



Placer County Sustainability Plan

Vulnerability Assessment Report

Administrative Draft | October 2018



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Prepared for Placer County Community Development and Resources Agency



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Executive Summary

This vulnerability assessment evaluates how the effects of climate change could be harmful to the people, buildings and infrastructure, ecosystems, economic drivers, and key services in the unincorporated areas of Placer County. It identifies the natural hazards in Placer County that climate change may affect, the damage that these hazards may cause to people and community assets, and the ability of people and assets to effectively resist and recover from these hazards.

Placer County prepared the vulnerability assessment, with the support of a consultant team led by PlaceWorks, and a Technical Advisory Committee (TAC), consisting of key staff from various departments and divisions. The assessment is a technical study for the Placer County Sustainability Plan, a comprehensive planning effort to reduce greenhouse gas (GHG) emissions and adapt to changing climate conditions. Placer County prepared this assessment in accordance with state guidelines, particularly the California Adaptation Planning Guide (APG). It evaluates eleven different hazards and assesses how these hazards may affect 58 distinct populations and assets, separated into six groups.

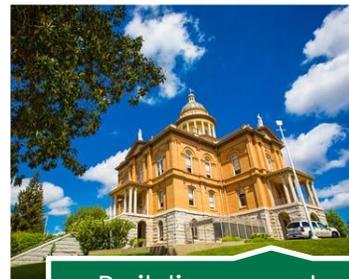
POPULATIONS AND ASSET GROUPS



Populations



Infrastructure



Buildings and Facilities



Economic Drivers



Ecosystems



Key services

Photo credits: Placer County

HAZARDS



Agriculture and Forestry Pests and Diseases



Avalanche



Droughts



Extreme Heat



Flooding



Fog



Human Health Hazards



Landslides



Severe Weather



Severe Winter Weather



Wildfire

Placer County relied on local plans and reports, scholarly research, spatial data, and other scientific and government studies to assess the damage these hazards can cause and the capacity of people and assets to resist this damage and adapt to it. As part of this analysis, a measure of vulnerability is assigned to each population and asset type for each applicable hazard condition. This assessment measures vulnerability (V) on a scale of 1 to 5, with V1 being the least vulnerable and V5 being the most vulnerable. Of the 58 populations and assets in this analysis, 31 have a high level of vulnerability (scoring V4 or V5) for at least one of the eleven hazards. Additionally, ten of the eleven hazards created a high level of vulnerability for at least one population or asset. The one exception is fog, which did not result in a score higher than V3.

Key findings of this vulnerability assessment include the following.

- Most of the vulnerable people in Placer County are those who have socio-economic challenges (e.g. people in poverty) and persons who are more likely to have physical or behavioral limitations that can impede their ability to respond to emergency conditions.
- Vulnerable infrastructure systems include various parts of the local transportation network and systems that help provide electrical and communication services.
- The most vulnerable buildings and facilities are in more rural areas, where they are more likely to be exposed to harmful events such as wildfires or landslides.
- The economic drivers most at risk from climate change range widely, although the agricultural and recreational industries are among the most susceptible.
- Placer County's conifer forests, already harmed by events such as bark beetles and wildfires, are among the most vulnerable ecosystems, along with grasslands and mountain meadow/scrubland.
- Among key services, the communication and energy delivery services are the most vulnerable.

The results of the vulnerability assessment will be used to develop strategies to improve resiliency to climate-related hazards in Placer County. The strategies will be included in the Placer County Sustainability Plan. This assessment and the subsequent adaptation strategies also support the County's compliance with recent statutory requirements established by Senate Bill 379.

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Photo credit: Placer County

Chapter 1: Introduction

Placer County is currently preparing a Sustainability Plan, intended to reduce community-wide greenhouse gas (GHG) emissions and help Placer County adapt to potential harm caused by climate change. A critical component of the Sustainability Plan is the vulnerability assessment. This is an analysis of how a changing climate may harm Placer County and which elements—people, buildings and structures, resources, and many other assets—are most vulnerable to its effects. This report summarizes these results, which will be used to prepare strategies to make Placer County more resilient. These strategies will be included in the Sustainability Plan.

The vulnerability assessment and the resiliency strategies that will be prepared based on the assessment's results will let Placer County to identify and take action to address dangerous conditions before they develop or become more common. This will help protect the health and safety of residents and visitors, reduce damage and destruction of public and private property, minimize interruption to important services, protect local ecosystems, and keep Placer County's economy diverse and strong.

The vulnerability assessment will also help Placer County comply with state laws, including Senate Bill 379. Senate Bill 379 requires local governments to conduct

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vulnerability assessments as part of their long-range public safety planning efforts, and to prepare policies that will protect against harm caused by climate change. This vulnerability assessment, along with other planning projects and/or programs, will help Placer County meet the state's requirements.

COMMUNITY PROFILE

Placer County is in northern California and runs from the Sacramento urban area to the Nevada border. Western Placer County is largely flat and is part of the Sacramento Valley. This area includes a mix of agricultural land and fast-growing suburban communities. Past the Sacramento Valley are the forested foothills of Placer County's Gold Country, including the incorporated communities of Auburn and Colfax. Beyond Gold Country is the Sierra Nevada mountain range, a heavily forested and sparsely populated area dotted with lakes and crossed by the North and Middle Forks of the American River. East of the Sierra Nevada crestline, Placer County includes the northern half of the Lake Tahoe basin, a region of lakeside towns and world-famous ski resorts. With the exception of the Lake Tahoe area, most people in Placer County live along the Interstate 80 corridor, which runs the length of the county.

The vulnerability assessment, along with other components of the Placer County Sustainability Plan, covers the unincorporated areas of Placer County. According to the California Department of Finance, the unincorporated area is home to 113,313 people as of 2018.¹ The six incorporated communities (Auburn, Colfax, Lincoln, Loomis, Rocklin, and Roseville) are not included in this assessment, although some findings may apply to these communities. State and federal land, which makes up a large amount of Placer County's land area (particularly in the Sierra Nevada region), is included in this assessment.

METHOD

This vulnerability assessment follows the recommended process in the California Adaptation Planning Guide (APG). The APG, published in 2012 by the California Natural Resources Agency and the California Emergency Management Association,¹ guides regional and local governments in identifying and reducing the harmful effects of climate change.

What is vulnerability?

California's Adaptation Planning Guide defines vulnerability as how much someone or something (a group of people, a building, an ecosystem, etc.) may be harmed by climate change.

What is resiliency?

According to the Adaptation Planning Guide, resiliency is the ability of someone or something to resist harm and recover from damage or other hardships.

¹ Now called the California Office of Emergency Services, or Cal OES.

The APG recommends a five-step method to prepare a vulnerability assessment, which is shown and described below. ⁱⁱ

Step 1: Identify exposures

Step 2: Identify sensitivities

Step 3: Analyze potential impacts

Step 4: Evaluate adaptive capacity

Step 5: Adjust for risk and onset

Step 1: Identify exposures. In the context of a vulnerability assessment, an exposure is an effect of climate change, such as an increase in how frequently natural disasters occur or how severe these disasters are. The first step of a vulnerability assessment is to figure out which effects are expected to take place (or already occur) in Placer County. See **Chapter 2** of this report for details on which exposures are in this vulnerability assessment.

Step 2: Identify sensitivities. A sensitivity is someone or something that may be harmed by climate change. This includes groups of people as well as community assets such as buildings, infrastructure, and government services. The County selected specific populations and assets to analyze in detail how different population and assets may be affected. See **Chapter 3** of this report for more information on which populations and assets are in this vulnerability assessment.

Step 3: Analyze potential impacts. Climate change will affect people and assets in Placer County in different ways. These effects, particularly the negative ones, are called impacts. For each group of people and assets analyzed in the vulnerability assessment, the County looked at what the potential impacts could be for each exposure.

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Step 4: Evaluate adaptive capacity. Adaptive capacity is the ability of people and assets to recover from and adapt to the impacts of climate change. The vulnerability assessment includes an analysis of what the adaptive capacity is for each group of people and assets for each exposure.

Step 5: Adjust for risk and onset. Some impacts of climate change are much more likely than others. For example, climate change may affect the frequency of tornadoes in Placer County, but since these hazards are already rare in the area, the risk from them is low. Some impacts are also not expected to occur in a significant way for several decades. The APG recommends that communities adjust the results of the vulnerability assessment to make sure they reflect how often impacts occur and when they are expected to take place.

ASSESSMENT PROCESS

After selecting the exposures and sensitivities to include in the vulnerability assessment, Placer County looked at which exposures are likely to affect which sensitivities, because not all exposures would affect all sensitivities. For example, rice fields in Placer County are in flat areas away from hills and mountains, and so landslides are not a matter of concern for rice growers, but the flat topography and nearby rivers make flooding a primary hazard of concern for rice fields. For each sensitivity, Placer County next assessed the impacts and adaptive capacity for each relevant exposure.

ASSESSING IMPACT

To identify how great the impacts of each relevant exposure are on the sensitivities, Placer County considered a number of different questions that helped ensure that the assessment broadly covers the range of potential harm. Examples of these questions include:

- What types of impacts may occur? Could they cause physical injury or damage? Is there a risk of behavioral or mental harm, loss of economic activity, or other nonphysical effects?
- How many people or community assets could be affected by both direct and indirect harm?
- How long would the impacts persist?

Impact and Adaptive Capacity

The difference between impact and adaptive capacity can sometimes be hard to understand. In the context of a vulnerability assessment, impact is based on the potential harm that the exposure could cause, while adaptive capacity looks at the potential to resist that harm or recover from it.

For example, consider two communities that receive water from the same lake. Both communities have an equal chance of having their water supply disrupted by drought, so the **impact** is the same. However, imagine that one community has already taken action to reduce water use. This community has a greater **adaptive capacity** than the other, because it is better-positioned to resist and recover from the drought.

- Is there a substantial chance of death or widespread destruction?

Based on the results of the impact assessment (IM), Placer County ranked each sensitivity on a five-point scale (0 – 4) for each relevant exposure. IM0 is the lowest score (lowest impact), and IM4 is the highest score (highest impact). Impact is a negative quality, so a lower impact score is better. In keeping with the method of the APG, Placer County adjusted these scores up or down to account for risk levels and onset.

The rubric below provides more detail about what each score means.

IMPACT SCORE	MEANING (PEOPLE AND ECOSYSTEMS)	MEANING (BUILDINGS, INFRASTRUCTURE, SERVICES, AND ECONOMIC DRIVERS)
IM0. Minimal Impact	Community members may not notice any change.	Damage, interruption in service, or impacts on the local economy are small or intermittent enough to mostly go unnoticed.
IM1. Low Impact	Community members notice minor effects. Daily life may experience mild, occasional disruptions.	There are minor but noticeable interruptions in service, damage, or negative effects on the economy.
IM2. Moderate Impact	There is a marked impact to the community. Quality of life may decline. Impacts may be chronic, and at times substantial.	Damage, service interruptions, and other impacts are clearly evident. Impacts may be chronic and occasionally substantial.
IM3. Significant Impact	The well-being of the community declines significantly. The community's current lifestyle and behavior may no longer be possible.	Impacts are chronic. Buildings, infrastructure, and services may be often or always unable to meet community demand. Large sections of the economy experience major hardships.
IM4. Severe Impact	There is a severe risk of widespread injury or death to people, or of significant or total ecosystem loss.	Buildings, infrastructure, and services cannot function as intended or needed. Economic activities are not viable.

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ASSESSING ADAPTIVE CAPACITY

Placer County next assessed the adaptive capacity of each population and asset for each relevant exposure. Following a similar process as used to analyze impacts, Placer County considered various questions to help make sure that the adaptive capacity assessment covers the full potential of a sensitivity to resist and recover from harm. Examples of these questions include:

- Are there existing programs and policies to provide assistance? Can affected community members take advantage of these programs?
- Are there barriers that limit response or recovery? Are these barriers financial limitations, political challenges, lack of access to technology or other resources, or others?
- For community assets, do alternatives exist in or near Placer County that community members can use?

Based on the results of the adaptive capacity (AC) assessment, Placer County ranked each sensitivity on a five-point scale (0 - 4) ranging from AC0 (the lowest adaptive capacity) to AC4 (the highest adaptive capacity). Adaptive capacity is a positive quality, so a higher adaptive capacity score is better. As recommended by the APG, Placer County adjusted the adaptive capacity scores to ensure that they reflect risk levels and onset periods.

The rubric below provides more detail about what each score means.

ADAPTIVE CAPACITY SCORE	MEANING (ALL SENSITIVITIES)
AC0. No Adaptive Capacity	Currently, there are no feasible means of adapting.
AC1. Low Adaptive Capacity	Adaptive solutions are available, but they are expensive, technologically difficult, and/or politically unpopular.
AC2. Some Adaptive Capacity	Some adaptation methods are available, but not always feasible. Adapting may create significant challenges for some sensitivities.
AC3. High Adaptive Capacity	Adaptation solutions are feasible for most or all sensitivities. There may be occasional or small-scale challenges to implementing adaptation methods.
AC4. Outstanding Adaptive Capacity	Sensitivities can adapt with little or no effort. Quality of life is unchanged or may improve.

VULNERABILITY SCORING

Placer County used the impact and adaptive capacity scores for each sensitivity and relevant exposures to determine a vulnerability score. The vulnerability (V) score reflects how susceptible the sensitivity is to harm from a particular exposure.

Vulnerability is assessed on a scale of 1 to 5:

- V1: Minimal vulnerability
- V2: Low vulnerability
- V3: Moderate vulnerability
- V4: High vulnerability
- V5: Severe vulnerability

The matrix below shows how different impact and adaptive capacity scores translate to a vulnerability score.

		IMPACT SCORE				
		IM0	IM1	IM2	IM3	IM4
ADAPTIVE CAPACITY SCORE	AC0	V3	V4	V5	V5	V5
	AC1	V2	V3	V4	V5	V5
	AC2	V1	V2	V3	V4	V5
	AC3	V1	V1	V2	V3	V4
	AC4	V1	V1	V1	V2	V3

DATA SOURCES

The vulnerability assessment must be based on the best available science and information. Placer County used data from a variety of credible sources to prepare the vulnerability assessment, including determining the impact and adaptive capacity scores, and to support the conclusions presented in this report. These sources include scholarly research, locally-provided data, and state and federal data.

SCHOLARLY RESEARCH

Much of the information came from an extensive body of scientific research that discusses how climate change may affect people and community assets. In most cases, this research was not conducted in Placer County, but the results are applicable and relevant. Much of this research is peer reviewed, which ensures greater accuracy. Some studies were published in various scientific journals, such as the *Proceedings of*

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the National Academy of Science, Geophysical Research Letters, or Climate Change. Placer County backed the information in these studies and reports with websites and publications from scientific and academic institutions, government organizations, and credible local and national sources.

LOCAL DATA

Local government agencies have already prepared a number of plans and reports that support the vulnerability assessment or contain information relevant to the analysis. Placer County relied on several local plans and reports to prepare the vulnerability assessment, including:

- Placer County General Plan (1994-2013)
- Lake Tahoe Sustainability Action Plan (2013)
- Placer County Water Agency Urban Water Management Plan (2015)
- Placer County Local Hazard Mitigation Plan (2016)
- Placer County Agricultural Crop Reports (2017)
- Placer County Homeless Count (2018)
- Placer County Conservation Plan (Ongoing)

Placer County also relied on spatial data maintained by the County. These data show the location of various buildings and infrastructure, different land uses, boundaries, areas at risk of different hazards, and other items of importance to the vulnerability assessment.

STATE AND FEDERAL DATA

Placer County supplemented the scholarly research and local data with data from state and federal agencies, including published reports and datasets. The state APG provided extensive information about climate-related exposures and vulnerabilities, as did federal reports such as the National Climate Assessment. Cal-Adapt, a web-based tool developed by the California Energy Commission, provided highly specific information about historic climate conditions and future climate projections. Documents from the California Natural Resources Agency, such as the Safeguarding California and California Climate Adaptation Strategy reports, provided additional information about state climate vulnerabilities and adaptation strategies. Placer County relied on information from several agencies, including the Centers for Disease Control and Prevention, the California Energy Commission, and the California Department of Forestry and Fire Protection (Cal Fire). Placer County also relied on the US Census Bureau for demographic data, including information about the numbers and locations of disadvantaged persons in the community.

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ⁱ California Department of Finance (DoF). 2018. E-1 Population Estimates for Cities, Counties, and the State – January 1, 2017 and 2018 [data table].

<http://www.dof.ca.gov/Forecasting/Demographics/Estimates/E-1/>.

ⁱⁱ California Natural Resources Agency (CNRA). 2012. *California Adaptation Planning Guide: Planning for Adaptive Communities*. <http://resources.ca.gov/climate/safeguarding/local-action/>.



Photo credit: Placer County

Chapter 2: Exposures

An exposure is an effect of climate change and is usually negative. Exposures can be a change in existing conditions (such as wildfires becoming more common) or an entirely new condition (such as a new pest insect that previously could not live in the area). In the context of a vulnerability assessment, exposures are usually changes to various natural hazards. Placer County is currently experiencing some of these changes, but others may not occur or be apparent for several years or decades.

SELECTED EXPOSURES

Placer County reviewed extensive scientific reports and datasets to assess which exposures apply to Placer County. Included were a number of state and federal reports as well as local planning documents such as the Placer County Local Hazard Mitigation Plan. Staff from key county agencies, such as the Office of Emergency Services, recommended appropriate issues to discuss in this vulnerability assessment. Additionally, Placer County asked members of the public to weigh in on topics as part of initial phase of the public engagement effort for the Placer County Sustainability Plan.

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During this selection process, Placer County did not evaluate all natural hazards in the area because only climate-related ones are considered for the vulnerability assessment. For example, although earthquakes and seismic activity may be harmful in parts of Placer County, these hazards are not linked to climate change and so are not considered. The review included exposures that are only a concern in some parts of Placer County, such as avalanches, although many pose a danger to the entire community.

After reviewing the reports and data, Placer County selected the following eleven exposures, listed in alphabetical order, to consider in the vulnerability assessment.

1. Agriculture and forestry pests and diseases
2. Avalanche
3. Drought
4. Extreme heat
5. Flooding
6. Fog
7. Human health hazards
8. Landslides
9. Severe weather
10. Severe winter weather
11. Wildfire

EXPOSURE CONSIDERATIONS

When selecting these exposures and determining how they apply to Placer County, there are a few important considerations to keep in mind: differences in climate scenarios, the distinction between weather and climate, and what climate models and downscaling are.

CLIMATE SCENARIOS

An exposure is a description of what future conditions are expected to be like. Like any forecast, these projections have some degree of uncertainty. Because climate change is caused by an increase in greenhouse gases (GHGs) in the atmosphere, especially as a result of human activities, the specific severity of exposures will depend largely on the volume of GHGs that are emitted in the future, how long they are emitted for, and whether they are emitted in the near or distant future. Levels of GHG emissions themselves are affected by several factors, such as population levels, economic activity, government policies, and personal behavior. If GHG emissions drop quickly and significantly, emission levels overall will be lower, and exposures will be less severe. Continued and long-term increases in GHG emissions will lead to greater changes and more severe exposures.

Many forecasts of exposures rely on multiple scenarios that reflect different levels of GHG emissions. These forecasts cover a reasonable range of future climate conditions, although it is possible that future changes may occur outside of these ranges. The Intergovernmental Panel on Climate Change (IPCC), an organization that represents the global scientific community on the subject of climate change, commonly uses four scenarios, known as Representative Concentration Pathways (RCPs). RCPs are labeled

with different numbers (e.g. RCP 2.6, RCP 6, etc.) that refer to the increase in the amount of energy that reaches each square meter of Earth's surface under that scenario. More GHGs in the atmosphere means more heat energy is trapped close to Earth's surface, so higher GHG levels lead to greater increases in surface-level energy. The four RCPs are:

- **RCP 2.6:** Under this scenario, global GHG emissions peak around 2020 and then decline quickly. Emissions of carbon dioxide, the most common GHG, reach zero around 2075.
- **RCP 4.5:** Under this scenario, global GHG emissions peak around 2040 and then decline. Carbon dioxide levels are less than half of current levels by 2080.
- **RCP 6:** Global emissions continue to rise until the middle of the century. Carbon dioxide emissions decline, although they remain higher than current levels.
- **RCP 8.5:** Global emissions continue to increase at least until the end of the century. ⁱⁱⁱ

For California-specific projections, the most accurate data is available for the RCP 4.5 and RCP 8.5 scenarios. These are the two scenarios that the Cal-Adapt database has downscaled to provide detailed data on climate projections (see the Climate Models and Downscaling discussion below). Placer County used these two scenarios to identify the severity of climate change impacts in California, as detailed California-specific data for RCP 2.6 and 6 is not currently available.

WEATHER AND CLIMATE

This vulnerability assessment relies on the understanding that “weather” and “climate” are two different things. “Weather” describes the conditions at a particular time and place, and “climate” describes the long-term average of conditions. For example, the high temperature in Auburn averages approximately 74 degrees Fahrenheit. However, in 2017 the high temperature in Auburn ranged from as high as 105 degrees to as low as 41 degrees. The average of 74 degrees is the climate, and the daily conditions between 41 and 105 refer to the weather.

