown in 10-year increments, and the state gross domestic product produced by the employment. The results presented are based on the available data and assumptions as described in the methodology section.

Economic Impacts

Using an econometric model developed in-house for this project, the Gardner Institute estimates that CUP construction expenditures during the years 1960–2020 (projected) generated approximately $5.9 billion of state gross domestic product (GDP), or about 0.15% of total statewide cumulative GDP, measured in inflation-adjusted 2019 dollars. The average annual total number of jobs created, those directly involved with CUP and those that result as secondary impacts, varies by decade, from a low of 481 during 1960–1970 to a high of 2,820 during 1980–1990.

Job impacts associated with CUP construction are reported in Table 1. To illustrate, the Gardner Institute estimates that construction spending between 1970 and 1980 directly involved 542 jobs over that 10-year period (an average of the number of jobs estimated for each year). With an impact multiplier of 1.73, we estimate that these 542 direct jobs created an additional 938 average annual indirect and induced jobs, for a total increase of 1,480 jobs, representing about 0.6% of the overall increase in statewide jobs between 1970 and 1980.

Table 2 shows the earnings and GDP impacts associated with the total new jobs reported in Table 1. For example, the 481 additional average annual jobs over the period 1960–1970 generate $216.1 million in earnings and $240.5 million in additional GDP (in inflation-adjusted 2019 dollars). Over the period 1960–2020, cumulative earnings is about $4.2 billion

Table 1: Average Annual Job Impacts Associated with CUP Construction

Years	Direct	Indirect & Induced	Total
1960–1970	176	305	481
1970–1980	542	938	1,480
1980–1990	1,033	1,787	2,820
1990–2000	790	1,366	2,156
2000–2010	585	1,012	1,596
2010–2020	219	378	597

Source: Kem C. Gardner Policy Institute analysis of data provided by the Central Utah Water Conservancy District and U.S. Bureau of Reclamation

Table 2: Earnings and State Gross Domestic Product Impacts Associated with CUP Construction
(Millions of constant 2019 dollars)

Years	Jobs	Earnings	GDP
1960–1970	481	$216.1	$240.5
1970–1980	1,480	$667.4	$817.5
1980–1990	2,820	$1,240.7	$1,673.4
1990–2000	2,156	$972.0	$1,430.5
2000–2010	1,596	$764.3	$1,265.6
2010–2020	597	$302.5	$509.4

Source: Kem C. Gardner Policy Institute analysis of data provided by the Central Utah Water Conservancy District and U.S. Bureau of Reclamation

Table 3: Fiscal Impacts Associated with CUP Construction
(Millions of constant 2019 dollars)

Years	Earnings	State Income Tax	State Sales and Gross Receipts Taxes	Local Sales, Use, and Restaurant Taxes	Total Fiscal Impacts
2010–2020	$302.5	$10.0	$11.1	$2.0	$23.1

Source: Kem C. Gardner Policy Institute Analysis of data provided by the Central Utah Water Conservancy District and U.S. Bureau of Reclamation

and cumulative GDP is about $5.9 billion. These amounts represent approximately 0.15% of total statewide cumulative earnings and 0.15% of total statewide cumulative GDP over the similar period 1960–2017.

Lastly, Table 3 shows estimated statewide average annual fiscal impacts for the years 2010–2020. These figures are "gross" in the sense that they do not reflect any payments by state or local government to CUP. The average annual earnings impact of $302.5 million during 2010–2020 (see Table 2) gives rise to an additional $10.0 million in state income tax, $11.1 million in state sales and gross receipts taxes, and $2.0 million in local sales, use, and restaurant taxes, for a total average annual fiscal impact of $23.1 million.

In general, the economic impact of some event (e.g. CUP construction) refers to a counterfactual value that would not have occurred but for the event. In order for the estimates presented in this section to represent economic impacts, several assumptions must be met. First, we assume that of the $2.5 billion in federal CUP spending 1958–2017, the portion Utah must repay is $189.7 million, so that the remaining $2.3 billion is, in effect, a contribution from the federal government. The $189.7 million is the amount Utah has repaid through 2017. Although it is difficult to pin down the repayable portion exactly, CUWCD officials indicated to us that the portion paid through 2017 ($189.7 million) is a reasonable approximation to the total repayable part of 1958–2017 spending ($2.5 billion). Because Utah citizens and businesses pay federal taxes, some part of the "contribution" must have been repaid, though it would be difficult to say just how much. Since the method we use to estimate impacts is a constant multiple of the non-repayable portion of spending, if the non-repayable portion is higher than $189.7 million, impacts would be reduced proportionally. For example, in the extreme, if all federal spending had to be repaid by the state, then there would be no economic impact stemming from this spending (the spending then would be best thought of as shifting jobs, GSP, and tax revenue from one point in time to another). Similarly, the non-repayable federal portion must not have supplanted other federal spending in the state. This assumption would be incorrect if, for example, federal financial assistance for CUP precluded or diminished federal assistance for other projects in Utah. Given these assumptions, the figures presented above are estimates of the addition of jobs in the state *because of* CUP construction.

A final technical note concerning this analysis is that the impacts stem from the non-repayable portion of federal spending and the specific industries that were the beneficiaries of that spending. Any project with the same level of spending and with the same distribution of recipient industries would have produced the same economic impact.

Counterfactual: What If There Were No Federal Funding of CUP?

