



# Climate Impacts in Larimer County

## Summary Statement

Larimer County is creating a Climate Smart and Future Ready Plan to proactively address the risks from worsening air quality, extreme heat, prolonged droughts, and natural disasters and assist our community in mitigating and adapting to the social equity and economic impacts resulting from climate change. This memo is a high-level overview of the anticipated climate impacts in Larimer County and their implications.

## Climate Background

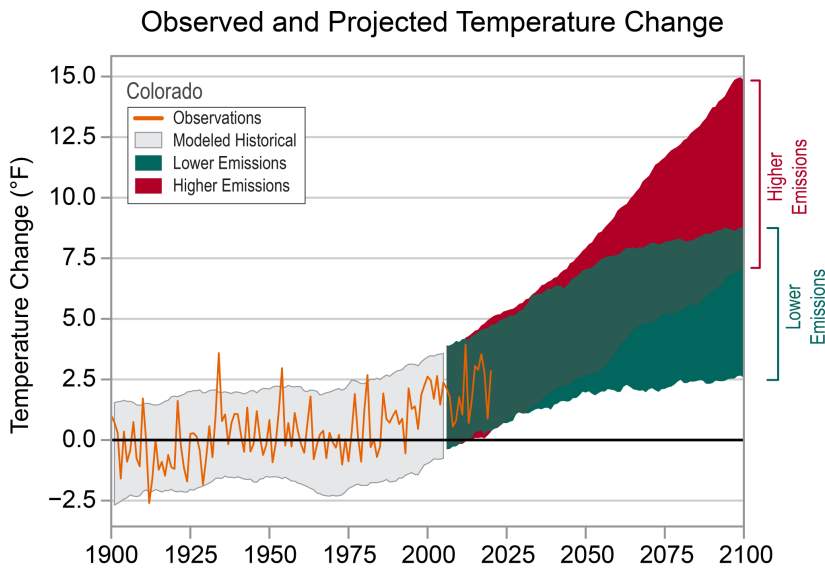
### Colorado

Colorado is home to a diverse array of landscapes, from the Eastern Plains to the Rocky Mountains to the Colorado Plateau. The high elevation, sun exposure, and orientation of the mountain ranges heavily influence the climatic character of each area. One county can contain several microclimates depending on geomorphology. On average, Colorado has seen a 2.5°F rise in average temperatures since 2000 (Figure 1) and temperatures have remained consistently higher than the long-term (1895–2000) average since 1998.<sup>1</sup> The trend is expected to continue as six of the eight warmest years on record have happened since 2012 and the number of very hot days (95°F or above) has been above average since 2000. This is reflected in Figure 1,<sup>2</sup> which models two possible futures for Colorado: one where greenhouse gases continue to rise rapidly and one where they increase at a slower rate. In the low emissions scenario, less warming is expected; the coldest warming projection is about 2°F warmer than the historical average. In the higher emissions scenario, more warming is expected; the hottest projection is about 11°F warmer than the hottest year in the historical record.

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<sup>1</sup> Kunkel, K. R. F. J. R. S. C. L. S. D. E. B. S. a. M. a. C. L. (2022). *State Climate Summaries for the United States 2022*. NOAA Technical Report NESDIS 150. <https://statesummaries.ncics.org/chapter/co/>

<sup>2</sup> Kunkel, K. R. F. J. R. S. C. L. S. D. E. B. S. a. M. a. C. L. (2022). *State Climate Summaries for the United States 2022*. NOAA Technical Report NESDIS 150. <https://statesummaries.ncics.org/chapter/co/>



**Figure 1. Observed and projected changes (compared to 1901-1960 average) in near-surface air temperature for Colorado.**

### Larimer County

Larimer County’s diverse landscape includes Rocky Mountain National Park, Arapaho & Roosevelt National Forests, the foothills, and the transition to the Eastern Plains. Much like the state, the county’s climate varies depending on the location. Figures 2 and 3 below<sup>3</sup> show how Larimer County has seen a warming trend over time and has seen average annual temperatures consistently above the 100-year average since 1990. Annual variability in precipitation from the 100-year average is following a different trend, one that is trickier to predict (Figure 2). Since the mid-1990s Larimer County has only experienced positive temperature anomalies, meaning that the observed annual temperature was greater than the baseline temperature (Figure 3). Growing uncertainty in precipitation totals leaves residents, especially our county’s farmers and ranchers, vulnerable to drought impacts, water restrictions, and flooding impacts. Increased temperatures place Larimer County at additional risk for droughts, wildfires, and extreme heat days.

