Analysis and Technical Update to the Colorado Water Plan

Technical Memorandum

Prepared for:

Colorado Water Conservation Board

Subject:

Updated Population Projections for Water Plan Scenarios

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Section 1: Overview

Population projections, by basin and for the state as a whole, are a primary driver in the municipal and industrial demand projections developed by Element Water. This memo describes the methodology used by BBC Research & Consulting (BBC) to develop updated population projections for each of the scenarios in the Water Plan.

Section 2: Background on Previous Methodologies

2.1 OVERVIEW OF METHODOLOGIES USED IN SWSI 2010

As documented in Appendix H, "State of Colorado 2050 Municipal & Industrial Water Use Projections", alternative population scenarios through 2050 were also developed for the previous SWSI effort. That work, primarily conducted in 2008-09, required both extending the county and state population projections available at the time from the State Demography Office (SDO) from 2035 to 2050 and developing alternative high and low scenarios.

Harvey Economics, in collaboration with the SDO, essentially sought to extend the existing SDO projections using a similar approach to the methods the SDO used to develop their forecasts (which at the time covered the period of 2005 through 2035). Those methods included developing economic (e.g. employment) forecasts for the state and each county to develop estimates of future labor demand. Future labor demand was then compared to projected future labor supply based on an extended cohort component demographic model similar to the SDO's demographic model. In areas where labor demand was projected to exceed available labor supply, additional net in-migration was assumed to occur in order to balance the labor markets. In situations where labor supply was projected to exceed labor demand, net out-migration was assumed to occur to balance the labor markets.

The need to extend the SDO's projections from 2035 to 2050 also served as the basis for developing the alternative high growth and low growth scenarios. In the previous SWSI effort, the population scenarios all assumed the same growth (the SDO forecast) through 2035. However, the high growth scenario incorporated more aggressive economic/employment growth assumptions for the extension from 2035 through 2050, while the low growth scenario incorporated lower economic/employment assumptions from 2035 through 2050 compared to either the high scenario or the medium scenario.

2.2 METHODOLOGY ENHANCEMENTS FOR TECHNICAL UPDATE

Two factors led to modifications to the approach to developing population projection scenarios for the Technical Update:

- The SDO population projections are now available through 2050 (which remains the endpoint for this SWSI update). It was no longer necessary to extend the SDO projections in order to create the middle, or base case, population projections.
- During the scenario planning workshop held in early March 2017, CWCB (and other members of the SWSI team) suggested it would be beneficial to find a simpler approach for developing the alternative scenarios that would be easier to explain and involve fewer assumptions.

After further discussions with other members of the study team and the SDO, BBC developed a simplified approach for constructing the alternative population scenarios for this Technical Update. While the previous approach was methodologically rigorous in producing an internally consistent set of employment and population forecasts, only the population numbers were actually used in deriving the future water demand forecasts. Moreover, development of alternative employment forecast scenarios for various sectors in all 64 counties in Colorado inevitably involved making numerous assumptions about conditions far in the future that were based almost entirely on judgment. By avoiding these types of judgment-based assumptions, the methodology adopted for the SWSI update also avoids "picking winners and losers" in developing population scenarios for smaller areas such as the basins and individual counties.

Section 3: Description of Revised Methodology

The updated population forecasts for the planning scenarios were based on the existing SDO population forecasts that now span the entire Technical Update study period and provide the base case or middle projection, and probabilistic analysis of the potential variance around those forecasts to develop high and low growth projections. The variance around the SDO projections was estimated from the historical population growth experience of the state, and each of its basins. As discussed later in Section 5, these three sets of initial projections, with some modifications to the distribution of growth within the state, were then used to develop population forecasts consistent with the five planning scenarios developed in the Colorado Water Plan.

3.1 SPECIFIC METHODOLOGY

Only three pieces of information were required to develop probabilistic estimates of the potential range surrounding the "median" population projections produced by the SDO. Those information requirements were:

- **The compound average annual growth rate implied by the SDO forecast.** For example, for the State of Colorado as a whole, the SDO's 2017 forecast anticipates a 2050 population of 8,461,296 residents. By comparing that projection to the 2010 population of 5,029,196, we can calculate the compound average annual growth rate over the 40-year period to be 1.309 percent per year.
- **The historical standard deviation in population growth rates by decade.** As shown in Table 1, from 1940 through 2010, the standard deviation in average annual population growth rates by decade for the State of Colorado was 0.634 percent.
- **The historical compound average annual growth rate for the area being projected.** Also shown in Table 1, from 1940 through 2010, the average annual compound growth rate for Colorado as a whole was 2.165 percent.

State of Colorado Population Growth 1940-2010
(Compound Average Growth Rate and Standard Deviation by Decade)

Year	Population	Avg. Rate
1940	1,123,296	
1950	1,325,089	1.67%
1960	1,753,947	2.84%
1970	2,207,259	2.33%
1980	2,889,964	2.73%
1990	3,294,394	1.32%
2000	4,301,261	2.70%
2010	5,029,196	1.58%
1940-2010 Compound Growth Rate	2.165%	
Standard Deviation in Growth Rate by Decade		0.634%

Table 1. State of Colorado Population Growth, 1940-2010 (Compound Average Growth Rate and Standard Deviation in Average Growth Rate by Decade)

Source: U.S. Census Bureau, 2017. Growth rates and standard deviations calculated by BBC.

Fundamentally, this approach relies on a couple of key assumptions:

- The compound growth rate for 2015 through 2050 derived from SDO population projections represents the median average annual growth rate forecast for each area. Out of a hypothetical million potential alternative futures, the future described in the SDO forecast would fall in the middle.
- The variability of growth rates in future decades (and corresponding potential variance around the SDO-based median forecast) can be estimated based on historical variability in growth rates by decade since 1940. However, BBC has further assumed that the "coefficient of variation" for the growth rates in each basin will remain the same in the future as they have been in the past. This means that the size of the standard deviation in each basin's future growth rate will change in proportion to the ratio of their projected median growth rate in the future to their median growth rate in the past. For example, if the median future annual growth rate is projected to be ½ of the historical annual growth rate, the future standard deviation by decade is also assumed to be ½ of the historical standard deviation.

The second assumption described above is both logical and supported by the historical data.

BBC calculated the historical compound average annual growth rates for each of Colorado's 63 counties (excluding Broomfield) from 1940 through 2010, and the historical standard deviations in growth rates by decade for each county. There was a correlation of 0.50 between the absolute values of the compound average annual growth rates and the standard deviations across all of the counties.

