

A 2050 VISION FOR COLORADO'S WATER SUPPLY FUTURE

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ABSTRACT

The last decade has brought many changes to Colorado's water supply outlook. Despite the recent economic recession, the state has experienced significant population growth, and Colorado's population is expected to nearly double within the next 40 years. Other pressures on Colorado's water supply include severe drought, a desire to meet multiple needs (i.e., municipal, environmental, recreational) with existing resources, and impacts to agriculture due to water shortages, urbanization, and transfers to new users. To address these challenges, the Colorado Water Conservation Board (CWCB) has undertaken a visioning process to explore solutions to these future water supply challenges. As part of this process, CWCB has led the state in identifying demand and supply strategies to meet the state's future water needs while considering vision goals and objectives. These strategies have been combined into varying portfolios that include methods such as conservation, local water projects, new Colorado River development, and agricultural transfers. This paper details the development and evaluation of these portfolios and describes the stakeholder process used in this effort.

KEYWORDS

State water planning, vision process, integrated resource planning, scenario planning, and Colorado

INTRODUCTION

The last decade has brought many changes to Colorado's water supply outlook. Despite the recent economic recession, the state has experienced significant population growth, and Colorado's population is expected to nearly double within the next 50 years. Other pressures on Colorado's water supply include severe drought, a desire to meet multiple needs (i.e., municipal, environmental, recreational) with existing resources, and impacts to agriculture due to water shortages, urbanization, and transfers to new users.

To help understand and address these trends, the Colorado Water Conservation Board (CWCB) has undertaken a number of important initiatives. CWCB is statutorily charged to conserve, protect, manage, and develop Colorado's water resources for current and future generations. In accomplishing this mission, the CWCB must help ensure that water is utilized to meet the needs of Colorado's citizens while protecting the environment.

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In the last few years, state leaders and resource management agencies have been increasingly focused on helping ensure that Colorado has an adequate water supply for its citizens and the environment. In 2003, the Colorado General Assembly authorized CWCB to implement the Statewide Water Supply Initiative (SWSI). SWSI was a comprehensive identification of Colorado's current and future water needs and it examined a variety of approaches Colorado could take to meet those needs. SWSI implemented a collaborative approach to water resource issues by establishing “Basin Roundtables”—diverse groups of people from which the state seeks input on water issues. Nine Basin Roundtables were institutionalized in the 2005 Colorado Water for the 21st Century Act, which creates a voluntary, collaborative process to help the state address its water challenges. This process is based on the premise that Coloradoans can work together to address the water needs within the state.

Figure 1 illustrates the nine Basin Roundtables which were organized to represent Colorado's eight major river basins and a separate roundtable for the Denver Metro area. The Yampa/White, Colorado, Gunnison, and Southwest Basin Roundtables are all based on tributaries to the Colorado River. The North Platte, Metro, and South Platte Basin Roundtables represent watersheds tributary to the Platte River. The Arkansas and Rio Grande Basin Roundtables are the headwaters of these river systems.

