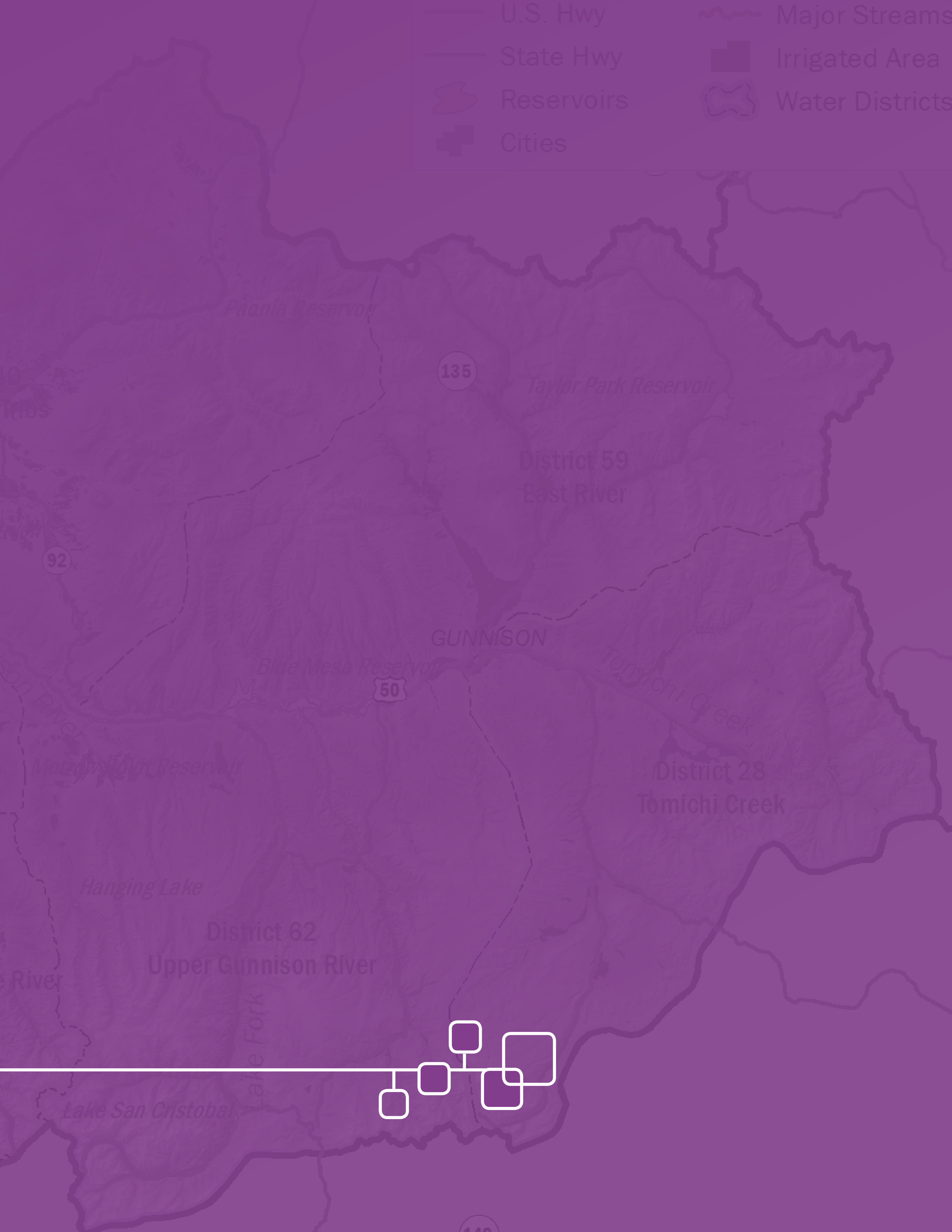
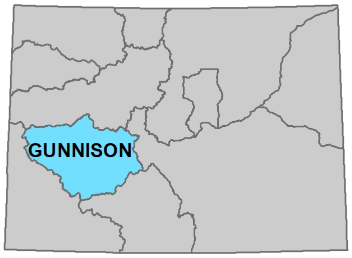
The Gunnison Basin stretches across more than 8,000 square miles of western Colorado, extending from the Continental Divide to the confluence of the Gunnison and Colorado rivers near Grand Junction. The basin is largely forested, with forest covering approximately 52 percent of the total basin area. About 5.5 percent of the basin is classified as planted or cultivated land, and these lands are primarily concentrated in the Uncompahgre River Valley between Montrose and Delta with additional pockets near Gunnison and Hotchkiss. Key future water management issues in this basin as described in The Colorado Water Plan include agricultural water shortages and increased growth and tourism in the headwaters region.


# GUNNISON


U.S. Hwy
State Hwy
Reservoirs
Cities
Major Streams
Irrigated Area
Water Districts
Paonia Reservoir
135
Taylor Park Reservoir
District 59
East River
92
GUNNISON
Blue Mesa Reservoir
50
Tomichi Creek
District 28
Tomichi Creek
Morrow Point Reservoir
Hanging Lake
District 62
Upper Gunnison River
Lake Fork
Lake San Cristobal

# 4.5 GUNNISON BASIN RESULTS




## 4.5.1 BASIN SUMMARY

Key future water management issues in this basin as described in The Colorado Water Plan include agricultural water shortages and increased growth and tourism in the headwaters region.

**Table 4.5.1 Key Future Water Management Issues in the Gunnison Basin**

<table>
<tr><th>Agriculture</th><th>Environment and Recreation</th><th>Municipal and Industrial</th><th>Compacts and Administration</th></tr>
<tr><td>• Addressing agricultural water shortages in the upper portion of the basin is an important goal of the community. Lack of financial resources is an impediment.</td><td>• The Gunnison River Basin faces a complex set of environmental issues associated with water quality, water quantity and associated impacts to fish and wildlife habitat in the context of regulatory drivers associated with the Endangered Species Act (ESA) and the Clean Water Act (CWA).</td><td>• Growth in the headwaters region will require additional water management strategies.</td><td rowspan="2">• Possible future transbasin diversions have been a concern, along with the potential effect this might have on existing uses within the basin.</td></tr>
<tr><td colspan="3">• The area between Ouray and Montrose is rapidly growing. Tourism is important in the headwaters areas, but agriculture is dominant in the Uncompahgre Valley. A rapid influx of retirees and growth in the Uncompahgre Valley may dramatically change agricultural uses and other land uses in the area.</td></tr>
</table>