Because there is so much variation in the weather, it is difficult to accurately project weather conditions beyond a few days in advance. However, because climate is a long-term average, it can be projected out for years or decades with a high degree of accuracy. This means that scientists can reasonably say what the average temperature range may be decades in the future (a projection of climate). ^{iv}

It is important to remember that climate is an average. It does not say whether a condition will or will not occur, only how likely such an event is. For example, one exposure of climate change is that droughts are likely to become more frequent in Placer County. A year where there is no drought does not mean that this projection is wrong, because the projection only says that droughts may occur, on average, more often than they previously did.

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CLIMATE MODELS AND DOWNSCALING

Projections of climate exposures rely on climate models, which are computer simulations that forecast future climate conditions. No model can project future conditions perfectly, but current models are heavily reviewed by climate scientists and can accurately reproduce observed climate conditions. This speaks highly to their ability to project future conditions.

Most climate models are meant to simulate conditions across the globe. The model divides Earth's surface into cells using a grid, and then forecasts the conditions in each square of the grid. The size of these squares makes them suitable for projecting global conditions, but they are too big to accurately model the difference in climate across smaller areas. ^{v vi}

Scientists in California and elsewhere have created much finer grids using a process called "downscaling." This process uses various mathematical techniques to calculate more detailed climate projections, using the original model as a starting point. State guidance documents identify four priority models that have been downscaled and are most suitable for projections in California, plus six other downscaled models as well as a downscaled average of 32 global models.

State guidance documents recommend that planners create an average of multiple models and use this average to generate projections of future conditions. Averages are likely to be more accurate than an individual model. An average of the four priority models is often a good approach, although planners may choose instead to use an average of other models. This guidance also recommends that planners look at the results of individual models to get a sense of the full range of potential outcomes. Placer County used an average of the four priority models to generate the projections in this vulnerability assessment.

Climate Model Grid Size

The early climate models had grids that were as big as about 350 miles on each side. A model like this could assume that Placer County had the same climate as areas as far apart as Death Valley, Monterey, Eureka, and the northern Nevada desert.

By contrast, the downscaled models recommended by state guidance documents have grids that are less than 4 miles on each side. This is enough to forecast different conditions between areas as close as Kings Beach and Carnelian Bay.

EXPOSURE PROFILES

AGRICULTURE AND FORESTRY PESTS AND DISEASES

The forests, farms, and ranches of Placer County all face risk from assorted pests and diseases that may affect crop plants, trees, and livestock. These pests and diseases can cause plants and animals to grow slower, damage them so that their products are less appealing and harder to sell, or even die. While there are treatment options for a number of agriculture and forestry diseases, some have no cure—such as the devastating citrus disease huanglongbing (HLB).

One of the most direct effects of climate change is that average temperatures will increase, and this has a bearing on many pests and diseases. Many pests and organisms that carry diseases are most active during warmer months, so the threat of infection or infestation can be higher during this time of year. Temperatures are expected to get warmer earlier in the year and remain warmer until later in the year due to climate change, creating a wider window for pests and diseases to be active. ^{vii} **Map 1**² shows the areas in Placer County where tree deaths have been reported, as a combination of drought and bark beetle infestations. These areas are expected to spread, and the infestation severity is projected to increase as a result of climate change.

Climate change can also indirectly create a greater risk of agriculture and forestry pests and diseases. Many crop plants, trees, and livestock may be harmed and consequently weakened by warmer temperatures and changes in precipitation. The weaker plants and animals may not be able to fend off infestations or infections as well as a stronger plant or animal, causing pests and diseases to affect more of the population.

Bark Beetles in Placer County

One of the worst pests in Placer County is the bark beetle, an insect that has contributed to the death of 1.5 million trees in Placer County's forests alone. The dead trees create more fuel for wildfires and are a safety risk for people and property.

Climate change is likely to worsen bark beetle infestations. The warmer temperatures and shorter periods of cold weather create a longer period for bark beetles to be active and reproduce. Drought and extreme heat also stress and weaken trees, making them more susceptible to bark beetle infestation.

On October 30, 2015, Governor Brown declared tree mortality due to drought conditions and bark beetle infestations to be a statewide emergency. The governor's order directs state agencies to remove affected trees and identify uses for the wood from these trees. Placer County's Board of Supervisors declared a local emergency on December 8, 2015 due to tree mortality, and in 2016 adopted a Hazard Tree Removal Plan to reduce local vulnerabilities.

² The maps for Chapter 2 (Maps 1 through 6) are located at the end of the chapter, beginning on page 29.

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An avalanche occurs when some or all of the snow on the side of a hill falls or slides down the slope. They are usually caused when enough snow falls on a slope to unbalance it or by warmer weather causing some snow to melt, making it easier for the rest of the snow to move down the hill. There is enough force and speed in a large avalanche to damage or destroy vehicles, trees, and buildings in their paths. Even smaller avalanches can injure or kill a person.

Indirectly, climate change can increase the risk of avalanches in the parts of Placer County that are already prone to these events. The warmer temperatures brought on by climate change are projected to cause more rapid melting of snow, which may destabilize snow on hillsides, causing an avalanche. Climate change is likely to cause more intense winter storms (leading to more periods with heavier snowfall), and warmer conditions are likely to cause a greater percent of precipitation to fall as rain instead of snow. ^{vii} A combination of these factors may also increase the avalanche risk in Placer County.

DROUGHT

A drought is a long period when precipitation levels are well below normal. This makes less water available for people (especially if the local water supply depends on surface water) and natural systems. Communities in Placer County may experience water shortages during drought conditions, which could lead to mandatory water use restrictions. Farmers may need to cut back on irrigation activities, and ranchers may need to reduce their number of livestock. Less snow falling in mountainous areas causes water levels in lakes and reservoirs to drop, which can affect recreation activities. Local ecosystems that are not well adapted to drought conditions can be more easily harmed by it. During drought events, the flow of water in creeks and streams is reduced, creating more slow-moving or standing water. This can concentrate sediment and toxins in the low water levels, causing harm to plants and animals. Many fish species also prefer specific stream flow speeds, especially for spawning and egg incubation, and changes to stream velocity as a result of drought conditions can affect reproduction. Droughts can also

Avalanches in Placer County

Although not common, avalanches do occur in Placer County and may become more frequent. Federal records list 15 avalanches in Placer County, all of which happened since 1996. Of the 8 fatal avalanches recorded, 7 have occurred since 2008.

Climate Change and Precipitation Levels

State data from 2012 indicated that California was likely to see a decline in precipitation levels due to climate change. Current studies show more uncertainty in the change of average precipitation levels, but scientists expect that the state is likely to experience more extreme precipitation events. This is projected to cause an increase in both droughts and floods.

indirectly lead to more wildfires, and the stress caused by water shortages can weaken plants, making them more susceptible to pests and diseases.

Although droughts are a regular feature of California's climate, scientists expect that climate change will lead to more frequent and more intense droughts statewide. Overall, precipitation levels are expected to stay similar, and may even increase in some places. However, the state's current data say that there will be more years with extreme levels of precipitation, both high and low, as a result of climate change. This is expected to cause more droughts that last longer and are more intense, compared to historical norms. Higher air temperatures are expected to increase evaporation, causing more water loss from lakes and reservoirs. ^{vii}

Drought conditions will also likely be made worse by changes to Placer County's snowpack, which is the level of accumulated snow that builds up in the Sierra Nevada Mountains. Usually this snow melts slowly over the year, helping to provide a regular supply of water during dry months. However, because of climate change, less precipitation is expected to fall as snow, leading to a smaller snowpack. More precipitation falling as rain and warmer temperatures over the course of the year are expected to cause the snowpack that does build up to melt faster. This may make water levels particularly low in late summer and early autumn, which are also often the hottest parts of the year. ^{vii}

EXTREME HEAT

Extreme heat is any period of time when the temperatures are well above the usual level. Because this level is relative to the area, this means that extreme heat events may occur anywhere in Placer County, even though temperatures in the valley regions will almost always be the hottest.

Extreme heat events are dangerous because people exposed to extreme heat can suffer a number of heat-related illnesses, including heat cramps, heat exhaustion, and (most severely) heat stroke. Very high temperatures can harm plants and animals that are not well adapted to them—wild ecosystems as well as farm crops and livestock. ^{vii} Extreme heat can increase the temperature of water in lakes, streams, creeks, and other water bodies, especially during drought events when water levels are lower. Some fish species, such as the Chinook salmon, require very specific water temperatures to spawn and for the eggs to incubate, and these conditions can be disrupted by extreme heat events. In some cases, water temperatures may exceed comfortable levels for a number of plants and animals, causing ecological harm. Indirectly, extreme heat puts more stress on power lines, causing them to run less efficiently. The heat also causes more demand for

What is extreme heat?

There is no universal definition of extreme heat. California guidance documents define extreme heat as temperatures that are hotter than 98 percent of the historical high temperatures for the area, as measured between April and October of 1961 to 1990. Days that reach this level are called extreme heat days. An event with five extreme heat days in a row is called a heat wave.

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electricity (usually to run air conditioning units), and in combination with the stress on the power lines, may lead to brownouts and blackouts.

The warmer temperatures brought on by climate change are likely to cause an increase in extreme heat events in all parts of California, including the different areas of Placer County. Depending on emission levels, the number of extreme heat days is expected to rise from a historical average of 4 annually to between 22 and 32 by the middle of the century, and to between 33 and 62 by the end of the century, depending on the location and level of emissions. ^{vi} According to the state Cal-Adapt database, cooler areas may see about as many extreme heat days as warmer areas. For example, even though the extreme heat threshold in Tahoe City is more than 20 degrees cooler than the threshold in Sheridan, both communities are projected to see a similar number of extreme heat days. **Table 1** shows extreme heat thresholds and projections for the number of extreme heat days in different communities in the unincorporated area of Placer County.

TABLE 1: EXTREME HEAT IN PLACER COUNTY

COMMUNITY	EXTREME HEAT THRESHOLD (F°)	NUMBER OF HISTORICAL EXTREME HEAT DAYS	NUMBER OF EXTREME HEAT DAYS (2040–2060)		NUMBER OF EXTREME HEAT DAYS (2070–2099)	
			MEDIUM GHGS (RCP 4.5)	HIGH GHGS (RCP 8.5)	MEDIUM GHGS (RCP 4.5)	HIGH GHGS (RCP 8.5)
Granite Bay	104.6	4.3	23	30	33	53
Penryn	104.1	4.3	24	32	35	56
Sheridan	105.0	4.3	25	32	37	59
Meadow Vista	100.8	4.3	22	31	35	58
Foresthill	99.3	4.3	22	30	34	58
Alta	94.3	4.2	23	30	35	62
Tahoe City	82.1	4.2	22	31	36	61
Kings Beach	82.7	4.3	23	31	36	60

Source: Cal-Adapt

In addition to the increases in extreme heat events, all of Placer County is also expected to see an increase in the average daily high temperatures. Although the temperature increases may appear modest, the projected high temperatures are substantially greater than historical norms. These increases also make it more likely that

an above-average high temperature will cross the extreme heat threshold. **Map 2** shows the projected increases in average high temperatures by the end of the century under the high emission RCP 8.5 scenario.

FLOODING

A flood is simply when there is too much water on the ground to be held within local bodies of water or to be carried away by drainage systems, causing the water to flow into normally dry areas. They can be caused by heavy rainfall, long periods of moderate rainfall, or rapid melting of accumulated snow. In rare cases, floods happen when a dam, levee, or water pipeline breaks. Floodwaters can be deep enough to drown people and move fast enough to sweep people and vehicles away. Moving floodwaters can be strong enough to lift buildings off of foundations and can carry debris that smashes into buildings and other property. If water levels rise high enough to get inside buildings, it can cause extensive damage to personal property and the structure itself. Flood events that develop very quickly, called flash floods, are especially dangerous because there may be little advance warning.

Floods are among the most damaging natural hazards in Placer County, and climate change is expected to make them worse. Although climate change may not change average precipitation levels very much, scientists expect that it will cause more years with extreme precipitation events. This means that more years are likely to see particularly intense storm systems that drop enough precipitation over a short enough period to cause flooding.^{vii} Because of this, floods are expected to occur more often in Placer County. **Map 3** shows the areas in Placer County that are currently considered flood-prone, including areas that could be flooded if a dam fails. Localized flooding can occur outside of these mapped areas, and climate change may expand the parts of Placer County that are considered flood-prone.

There are some indirect effects of climate change that may also increase flooding in Placer County. Climate change is expected to increase the frequency and severity of droughts, which cause soil to dry out and become hard. When precipitation does return, more water runs off the surface rather than being absorbed into the ground, which can lead to floods. Wildfires, which are also expected to become more frequent due to climate change, cause a similar effect by baking the surface of the ground into a harder and less penetrable layer. Trees and other vegetation help slow water down, which lets the water absorb into the soil and prevents it from turning into runoff. Because of this, the loss of trees and other plants from wildfires, pests, diseases, or other climate-related exposures can also increase flooding risk.

Fog

Fog is a very low cloud—usually low enough to touch the ground—which forms when the air near the surface reaches the right temperature for water vapor in the air to condense into a cloud. In Placer County, fog usually forms in the valley regions, although it sometimes appears in the Tahoe Basin. The cool air brought by fog during the winter is necessary to the growth of many fruit and nut trees. However, fog can be

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dangerous because it decreases visibility. This can lead to traffic accidents, which can cause significant injuries or deaths.

The impacts of climate change on fog are less clear. There have been significantly fewer days with fog in California's Central Valley in recent years than in the past, close to a 50 percent reduction since the early 1980s. Scientists believe that the warmer temperatures created by climate change make it harder for the air to become cool enough to create fog, and that warmer temperatures are more likely to evaporate any fog that does form. However, scientists have also found that fog formation may be linked to levels of air pollution, because particles of pollutants in the air help water vapor to condense, and so a reduction in pollution can make it harder for fog to form. The most recent science suggests that both warmer temperatures and a decline in air pollution may be responsible for the decrease in fog, although more research is needed. ^{vii}

Tule Fog

The most dangerous form of fog in Placer County is called tule fog, which forms throughout the Central Valley between late autumn and early spring, usually after a heavy rain. The thick fog causes very low visibility, which makes it a major cause of accidents in the region. Under the right conditions, tule fog can persist for days or even weeks.

HUMAN HEALTH HAZARDS

There are a number of diseases that are linked to climate change and can be harmful to the health of Placer County community members. Examples of these diseases include hantavirus pulmonary syndrome, Lyme disease, West Nile fever, and influenza. Many of these diseases are carried by animals such as mice and rats, ticks, and mosquitos, which are usually seen as pests even if they do not cause infections. Although some of these diseases may not be serious for most people, others can be debilitating or even fatal. For example, hantavirus pulmonary syndrome, caused by a virus carried by mice and rats, kills more than a third of people infected with it.

Climate change can increase the rates of infection for various diseases because many of the animals that carry diseases are more active during warmer weather. Warmer temperatures earlier in the spring and later in the winter can cause these animals to be active for longer periods, increasing the time that these diseases can be transmitted. Warmer temperatures may also cause some mosquito-carried illnesses not currently present in California, such as Zika, to potentially appear. West Nile virus appears to be more active during drought periods, and periods of intense precipitation can increase populations of rodents and ticks. ^{vii}

LANDSLIDES

Landslides happen when a hillside becomes unstable, causing soil and rocks to slide downslope. They can be caused by earthquakes, but this vulnerability assessment will focus on landslides caused by rain or snow. In these cases, the hillside soaks up enough water that it is no longer stable. Steep slopes made up of loose or fractured material

are more likely to slide. In some cases, the hillside can become so waterlogged that the sliding soil becomes mud, causing a mudslide. Landslides and mudslides can move fast enough to damage or destroy buildings or other structures in their path, block roads or railways, and injure or kill people caught in them.

Climate change is expected to cause an increase in the number of years that see intense levels of precipitation. During these years, heavy rainfall or snowfall could cause an increase in the number of landslides or make landslides larger than normal.

Vegetation helps to hold the material of a hillside together, but vegetation can be stripped away by climate exposures such as increased wildfires, more frequent and intense droughts, or disease/pest infestations. Without vegetation to help stabilize the slope, hills may be more likely to slide. Combined with the increase in intense rainfall years, there may be a significant increase in landslides because of climate change.

Map 4 shows the current landslide risk levels in Placer County.

SEVERE WEATHER

Severe weather includes strong winds, hail, and lightning. Severe weather is usually caused by intense storm systems, although types of strong winds can occur without a storm. The types of dangers posed by severe weather vary widely and may include injuries or deaths, damage to buildings and structures, fallen trees, roads and railways blocked by debris, and fires sparked by lightning. In Placer County, most severe weather is linked to high winds. Hail events are rare, and there have been no reported injuries from hail in Placer County, although a hailstorm in 1998 did cause a car crash near Kings Beach. Lightning happens occasionally, although there has been no direct injury or damage from lightning reported in Placer County.

Climate change is expected to cause an increase in intense rainfall, which is usually associated with strong storm systems.^{vii} This means that Placer County could see more intense storms in the coming years and decades. Such an increase may not affect all forms of severe weather and may not always be apparent. For example, hail is rare enough in Placer County that even if it does become more common, the increase and any effects may not be apparent.

SEVERE WINTER WEATHER

Severe winter weather includes heavy snowfall, ice storms, extreme cold, and similar events. In Placer County these events are usually limited to the Sierra Nevada region, although in very rare cases severe winter weather can occur at lower elevations such as the communities of Colfax or Foresthill. Blizzards and ice storms can cause extensive damage to buildings and other structures, vehicles, and power lines. Ice may form on roadways, creating dangerous driving conditions and a higher risk of vehicle crashes. People who are exposed to extreme cold may suffer from conditions such as trench foot, frostbite, or hypothermia.

Overall, climate change is expected to increase average temperatures, so the total number of days with cooler temperatures is expected to drop.^{vi vii} However, climate

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change may increase the number of severe storms affecting Placer County. ^{vii} These intense storm systems could create severe winter weather conditions in the Sierra Nevada and more severe winter weather events in the area.

WILDFIRE

Wildfires are a regular feature of California's landscape. Wildfires are fires burning in natural areas, although they can spread into developed areas between urbanized and wildland areas (called the wildland-urban interface, or WUI) where they can do more damage to people and property. They happen most often in late summer and autumn, when temperatures are high and several months without significant precipitation have occurred, creating large amounts of dry plants that can act as fuel. Wildfires can directly cause injuries, deaths, and extensive damage to property and natural lands. The smoke from wildfires can increase air pollution levels and create a significant health risk in the region, particularly under weather conditions that prevent smoke from clearing.

Climate change is expected to lead to an increase in wildfires throughout California. Warmer temperatures and an increase in drought conditions are likely to create more fuel for fires in the state's wildlands, leading to a greater chance that a spark will grow into a potentially dangerous blaze. The biggest increase in wildfires is projected to occur along the western slope of the Sierra, although areas closer to Lake Tahoe are also likely to see more areas burned by wildfires. ^{vi vii} Because wildfires burn the trees and other vegetation that help stabilize a hillside and absorb water, more areas burned by fire may also lead to an increase in landslides and floods. **Map 5** shows the areas in Placer County that are currently considered at risk of wildfires, categorized as moderate, high, or very high risk zones. These risk levels are determined by Cal Fire, and may change in the future.

Historically, an average of approximately 2,500 acres of Placer County burns each year. Under a scenario of moderate GHG emissions, this average is expected to increase to approximately 3,100 acres burned each year between 2040 and 2060, and approximately 3,800 acres burned annually from 2070 to 2099. Under a scenario of high GHG emissions, Placer County is projected to see an average of approximately 3,500 acres burned annually between 2040 and 2060, and approximately 5,800 acres burned annually from 2070 to 2099. ^{vi} **Map 6** shows the average annual increase in burned acreage for locations across Placer County.

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iii Intergovernmental Panel on Climate Change (IPCC). *Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change, Chapter 12: Long-term Climate Change: Projections, Commitments, and Irreversibility*. <http://www.ipcc.ch/report/ar5/wg1/>.

iv Intergovernmental Panel on Climate Change (IPCC). *Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change, Chapter 11: Near-term Climate Change: Projections and Predictability*. <http://www.ipcc.ch/report/ar5/wg1/>.

