



The Impact of Climate Change: Projected Adaptation Costs for Boulder County, Colorado

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RESILIENT
ANALYTICS



Task

What is the projected impact of climate change on Boulder County through 2050?

- An Initial Study of a Limited Number of Impact Areas
- Conservative Estimates for Planning and Risk Analysis



Task

Wildfire

Insect
Infestation

Drought

Human
Health

Urban
Drainage

Roads

Bridges

Buildings



Process

Multiple Climate Models

- RCP 4.5 and 8.5 Scenarios for each model
- Broad range to provide a risk perspective
- Equally likely to occur from our perspective



Established Science and Engineering Guidelines

- Peer-Reviewed Science
- Peer-Reviewed Research
- Material Studies



Boulder County Inventories

- Maps
- Data



Process

Compare Historic
Environment to
Projected
Environment



Determine Potential
Damages Using IPSS

- Based on typical design and maintenance guidelines

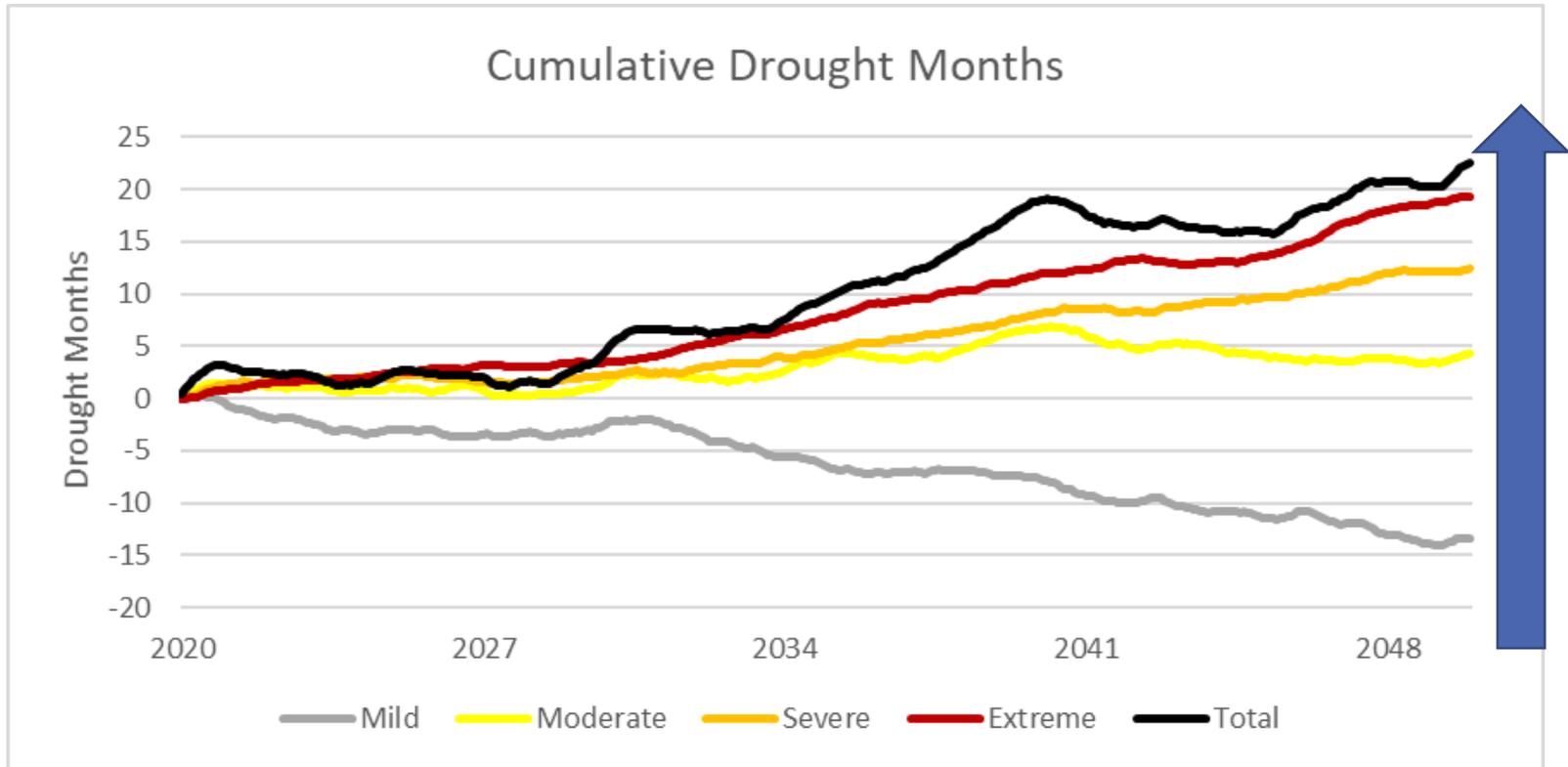


Calculate Costs

- Costs to Repair as Damage Occurs (Reactive)
- Cost to Adapt to Mitigate Damage (Proactive)



Drought

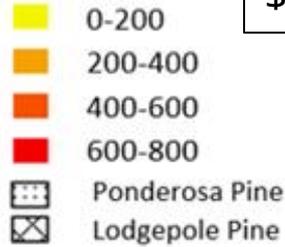
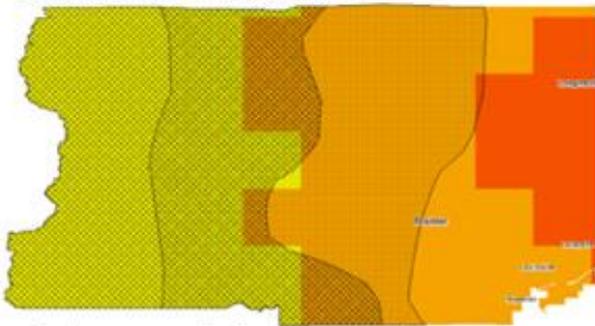




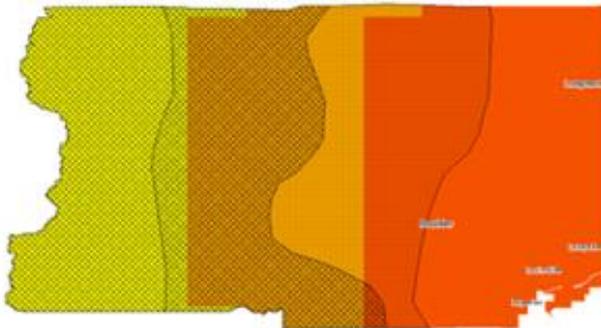
Wildfire

Projected Increase in Burned Acres:
7,000 Acres (RCP 4.5)
9,000 Acres (RCP 8.5)
\$1.5 Billion in Property at risk
\$20 million+ for household fire mitigation