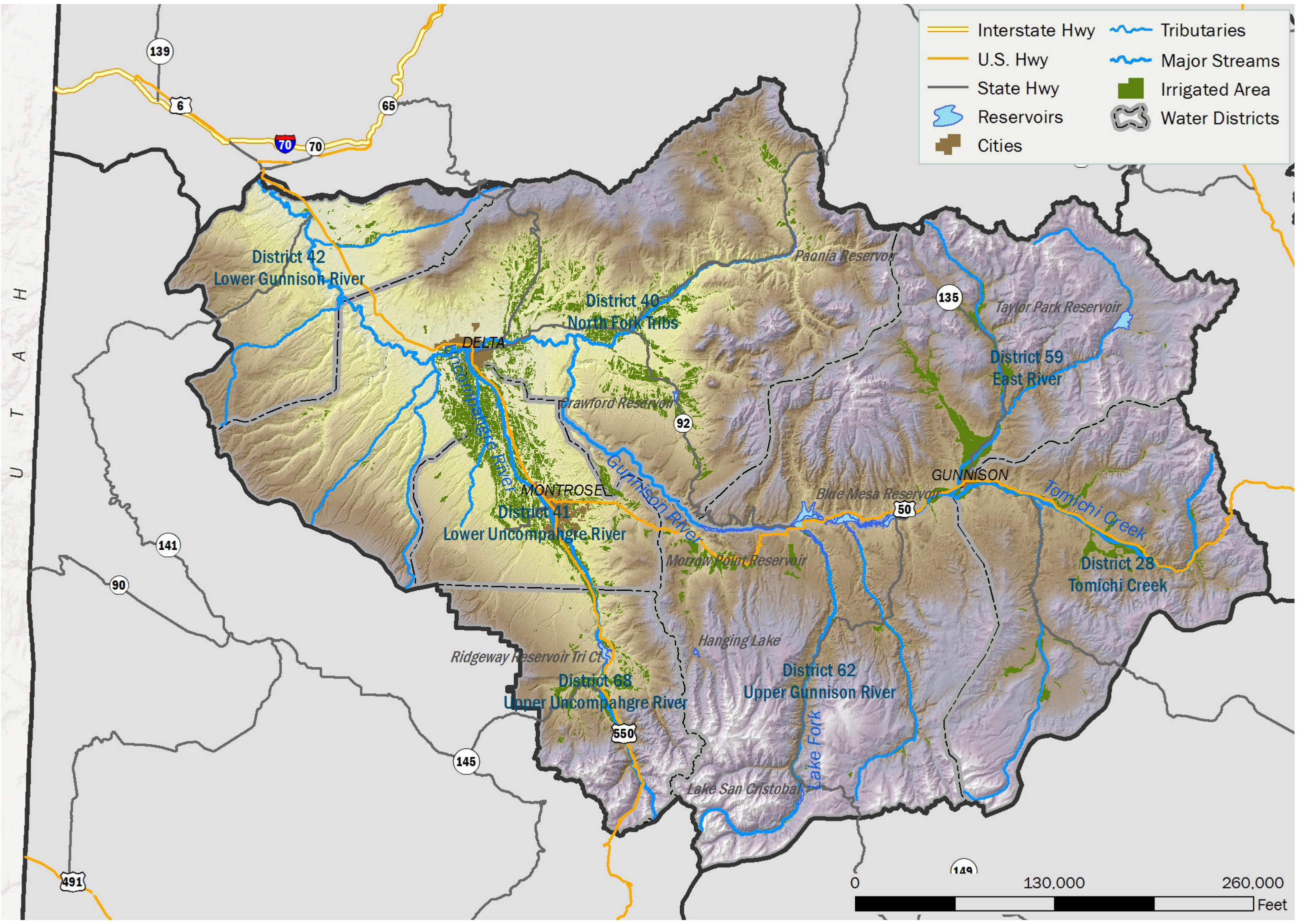



Figure 4.5.1 Map of the Gunnison Basin

## 4.5.2 SUMMARY OF TECHNICAL UPDATE RESULTS

Key results and findings of the Technical Update pertaining to agricultural and M&I demands and gaps as well as findings related to environmental and recreational attributes and future conditions are summarized below in Table 4.5.2.

**Table 4.5.2 Summary of Key Results in the Gunnison Basin**

| Agriculture | Environment and Recreation | Municipal and Industrial |
|---|---|---|
| • Agricultural demand is a major factor in this basin and represents 99% of the total water demand.<br>• Increases in agricultural demand and gaps will occur with a warmer and drier climate.<br>• Increases in system efficiency and reductions in irrigation water requirements significantly reduce diversion demand and the gap in Adaptive Innovation. | • Aquatic and riparian attributes may be affected differently based on location and potential changes in streamflow magnitude and timing.<br>• Flow recommendations, Instream Flow water rights, and recreational in-channel diversions may be met less often in climate-impacted scenarios. | • Population increases are the main driver for increased M&I demands in the planning scenarios, as per capita water use decreased for every scenario except Hot Growth.<br>• Growth in Montrose County accounts for 50% of the M&I demand.<br>• The only SSI use in the basin is snow-making, and it is a relatively small proportion of demands. |

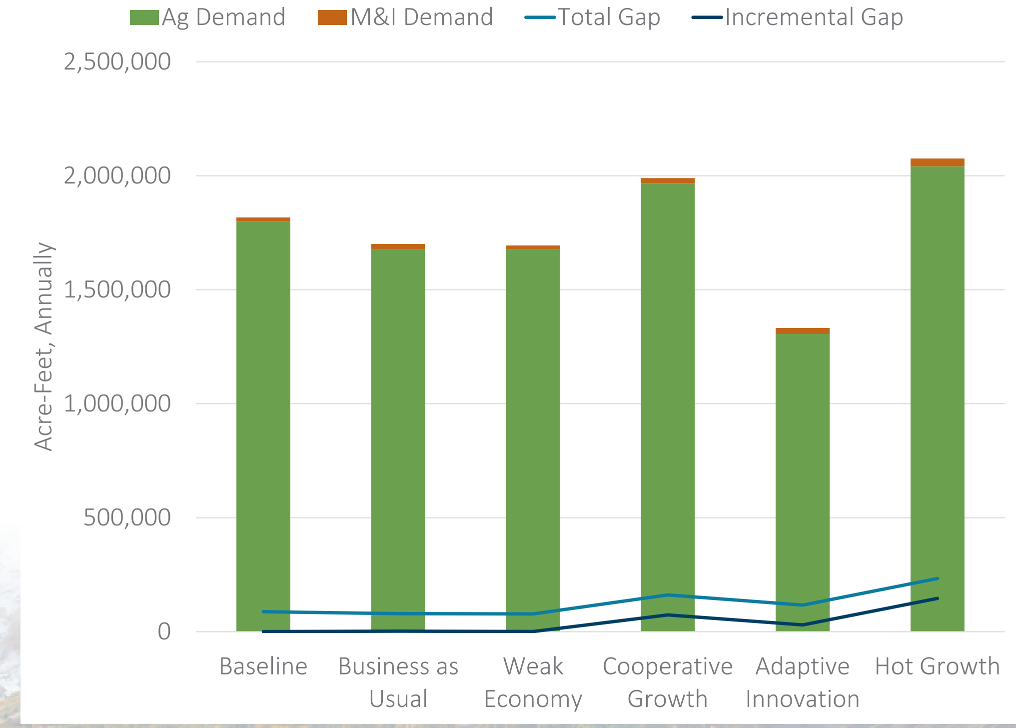
Results describing current and potential future M&I and agricultural demands and gaps are summarized in Table 4.5.3 and in Figure 4.5.2.

**Table 4.5.3 Summary of Diversion Demand and Gap Results in the Gunnison Basin**

| | Current (2015) | Business as Usual | Weak Economy | Cooperative Growth | Adaptive Innovation | Hot Growth |
|---|---|---|---|---|---|---|
| **Average Annual Demand** | | | | | | |
| Agricultural (AFY) | 1,800,200 | 1,675,500 | 1,675,500 | 1,967,200 | 1,305,700 | 2,041,500 |
| M&I (AFY) | 17,000 | 24,800 | 19,100 | 22,900 | 26,400 | 34,100 |
| **Gaps** | | | | | | |
| Ag (avg %) | 5% | 5% | 5% | 8% | 9% | 11% |
| Ag (incremental-AFY) | - | - | - | 70,300 | 25,300 | 134,700 |
| Ag (incremental gap as % of current demand) | - | - | - | 4% | 1% | 7% |
| M&I (max %) | 0% | 9% | 4% | 15% | 16% | 34% |
| M&I (max-AF) | 0* | 2,300 | 700 | 3,500 | 4,300 | 11,500 |

*CDSS water allocation model in this basin calculates small baseline M&I gaps, but they are either due to calibration issues, or they are reflective of infrequent, dry-year shortages that are typically managed with temporary demand reductions such, as watering restrictions.

