City of Fort Collins
Climate Adaptation Planning Workshop for Senior Managers

November 14, 2013

8:00am – 12:00pm

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Agenda

- 8:00 – 8:15 Welcome and Background
- 8:15 – 8:30 Project goals, steps and timeline
- 8:30 – 8:40 Introductions
- 8:40 – 9:10 Climate science review
- 9:10 – 9:25 Storytelling from recent climate events
- 9:25 – 9:50 Introduction to vulnerability assessment
- 9:50 – 10:00 Break
- 10:00 – 11:15 Vulnerability Assessment matrix and ranking
- 11:15 – 11:40 Translating to action
- 11:40 – 12:00 Next steps

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Project Goals, Steps, and Timeline

- Outcomes/Goals
  - Risk and vulnerability assessment matrix
  - Framework/tool for adaptation integration
- Steps/Timeline
  - November 14th (today) – Vulnerability Assessment with Senior Management
  - December 6th – Key Vulnerabilities Identified
  - December 10th – Preparedness Goals and Adaptation Solutions with Staff
    - Who should participate?
  - December 31st (tentative) – Draft Adaptation Integration Framework
    - Aligning with other City efforts

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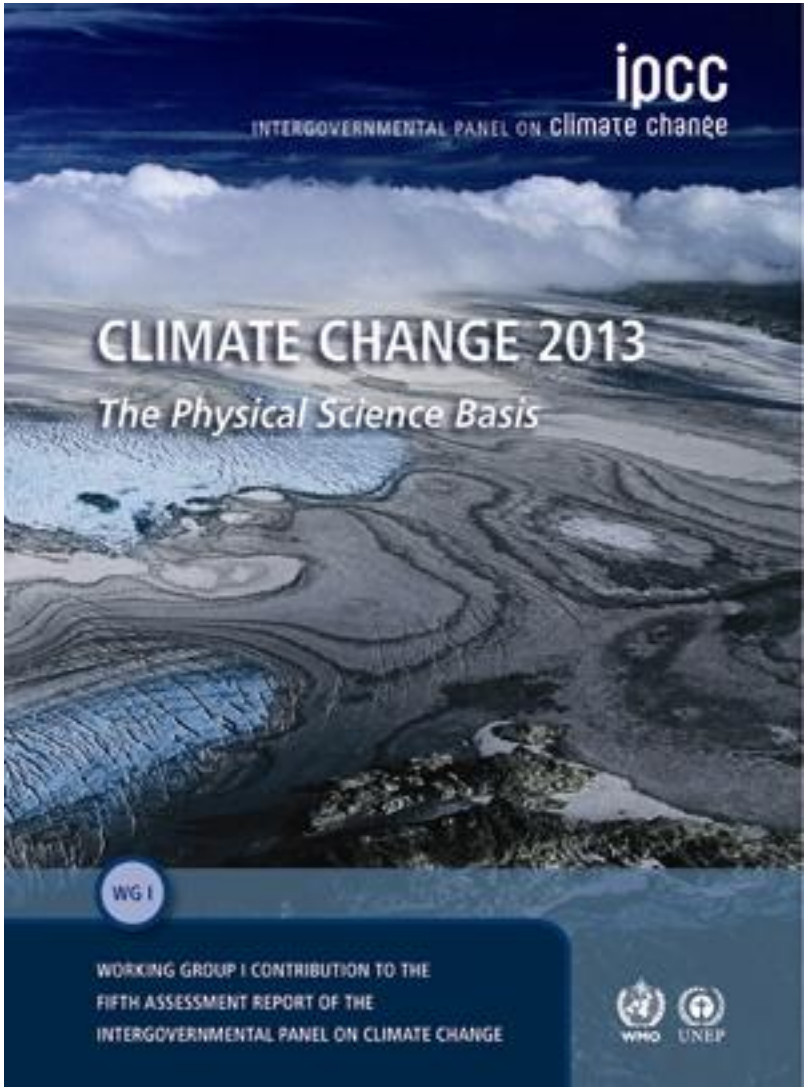
Introductions

- Name
- Title
- Department
- One thing that you love/value most about Fort Collins and/or the Front Range of Colorado

Climate Science Review



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Climate Science Review

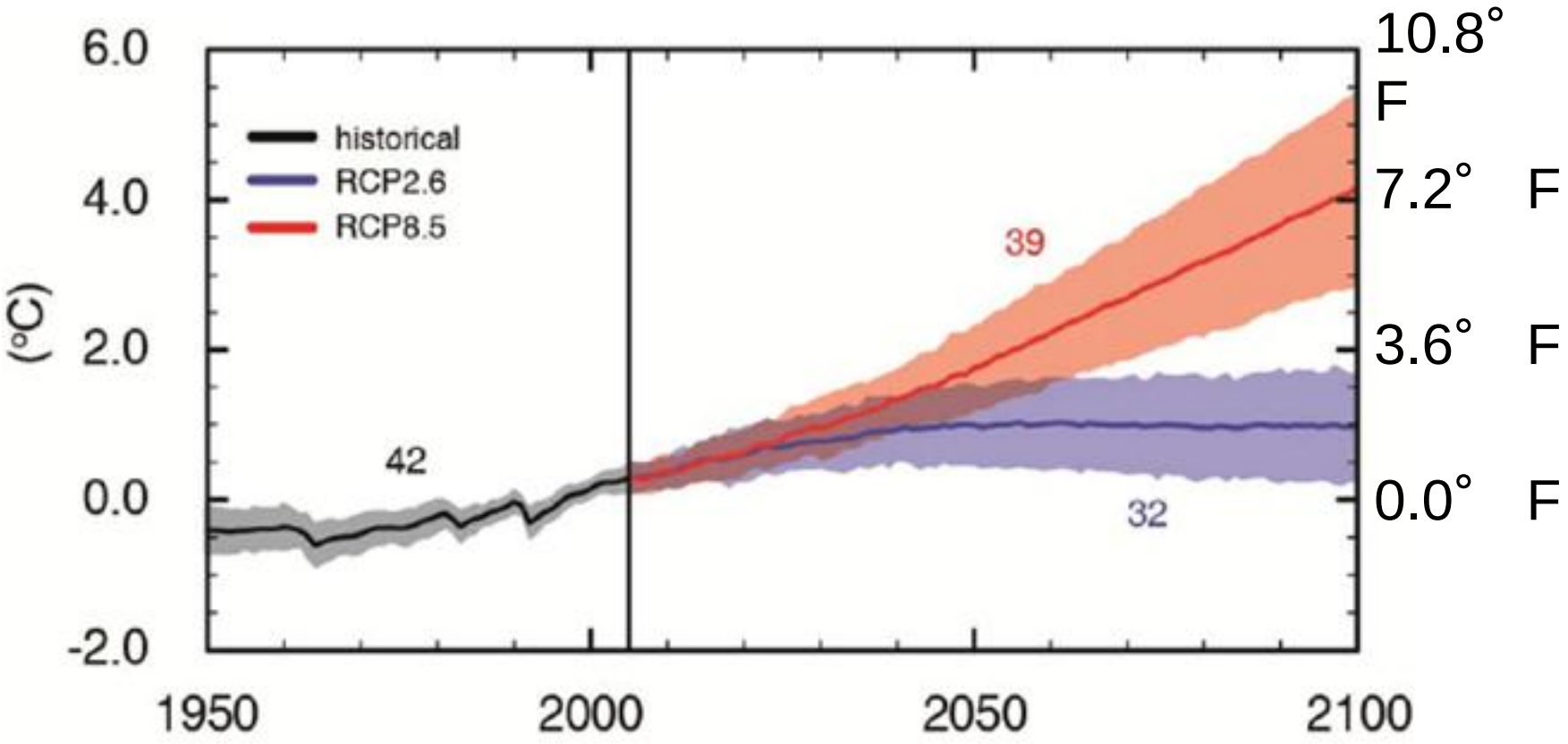

Figure 1. The future temperature development in the highest emissions scenario (red) and in a scenario with successful climate mitigation (blue) – the “4-degree world” and the “2-degree world.”