We also sorted the counties into quintiles based on their compound average annual growth rates and reviewed the average standard deviation across each quintile. In the fastest growing quintile of counties, the historical compound average annual growth rate from 1940 to 2010 averaged 3.7 percent per year, while the standard deviations in growth rates by decade averaged 3.1 percent. In the slowest growing

quintile of counties, the historical compound average annual growth rate from 1940 to 2010 averaged 0.1 percent per year, while the standard deviations in growth rates by decade averaged 1.3 percent.

3.1.1 STEPS TO IMPLEMENT THIS ANALYSIS

The following sequence of steps was used to implement the analysis.

1. Calculate median compound average annual growth rate for the state (as shown in Figure 1) and each basin based on the 2017 SDO projections through 2050.
2. Estimate the standard deviation in future growth rates by decade for the state and each basin based on the following calculation:

   Future standard deviation = historical standard deviation (1940 – 2010) x projected median compound growth rate in future (2010-2050) / historical compound growth rate (1940 – 2010)
3. Use Monte Carlo simulation techniques to simulate alternative future populations for each area based on baseline compound average annual growth rate (from SDO projections) and estimated standard deviation in growth rates by decade. Each "run" for each geographic area built to a 2050 population projection as follows:
   a. 2020 population = 2010 population (estimate from SDO) x (1 + X) ^10, where X is a randomly drawn average annual growth rate from a normal distribution with its mean based on the compound growth rate from the SDO projections, and its standard deviation estimated based on step 2.
   b. 2030 population = 2020 population estimate (from step 3a) x (1 + X) ^10, where X is another randomly drawn average annual growth rate from the distribution described in step 3a.
   c. Repeat step 3b until we reach 2050.
4. Based on thousands of "runs", identify the estimated overall distribution of potential future population totals for the state and each basin in 2050.

To encompass a wide range of potential future population growth outcomes, BBC and CWCB selected the 10 percent exceedance probability for the "high growth" projections and the 90 percent exceedance probability for the "low growth" projections. Based on these thresholds, there is an estimated 1 in 10 chance that the actual future 2050 population could be higher than the "run" with the estimated 10 percent exceedance probability, and a 1 in 10 chance the actual future 2050 population could turn out to be lower than the "run" with the estimated 90 percent exceedance probability.

3.1.2 STATEWIDE POPULATION EXAMPLE

To more specifically illustrate the application of this methodology, Figure 1 shows the resulting estimated range of possible future population totals for the State of Colorado as a whole.

The SDO's 2017 population projection for Colorado in 2050 was 8,461,296 residents. That projection is represented in Figure 1 by the red line labelled "median population," and provides the middle or base case population scenario for SWSI.

Using the 10 percent exceedance probability for the high growth forecast, the 2050 population projection for that forecast is 9,312,421. Using the 90 percent exceedance probability to represent the low growth forecast for future population, that forecast has a projected statewide population in 2050 of 7,683,154 residents.

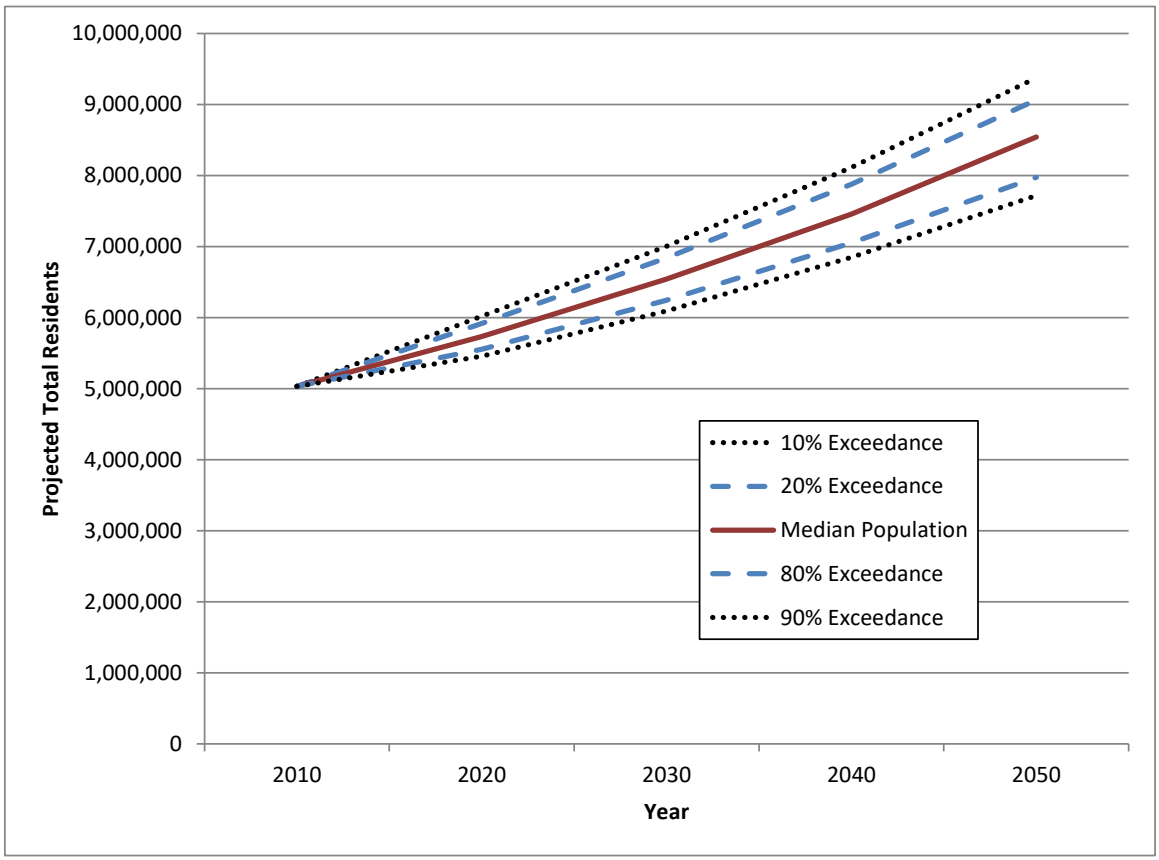


Figure 1. Range of Potential State of Colorado Population Growth, 2010-2050 (Selected Exceedance Intervals)

Note: For simplicity in calculation and illustration, this example uses the average compound growth rate from the SDO statewide projections over the entire period, and does not reflect the declining growth rates from decade to decade embodied in the SDO projections. Consequently, the median population line is lower than the actual SDO projections for all years before 2050.

3.1.3 APPLICATION TO BASINS AND COUNTIES

The same methodology was applied to generate high growth and low growth projections for each of the basins and counties, with a couple of refinements.