The Gardner Institute considered the role of the Central Utah Project in the state's development and conducted a counterfactual analysis exploring what the state might look like without federal funding of CUP.

We construct an alternative funding timeline in which there is no federal funding of CUP. For comparison and modeling purposes, we develop a simplified counterfactual scenario in which the state of Utah issues bonds to pay for the same level of construction that actually occurred between 1958 and 2019. We assume the state stays within its existing legal debt margin and, starting in 1989, the statutory debt limit. We maintain the existing bonding that took place over this period and make the simplifying, but strong assumption that additional CUP-related bonding up to annual debt limits would have been politically feasible. We also assume the state would have been willing to assume liability for any dam failures, another strong assumption that could have limited dam—and thus reservoir—sizes under state funding. Under these conditions, construction funding is ultimately delayed by 26 years from what happened historically; that is, by 2019 the state would have been able to pay for the actual spending that occurred only through 1993. This delay could also be interpreted as a reduction in the size of the projects. Under state funding, by 2019 only 44% of the actual federal funding would have taken place. To the extent that this level of bonding would not have been politically feasible, construction of CUP infrastructure would be even further delayed or reduced.

This delay or reduction in the provision of CUP water, particularly to Salt Lake and Utah counties, would have had noticeable effects. CUP currently provides 151,160 acre-feet of water annually to Salt Lake, Utah, Wasatch, and Duchesne counties. This supports approximately 660,000 people. Without this supply, residents of these counties would have to either reduce consumption significantly (by 25% in Wasatch, about 33% in Salt Lake and Utah, and 46% in Duchesne) or find alternative sources (exercise Bear River rights, increase groundwater withdrawals, convert some agricultural uses to M&I), or follow some combination of these strategies. Lower consumption and less certain supply would also likely have influenced growth along the Wasatch Front.

Any exercise of this type is based on assumptions. We attempt to make ours clear throughout the analysis. Any change in these assumptions would affect the results discussed below.

State Funding of CUP Construction Appropriations

Without federal funding of the Central Utah Project, the state of Utah would have had to find alternative sources of funding to build a similar water-delivery infrastructure. We examine a scenario where the state issues general obligation bonds. This is an optimistic "best case" alternative to federal funding. We also make the strong, but simplifying, assumption that the state would have followed the actual annual federal appropriations from 1958 through 2019, as provided by CUWCD. We treat these as expenditures in the year appropriated.

We allow for the actual general obligation bonding that occurred over this period.[1] We assume the state would have stayed within its legal debt margin from 1958 through 1988, and the more conservative statutory debt limit and resulting additional general obligation debt-incurring capacity that came into effect in 1989.

Since Utah has consistently maintained the highest credit rating, in each year that a bond is issued we assume the interest rate is equal to Moody's average yield on 20-year Aaa-rated municipal bonds as of January of that year. All bonds have a 20-year maturity. Our modeling is a somewhat aggressive scenario in that the state bonds for as much CUP spending as its debt limit allows in any given year. We do not make any assumptions about how this would affect the state's credit rating, which would very likely have been lowered due to such high levels of debt, raising bond interest rates and thus costs to the state. For simplicity, we also assume that this level of bonding would have been politically feasible, a strong assumption in a fiscally conservative state like Utah. We attempt to follow the actual schedule of expenditures as much as is reasonably possible. Expenditures that are delayed from the actual schedule are adjusted for inflation using the producer price index for construction materials and components. This analysis does not consider the effects of any original issue premiums (or discounts) on the state's capacity to fund construction. Any premiums at the time of bond sale would have reduced the funds available, further delaying development.

In 1958, the state's legal debt margin—the constitutional debt limit less outstanding general obligation debt—was approximately $65.3 million. We assume the state issued $67.8 million in bonds that year to fund the first 13 years of CUP expenditures.[2] From 1959 through 1973, the new debt margin would not have been large enough to fund additional expenditures, so we assume the state would wait for the initial CUP bond to be paid off. The next bond is issued in 1979 for $174.7 million, covering the next six years of expenditures, followed by a $296.6 million bond issue in 1985 to fund another five years of expenditures. No expenditures are funded in 1990 through 2006. The state issues $293.7 million of CUP bonds in 2006 and $359.8 million in 2008, funding a total of five years of expenditures, then $207.5 million in 2013, $273.9 million in 2015, and $333.1 million in 2017 to fund a total of seven years of expenditures. By 2019, the state on its own would be funding the actual expenditures that occurred in 1993.

Thus, under relatively aggressive assumptions, if the state had funded the expenditures itself, it would currently be 26 years behind schedule. The total cost through 2019 of $2.0 billion would have covered only 44% of what the $2.6 billion in actual expenditures has built, plus the state would have to pay an additional $1.6 billion in interest expenses. This does not include the additional $2.1 billion (in 2019 dollars) of expenditures, plus associated interest payments, required to bring the state up to what has actually been spent as of 2019. Beyond the state's legal ability to fund construction of a CUP-like project, the cost of making principal and interest payments would have reduced its capacity to fund regular state functions and activities for decades. A less aggressive, more fiscally conservative approach to funding CUP construction would delay completion even further. Table 4 provides annual expenditures, bond amounts, and interest payments as they were modeled.

The delay in CUP completion under state funding could also be iterpreted as a reduction in the size of infrastructure built. By 2019 state funding would have covered 44% of what actually occurred. This could translate, for example, to smaller dams at Jordanelle, Starvation, and Soldier Creek, creating smaller reservoirs that provide fewer years of reserve supply.