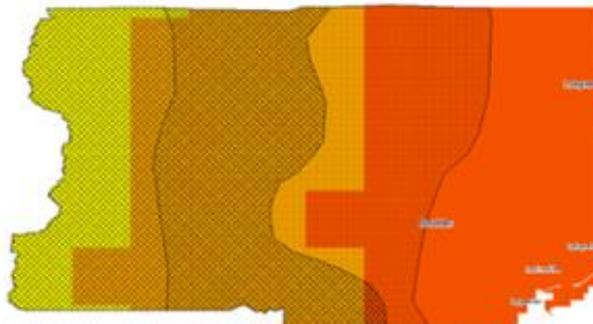
Historic Max Annual KBDI



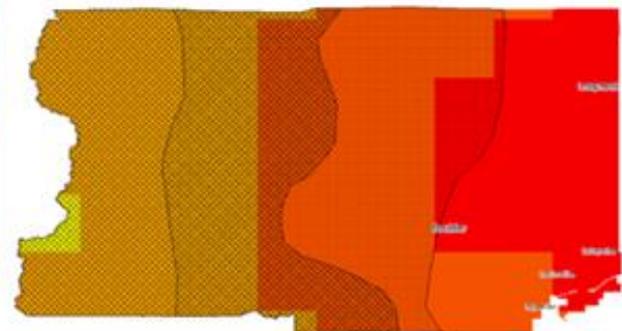
Minimum Model Max Annual KBDI



Median Model Max Annual KBDI

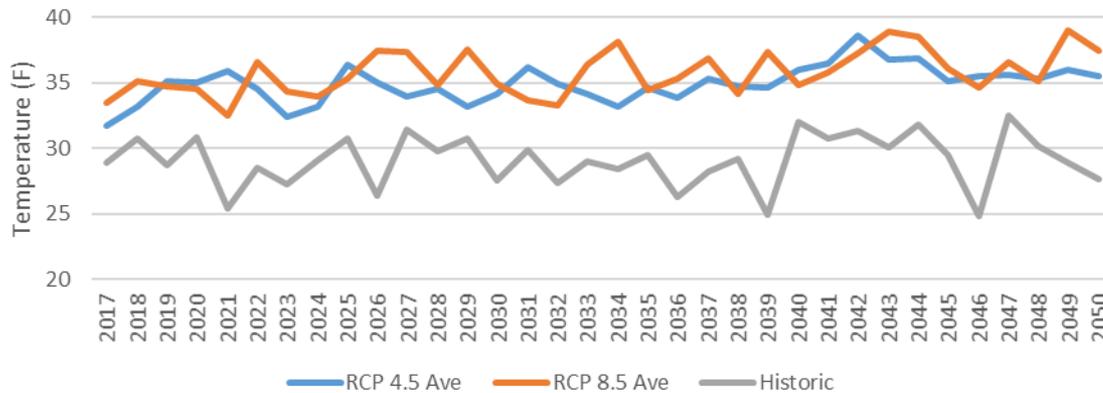


Maximum Model Max Annual KBDI

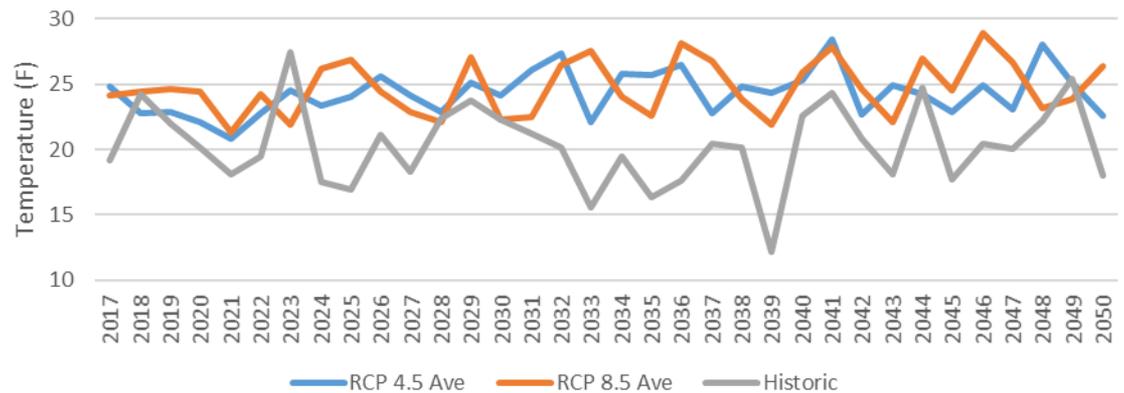


Insect Infestation

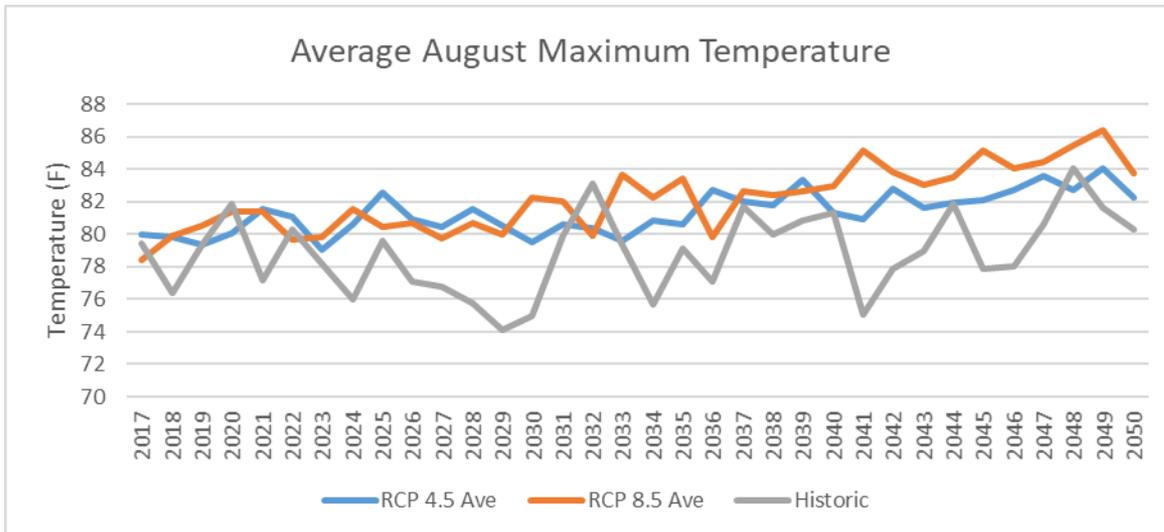
Average October Minimum Temperature



Average March Minimum Temperature