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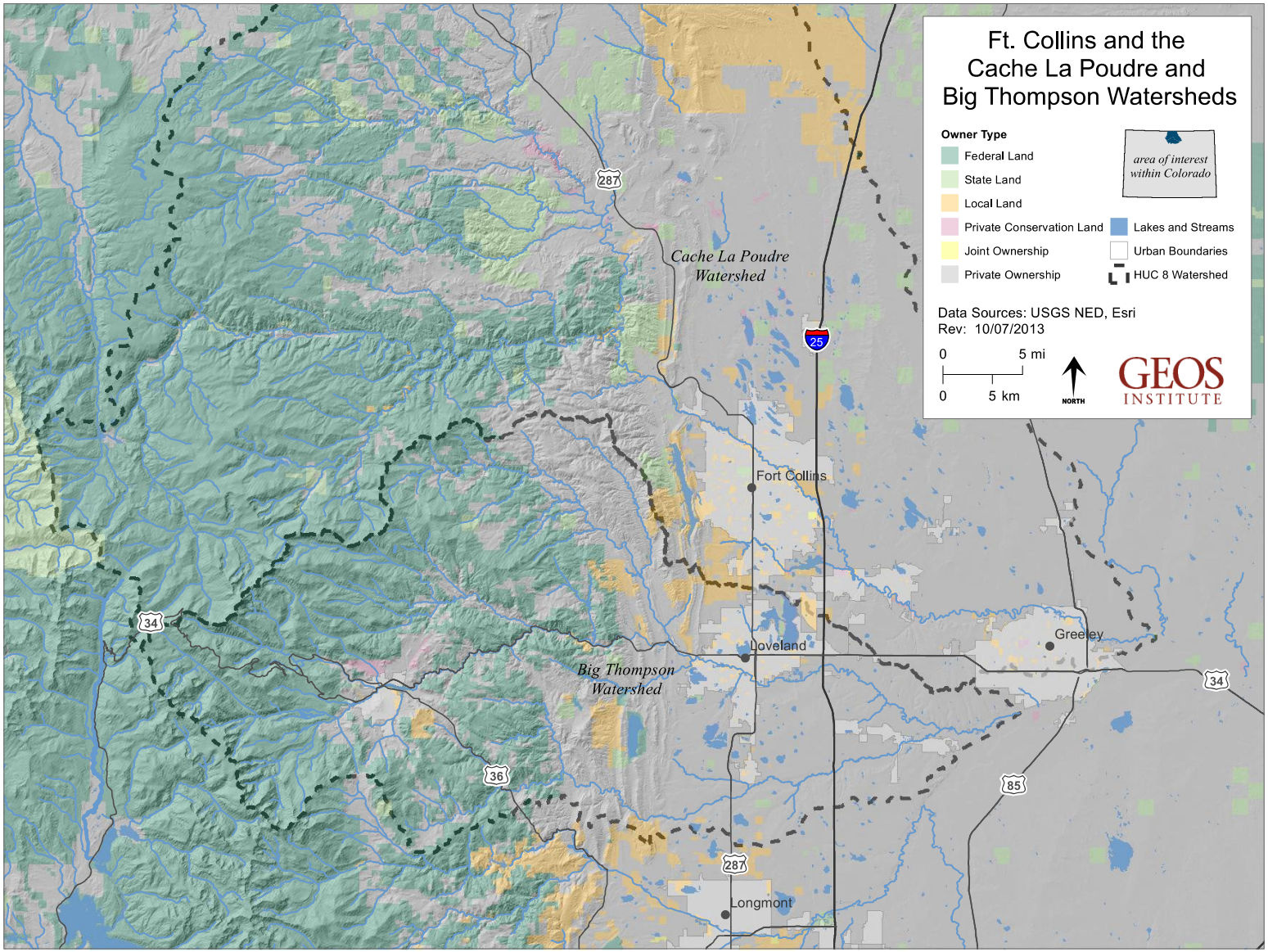

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Temperature

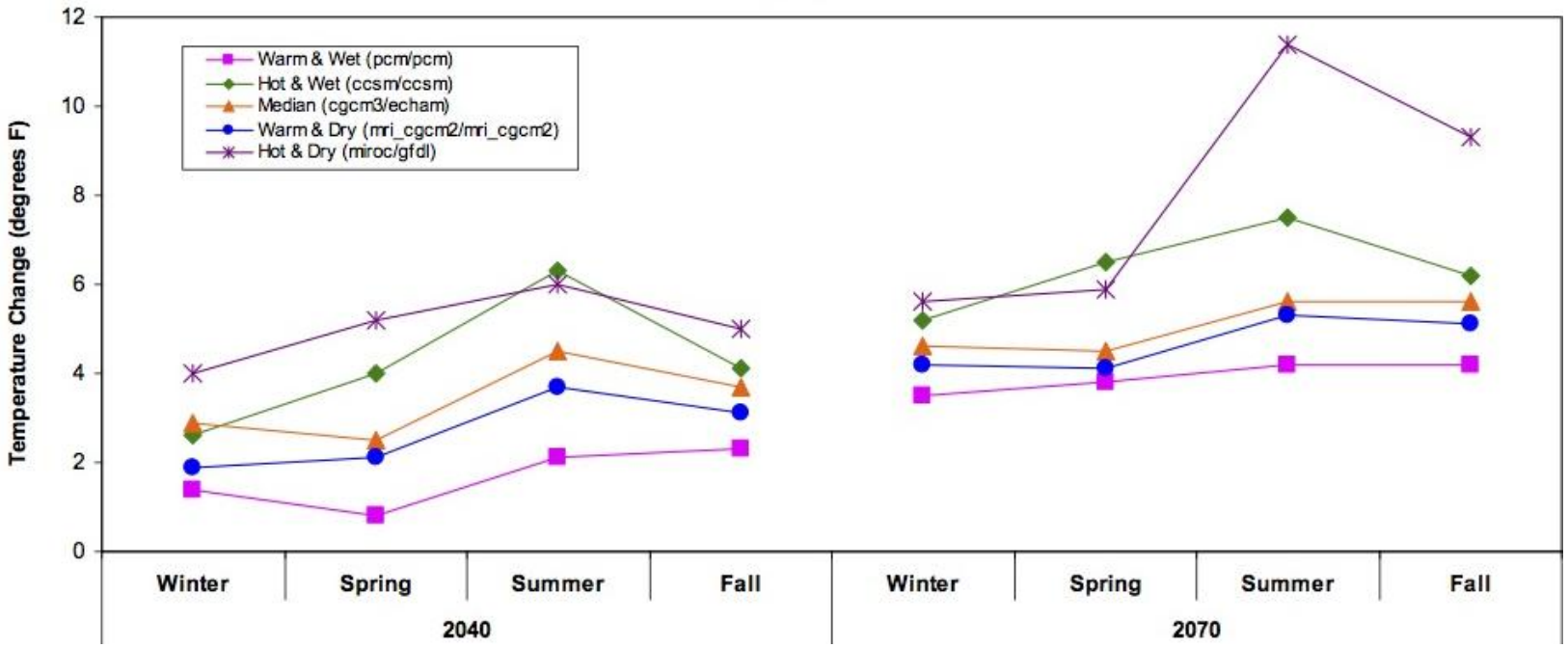

Figure 2. Average temperature change for the Front Range of Colorado, by season, projected for mid-century (left; 2035-45) and late-century (right; 2065-75). From Joint Front Range Climate Change Vulnerability Study 2012. Water Research Foundation.

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Annual Average Temperature

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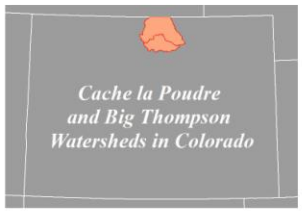

Degrees Fahrenheit

28 - 30.5	45.6 - 48
30.6 - 33	48.1 - 50.5
33.1 - 35.5	50.6 - 53
35.6 - 38	53.1 - 55.5
38.1 - 40.5	55.6 - 58
40.6 - 43	58.1 - 60.5
43.1 - 45.5	60.6 - 63

Data Source: A2 emissions scenario downscaled by PNW Research Station, USDA Forest Service, following Flint and Flint (2012)

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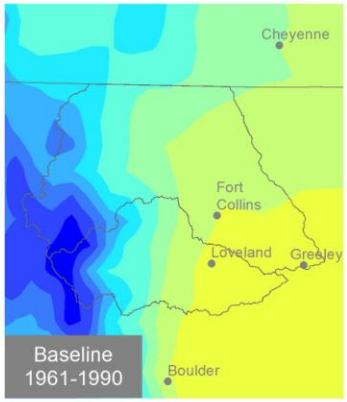
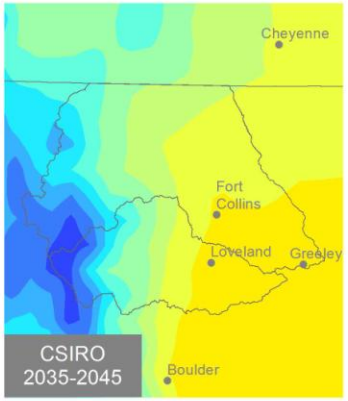
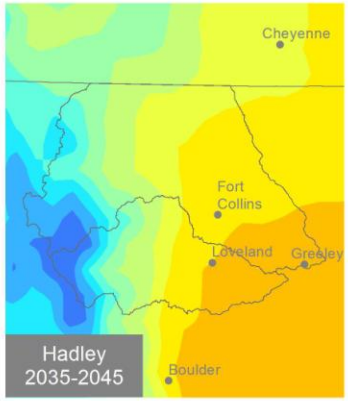
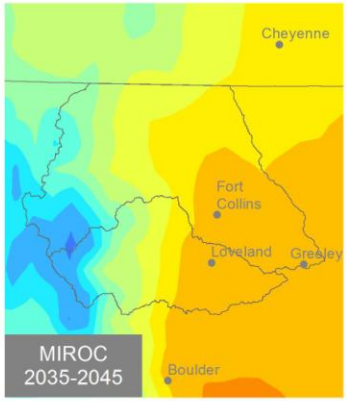
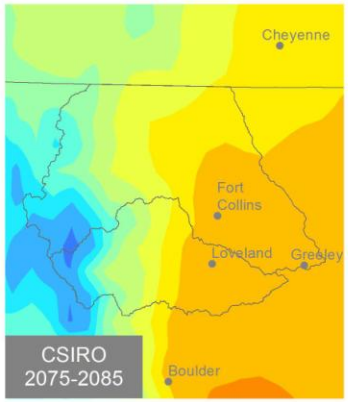
0 20 mi
0 20 km
NORTH