The first deliveries of CUP water to Utah and Salt Lake counties occurred in 1986. Under our state funding scenario, this would not have happened until 2010, the year that 1986's actual appropriations are funded. Also, under state funding, there would have been no subsidy for irrigation users of the water and the state would bear the liability for any dam failures.

Implications

To support the growth that has occurred since 1986—450,324 new residents of Salt Lake County and 404,356 in Utah County—without deliveries of CUP water, there would have to be sizable reductions in per-capita consumption and/or development of additional water supplies. Lower consumption and less certain supply would also likely have influenced growth along the Wasatch Front. While M&I water supply is generally not a direct factor in households' decisions to relocate, it does affect real estate developers' decisions to build. Most residential developers are required to pay impact fees and hookup fees to secure water supplies for the homes they build.

Table 4: State Funding of Actual CUP Construction Expenditures, 1958–2019
(Millions of Nominal Dollars)

Year	January 1 Aaa yield	Actual Approp. Year	State Expenditure	Actual Debt Margin*	New Debt Margin	Amount Bonded	Interest Paid
1958	2.75%	1958	$1.0	$65.3	$0.0	$67.8	$1.9
1959	3.19%	1959	$3.0	$65.8	-$2.0		$1.9
1960	3.49%	1960	$2.0	$66.4	-$1.4		$1.9
1961	3.15%	1961	$3.4	$67.2	-$0.6		$1.9
1962	3.32%	1962	$1.5	$69.1	$1.3		$1.9
1963	2.95%	1963	$0.2	$72.5	$4.7		$1.9
1964	3.09%	1964	$0.3	$74.8	$7.0		$1.9
1965	2.97%	1965	$2.8	$76.4	$8.6		$1.9
1966	3.40%	1966	$9.5	$77.0	$9.2		$1.9
1967	3.50%	1967	$15.1	$80.6	$12.8		$1.9
1968	4.06%	1968	$13.4	$83.0	$15.2		$1.9
1969	4.58%	1969	$5.8	$69.5	$1.7		$1.9
1970	6.38%	1970	$9.7	$73.9	$6.1		$1.9
1971	5.08%			$78.6	$10.8		$1.9
1972	4.84%			$82.4	$14.6		$1.9
1973	4.90%			$85.8	$18.0		$1.9
1974	5.03%			$92.0	$24.3		$1.9
1975	6.39%			$110.8	$43.0		$1.9
1976	6.16%			$128.5	$60.7		$1.9
1977	5.10%			$134.8	$67.0		$1.9
1978	5.20%			$92.0	$92.0		
1979	5.95%	1971	$21.3	$189.0	$14.3		
1980	6.58%	1972	$37.1	$223.0	$48.3		
1981	8.98%	1973	$61.3	$326.0	$151.3		
1982	12.30%	1974	$11.5	$368.0	$193.3		
1983	9.00%	1975	$7.6	$374.0	$199.3		
1984	9.00%	1976	$35.9	$426.0	$251.3		
1985	9.54%	1977	$35.7	$545.0	$73.6	$296.6	$28.3
1986	7.70%	1978	$50.1	$534.0	$62.6		$28.3
1987	6.09%	1979	$61.8	$540.0	$68.6		$28.3
1988	7.31%	1980	$53.9	$509.0	$37.6		$28.3
1989	7.23%	1981	$95.2	$74.4	-$396.9		$28.3
1990	6.81%			$87.4	-$383.9		$28.3
1991	6.57%			$140.4	-$331.0		$28.3
1992	6.13%			$164.0	-$307.4		$28.3
1993	5.91%			$60.4	-$411.0		$28.3
1994	5.14%			$73.0	-$398.4		$28.3
1995	6.41%			$113.0	-$358.4		$28.3
1996	5.60%			$148.6	-$322.8		$28.3
1997	5.40%			$243.0	-$228.4		$28.3
1998	4.85%			$48.2	-$423.1		$28.3
1999	4.85%			$362.4	$65.8		$28.3
2000	5.91%			$430.4	$133.8		$28.3
2001	5.00%			$521.7	$225.1		$28.3
2002	5.05%			$337.4	$40.8		$28.3
2003	4.74%			$136.4	-$160.2		$28.3
2004	4.42%			$227.3	-$69.3		$28.3
2005	4.24%			$249.8	$249.8		
2006	4.29%	1982	$133.4	$386.0	$92.3	$293.7	$12.6
2007	3.89%	1983	$160.3	$531.1	$237.4		$12.6
2008	4.12%	1984	$153.9	$680.3	$26.8	$359.8	$27.4
2009	4.64%	1985	$135.6	$648.5	-$5.1		$27.4
2010	3.96%	1986	$70.3	$646.5	-$7.1		$27.4
2011	4.86%			$724.5	$71.0		$27.4
2012	3.60%			$836.9	$183.4		$27.4
2013	2.81%	1987	$176.8	$921.9	$60.9	$207.5	$33.2
2014	3.94%	1988	$30.7	$1,051.5	$190.4		$33.2
2015	2.90%	1989	$76.0	$1,164.1	$29.1	$273.9	$41.2
2016	2.91%	1990	$197.9	$1,377.8	$242.8		$41.2
2017	3.21%	1991	$163.7	$1,549.9	$81.9	$333.1	$51.9
2018	2.94%	1992	$110.5	$1,466.0	-$2.1		$51.9
2019	3.23%	1993	$58.8	$1,561.0	$92.9		$51.9
Total			**$2,007.2**				**$1,069.9**

* Amounts for 1958–77 were estimated by multiplying the annual debt limit by the 1978–97 average debt margin share of the debt limit (66.6%). Starting in 1989, this is the additional GO bonding capacity as reported in the state's comprehensive annual financial reports.
Notes: The January 1 Aaa Yield is Moody's average municipal bond yield for 20-year Aaa-rated bonds. State expenditure amounts were adjusted for inflation from the actual federal appropriation amounts using the Producer Price Index for construction materials and components. Negative new debt margin amounts imply other bonds may not have been funded in those years.
Source: Kem C. Gardner Policy Institute analysis of federal CUP expenditure data provided by the Central Utah Water Conservancy District.