In general, the smaller geographic areas represented by the basins have larger coefficients of variation in their historical population growth rates than the state as a whole. This implies that their population projections, under the methodology described in this memo, also have larger variance (on a relative basis) than the state as a whole. Carried further, the larger variance in the basin population projections means that the sum of the basin populations for the high growth projections (the 10 percent exceedance probability) is greater than the overall statewide population projection for the same exceedance probability. Correspondingly, the sum of the low growth projections for the basins (the 90 percent exceedance probability) is lower than the 90 percent exceedance probability estimate for Colorado as a whole.

It could be argued that these discrepancies are logical. There is no reason to believe that a future high population growth scenario for Colorado as a whole necessarily means that every basin would simultaneously experience high growth, and vice-versa for the low scenario.

However, it would be problematic from a planning standpoint to deal with a set of high growth projections for the basins that collectively exceed the high growth projection for the State (or vice versa

for the low growth projections). BBC dealt with this issue by constraining the high and low projections for the basins to sum to the statewide total. The constraint was imposed by proportionally reducing growth in each basin (under the high growth projections) as needed to make the sum of the basin projections match the statewide total – or proportionally increasing growth in each basin (under the low growth projections) so that the sum of the basin projections matched the statewide low projections.

Alternative population scenarios for the state's individual counties were also used in developing the Technical Update municipal demand forecasts. The potential issues regarding consistency between the statewide population projections and projections for smaller areas are even greater at the individual county level. Consequently, BBC did not develop probabilistic population forecasts for the individual counties. Instead, BBC apportioned the probabilistic basin growth projections to their component counties based on each county's share of the median, SDO projections for its basin.

Six of Colorado's 64 counties include lands located in more than one basin. Current and projected future populations for these counties were divided between the relevant basins using the same proportions utilized in the SWSI 2010 population projections.

Section 4: Illustration of Range of Population Growth Projections for Selected Basins

The following charts illustrate the SDO projections and the statistically-derived high growth projections and low growth projections for three basins. One of the basins (the Arkansas Basin) is an example of an area which has historically experienced comparatively low variability in terms of its growth trajectory. The second example is the Colorado River Basin, which has historically experienced medium variability in terms of its growth trajectory. The final example is the Gunnison Basin, which has historically experienced high variability in its growth trajectory. The high growth and low growth projections shown in these figures reflect the unconstrained statistical projections for each basin, prior to adjustments to make the sum of the basin projections match the overall state high growth and low growth projections.

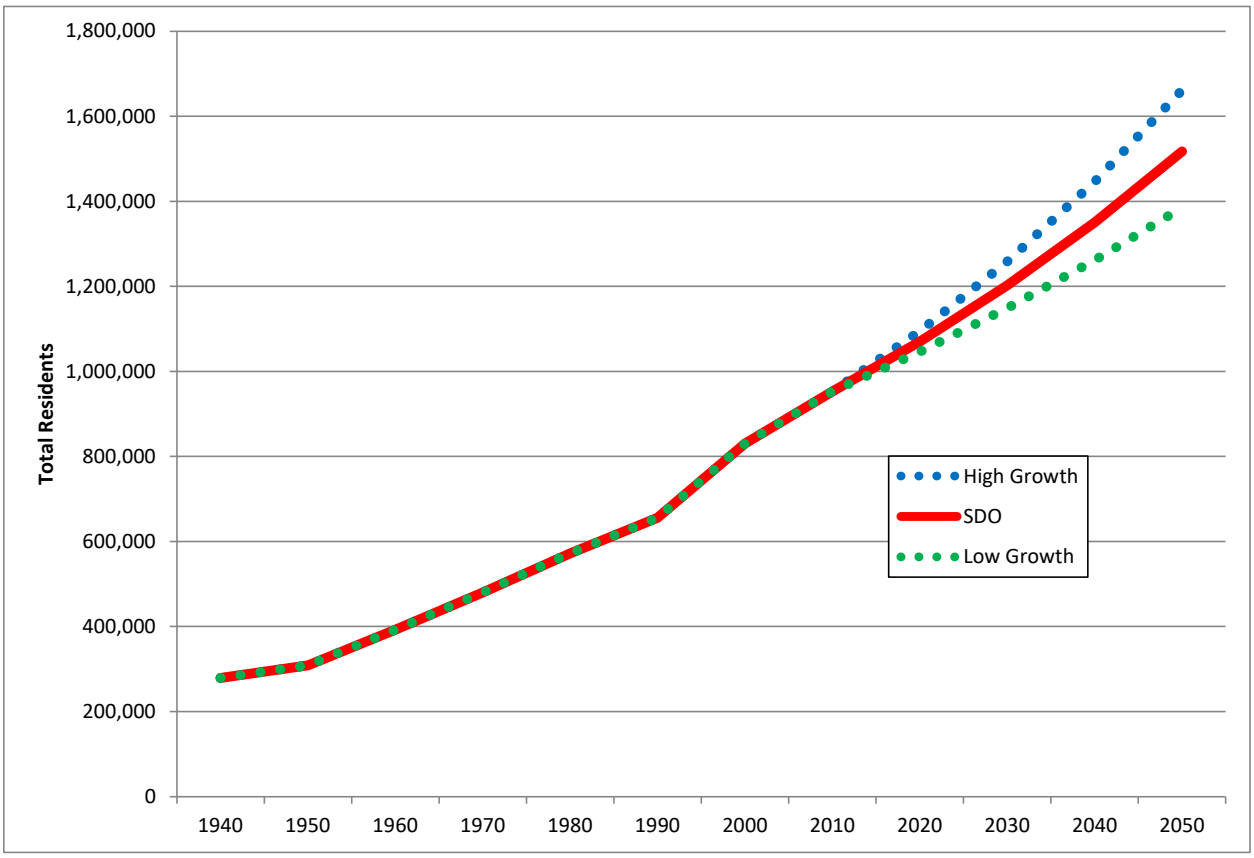


Figure 2. Arkansas Basin SDO and Statistically-derived Low and High Growth Projections
(Example of basin with low historical growth variability)