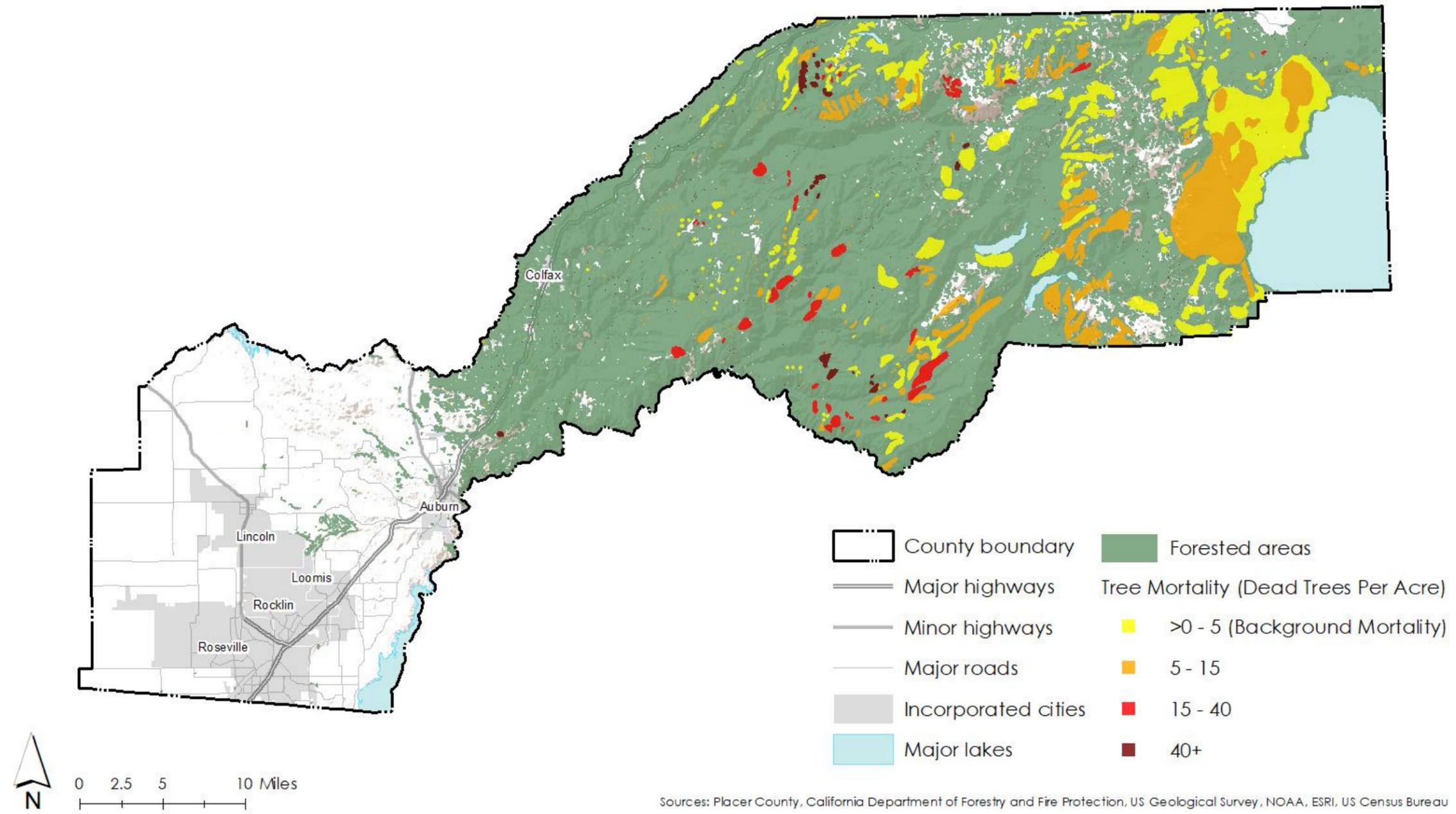
v Intergovernmental Panel on Climate Change (IPCC). *Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change, Chapter 9: Evaluation of Climate Models*. <http://www.ipcc.ch/report/ar5/wg1/>.

vi California Energy Commission (CEC). 2018. "Cal-Adapt: Guidance on Using Climate Projections". <http://cal-adapt.org/resources/using-climate-projections/>.

vii California's Governor's Office of Planning and Research (OPR), California Natural Resource Agency (CNRA), and California Energy Commission (CEC). 2018. "California's Fourth Climate Change Assessment". <http://www.climateassessment.ca.gov/>.

Map 1

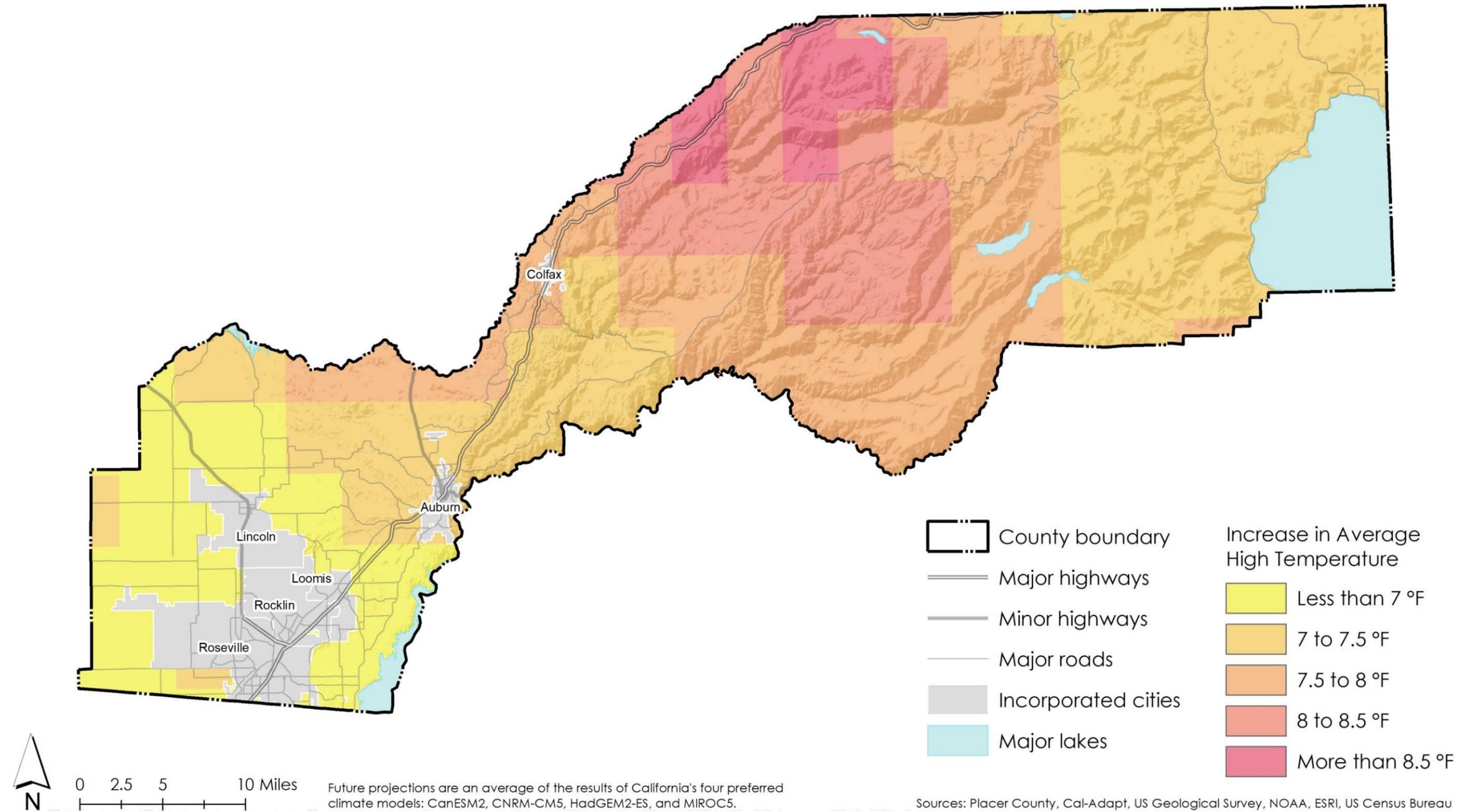
2017 Tree Mortality



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Map 2

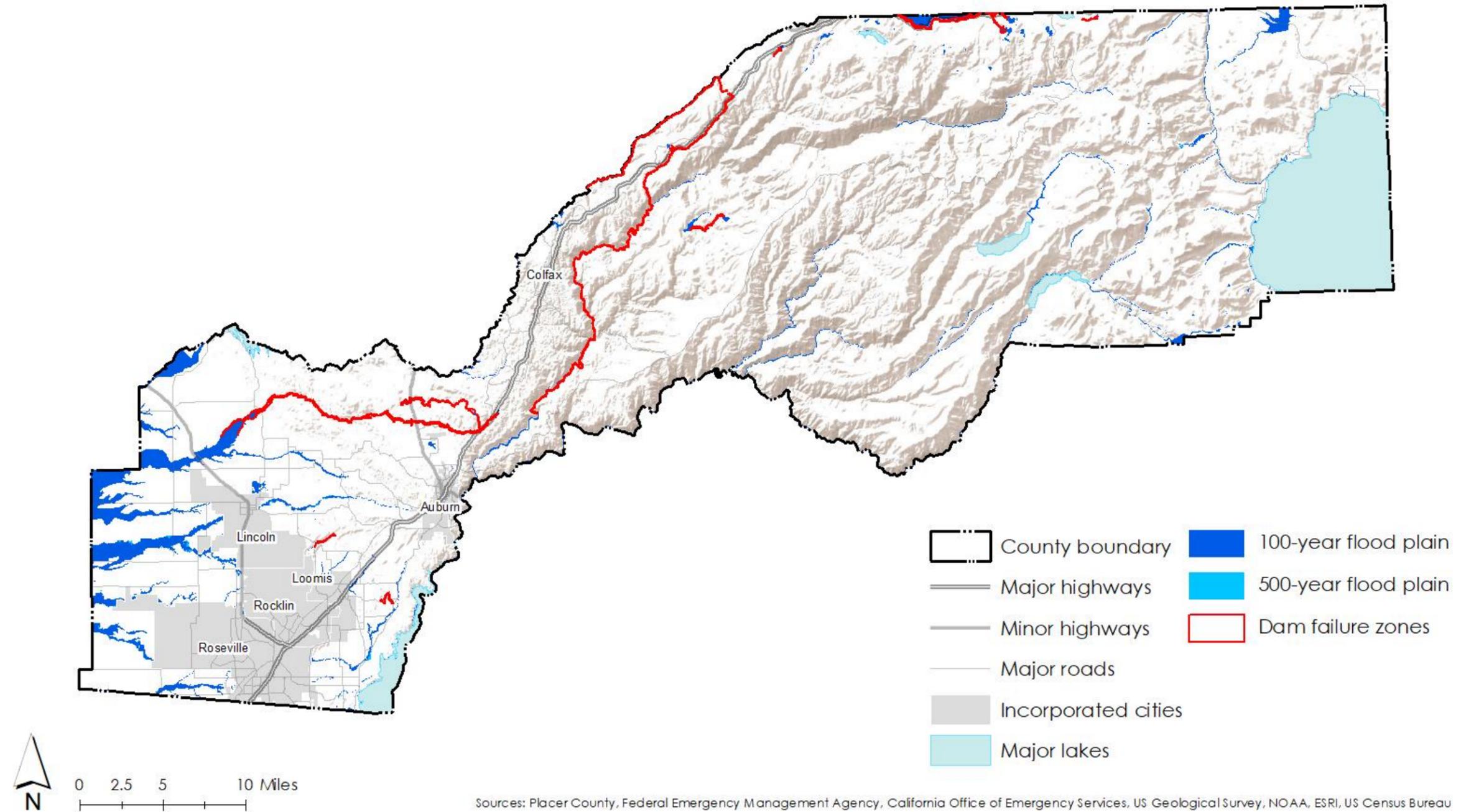
Changes in Average High Temperature, 1994-2013 to 2070-2099 (RCP 8.5)



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Map 3

Current Flood-Prone Areas

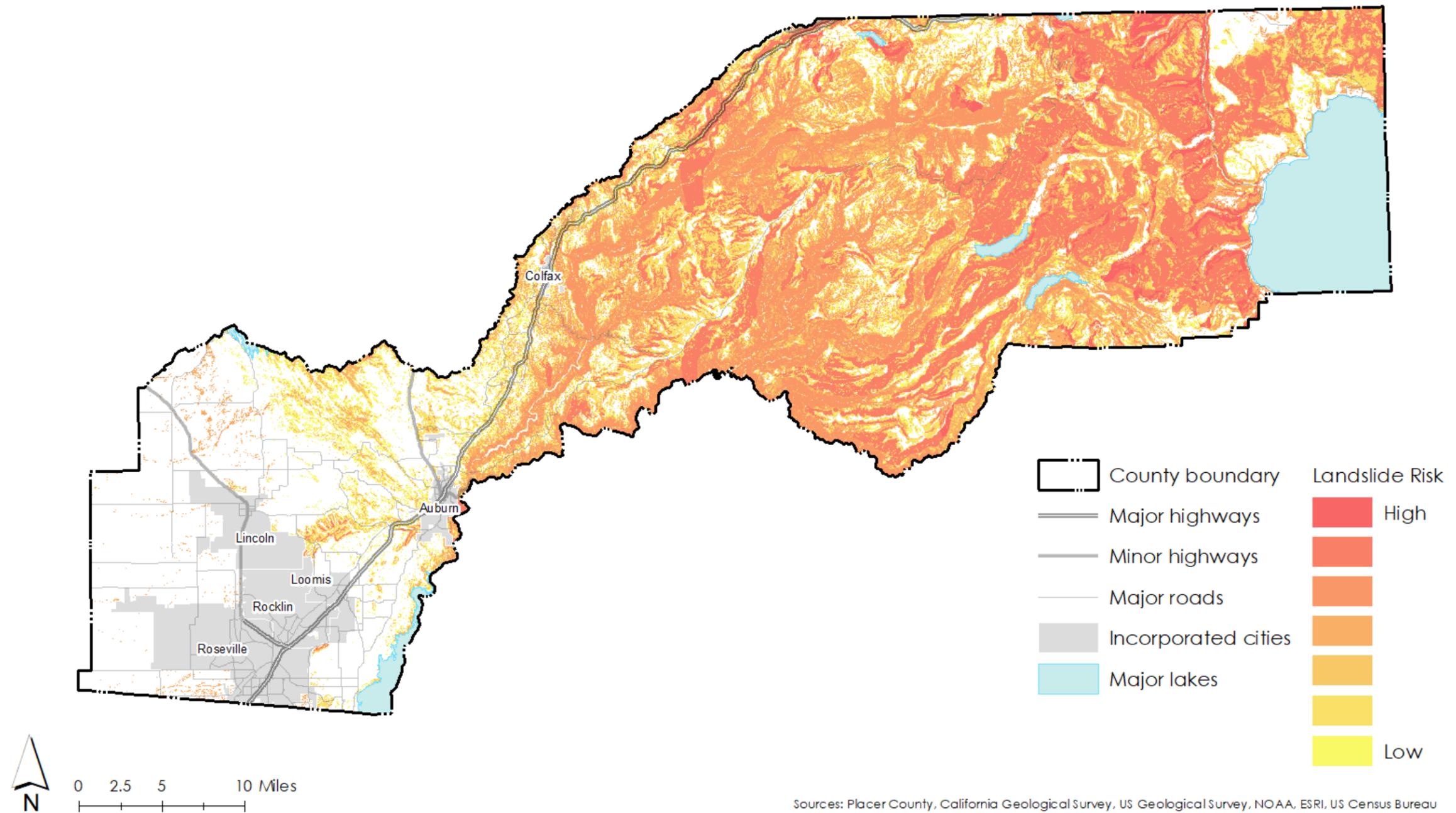


Sources: Placer County, Federal Emergency Management Agency, California Office of Emergency Services, US Geological Survey, NOAA, ESRI, US Census Bureau

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Map 4

Current Landslide Risk

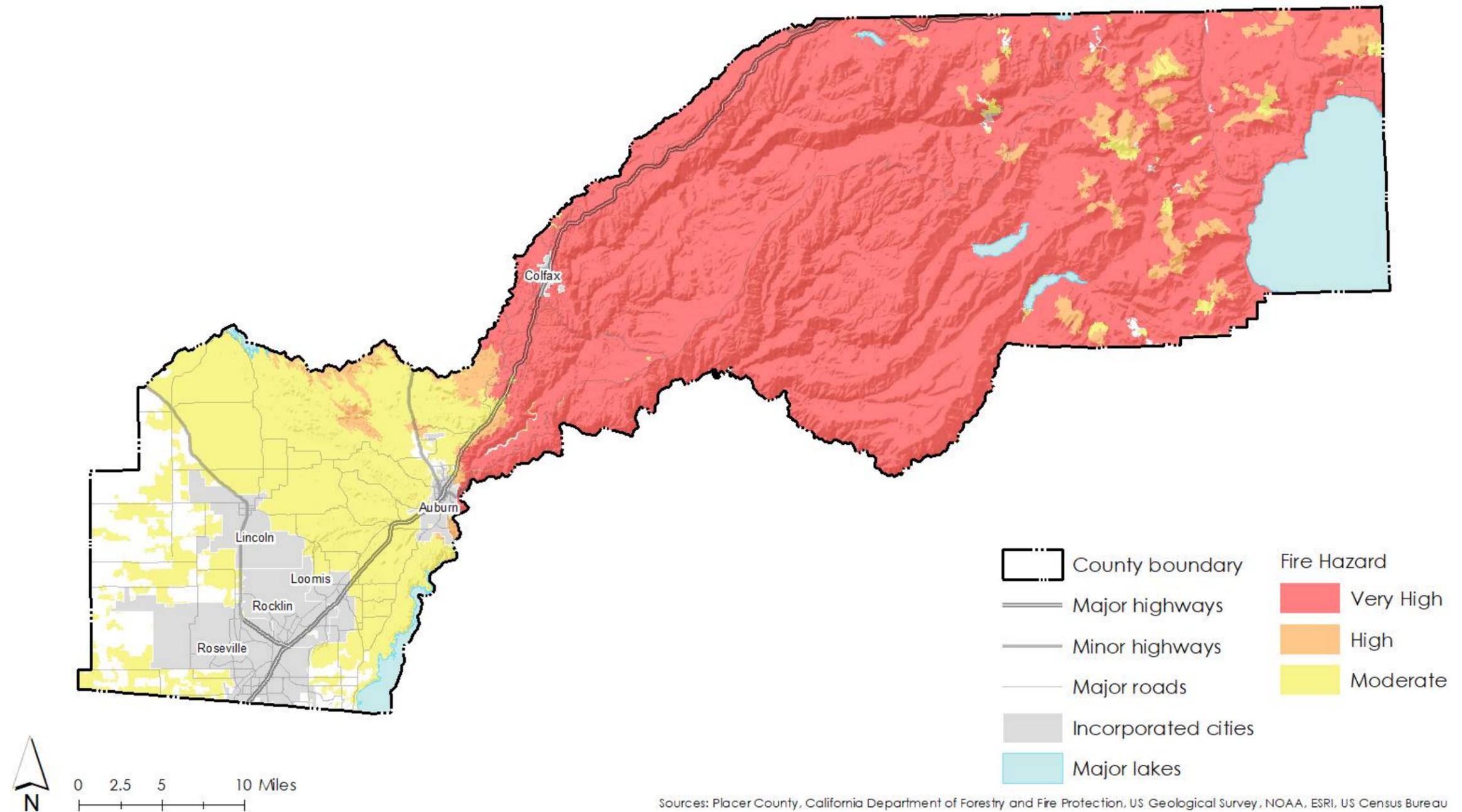


Sources: Placer County, California Geological Survey, US Geological Survey, NOAA, ESRI, US Census Bureau

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Map 5

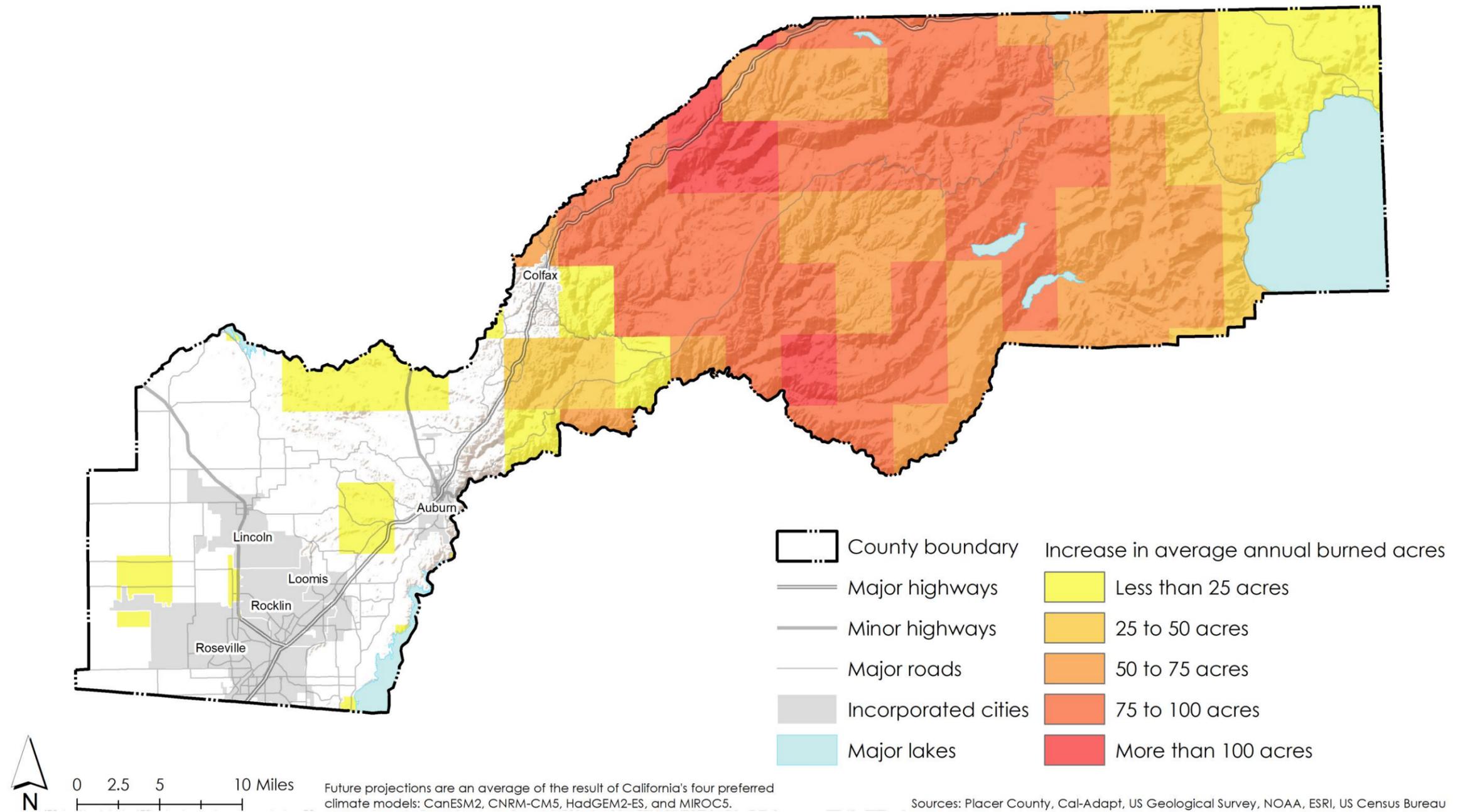
Current Wildfire Risk



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Map 6

Changes in Burned Acres, 1994-2013 to 2070-2099 (RCP 8.5)



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Photo credit: Placer County

Chapter 3: Populations and Assets

Populations and assets, also known as sensitivities, are the people and things in Placer County that can be affected by climate change. This vulnerability assessment looked at how each population and other community asset may be affected by each of the climate-related hazards discussed in **Chapter 2**.