Without CUP water these fees would likely be higher, leading to less and/or more expensive housing in Salt Lake and Utah counties. (While the cost of providing water has to show up somewhere, adding it to the price of housing or property taxes would not necessarily lead to more efficient water use.)

To explore the possible effects of a delayed or smaller, state-funded CUP project or none at all, we examine current consumption rates and how they would have to change to support the current population without CUP's supply. We discuss pricing as a mechanism for inducing conservation, and assess alternative water sources: the Bear River, groundwater, and agricultural conversions. We also offer some thoughts on the less quantifiable effects of reduced supply, such as lost recreational opportunities and supply uncertainty.

Consumption

The Central Utah Project provides 151,160 acre-feet per year (AFY) of municipal and industrial (M&I) water to Salt Lake, Utah, Wasatch, and Duchesne counties. At 2018 county-specific usage rates calculated by the Division of Water Resources, this supports an estimated 659,489 people, 20% of the state's 2019 population and 35% of the four counties' combined population (see Table 5). Salt Lake County receives 100,000 AFY of water from Jordanelle and Strawberry reservoirs. At the county's 2018 consumption rate of 197 gallons per capita per day (GPCD), this supports approximately 453,000 people, 39% of the county's 2019 population. Utah County receives 45,000 AFY of CUP M&I water. At the county's 2018 consumption rate of 210 GPCD, this supports over 191,000 people, 29% of the county's population. In Wasatch County, the Jordanelle Reservoir provides 2,400 AFY of M&I water to the Heber area and Strawberry Reservoir provides 260 AFY for Strawberry Valley municipal supplies, for a county total of 2,660 AFY. The county's 2018 consumption rate of 277 GPCD implies that CUP water supports almost 8,600 people in the county, more than one-quarter of the population. Duchesne County receives 3,500 AFY of M&I water through the Uinta Basin Replacement Project and Starvation Reservoir. At the county's 2018 consumption rate of 454 GPCD, this supports 6,900 residents, roughly one-third of the county's 2019 population.

To maintain the current population without CUP water, consumption would have to be 34% lower across the four counties than it was in 2018. County-level reductions would have ranged from 25% in Wasatch (277 to 208 GPCD) to 32% in Salt Lake (197 to 135 GPCD), 33% in Utah (210 to 141 GPCD), and 46% in Duchesne (454 to 244 GPCD).

Table 5: Required Consumption Rates Without CUP Water, by County

County	CUP Supply (AFY)	2018 GPCD	Population Supported by CUP	Share of 2019 Pop.	GPCD w/ out CUP
Salt Lake	100,000	197	452,868	39.3%	135
Utah	45,000	210	191,175	29.3%	141
Wasatch	2,660	277	8,567	26.1%	208
Duchesne	3,500	454	6,878	33.0%	244
Total	**151,160**	**212**	**659,489**	**35.5%**	**139**

AFY = acre-feet per year; GPCD = gallons per capita per day
Source: Kem C. Gardner Policy Institute analysis of data from Utah Division of Water Resources and Central Utah Water Conservancy District.

Pricing

Economists' favorite tool for rationing scarce resources is prices. Therefore, with a delayed supply of CUP water or none at all, one approach for encouraging conservation and reducing per-capita consumption could be to increase retail water prices. As the price of water rises, in general, consumers will tend to use less.

The effectiveness of prices in allocating goods depends on how responsive consumers are to changes in prices. Estimates of the responsiveness of water consumption to prices range around 3% to 8% decreases in consumption for a 10% increase in price.[3] Therefore, pricing strategies, likely in conjunction with other efforts, could have been used to reduce consumption rates had the state needed to make due with a smaller water supply.

Retail water rates vary widely across the state. The Governor's Office of Management and Budget surveyed rates in 121 communities across the state, and found that the monthly charge for 30,000 gallons ranges from $25.60 in Hyrum to $347.68 in Park City. Park City is something of an outlier; the next highest in GOMB's analysis is Cedar Hills at $172.76 for 30,000 gallons. This is still almost seven times higher than the lowest rate. Even within Salt Lake County, among the 17 water providers surveyed, retail residential rates for 30,000 gallons range from $46.05 in Murray to $119.50 in Draper.

Another complicating factor is the variety and complexity of water rate structures. Most of the 36 retail water providers in Salt Lake County use increasing-block rate structures or at least seasonal rates to encourage conservation. However, there is significant variation in the number of blocks (per-gallon prices), block sizes (the range of consumption levels covered by a given price), and size of the price increase from one block to the next. Also, fixed base charges can reduce the effective average price per gallon as the quantity consumed increases.