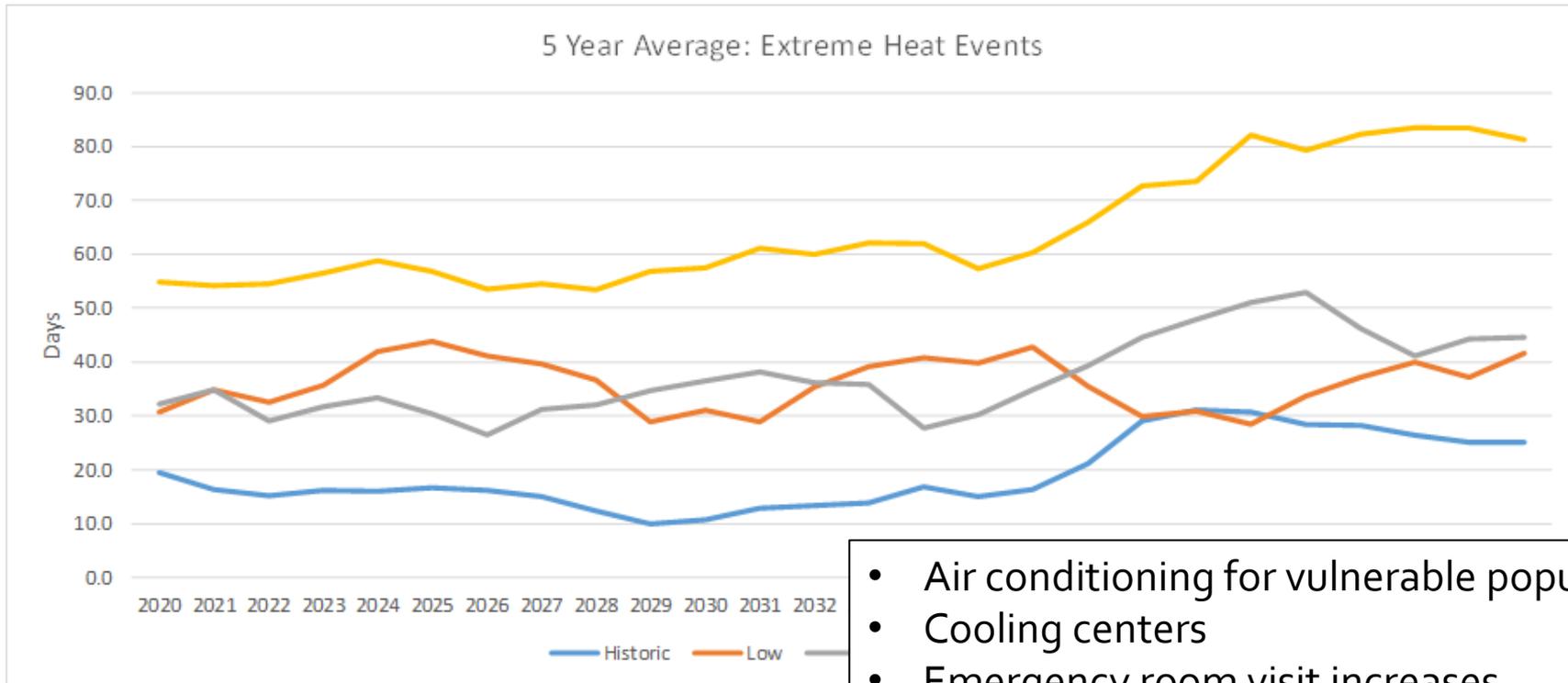
Insect Infestation



- Warmer winters reduce opportunity to prevent expansion of infestation
- Warmer summers increase impact
- Drought with temperature is strong indication for increased insect infestation



Human Health – Extreme Heat



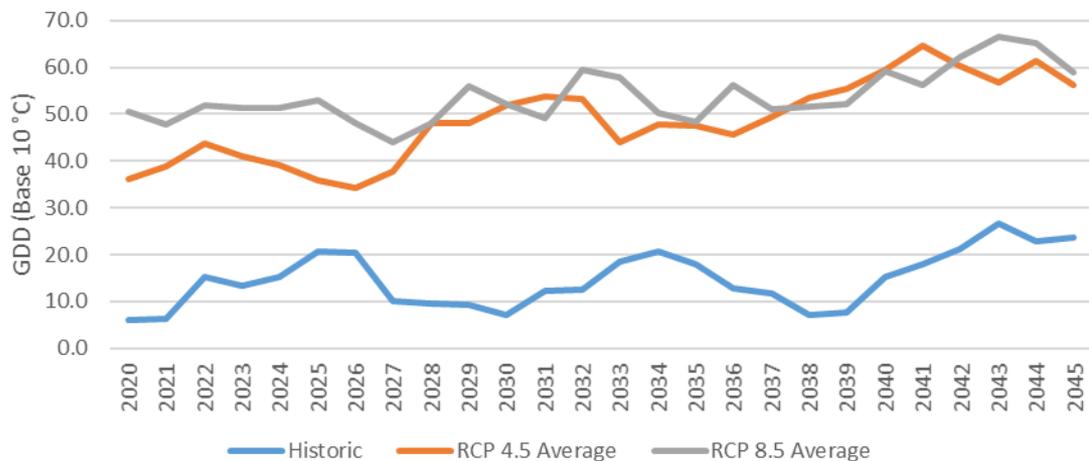
- Air conditioning for vulnerable populations
- Cooling centers
- Emergency room visit increases
- Public health campaigns