SELECTED POPULATIONS AND ASSETS

The APG provides a general list of populations and assets to include in a vulnerability assessment. Placer County revised this list to be more appropriate to the county and to ensure that the vulnerability assessment looks at all sensitivities that are important to the community. In total, Placer County identified 58 distinct populations and assets.

Populations	People with something in common that may make them more vulnerable to climate-related hazards than the average person.
Infrastructure	Structures that provide various services to Placer County community members.
Buildings and facilities	Homes, nonresidential buildings, and other land uses.
Economic assets	Properties and activities that make significant contributions to the Placer County economy.
Ecosystems	Different types of wild and natural land.
Services	Important functions to community members provided by government agencies and private companies.

POPULATION AND ASSET CONSIDERATIONS

In selecting and assessing the various populations and assets to include in the vulnerability assessment, it is important to keep a few considerations in mind: differences in the population universes between datasets, the limitations of the data sources that Placer County used to prepare this assessment, and how some population and asset categories may appear to refer to the same thing.

POPULATION UNIVERSES

Statistics, especially statistics related to population, uses the concept of a “universe.” In this context, a universe refers to an entire group of people being measured or studied. For example, in a political poll that is conducted among registered voters, the universe is registered voters, since people who are not registered voters are not counted.

This concept is important for the Placer County Vulnerability Assessment because some of the demographics used have different universes. Most of the demographic data come from the US Census Bureau's American Community Survey (ACS), and most of this data has a universe of either all residents or all households in Placer County. However, a few that are different include:

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- Data on persons with limited English proficiency only counts people who are at least five years old, since young children generally are not proficient in any language.
- Statistics that only count the noninstitutionalized population (e.g. people not in prisons or long-term care homes).

This does not affect the outcome of the vulnerability assessment, but it can create slight differences in the number of people counted as part of each population.

DATA LIMITATIONS

As discussed in **Chapter 1**, the vulnerability assessment pulls in data from a wide array of sources. Placer County took care to only use reliable, credible sources with the best available information. However, in a few cases, credible information was limited or not available, and so the vulnerability assessment does not include data that would have been useful but could not be obtained from a reliable source. For example, there is no accurate information about the distribution of undocumented persons in Placer County, and even information about the total number of undocumented persons county-wide is an educated estimate. Because of this, the vulnerability assessment considers undocumented persons but cannot identify specific areas where they may face an elevated risk from certain hazards.

RELATED ASSETS

Throughout the 58 populations and assets in the vulnerability assessment, there are a few that may appear redundant. For example, the vulnerability assessment looks at both public safety buildings (as a Buildings and Facilities asset) and at public safety response (as a Service asset). In order to be as comprehensive as possible, the vulnerability assessment looks at physical structures separately from the services or benefits they provide. In the same way, this assessment looks at vulnerable people separately from the homes they live in or the industries where they are employed.

This is because the effects of climate change on one type of population or asset can be very different from the effects on related populations and assets. For example, if a flood destroyed the Foresthill Bridge, it would have a significant impact on public safety services in and around Foresthill, particularly if staff or resources were needed from elsewhere in Placer County. However, the loss of the Foresthill Bridge would do no damage to sheriff or fire stations or other public safety buildings. Similarly, a drought can have a major effect on water and wastewater services by reducing the amount of water available to the community, but droughts have very little physical effect on water and wastewater pipelines, pumps, or treatment facilities.

POPULATION AND ASSET PROFILES

POPULATIONS

The vulnerability assessment looked at the following 14 populations that may be disproportionately harmed by the effects of climate change.

Children: Children ten years old or younger. According to the 2015 ACS, approximately 11,390 children live in the unincorporated areas of Placer County, or approximately 10.1 percent of the total population. ^{viii}

Homeless persons: Persons who do not have a permanent home, including those who live in temporary shelters. There are approximately 580 homeless persons in Placer County, according to the County's 2018 homeless count, although most of these persons are likely in incorporated communities. ^{ix}

Households in mobile homes: Households who live in mobile homes (not including recreational vehicles, or RVs). The 2015 ACS reports approximately 2,500 households in the unincorporated areas of Placer County who live in mobile homes, or approximately 6.0 percent of the total number of households. ^{viii}

Outdoor workers: People who mostly work outdoors, including construction workers and people who work in agricultural operations.

Persons in poverty: People living in households with an income below the poverty limit, which is \$25,100 for a household of four people. There are approximately 10,120 people in Placer County who live in poverty, or approximately 9.1 percent of the total population for whom poverty status can be determined, according to the 2015 ACS. ^{viii}

Persons in overcrowded households: People living in households with more than one person per room in the house, not including bathrooms. The 2015 ACS reports approximately 1,180 households in the unincorporated areas of Placer County living in overcrowded or severely overcrowded (more than 1 and a half people per room) conditions, or approximately 2.9 percent of the total number of households. ^{viii}

Persons with chronic health problems: People who have a long-term or permanent health condition that can create regular challenges in their day-to-day lives. These health problems include obesity, cancer, heart disease, and arthritis.

Persons with disabilities: Persons with any kind of disability, including mobility challenges, hearing and/or vision impairments, behavioral disabilities, and challenges living independently or taking care of themselves. Some people may have more than one disability. According to the 2015 ACS, approximately 13,440 people in the unincorporated areas of Placer County have a disability, or approximately 12.1 percent of the total noninstitutionalized population. Approximately 10,270 households, or approximately 24.9 percent, have at least one household member with a disability. ^{viii}

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Persons with limited English proficiency: People who say they do not speak English “well”, or “very well,” although the Census Bureau does not formally define what these terms mean. The 2015 ACS reports that approximately 2,380 people in the unincorporated areas of Placer County who are at least 5 years old have limited English proficiency, or approximately 2.2 percent of the total population. ^{viii}

Persons without access to lifelines: These are individuals who do not have access to basic technology or services, such as transportation or modern telecommunication. These persons may live in areas where these lifelines are not available or feasible, may not be able to afford these lifelines, or for personal reasons may choose not to have them. While data is not available on all persons without lifelines, the 2015 ACS reports that approximately 1,350 households do not have vehicles, or approximately 3.3 percent of all households. ^{viii}

Renters: People who live in homes that they (or the head of their household) do not own. According to the 2015 ACS, approximately 8,920 households in the unincorporated areas of Placer County are renters, or approximately 21.6 percent of all households. ^{viii}

Senior citizens: Persons 65 years of age or older. The 2015 ACS reports that there are approximately 21,260 senior citizens in the unincorporated areas of Placer County, or approximately 18.9 percent of the total population. ^{viii}

Senior citizens living alone: Senior citizens who are the only people living in their homes, although they may have one or more caretakers. According to the 2015 ACS, approximately 4,220 senior citizens live alone in the unincorporated areas of Placer County, or approximately 19.8 percent of all senior citizens. ^{viii}

Undocumented persons: People who do not have formal permission to live in the United States (they do not have citizenship, permanent residency, visas, or other similar status). There are no official counts of how many undocumented persons live in Placer County, but a 2017 study estimated that the total number of undocumented persons in Placer County (including those living in incorporated areas) was 11,600 (other studies have reported somewhat lower populations). ^{x xi}

INFRASTRUCTURE

There are 13 types of infrastructure in this vulnerability assessment. Some infrastructure is publicly owned by Placer County or other government agencies, and others are private property.

Access roads: These roadways are one of a few, or the only, ways in and out of some communities or neighborhoods. The single or limited number of entry and exit points does not make the road itself more vulnerable than other roads, but loss of these roadways can effectively cut off large numbers of people from the rest of Placer County. Foresthill Road is one of the primary access roads, though a number of other smaller examples exist.

Biking and hiking trails: These trails are mostly intended for hiking and biking, although some are suitable for equestrian activity and off-road vehicles. These trails may be paved or unpaved. Some trails are part of much larger networks, such as the 2,659-mile-long Pacific Crest Trail. These trails are shown in **Map 7**.³

Bridges: Bridges may carry roads, rails, or trails. In Placer County, these range from the large, state-owned bridges that carry Interstate 80, to locally owned bridges that carry hiking trails over small creeks. **Map 8** shows the locations of state and locally owned bridges.

Communication facilities: These facilities include public radio and television transmitters, cell phone towers, emergency communication antennae, and a wide range of other public and private communication infrastructure systems. Most of these are found in populated areas or along the Interstate 80 corridor, although some are scattered in more remote parts of Placer County.

Electrical substations: Electrical substations are facilities that convert electricity from one voltage to another, making it suitable for long-distance transmission or for use by homes, businesses, and other electrical customers. There are 27 substations in the unincorporated areas of Placer County, most of which are owned by the Pacific Gas and Electric Company (PG&E). **Map 9** shows the locations of these substations.

Electrical transmission lines: Electrical transmission lines are power lines that carry high-voltage electricity long distances between power plants and electrical customers. There are several transmission lines in western Placer County, with others running along the Interstate 80 corridor, between Truckee and the Tahoe Basin, and out to Foresthill and Hell Hole Reservoir. PG&E owns most transmission lines in Placer County although some are owned by the Sacramento Municipal Utility District and other utilities. **Map 9** shows electrical transmission lines in Placer County.

Flood control infrastructure: This infrastructure includes levees, dikes, drainage channels, and other infrastructure meant to help prevent the rivers, creeks, and other water bodies in Placer County from overflowing their banks and causing floods. The Placer County Flood Control and Water Conservation District is the agency responsible for local flood control projects.

Major roads and highways: Placer County's major roads and highways connect individual communities to others in the region and to points beyond. Major highways include Interstate 80, State Highway 65, State Highway 49, and State Highway 89. Key roads that are not part of California's highway system include Foresthill Road, McCourtney Road, and Auburn Folsom Road.

³ The maps for Chapter 3 (Maps 7 through 12) are located at the end of the chapter, beginning on page 57.

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Natural gas facilities: These facilities help to keep the local natural gas network safe and operational by keeping gas flowing at safe pressures. There are six of these facilities in the unincorporated areas of Placer County, all in the western part of the county. **Map 9** shows the location of these facilities.

Natural gas transmission pipes: Natural gas pipelines carry large volumes of natural gas between communities. In the unincorporated areas of Placer County, one main pipeline runs roughly parallel to Interstate 80 and a second pipeline runs parallel to State Highway 65. Both have small spur lines running off of the main pipes. **Map 9** shows the location of these pipelines.

Power plants: Power plants generate large amounts of electricity that is distributed through the state and regional electrical grid. There are 14 power plants in the unincorporated areas (not including small-scale facilities such as rooftop solar panels), including the large Ralston and Middle Fork hydroelectric power plants. **Map 9** shows the location of power plants in Placer County.

Rail lines: There are two rail lines in Placer County, one running parallel to Interstate 80 and the other running roughly parallel to State Highway 65. Both are used for freight trains. The Interstate 80 line is also used for the Capitol Corridor commuter train (as far east as Auburn) and the long-distance California Zephyr train. **Map 8** shows the location of rail lines in Placer County.

Water and wastewater treatment plants: These facilities treat water for public use and treat wastewater so it can be safely discharged into the environment. There are twelve water and wastewater treatment plants in the unincorporated areas, although some of these facilities treat water and wastewater for people living in incorporated communities. **Map 9** shows water and wastewater facilities in Placer County, including treatment plants.

BUILDINGS AND FACILITIES

Buildings and facilities include different types of public and private structures. There are nine different types of building and facility assets in the vulnerability assessment.

Airports: In the unincorporated areas of Placer County, the one operational airport is the public Blue Canyon-Nyack Airport near Emigrant Gap, along with a CAL FIRE helipad outside of Auburn and a seaplane base of operations on Lake Tahoe. Although the Blue Canyon-Nyack Airport is used only for general aviation, seaplanes provide charter service from Lake Tahoe to the San Francisco Bay Area.

Businesses: Businesses include retail and wholesale stores, offices, warehouses, industrial facilities, or any other place where goods or services are produced or sold (excluding farms and other agricultural operations). They are mostly located in or around developed communities, although some businesses are in more remote areas.

Community facilities: Community facilities are public properties such as libraries, museums, community centers, landfills, and recreational centers. They are owned by the County government or by special government districts. **Map 10** shows the locations of these various community facilities. (Public properties such as government offices, parks, schools, and public safety buildings are discussed under their own categories.)

Community and regional parks: There are a number of parks and open space areas in the unincorporated areas of Placer County that are operated by the local government, such as Hidden Falls Regional Park, Doyle Ranch Park, and North Tahoe Regional Park. **Map 7** shows community and regional parks in Placer County.

County government offices: County government offices are the administrative and operational facilities of the Placer County government in unincorporated areas. These include the DeWitt Government Center in north Auburn as well as several smaller facilities throughout the county. **Map 10** shows the location of county government offices.

Homes: Homes are any building intended for people to live in, ranging from single-family homes on large parcels all the way to large-scale apartment buildings; they include mobile homes as well as conventional structures. Most homes are in the western valley areas, Foresthill, along the Interstate 80 corridor, and in various communities in the Tahoe Basin, although some are in more remote areas of the Sierra Nevada.

Medical facilities: In the unincorporated areas of Placer County, the primary medical facility is the Sutter Auburn Faith Hospital and its associated facilities in North Auburn. There is also a medical clinic in Kings Beach and a surgery center in Granite Bay.

Public safety buildings: Public safety buildings include police and sheriff buildings, fire stations, California Highway Patrol facilities, and related structures such as dispatch centers, correction facilities, animal shelters, and emergency operation centers. Most of the public safety buildings in Placer County are fire stations. **Map 10** shows the location of these facilities.

Schools: Schools in the unincorporated areas of Placer County include elementary schools, middle schools, and high schools, and continuing education and special education facilities. They are mostly in the developed areas along the Interstate 80 corridor; some facilities are in Sheridan, Foresthill, and along the shores of Lake Tahoe. **Map 10** shows the location of schools in Placer County.

ECONOMIC DRIVERS

Economic drivers are the primary contributors to the Placer County economy. This category of the vulnerability assessment covers ten primary economic drivers, including agricultural operations, outdoor recreation facilities, and various major employers.

Farms, orchards, and vineyards: This category includes field crops (such as vegetables, strawberries, and grains not including rice), fruit and nut orchards, vineyards, and plant

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nurseries. These farming operations are scattered throughout western Placer County, especially around Sheridan and the area between Lincoln and Auburn. In 2017, farms and orchards produced approximately \$28 million in agricultural products. ^{xii} **Map 11** shows the areas in Placer County that are designated for agriculture, and where farms, orchards, and vineyards are located.

Livestock: Cattle and calves, sheep, and chickens are among the largest livestock populations in the unincorporated areas of Placer County. Including apiary (bee) products, Placer County produced approximately \$15.3 million in livestock products in 2017. Cattle and calves were the single largest agricultural product produced in Placer County, with a 2017 value of approximately \$9.9 million. ^{xii} **Map 11** shows the areas in Placer County that are designated for agriculture, and where pasture lands for livestock are located.

Major employers: The largest employers in Placer County are spread throughout the county. They include ski resorts, major retailers and shopping centers, large hotels, schools, and government facilities. Many of these organizations employ over 1,000 people.

Outdoor recreation: Outdoor recreation is a critical part of Placer County's economy. It includes winter sports such as skiing and snowboarding; biking, hiking, and trail running; swimming; and all other types of outdoor activities. A number of outdoor recreation events, such as the Western States 100-Mile Endurance Run, attract participants from across the United States and beyond. Many outdoor recreation sites are in the more mountainous areas of Placer County east of Auburn.

Pastures: Pastures are the lands where many livestock species, including cattle, are raised. Pastures are widely spread throughout the more rural areas of western Placer County. The largest single plots of pasture land are close to 800 acres in size.

Rice-growing areas: Rice is the single most valuable plantcrop in Placer County. In 2017, rice growers in Placer County produced approximately \$8.3 million worth of rice. ^{xii} Flooded rice fields also act as temporary habitat for migrating waterfowl and other species. The rice-growing areas of Placer County are in the flat, wet areas west of Roseville and Lincoln near the border with Sutter County. **Map 11** shows the rice-growing areas in Placer County.

Ski resorts: The ski resorts of Placer County, along the Sierra Nevada crest and in the Tahoe Basin, are among the most popular winter recreation destinations in the United States. They include the five major downhill ski resorts (Alpine Meadows, Homewood, Northstar, Olympic Valley, and Sugar Bowl) and the cross-country ski areas. **Map 7** shows the ski resorts in Placer County.

State and national protected lands: Large sections of Placer County east of Auburn are under state or federal ownership, and much of this land is protected. The single largest protected area is the Tahoe National Forest. Other major areas include Burton Creek

and Donner Memorial State Parks, and the Auburn State Recreation Area. **Map 7** shows state and federal lands in Placer County.

Timberlands: Large sections of Placer County are forest, and although most forests are state or federal lands, much of the remaining forested areas are dedicated for timber. These timberlands extend east of Colfax to the Nevada border and cover more than 132,000 acres. **Map 12** shows the dedicated timber areas in Placer County.

Water recreation sites: Water recreation activities include boating, swimming, fishing, and rafting. Lakes and reservoirs, rivers, and even smaller streams and creeks can be suitable for water recreation. The major water recreation sites in Placer County include Lake Tahoe, Folsom Lake, French Meadows Reservoir, Hell Hole Reservoir, and the Middle and North Forks of the American River.

ECOSYSTEMS

There are 17 primary ecosystem types in Placer County (not including barren, agricultural, and developed land) according to the state's California Wildlife Habitat Relationships (CWHR) classification system, although many of these can be subdivided into specific habitats. The vulnerability assessment grouped local ecosystems into six categories. **Map 12** shows the location of these vegetation communities in Placer County. **Table 2** lists these six wild vegetated areas as well as developed and wild unvegetated areas and their acreage in Placer County.