Increased temperature and precipitation unpredictability place Larimer County at risk of

#### Primary Risks

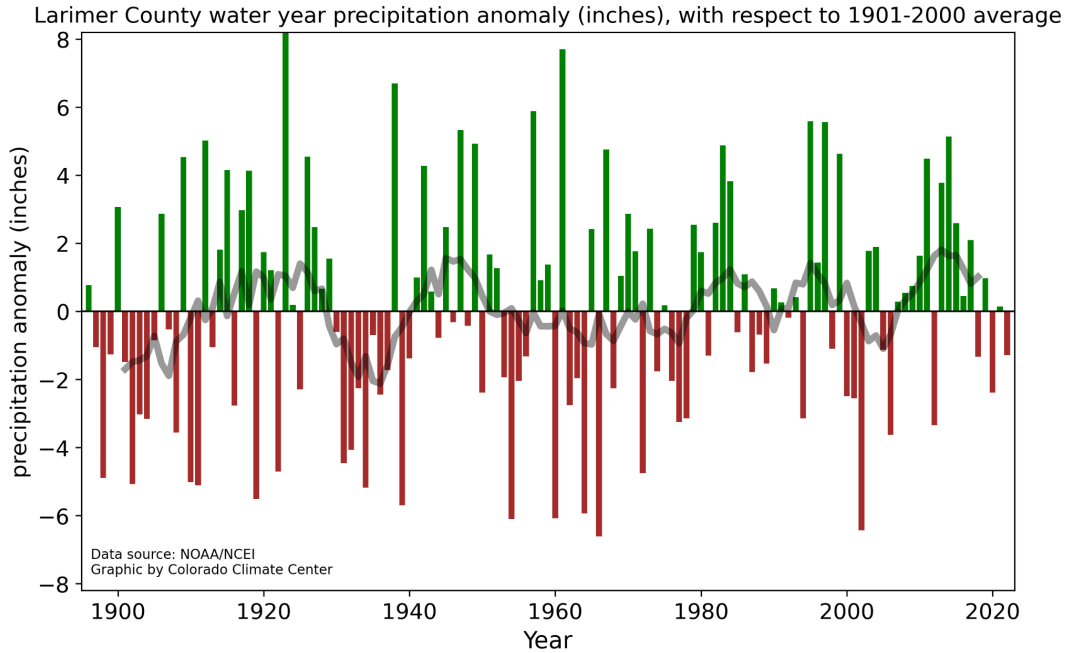
- Wildfires
- Flash floods
- Winter storms