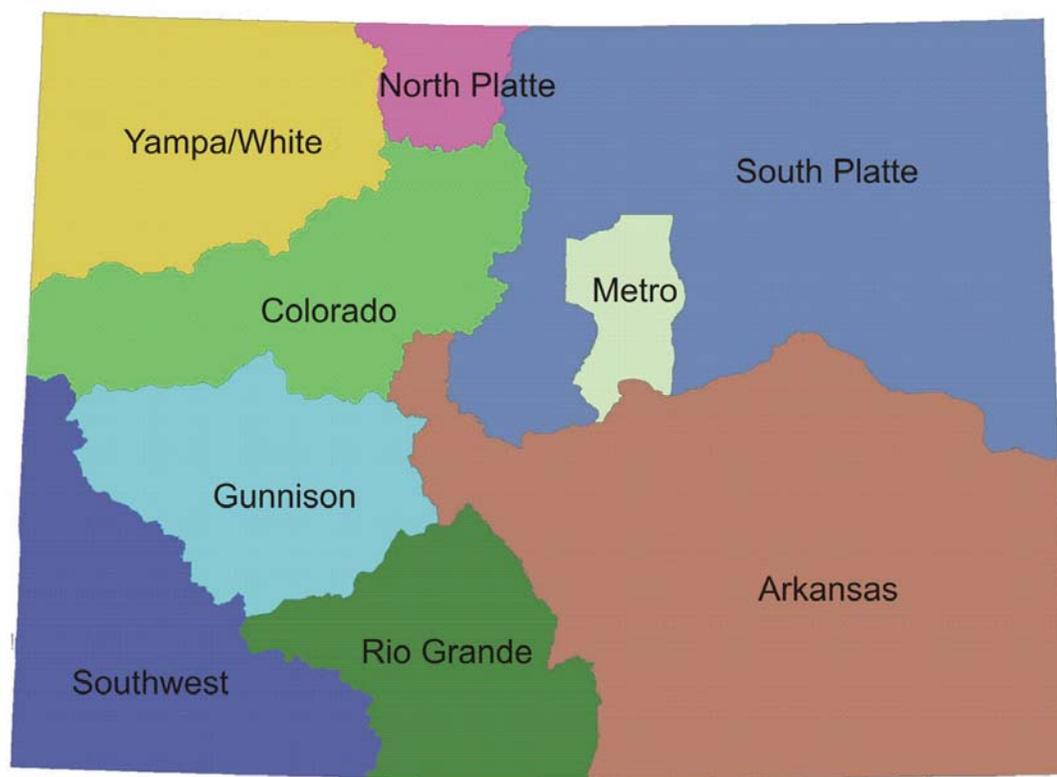


Figure 1. Colorado's Nine Basin Roundtables provide a voluntary and collaborative process to help the state address its water challenges.

The majority of Colorado's population resides in the South Platte and Arkansas Basins, while the majority of the state's water supply is located on Colorado's western slope (Yampa/White, Colorado, Gunnison, and Southwest basins). The largest water user in the state has historically been irrigated agriculture. These facts are illustrated in Figure 2. In 2008, the state's population was just more than 5 million people, with the majority of that population located in the South Platte and Arkansas Basin Roundtables. The CWCB also has projected that there are nearly 2.5 million irrigated acres in the state and the majority of these acres are also located in the South Platte and Arkansas Basin Roundtables. Figure 2 shows that the majority of the water supply is located on Colorado's western slope, with an average of just more than 8 million acre-feet/year leaving Colorado's western slope toward the Pacific Ocean.

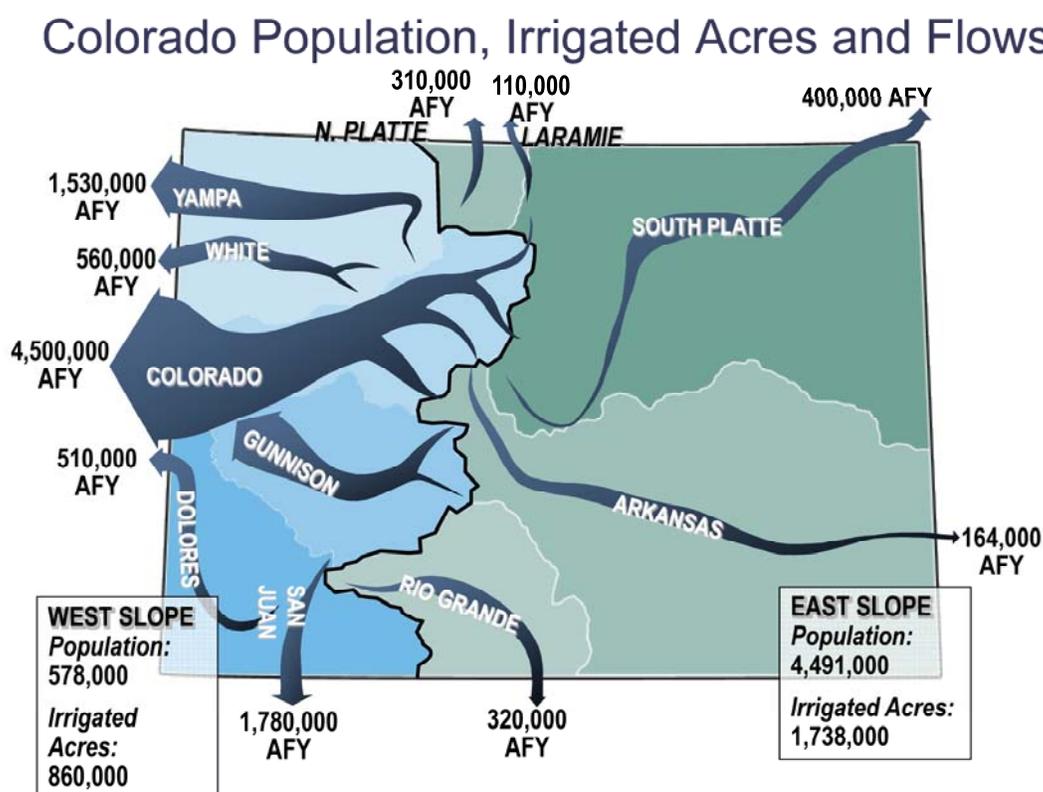


Figure 2. Colorado's Population, Irrigated Acres, and Average Annual Flows Leaving the State's Major River Basins.