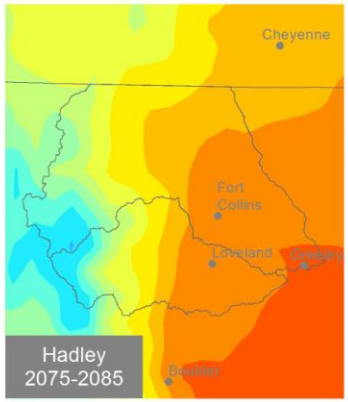


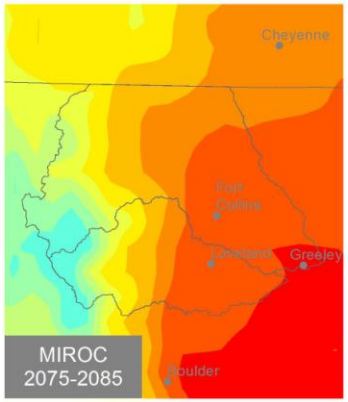












Model Info: Historic PRISM data (Gibson et al. 2002), HadleyCM3 (Met Office, Hadley Center, NCAS British Atmospheric Data Centre), MIROC 3.2 medres (Japan Agency for Marine-Earth Science and Technology, Atmosphere and Ocean Research Institute and National Institute for Environmental Studies), CSIRO Mk3 (Gordon et al. 2002)

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Temperature

Table 1. Average days per year of especially hot temperatures. For the future periods, the values shown are the medians of 60 projections. The percentages in parentheses are comparisons to 1961–1999 averages. This information from Rocky Mountain Climate Organization is in **DRAFT** form and is not for citation or circulation.

Hot Days per Year in Fort Collins
Observations and Projections

	Observations		Lower Emissions		Medium-High Emissions	
	1961–1999	2000–2013	2045–2064	2081-2100	2045–2064	2081-2100
Single Days						
90° or hotter	17.9	33.7 (188%)	43 (240%)	49 (274%)	55 (307%)	81 (453%)
95° or hotter	2.9	8.8 (303%)	10 (344%)	12 (414%)	17 (586%)	38 (1,310%)
100° or hotter	0.1	0.6 (600%)	1 (1,000%)	1 (1,000%)	2 (2,000%)	10 (10,000%)

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Precipitation

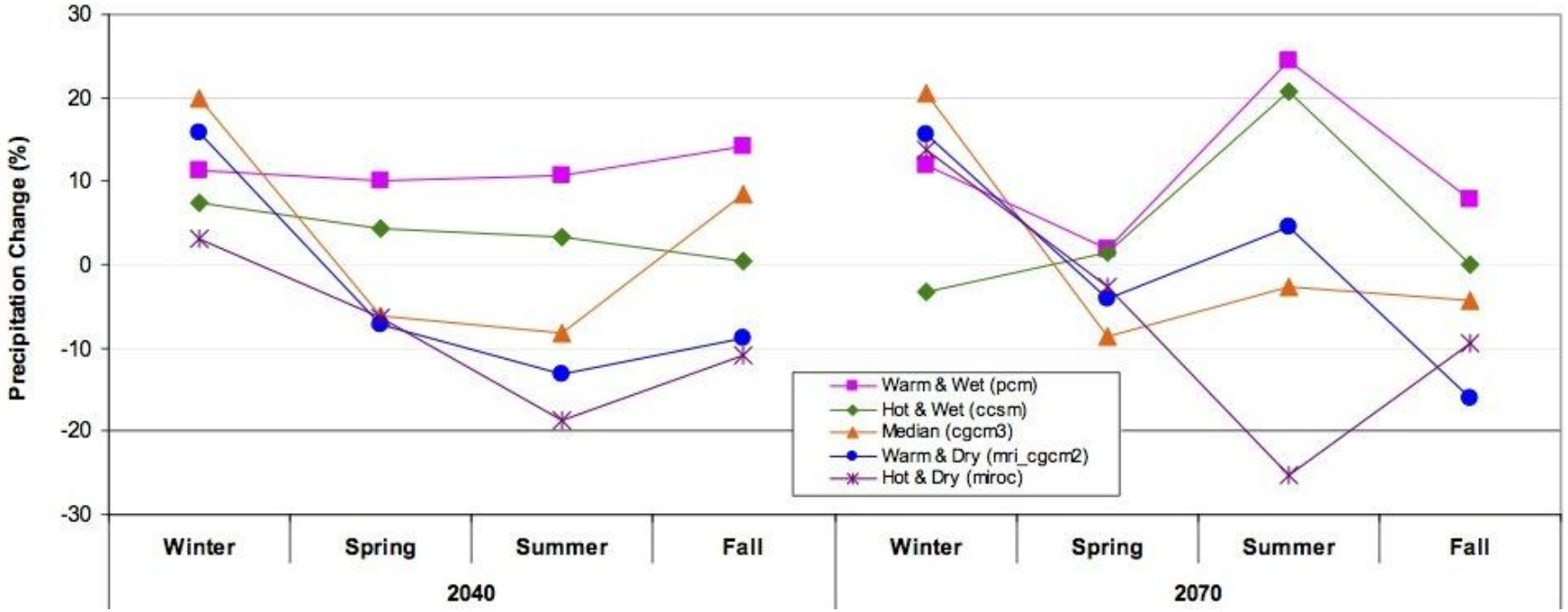

Figure 4. Average seasonal percent change in precipitation for the Front Range of Colorado, projected for mid-century (left; 2035-45) and late-century (right; 2065-75). From Joint Front Range Climate Change Vulnerability Study 2012. Water Research Foundation.

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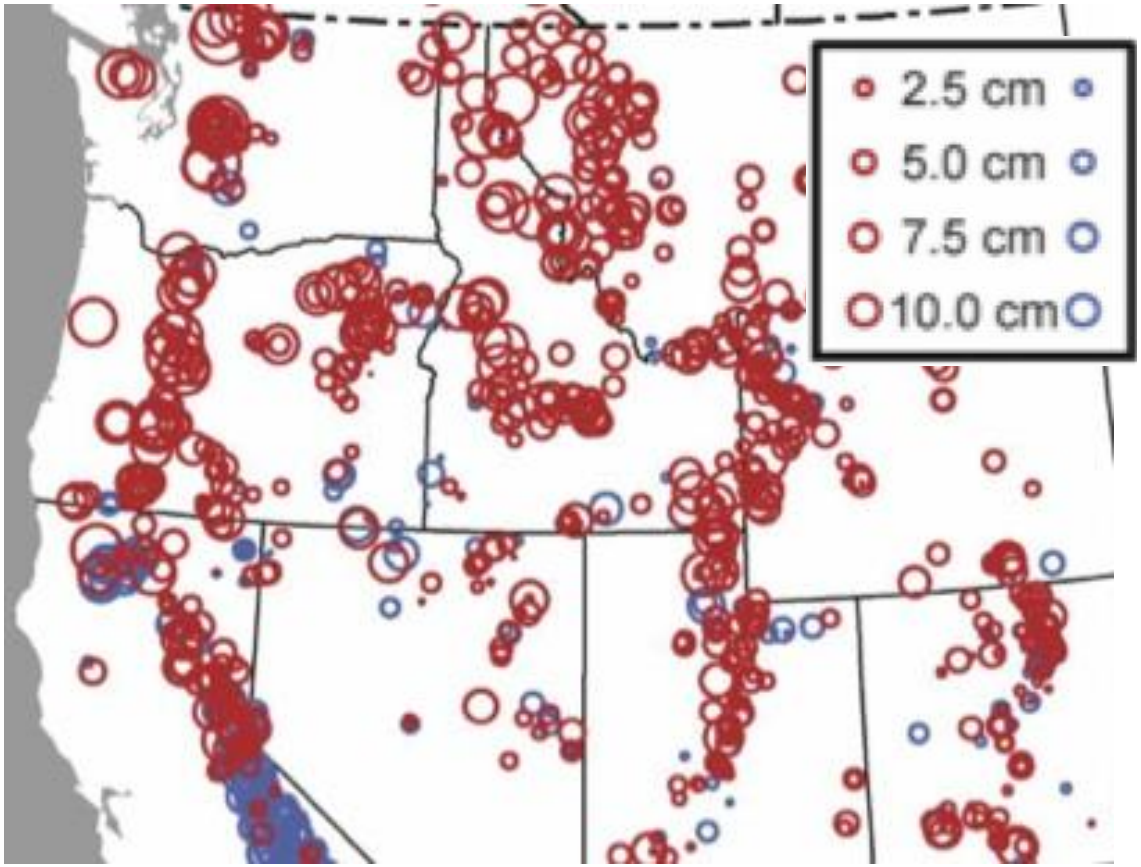
Snowpack



1 inch
2 inches
3 inches
4 inches

Figure 5. Increases (in blue) and decreases (in red) in April 1st snow-water equivalent (SWE) over the 1960–2002 period of record, adapted from Mote.[12]