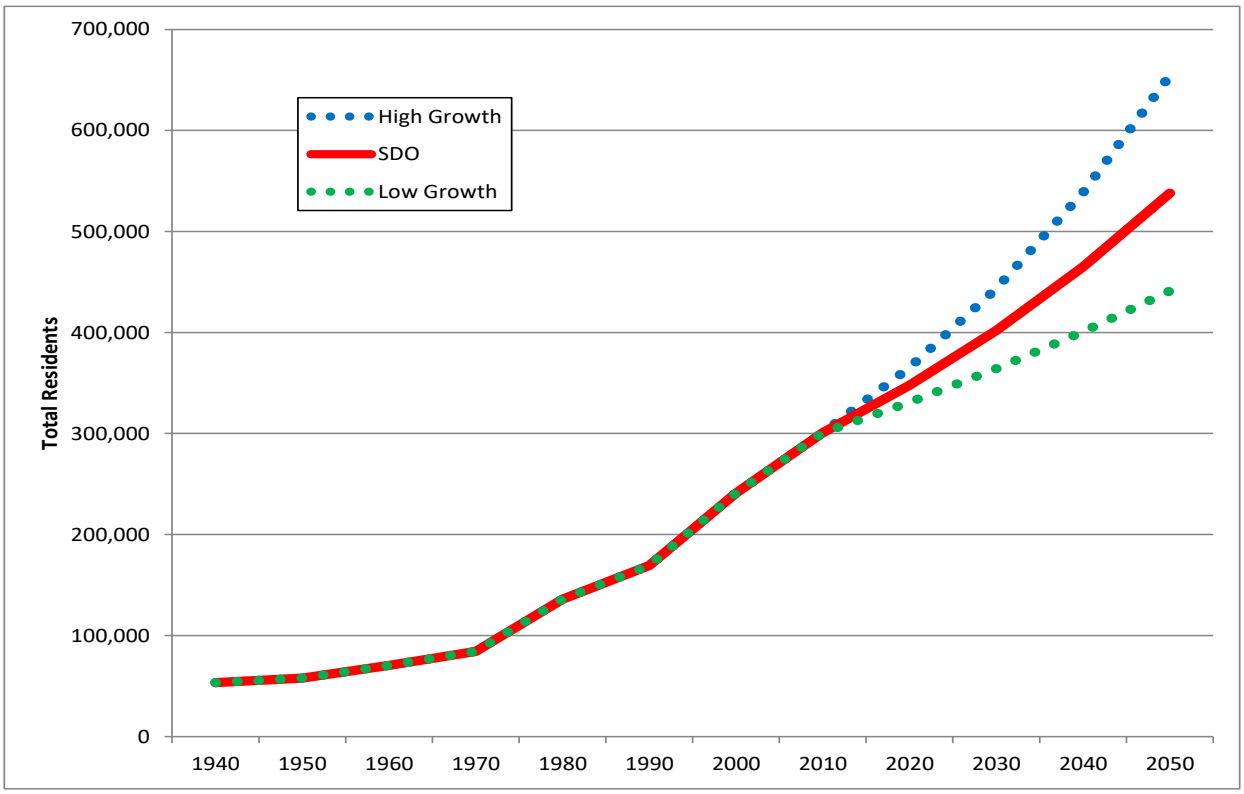


Figure 3. Colorado Basin SDO and Statistically-derived Low and High Growth Projections
(Example of basin with medium historical growth variability)

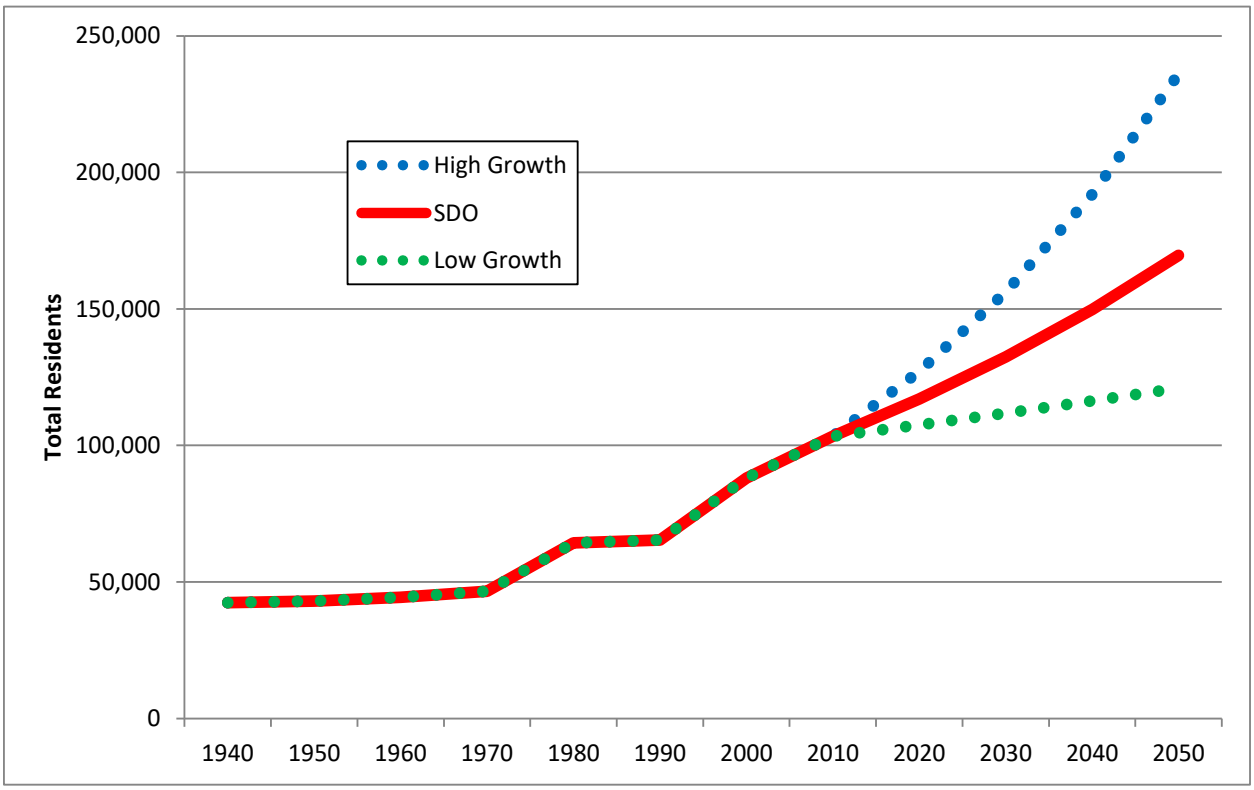


Figure 4. Gunnison Basin SDO and Statistically-derived Low and High Growth Projections
(Example of basin with high historical growth variability)

Section 5: Development of the Five Technical Update Population Scenarios

During the creation of the Colorado Water Plan, five alternative future scenarios were developed. These scenarios were entitled "business as usual," "weak economy," "cooperative growth," "adaptive innovation," and "hot growth."

As described in the Water Plan, each of the five scenarios includes distinctive assumptions regarding future demographic growth. The following are excerpts from the descriptions of each scenario specifically related to population growth, and descriptions of the manner in which BBC implemented the population projections for each scenario.

5.1 BUSINESS AS USUAL SCENARIO

- Excerpts from Colorado Water Plan description:

  "Recent trends continue into the future. Few unanticipated events occur. The economy goes through regular cycles, but grows over time. By 2050, Colorado's population is close to 9 million people. Single family homes dominate, but there is a slow increase of denser developments in large urban areas."

