

Climate & Colorado's Water Future

Taryn Finnessey

Senior Climate Change Specialist



COLORADO Department of Natural Resources





EXECUTIVE SUMMARY

COLORADO CLIMATE PLAN

State Level Policies and Strategies to Mitigate and Adapt

co



COLORADO

Department of Natural Resources

HB 13-1293

"The general assembly hereby declares that climate change presents serious, diverse, and ongoing issues for the state's people, economy, and environment...ensure that the state is apprised of the threats that climate change poses to Colorado and the progress made to mitigate and address those threats..."

- Development of a Plan
- Collaboration with other entities regarding climate change preparedness studies.
- Annual Report to legislature
 - Efforts to reduce emissions of gasses and to reform practices known to exacerbate climate change
 - Efforts (proposals) to prepare the state for the effects of climate change





Mutli-sectoral state level policies and recommendations

Includes mitigation and adaptation

Collaborative effort by state agencies



COLORADO CLIMATE PLAN

State Level Policies and Strategies to Mitigate and Adapt





Climate Change in Colorado

A Synthesis to Support Water Resources Management and Adaptation



- A synthesis of climate change science important for Colorado's water supply.
- Observed trends, modeling, and projections of temperature, precipitation, snowmelt, and runoff.
- Colorado-specific findings from peer-reviewed regional studies.
- Presents new graphics derived from existing datasets.
- Released August 2014



Climate Change Vulnerability Study



CLIMATE CHANGE VULNERABILITY STUDY

A report submitted to the Colorado Energy Office

Eric Gordon, University of Colorado Boulder Dennis Ojima, Colorado State University



- Lead Agency: CEO
- Project Goal: To provide an assessment of the key climate change vulnerabilities facing Colorado's economy and resources.
- Qualitatively assesses vulnerabilities in the following sectors:
 - Water
 - Energy Public Health
 - Transportation
- Ecosystems Agriculture
- Tourism
- Conducted by researchers at CU & CSU
- Released February, 2015



Observed temperature departures for Colorado, the US, and globally, smoothed with a 10-year running mean



Climate variability is relatively larger at smaller scales, as seen in the US and Colorado time-series. You shouldn't judge the global trends from what is going on in Colorado. But all three records have followed a similar trajectory since 1900.



Colorado statewide annual temperatures have warmed by 2°F in past 30 years



Source: Western Water Assessment, updated from Lukas et al 2014



http://wwa.colorado.edu

Observed statewide climate trends since 1980s

Annual temperature

Heat waves more freque

Cold waves

Frost-free season

Annual precipitation

April 1 SWE

Snowmelt

Peak runoff timing

Annual streamflow

Palmer Drought Index

warmer more frequent less frequent longer no significant trends lower? earlier earlier lower? more drought



Source: Summarized from Lukas et al 2014

Global warming trend continues; 2016 was warmest year on record (since 1880)





Source: NASA GISS

Observed & Projected Annual Temperatures





2050 Temperature Projections in Context

2°F: Denver's seasonal temperature cycle will become more like Pueblo today

4°F: Denver's seasonal temperature cycle will become more like Lamar today

6°F: Denver's seasonal temperature cycle will become more like Albuquerque today









Water

<u>Vulnerabilities:</u> Changes in streamflow, peak runoff and crop demands. Decreases in Snowpack. Increases in drought. Increased water temperatures. Decreased water quality.





Projected climate and hydrology changes

Annual streamflow Peak runoff timing Crop water use April 1 snowpack Palmer Drought Index Heat waves Cold waves **Frost-free season** Wildfires

decreases in majority of projections earlier in all projections increases decreases in most projections more drought more frequent less frequent longer more frequent