**Figure 4.5.2 Summary of Diversion Demand and Gap Results in the Gunnison Basin**




### Summary of Environmental and Recreational Findings

- Reduced peak flows below major reservoirs on the Uncompahgre and Gunnison mainstems under baseline conditions create high risk to riparian/wetland habitat and may not support sediment dynamics needed to maintain fish habitat.
- Across most locations, mid- and late-summer flows drop, but risk to fish remains moderate; however, the metric used to assess risk for fish does not include the month of July because historically July flows have been sufficient. Under *Cooperative Growth*, *Adaptive Innovation*, and *Hot Growth*, July flows drop substantially, which increases the risk for fish.
- In several locations, Instream Flow water rights may be met less often. At least one RICD may be met less often.
- In critical habitat for endangered species, much reduced flows in mid- and late-summer will make it more difficult to meet flow recommendations.
- In at least one location (Cimarron River), winter flows become extremely low and puts fish at risk.

## 4.5.3 NOTABLE BASIN CONSIDERATIONS

Section 4.1 described several analysis assumptions and limitations that apply to all basins and should be considered when reviewing and interpreting analysis results. An additional consideration with respect to the Gunnison Basin is that agricultural system efficiencies in this basin are generally lower than in other basins due to factors described in the next section. The associated return flows, however, become the supplies for downstream irrigators and are reused.

## 4.5.4 AGRICULTURAL DIVERSION DEMANDS

### Agricultural Setting

Agriculture in the Upper Gunnison Basin, above Blue Mesa Reservoir, is dominated by large cattle ranches located along the tributaries and mainstem river. Ranchers generally rely on flood irrigation to fill the alluvial aquifer during the runoff season, as supplies are typically scarce later in the irrigation season. Agricultural diversion demands are higher in this basin due to the presence of gravelly soils, which leads to generally lower irrigation efficiencies than in other basins.

Several Bureau of Reclamation Projects provide supplemental irrigation supplies for much of the irrigated acreage in the Lower Gunnison Basin. The most notable irrigation projects in the area include the Uncompahgre, Paonia, Smith Fork, Fruitland Mesa, Bostwick Park, and the Fruitgrowers Dam projects. Lower elevations and warmer temperatures in the Lower Gunnison Basin provide conditions to grow a variety of fruits, vegetables, corn grain, and root crops on more than 185,000 acres of the total 234,000 irrigated acres in the basin.

### Planning Scenario Adjustments

Section 2 described ways in which inputs to agricultural diversion demand estimates were adjusted to reflect the future conditions described in the planning scenarios. Adjustments in the Gunnison Basin focused on urbanization, potential future climate conditions, and implementation of emerging technologies.

Many of the municipalities in the basin are surrounded by or near irrigated lands, and many counties in the basin are projected to have significant population increases by 2050. The resulting urbanization of irrigated acreage from this growth was estimated to be approximately 14,600 acres, primarily around Gunnison, Montrose, Delta, and the corridor between Cedaredge and Orchard City.

Table 4.5.4 summarizes the planning scenario adjustments described above and other adjustments that impact agricultural diversion demands in the scenarios.

**Table 4.5.4 Planning Scenario Adjustments for Agricultural Demands in the Gunnison Basin**

| Adjustment Factor* | Business as Usual | Weak Economy | Cooperative Growth | Adaptive Innovation | Hot Growth |
|---|---|---|---|---|---|
| Change in Irrigated Land due to Urbanization | 14,600 Acre Reduction | 14,600 Acre Reduction | 14,600 Acre Reduction | 14,600 Acre Reduction | 14,600 Acre Reduction |
| Increase in IWR due to Climate | - | - | 22% | 30% | 30% |
| Emerging Technologies | - | - | - | 10% IWR Reduction; 10% System Efficiency Increase | - |

**See Section 2.2.3 for descriptions of adjustment methodologies and assumptions.*

## Agricultural Diversion Demand Results

Table 4.5.5 and Figure 4.5.3 summarize the acreage, IWR, and the agricultural diversion demand for surface water supplies in the Gunnison Basin for current conditions and the five planning scenarios. The largest variation in the basin occurred in the *Adaptive Innovation* scenario due to 10 percent reduction in IWR and 10 percent increase to system efficiency, both of which reduce diversion demands. The combined effect of the *Adaptive Innovation* scenario adjustments resulted in an agricultural diversion demand that is lower than the current demand. Diversion demands increased in *Cooperative Growth* and *Hot Growth* due to higher IWR resulting from a warmer and drier future climate.

### SYSTEM EFFICIENCY

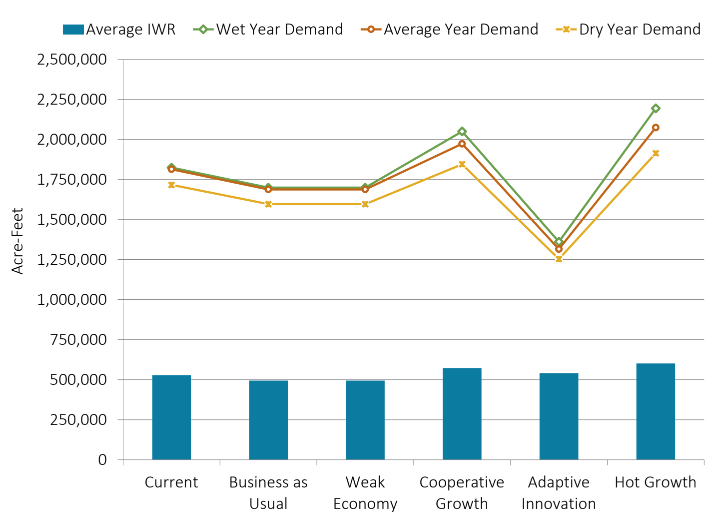
In some cases, diversion demands can be higher in wet years because system efficiency decreases due to the relative abundance of supply.

**Table 4.5.5 Summary of Agricultural Diversion Demand Results in the Gunnison Basin**

| | Current (2015) | Business as Usual | Weak Economy | Cooperative Growth | Adaptive Innovation | Hot Growth |
|---|---|---|---|---|---|---|
| Irrigated Acreage (acres) | 234,400 | 219,800 | 219,800 | 219,800 | 219,800 | 219,800 |
| Average IWR (AFY) | 528,200 | 494,000 | 494,000 | 573,000 | 541,000 | 601,000 |
| **Diversion Demand** | | | | | | |
| Average Year (AFY) | 1,814,000 | 1,688,000 | 1,688,000 | 1,973,000 | 1,315,000 | 2,074,000 |
| Wet Yr. Change | 1% | 1% | 1% | 4% | 3% | 6% |
| Dry Yr Change | -5% | -5% | -5% | -6% | -5% | -8% |

*Average agricultural diversion demand was calculated using the average hydrologic years (i.e., years classified as neither wet or dry) from 1950-2013*

**Figure 4.5.3 Agricultural Diversion Demands and IWR Results in the Gunnison Basin**



## Municipal and Self-Supplied Industrial Diversion Demands

### Population Projections

The Gunnison Basin includes about 2 percent of the statewide population. Between the years 2015 and 2050, it is projected to grow from approximately 100,000 to between 120,000 and 200,000 people in the low and high growth projections, respectively, which is an increase in population of 19 to 99 percent. Table 4.5.6 shows how population growth is projected to vary across the planning scenarios for the Gunnison Basin.

