

# INTERMOUNTAIN WEST CLIMATE SUMMARY



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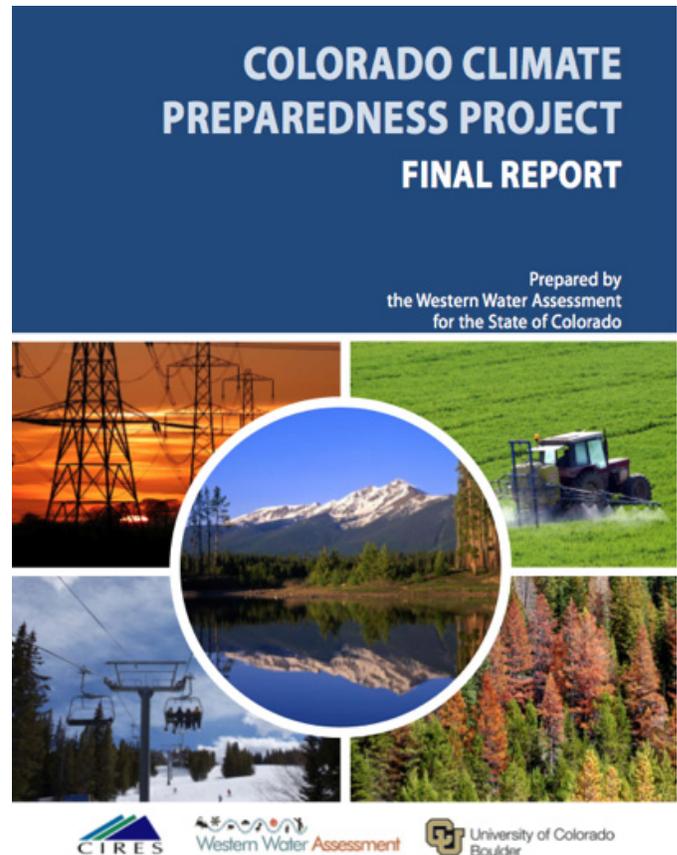
## The Colorado Climate Preparedness Project - Capturing the state of climate adaptation in Colorado

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In Colorado and the other western states, both public entities and private enterprises have a long history of adapting to natural climate variability such as droughts—reducing potential damages through planning and preparatory actions. Similarly, adaptation to future climate change is now widely acknowledged to be essential in minimizing societal impacts.

The Colorado Climate Preparedness Project (CCPP), recently completed by the Western Water Assessment, was an effort to summarize current and planned climate adaptation efforts undertaken in Colorado by state agencies, their federal counterparts, nonprofit organizations, and private industry, as part of planning and policymaking activities. The project examined implicit and explicit adaptation to both natural climate variability and climate change. Although the CCPP report was not meant to be a comprehensive assessment of climate vulnerabilities and adaptation efforts, it is intended to provide the governor with a foundation on which to build future climate adaptation planning.

The CCPP was initiated in 2010 by Colorado Governor Bill Ritter, and carried out by a project team (see box, page 3) working under the guidance of a state advisory board comprised of representatives from the Governor’s Energy Office, Colorado Water Conservation Board, Colorado Department of Agriculture, Colorado Department of Public Health and Environment, Governor’s Office, Colorado Department of Natural Resources, and Colorado Division of Wildlife. The project focused on five sectors identified by the



state advisory board as being both important to the state and particularly sensitive to the impacts of climate variability and change:

- Water
- Wildlife, ecosystems and forests
- Electricity
- Agriculture
- Tourism and outdoor recreation

The project team produced a publicly accessible database (described in this month’s IWCS Focus Article), and a report to the state, described in this article. The report presents the authors’ review of climate impacts

The Colorado Climate Preparedness Project report is available here:

[http://wwa.colorado.edu/climate\\_change/docs/CCPP\\_final\\_report.pdf](http://wwa.colorado.edu/climate_change/docs/CCPP_final_report.pdf)



and adaptation-related planning and activities in the five sectors listed above. The project team relied on agency documents and information obtained through 22 interviews with representatives from key state and federal agencies and other entities in each sector. Table 1 lists, by sector, the interviewed organizations, with some interviews listed under multiple sectors. Among other questions, the interviewees were asked to identify their organization’s top three concerns about the impacts that climate variability and climate change are having or will have on their sector, their existing or anticipated planning for climate variability and climate change, and the barriers to adaptation that they face.