- Implementation:

  Used the current SDO state and county projections for 2050. BBC met with the SDO on 5/30/2017 and confirmed that this scenario was consistent with the assumptions embodied in their forecast. As noted in Section 2.1 of this memo, the SDO projections are based on a sophisticated combination of a cohort component demographic model and regional employment forecasts throughout the state. Further, the SDO projections are regularly reviewed with local governments and planners, and modified (as necessary) based on local input. The SDO projections are also the "official" population projections for the State of Colorado and are used for a variety of purposes, including the distribution of funds to local governments.

5.2 WEAK ECONOMY SCENARIO

- Excerpts from Colorado Water Plan description:

  "The world's economy struggles, and the state's economy is slow to improve. Population growth is lower than currently projected, slowing the conversion of agricultural land to housing… Many sectors of the state's economy, including most water users and water-dependent businesses, begin to struggle financially."

- Implementation:

  Used the statistically-derived low growth projections. These projections are consistent with an overall reduction of future growth in Colorado. Based on the methods used to develop the low growth projections, areas with the most consistent growth histories (through booms and busts) would see the smallest reductions in their projected growth relative to the SDO forecasts, while areas that have historically been the most vulnerable to economic busts would see larger reductions in their projected growth.

5.3 COOPERATIVE GROWTH SCENARIO

- Excerpts from Colorado Water Plan description:

  "Environmental stewardship becomes the norm. Broad alliances form to provide for more integrated and efficient planning and development. Population growth is consistent with current forecasts. Mass transportation planning concentrates more development in urban centers and mountain resort communities, thereby slowing the loss of agricultural land and reducing the strain on natural resources compared to traditional development."

- Implementation:

  Constrained overall growth to statewide SDO projections. Defined mountain resort communities and urban centers. Increased projected 2015-2050 BAU population growth in mountain resort communities by 20%, increased projected 2015-2050 BAU population growth in urban centers by 10%. Adjusted other areas (basins and counties) to maintain overall state totals from SDO projections.

- Definitions of mountain resort communities: Grand, Summit, Eagle, Garfield, Routt, Pitkin, Gunnison, San Miguel, and La Plata counties.
- Definitions of urban centers: Denver, El Paso, Pueblo, Boulder, Larimer, Weld, and Mesa counties.

5.4 ADAPTIVE INNOVATION SCENARIO

- Excerpts from Colorado Water Plan description:

  "A much warmer climate causes major environmental problems globally and locally... Colorado is a research hub and has a strong economy. The relatively cooler weather in Colorado (due to its higher elevation) and the high-tech job market cause population to grow faster than currently projected… The warmer climate reduces global food production, increasing the market for local agriculture and food

imports to Colorado. More food is grown locally, increasing local food prices and reducing the loss of agricultural land to urban development... More compact urban development occurs through innovations in mass transit."

- Implementation:

  Used statewide forecast from high growth projections. Used unconstrained high growth forecast for urban center counties (see definitions recommended for Cooperative Growth Scenario) and reduced forecast as needed in other areas to balance to state totals.[1]

5.5 HOT GROWTH SCENARIO

- Excerpts from Colorado Water Plan description:

  "A vibrant economy fuels population growth and development throughout the state... A much warmer global climate brings more people to Colorado with its relatively cooler climate. Families prefer low-density housing and many seek rural properties, ranchettes, and mountain living. Agricultural and other open lands are rapidly developed… Communities struggle unilaterally to provide services needed to accommodate the rapid business and population growth."

- Implementation:

  Used statistically-derived high growth projections, which project disproportionate population increases in the state's more rural areas (due to their greater historical variability in population growth and their higher growth rates during boom periods).

Section 6: Projected Population by Basin and County for the Planning Scenarios

As described in the preceding sections, population projections for the five planning scenarios were derived from the 2017 SDO population projections and statistically-derived high growth projections and low growth projections for each basin.

The revised methodologies in this Technical Update for developing projected M&SSI water needs, and for hydrologic analysis, required further disaggregation of the basin population projections. GIS analysis was used to identify the portion of the South Platte Basin population that is located within the Republic River sub-basin. The population of the Yampa Basin was subdivided between the Yampa sub-basin and the White sub-basin for these purposes.

The following table presents the 2015 population estimates for each basin and county, and the projected 2050 population for each area under the five planning scenarios.

[1] Unconstrained high growth projections refer to projections for these areas based on their basins' probabilistic high growth projections, prior to downward adjustments to force the sum of all of the basins' high growth projections match the statewide high growth projection.

Basin Forecasts	2015 Population	Business as Usual	Weak Economy	Cooperative Growth	Adaptive Innovation	Hot Growth
Arkansas Basin	**1,008,434**	**1,509,463**	**1,462,821**	**1,544,367**	**1,625,970**	**1,567,968**
Colorado Basin	**307,570**	**515,472**	**456,321**	**549,176**	**572,860**	**577,827**
Gunnison Basin	**103,121**	**162,632**	**123,070**	**158,587**	**195,998**	**204,931**
Metro	**2,768,126**	**4,061,899**	**3,817,099**	**3,921,976**	**4,161,584**	**4,317,749**
North Platte Basin	**1,353**	**1,279**	**1,055**	**1,210**	**1,364**	**1,457**
Rio Grande Basin	**45,975**	**55,104**	**42,270**	**52,141**	**62,972**	**67,252**
South Platte Basin	**1,061,754**	**1,892,367**	**1,616,081**	**1,962,391**	**2,330,861**	**2,189,906**
Republican Basin	31,616	35,476	30,297	33,569	38,441	41,054
Remainder S. Platte	1,030,138	1,856,891	1,585,784	1,928,822	2,292,420	2,148,852
Southwest Basin	**107,999**	**195,837**	**125,814**	**201,010**	**264,189**	**282,144**
Yampa-White Basin	**43,723**	**67,242**	**38,623**	**70,437**	**96,621**	**103,188**
Yampa Basin	37,194	59,866	34,386	63,458	86,022	91,869
White Basin	6,529	7,376	4,237	6,979	10,599	11,319
Statewide Totals	**5,448,055**	**8,461,296**	**7,683,154**	**8,461,296**	**9,312,421**	**9,312,421**