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Hydrology

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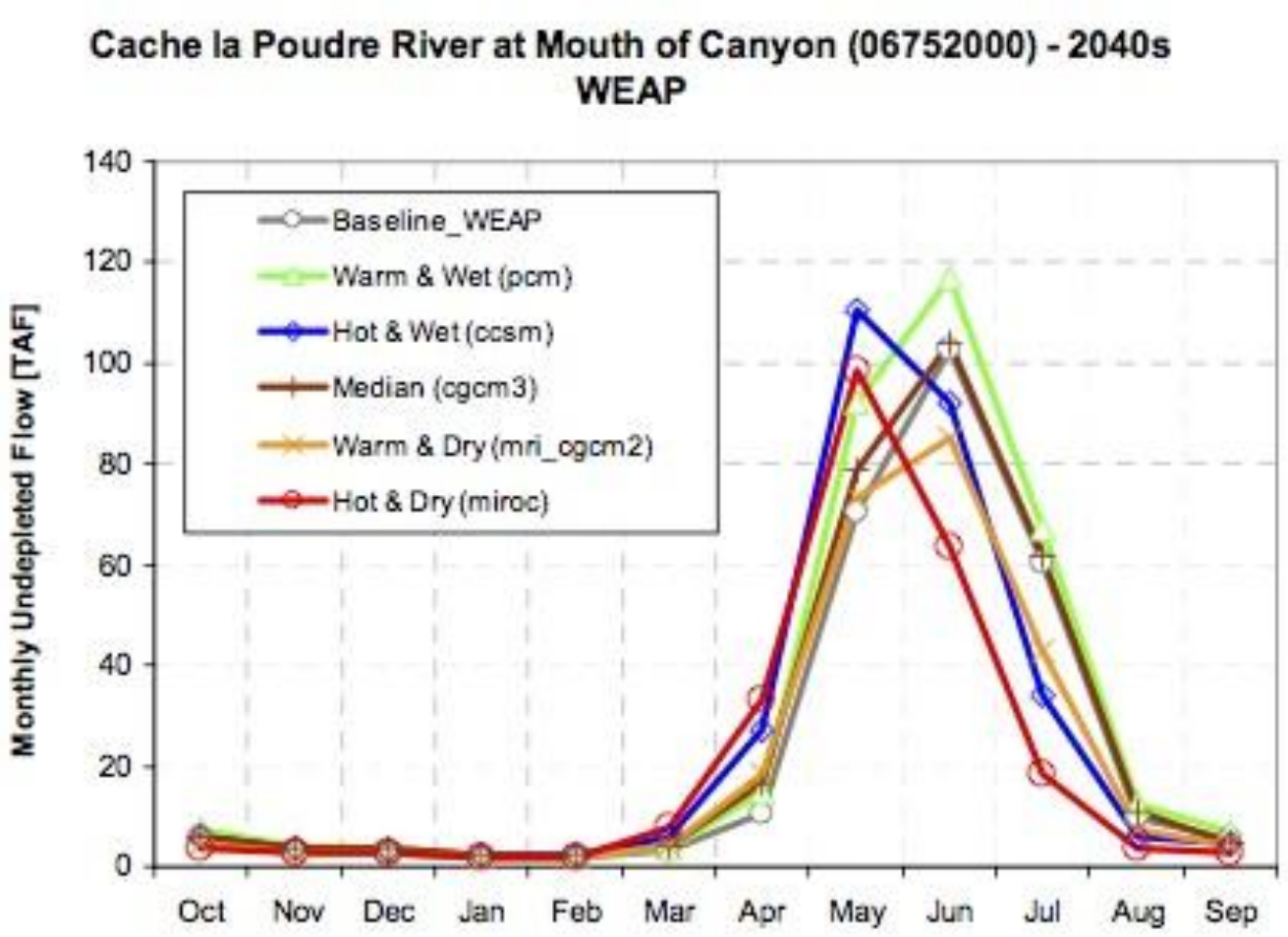
Hydrology



From Joint Front Range Climate Change Vulnerability Study 2012. Water Research Foundation

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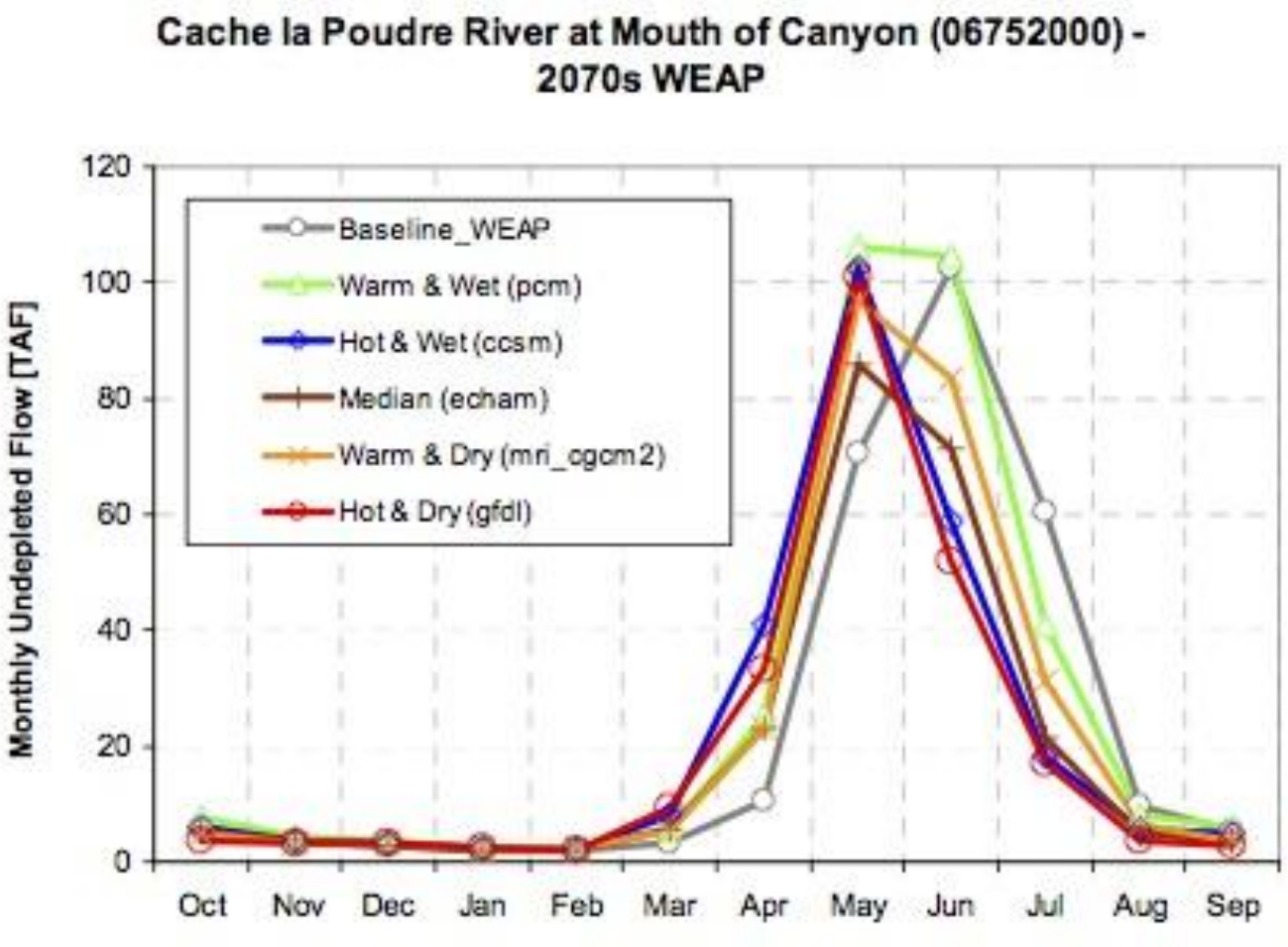
Hydrology



From Joint Front Range Climate Change Vulnerability Study 2012. Water Research Foundation

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Vegetation Type

Data Source: MC1 from USDA-FS MAPPS team

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Classification

- Tundra
- Subalpine Forest
- Temperate Evergreen Needleleaf Forest
- Temperate Deciduous Broadleaf Forest
- Temperate Cool Mixed Forest
- Temperate Evergreen Needleleaf Woodland
- Temperate Deciduous Broadleaf Woodland
- Temperate Cool Mixed Woodland
- Temperate Shrubland
- Temperate Grassland

0 20 mi
0 20 km
NORTH

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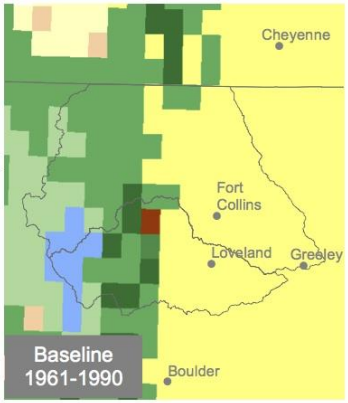