**Table 4.5.6 Gunnison Basin 2015 and Projected Populations**

| Baseline (2015) | Business as Usual | Weak Economy | Cooperative Growth | Adaptive Innovation | Hot Growth |
|---|---|---|---|---|---|
| 103,100 | 162,600 | 123,100 | 158,600 | 196,000 | 204,900 |

### Current Municipal Demands

Sources of water demand data such as 1051 or WEP data made up less than 50 percent of the available information in the Gunnison Basin, and baseline water demands were largely estimated as shown on Figure 4.5.4.

Figure 4.5.5 summarizes the categories of municipal, baseline water usage in the Gunnison Basin. On a basin scale, the residential indoor demand as a percentage of the systemwide demands are relatively high, at almost 40 percent of the systemwide demands.

**Figure 4.5.4 Sources of Water Demand Data in the Gunnison Basin**

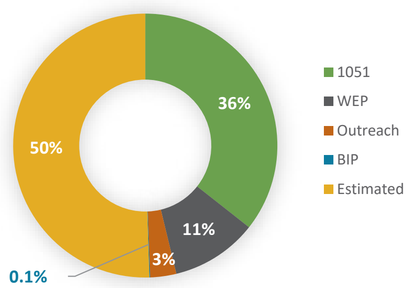
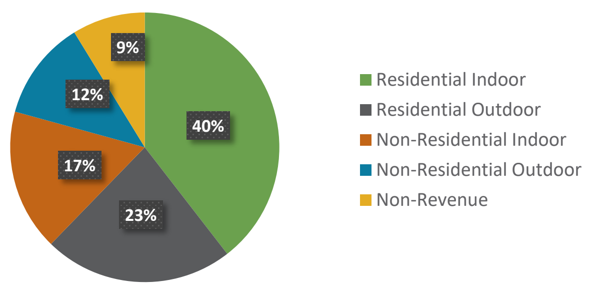



**Figure 4.5.5 Categories of Water Usage in the Gunnison Basin**




## Projected Municipal Demands

Figure 4.5.6 provides a summary of per capita baseline and projected water demands for the Gunnison Basin. Systemwide, the per capita demands are projected to decrease relative to the baseline except for *Hot Growth*. Outdoor demands are projected to increase significantly for *Hot Growth* due to hotter and drier climate conditions.

The Gunnison Basin municipal baseline and projected diversion demands provided in Table 4.5.7 show the combined effect of population and per capita demands. Municipal demands are projected to grow from approximately 18,000 AFY in 2015 to between 21,000 and 37,000 AFY in 2050. Montrose County accounts for almost half of the baseline demand, followed by Delta County at about one-fifth of the basin demand.

**Figure 4.5.6 Gunnison Basin Municipal Baseline and Projected per Capita Demands by Water Demand Category**

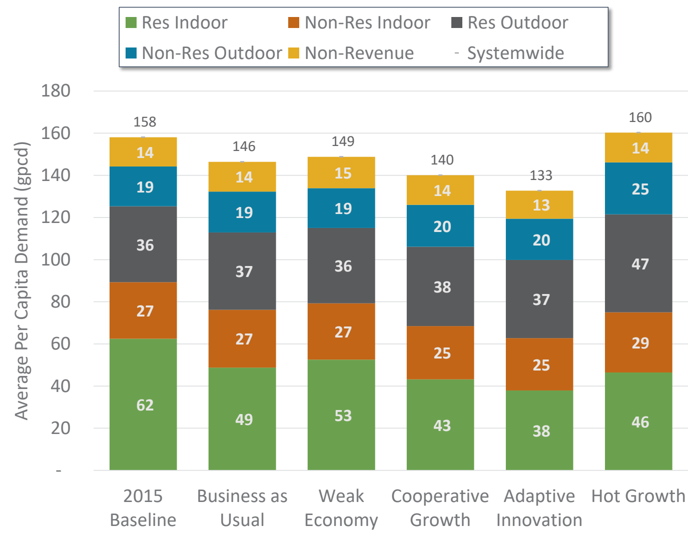
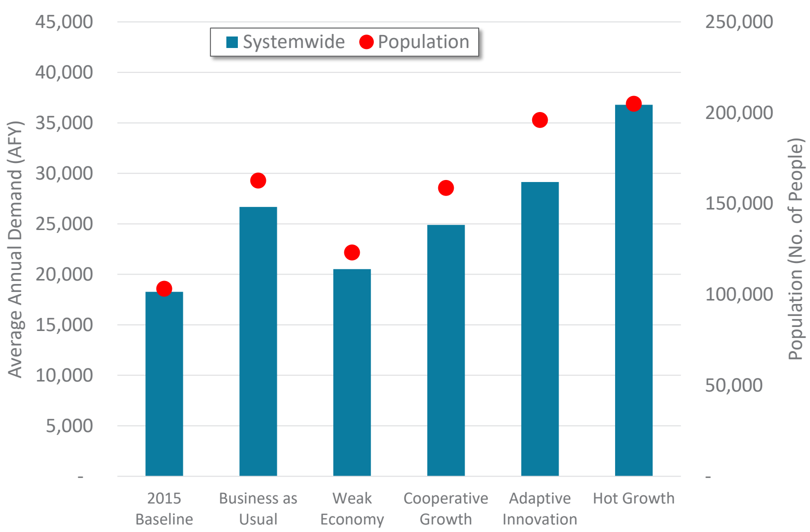



**Table 4.5.7 Gunnison Basin Municipal Baseline and Projected Demands (AFY)**

| Baseline (2015) | Business as Usual | Weak Economy | Cooperative Growth | Adaptive Innovation | Hot Growth |
|---|---|---|---|---|---|
| 18,300 | 26,700 | 20,500 | 24,900 | 29,100 | 36,800 |

The baseline and projected demand distributions are shown on Figure 4.5.7, which also shows how the population varies between the scenarios. All of the planning scenarios show an increase relative to the baseline. Demands generally follow the population patterns; however, increased outdoor demands for the "Hot and Dry" climate projection have a greater impact on gpcd, resulting in higher demands for *Hot Growth*. Higher levels of conservation associated with *Adaptive Innovation* help limit the impacts of the "Hot and Dry" climate projection and higher population.

**Figure 4.5.7 Gunnison Basin Baseline and Projected Population and Municipal Demands**



### Self-Supplied Industrial Demands

The Gunnison Basin currently includes less than one percent of the statewide SSI demand. SSI demands in this basin are associated exclusively with the snowmaking sub-sector. There are no demands projected for the large industry, thermoelectric, or energy development sub-sectors. Basin-scale SSI demands are shown on Figure 4.5.8 and summarized in Table 4.5.8.

The baseline snowmaking demand is 270 AFY as compared to 260 AFY in SWSI 2010. All snowmaking occurs in Gunnison County. Projected SSI demands increase to 650 AFY under all scenarios.