#### Other Risks

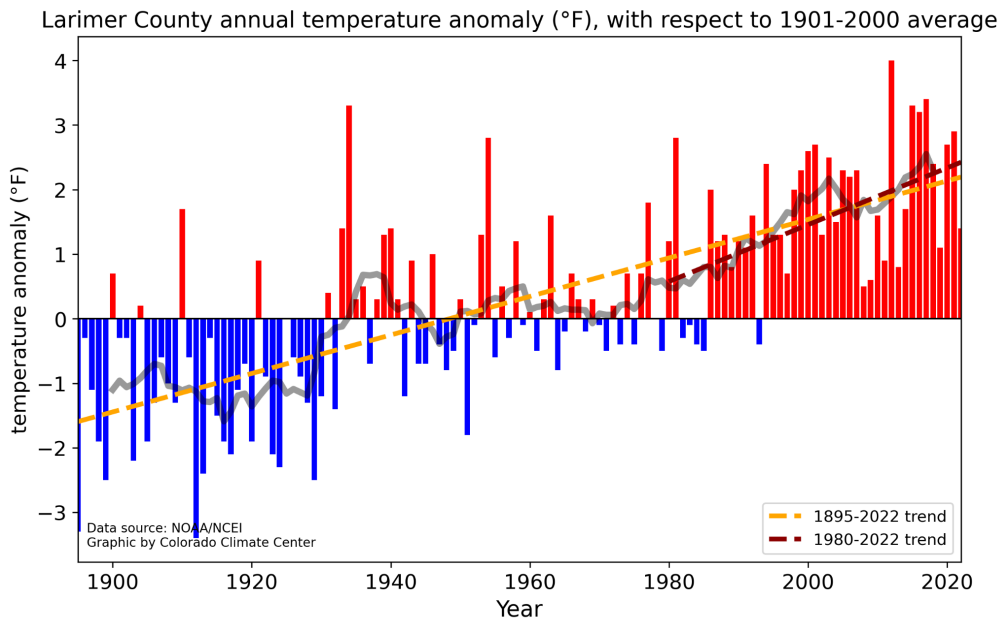
- Hail storms
- Tornadoes

<sup>3</sup> Kunkel, K. R. F. J. R. S. C. L. S. D. E. B. S. a. M. a. C. L. (2022). *State Climate Summaries for the United States 2022*. NOAA Technical Report NESDIS 150. <https://statesummaries.ncics.org/chapter/co/>

**Figure 2. Larimer County annual variability in precipitation.**

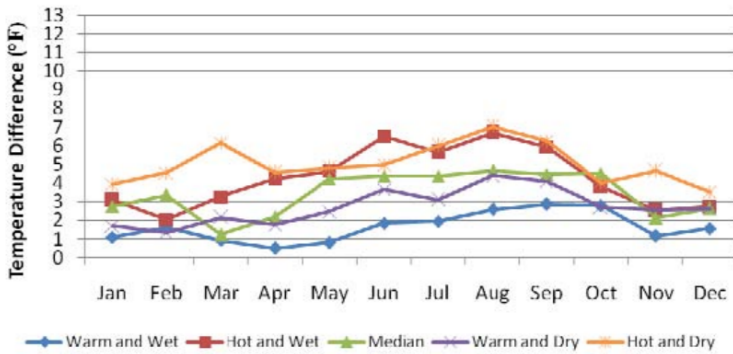


**Figure 3. Larimer County annual variability in temperature.**

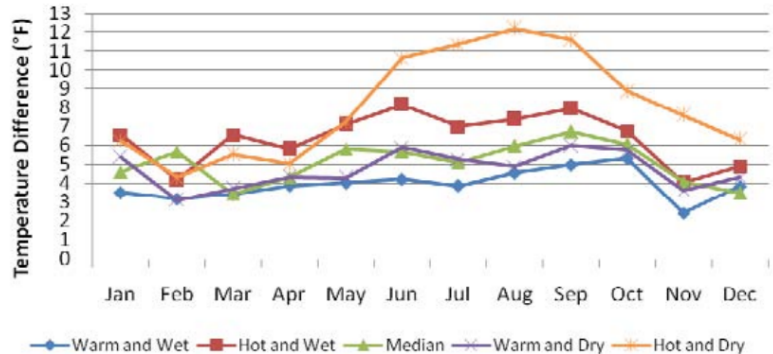


Figures 4 and 5 show the predicted average temperature by change for the Fort Collins area. These projections, from a study released by The Water Research Foundation,<sup>4</sup> further show the expected continued increase in average temperatures and precipitation.