In addition to the nine Basin Roundtables, the act established the 27-member Interbasin Compact Committee (IBCC) to facilitate conversations between basins and to address statewide issues. IBCC established its charter in 2006, which was soon ratified by Colorado's General Assembly. The charter outlines the roles of IBCC: to provide a "framework that creates incentives for successful deliberations, agreements, and their implementation." To help advance this role, IBCC embarked on a visioning process, through which IBCC, CWCB, and Basin Roundtables agreed

to evaluate water demand and supply strategies that could help address Colorado's water supply future. This paper details the development of water supply portfolios and the strategies associated with these portfolios. In addition, it describes the stakeholder process used in this effort.

COLORADO'S FUTURE WATER NEEDS

Colorado's population is expected to nearly double by 2050. In 2008, approximately 5 million people resided in the state. By 2050, Colorado's population is projected to be between 8.7 and 10.3 million people, with the majority residing in the Arkansas, South Platte and Metro Basins. However, the western slope of Colorado will see the greatest percentage increase in population during the next 40 years. Another factor considered by CWCB, IBCC, and Basin Roundtables is the potential water requirements for energy development on Colorado's western slope. Oil shale development in northwestern Colorado alone could require up to 400,000 acre-feet/year of water development (URS Corporation 2009). These additional water needs will put pressure on existing water uses, such as irrigated agriculture and instream flow needs for the environment and recreation.

Because of the uncertainties associated with projecting population 40 years into the future and with energy development water needs, water demands for this effort were estimated as "low," "medium," and "high," based on varying economic factors. Colorado's future municipal and industrial water needs are summarized in Figure 3. As part of the visioning process and initiatives completed by CWCB, the purple portion of the chart is referred to as the municipal and industrial water needs gap. The gap between Colorado's municipal and industrial water supply and demand is dependent upon the success of projects, conservation plans, and other planning processes currently being pursued by water providers across the state. These are referred to as "identified projects and processes," and are represented in the green portion of Figure 3. To the extent these identified projects and processes are unsuccessful, the gap will be larger and occur sooner. The implementation of many of them is uncertain, as many projects are undergoing a National Environmental Policy Act (NEPA) analysis and need numerous federal and local permits. Assuming 100 percent of the identified projects and processes are successful, the 2050 municipal and industrial gap will range between 320,000 and 1,100,000 acre-feet/year (Colorado Water Conservation Board 2009b). To put this potential gap in perspective, Denver Water, which serves the city of Denver and is the state's largest domestic water provider, uses about 245,000 acre-feet/year (Denver Water 2010). Therefore, the state of Colorado will need to develop up to the equivalent of four Denver Water systems in the future.