**Figure 4.5.8 Gunnison Basin Self-Supplied Industrial Demands**

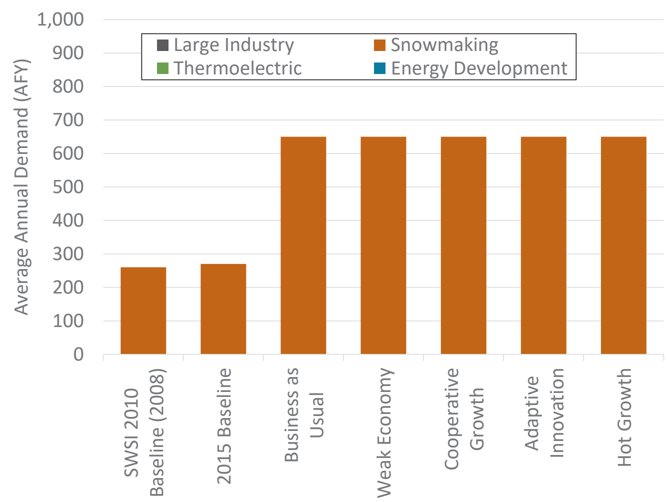



**Table 4.5.8 Gunnison SSI Baseline and Projected Demands (AFY).**

| Sub-sector | Baseline (2015) | Business as Usual | Weak Economy | Cooperative Growth | Adaptive Innovation | Hot Growth |
|---|---|---|---|---|---|---|
| Large Industry | - | - | - | - | - | - |
| Snowmaking | 270 | 650 | 650 | 650 | 650 | 650 |
| Thermoelectric | - | - | - | - | - | - |
| Energy Development | - | - | - | - | - | - |
| **Sub-Basin Total** | **270** | **650** | **650** | **650** | **650** | **650** |

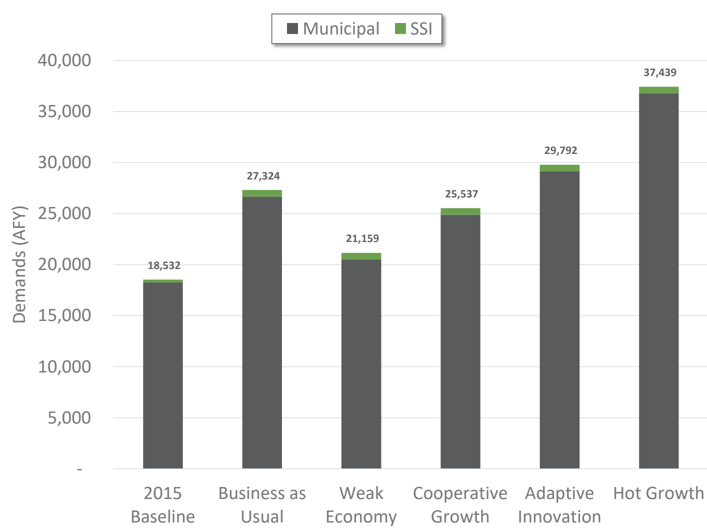
### Total M&I Diversion Demands

Gunnison Basin combined M&I demand projections for 2050 range from approximately 21,000 AFY in *Weak Economy* to more than 37,000 AFY in *Hot Growth* as shown on Figure 4.5.9. Under every planning scenario, municipal demands are the majority (at least 97 percent) of the total M&I demands. On a basin scale, the demand projections follow the statewide sequence of the scenario rankings described in the CWP.

## 4.5.5 Water Supply Gaps

The agricultural and M&I diversion demands were compared against available water supply modeled for current conditions and the five planning scenarios. Gaps were calculated when water supply was insufficient to meet demands.

**Figure 4.5.9 Gunnison Basin Municipal and Self-Supplied Industrial Demands**



## Agricultural

The Gunnison Basin agricultural diversion demands, demand gaps, and consumptive use gaps for the baseline and planning scenarios are presented in Table 4.5.9 and illustrated in Figure 4.5.10. An annual time series of gaps in terms of percent of demand that was unmet is shown on Figure 4.5.11.

**INCREMENTAL GAP**

The incremental agricultural gap quantifies the degree to which the gap could increase beyond what agriculture has historically experienced under water shortage conditions.

**Table 4.5.9 Gunnison Basin Agricultural Gap Results (AFY)**

| | | Scenario | | | | | |
|---|---|---|---|---|---|---|---|
| | | Scenario | Business as Usual | Weak Economy | Cooperative Growth | Adaptive Innovation | Hot Growth |
| Average | Average Annual Demand | 1,800,200 | 1,675,500 | 1,675,500 | 1,967,200 | 1,305,700 | 2,041,500 |
| | Average Annual Gap | 87,300 | 77,200 | 77,300 | 157,600 | 112,600 | 222,000 |
| | Average Annual Gap Increase from Baseline | - | - | - | 70,300 | 25,300 | 134,700 |
| | Average Annual Percent Gap | 5% | 5% | 5% | 8% | 9% | 11% |
| | Average Annual CU Gap | 43,200 | 38,200 | 38,300 | 74,800 | 64,700 | 104,000 |
| Maximum | Demand in Maximum Gap | 1,841,100 | 1,713,900 | 1,713,900 | 1,833,600 | 1,247,600 | 1,912,700 |
| | Gap in Maximum Gap Year | 339,700 | 313,500 | 314,800 | 432,600 | 319,600 | 590,800 |
| | Increase from Baseline Gap | - | - | - | 93,000 | - | 251,100 |
| | Percent Gap in Maximum Gap Year | 18% | 18% | 18% | 24% | 26% | 31% |

*Study period for Water Supply analysis is 1975-2013, reflecting different baseline demand than described in Agricultural Diversion Demands section*

**Figure 4.5.10 Projected Average Annual Agricultural Diversion Demand, Demand Met, and Gaps in the Gunnison Basin**

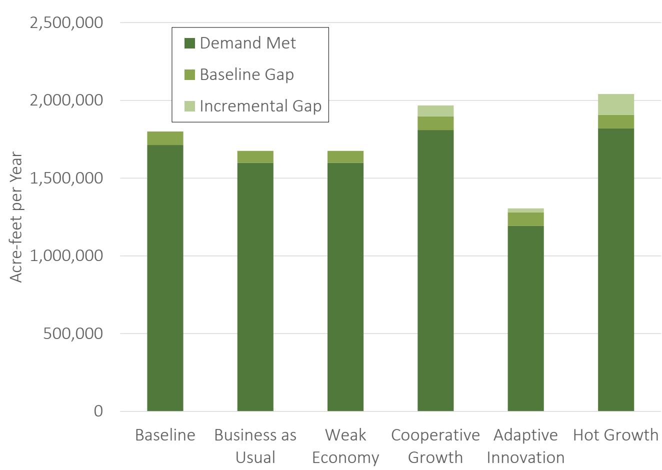
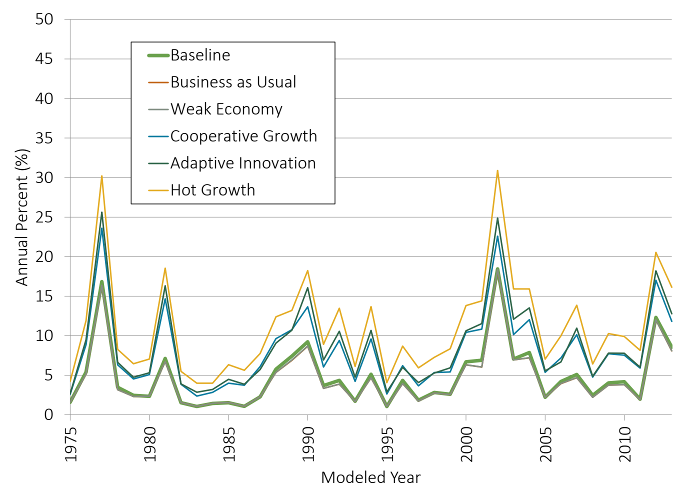



**Figure 4.5.11 Annual Agricultural Gaps (expressed as a percentage of demand) for Each Planning Scenario**




The following are observations on agricultural diversion demands and gaps:

- Agricultural diversion demands are projected to decrease in three of the five planning scenarios due to urbanization and the associated reduction of irrigated acres and the adoption of emerging agricultural technologies (in *Adaptive Innovation*).
- Agricultural diversion demands are projected to increase by 9 to 13 percent above current in *Cooperative Growth* and *Hot Growth* due to climate impacts.
- Agricultural gaps are projected to increase beyond existing gaps in the climate-impacted planning scenarios.
- While the gap as a percent of demand is projected to be relatively small in average years (5 to 11 percent), it may nearly triple (in terms of percent of demand) in maximum gap years.