In addition to the five sector chapters, the report contains a chapter that draws lessons from three other states—Alaska, California, and Maryland—which have recently produced statewide climate adaptation

plans. After a brief discussion of cross-sectoral impacts in Colorado, the report concludes with a synthesis of the key points from the sector chapters, and a set of overarching recommendations for the governor.

Below are the key points from each sector chapter, and the key points that emerged from the overall project.

### Key Points from the Sector Chapters

Key points from each of the sector chapters describe the major state player(s) in adaptation, the impacts to the sector expected from climate change, the status of adaptation planning in the sector, barriers to successfully implementing adaptive strategies, and the most important adaptation options identified by the interviewees.

Agriculture	Electricity	Wildlife, Ecosystems, Forests	Outdoor Recreation	Water	All sectors
Colorado Dep’t of Agriculture	Governor’s Energy Office	Colorado Dep’t of Natural Resources - Executive Director’s Office	Colorado State Parks	Colorado Water Conservation Board	Rocky Mountain Climate Organization
Rocky Mountain Farmers Union	Public Utilities Commission	Colorado State Forest Service	Colorado Division of Wildlife	Colorado Division of Water Resources	Western Governors’ Association
CSU Colorado Water Institute	Xcel Energy	Colorado Division of Wildlife	U.S. Forest Service - White River NF	Colorado Dep’t of Public Health and Environment	CSU Colorado Climate Center
CSU Dep’t of Agricultural and Resource Economics		U.S. Forest Service - White River NF		Denver Water	
		U.S. Fish and Wildlife Service			
		The Nature Conservancy			
		Trout Unlimited			

Table 1. Organizations interviewed for the CCPP report, listed by sector. Some organizations are listed under more than one sector.



## Water

- Among state agencies, the Colorado Water Conservation Board (CWCB) has the most prominent adaptation role in this sector.
- The most serious anticipated impacts of climate change include shifts in timing and intensity of streamflows and runoff, reductions in late-summer flows, decreases in annual runoff, increases in drought, and modest declines for Colorado's high-elevation snowpack.
- Most state agencies in this sector are working to explicitly incorporate climate adaptation into their strategic planning and activities, most notably CWCB.
- Among the significant barriers to implementing adaptation planning in this sector are (1) gaps in climate and hydrology monitoring; (2) gaps in hydrology and climate-related research on changes in extreme events, demands, runoff, and groundwater-surface water interactions; (3) gaps surrounding new sources of supply; (4) gaps relating to the need for new forms of planning that can encompass new forms of uncertainty, multiple futures, and the use of greatly expanded new information from models and monitoring stations; (5) gaps and barriers related to the need for better public communication and organizational structures to facilitate cross-agency communication; and (6) knowledge gaps about a number of legal issues relating to changes in timing of water rights, compact issues, water rights administration, the impact of federal environmental laws on state water rights, compliance with NEPA requirements, and federal constraints on the use of model output for planning and operations.
- CWCB efforts are critical for all water-related climate adaptation. Adaptation coordination within the Department of Natural Resources (DNR) will require enormous effort given the size and breadth of the department. The Statewide Water Supply Initiative (SWSI) process needs to continue, and should explicitly consider climate variability and change. Quantitative studies should be performed whenever possible. Qualitative studies can be useful in all other cases.

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## Wildlife, Ecosystems, and Forests

- Climate adaptation in this sector is strongly influenced by the activities of the federal resource management agencies, which manage 35 percent of Colorado's land base and share responsibility for managing Colorado's wildlife. Among state agencies, the Colorado Division of Wildlife (DOW) has the most prominent adaptation role in this sector.
- The most serious anticipated impacts of climate change include increasing frequency and severity of forest insect infestations and wildfires (both of which are believed to be occurring already), and changes in the hydrologic cycle that will impact fish and other aquatic organisms. These changes include a reduction in streamflow, a shift to earlier spring runoff, and an increase in stream and lake temperatures.
- Most state agencies in this sector are working to explicitly incorporate climate adaptation into their strategic planning and activities, most notably DOW. Several federal resource management agencies have recently released agency-wide strategic plans to adapt to climate change. The adaptation "tool kit" available to



resource managers is largely that already used to manage ecosystems for other stressors, employed to increase the “resilience” of ecosystems and species to external change.