TABLE 2: ECOSYSTEM COVERAGE IN PLACER COUNTY

ECOSYSTEM	ACRES	PERCENT OF WILD VEGETATED AREA	PERCENT OF ALL UNINCORPORATED AREA
Wild vegetated areas			
Chaparral	60,997	8.4%	6.8%
Conifer forests	526,822	72.8%	58.7%
Grasslands	69,290	9.6%	7.7%
Mountain meadows and scrub	2,195	0.3%	0.2%
Valley and riparian woodlands	61,677	8.5%	6.9%
Wetlands	2,866	0.4%	0.3%
All wild vegetated areas	723,847	100%	80.6%

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ECOSYSTEM	ACRES	PERCENT OF WILD VEGETATED AREA	PERCENT OF ALL UNINCORPORATED AREA
Developed and wild unvegetated areas			
Agriculture	50,243	-	5.6%
Barren	18,613	-	2.1%
Urban	42,156	-	4.7%
Water bodies	62,876	-	7.0%
Total developed and wild unvegetated areas	173,888	-	19.4%
Total unincorporated area	897,735	-	100%

Source: California Department of Fish and Wildlife

Chaparral: This habitat is made up of several types of evergreen shrubs, including manzanita, ceanothus, and scrub oak. Most chaparral species are found in lowland areas, although some chaparral ecosystems in Placer County live in higher elevations. These ecosystems are called montane chaparral. Common chaparral habitats are found in patches throughout the western side of the Sierras and along Big Granite Creek near Sawtooth Ridge. Montane chaparral ecosystems are widely scattered across the crest of the Sierra Nevada and in isolated elevated patches of the western Sierras. ^{xiii}

Conifer forests: This ecosystem group is made up of forests dominated by conifer species, most of which are evergreens, and include trees such as pines, fir trees, redwoods, and cedars. This is the most common ecosystem in Placer County, covering most of the land from the foothills east of Auburn all the way across the Sierra Nevada to the Nevada border. ^{xiii}

Grasslands: This ecosystem category is mostly made up of areas dominated by many different grass

Placer County Conservation Program

The Placer County Conservation Program (PCCP) is an effort to protect and enhance natural habitat in parts of western Placer County. It will help conserve these valuable and important ecosystems while also making it easier to conduct environmentally responsible infrastructure improvements, developments, and habitat restoration activities. ^{xiv} Although the PCCP and the PCSP are two separate efforts, the PCSP will help support the PCCP by improving the resilience of local and regional habitats, so that they can continue to thrive and remain a critical part of the local community.

species, including native and nonnative species. It also includes ecosystems made up of sage scrubs and other scrub plants. Grasslands may be made up of annuals (species that grow and die each year) or perennials (species that survive multiple years). Some grassland species include vernal pools, which are depressions in the ground that fill with water for part of the year, creating seasonal wetlands. Most grasslands are found in western Placer County, especially at elevations below 300 feet, although there are scattered areas of grasslands on the western slopes of the Sierra, near French Meadows Reservoir, along the crest of the Sierra, in the Martis Valley south of Truckee, and in patches around the Tahoe Basin. Sensitive animal species in grassland ecosystems include the burrowing owl, vernal pool fairy shrimp, and the endangered vernal pool tadpole shrimp and conservancy fairy shrimp. The grasslands ecosystem category includes the lands classified as grassland and vernal pool complex in the Placer County Conservation Program. ^{xiii xiv}

Mountain meadows and scrub: This ecosystem group is grasslands and scrubs that are specially adapted to high elevations and are mostly found in two places in Placer County. Mountain meadows are made up of several types of grasses and low shrubs and sit above the timber line on a handful of peaks along the Sierra Nevada crest, including Ward Peak, Granite Chief, and Lyon Peak. Mountain scrub is dominated by sagebrush scrubs and found south of Truckee in the Martis Valley. ^{xiii}

Valley and riparian woodlands: This ecosystem category is made up of several types of woodlands with mixes of deciduous trees, evergreens, and grasses and shrubs. Most habitats in this category are found in the low-lying valleys of western Placer County. Foothill oak woodlands, as well as valley oak woodlands, are part of this ecosystem category. Along the creeks and streams, these woodlands are made up of cottonwood, willow, sycamore, and in some places palm trees. In drier parts of the valley, these habitats are home to a diverse range of oak trees, pines, and cypress. One type of valley and riparian woodland habitat is specially adapted to higher elevations and is found in scattered patches near the Sierra Nevada crest and Tahoe Basin. The Swainson's hawk, a sensitive bird species, lives in valley and

Habitat Classification Systems

The PCSP classifies habitat types using the CWHR system, developed by state agencies for use in natural resource planning and management. Many of the studies used to identify the effects of climate change on habitat types use this classification or related versions. Although the PCCP uses a somewhat different classification system, comparing the habitat names in the two systems is quite easy:

- The land called "grasslands/vernal pool complex" in the PCCP is called "grasslands" in the PCSP.
- The land called "aquatic/wetland complex" in the PCCP is part of the "wetlands" category in the PCSP.
- The land called "oak woodland" in the PCCP is called "valley and riparian woodlands" in the PCSP. ^{xiii xiv}

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riparian woodlands, as does the Valley elderberry longhorn beetle, a federally-listed threatened species. The valley and riparian woodlands ecosystem category includes the land classified as various types of oak woodland in the Placer County Conservation Program. ^{xiii xiv}

Wetlands: Wetlands include the lakes, rivers, creeks, and streams as well as permanent or semi-permanent freshwater marshes. Permanent marshlands are found in scattered places throughout western Placer County, in patches of land between agricultural areas and grassland habitats. Semi-permanent wetlands are limited to isolated patches throughout the Sierra Nevada. The marshlands along Squaw Creek in Olympic Valley are the largest concentration of this habitat in Placer County. The wetlands and water bodies of Placer County support a large number of important animal species, including the tricolored blackbird, the California black rail, the western pond turtle, the foothill yellow-legged frog, the California red legged-frog, and the giant garter snake. Sensitive fish, including the Chinook salmon and the Central valley steelhead, also live in this ecosystem category. The wetlands ecosystem category includes areas classified as aquatic and wetlands complex, as well as riverine and riparian complex, in the Placer County Conservation Program. ^{xiii xiv}

SERVICES

There are six key services examined as part of this vulnerability assessment:

Communication: Communication services include radio, television, cellular and land-line phone, and Internet. These services can be delivered via wires or wirelessly, and most are delivered by private companies. Communication services are often used for entertainment but are also vital for information sharing and remaining connected.

Emergency medical response: Emergency medical response services are usually ambulances but may also be fire or police respondents if ambulances are not available. In remote areas away from roads, emergency medical response may arrive by helicopter. These services are critical in providing rapid and urgent medical care.

Energy delivery: Energy services in Placer County include electricity and natural gas delivered through high-capacity utility lines. In parts of Placer County, especially more remote areas and in the Tahoe Basin, energy comes in the form of propane or wood purchased by individuals at stores. Energy is needed for vital functions such as space heating and telecommunications as well as many other forms of entertainment and comfort. Major energy providers include PG&E, Pioneer Community Energy, Liberty Utilities, and the Southwest Gas Corporation.

Freight and shipping: These services involve transporting goods between places of production, warehouse and distribution centers, and retail stores. Freight movement in Placer County can be by on-road vehicles, such as truck, or by rail.

Public safety response: Public safety services are provided by law enforcement and fire agencies. These agencies include the Placer County Sheriff's Department, a variety of

fire protection districts and CAL FIRE, and (in limited cases) the California Highway Patrol and the United States Forest Service.

Water and wastewater services: These services involve treating and transporting water to be used by customers and transporting and treating wastewater so it can be safely released into the environment. Water and wastewater services are provided by a number of agencies and small private organizations throughout Placer County and are critical to ensuring public and environmental health.

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^{viii} US Census Bureau. 2016. American Community Survey, 2011 – 2015.

^{ix} Placer County. 2018. "Placer County's 2018 homeless point-in-time count shows slight decline from previous year". <https://www.placer.ca.gov/news/2018/april/homeless-count-results>.

^x Institute on Taxation and Economic Policy. 2017. *State and Local Tax Contributions of Undocumented Californians, County-by-County Data*. <https://itep.org/wp-content/uploads/CA-UnDOC-State-and-Local-Taxes.pdf>.

^{xi} Public Policy Institute of California. 2013. "Undocumented Immigrants in California". <http://www.ppic.org/publication/undocumented-immigrants-in-california/>.

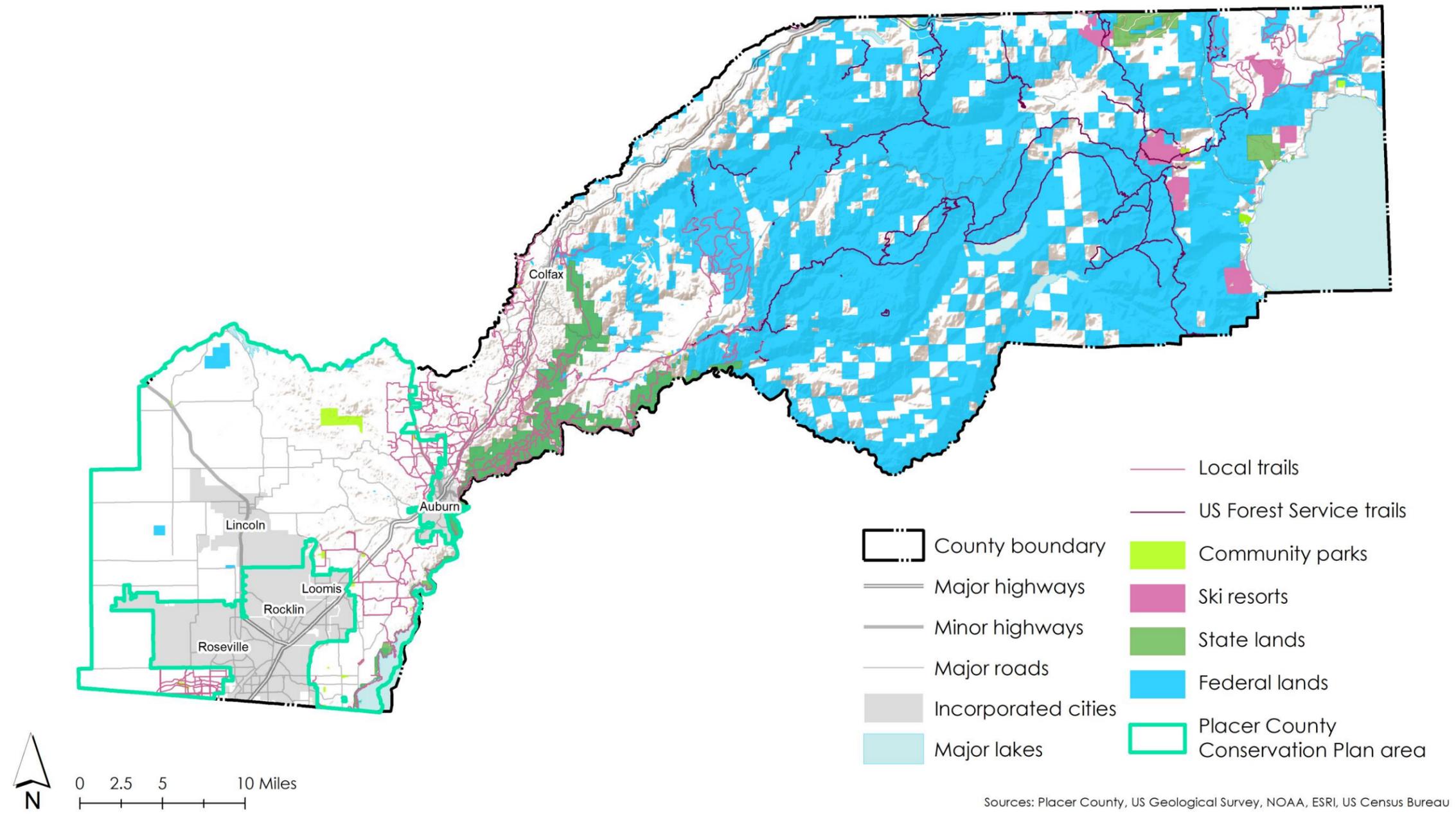
^{xii} Placer County Agricultural Commissioner. 2018. *County of Placer 2017 Crop Report*. <https://www.placer.ca.gov/departments/agriculture/agrcroprpts>.

^{xiii} California Department of Fish and Wildlife. 2018. "Vegetation Classification and Mapping Program". <https://www.wildlife.ca.gov/Data/VegCAMP>.

^{xiv} Placer County Community Development Resource Agency 2018. *Placer County Conservation Program – Update (Staff Report, August 9, 2018, Item 2)*.