## M&I

The diversion demand and gap results for M&I uses in the Gunnison Basin are summarized in Table 4.5.10 and illustrated on Figure 4.5.12. An annual time series of gaps in terms of percent of demand that was unmet is shown on Figure 4.5.13.

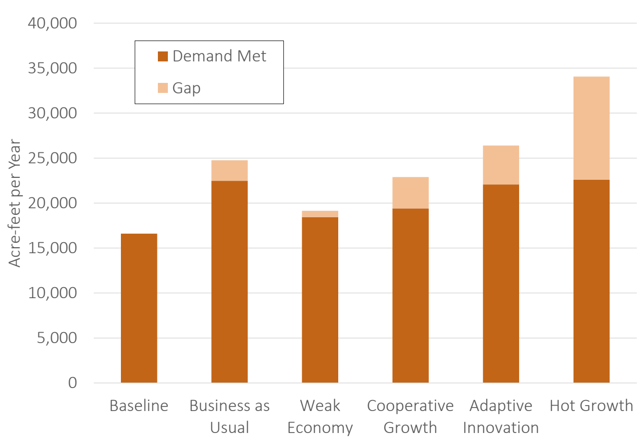
### Table 4.5.10 Gunnison Basin M&I Gap Results (AFY)

| | | Scenario | | | | | |
|---|---|---|---|---|---|---|---|
| | | Scenario | Business as Usual | Weak Economy | Cooperative Growth | Adaptive Innovation | Hot Growth |
| Average | Average Annual Demand | 17,000 | 24,800 | 19,100 | 22,900 | 26,400 | 34,100 |
| Average | Average Annual Gap | 0* | 1,000 | 200 | 1,400 | 2,200 | 5,000 |
| Average | Average Annual Percent Gap | 0% | 4% | 1% | 6% | 8% | 16% |
| Maximum | Demand in Maximum Gap Year | 17,000 | 24,800 | 19,100 | 22,900 | 26,400 | 34,100 |
| Maximum | Gap in Maximum Gap Year | 0* | 2,300 | 700 | 3,500 | 4,300 | 11,500 |
| Maximum | Percent Gap in Maximum Gap Year | 0% | 9% | 4% | 15% | 16% | 34% |

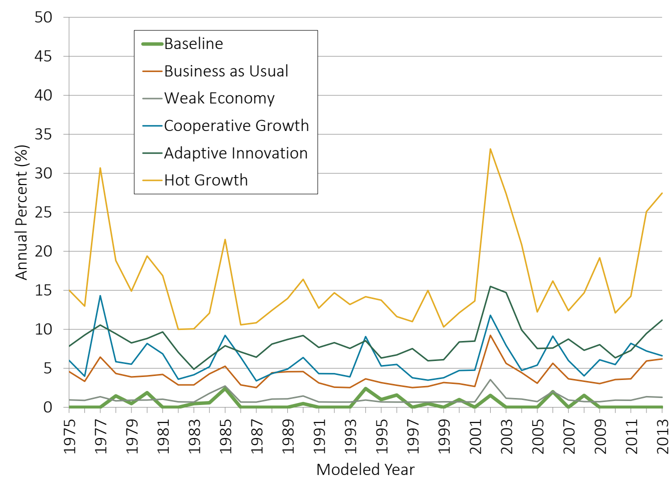
**CDSS water allocation model in this basin calculates small baseline M&I gaps, but they are either due to calibration issues or they are reflective of infrequent, dry-year shortages that are typically managed with temporary demand reductions, such as watering restrictions.*

*Study period for Water Supply Analysis is 1975-2013, reflecting different baseline demand than described in M&I Demand section. Baseline demand also may vary slightly from previous section due to differences in geographic distribution of demand for counties that lie in multiple basins.*

### Figure 4.5.12 Projected Maximum Annual M&I Demand Met and Gaps in the Gunnison Basin




### Figure 4.5.13 Annual M&I Gaps (expressed as a percentage of demand) for Each Planning Scenario



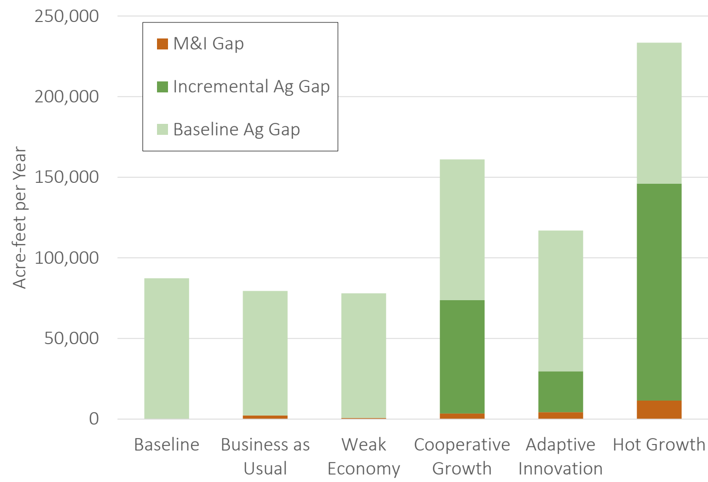

The following are observations on M&I diversion demands and gaps:

- The average annual M&I gap in the Gunnison Basin is projected to be less than the agricultural gap, ranging from 200 AF to over 5,000 AF.
- The maximum M&I gap for the five planning scenarios is projected to range from 700 AF to more than 11,000 AF.
- Population increases are the primary driver for increased M&I demands in the planning scenarios, as per capita water use is projected to decrease for every scenario except *Hot Growth*.
- The only SSI use in the basin is snowmaking, which is not projected to increase over baseline.
- For *Hot Growth*, the maximum M&I gap is much larger than other scenarios (at 34 percent of demand), which reflects lower supplies, large population growth, and less conservation.

## Total Gap

Figure 4.5.14 illustrates the total combined agricultural and M&I diversion demand gap in the Gunnison Basin. The figure combines the average annual baseline and incremental agricultural gaps and the maximum M&I gap. In *Cooperative Growth*, *Adaptive Innovation*, and *Hot Growth*, gaps were driven by agricultural demands, which increase in the *"Hot and Dry"* climate projection.

**Figure 4.5.14 Projected Average Annual Agricultural Gaps and Maximum M&I Diversion Demand Gaps in the Gunnison Basin**




## Supplies from Urbanized Lands

By 2050, irrigated acreage in the Gunnison Basin is projected to decrease by 14,600 acres due to urbanization. Irrigation supplies for these lands could potentially be used for M&I needs in the future (subject to a variety of unknowns such as seniority and type of water supply, willingness to change the use of water through water court, etc.). The average annual historical consumptive use associated with potentially urbanized acreage for each scenario is reflected in Table 4.5.11. The data in the table represent planning-level estimates of this potential supply and has not been applied to the M&I gaps.