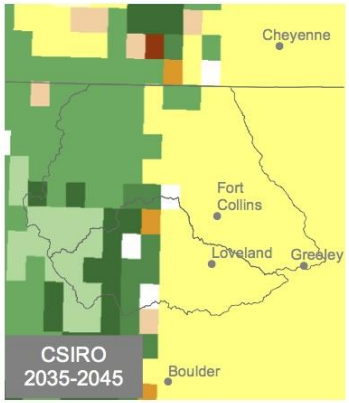

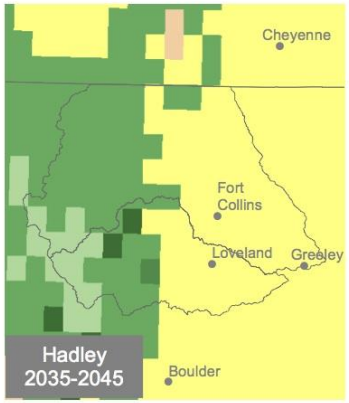

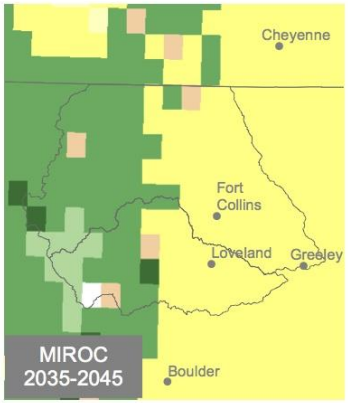

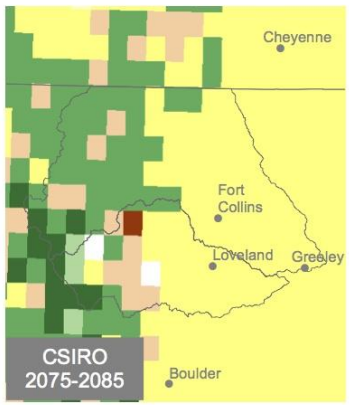

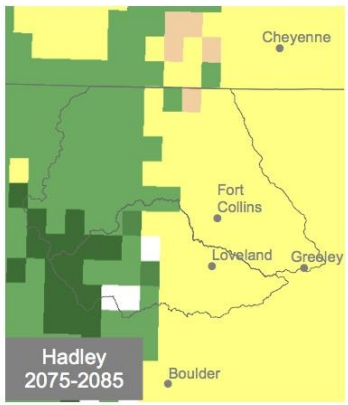

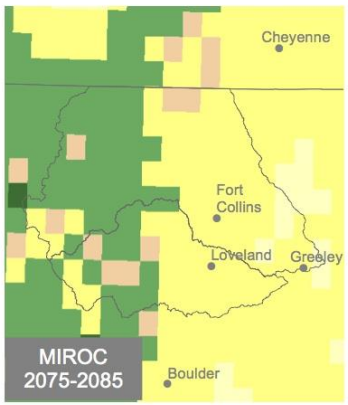

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Wildfire

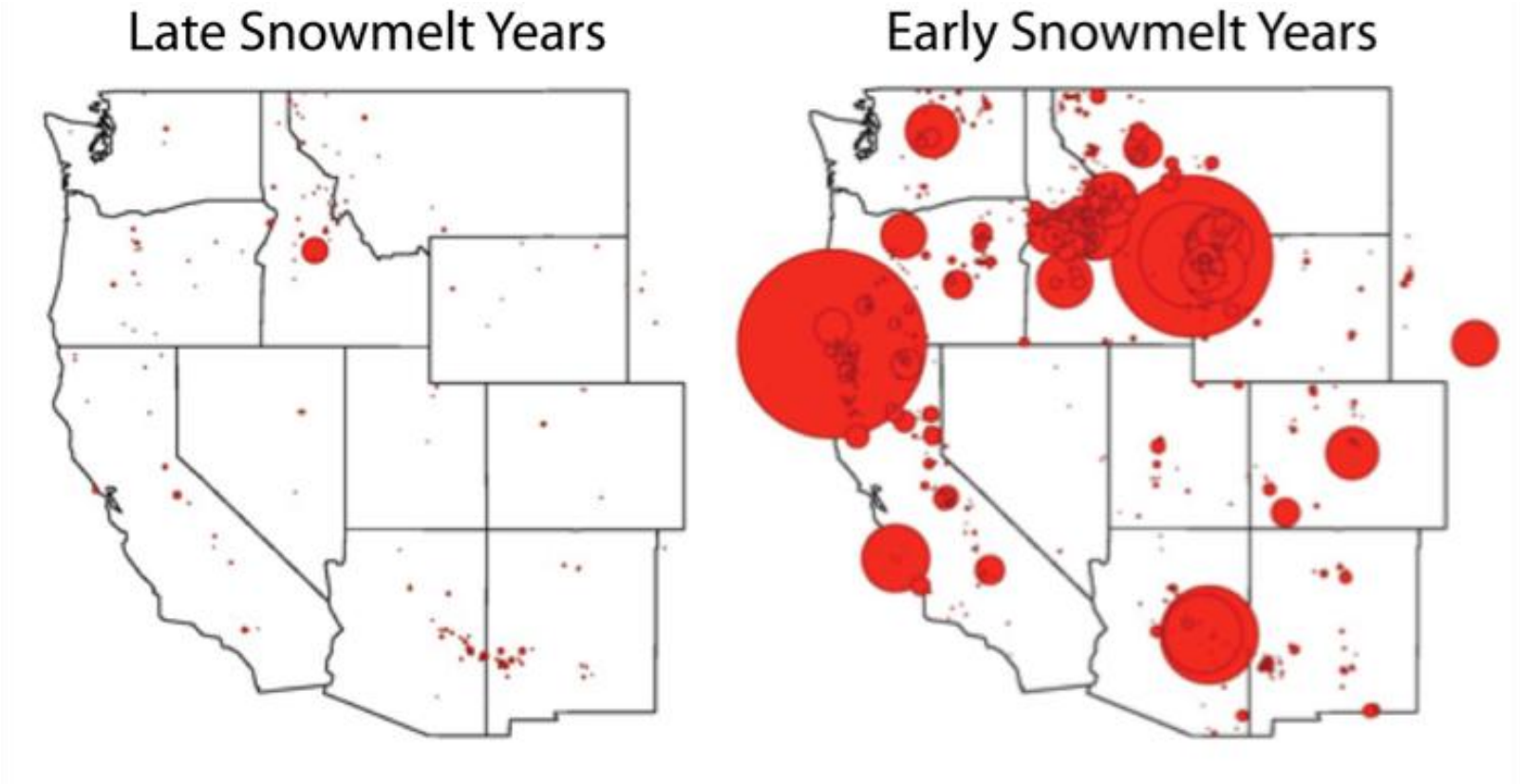

Figure 15. Forest Service, Park Service and Bureau of Indian Affairs large forest wildfires (>1000 acres) for years with early or late spring snowmelt, 1972 - 2003. From *Westerling et al 2006.*

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Biomass Consumed by Fire

Grams per Square Meter

- 0 - 5
- 6 - 10
- 11 - 25
- 26 - 50
- 51 - 75
- 76 - 100
- 101 - 150
- 151 - 200
- 201 - 300
- 301 - 472

Data Source: A2 emissions scenario downscaled by PNW Research Station, USDA Forest Service, following Flint and Flint (2012)

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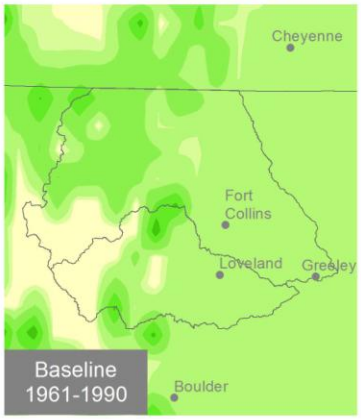
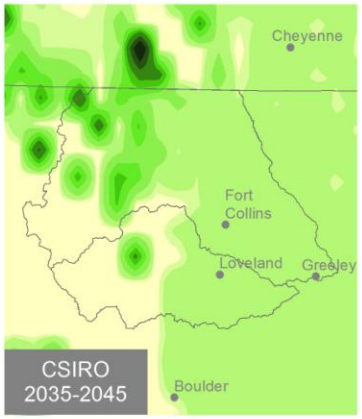
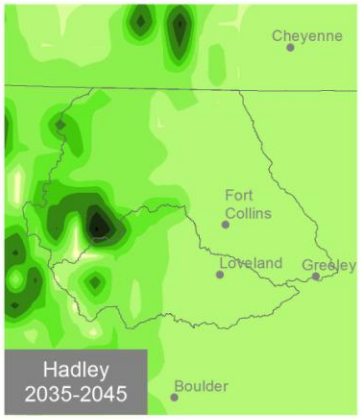
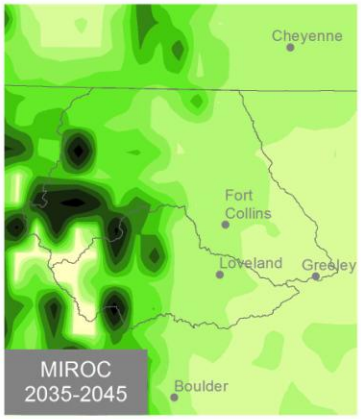
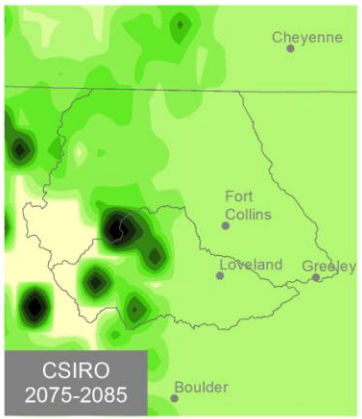
0 20 mi
0 20 km
NORTH