TABLE 4-1

SUMMARY OF PROJECTED CLIMATE CHANGES AND POTENTIAL EFFECTS ON COLORADO'S WATER RESOURCES¹⁸

PROJECTED CHANGES AND POTENTIAL EFFECTS	STUDIES THAT HAVE ASSESSED THIS VULNERABILITY FOR COLORADO
Most projections of future hydrology for Colorado's river basins show decreasing annual runoff and less overall water supply, but some projections show increasing runoff. Warming temperatures could continue the recent trend toward earlier peak runoff and lower late-summer flows.	Colorado Water Conservation Board (CWCB) (2012); Bureau of Reclama- tion (BOR) (2012); Woodbury et al. (2012)
Changes in the snowpack and in streamflow timing could affect reservoir operations, including flood control and storage. Changes in the timing and magnitude of runoff could affect the functioning of diversion, storage, and conveyance structures.	CWCB (2012); BOR (2012)
Warming temperatures could increase the loss of water from plants and soil, lengthen growing seasons, and increase overall water demand.	CWCB (2012); BOR (2012)
Earlier and/or lower runoff could complicate administration of water rights and interstate water compacts, and could affect which rights-holders receive water.	CWCB (2012)
Warmer water temperatures could cause many indicators of water quality to decline. Lower streamflows could lead to increasing concentrations of pollutants.	Environmental Protection Agency (EPA) (2013)
Groundwater demand for agricultural use could increase with warmer tem- peratures. Changes in precipitation could affect groundwater recharge rates.	
Warmer temperatures could place higher demands on hydropower facilities for peaking power in summer. Warmer lake and stream temperatures, and earlier runoff, could affect water use for cooling-power plants and in other industries.	Mackenick et al. (2012)
Warmer temperatures could increase the frequency and severity of wildfire, and make trees more vulnerable to insect infestation. Both have implications for water quality and watershed health.	
Warmer stream temperatures could have direct and indirect effects on aquatic ecosystems, including the spread of non-native species and diseases to higher elevations. Changes in streamflow timing could also affect riparian ecosystems.	Rieman and Isaak (2010)
Earlier streamflow timing could affect rafting and fishing. Changes in reservoir storage could affect recreation on-site and downstream. Declining snowpacks could affect winter mountain recreation and tourism.	BOR (2012); Battaglin et al. (2011); Lazar and Williams (2008)
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Colorado statewide precipitation change by 2050 uncertain; we're between regions expected to get drier and wetter



CO a little wetter in CMIP5 vs. CMIP3





Projected



Any future change in annual precipitation will be difficult to detect as such against the high variability



Figure 5-4



Projected

STRATEGIES AND POLICY RECOMMENDATIONS

*Promote and encourage water efficiency and/or conservation at the local and state agency level.

- Encourage water providers to do comprehensive integrated water resource planning, geared toward implementing the best practices at the higher customer participation levels to achieve state endorsement of projects and financial assistance.
- Support water sharing agreements where feasible and cost effective.
- Explore options to increase reuse of fully consumable water.
- Encourage opportunites for réservoir enlargement statewide (where feasible and cost effective) that could be used for municipal, agricultural, recreational and environmental purposes.
- *Support improvements in Colorado's water infrastructure system by providing low-interest loans and grants, and encourage partnerships and resource-sharing with federal agencies.
- Promote and encourage drought preparedness through comprehensive drought planning and mitigation implementation.
- Identify climate change risks related to integrated water quality and water quantity management.
- Incorporate climate variability and change into long-term, statewide water planning efforts.
- Work with regulators to modify existing water quality standards to factor in climatic change into regulations.
- Work with utilities and federal agencies to identify and address regulatory barriers to climate preparedness and adaptation.
- *Assist local communities in building resilience through the development and implementation of regional and local resiliency plans.
- *Collaborate across jurisdictions to protect and restore ecosystems associated with healthy watersheds Fund and enhance existing weather monitoring systems.
- *Fund and enhance stream and lake quantity and quality monitoring.



Public Health

<u>Vulnerabilities:</u> decreased air quality, water quality, increased vector-borne disease, and frequency/intensity of extreme weather events





Agriculture

<u>Vulnerabilities:</u> decreased water availability, increased drought, increased crop demands, increased heat stress, decreased crop yield, increased weeds & pests





Tourism and Recreation

<u>Vulnerabilities:</u> Warming in the shoulder seasons & decreased cold snaps may effect snow-making operations, earlier melt, temperature & seasonal shifts, occurrence of avalanches,





Ecosystems

<u>Vulnerabilities</u>: increased susceptibility to insect and pathogen invasions, phenology shifts, wildfire, decline in habitat suitability, drought stress





With projected warming, climate regimes will shift upward, by 1000' per 3-4 F

42N 42N 41.5N 41.5N 41N 41N 40.5N 40.5N 40N 40N 39.5N 39.5N 39N 39N 38.5N 38.5N 38N 37.5N 38N 37.5N 37N 37N -36.5N 36.5N 36N 110W 109W 107W 106W 105W 104W 103W 108W 102W 101₩ 36N 110W 109W 108W 107W 106W 105W 104W 103W 102W 101W **Degrees** Fahrenheit **Degrees** Fahrenheit

Observed July temperatures 1950-1999

Projected July temperatures 2050



Source: Western Water Assessment, Ray et al 2008

Moving Forward





Estimated % of adults who support regulating CO2 as a pollutant, 2016





Estimated % of adults who are worried about global warming, 2016





Estimated % of adults who discuss global warming at least occasionally, 2016





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Questions?

Taryn Finnessey

Senior Climate Change Specialist 303.866.3441 X3231 taryn.finnessey@state.co.us



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