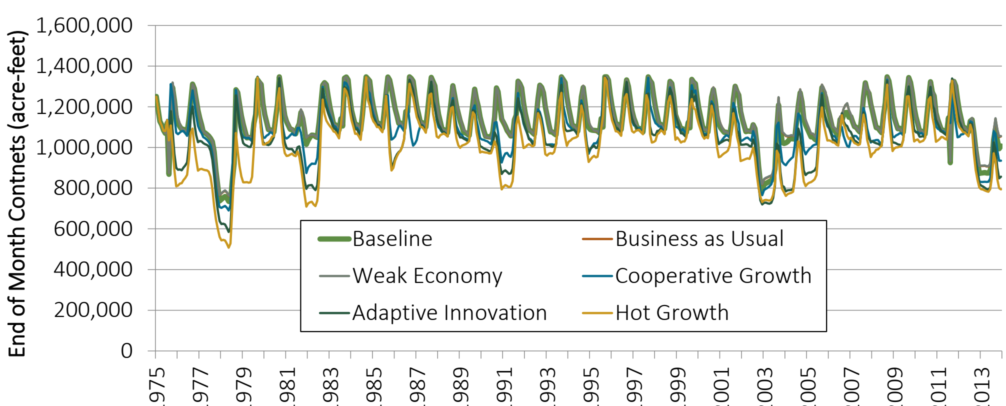
**Table 4.5.11 Estimated Consumptive Use from Lands Projected to be Urbanized by 2050 in the Gunnison Basin**

| | Business as Usual | Weak Economy | Cooperative Growth | Adaptive Innovation | Hot Growth |
|---|---|---|---|---|---|
| Urbanized Acreage (acres) | 14,600 | 14,600 | 14,600 | 14,600 | 14,600 |
| Estimated Consumptive Use (AFY) | 30,300 | 30,300 | 33,100 | 31,600 | 33,000 |

## Storage

Total simulated reservoir storage from the Gunnison River water allocation model is shown in Figure 4.5.15. Baseline conditions show the highest levels of water in storage (in general), and the lowest is in *Hot Growth*. *Cooperative Growth*, *Adaptive Innovation*, and *Hot Growth* show lower amounts of water in storage during dry periods than the two scenarios that do not include the impacts of a drier climate; however, storage levels generally recover back to baseline levels after dry periods.

**Figure 4.5.15 Total Simulated Reservoir Storage in the Gunnison Basin**



## 4.5.6 Available Supply

Figures 4.5.16 and 4.5.17 show estimated simulated monthly available flow in the Gunnison River at a location below the Aspinall Unit and Gunnison Tunnel diversions but upstream of the Redlands Canal, which is the primary calling right in the lower basin. The canal diverts for power and irrigation, and return flows accrue to the Colorado Basin, which reflects a total depletion to the Gunnison River.

The figures show that flows are projected to be available in many years, though the amounts will vary greatly on an annual basis and across scenarios (available flows under the scenarios impacted by climate change are less than in other scenarios). In *Hot Growth* and *Adaptive Innovation*, very little flow may be available at this location for long periods of time during dry times. Peak flows are projected to occur earlier in the year under scenarios impacted by climate change.

**Figure 4.5.16 Simulated Hydrographs of Available Flow at Gunnison River Below Gunnison Tunnel**

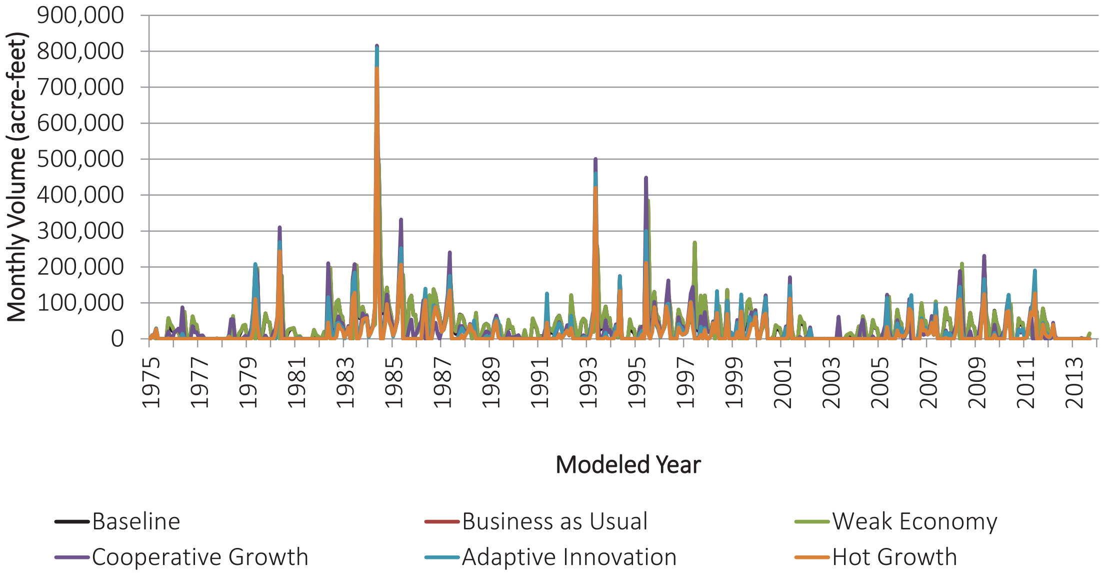
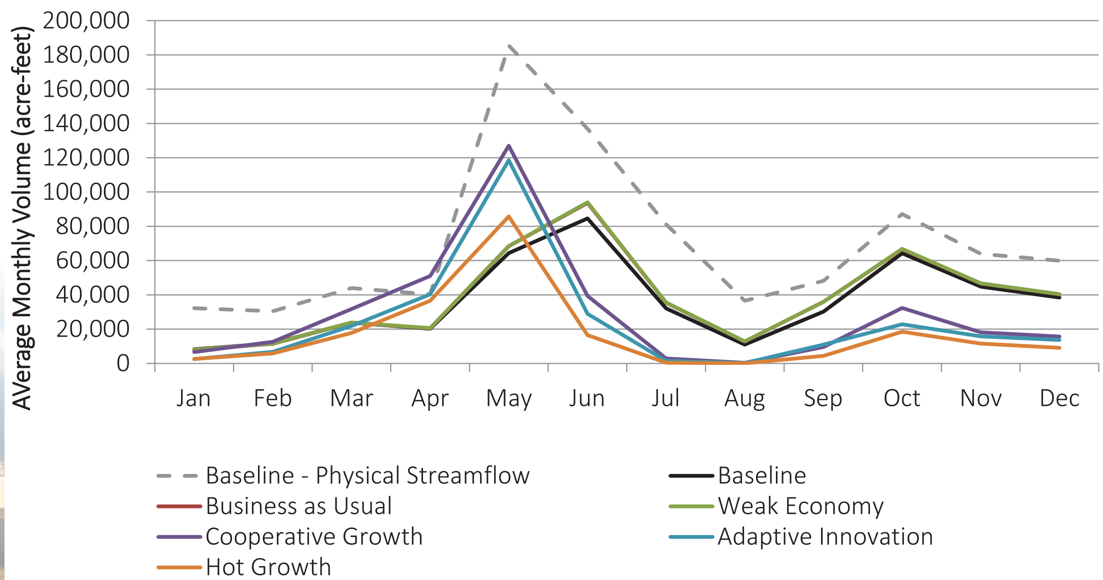