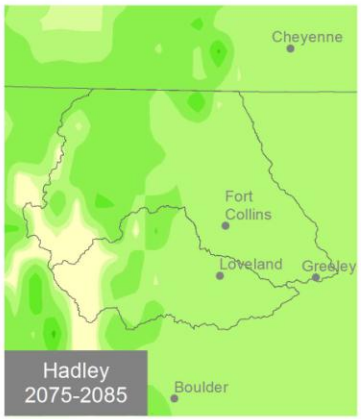


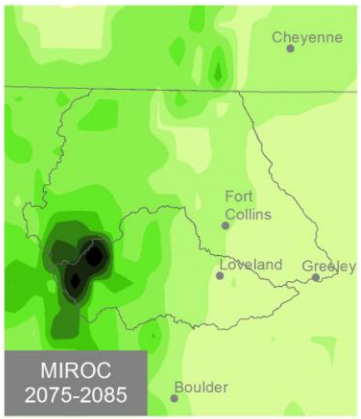












Model Info: Historic PRISM data (Gibson et al. 2002), HadleyCM3 (Met Office, Hadley Center, NCAS British Atmospheric Data Centre), MIROC 3.2 medres (Japan Agency for Marine-Earth Science and Technology, Atmosphere and Ocean Research Institute and National Institute for Environmental Studies)

Carbon Stored in Vegetation

Grams per Square Meter

- 0 - 2,000
- 2,001 - 4,000
- 4,001 - 6,000
- 6,001 - 8,000
- 8,001 - 10,000
- 10,001 - 12,000
- 12,001 - 14,000
- 14,001 - 16,000
- 16,001 - 18,000
- 18,001 - 20,000

Data Source: A2 emissions scenario downscaled by PNW Research Station, USDA Forest Service, following Flint and Flint (2012)

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0 20 mi
0 20 km
NORTH

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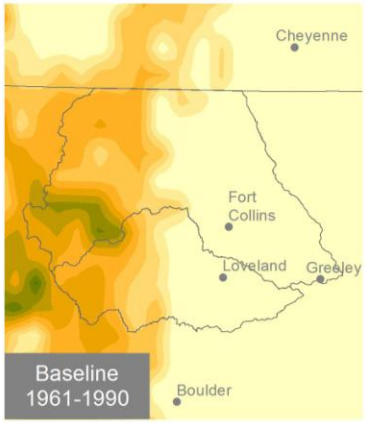

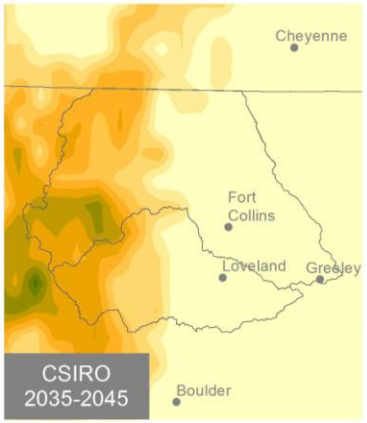

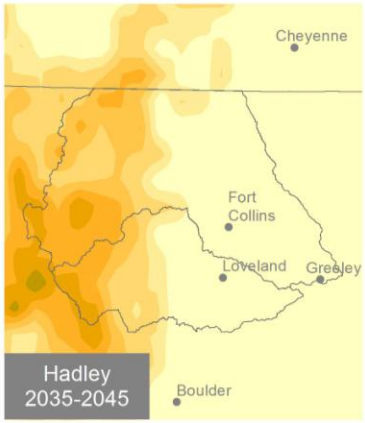

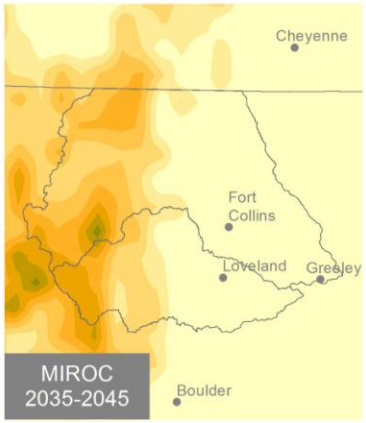

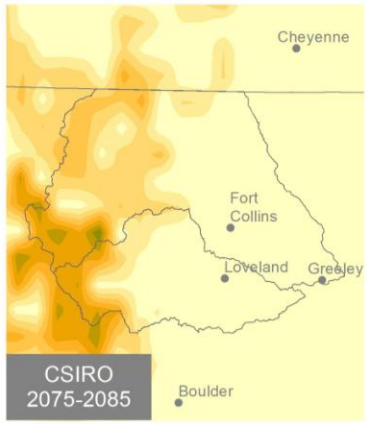

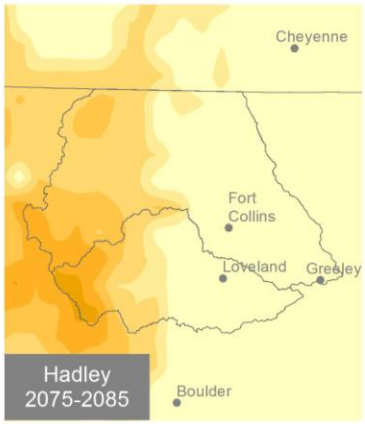

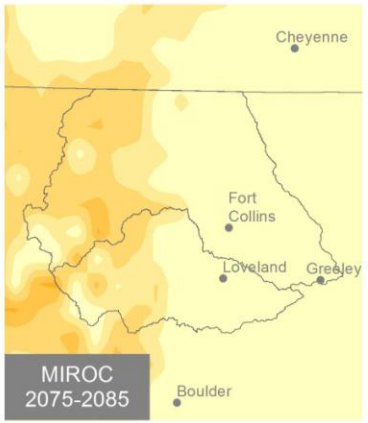

Model Info: Historic PRISM data (Gibson et al. 2002), HadleyCM3 (Met Office, Hadley Center, NCAS British Atmospheric Data Centre), MIROC 3.2 medres

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Ecological Change

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Human Health

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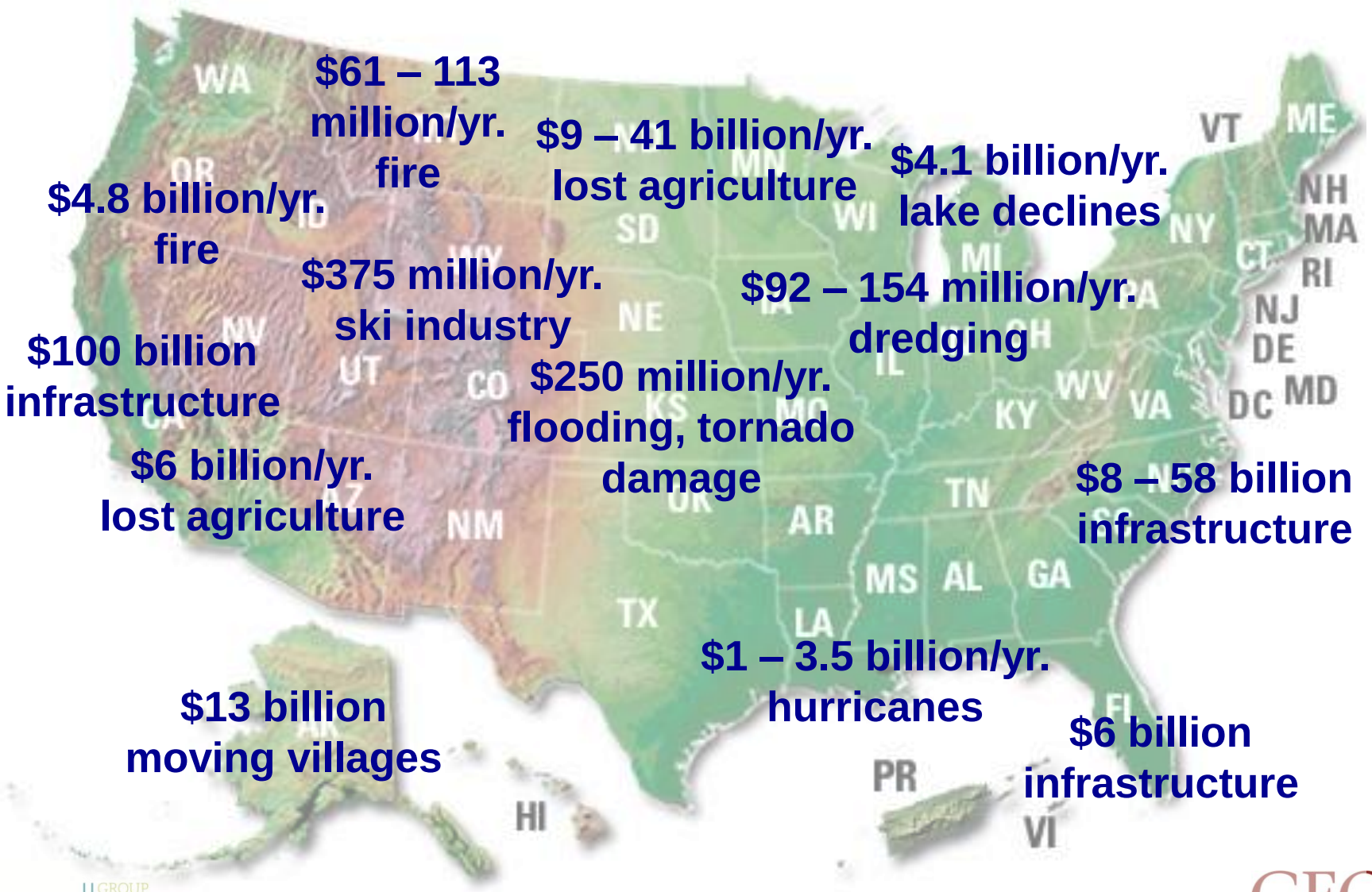
Economics