Map 7

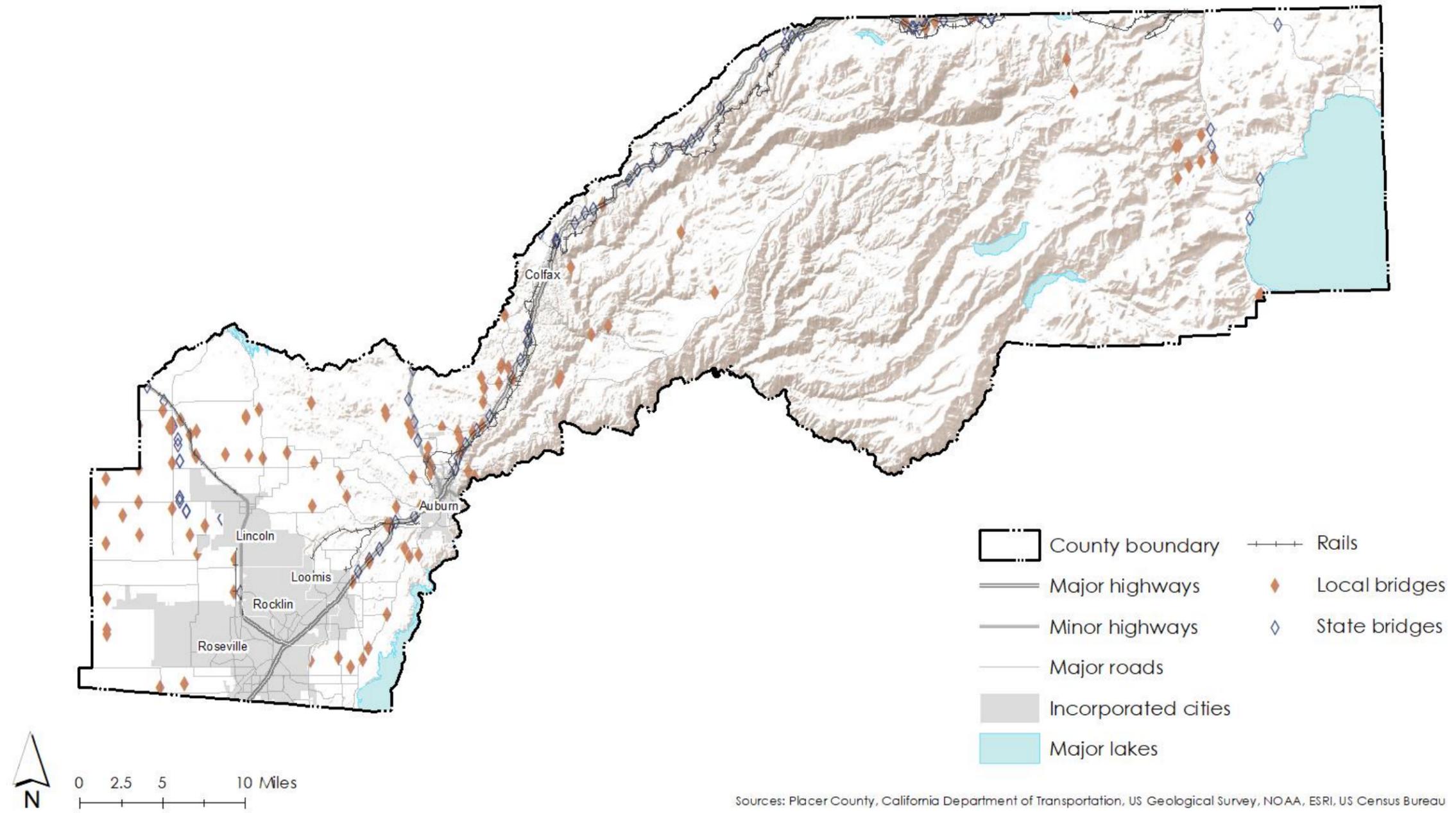
Recreation and Protected Lands



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Map 8

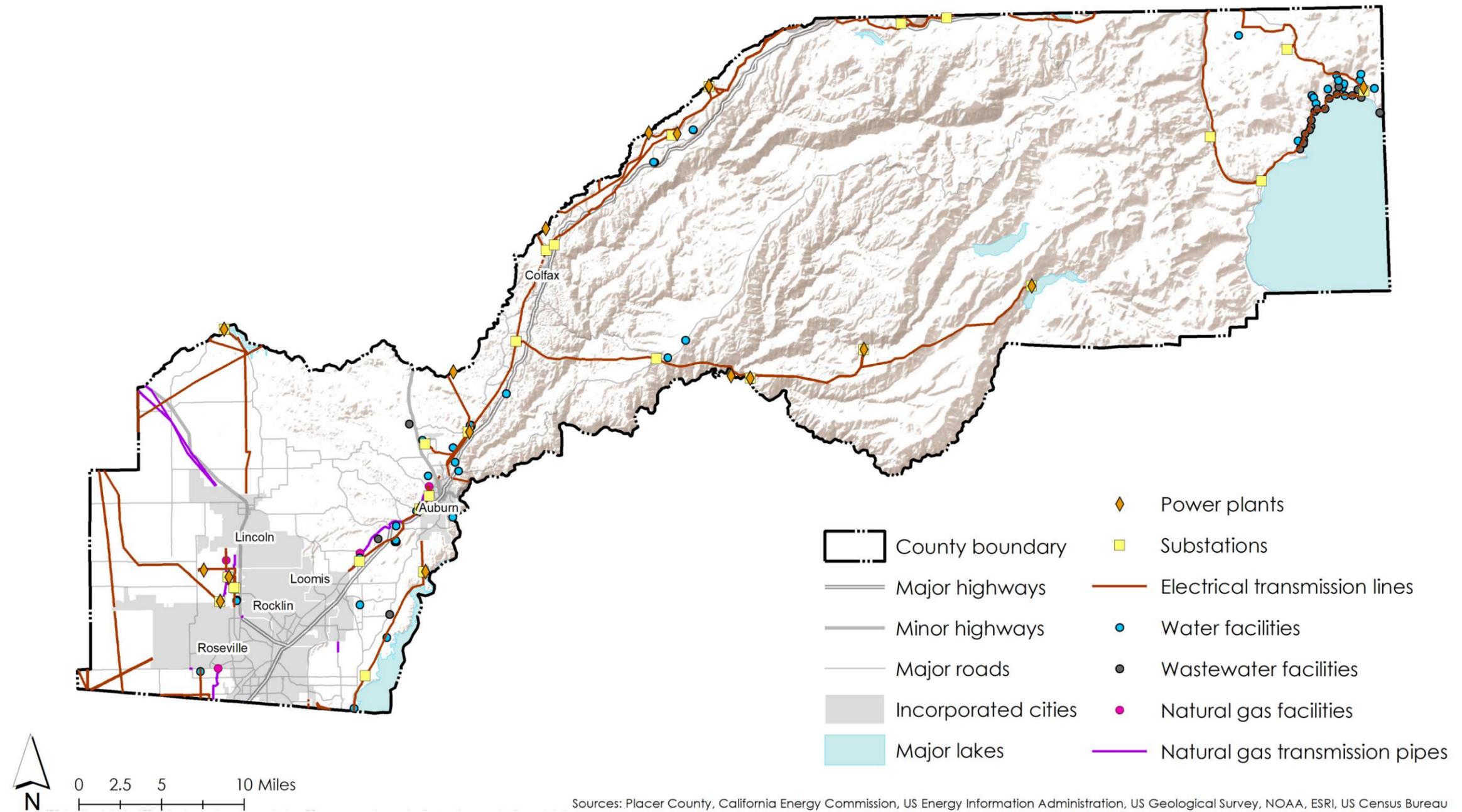
Transportation Infrastructure



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Map 9

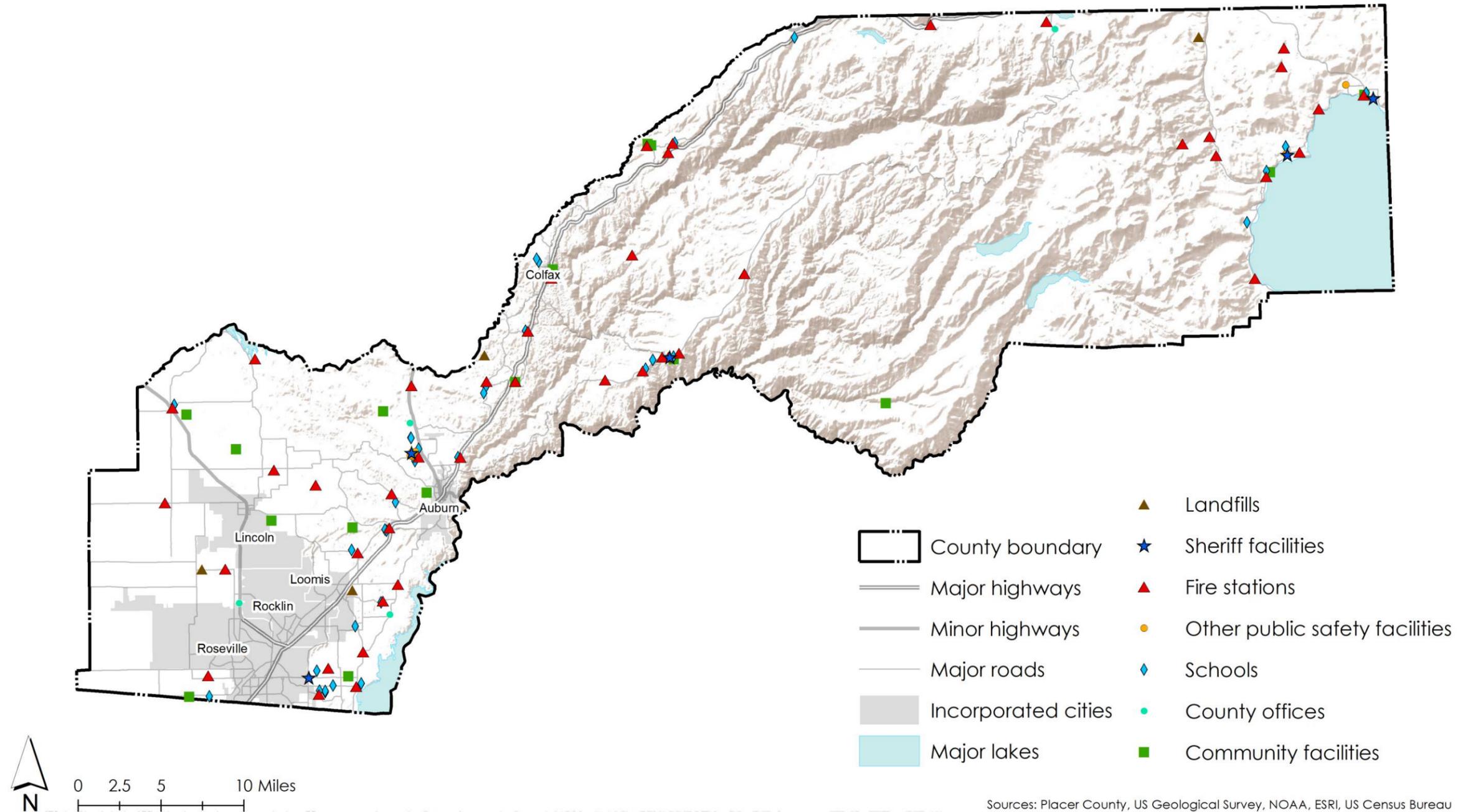
Utility Infrastructure



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Map 10

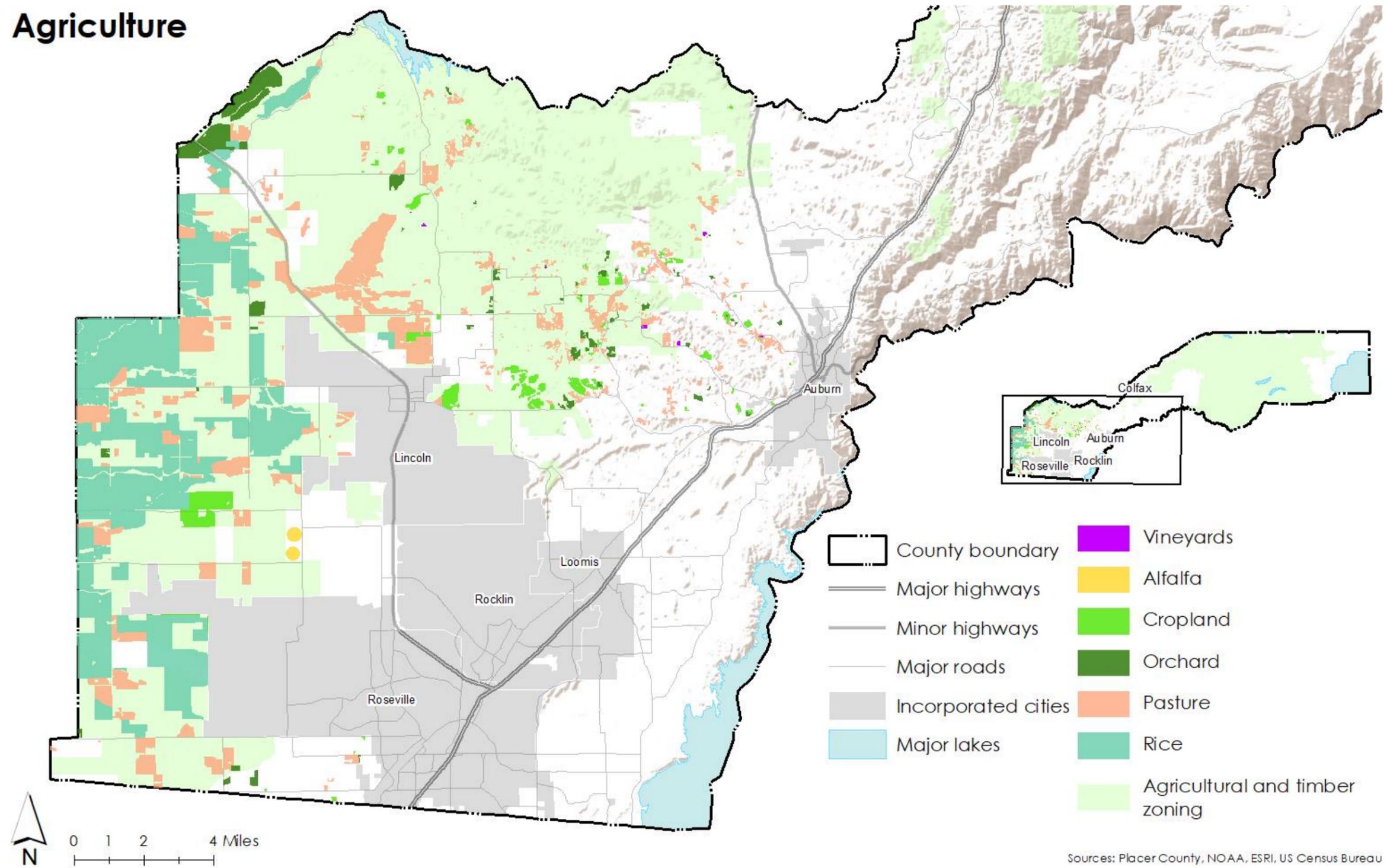
Government Facilities



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Map 11

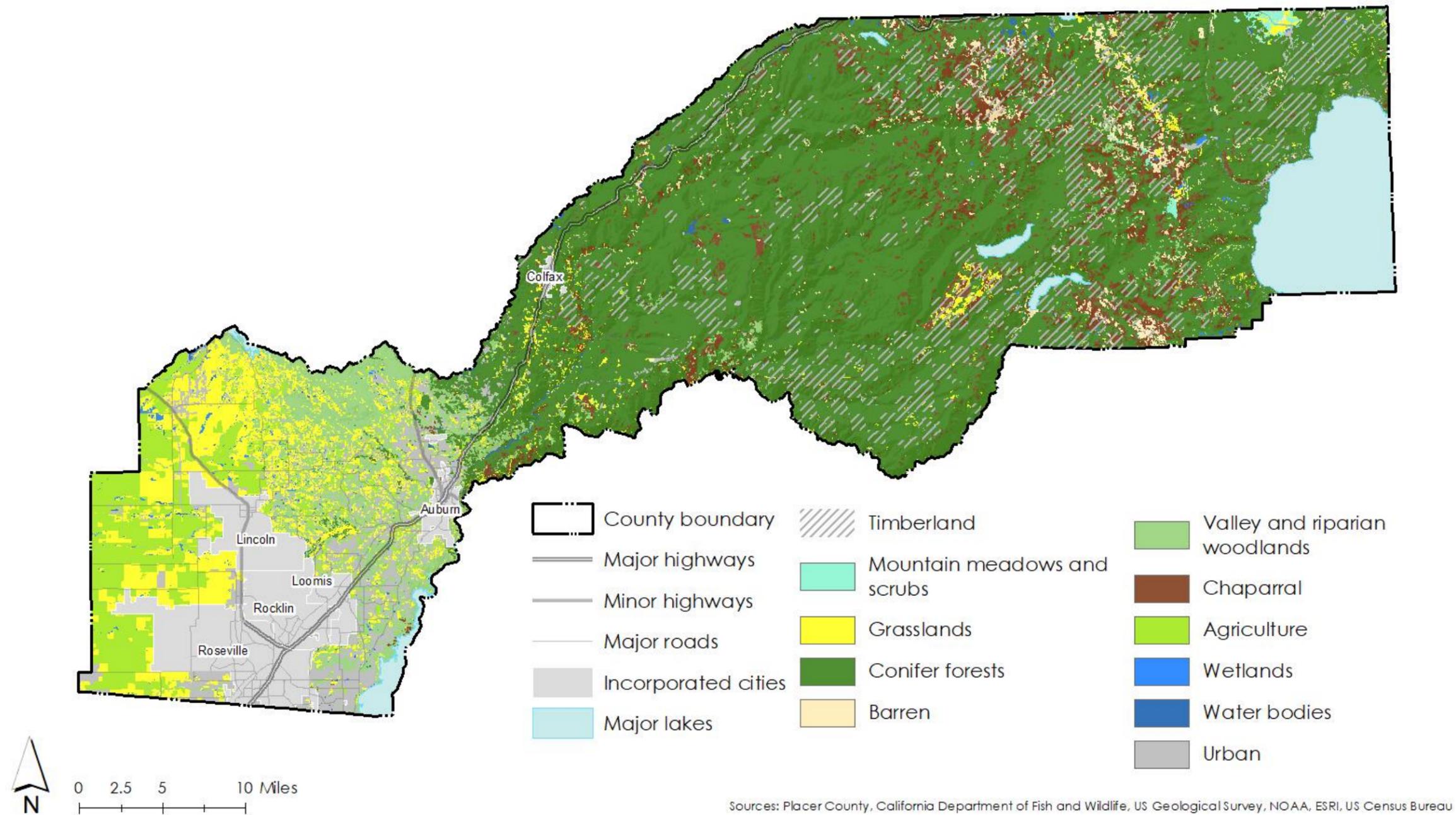
Agriculture



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Map 12

Vegetation



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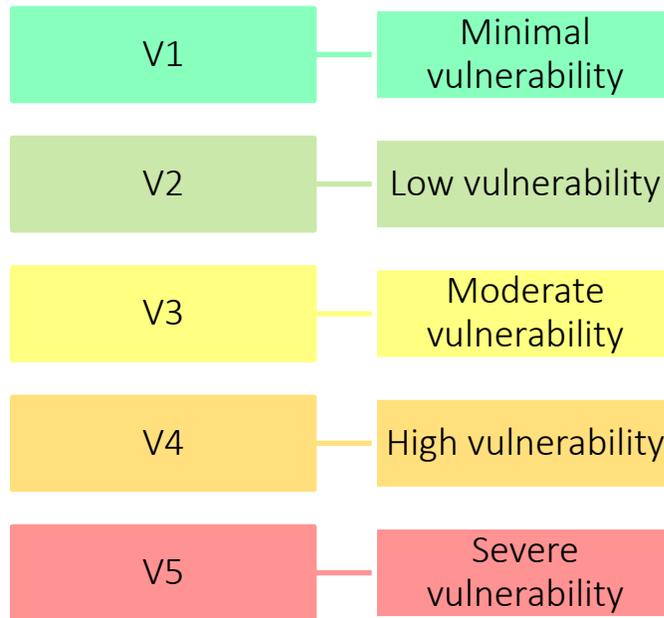
Photo credit: Placer County

Chapter 4: Results

As described in **Chapter 1**, the vulnerability assessment evaluates the impact and adaptive capacity of each population and asset for each relevant exposure and assigns a final vulnerability score on a scale of 1 to 5 (adjusted for risk and onset of the exposure). The vulnerability score reflects how susceptible the population or asset is to the harm posed by the exposure.

In total, this vulnerability assessment assigns vulnerability scores to 339 different pairings of exposures and sensitivities. Although there are 638 potential pairings of exposures and sensitivities, many were not given a score because the exposure is not considered a threat to the population or asset. For example, no score was given to rice-growing activities for avalanche hazards, because avalanches do not pose a threat to rice growing in Placer County.

The vulnerability scores are as follows:



KEY RESULTS BY SENSITIVITY TYPE

For the purposes of this vulnerability assessment, a score of V4 or V5 is considered significant. Populations and assets that score at least a V4 for one or more exposures are considered substantially vulnerable. The summaries in this vulnerability assessment focus on scores of at least V4. However, lower scores should not be ignored, and the Placer County Sustainability Plan will include adaptation strategies to improve resilience for populations and assets that scored a V3 or below for certain exposures.

This section discusses the significant vulnerabilities within each of the six main categories of sensitivities (populations, infrastructure, buildings and facilities, economic assets, ecosystems, and services). For a complete listing of the vulnerability scores for all sensitivities and exposures, see **Appendix 1**.

This section also includes examples of adaptive strategies that could improve resiliency for these populations and assets. The examples provided are based on best practices. Although one example strategy is provided for each population and asset, the County could choose to identify multiple strategies and/or combine strategies to address multiple issues. As a next step, Placer County staff will develop locally appropriate and feasible adaptation and resiliency strategies for public review and inclusion in the Sustainability Plan.

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VULNERABLE POPULATIONS

Among the 14 different populations analyzed, 9 scored V4 or V5 for at least 1 exposure type. At least 1 population group scored at least V4 for ten of the eleven exposures that Placer County assessed in this study. The one exception is fog, which was not found to have any impact on populations.

Children: The primary threat to children in Placer County is from extreme heat, especially to child athletes and children under the age of four. Children often have a lower level of awareness about avoiding heat-related illnesses, and there is some evidence that children are physiologically harder to keep cool than adults. Additionally, not all children may have access to air-conditioned spaces. All these factors can create significant health risks during extreme heat events.

Example adaptation strategies:

- Provide outreach and education about extreme heat to school districts, students, parents, and teachers, with an emphasis on areas with high populations of children and youth sports organizations.
- Ensure that County venues used for youth sports, such as community centers, parks, and similar facilities, are equipped with air conditioners, shade structures, or other features to provide cool areas.

Homeless persons: Homeless persons are highly susceptible to extreme heat, human health hazards, severe weather, and severe winter weather. Because most homeless persons in Placer County are unsheltered (meaning that they do not live in temporary housing), they are much more exposed to extreme weather conditions. They are more likely to experience dehydration, heat-related illness, hypothermia, and exposure to disease-carrying pests. A lack of medical care and little access to supplies that provide comfort and basic hygiene increase the vulnerability of homeless persons.

Example adaptation strategy:

- Include information about staying safe during extreme events and available assistance as part of homeless outreach activities, including the annual homeless persons survey.

Households in poverty: Households in poverty are one of the most vulnerable populations in the county. Drought, extreme heat, flooding, human health hazards, landslides, and severe winter weather all pose increased threats to these persons. Households in poverty have very limited financial resources, so they are frequently unable to retrofit their homes to better resist climate-related hazards, to afford supplies and equipment that can help adapt or respond to these conditions, or to move into less vulnerable housing. These households are also less likely to be able to absorb the costs of moderate repair or recovery activities, so a disaster can be much more

financially damaging to a household in poverty than households with higher income levels.

Example adaptation strategy:

- Identify funding opportunities, including potential grant assistance programs, to support repairs of structural concerns in homes and apartments occupied by households in poverty.

Outdoor workers: Outdoor workers are much more exposed to the elements than most people, so they are more susceptible to extreme heat conditions and the potential illnesses associated with very high temperatures. Although protective clothing and regular access to water can significantly reduce the threat, these options may not always be available. Agriculture and forestry pests and diseases can also be indirectly harmful to these workers by threatening the industries that provide their livelihood.

Example adaptation strategy:

- Provide expanded, widely distributed notifications of extreme heat conditions in multiple languages, with advice for reducing harm during very high temperatures.

Persons in mobile homes: Although tornadoes and hurricanes are often considered the greatest risk for mobile homes, people living in these homes also face elevated vulnerabilities from flooding, severe weather, and wildfires. Mobile homes are usually less structurally sturdy than conventional homes, making them more likely to suffer damage. In Placer County, mobile homes are on average older than conventional homes, and such homes may not be as well maintained. Persons living in mobile homes typically have lower income levels and usually do not own the land their mobile home sits on, making it harder for them to install protective landscaping or take other actions to increase their resiliency.

Example adaptation strategy:

- Coordinate with mobile home park owners and tenants in wildfire hazard zones to reduce fuel availability and maximize defensible space.

Persons with chronic health problems: Extreme heat can be highly dangerous to persons with chronic health conditions, because very high temperatures can exacerbate diabetes, cardiovascular conditions, respiratory ailments, and cerebrovascular diseases. Some medication taken by persons with chronic health problems interferes with their ability to maintain a safe internal temperature, further increasing the risk of heat-related illnesses. Power losses, a frequent consequence of extreme heat, can create risks for persons who depend on medical devices. The weakened immune system of these persons can make them more likely to contract illnesses, making them more vulnerable to human health hazards. Their medical conditions can limit their ability to effectively take care of themselves and avoid

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significant harm, especially people with substantial health problems who do not have regular assistance.

Example adaptation strategy:

- Ensure that County health programs share information about projected increases in extreme heat events with medical providers for persons with chronic health conditions.

Persons without access to lifelines: Severe winter weather is highly dangerous to people without access to lifelines. They may not be aware of impending severe winter conditions and are more likely to be stranded in their homes without sufficient food or other supplies. The threat is greater for people who do not have assistance from family, friends, or other support networks.

Example adaptation strategy:

- In areas that experience severe winter weather, promote the creation of community support networks to check on persons without access to lifelines during dangerous conditions.

Senior citizens: Although senior citizens are vulnerable to a number of different exposures, the ones of greatest concern are extreme heat and wildfire. Senior citizens are more likely to have medical conditions that can worsen with extreme heat, and often take medicine that makes it harder for them to stay cool. Senior citizens are more susceptible to poor air quality associated with wildfires, and seniors may have a decreased awareness of impending fire events. Decreased access to transportation and physical or behavioral disabilities can make it harder for senior citizens to take protective actions or evacuate to safe areas. **Map 13**⁴ shows the percentage of residents who are senior citizens compared to the wildfire risk hazards in Placer County.

Example adaptation strategy:

- Identify and/or support programs that provide free or reduced-cost energy

Senior citizens and evacuations

Evacuations are one of the biggest challenges to improving resiliency among senior citizens, especially senior citizens living alone. Difficulty seeing or hearing, cognitive impairments, and mobility challenges can all make it more difficult for senior citizens to recognize when evacuations may be needed and to act accordingly. Some seniors have little or no access to transportation, further impeding evacuations and requiring them to rely on others for assistance. These factors were on display in the 2017 northern California wildfires. Most of the 44 people killed by the fires were senior citizens.

⁴ The maps for Chapter 4 (Maps 13 through 19) are located at the end of the chapter, beginning on page 91.

efficient air conditioning units to senior citizens.

Senior citizens living alone: Senior citizens living alone are highly vulnerable to more exposures than any other group analyzed in this vulnerability assessment, showing an increased threat from avalanches, extreme heat, flooding, human health hazards, landslides, severe weather, severe winter weather, and wildfires. Ultimately, these vulnerabilities all stem from similar factors. The physiology of senior citizens can make them more susceptible to many health-related risks of these exposures. Reduced mobility, physical disabilities, and memory loss or other behavioral conditions can decrease their awareness of impending hazardous conditions and their ability to take necessary steps. While these challenges exist for all senior citizens, a lack of someone else in the household can make these actions much more difficult. **Map 13** indicates where the greatest proportions of senior citizens live alone.

Example adaptation strategy:

- Ensure that emergency notification and evacuation plans include contingencies for senior citizens who live alone.

Undocumented persons: Undocumented persons who work in agricultural or forestry operations are highly vulnerable to agriculture and forestry hazards. If an agricultural or forestry operation suffers due to these hazards and begins cutting jobs as a result, undocumented persons are likely to be among the first to be let go. These hazards create an indirect risk of economic hardship to undocumented persons. If the increase in agricultural and forestry pests and diseases causes operators to use more pesticides and other potentially harmful chemicals, undocumented persons and other workers could suffer health impacts from increased exposure to these chemicals.

VULNERABLE INFRASTRUCTURE

Out of the 13 different types of infrastructure that are analyzed in this vulnerability assessment, 6 scored a V4 or V5 for at least one type of exposure. Landslides are the exposure that poses the greatest risk to Placer County infrastructure. Other exposures that may be particularly damaging are flooding, severe weather, severe winter weather, and wildfire. **Map 14** shows key utility infrastructure and landslide-prone areas, and **Map 15** shows utility infrastructure and wildfire risk zones.

Access roads: Access roads can be damaged by flooding and landslide events, in addition to any subsidence due to drought conditions. Severe winter weather and wildfires are also harmful, since these hazards can block or close the road even if they do not cause physical damage. Because these roads are critical for access to various communities and neighborhoods, any damage or closure can effectively isolate these communities, potentially creating severe health and safety risks. The remote nature of some of these roads can make repair activities more challenging.

Example adaptation strategies:

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- Encourage people in communities located on these roads to maintain enough emergency supplies to last at least three days.
- Explore opportunities to protect vulnerable access roads against damage from natural hazards.

Biking and hiking trails: The biking and hiking trails of Placer County are highly susceptible to being swept away or buried as a result of landslides, since many of these trails travel through landslide-prone areas. Reconstruction work can be delayed because of the remote location of some trails, and they are likely to receive lower priority than any damaged roadways. Wildfires are unlikely to significantly damage trails directly, but they can force widespread trail closures. Although less severe than the effects of other exposures, droughts can cause the surface of trails to fracture or sink, making the trails harder to navigate. The locations of trails in wildfire hazard zones are shown in **Map 16**.

Example adaptation strategy:

- Stabilize slopes above and below trails, particularly highly trafficked trails or those that connect to isolated communities.

Bridges: Placer County's bridges are highly vulnerable to flooding and severe weather. These events can damage bridges, potentially reducing their capacity or requiring them to be closed for repairs. In more severe cases, bridges may be completely destroyed by these events. While bridges can be retrofitted to better resist these consequences, the large number of bridges in Placer County and the remote location of many of them can make such activities challenging.