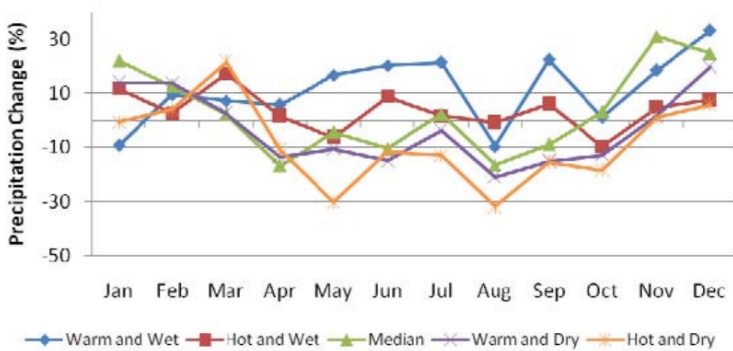
**Temperature Change Patterns, 2040**



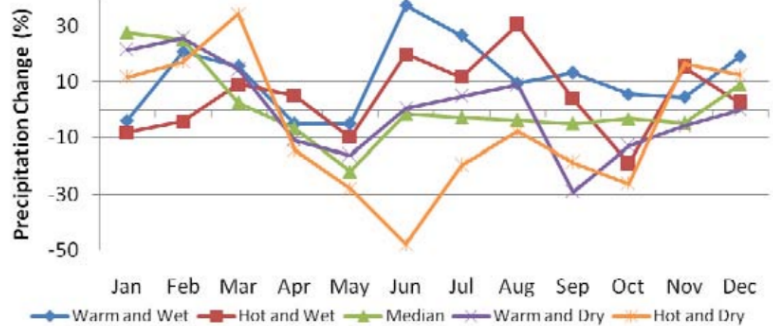
**Temperature Change Patterns, 2070**



**Precipitation Change Patterns, 2040**



**Precipitation Change Patterns - 2070**



**Figure 4. Monthly change patterns for temperature and precipitation, 1950-1999 versus 2025-2054 (2040)**

**Figure 5. Monthly change patterns for temperature and precipitation, 1950-1999 versus 2055-2084 (2070)**

It is important to note that having naturally occurring wet years does not result in significant changes in areas affected by drought. NASA explains: “Current climate models indicate that rising temperatures will intensify the Earth’s water cycle, increasing evaporation. Increased evaporation will result in more frequent and intense storms, but will also contribute to drying over some land areas. As a result, storm-affected areas are likely to experience increases in precipitation and increased risk of flooding, while areas located far away from storm tracks are likely to experience less

<sup>4</sup> Joint Front Range Climate Change Vulnerability Study. (2012). The Water Research Foundation. <https://dnrweblink.state.co.us/CWCB/0/edoc/157704/Joint%20Front%20Range%20Climate%20Change%20Vulnerability%20Study.pdf>

precipitation and increased risk of drought.”<sup>5</sup> When Larimer County experiences higher precipitation, the increased evaporative demand will result in water not going as far.

In a 2019 modeling study, NOAA suggests that feedback loops will amplify heat waves during droughts.<sup>6</sup> NOAA built these models by looking at the effects of low soil moisture and high temperatures that have been caused by heat waves from an underlying drought. The results showed that in the southwest especially, cooling by evapotranspiration is more severely reduced during droughts in today’s climate. This results in a continuous rise in temperatures which further escalates the impacts of a warmer climate (e.g., surface warming, hotter heat waves, etc.). These results did not take into account warming due to climate change. The study shows that if the current temperature trend continues and is factored into these results, a compound heat wave-drought in the 21st century could end up being between 7.2 and 9.9 degrees F hotter than a similar drought in 1850.<sup>7</sup>

Additional risks can be found at the [Colorado Resiliency Office website](#).

## Economic Impacts

Climate change also threatens taxpayer-funded programs, as costs may increase to cover the response to these increasingly frequent severe weather events. According to the National Institute of Building Sciences,<sup>8</sup> natural hazard mitigation saves \$6 on average for every \$1 spent on federal mitigation grants. Spending the money preparing for these events saves the government and taxpayers money and helps create more resilient communities that can bounce back better and quicker after disasters.