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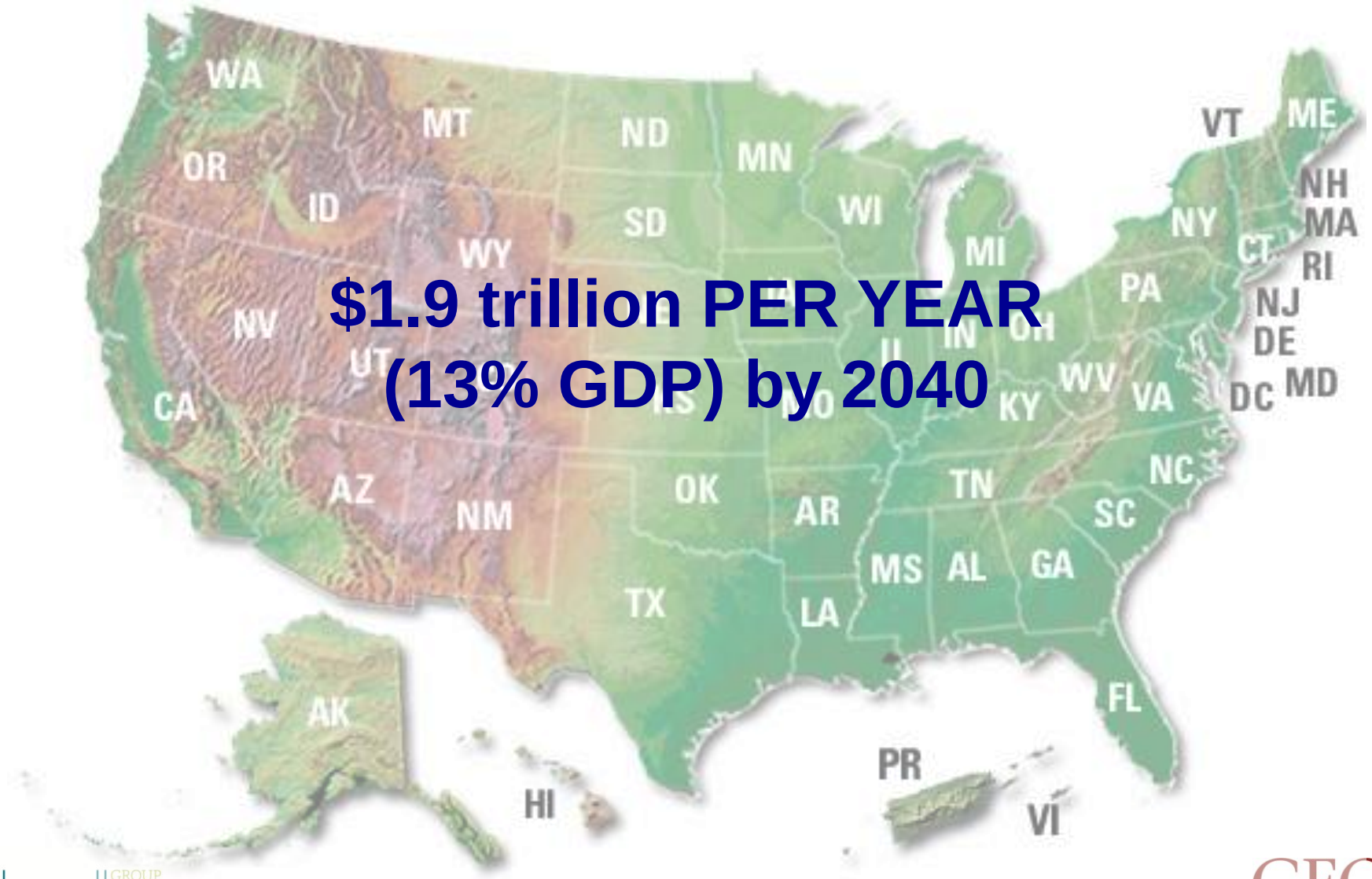
Economics



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Climate Change Response

More dams as snow pack declines

More ag land as production declines

More forest thinning with wildfire risk

Displacement from floods, fires, and storms

More energy development

More air conditioning

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We work to prepare communities in a coordinated, synergistic, and ecologically sound manner

Cultural Systems

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Mainstreaming

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Storytelling from Recent Events

- How was your department affected by High Park and/or the flood? The drought? Extreme heat events?
- What worked well?
- How can departments prepare for future events?

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Vulnerability Assessment Introduction

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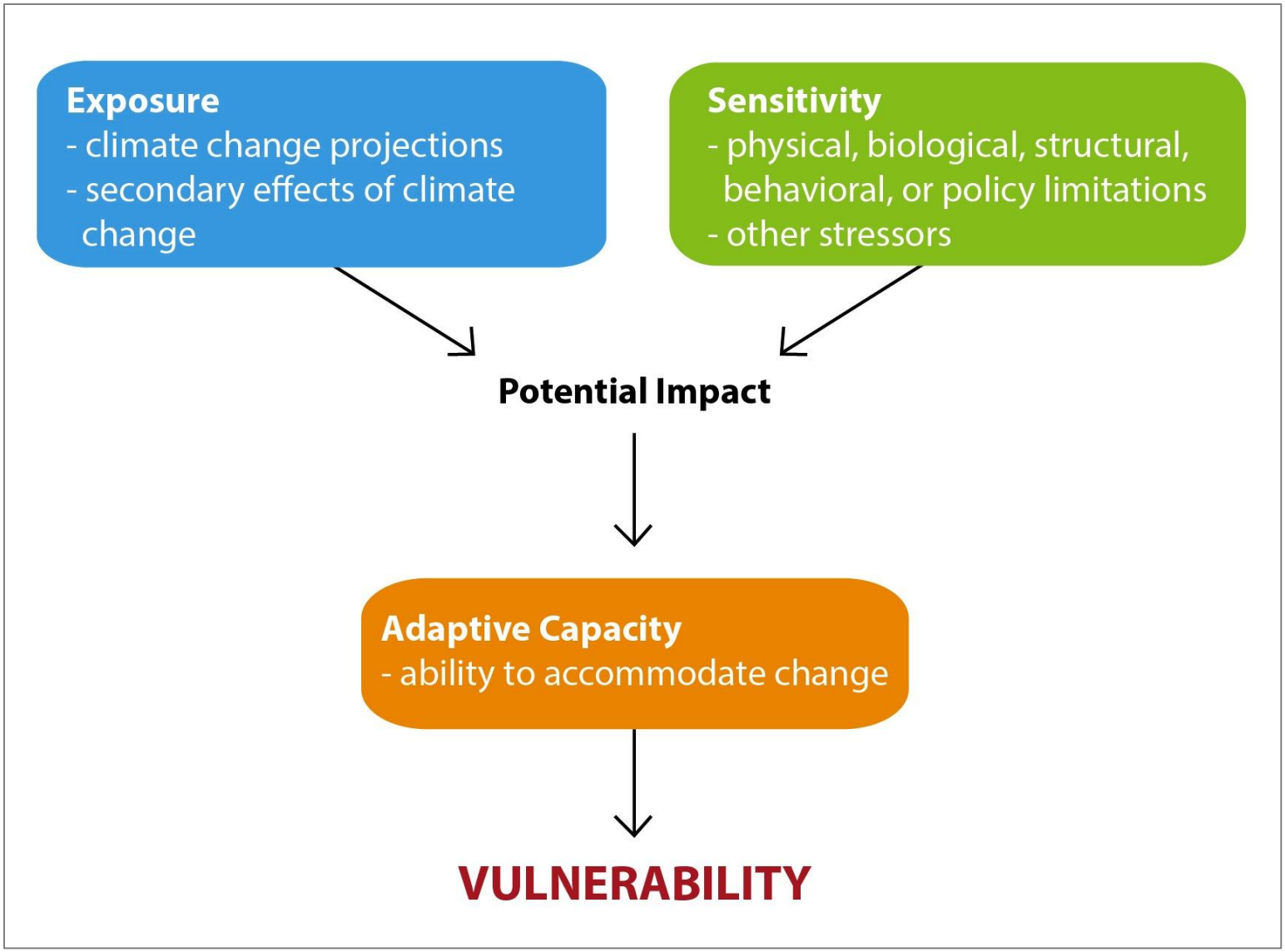