- Among the significant barriers to implementing adaptation planning in this sector are (1) the lack of ecological data and models to bridge from climate projections (which are themselves seen as too uncertain) to specific climate impacts on ecosystems, and (2) lack of coordination among the state and federal agencies trying to implement climate adaptation.
- Options for facilitating adaptation for this sector provided by interviewees were (1) promote interagency coordination in adaptation planning and implementation, and (2) continue to build state agency capacity to implement adaptation. Both would be usefully manifested in carrying out other key options: (3) develop the ecological data to bridge from climate projections to climate impacts, (4) conduct a statewide vulnerability assessment for species and ecosystems, and (5) monitor the effects of adaptation strategies that are implemented.

### *Electricity*

- The electricity sector in Colorado is a complex mix of investor-owned utilities, rural electric associations, and municipal utilities. The Public Utilities Commission (PUC) and the Governor’s Energy Office are the two primary state-level entities with regulatory and policymaking authority for this sector, although several other state and federal agencies also play important roles.
- Electric utilities in Colorado face a number of climate-sensitive challenges that could be exacerbated by future warming. These challenges include meeting short-term peaks in demand often caused by the need for summertime space cooling; providing water supplies to water-cooled generation units, especially coal-fired power plants; and adapting to impacts of policies and technologies designed to reduce greenhouse gas emissions, including carbon pricing mechanisms and electric vehicles.
- Electric utilities and state agencies already possess

significant adaptive capacity through the electric resource planning process, which requires utilities to plan for long-term shifts in demand. Utilities are also accustomed to using a variety of mechanisms to accommodate significant short-term peaks in demand, although current mechanisms are relatively inefficient. Demand response and dynamic metering mechanisms such as the new SmartGridCity offer significant promise for increasing future adaptive capacity in the electricity sector.

- The difficulty of siting new transmission lines to bring renewable power from areas of high potential generation to areas of high demand is a significant barrier currently facing the sector, as is uncertainty about the impact of increased penetration of renewable generation resources.
- Options for facilitating adaptation in the electricity sector include (1) promoting additional research on integrating renewable resources in the grid, (2) giving the PUC a more proactive role in directing utilities to incorporate additional renewables, and (3) tying adaptation and mitigation measures to economic development.

### *Agriculture*

- The agricultural sector is a complex mixture of different production systems spread across Colorado’s varied terrains and different climates, involving thousands of individual producers who operate within the changing context of technology, markets, and policy. The dominant policy forces emanate from federal agricultural regulations and support programs. The state plays a supportive role in marketing, extension, federal policy advocacy, research, and data collection, and through programs such as drought response, water and soil conservation, wildlife interactions, and pest management policy.
- Most agricultural production systems rely to some extent on water resources and thus the sector is sensitive to changes in water supply, policy, management, and infrastructure. The sector is further exposed to weather and climate extremes of many types, including extreme heat and cold, winter storms, frost, hail, and flooding, and associated pests and pathogens.
- Despite its exposure to risks, agriculture is widely



viewed as particularly adaptable in the face of multiple challenges including climate variability, and the sector in Colorado may be in a position to benefit from some anticipated climate changes, such as warmer conditions and longer growing seasons.

- Barriers to adaptation include market uncertainty at all scales (from local to global), transition costs of changing practices and technology if conditions demand it (including credit and insurance), and increasing competition for water supply.
- Options for the state to facilitate adaptation include mechanisms such as (1) market development; (2) supportive water policy; (3) drought response; (4) research, extension, and technology transfer; (5) insurance and disaster relief; (6) soil and land conservation policy; and (7) provision of climate information and forecasts.