How groups experience climate impacts depends on the climate scenario, population scenario, and region. Agriculture (cattle and crops) faces the highest amount of damage costs from droughts, ranging from \$10M to \$97M, depending on the population scenario. Given that Larimer County is one of the top 10 agricultural counties in Colorado, this would result in high economic damage to the local economy as feed costs would increase and crop production would decrease. Infrastructure (bridges and buildings) faces the highest amount of damage costs from floods and wildfires, ranging from \$51M to \$290M, depending on the population scenario. Larimer County’s proximity to

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<sup>5</sup> NASA. (n.d.). *How does climate change affect precipitation?* NASA. Retrieved April 21, 2023, from <https://gpm.nasa.gov/resources/faq/how-does-climate-change-affect-precipitation>

<sup>6</sup> Stein, T. (2019, July 15). Climate change to make hot droughts hotter in the US southern plains. NOAA Research. <https://research.noaa.gov/article/ArtMID/587/ArticleID/2472/Climate-change-to-make-hot-droughts-hotter-in-the-US-southern-plains>

<sup>7</sup> Stein, T. (2019, July 15). Climate change to make hot droughts hotter in the US southern plains. NOAA Research. <https://research.noaa.gov/article/ArtMID/587/ArticleID/2472/Climate-change-to-make-hot-droughts-hotter-in-the-US-southern-plains>

<sup>8</sup> Federal Insurance and Mitigation Administration. (2018). *Natural Hazard Mitigation Saves Interim Report* [fact sheet]. [https://www.fema.gov/sites/default/files/2020-07/fema\\_mitsaves-factsheet\\_2018.pdf](https://www.fema.gov/sites/default/files/2020-07/fema_mitsaves-factsheet_2018.pdf)

the mountains, with the Poudre Canyon and Cache la Poudre River running through it, put the county at risk for flooding. Recreation (boating and skiing) faces the highest amount of damage costs from droughts, ranging from \$800K to \$18M, depending on the population scenario. The opportunity to boat and ski will drop significantly and will reduce money coming in from outdoor tourism. Suppression (firefighting costs) faces the highest amount of damage costs from wildfires, ranging from \$5.9M to \$18M, depending on the population scenario. Wildfires in Colorado and Larimer County have increased in the last years, and this trajectory is projected to continue which will result in property damage and increased costs to suppress these.

Continuous climate impacts and their implications are an economic burden for everyone, especially governments. The Colorado Water Conservation Board’s Future Avoided Costs Explorer tool<sup>9</sup> predicts that those costs will depend on factors like the type of hazard, climate scenario, population scenario, and sector. The information in the following tables showcases the estimated impacts in Larimer County from drought, flood, or wildfire with the current county population scenario of 333,000 and the current, moderate, and more severe climate scenarios. Impacts are reported in terms of expected annual damages.

**Currently, residents spend approximately \$70 per year on drought, flood, and wildfire impacts.**

**For definitions of population scenarios click [here](#).**

**For definitions of climate scenarios for drought click [here](#).**

Drought–Economic Impacts in 2050		
Climate Scenario	Current Population Scenario	
	Annual Total Damages	Total Damages per Person
Current	\$1.9M	Less than \$10
Moderate	\$3.5M	\$10
More Severe	\$5.0M	\$20

<sup>9</sup> Future Avoided Cost Explorer: Colorado Hazards. (2020, June 5). ArcGIS StoryMaps. <https://storymaps.arcgis.com/stories/4e653ffb2b654ebe95848c9ba8ff316e>

For definitions of climate scenarios for flood click [here](#).

Flood–Economic Impacts in 2050		
Climate Scenario	Current Population Scenario	
	Annual Total Damages	Total Damages per Person
Current	\$13M	\$40
Moderate	\$17M	\$50
More Severe	\$30M	\$90

For definitions of climate scenarios for wildfire click [here](#).