Ideally, retail water rates would be structured to further discourage consumption and encourage conservation, while providing sufficient revenues for water providers to cover their fixed costs.

Alternative Sources

Bear River

The Bear River Development Act granted Salt Lake County rights to up to 50,000 AFY of Bear River water, which supply has not yet been developed. At the county's current consumption rate of 197 GPCD, Bear River water could support up to 226,400 people. Without CUP, this supply would have likely been developed by now. Under a slower or smaller state-funded scenario, Salt Lake County may have opted to develop its Bear River rights by now.

Table 6: Groundwater Withdrawals and Safe Yields, Salt Lake and Utah Counties, 2016
(Acre-Feet)

Area	Irrigation	Industrial	Public Supply	Domestic & Stock	Total	Safe Yield	Excess Capacity
Salt Lake Valley	100	42,400	94,300	490	137,290	165,000	27,710
Utah County	35,700	11,500	76,300	1,880	125,380	174,430	49,050
Northern Utah Valley–East	2,200	8,800	48,800	600	60,400	76,000	15,600
Northern Utah Valley–West*	1,000	0	10,500	280	11,780	22,300	10,520
Southern Utah Valley	8,900	2,700	16,600	900	29,100	66,700	37,600
Goshen Valley	23,600	0	400	100	24,100	9,430	–14,670

* Northern Utah Valley–West includes Cedar Valley.
Source: *Groundwater Conditions in Utah, Spring of 2017*, Utah Department of Natural Resources, Utah Department of Environmental Quality, and United States Geological Survey; Salt Lake Valley Groundwater Management Plan (2002); Cedar Valley and Northern Utah Valley Groundwater Management Plan (2014); *Evaluation of the Groundwater Flow Model for Southern Utah and Goshen Valleys, Utah, Updated to Conditions through 2011, with New Projections and Groundwater Management Simulations*, USGS (2013); Mt. Nebo Water Agency Regional Water Supply Study; Remaining Safe Yield Report, Hansen Allen & Luce for CUWCD (2020).

Groundwater

All groundwater in Salt Lake and Utah counties is fully appropriated, if not over-appropriated, and closed to new appropriations. Also, withdrawals in Salt Lake Valley, Cedar Valley, Northern Utah Valley, Southern Utah Valley, and Goshen Valley are restricted to remain within the estimated long-term safe yields. According to the 2002 Salt Lake Valley Groundwater Management Plan, annual safe yields for Salt Lake County total 165,000 AFY.[4] In Utah County, total safe yield for the county is 174,430 AFY.

According to the USGS and the Utah Department of Natural Resources, 2016 groundwater use in the Salt Lake Valley was 137,290 AFY, which is 27,710 AFY below the safe yield (see Table 6).[5] Without CUP supplies, this "buffer" could have provided water for an additional 118,300 people at 2016 Salt Lake County per-capita consumption rates.[6] Total 2016 groundwater use in Utah County was 125,380 AFY, 49,050 AFY below safe yield. This excess capacity could have supported an additional 197,100 people at 2016 consumption rates. However, because the groundwater in both counties is fully appropriated, some transfers of water rights would have been necessary to incorporate it into the M&I supply.

Agricultural Conversions

Besides the Bear River and groundwater, another potential source of water in the absence or delay of CUP supplies is conversion from agricultural uses. Some of this will occur naturally as farmland is converted to housing to accommodate additional population. But, without CUP water, there could be more pressure for municipalities to purchase water rights from farmers in order to supply M&I water.

Since 1929, about three-quarters of Utah farms' cash receipts, on average, have come from animals and animal products, primarily cattle and hogs. The remaining quarter stems from crops, the largest component of which is currently feed crops, representing 14% of total cash receipts in 2018 and 47% of crop receipts.

At almost 2.8 million AFY, Utah had the sixth-largest withdrawals of fresh surface water for irrigation in 2015 out of the eight Mountain West states. However, this does not account for the number of acres irrigated or the types of crops grown. Dividing the value of cash receipts for crops by irrigation withdrawals provides a standardized measure of the productivity of water use. By this metric, Utah is also sixth out of the eight states, earning $185 per acre-foot of surface water withdrawn (see Table 7). Utah was the third least productive user of irrigation water from 1965 through 1985, behind Wyoming and Nevada. In 1990, 1995, 2005, and 2010 Utah was the second least productive irrigator, behind only Wyoming. Despite this poor relative performance, the state has increased its crop productivity by 173% over the past 50 years. This was the second-largest increase among the eight states, behind only Nevada's 337% improvement.

In 1965, feed crops accounted for 28% of total crop receipts in Utah. This grew to 49% in 1990 and has remained near that level since, reaching 60% in 2008, then dipping to 47% in 2018 (see Figure 1). Receipts from feed crops have more than tripled since 1965, after adjusting for inflation (see Figure 2). Prior to the mid-1960s, vegetables, melons, fruits, and nuts accounted for a greater share of crop receipts than did feed crops. While these higher-valued crops represented at least 20% of crop receipts from 1960 through 1993, by 2018 their share had shrunk to less than 5%. Annual receipts from vegetables and melons averaged about $41.0 million, adjusting for inflation, between 1958 and 1998. Since then, they have shrunk by three-quarters to just $8.8 million in 2015 (the most recent available data).