Example adaptation strategy:

- Conduct structural retrofits for at-risk bridges and ensure that these retrofits include protections against flooding.

Communication facilities: Many of Placer County's communication facilities are in the hilly or mountainous areas of the county, at an elevated risk of landslides. A landslide can damage or destroy these facilities, making them unable to function the way they are supposed to. Reaching these facilities for repair or reconstruction work can be

The bridges of Interstate 80

Interstate 80 is Placer County's primary east-west roadway. It runs through or near most of the county's population centers and connects to nearby large cities such as Sacramento and Reno. Along its route through unincorporated Placer County, Interstate 80 travels over 57 different bridges, including several over the floodplains of the South Yuba River. Damage to these bridges, especially in rural areas, could cause significant congestion and force large detours.

challenging, particularly if the landslide was a major event that significantly altered the local terrain.

Example adaptation strategy:

- Work with landowners to stabilize slopes above and below key communication facilities.

Electrical transmission lines: The electrical transmission lines in Placer County run through landslide-prone areas and can be damaged or destroyed by these events. The transmission lines that connect to Placer County's hydroelectric facilities in remote areas are at particular risk. Alternatives to these transmission lines are not usually available and accessing remote locations for repairs or reconstruction can be challenging.

Example adaptation strategy:

- Work with electrical providers to ensure that they have the capabilities to rapidly access and repair remote transmission lines during and after extreme events.

Power plants: Landslides are the primary exposure that threatens Placer County's power plants. Although large industrial facilities such as power plants are not often in landslide-prone areas, in Placer County there are several hydroelectric power plants on the lakes and rivers in the Sierra Nevada. The mountainous terrain surrounding these power plants is susceptible to landslides, which can harm the connecting electrical lines and block access. If the sliding material ends up in the lake or river, it can also reduce a power plant's capacity. Damage to the facilities themselves is also possible in the case of a major landslide. Alternative power plants may not be immediately available if a power plant is taken off-line because of landslides, and there may be temporary outages until other sources of power are found.

Example adaptation strategy:

- Conduct vulnerability assessments of County-owned power plants and encourage other power plants in Placer County to do the same.

VULNERABLE BUILDINGS AND FACILITIES

The vulnerability assessment reviewed nine different types of buildings and facilities in Placer County and found that three scored V4 or higher for at least one exposure. Wildfire poses the greatest risk to Placer County's buildings and facilities. **Map 17** shows key government facilities in wildfire risk zones.

Homes: Homes are the most vulnerable building or facility type in Placer County. Some are in remote, hazard-prone areas where most other building types do not locate, and so larger numbers of them may be exposed to dangerous conditions. Landslides, severe weather, and wildfires can all damage or destroy houses, and though protective

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measures and retrofits can help resist damage, they are not always economically feasible. Agriculture and forestry pests and diseases can also pose a threat, primarily bark beetles and other forestry pests. In forested areas, bark beetles and similar pests can weaken tree limbs or entire trees, creating a risk that trees will fall on nearby houses if the trees are not properly trimmed.

Example adaptation strategy:

- Provide financial assistance to help private homeowners trim or remove bark beetle-infested trees near structures, supplementing existing cost-sharing programs.

Community facilities: Community facilities in large areas of Placer County are at risk of damage or destruction from wildfires. Although retrofits and other fire-safe strategies can help reduce the risk, limited budgets and the nonvital nature of many community facilities can make them a lower priority for fire protection activities.

Example adaptation strategy:

- Conduct fire-safe retrofits at community facilities in areas of elevated wildfire risk.

Community and regional parks: Community and regional parks in wildfire-prone areas are subject to harm from wildfire events. The park facilities can be damaged or destroyed by a blaze, and landscaped areas and natural lands in these parks may be burned. Facilities themselves and some landscaped areas can be protected against wildfire events, but these options are not always feasible. Natural lands largely cannot be protected against wildfire, and though ecosystems will likely eventually recover, the park's scenic and recreational appeal can be diminished in the meantime. **Map 16** shows the location of these facilities and the wildfire risk zones in Placer County.

Example adaptation strategy:

- Provide fire-safe landscaping around park perimeters and key facilities as feasible.

VULNERABLE ECONOMIC DRIVERS

Eight of the ten economic drivers analyzed in this vulnerability assessment are considered highly vulnerable to climate change because they scored V4 or V5 for at least one exposure. Drought has a significant effect on the largest number of economic drivers, followed by extreme heat.

Farms, orchards, and vineyards: These operations have a high level of vulnerability to a number of different exposures. Extreme heat is expected to have the most severe effect, but drought, flooding, and severe weather may also cause significant harm. Droughts can make less water available for crop irrigation, reducing yield and altering cropping patterns if farmers cannot find alternative supplies. Extreme heat can damage a number of different crops in Placer County, and crops such as walnuts depend on long, cold winters that are likely to be less common in the future. Floods and severe weather can heavily harm or kill crops, and damage infrastructure, reducing agricultural yields and creating costly repairs. In some cases, farmers may be able to find crop varieties that are more resilient to these changes. Improved drainage and other infrastructure, changes to pest management activities, and increased personnel levels at farming operations may help reduce damage from exposures. However, many of these actions can be expensive and may not be appropriate for all types of farming operations.

Example adaptation strategy:

- Work with farming organizations and the University of California Cooperative Extension to promote the availability of crop varieties that are more resilient to climate change exposures while meeting market demand for yield and quality, as options become available.

Livestock: Livestock in Placer County, especially cattle, are highly vulnerable to drought and extreme heat events. The large amount of water required for livestock (and feed) is not always available or affordable during major drought events, and extreme heat can result in widespread animal illnesses or even death. Operators can reduce the size of their herds or flocks and apply for government assistance programs. In the case of extreme heat, shade structures and increased water supplies can help protect against harm. However, despite best efforts, economic harm from these hazards remains likely.

Example adaptation strategies:

- Identify financial assistance or other opportunities to support ranchers with tree plantings and shade structure installations on rangelands.

Construct new and enhance existing water storage facilities to augment surface and groundwater supplies for agricultural uses. **Outdoor recreation:** Many outdoor recreation activities,

Drought and rice

Most rice fields in California are flooded with 4 to 6 inches of water during much of the growing season, making it one of the most water-intensive crops in the state. Over the course of a growing season, an acre of rice uses between 1.3 and 2 million gallons of water. In part because of rice's high water demand, rice production throughout California, including Placer County, drops during significant droughts. At the height of the most recent drought, statewide rice production dropped 30 percent.

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such as running, hiking, and biking, are susceptible to harm from extreme heat, severe winter weather, and wildfire events. People participating in these activities are already experiencing an increase in heat-related illnesses. Intense physical activity during any of these events can threaten people's health if they are exposed to extreme temperatures or poor air quality. Wildfires can also directly damage outdoor recreation sites. In some cases, outdoor recreation facilities may have to close to protect visitors. Alternative recreation facilities may not be available in Placer County, which can cause a loss of economic activity county-wide from visitors affected by these events.

Example adaptation strategy:

- Provide notifications before and during extreme events to warn people about dangerous conditions and to identify alternative activities and areas.

Rice-growing areas: The rice-growing activities in western Placer County face elevated vulnerability from both drought and flooding events. Rice production decreases during drought because most rice varieties require significant amounts of water. Although rice fields are flooded during much of the season, flood events outside of this season can delay planting and damage harvest-ready rice, decreasing Placer County's rice yield and damage equipment and infrastructure, requiring expensive repairs. There is a growing number of drought- or flood-resistant rice species that farmers can plant, but these varieties may not meet market demand or be feasible for all lands. As rice fields also support migrating waterfowl, decreases in rice yield may also harm regional bird species.

Example adaptation strategy:

- Work with local rice growers to encourage adoption of drought- and flood-resistant species as market-suitable varieties become available.

Ski resorts: Drought, landslides, and severe weather can all threaten the ski resorts of Placer County. Droughts can significantly reduce snow levels at ski resorts, decreasing their ability to operate during the entire winter season. Landslides and severe weather can make conditions at ski resorts unsafe for outdoor activities, and in some cases, landslides can damage or destroy facilities or a ski run. Artificial snow can help supplement natural snowfall, but it may not be feasible during intense droughts. Ski resorts can harden themselves against severe weather, and to some degree against landslides, but alternatives to outdoor activities during dangerous conditions are often not available to meet visitors' demands. **Map 18** shows the location of ski resorts and projected changes in snowpack levels.

Example adaptation strategy:

- Encourage ski resorts to begin exploring additional activities for visitors that are less dependent on snowpack levels.

State and national protected lands: The state and national protected lands in Placer County face a high threat level from agriculture and forestry pests and diseases as well as from wildfires. Forestry pests such as various bark beetle species can be highly damaging to the conifer forests that make up most of these lands. These pests can kill trees or significantly damage them, particularly during periods of drought or high temperatures that can weaken the trees. Wildfires can cause widespread destruction of these protected forests and any associated facilities. The damage to these lands can significantly reduce the number of visitors, decreasing economic activity. **Map 16** shows the location of state and national lands along with wildfire risk zones.

Example adaptation strategy:

- Continue to work with state and federal land management agencies to support fuel and pest management activities.

Timberlands: Placer County's timberlands are highly susceptible to agriculture and forestry pests and diseases, in particular to the bark beetle and associated species. While trees damaged or killed by these pests can temporarily cause an increase in the supply of harvest-ready trees, creating greater economic activity, long-term damage is expected to have an overall negative effect on Placer County's timber production. Drought and extreme heat events can both weaken or kill large numbers of trees, further reducing the long-term supply of harvest-ready trees. These events can also make forests more susceptible to pests and wildfires, which can cause more widespread tree losses. The local timber industry may be challenged to find new markets and opportunities if the supply of trees for lumber is significantly curtailed and new resources are not available.

Example adaptation strategy:

- Explore opportunities to create local timber processing facilities for bark beetle-infested wood.

Water recreation sites: Drought conditions can significantly harm water recreation sites. These facilities depend on an inflow of water to maintain operations, and recreational activities can be constrained if water levels drop too low. This can cause fewer visitors and may lead to closures until conditions improve. No alternative source of water is usually available for water recreation, and though other activities that are less dependent on water may be an option at some sites, these options are limited and could be cost prohibitive.

Example adaptation strategy:

- Work with owners of water recreation sites to begin installing alternative, land-based forms of recreation for visitors

DRAFT VULNERABILITY ASSESSMENT**VULNERABLE ECOSYSTEMS**

Out of the six main ecosystem categories included in this vulnerability assessment, three scored V4 or V5 for at least one exposure. Drought, extreme heat, and wildfire are likely to be among the most harmful climate exposures for the ecosystems in Placer County.

Conifer forests: These forests, the largest of Placer County's six main ecosystem categories, are highly vulnerable to a number of different hazard types. Agriculture and forestry pests and diseases, drought, extreme heat, and wildfire all pose a substantial threat to conifer forests. Drought and extreme heat can stress trees, weakening them or killing them outright. Weakened trees are more susceptible to forestry pests, creating a risk of further damage. Many conifers, especially some species of fir trees, are especially vulnerable to large and intense wildfires. While conifers may be adapted to these conditions, the extremes that are expected as a result of climate change can exceed the trees' comfort ranges. Lower-elevation species, including invasive species, are likely to move to higher elevations in the Sierra Nevada, displacing and excluding native species. Invasive species can require more water than natives, potentially exacerbating drought conditions and fire threats. Native species at higher elevations may disappear from Placer County by 2100. Animal species that depend on old, complex conifer forests are likely to face the greatest harm as a result of forests converting to other habitat types. Studies estimate that the critical habitat for 40% to 60% of key conifer forest animal species will substantially shrink within the next 40 to 90 years.

Example adaptation strategy:

- Work with local, state, and federal plant and wildlife management agencies and organizations to protect vulnerable habitat and improve ecosystem connectivity.

Grasslands: Placer County's annual and perennial grasslands face an elevated threat from wildfire. Many plants in these ecosystems can suffer significant damage from wildfires and have a poor ability to recover afterwards. Some cool-weather grassland species are more resistant to fires, but they make up the minority of grassland habitat in Placer County. While grassland ecosystems may be partially adapted by expanding into higher elevations, some overall loss of territory is expected by 2100.

Example adaptation strategy:

- In coordination with local, state, and federal plant and wildlife management

Ecosystem shift

Climate change in Placer County is expected to alter where different ecosystems are found. As temperatures get warmer, ecosystems are expected to move to higher elevations to stay in a comfortable temperature range. Shifts in precipitation patterns are also likely to cause changes in ecosystem locations. The most significant changes in local ecosystems are expected to occur along the western slopes of the Sierra Nevada below 5,000 to 5,500 feet, along the crests of the Sierra Nevada, and in the northern Tahoe Basin.

agencies and organizations, monitor shifts in grassland habitat and ensure that land that grassland habitat is expected to migrate into is protected.

Mountain meadows and scrub: These high-elevation habitats are vulnerable to drought and extreme heat events because they may be weakened or killed off by substantial changes in the local climate. Grasses and scrub species face the greatest threat, although some trees can be significantly harmed by drought conditions. Invasive species are likely to move into higher elevations, potentially crowding out native plants and animals. These invasive species can sometimes use much more water than native species, which may cause less competitive native species to lose moisture and be more susceptible to wildfires. Some ecosystems in this habitat group will likely be able to survive these changes by being well adapted to extreme heat or by moving to more suitable areas, but very-high-elevation species are projected to disappear from Placer County by 2100.

Example adaptation strategy:

- Improve ecosystem connectivity between existing mountain meadow and scrub habitats and higher elevation areas that may become newly suitable for these ecosystems.

VULNERABLE SERVICES

The vulnerability assessment looked at six key services in Placer County. Of these, two services had a high vulnerability score for one hazard.

Communication: The communication services in Placer County are highly susceptible to severe weather. These conditions can damage communication infrastructure, decreasing network capacity. There may be a higher demand for communication services during severe weather, potentially putting stress on the network and increasing the risk of service interruptions. Although the infrastructure can be hardened against severe weather damage, other upgrades, such as installing alternative systems or increases to capacity, are not always feasible unless there is demand for these upgrades during normal operating times, not only during severe weather events.

Example adaptation strategy:

- Encourage communication providers to install redundant facilities, reducing the chance of service outages, with an emphasis on communication facilities that provide essential services.

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Energy delivery: Energy delivery, specifically electricity delivery, is subject to harm during extreme heat events. Extreme heat can lead to power outages by causing mechanical failure of grid equipment, by causing heat damage to power lines, and by creating a high demand for electricity to power air conditioners, all of which places stress on the network. This is likely to lead to greater service disruptions. Community members can reduce electricity use through a variety of strategies to decrease network stress. Additionally, utilities can retrofit power lines and other equipment to insulate them against extreme heat events or to provide greater redundancy, although this can be expensive and may not be feasible in some cases.

Example adaptation strategy:

- Encourage electrical customers to enroll in demand management programs to incentivize reduced use of electricity during periods of high demand.

Extreme heat and electricity

Very high temperatures affect the physical properties of power lines, decreasing their capacity to carry large amounts of electricity. By the middle of the century, electrical power lines are likely to experience a 2 to 5 percent reduction in their capacity. By 2080, power line capacity could be reduced by as much as ten percent. In combination with high electricity demand, this can stress the electrical grid and make outages more likely.

SOCIAL VULNERABILITY INDEX

The vulnerability assessment process allows County staff, elected and appointed officials, and members of the public to identify specific community assets that are vulnerable to exposures. For example, the vulnerability assessment can identify the specific community facilities that lie within areas of an elevated wildfire risk. These facilities can then be targeted for adaptation efforts.

As part of this vulnerability assessment, Placer County prepared an analysis called a social vulnerability index, which identifies the specific locations in the county where there are large levels of socially vulnerable people. The social vulnerability index serves a similar function, allowing efforts to help vulnerable populations to be focused on specific areas.

The social vulnerability index relies on data from the US Census American Community Survey. The Census Bureau has divided Placer County into several small areas, called census block groups, each of which is home to between a few hundred to a few thousand people. American Community Survey data include the number of people who are considered members of a vulnerable population within each block group. To prepare the social vulnerability index, Placer County looked at the proportion of people within each block group who belong to each vulnerable population. Areas with a high proportion of people belonging to several vulnerable populations are considered highly

vulnerable communities. Similarly, areas with a low proportion of people belonging to only one or a few vulnerable populations are considered less vulnerable.

The social vulnerability index shows the level of social vulnerability relative to other areas of Placer County, so these results should not be compared to other indexes of social vulnerability for other communities. Not everyone living in an area with a high level of social vulnerability is necessarily socially vulnerable. In the same way, areas with a low level of social vulnerability still have residents who are socially vulnerable, though comparatively fewer of them.

The data used in the social vulnerability index have some characteristics that may be inconsistent with the on-the-ground knowledge of community members and other information. These inconsistencies do not affect the overall outcome of the social vulnerability index, but they may cause some uncertainty around specific data points.

The American Community Survey that Placer County used to prepare the social vulnerability index is not a firm count like the decennial census. Instead, the American Community Survey is an educated estimate prepared by the Census Bureau. Because of this, the results of the American Community Survey, and by extension the social vulnerability index, may differ somewhat from on-the-ground conditions. Additionally, the boundaries of the census block groups used for the social vulnerability index may not perfectly line up with recognized boundaries for unincorporated communities. For the communities of Foresthill and Sheridan, Placer County chose to use the boundaries of the County's own planning documents for these areas, rather than the boundaries of the Census block group. This creates a more realistic analysis, and lets the social vulnerability index be more consistent with existing County efforts.

SOCIAL VULNERABILITY INDEX SCORE

The results of the social vulnerability index showed eight communities that had very high levels of social vulnerability. This section discusses these communities and the factors that contribute to their elevated levels of social vulnerability. **Map 19** shows the social

Social Vulnerability Index categories

The social vulnerability index primarily looks at the same populations assessed elsewhere in this vulnerability assessment, as discussed earlier in this chapter. However, the social vulnerability index does not include homeless persons, outdoor workers, persons with chronic health problems, persons without access to lifelines, and undocumented persons. This is because data on the number of these persons within each block group is not available. The social vulnerability index also treats all persons equally and does not assume that any one group is more vulnerable than another. For example, senior citizens are considered as vulnerable as renters for the purpose of this analysis.

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vulnerability index for the unincorporated areas of Placer County, with these eight communities highlighted.

West Placer County Communities with High Social Vulnerability Scores

Sheridan: Sheridan is in the northern part of Placer County's western region, near the Bear River and Camp Far West Reservoir. It has high proportions of households with disabled persons, households living in poverty, English-limited households, and households living in mobile homes.

North Auburn: The unincorporated areas north of Auburn are split into two areas by State Route 49, each with a unique set of social vulnerability factors. The area west of State Route 49 has high numbers of children, persons in poverty, and rental households. The area east of State Route 49 has a high proportion of senior citizens, households with a disabled individual, and English-limited households. Both parts of North Auburn have a high proportion of households in mobile homes.

Elders Corner: Elders Corner is beyond North Auburn, in the area north of Bell Road and west of State Route 49. There are a large number of children living in this area, senior citizens (including seniors living alone), households with a disabled individual, English-limited households, rental households, households in poverty, and households in mobile homes.

Table 3 shows the social vulnerability factors for West Placer County communities (Sheridan, North Auburn, and Elders Corner) relative to the total unincorporated areas of Placer County.

TABLE 3: PROPORTIONS OF RESIDENTS IN SOCIALLY VULNERABLE GROUPS (WEST PLACER COUNTY)

SOCIAL VULNERABILITY FACTOR	SHERIDAN	NORTH AUBURN (WEST)	NORTH AUBURN (EAST)	ELDERS CORNER	UNINCORPORATED PLACER COUNTY
Children as a percent of the population	15.38%	14.52%	9.54%	14.53%	10.12%
Seniors as a percent of the population	4.79%	12.50%	29.08%	27.76%	18.89%
Percent of seniors living alone	30.67%	23.83%	27.59%	29.53%	19.84%
Percent of households with a disabled member	38.02%	18.31%	38.13%	34.88%	24.88%
Percent of households that are English limited	8.40%	3.26%	5.94%	13.21%	2.17%
Percent of households in poverty	14.32%	33.65%	23.66%	57.62%	8.83%
Percent of households that rent	18.27%	34.80%	30.49%	63.60%	21.61%
Percent of households that are overcrowded	10.67%	4.05%	4.47%	2.99%	2.02%
Percent of households that are severely overcrowded	0.00%	4.12%	0.00%	0.00%	0.84%
Percent of households living in mobile homes	24.69%	12.23%	35.12%	17.28%	6.05%

Red bold text means that the community is in the top quartile for the percent of residents in each socially vulnerable group. For example, all four communities in this table are in the top quartile for percent of households living in mobile homes.

Central Placer County and Tahoe Basin Communities with High Social Vulnerability Scores

Shady Glen: Shady Glen is a community immediately north of Colfax, along the Interstate 80 corridor. It has a large proportion of seniors living alone, households with a disabled individual, persons in poverty, renters, and persons living in mobile homes.