Table 2. Population Projections by Basin for the Five Planning Scenarios

Forecasts by County		2015 Population	Business as Usual	Weak Economy	Cooperative Growth	Adaptive Innovation	Hot Growth
Arkansas Basin							
Baca		3,594	2,949	2,858	2,790	2,868	3,063
Bent		5,847	6,607	6,403	6,252	6,426	6,863
Chaffee		18,603	27,145	26,306	25,686	26,403	28,197
Cheyenne	*part*	686	615	596	582	599	639
Crowley		5,569	7,754	7,514	7,337	7,542	8,055
Custer		4,457	5,934	5,751	5,615	5,772	6,164
El Paso		676,178	1,076,486	1,043,223	1,116,517	1,177,637	1,118,209
Elbert	*part*	7,634	20,526	19,891	19,422	19,964	21,321
Fremont		46,659	56,406	54,663	53,373	54,864	58,592
Huerfano		6,456	5,983	5,798	5,661	5,819	6,215
Kiowa		1,396	1,193	1,156	1,129	1,160	1,239
Lake		7,502	9,868	9,563	9,337	9,598	10,250
Las Animas		14,061	13,249	12,840	12,537	12,887	13,763
Lincoln	*part*	4,485	6,857	6,645	6,488	6,669	7,123
Otero		18,265	15,302	14,829	14,479	14,884	15,895
Prowers		11,905	11,441	11,087	10,826	11,128	11,884
Pueblo		163,196	224,184	217,257	230,283	245,249	232,873
Teller	*part*	11,941	16,964	16,440	16,052	16,501	17,622
Colorado Basin							
Eagle		53,320	94,459	83,620	102,687	99,147	105,885
Garfield		57,779	105,711	93,581	115,297	110,957	118,498
Grand		14,602	27,406	24,261	29,967	28,766	30,721
Mesa	*part*	134,096	212,859	188,433	220,735	255,228	238,608
Pitkin		17,845	23,209	20,546	24,282	24,361	26,017
Summit		29,928	51,828	45,881	56,208	54,400	58,097
Gunnison Basin							
Delta		29,973	42,126	31,878	39,861	49,704	53,082
Gunnison		16,097	22,728	17,199	24,054	26,817	28,639
Hinsdale		767	1,573	1,190	1,488	1,856	1,982
Mesa	*part*	14,927	23,695	17,931	24,572	32,067	29,858
Montrose	*part*	36,710	66,942	50,658	63,343	78,985	84,353
Ouray		4,647	5,568	4,214	5,269	6,570	7,016

Table 3. Population Projections by County for the Five Planning Scenarios

Forecasts by County		2015 Population	Business as Usual	Weak Economy	Cooperative Growth	Adaptive Innovation	Hot Growth
Metro							
Adams		489,923	890,148	836,501	842,289	886,001	946,216
Arapahoe		629,066	899,738	845,513	851,363	895,546	956,410
Broomfield		64,656	95,566	89,806	90,428	95,121	101,585
Denver		680,658	952,955	895,523	980,185	1,067,123	1,012,979
Douglas		322,198	482,824	453,725	456,865	480,575	513,236
Jefferson		564,619	694,943	653,061	657,579	691,705	738,716
Elbert	*part*	17,006	45,725	42,970	43,267	45,512	48,606
North Platte							
Jackson		1,353	1,279	1,055	1,210	1,364	1,457
Rio Grande							
Alamosa		15,968	22,934	17,593	21,701	26,209	27,990
Conejos		8,074	8,997	6,902	8,513	10,282	10,980
Costilla		3,572	3,934	3,018	3,722	4,496	4,801
Mineral		729	959	736	907	1,096	1,170
Rio Grande		11,413	11,612	8,907	10,988	13,270	14,172
Saguache		6,219	6,668	5,115	6,309	7,620	8,138
South Platte							
Republican Basin							
Cheyenne	*part*	1,144	1,026	876	970	1,111	1,187
Kit Carson		8,219	9,595	8,194	9,079	10,397	11,104
Lincoln	*part*	1,064	1,627	1,390	1,540	1,763	1,883
Logan	*part*	2,032	2,711	2,315	2,565	2,938	3,137
Phillips		4,307	4,372	3,734	4,137	4,737	5,059
Sedgwick	*part*	1,008	984	840	931	1,066	1,139
Washington	*part*	3,790	3,763	3,214	3,561	4,078	4,355
Yuma		10,052	11,398	9,734	10,785	12,351	13,190
Remainder South Platte							
Boulder		318,570	447,843	382,458	460,770	558,020	518,258
Clear Creek		9,392	12,448	10,631	11,779	13,488	14,405
Gilpin		5,824	6,626	5,659	6,270	7,180	7,668
Larimer		332,830	543,588	464,224	564,664	677,320	629,057
Logan	*part*	20,090	26,805	22,891	25,364	29,045	31,019
Morgan		28,230	42,734	36,495	40,436	46,306	49,453
Park		16,716	23,797	20,323	22,518	25,786	27,539
Sedgwick	*part*	1,381	1,348	1,151	1,275	1,461	1,560
Teller	*part*	11,490	16,323	13,939	15,445	17,687	18,889
Washington	*part*	1,044	1,037	885	981	1,123	1,200
Weld		284,571	734,343	627,129	779,320	915,004	849,804
Southwest							
Archuleta		12,417	26,571	17,070	25,142	35,845	38,281
Dolores		1,972	2,597	1,668	2,457	3,503	3,742
La Plata		54,857	94,002	60,391	101,831	126,811	135,430
Montezuma		26,129	47,158	30,296	44,623	63,617	67,941
Montrose	*part*	4,085	7,449	4,785	7,048	10,048	10,731
San Juan		696	767	493	726	1,035	1,105
San Miguel		7,843	17,293	11,110	19,183	23,329	24,914
Yampa-White							
White Basin							
Rio Blanco		6,529	7,376	4,237	6,979	10,599	11,319
Yampa Basin							
Moffat		12,884	13,868	7,966	13,122	19,927	21,281
Routt		24,310	45,998	26,420	50,336	66,095	70,587

Table 3. Population Projections by County for the Five Planning Scenarios (continued)

Forecasts by County	2015 Population	Business as Usual	Weak Economy	Cooperative Growth	Adaptive Innovation	Hot Growth
Multi-basin Counties (complete totals by county)						
Cheyenne County	1,830	1,641	1,472	1,553	1,710	1,826
Elbert County	24,640	66,251	62,861	62,689	65,477	69,927
Lincoln County	5,549	8,484	8,035	8,028	8,432	9,006
Logan County	22,122	29,516	25,207	27,929	31,983	34,157
Mesa County	149,023	236,554	206,364	245,307	287,295	268,465
Montrose County	40,795	74,391	55,443	70,391	89,034	95,084
Sedgwick County	2,389	2,332	1,992	2,207	2,527	2,699
Teller County	23,431	33,287	30,380	31,497	34,187	36,511
Washington County	4,834	4,800	4,099	4,542	5,201	5,555

Table 3. Population Projections by County for the Five SWSI Scenarios (continued)