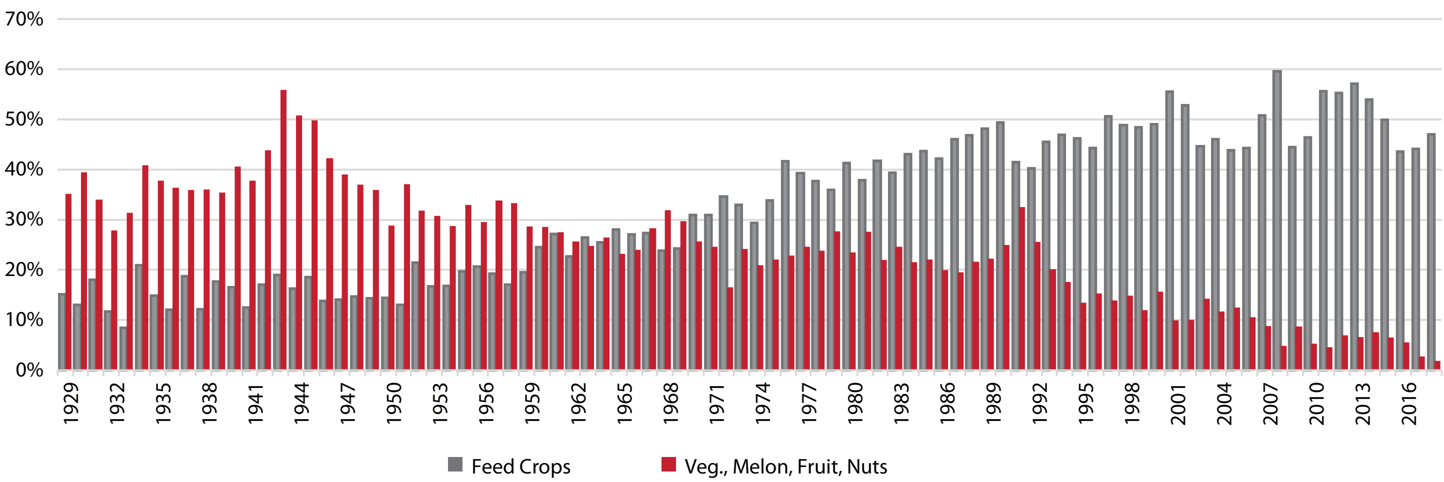
According to data from the USDA's Economic Research Service, from 2000 through 2018, the state exported an average of 14% of its feed crops, reaching 16% or higher since 2014.[7] Exported feed crops represented roughly 275,400 AFY of surface water in 2015, more than the total amount of M&I water provided by CUP and enough to support over 1 million people.

Table 7: Crop Receipts per Acre-Foot of Surface Water Irrigation Withdrawals in Utah and Mountain West States
(Constant 2020 dollars)

State	1965	1970	1975	1980	1985	1990	1995	2000	2005	2010	2015
Utah	$68	$67	$107	$116	$83	$86	$108	$95	$99	$142	$185
Arizona	$854	$533	$651	$635	–	–	$613	$626	$800	$752	$845
Colorado	$105	$115	$313	$225	$199	$209	$193	$190	$182	$288	$272
Idaho	$133	$131	$223	$246	$132	$221	$251	$173	$177	$280	$271
Montana	$161	$153	$198	$158	$103	$137	$176	$93	$127	$265	$196
Nevada	$36	$27	$48	$82	$57	$95	$179	$129	$234	$256	$159
New Mexico	$350	$276	$400	$340	$420	$472	$408	$396	$476	$590	$555
Wyoming	$32	$34	$54	$77	$47	$37	$40	$51	$49	$76	$46

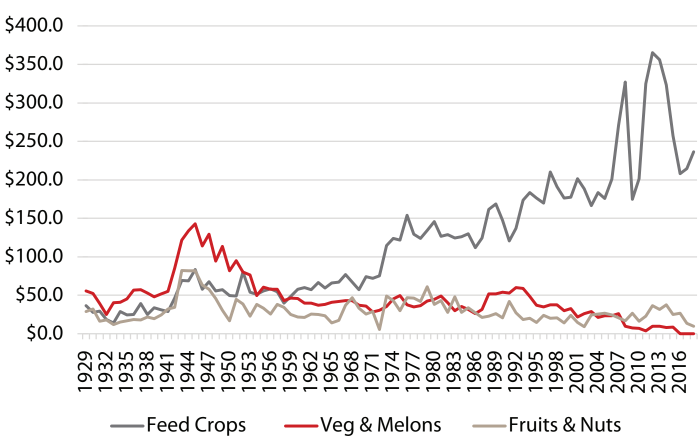
Source: Kem C. Gardner Policy Institute analysis of USGS and USDA ERS data.

Figure 1: Share of Total Crop Cash Receipts in Utah, 1929–2018



Source: USDA/ERS Farm Income and Wealth Statistics

Figure 2: Cash Receipts by Crop in Utah, 1929–2018
(Millions of constant 2020 dollars)



Source: USDA/ERS Farm Income and Wealth Statistics

In 2015, self-supplied fresh surface water withdrawals for irrigation were nine times as large as those for public supply and represented 88% of all fresh surface water withdrawals in Utah statewide. Irrigation also claimed 80% of total fresh surface and groundwater withdrawals in 2015. Since 1960, irrigation has accounted for an average of 90% of fresh surface water withdrawals and 83% of all freshwater withdrawals in the state. Yet since 1963, the first year of available data, the farm sector has never represented more than 3% of Utah's GDP. It has claimed less than 1% since 1994 and was just 0.4% in 2019. Farm earnings' share of total earnings in Utah has also been less than 1% since 1994, and as of 2019 farm earnings accounted for just 0.3% of total earnings (see Figure 3).