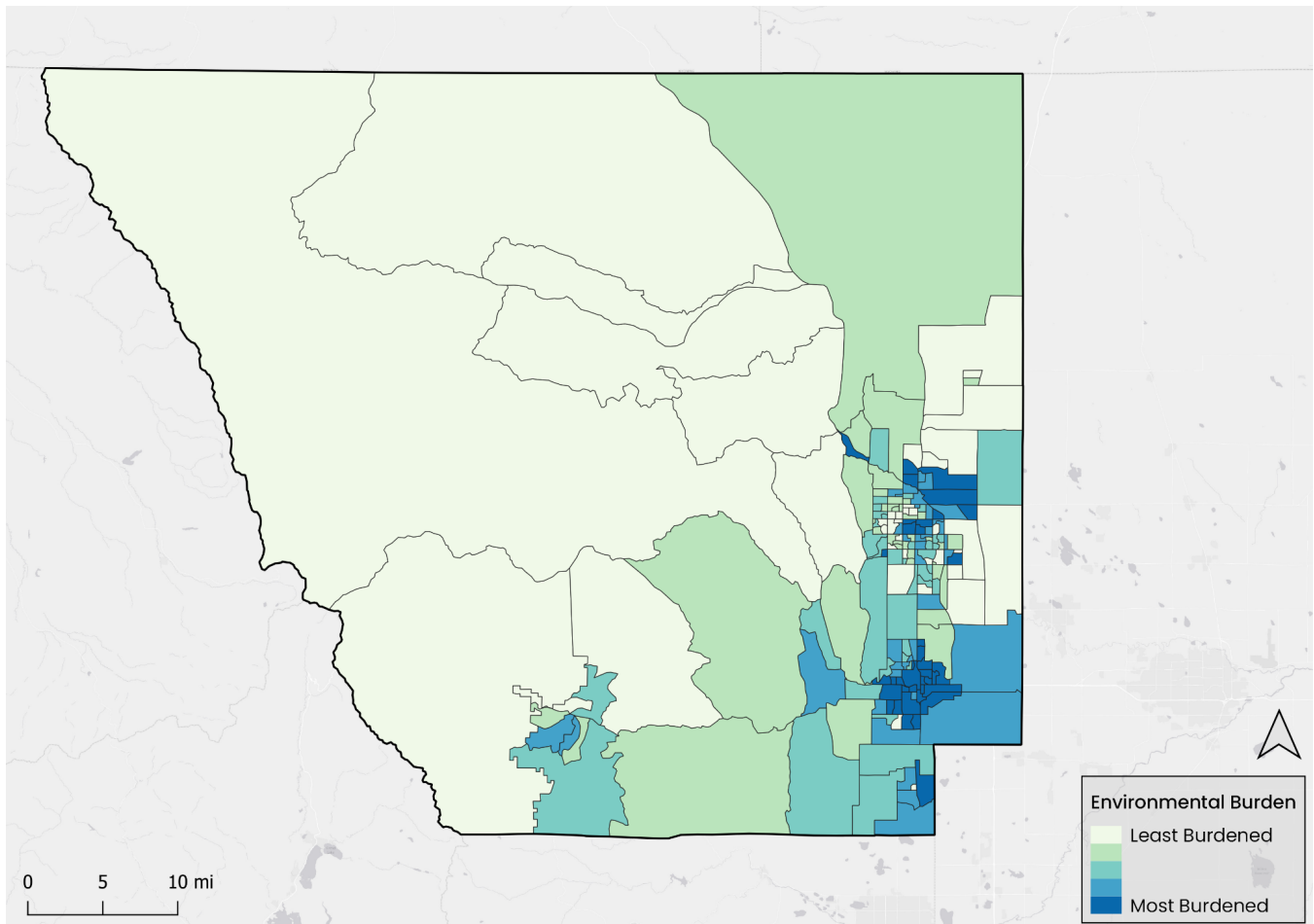
Wildfire–Economic Impacts in 2050		
Climate Scenario	Current Population Scenario	
	Annual Total Damages	Total Damages per Person
Current	\$6.7M	\$20
Moderate	\$9M	\$30
More Severe	\$10M	\$30

## 4. Health and Equity

The impacts of climate change are not evenly distributed. Historically marginalized, racialized, and low-income communities often bear the greatest brunt of climate impacts and environmental degradation. The Colorado EnviroScreen tool<sup>10</sup> measures environmental and health burdens across the state using demographic, environmental, exposure, and economic metrics. These metrics are grouped to provide each county, census tract, and census block group with a percentile rank. A higher EnviroScreen rank means the area is more likely to be affected by environmental health injustices than other communities in the state (e.g., a census block group with an EnviroScreen rank of 95 has a greater environmental health burden than 95% of all other census block groups in the state).