Extreme heat event is a day where the maximum temperature exceeds the 95th percentile of historic maximum temperatures. For Boulder County, this historic temperature level is defined in this study as 91 degrees.

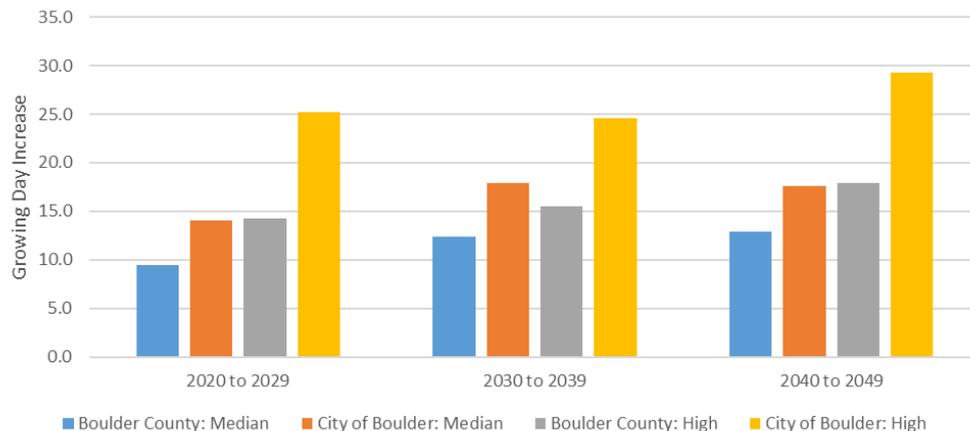
Centers for Disease Control and Prevention, “National Climate Assessment – Extreme Heat Events,” CDC WONDER, <https://wonder.cdc.gov/wonder/help/HeatWaveDays.html>