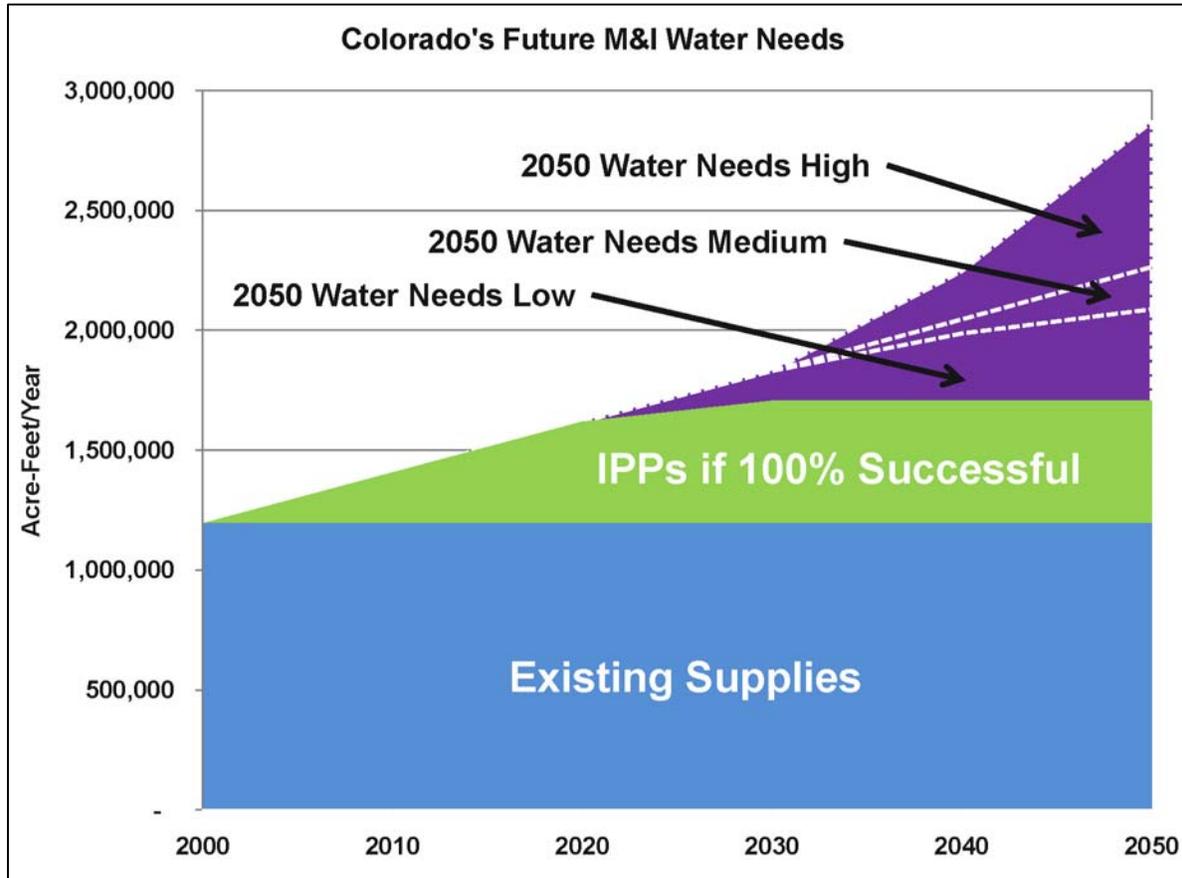


Figure 3. Colorado's Future Municipal and Industrial Water Needs.

IBCC AND CWCB VISIONING PROCESS

During the past 2 years, Colorado's water community has come together through the IBCC process to address the future water needs described above by embarking on a visioning process, to address the following questions:

- If we let Colorado's water supply continue to evolve the way it is now, what will our state look like in 50 years?
- Is that what we want it to look like?
- If not, what can and should we do about it?

IBCC, the Basin Roundtables, and CWCB have held many discussions about these questions and through that dialogue have generated the following statements:

- Colorado needs to provide an adequate water supply for our citizens and the environment. In doing so, the status quo approach to water supply will not lead to a desirable future for Colorado.
- Water supply in Colorado is transitioning from an era of undeveloped resources to an era of managing a more developed resource. Future water decisions will increasingly involve reallocating water between uses.
- Water is not an independent issue. Colorado's water supply future is tied to the larger economic, demographic, and cultural trends of our state.
- A range of strategies are needed to help meet our state's consumptive and nonconsumptive water supply needs. These include a combination of demand-side strategies, such as conservation; supply-side strategies, such as storage and agricultural transfers; and regional coordination strategies.
- IBCC, CWCB, Basin Roundtables, and other stakeholders should work together to examine the trade-offs, risks, and uncertainties associated with different strategies and combination of strategies.
- A statewide vision statement should be developed in combination with an evaluation of water supply strategies.

As part of the visioning process, IBCC, CWCB, and Basin Roundtables have developed a draft vision statement and goals, and begun to work on strategies to address Colorado's water supply future as represented in Figure 4. This vision statement, in the broadest sense, provides an overall directive or mission for the process and describes *what* is to be achieved. The vision goals represent the benchmarks for evaluation of the strategies and will play an important role in evaluating the performance of water supply strategies. These goals represent *why* the vision should be achieved. Strategies represent *how* the vision statement will be met. The CWCB intends to compare the performance of the strategies to the vision goals in order to assess if the vision statement can be achieved. This vision process is modeled after an integrated planning process. Elements



Figure 4. Components of the Visioning Process.

of an integrated resource planning process involve active stakeholder participation, examines demand-side management as vigorously as supply options, incorporates multiple criteria in decision-making, explores risk and uncertainty, and takes a long-term perspective (30 to 50 years). The visioning process developed by CWCB, IBCC and Basin Roundtables promotes sustainable solutions for Colorado's water supply future, because it focuses on the long-term, incorporates societal values, takes a holistic and interconnected perspective, and strives for balance in meeting multiple objectives (Colorado Water Conservation Board 2009b).