In Utah County, 205,710 AF of surface water were withdrawn for irrigation in 2015. At 2015 public supply usage rates, this could support 841,855 people. Salt Lake County's 25,430 AF of surface water withdrawals for irrigation could support 110,133 people. However, Salt Lake and Utah county farmers are some of the more productive agricultural water users in the state, earning $396 and $342, respectively, in crop receipts per acre-foot of surface water. Nonetheless, continued growth in these counties will likely lead to the conversion of farmland to housing developments, as the Gardner Institute projects an additional million people in these counties over the next 30 years.[8]

Figure 3: Farm Share of Earnings and GDP in Utah, 1960–2019

Note: Data for GDP are available only since 1963. GDP shares for 2018 and 2019 are estimated.
Source: Bureau of Economic Analysis.

Quality of Life

While water supply is generally not a direct factor in households' decisions to relocate, it does affect quality of life. The greenness of the landscape and the availability of water-based recreational opportunities affect the attractiveness of a region to current and potential residents. Based on the relative importance of these factors to individuals, combined with the state's other attributes (e.g., non–water-based recreational opportunities, business and political environment, economic opportunities, culture, etc.), a lower water supply could have affected population growth as described earlier.

Jordanelle State Park has averaged 310,700 visits annually since 1995, over 7.7 million in total through 2019. Starvation State Park has averaged 72,500 annual visits since 1980, for a total of 2.9 million through 2019. Strawberry Reservoir is also a popular site for boating and fishing, although visitation data are not readily available.[9] Without the dams creating or enlarging these reservoirs, or with smaller dams, these recreational opportunities would either not exist or would be significantly reduced.

Smaller dams, and thus smaller reservoirs, also means shorter or no multi-year backup water supply during extended droughts. The resulting supply uncertainty could have influenced farmers' planting decisions and harvest sizes, leading to a direct effect on income. It could also have affected the viability of large, new residential real estate developments. Since such developments are often required to secure adequate water rights to supply new residents, uncertainty around the availability of water could have prevented projects from receiving approval or increased project costs to ensure sufficient supplies.

A reduced water supply that led to lower consumption rates could have led to changes in residential and commercial landscaping. Rather than expanses of green lawns, higher retail water prices or other conservation efforts could have encouraged or required wider use of xeriscaping and other low-water-use approaches. This would have show up particularly in newer real estate developments as the region's growing population began to feel the effects of a reduced water supply.

Methodology

CUWCD provided the Gardner Institute with annual CUP appropriations and repayments from 1958 through the present and projected into the future. Other data sources include the U.S. Bureau of Economic Analysis, U.S. Bureau of Labor Statistics, and IPUMS-USA.

Because CUP construction expenditures span a period of time where the usual, off-the-shelf tools of economic impact analysis are unavailable, the Gardner Institute developed a purpose-built econometric model of impacts. The model is based on primary data and parallels econometric methods outlined in recent peer-reviewed journals.[10] This methodology is well suited to the limited expenditure data CUWCD was able to provide.[11]

The economic impacts presented in this report are based on estimates of the economic base multiplier. The base multiplier is part of an economic framework that divides a regional economy into two key sectors: an export-oriented ("basic," or "base") sector producing goods and services to meet external demand and a locally oriented ("local") sector producing goods and services to meet the demands of local consumers and businesses. The base multiplier is the average number of locally oriented jobs created for each new export-oriented job.

Viewing the CUP-funded jobs as base jobs, since they are in the service of economic activity funded by a source external to Utah, we apply the estimated economic base multiplier to these new basic jobs to obtain the estimated increase in locally oriented jobs. Since the economic base multiplier used in this analysis is 1.73, we estimate that, on average, each job directly connected with CUP construction gives rise to 1.73 additional jobs. These additional jobs include indirect and induced jobs. Indirect impacts are those deriving from the increase in output by local businesses to meet the additional demand for goods and services by businesses directly involved with CUP construction. Induced impacts follow when the earnings from these additional direct and indirect jobs are spent in the local economy, stimulating still more local business output.

The base multiplier applies to jobs, while CUWCD provided only total CUP expenditures. The Gardner Institute converted these expenditures to jobs using the (inverse) productivity of construction labor: the average amount of construction output per construction worker.

The estimates of employment, earnings, and GDP impacts are based on historical ratios of earnings to jobs and GDP to jobs.

Accurate estimates of the impacts of CUP require accurate estimates of the CUP funds that flowed into Utah from the federal government but did not flow back out in the form of repayment. For the purpose of these preliminary estimates we have assumed that of the full federal appropriation, the amounts reported as "CUWCD Annual Payments" in the data provided by CUWCD represent the full amount of funds repayable to the federal government. Starting with total nominal expenditures of $2,535,665,123 (including interest earned on federal appropriations and subsequently spent on planning and construction) over the period 1958–2017, we subtract repayments totaling $189,665,059, arriving at the figure $2,346,000,064. The impacts reported in this brief assume that this figure represents the amount of the total expenditure ($2,535,665,123) that does not have to be repaid. In other words, we are assuming that only about 7.5% of total CUP expenditures are subject to repayment. As noted earlier, if the actual repayable amount is higher than $189.7 million, all of the impact estimates presented in this section would be reduced proportionally.