<sup>10</sup> Colorado EnviroScreen | Department of Public Health & Environment. (n.d.). <https://cdphe.colorado.gov/enviroscreen>

Figure 6 shows the EnviroScreen ranks for census block groups within Larimer County. Portions of Loveland and Fort Collins have greater environmental burdens than the rest of the County. Twelve census block groups (many of the dark blue portions of the map) have EnviroScreen ranks above the 75th percentile, indicating higher environmental health burdens than 75% of census block groups in Colorado. Residents in these areas may already be experiencing negative environmental impacts and are more vulnerable to future impacts from climate change.



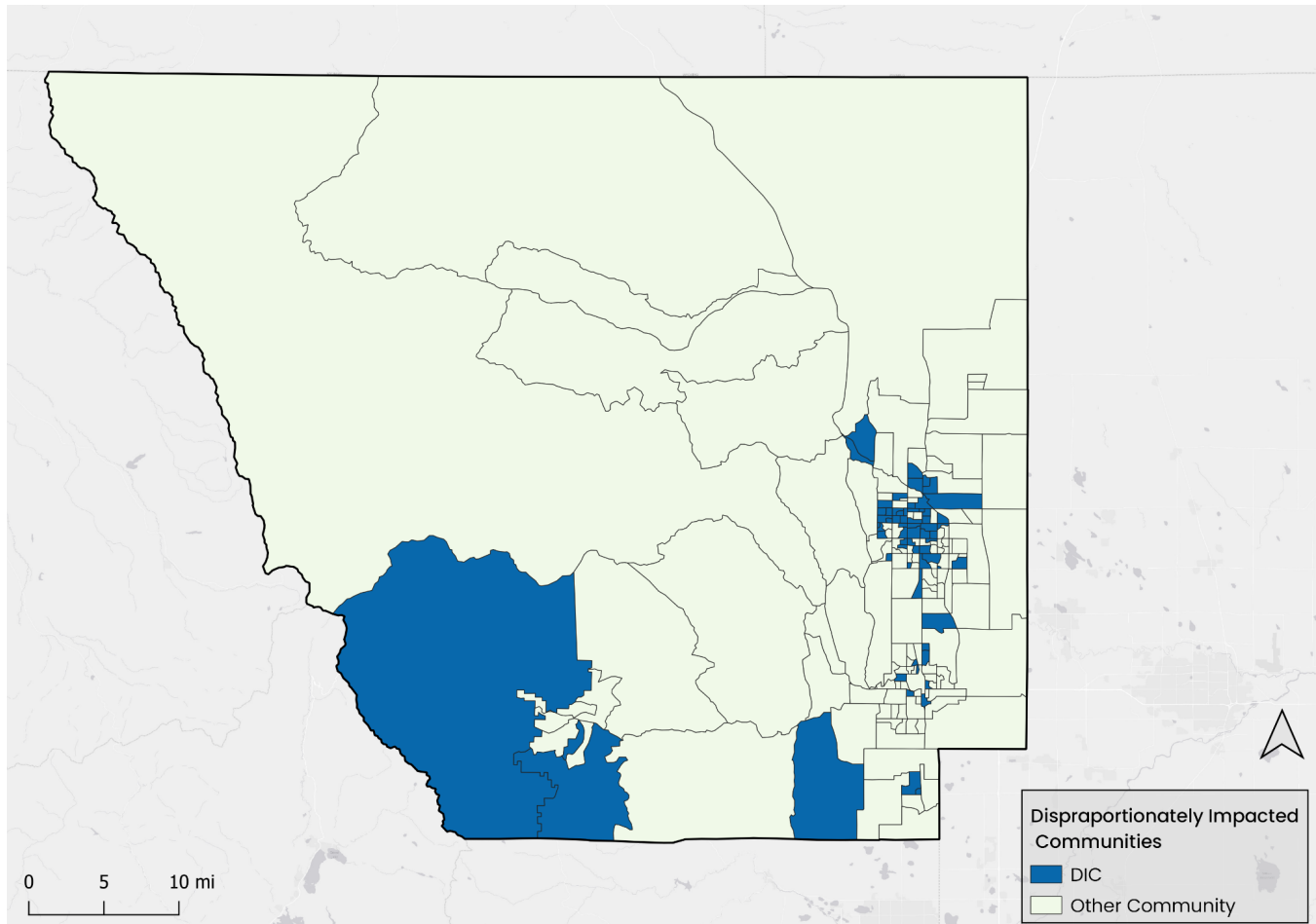
**Figure 6. Colorado EnviroScreen Percentile Rankings for Larimer County.**