Human Health - Allergens

5 Year Average GDD: January to March



Increase in Growing Season



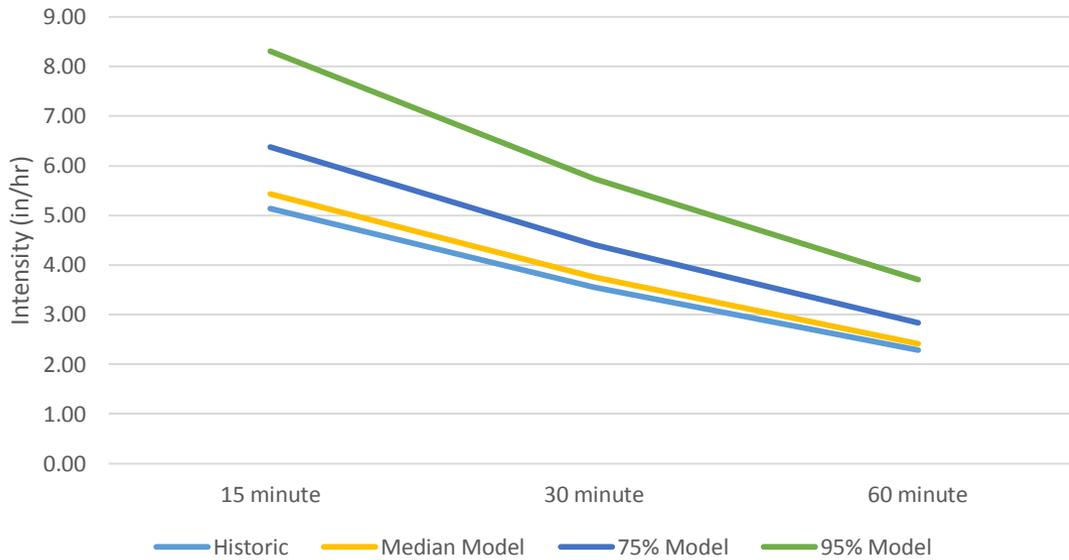


Human Health - Allergens

- Key allergens including Oak trees, Ragweed, and Maple trees will have an increased pollen generating season
- Increased impact on allergies and asthma
- Vulnerable populations have increased rate of contracting asthma according to medical research

Urban Drainage

Boulder County: 100-Year Event Rainfall Intensity Curve



	15 minute	30 minute	60 minute
5-Year Storm			
75th Percentile Model	15%	13%	13%
Median Model	6%	6%	7%
100-Year Storm			
75th Percentile Model	23%	24%	24%
Median Model	6%	6%	6%

City	Area (square miles)	Cost (thousands)
Boulder	25.23	\$ 5,218
Erie	4.92	\$ 1,017
Jamestown	0.57	\$ 118
Lafayette	8.87	\$ 1,833
Longmont	23.02	\$ 4,761
Louisville	8.93	\$ 1,846
Lyons	1.25	\$ 258
Nederland	1.52	\$ 314
Superior	3.72	\$ 768
Ward	0.53	\$ 109
Total	78.61	\$ 16,256