References

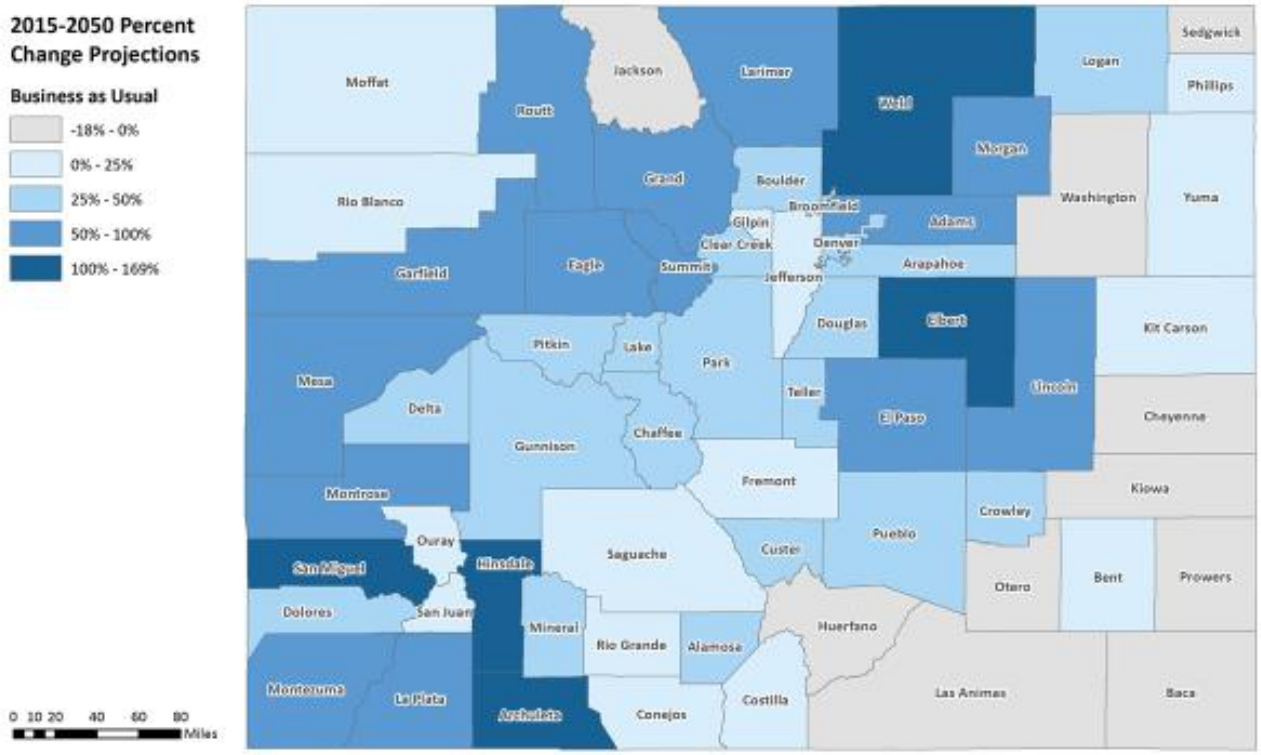
Harvey Economics, 2050 Population Projections for the State of Colorado Municipal and Industrial Water Use Projections, Colorado Water Conservation Board, 2010.

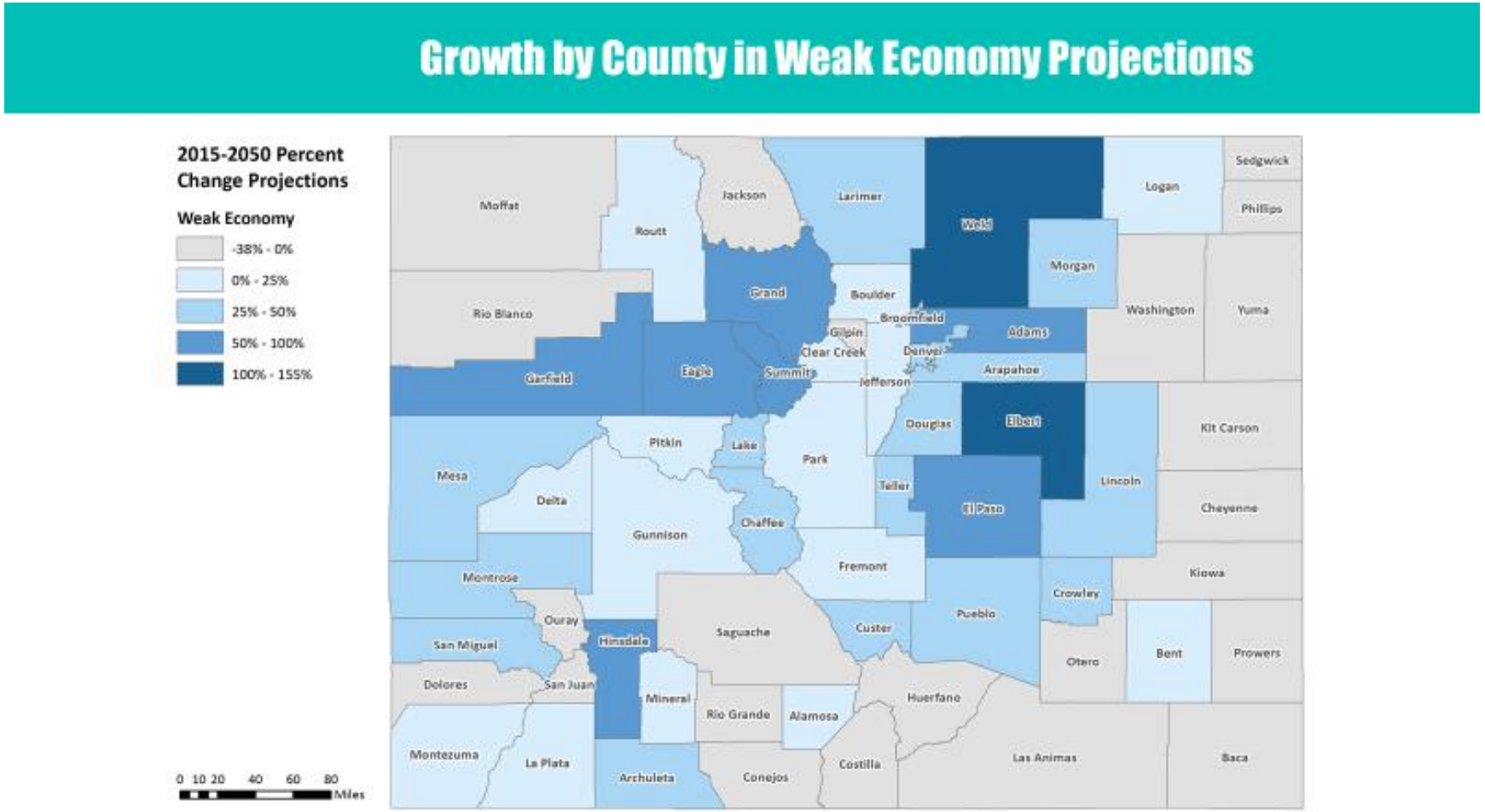
Colorado Division of Local Governments, State Demography Office. Preliminary Population Forecasts by Region and County, 2010 – 2050. 2016.