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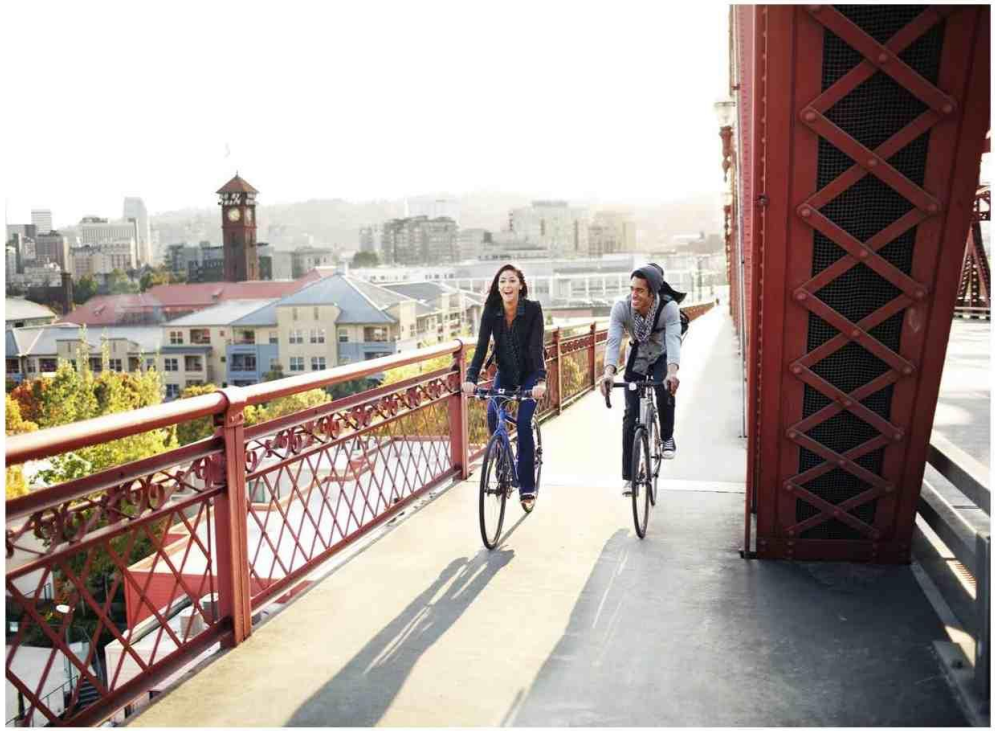
VULNERABILITY ASSESSMENT



A COMMUNITY WORKBOOK

Understanding the local risk of climate change

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Table 1. Results from City of Fort Collins Climate Change Adaptation Planning, presented in a vulnerability assessment format.

Target (resource, population, or service)	Exposure	Sensitivity	Adaptive Capacity
Water quantity for residents and businesses	Extended drought Higher evaporation and evapotranspiration leading to drier conditions, even if precipitation increases Lower snowpack – less storage, quicker runoff Lower summer stream flow	Current storage capacity limited and new storage is controversial. Demand expected to increase with c.c. Water rights may provide insufficient yields – use would be restricted. *Potential loss of business/revenue.*	Current reservoir storage can be increased. (?) New storage is expensive. Lack of diversity in supply increases vulnerability. Conservation measures allow some adaptive capacity.
Water quality for residents and businesses	Lower flows, extended drought Coupled with severe storms Flooding	Runoff following droughts or during floods will increase TOC and nutrients. *Potential loss of business/revenue.*	New treatment may be needed – currently not in place. Lack of diversity in supply limits adaptive capacity.
Wastewater return to the natural environment ("receiving")	Lower flows, extended drought Coupled with severe storms Earlier spring snow melt; rain-on-snow events Flooding Higher temperatures affect water chemistry.	Low flows and severe storms could increase pollutants. Effluent likely to not meet water quality standards. Higher and more frequent peak discharges could lead to facilities damage. *Maintenance/repair costs could increase. Public perception an issue.* Could challenge required limits for NPDES, but there is some room for change.	DWRF has more adaptive capacity then MWRF (can divert). Designed for 50-yr. to 100-yr. floods. Collection system has some areas of poor condition. Current system built based on historical standards – needs to be upgraded to provide level of protection that is expected. Conservation measures to retain flow allow some adaptive capacity.
Energy supply	Higher temperatures	Increased demand (in summer?) *Goal to reduce GHG emissions a consideration. Need to have low carbon sources.*	Additional resources needed to increase capacity. Conservation measures allow some adaptive capacity.

Table 2. Vulnerability assessment applied to Fort Collins Utilities climate change impacts and implications information (Note: this is an example, and is not based on expert input).

ADAPTIVE CAPACITY	SENSITIVITY: Low	SENSITIVITY: Med	SENSITIVITY: High
Low			Water quality
Med		Wastewater return	Water quantity
High			Energy supply

Red = highly vulnerable
Orange = med-high vulnerability
Yellow = medium vulnerability
Light green = med-low vulnerability
Dark green = low vulnerability

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Vulnerability Assessment Prioritization

Very high priority = High community **value** (cultural, social, economic), large magnitude of expected impacts, near-term and/or mid-term impacts.

High priority = High community **value**. Severe impacts, but timing may be many decades in the future or projections may be especially uncertain.

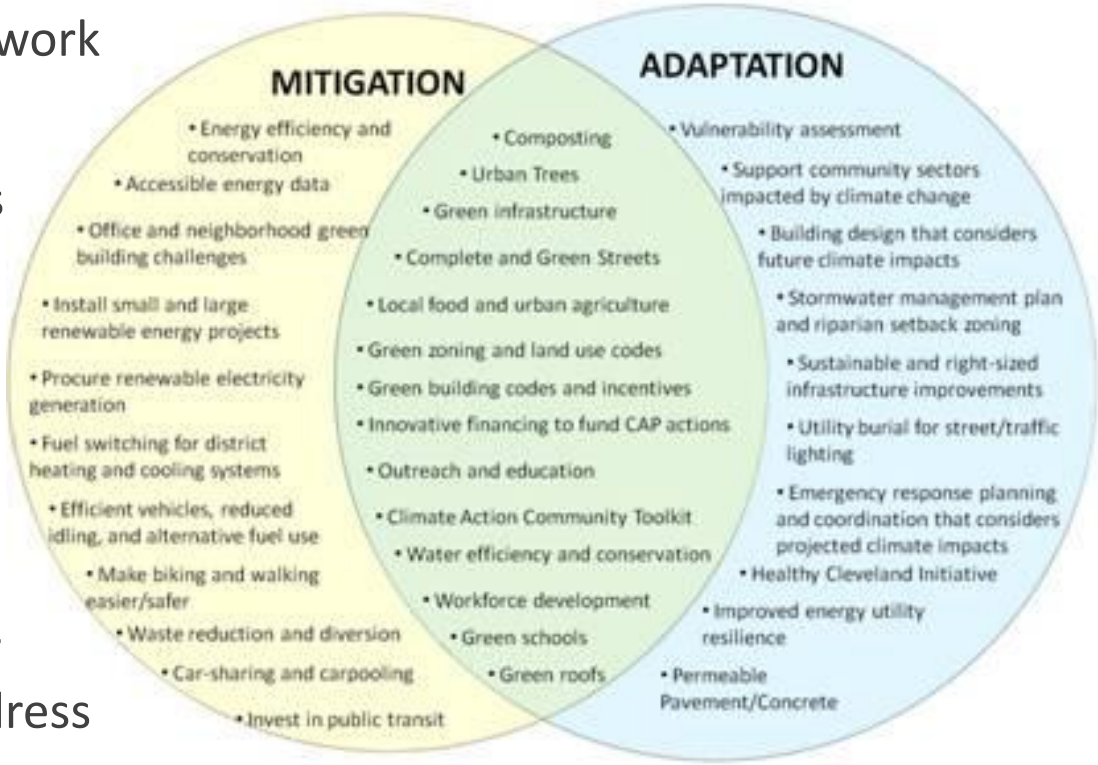
Medium priority = Very specific impacts with limited geographic scope. Medium community **value**.

BREAK

VULNERABILITY ASSESSMENT MATRIX AND RANKING

Translating to Action:
Strategic Planning and Directional Strategies

- How does adaptation planning fit into the current organization and decision making framework for your organization?
- What adjustments/changes need to made to integrate adaptation planning?
- How will the top ranked vulnerabilities impact your department?
- What ideas do you have for adaptation solutions to address these vulnerabilities?



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Translating to Action:
Adaptation Strategy Evaluation Criteria

- Estimated implementation cost
- Alignment with existing priorities
- Approximate timeframe required to implement action
- Level of effort required by staff to implement action
- Political feasibility as measured by the degree of political support for an action
- Technical feasibility
- Existing funding sources
- Co-benefits (climate mitigation, job creation, social equity)

Wrap-up and Next Steps

- December 6th – Key Vulnerabilities Identified
- December 10th – Preparedness Goals and Adaptation Solutions with Staff
  - Who should participate?
- December 31st (tentative) – Draft Adaptation Integration Framework
  - Aligning with other City efforts