Potential Costs Based on EPA Estimates



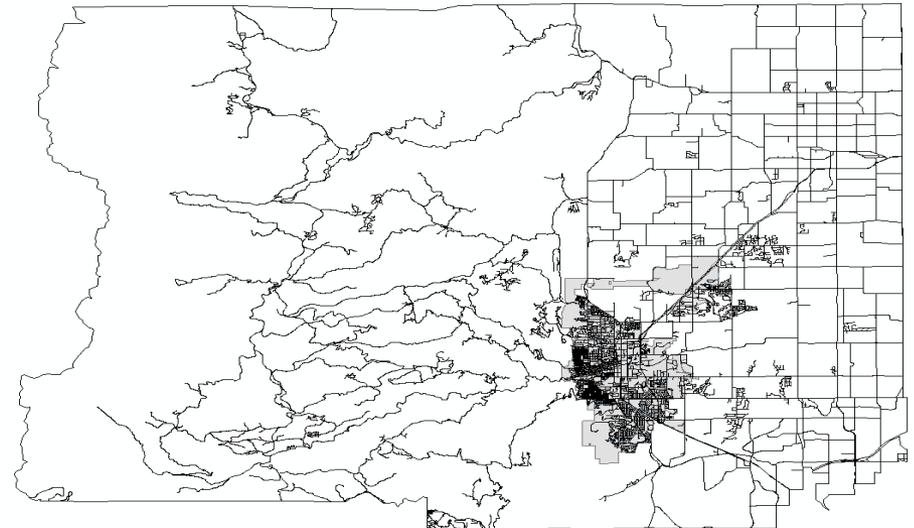
Roads

	Primary	Secondary	Tertiary	Total
Paved	40.4	512.0	531.3	1,083.7
Gravel	0.0	47.6	288.9	336.5

Boulder County

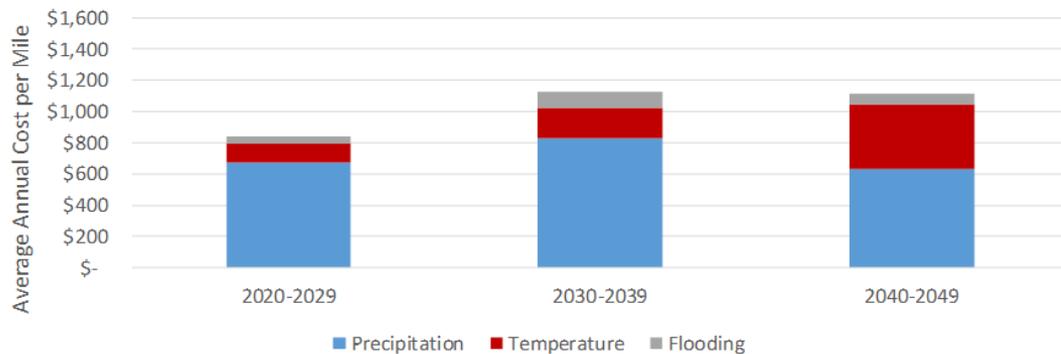
	Primary	Secondary	Tertiary	Total
Paved	0.0	39.5	255.1	294.6
Gravel	0.0	0.0	0.0	0.0

City of Boulder



Roads

Reactive Cost Profiles by Stressor for Mean Impact Climate Scenario - Boulder County