State gross domestic product (GDP), also known as "value added" or "gross state product," is the sum of total income and indirect business taxes. GDP is the most commonly used measure of the contribution of a region to the national economy as it avoids double counting of intermediate sales and captures only the "value added" by the region (or business) to final products.

The jobs numbers reported in this brief include both full- and part-time jobs. Wage and salary jobs are included, as well as self-employment. The number of jobs is not the same as the number of employed persons, since an employed person may hold more than one job.

Earnings are the sum of wage and salary disbursements, employer contributions for employee retirement and insurance funds and for government social insurance, and the income of self-employed sole proprietors and partners.

Conclusion

CUP construction expenditures during the years 1960–2020 generated approximately $5.9 billion of state gross domestic product (GDP), or about 0.15% of total statewide cumulative GDP, measured in inflation-adjusted 2019 dollars.

Without federal funding of CUP the state would most likely have funded similar, or smaller, water infrastructure developments. Had they been at the same level, it would have taken the state longer to complete and would have affected the state's ability to fund its normal operations. How these competing needs were balanced would influence the ultimate delivery date of Colorado River water to the Wasatch Front, with an estimated delay of at least 26 years.

Under relatively aggressive assumptions, if the state had issued bonds to build the Central Utah Project infrastructure, it would currently be an estimated 26 years behind schedule. The total cost through 2019 of $2.0 billion would have covered only 44% of what the $2.6 billion in actual expenditures has built, plus the state would have an additional $1.6 billion in interest expenses paid or obligated, affecting the state's ability to fund its normal operations. This does not include the additional $2.1 billion (in 2019 dollars) of expenditures, plus associated interest payments, required to bring the state up to what has actually been spent as of 2019.

Without the M&I water provided by CUP, residents of Salt Lake, Utah, Wasatch, and Duchesne counties would have had to either reduce consumption below current levels by an average of roughly one-third or find alternative sources. County-level reductions would range from 25% in Wasatch to 32% in Salt Lake, 33% in Utah, and 46% in Duchesne. While there is currently about 76,760 AFY of excess groundwater capacity in Salt Lake and Utah counties combined, this water is already appropriated and would have required transfers of water rights to incorporate it into the M&I supply. Salt Lake would likely have developed its rights to 50,000 AFY of Bear River water. There may have been increased pressure to convert agricultural uses to M&I. Most alternative sources are not without political and/or technical difficulties.

Even under state funding of the CUP infrastructure, the landscape of the Salt Lake and Utah valleys would likely be less verdant, as conservation efforts required more "water-wise" landscaping. And, the recreational opportunities afforded by the reservoirs in the CUP system would be significantly attenuated. Agriculture in Utah without CUP might be forced to shift, where possible, to higher-value crops that provided a greater return on constrained water supplies.

Alternatively, had the state pursued a scaled-down version of CUP, this would have resulted in less supply reliability during prolonged droughts and possibly smaller deliveries to the Wasatch Front. In either case, some mix of conservation and development of alternative sources would have been necessary to support the level of growth the region has seen since CUP deliveries actually began in 1986.

Endnotes

1. Existing net general obligation bonded debt for 1958 to1977 was estimated by multiplying the annual constitutional debt limit by the 1978–97 average bonded debt share of the debt limit (33.4%). This period was chosen because the share was relatively stable compared with subsequent years.
2. Since the $65.3 million margin is based on the 1978–97 average, we're granting ourselves some leeway to assume the margin in 1958 would accommodate $67.8 million.
3. See "The Price Elasticity of the Demand for Water in Utah," presentation by Gail Blattenberger to the Executive Water Finance Board, June 13, 2018, slide 22; gomb.utah.gov/wp-content/uploads/2019/04/Price-Elasticity-of-the-Demand-for-Water-in-Utah-Gail-Blattenberger.pdf.
4. This consists of 30,000 AF per year in the northern region of the county, 25,000 AF in the western region, 20,000 AF in the central region, and 90,000 AF in the eastern region.
5. Burden, Carole B., et al., 2017, *Groundwater Conditions in Utah, Spring of 2017*, Utah Department of Natural Resources, Cooperative Investigations Report No. 58.
6. County-level per-capita consumption rates are from the Utah Division of Water Resources, *2016 M&I Report, http://dwre-utahdnr.opendata.arcgis.com/pages/municipal2016.* Rates cover both potable and secondary water use.
7. Measured as receipts from exports as a share of total cash receipts for feed crops.
8. See Kem C. Gardner Policy Institute, 2015–2065 State and County Population Projections, gardner.utah.edu/demographics/population-projections/.
9. A 1978 *Strawberry Reservoir Enlargement: Recreation Master Plan* by the Bureau of Reclamation included an estimate of reservoir visitation in 1975 of 275,285.
10. Sources used in this work include: Dijk, J. J. (2017). Local employment multipliers in U.S. cities. *Journal of Economic Geography*, 465-487; Dijk, J. J. (2018). Robustness of econometrically estimated local multipliers across different methods and data. *Journal of Regional Science*, 1-14; Moretti, E. (2010). Local Multipliers. *American Economic Review*, 1-7; Moretti, E., & Thulin, P. (2013). Local multipliers and human capital in the United States and Sweden. *Industrial and Corporate Change*, 339-362.
11. CUWCD was only able to provide total construction expenditures without, for example, any direct information on expenditures by industry, jobs, wages, or benefits.