IBCC, CWCB and Basin Roundtables developed the following draft vision statement through a series of several meetings: "We envision a Colorado that balances municipal, industrial, agricultural, environmental, and recreational water needs and promotes cooperation among all water uses." Following are the draft vision goals:

- Meet municipal and industrial (M&I) demands
- Meet agricultural demands
- Meet Colorado's environment and recreation demands
- Promote cooperation between water supply planners and land use planners
- Promote more cooperation among all Colorado water users
- Optimize existing and future water supplies
- Promote cost-effectiveness
- Minimize the net energy used to supply water
- Protect cultural values linked to water resources
- Provide operational flexibility and coordinated infrastructure
- Promote increased fairness in relation to water transfers
- Comply with all applicable laws and regulations
- Educate all Coloradans on the importance of water

CWCB realizes that these goals may individually conflict and may not always be accomplished. However, by evaluating all the goals together, more balanced water supply strategies can be achieved (Colorado Water Conservation Board 2009b).

The third part of a statewide vision for Colorado's water supply future is water supply strategies. During its May and August 2009 meetings, IBCC discussed which water supply strategies may help meet our water supply needs. IBCC members agreed on a draft list of demand-side and supply-side strategies for further evaluation. Examples of demand-side strategies include reducing future water demands through land use and density of future development and conservation. Supply-side strategies include water reuse, transferring agricultural water rights to municipal use, optimization of existing systems, increased storage, additional development of Colorado River system supplies, and integrated management of groundwater and surface water. At the July 2009 CWCB Board meeting, the CWCB Board reviewed this draft list of strategies

and directed staff to begin describing and analyzing these strategies. Based on IBCC, Basin Roundtable, and CWCB direction, the CWCB staff began the development of these strategies in detail starting with conservation, transferring agricultural rights to municipal uses, and additional development of Colorado River system supplies.

SCENARIOS AND PORTFOLIOS FOR COLORADO'S FUTURE WATER SUPPLY

As described above, the IBCC and CWCB Board have identified draft goals for water use and management through a "visioning process" and have provided direction for several water supply and demand scenarios. These scenarios currently incorporate future M&I needs for water. Various stakeholders and CWCB are currently assessing water needs for agricultural, energy, and environmental and recreational needs. As these analyses are finalized, the CWCB plans to incorporate them into the current scenario planning analysis that the state has undertaken during 2009 (Colorado Water Conservation Board 2009b).

Traditional water supply planning efforts typically examine one predictive future. Because of the broad scale of CWCB's effort and because many factors that impact future needs are outside the control of water managers, CWCB has utilized a scenario planning process in addressing Colorado's future M&I needs. These factors include population growth, oil shale development, and climate change. Based on future uncertainties, CWCB has developed five municipal and industrial water demand and supply scenarios for 2050, as shown in Figure 5. These scenarios are not intended to be forecasts of the future, but are developed to represent potential future conditions that may impact M&I water supply and demand. The supply scenarios shown in Figure 5 are focused on the Colorado River system because the other major river systems in the state either have very limited water supplies or will be further developed as part of identified projects and processes planned by water providers statewide.

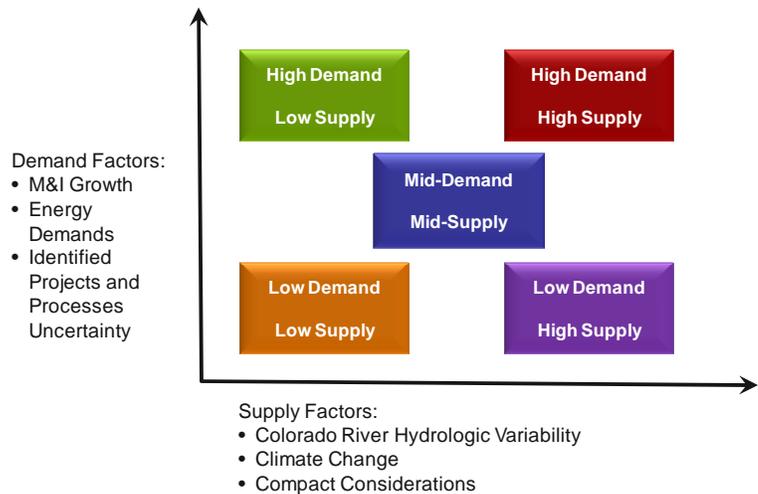


Figure 5. 2050 Statewide M&I Water Demand and Colorado River System Supply Scenarios.