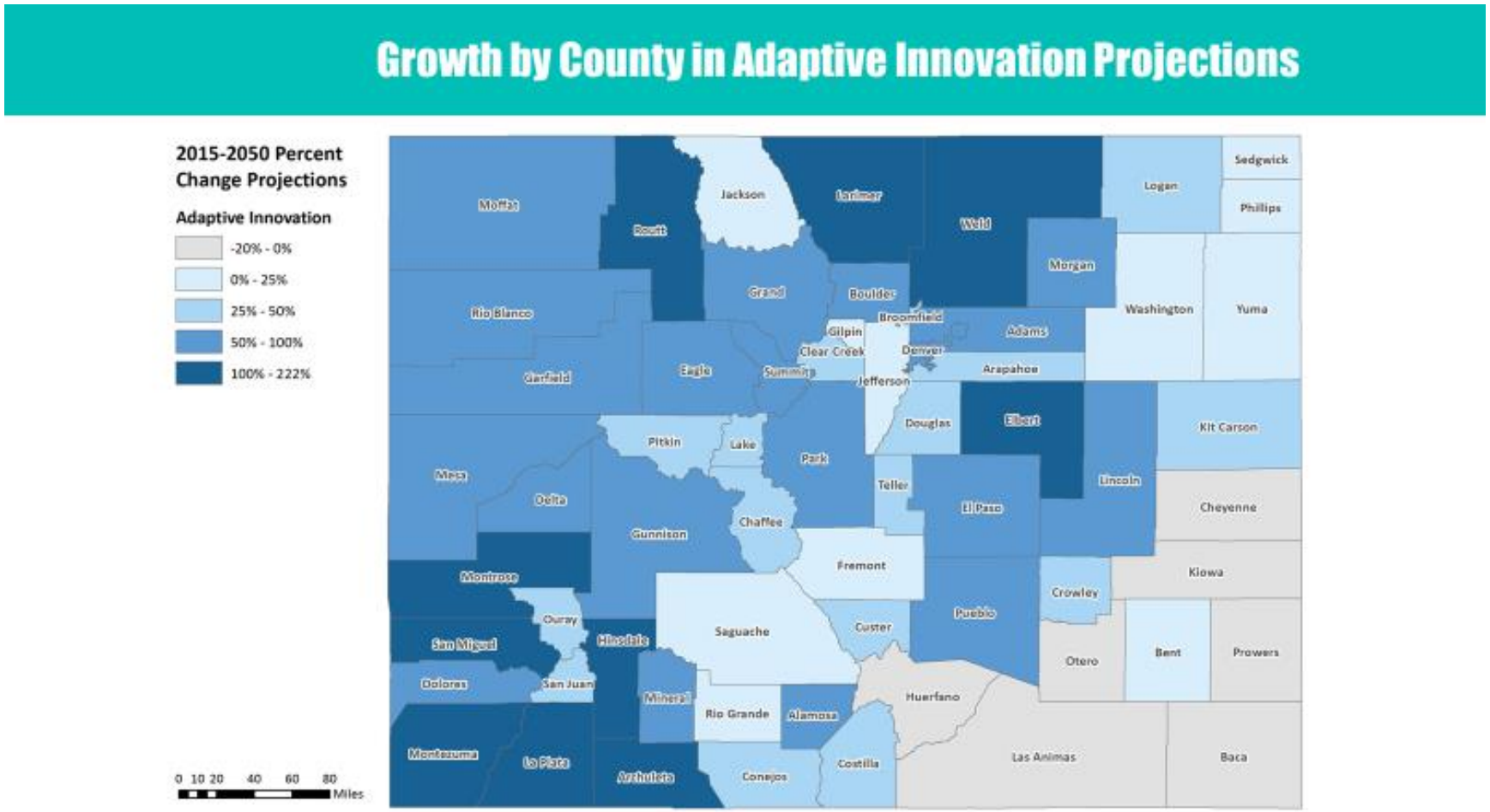
Colorado Water Conservation Board, Colorado's Water Plan, 2015. Chapter 6.

Appendix A: Maps of Population Projections for Three of the Five Planning Scenarios

Growth by County in Business as Usual Projections




Growth by County in Weak Economy Projections
2015-2050 Percent Change Projections
Weak Economy
-38% - 0%
0% - 25%
25% - 50%
50% - 100%
100% - 155%
0 10 20 40 60 80
Miles
Moffat
Routt
Jackson
Larimer
Weld
Logan
Sedgwick
Phillips
Morgan
Rio Blanco
Grand
Boulder
Washington
Yuma
Broomfield
Gilpin
Adams
Clear Creek
Denver
Garfield
Eagle
Summit
Jefferson
Arapahoe
Douglas
Elbert
Kit Carson
Pitkin
Lake
Park
Mesa
Delta
Teller
El Paso
Lincoln
Cheyenne
Gunnison
Chaffee
Fremont
Kiowa
Montrose
Crowley
Ouray
Custer
Pueblo
San Miguel
Hinsdale
Saguache
Otero
Bent
Prowers
Dolores
San Juan
Mineral
Rio Grande
Alamosa
Huerfano
Montezuma
La Plata
Archuleta
Conejos
Costilla
Las Animas
Baca


Growth by County in Adaptive Innovation Projections
2015-2050 Percent Change Projections
Adaptive Innovation
-20% - 0%
0% - 25%
25% - 50%
50% - 100%
100% - 222%
0 10 20 40 60 80
Miles
Moffat
Routt
Jackson
Larimer
Weld
Logan
Sedgwick
Phillips
Morgan
Washington
Yuma
Rio Blanco
Grand
Boulder
Broomfield
Gilpin
Clear Creek
Denver
Adams
Arapahoe
Jefferson
Garfield
Eagle
Summit
Douglas
Elbert
Kit Carson
Pitkin
Lake
Park
Teller
Lincoln
Mesa
Delta
Gunnison
Chaffee
El Paso
Cheyenne
Fremont
Kiowa
Montrose
Crowley
Ouray
Custer
Pueblo
San Miguel
Hinsdale
Saguache
Otero
Bent
Prowers
Dolores
San Juan
Mineral
Huerfano
Rio Grande
Alamosa
Montezuma
La Plata
Archuleta
Conejos
Costilla
Las Animas
Baca

Growth by County Across Three of the Five Scenarios