**Figure 4.5.17 Average Monthly Simulated Hydrographs of Available Flow at Gunnison River Below Gunnison Tunnel**



## 4.5.7 Environment and Recreation

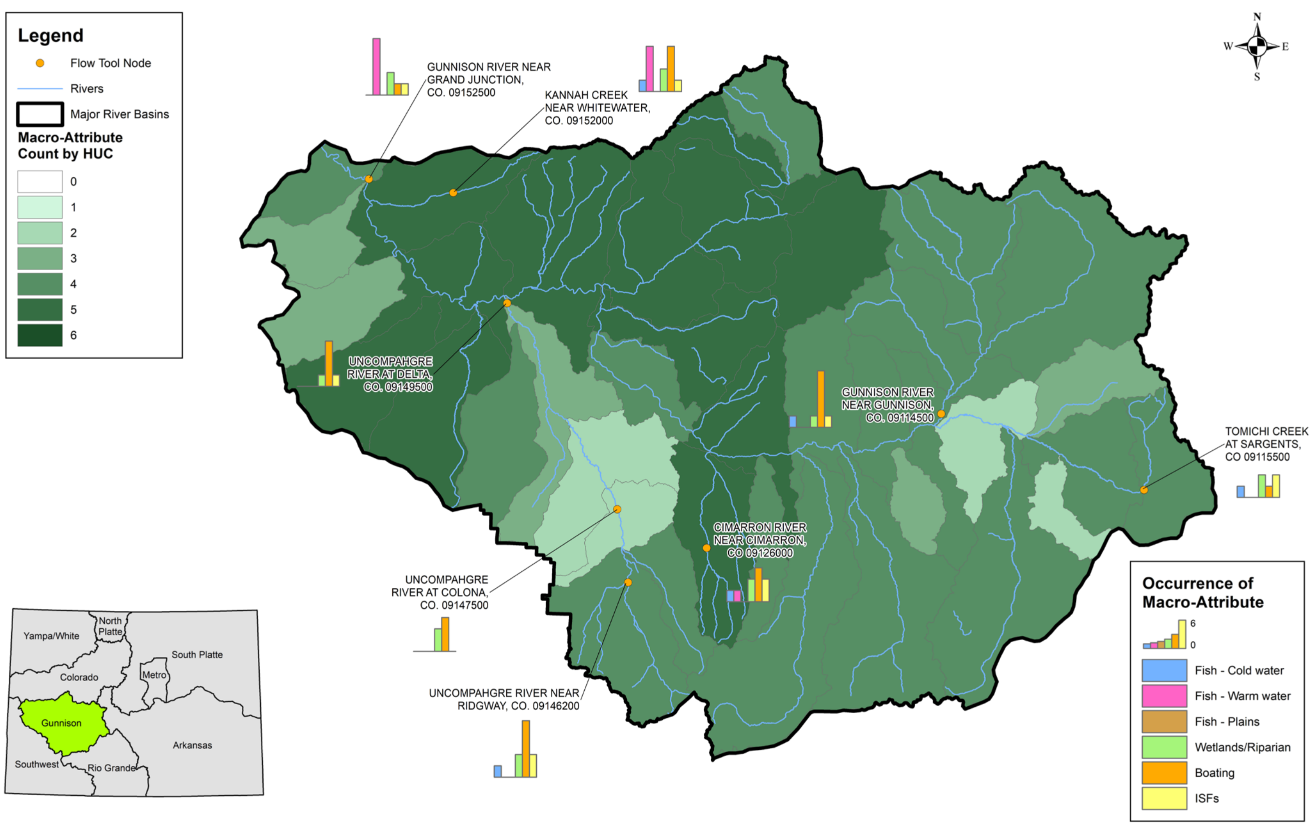
A total of eight water allocation model nodes were selected for the Environmental Flow Tool in the Gunnison Basin (see list below and Figure 4.5.18). Figure 4.5.18 also shows subwatersheds (at the 12-digit HUC level) and the relative number of E&R attributes located in each watershed.

- Gunnison River near Gunnison, Colorado (09114500)
- Tomichi Creek at Sargents, Colorado (09115500)
- Cimarron River near Cimarron, Colorado (09126000)
- Uncompahgre River near Ridgway, Colorado (09146200)
- Uncompahgre River at Colona, Colorado (09147500)
- Uncompahgre River at Delta, Colorado (09149500)
- Kannah Creek near Whitewater, Colorado (09152000)
- Gunnison River near Grand Junction, Colorado (90152500)

**NATURALIZED FLOW**

Naturalized flows reflect conditions that would occur in the absence of human activities. Baseline flows reflect current conditions as influenced by existing infrastructure and river operations. While observations regarding naturalized flows may be informative, baseline flows reflect actual conditions and the diverse operations of a river's many users.

**Figure 4.5.18 Flow Tool Nodes Selected for the Gunnison Basin**



Results of Flow Tool analyses using flow data developed in the water supply and gap analyses for baseline conditions and the planning scenarios are described below.

In the Gunnison Basin, pattern of flow varies as a function of elevation, major diversions, and location relative to reservoir storage. Observations related to projected changes in flow, potential ecological risks, etc. are provided in Table 4.5.12.

**Table 4.5.12 Summary of Flow Tool Results in the Gunnison Basin**

| Category | Observation |
|---|---|
| Projected Flows | At higher elevations (e.g., Gunnison River at Gunnison), mean annual flow under baseline conditions are close to naturalized conditions. Under climate-impacted scenarios (*Cooperative Growth*, *Adaptive Innovation*, *Hot Growth*), annual flows are projected to decrease. |
| | At locations lower in the basin (e.g., Gunnison River near Grand Junction), baseline annual flows are further depleted, and under climate change scenarios, depletions continue to grow. |
| | In some locations (e.g., Gunnison River at Gunnison), peak flow magnitude under baseline conditions is below naturalized conditions, but under climate change scenarios, peak flow magnitudes increase. As a general rule, however, peak flows change little from baseline under *Business as Usual* and *Weak Economy* scenarios but decrease more substantially under climate change scenarios. |
| | Below major reservoirs on the Uncompahgre and Gunnison mainstems, peak flow under baseline conditions can be half of the naturalized condition. Peak flows continue to decrease from naturalized under climate change scenarios. |
| | Under all climate change scenarios in all locations, runoff and peak flows occur earlier, with June flows decreasing and April and May flows increasing. This change in peak flow timing may cause mis-matches between flow dynamics and the flows needed to support species. |
| | At higher locations in the Gunnison Basin, mid- and late-summer flows under baseline conditions are 0 to 20 percent depleted from naturalized conditions. Under climate change scenarios, these flows drop further below naturalized. |
| | At lower elevations on mainstem rivers (e.g., Uncompahgre at Delta; Gunnison River near Grand Junction), mid- and late-summer flows under baseline conditions are 30 to 50 percent below naturalized. Under climate change scenarios, these flows are also projected to fall further below naturalized. |
| Ecological Risk | Ecological risk (riparian/wetland plants and fish habitat) related to projected changes in peak flow magnitude is generally low to moderate at higher elevations. Under climate change scenarios this risk is projected to increase at most locations. |
| | At lower elevations and on mainstems, peak flows are already reduced in general and reductions are projected to increase under climate change scenarios. |
| | Mid- and late-summer flows are projected to decline under climate change scenarios, though flow-related risk to coldwater fish (trout) is projected to remain moderate. However, the metric used to assess risk for fish does not include the month of July because historically, July flows are sufficient. Under *Cooperative Growth*, *Adaptive Innovation*, and *Hot Growth*, July flows are predicted to drop, increasing risk for fish by reducing habitat and increasing stream temperatures. In at least one location (Cimarron River), winter flows are projected to become low, also putting fish at risk. |
| ISFs and RICDs | In several locations, ISFs may be met less often, and at least one RICD (in Gunnison), may be met less often. In critical endangered species habitat, lower mean annual flows and reduced flows in mid- and late-summer will make it more difficult to meet flow recommendations. |
| E&R Attributes | Under baseline conditions and the *Business as Usual* and *Weak Economy* scenarios, current flow issues related to E&R attributes arise from in-basin diversions and storage of peak flows in reservoirs. |
| | Under climate change scenarios, the shift in the timing of peak flow, reductions in total runoff, and increasing consumptive demands are projected to contribute to reductions in mid- and late-summer flows. Several water management programs implemented in the context of the Upper Colorado Endangered Fish Program, including on the Gunnison River below the Apsinall Unit, have demonstrated that flow timing and magnitude can be planned in a way that better meets the needs of E&R attributes. |