Various factors influence future water demand and supply in Colorado. For demands, CWCB has projected statewide 2050 water demands on a low, medium, and high basis (Colorado Water Conservation Board 2009), as shown in Figure 3. A major factor in future municipal and industrial water needs is population growth. The economic model used to estimate future

population assumes that in addition to natural population growth (births and deaths), economic factors drive population growth. Because of the uncertainty in projecting economic conditions and employment levels in 2050, low-, medium-, and high-population projections were developed. The range of population projections are the basis for the demand scenarios summarized in Figure 5. For supply, CWCB has examined the Colorado River system for potential future development. CWCB is currently conducting the Colorado River Water Availability Study (CRWAS), which will provide a sophisticated analysis of where and when water is available in the Colorado River system. However, CWCB has used existing information on Colorado's compact entitlement and analysis by the Bureau of Reclamation (BOR) as a starting point for discussion with the IBCC, CWCB Board, and Basin Roundtables. Based on this information, CWCB has assumed a range of 100,000 acre-feet/year to 700,000 acre-feet/year could be developed in the future for this planning effort (Colorado Water Conservation Board 2009b).

Since September 2009, CWCB and IBCC have worked to develop conceptual water supply portfolios to address the five scenarios summarized in Figure 6. CWCB and IBCC have defined portfolios as combinations of strategies that collectively meet statewide municipal water demands. Strategies are broad categories of solutions for meeting Colorado's water needs. The demand-side and supply strategies discussed during the vision process are being considered in the scenario and portfolio development process. Figure 6 below shows the relationship between the portfolios and strategies that are being examined for the future scenarios.

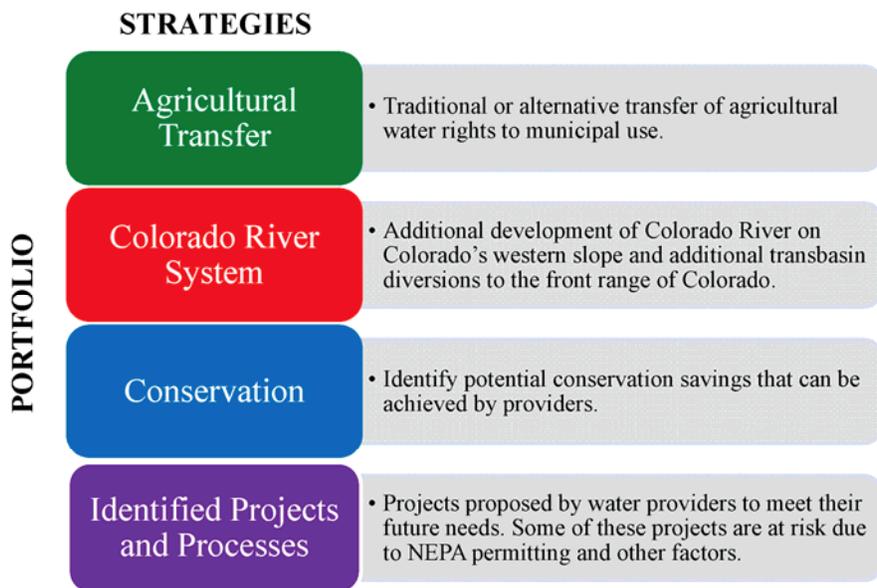


Figure 6. Relationship between Portfolios and Strategies.