EnviroScreen also identifies census block groups that qualify as Disproportionately Impacted Communities (DIC) based on definitions identified in the Colorado Environmental Justice Act.<sup>11</sup> DICs are census block groups where greater than 40% of the population are low-income, housing cost-burdened, or people of color. Low income is defined as communities where the median household income is at or below 200% of the federal poverty line. Housing cost-burdened is defined

<sup>11</sup> HB21-166 | Colorado General Assembly (2021). <https://leg.colorado.gov/bills/hb21-1266>



as households who spend greater than 30% of their income on housing costs.<sup>12</sup> DICs may have previously experienced environmental injustices and are more likely to be negatively impacted by the effects of climate change and future environmental degradation. Through the Environmental Justice Act, the Colorado Air Quality Control Commission must develop targeted outreach and engagement with DICs to ensure these communities can participate in environmental decision-making and prevent future environmental injustice. Sixty-five census block groups in Larimer County qualify as DICs, primarily within or near Fort Collins (Figure 7).



**Figure 7. Disproportionately Impacted Communities in Larimer County.**

<sup>12</sup> Colorado EnviroScreen | Department of Public Health & Environment. (n.d.). <https://cdphe.colorado.gov/enviroscreen>

See Appendix A for an overview of how the various EnviroScreens are scored.

<b>EnviroScreen Scores</b>	
<b>Category</b>	<b>Larimer County</b>
<b>Larimer County EnviroScreen Percentile</b>	62.5nd percentile
<b>Pollution and Climate Burden</b>	86th percentile
<b>Environmental Exposure</b>	81st percentile
<b>Environmental Effects</b>	94th percentile
<b>Climate Vulnerability</b>	55th percentile
<b>Sensitive Population</b>	34th percentile
<b>Demographics (Income, education, race, housing costs, etc)</b>	44th percentile

## Appendix A: EnviroScreen Definitions

- Pollution and Climate Burden: combines the scores from Environmental Exposures, Environmental Effects, and Climate Vulnerability.
- Environmental Exposure: represents a community's exposure to certain environmental risks relative to the rest of the state. Average data on diesel particulate matter, traffic proximity, ozone, PM 2.5, air toxics, other air pollutants, lead exposure risk, drinking water violations, and noise.
- Environmental Effects: represents how many hazardous or toxic sites are in a community relative to the rest of the state.
  - \*This score is weighted half as much as environmental exposures in the overall Pollution and Climate Burden score as most people are not directly exposed to these sites.
  - Hazardous, active non-National Priorities List (NPL)<sup>13</sup> sites (active superfund sites that are not on the NPL but may still pose health risks):
    - Carter Lake Water Treatment Plant - Berthoud
    - Larimer Landfill - Fort Collins
    - Fort Collins Lemay Avenue Indoor Air - Fort Collins
    - Fort Collins Metal Refining - Fort Collins
    - Camelot Cleaners - Fort Collins
    - Hourglass Lake Drums - Bellevue
- Climate Vulnerability: represents a community's risk of drought, flood, extreme heat, and wildfire compared to the rest of the state.
- Demographics: represents a community's social and economic vulnerabilities.

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<sup>13</sup> Homefacts.com. (n.d.). *Larimer County, CO Hazardous Waste Superfund Sites*.  
<https://www.homefacts.com/environmentalhazards/superfunds/Colorado/Larimer-County.html>