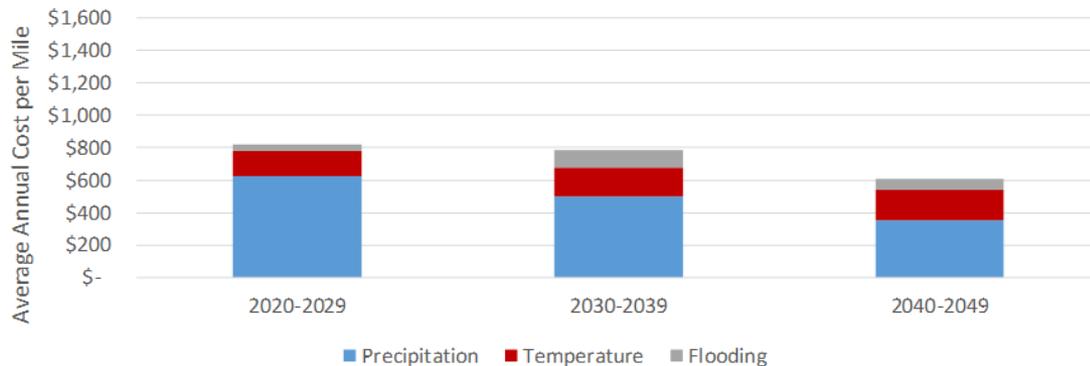


Boulder County Historic: \$650

City of Boulder Historic: \$720

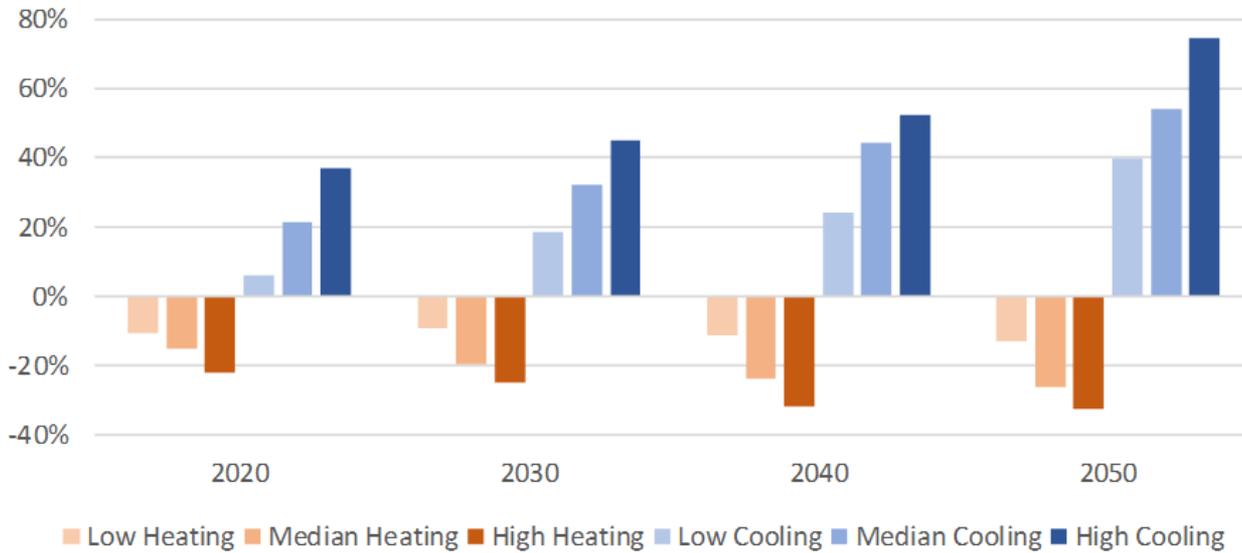
Boulder County Savings from Adaptation:
\$600 per mile/per year

Proactive Cost Profiles by Stressor for Mean Impact Climate Scenario - Boulder County

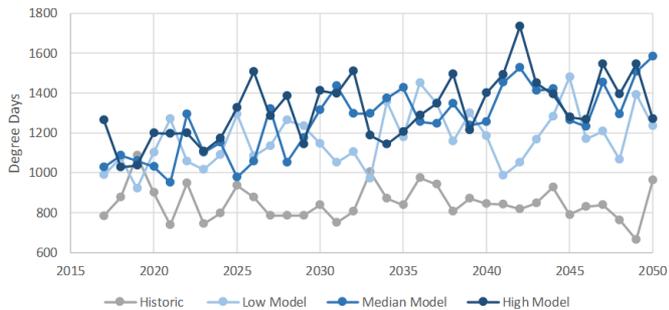


Buildings

Decadal Change in Heating and Cooling Costs



Average Annual Cooling Degree Days: 2017 to 2050





Timeline

- **2020-2030**
 - Reduce wildfire threats, reduce human health concerns, and address buildings that require increased cooling capacity.
 - Design guidelines for new construction should be modified to consider changing temperature conditions.
- **2030-2040**
 - Notable increase in temperatures as well as increases in short-term precipitation event intensity.
 - Attention to human health concerns, wildfire mitigation, road maintenance and design changes, urban drainage adaptation, and mountain pine beetle mitigation.
- **2040-2050**
 - The full impact of projected climate impacts. All sectors will be experiencing the effects of climate impacts.



Summary

The estimated total cost of adaptation for mitigating some of the potential effects of climate change in Boulder County through 2050 for the areas looked into is conservatively estimated at:

- \$96 million to \$157 million for the median and high impact scenarios with the City of Boulder incurring \$16 million to \$36 million of these adaptation costs.
- Increased demand for cooling in buildings will add another \$3.1 million to \$4.5 million in direct costs per year.
- Urban drainage improvements could increase this cost by an additional \$16.2 million depending on county versus incorporated city responsibilities.

This cost includes road adaptation, wildfire mitigation for houses, bridge adaptation, and cooling center costs for extreme heat events.



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