To facilitate the discussion of future scenarios, portfolios, and strategies, CWCB developed an interactive spreadsheet model that can generate water supply portfolios in a stakeholder meeting setting. The stakeholders can then use the spreadsheet model to develop different portfolios to address a given future scenario's water needs. The spreadsheet model also allows the stakeholder to identify trade-offs between the different portfolios and calculates the acres of irrigated agriculture land that would be taken out of production to implement a given portfolio. As mentioned above, one of the statements discussed during the vision process was, "water supply in Colorado is transitioning from an era of undeveloped resources to an era of managing a more developed resource. Future water decisions will increasingly involve reallocating water between uses." Trade-offs, such as reallocating irrigated agriculture water rights to municipal use, allow the stakeholders to assess individual portfolios. Figure 7 shows example results from CWCB's spreadsheet model. The stakeholders can quickly and easily create the scenario and portfolios in the top chart and immediately view the resulting trade-offs in the bottom chart.

The spreadsheet tool has allowed for more informed discussions on how Colorado will meet its future water needs. It has allowed the IBCC, Basin Roundtables, and other stakeholders to understand that there is not one single strategy that can address all of Colorado's future water needs.

FUTURE WORK

During 2010, CWCB plans to continue to work with IBCC and Basin Roundtables to develop a range of future scenarios and their associated portfolios. CWCB is revising the spreadsheet model to include additional trade-offs to

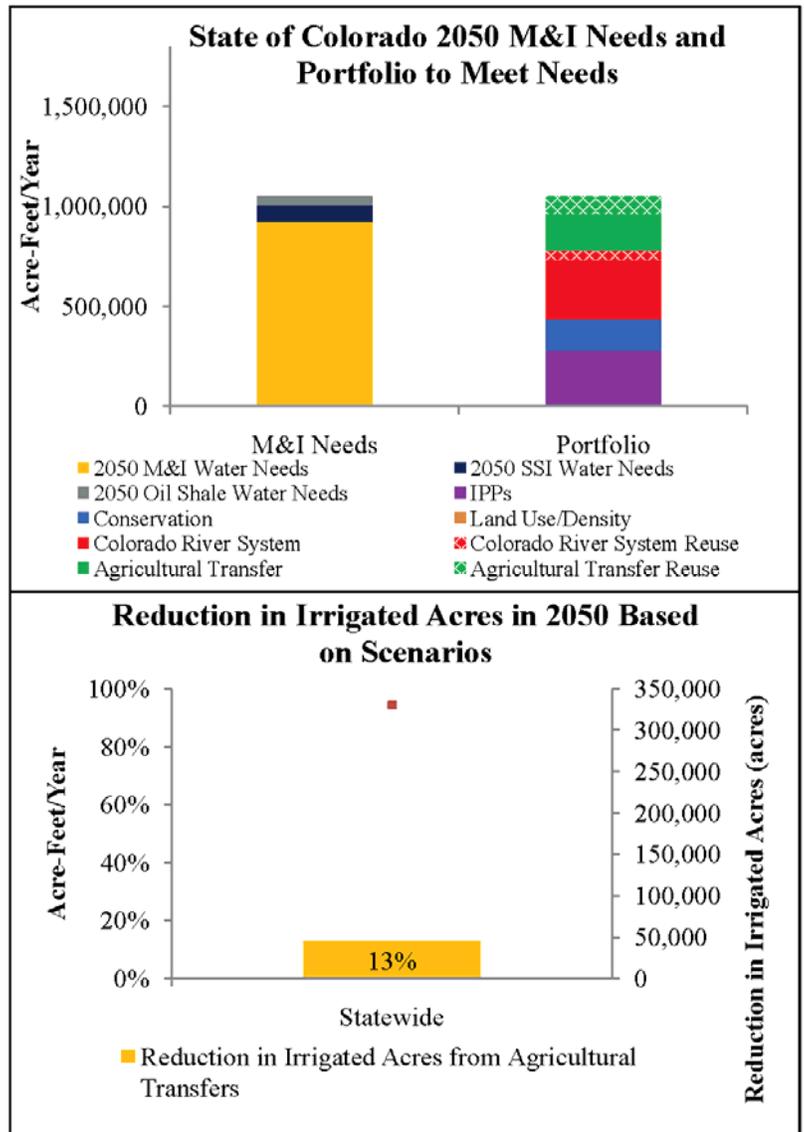


Figure 7. Example Output from CWCB Portfolio and Trade-off Tool.

assist IBCC and Basin Roundtables in developing and evaluating the portfolios associated with each future scenario.

ACKNOWLEDGEMENTS

The authors would like to acknowledge the commitment of the CWCB Board, IBCC, and Basin Roundtables in seeking to continue to explore collaborative and multi-purpose solutions to Colorado's future water needs.

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