### ***Outdoor Recreation***

- The outdoor recreation sector includes a diverse set of government agencies and private actors, although no state agency has overarching regulatory authority over the sector. State Parks manages state-owned recreational resources and has taken the lead on statewide comprehensive outdoor recreation planning. The Division of Wildlife (DOW) manages hunting, fishing, and wildlife viewing in the state. The Colorado Tourism Office promotes Colorado as a tourism destination. The Colorado Water Conservation Board (CWCB) manages instream flows and recreational in-channel diversions, and has studied interactions between water resources and outdoor recreation.
- Climate variability impacts to outdoor recreation identified by interviewees include drought, insect infestations, wildfire, and harm to aquatic species from warmer water temperatures. These impacts could intensify with climate change. Additional climate change impacts of concern include declining snowpack and its effect on water-based recreation, and increased warm weather visitation to the state.
- Most state agencies with a role in outdoor recreation (State Parks, DOW, CWCB) have started incorporating climate change

considerations into planning. Certain industries within the outdoor recreation sector, including the ski industry, have adapted to current climate variability to a significant extent.

- Among the most significant barriers to adaptation are lack of data regarding the impacts of climate on recreation; the need to attend to more immediate concerns; lack of coordination across substantive areas; and lack of stakeholder demand to address climate change adaptation in agency strategic planning.
- Options for this sector include (1) compiling and analyzing data on the economic impact of climate on recreation; (2) addressing the impact of increased outdoor recreation and tourism on transportation; and (3) coordinating outdoor recreation adaptation across industries and levels of government.

### **Key Points that Emerged from the Project**

The following is a summary of overall findings from the project that emerged either explicitly or implicitly from the interviews within each sector, and from background materials.

- Because many climate impacts cross sectors and traditional agency boundaries, adaptation will require coordination across the state government as well as with other entities including the federal government, other states, regional efforts, non-governmental organizations (NGOs) and municipalities.
- Monitoring is a critical element of climate adaptation, and includes both tracking climate variability and change at spatial and temporal scales that allow assessment of impacts and planning of adaptive responses, and monitoring the effectiveness of those adaptations.
- Additional research on the impacts of climate change on physical, ecological, economic, and legal systems is a need common to all sectors. Also, research is needed to anticipate the unintended consequences of climate adaptation and mitigation.
- A more complete impacts and vulnerability assessment centered on a range of plausible climate scenarios to prioritize Colorado's key climate threats and vulnerabilities could point to adaptations that



could reduce costs and potential losses.

- Climate impacts on water resources—e.g., changes in runoff patterns, snowpack, and storage—are a significant source of impacts to the other four sectors examined in this report.
- The state is already engaged in many activities that are not explicitly driven by climate adaptation but that might create resilience to the impacts of climate.
- Communication between stakeholders and the state about climate change impacts and response strategies emerged as another important element of an overall adaptive strategy.
- A recurring theme across the sectors is the challenge faced by planners and managers as they attempt to incorporate climate change into decision making. Even agencies that explicitly and successfully incorporate climate variability into planning are struggling with the inherent uncertainty of long-term climate projections and the incompatibility of the timescales of climate change with existing planning regimes.
- The state should actively engage with several federal initiatives including the new National Climate Assessment, the Landscape Conservation Cooperatives, and the Climate Science Centers, both to bring the state’s insights to bear and to benefit from these larger efforts.

as to reduce vulnerabilities across multiple sectors. Moreover, Colorado can draw on a unique combination of in-state strengths in climate, energy, and natural resources research and management. The state is in a good position to apply lessons from other states, and also to benefit from federal efforts like the many climate initiatives of the federal resource management agencies, emerging climate services structures, and the ongoing National Climate Assessment.

Working on the CCPP report and database provided the project team with an invaluable opportunity to engage with state agencies and other entities and learn their perspectives on climate vulnerability and adaptation, the status of planning efforts, and the needs for additional information. We look forward to working with these agencies and entities to help them keep pace with both the evolving science and best planning practices, and move forward with climate adaptation initiatives at multiple levels.

## Concluding Thoughts

While attention to climate variability and change varies across agencies and sectors, overall there is widespread awareness of the value of reducing the state’s vulnerability to climate impacts. But while the state continues to improve responses to droughts, floods, forest health, and other effects of typical climate variability, the large uncertainty that surrounds climate change poses a unique challenge: matching adaptive planning with the evolving science. Planning for climate change in Colorado is in the very early stages. Some entities are awaiting a better understanding of the full social and environmental implications, while others are moving forward based on current understanding and despite uncertainties.

The state is engaged regionally and nationally in climate assessments and efforts to shape policy so