Tahoe Vista: Tahoe Vista is a community on the north shore of Lake Tahoe between Carnelian Bay and Kings Beach. It has a high level of social vulnerability due to a large proportion of children, English-limited households, renters, overcrowded households, and households in mobile homes.

Kings Beach: Kings Beach is a community clustered along the north shore of Lake Tahoe. It has a high proportion of English-limited households, households in poverty, rental households, and overcrowded households.

Brockway: Brockway is in north Lake Tahoe along the Nevada state border, directly east of Kings Beach. A high proportion of seniors living alone, English-limited households, rental households, and severely overcrowded households contribute to its social vulnerability.

Table 4 shows the social vulnerability factors for Tahoe Basin communities (Tahoe Vista, Kings Beach, and Brockway) relative to the total unincorporated areas of Placer County.

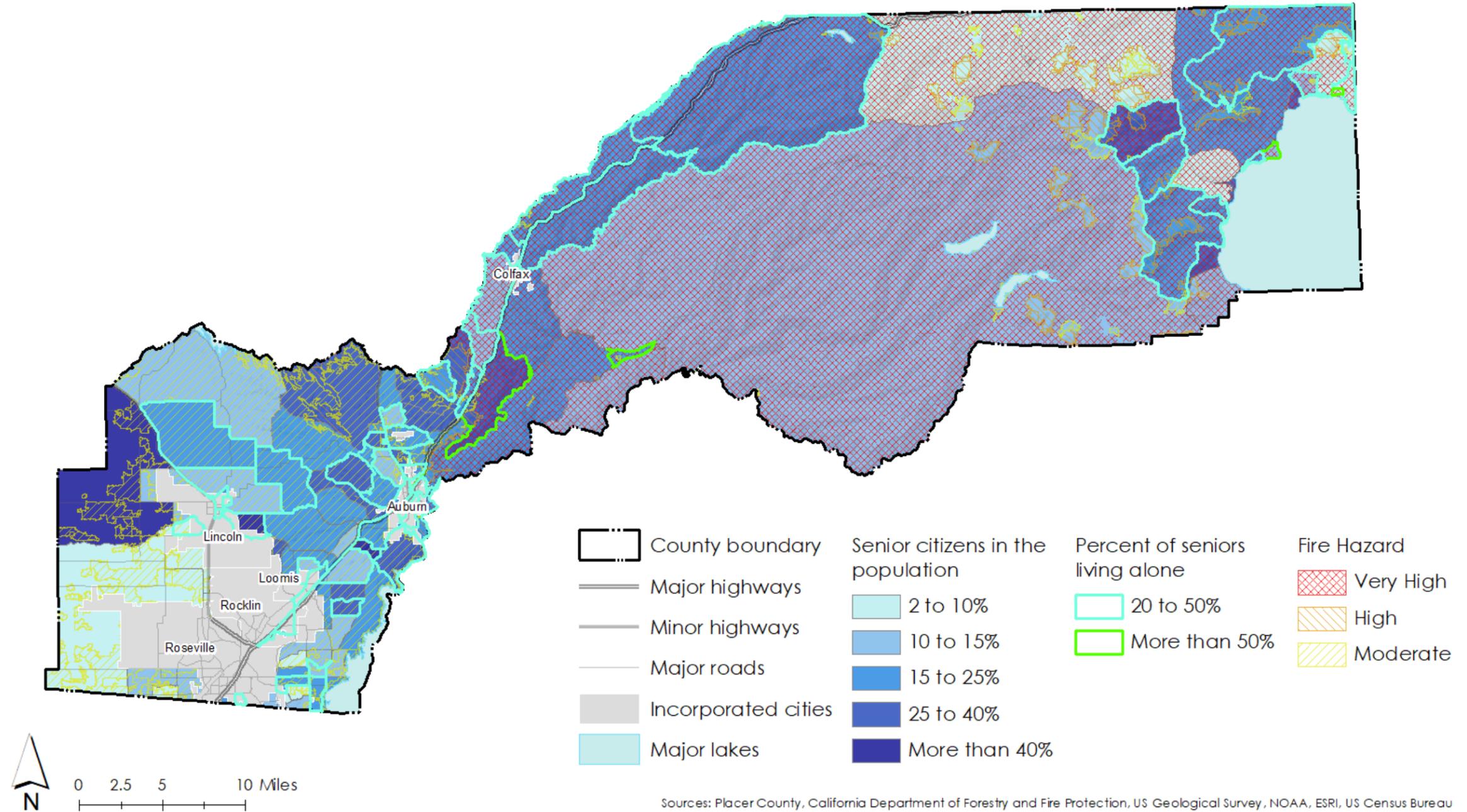
TABLE 4: SOCIAL VULNERABILITY FACTORS (CENTRAL PLACER COUNTY AND TAHOE BASIN)

SOCIAL VULNERABILITY FACTOR	SHADY GLEN	TAHOE VISTA	KINGS BEACH	BROCKWAY	UNINCORPORATED PLACER COUNTY
Children as a percent of the population	10.53%	17.09%	10.66%	6.86%	10.12%
Senior citizens as a percent of the population	15.12%	13.90%	2.59%	6.37%	18.89%
Percent of senior citizens living alone	30.94%	27.52%	55.81%	45.63%	19.84%
Percent of households with a disabled member	33.48%	11.15%	10.00%	23.21%	24.88%
Percent of households that are English limited	0.00%	9.29%	31.63%	9.00%	2.17%
Percent of households in poverty	34.13%	7.81%	73.06%	31.79%	8.83%
Percent of households that rent	43.04%	35.32%	64.49%	62.31%	21.61%
Percent of households that are overcrowded	2.83%	11.90%	25.71%	0.00%	2.02%
Percent of households that are severely overcrowded	0.00%	0.00%	9.80%	9.00%	0.84%
Percent of households living in mobile homes	13.70%	22.30%	3.88%	0.00%	6.05%

Red bold text means that the community is in the top quartile for the percent of residents in each socially vulnerable group. For example, Tahoe Vista is in the top quartile for percent of residents who are children.

Map 13

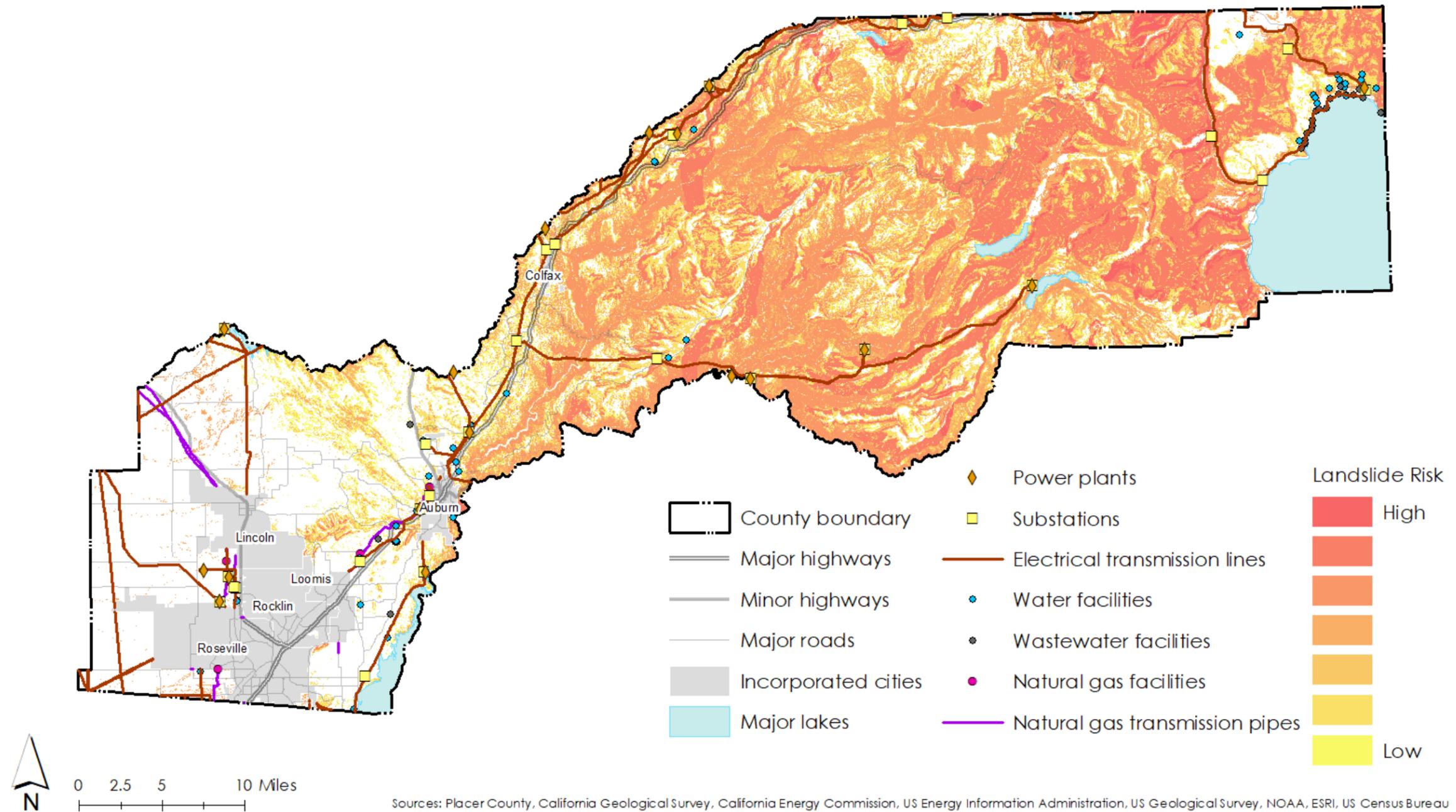
Senior Citizens and Wildfire Risk



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Map 14

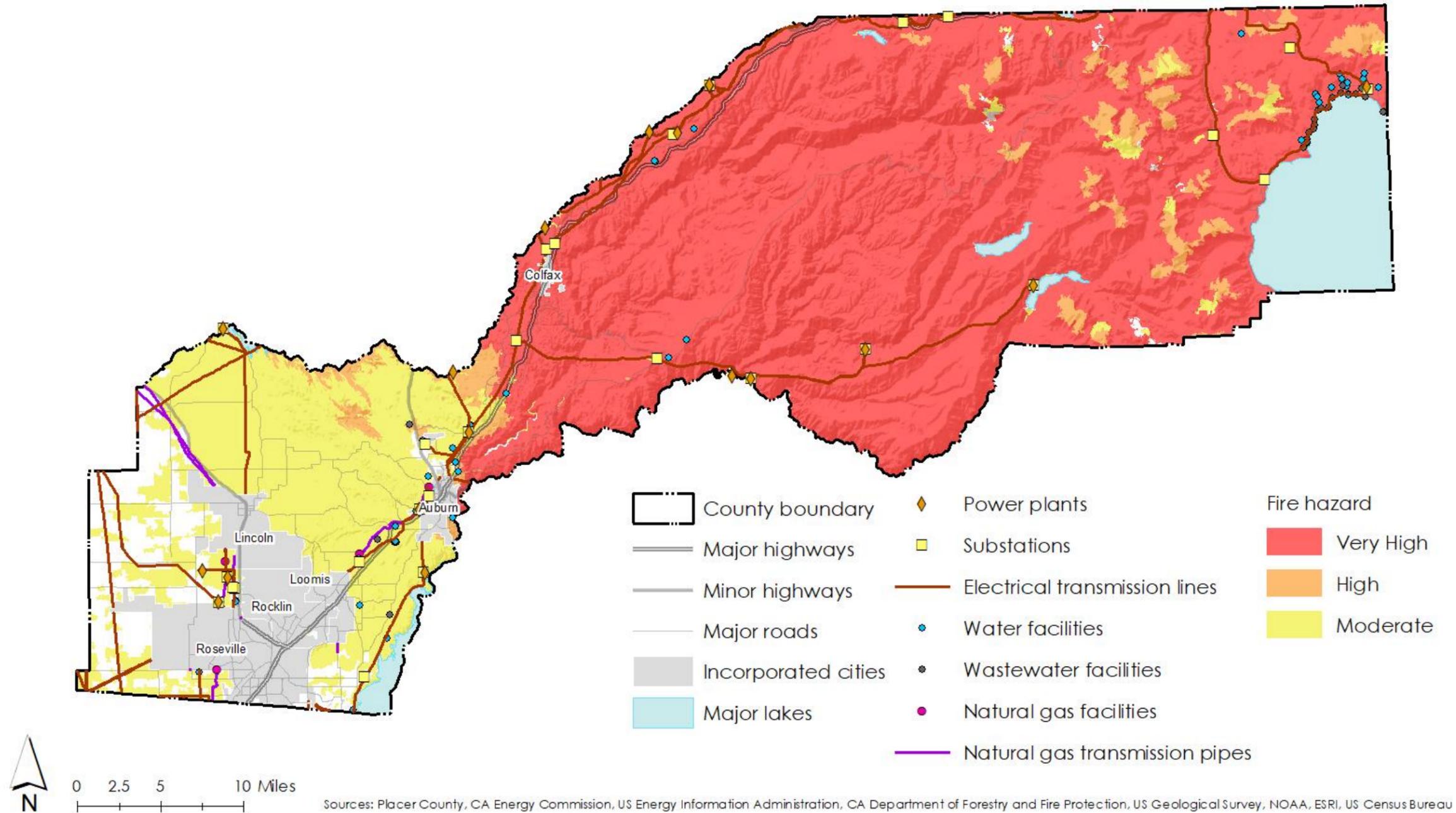
Utility Infrastructure and Landslide Risk



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Map 15

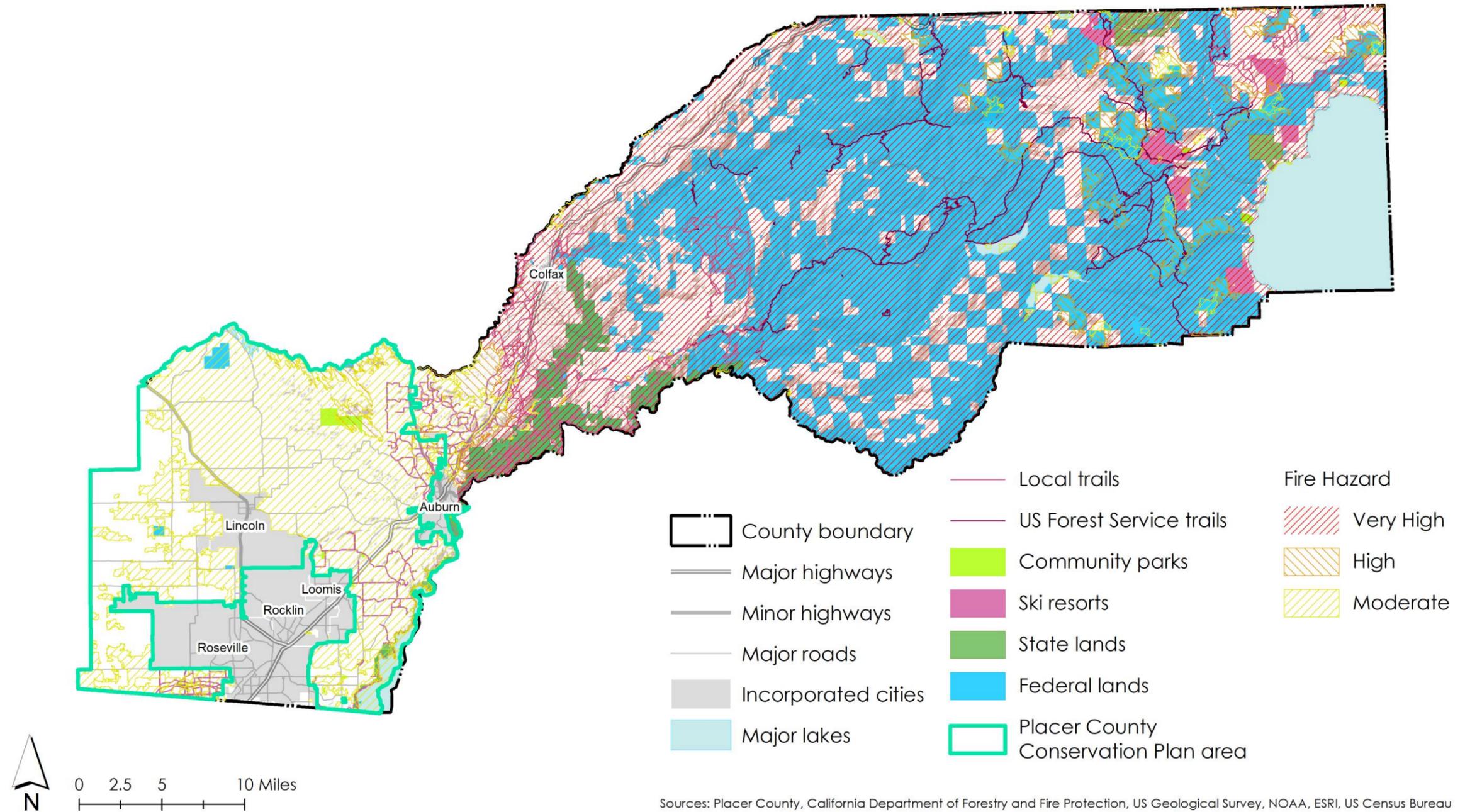
Utility Infrastructure and Wildfire Risk



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Map 16

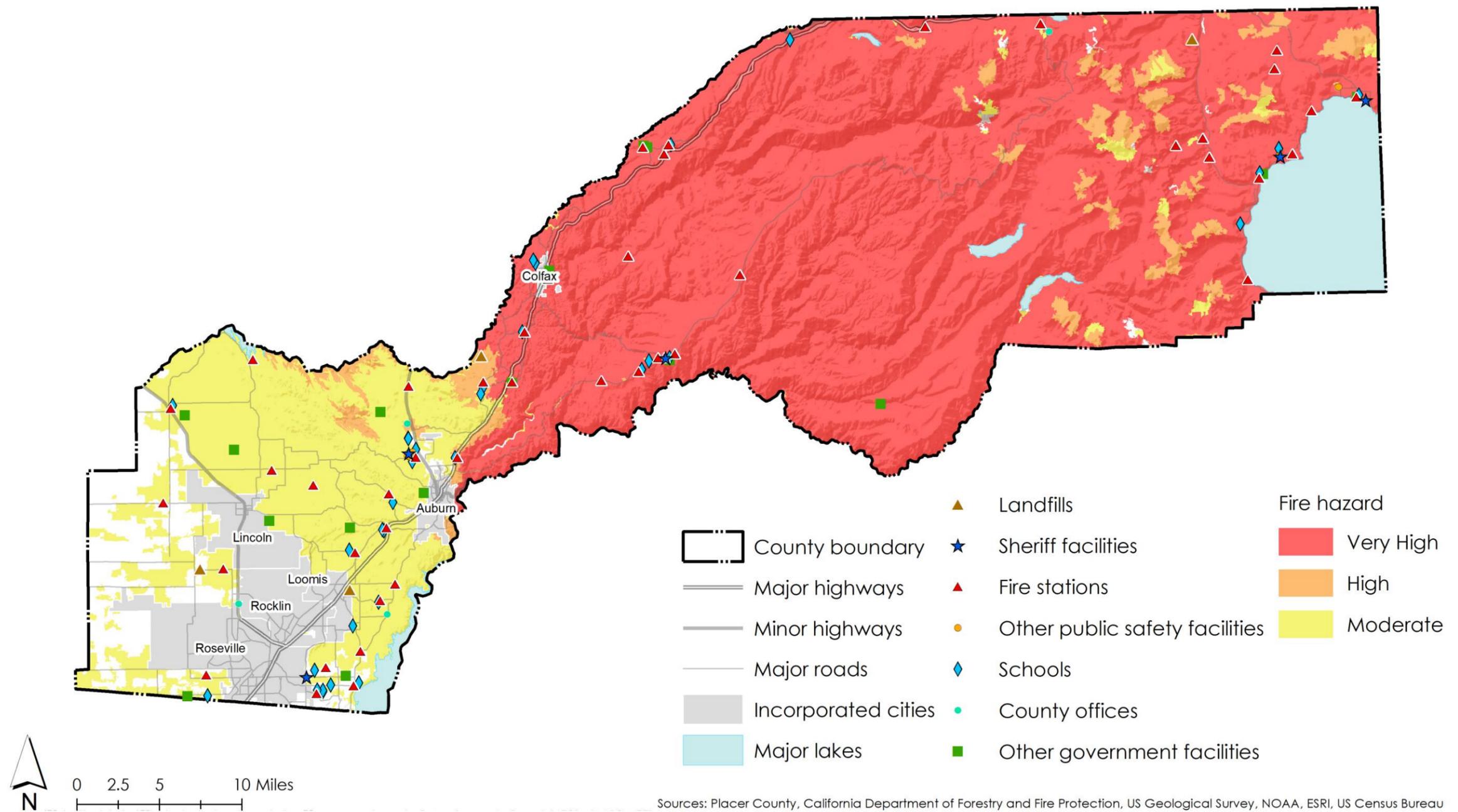
Recreation, Protected Lands, and Wildfire Risk



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Map 17

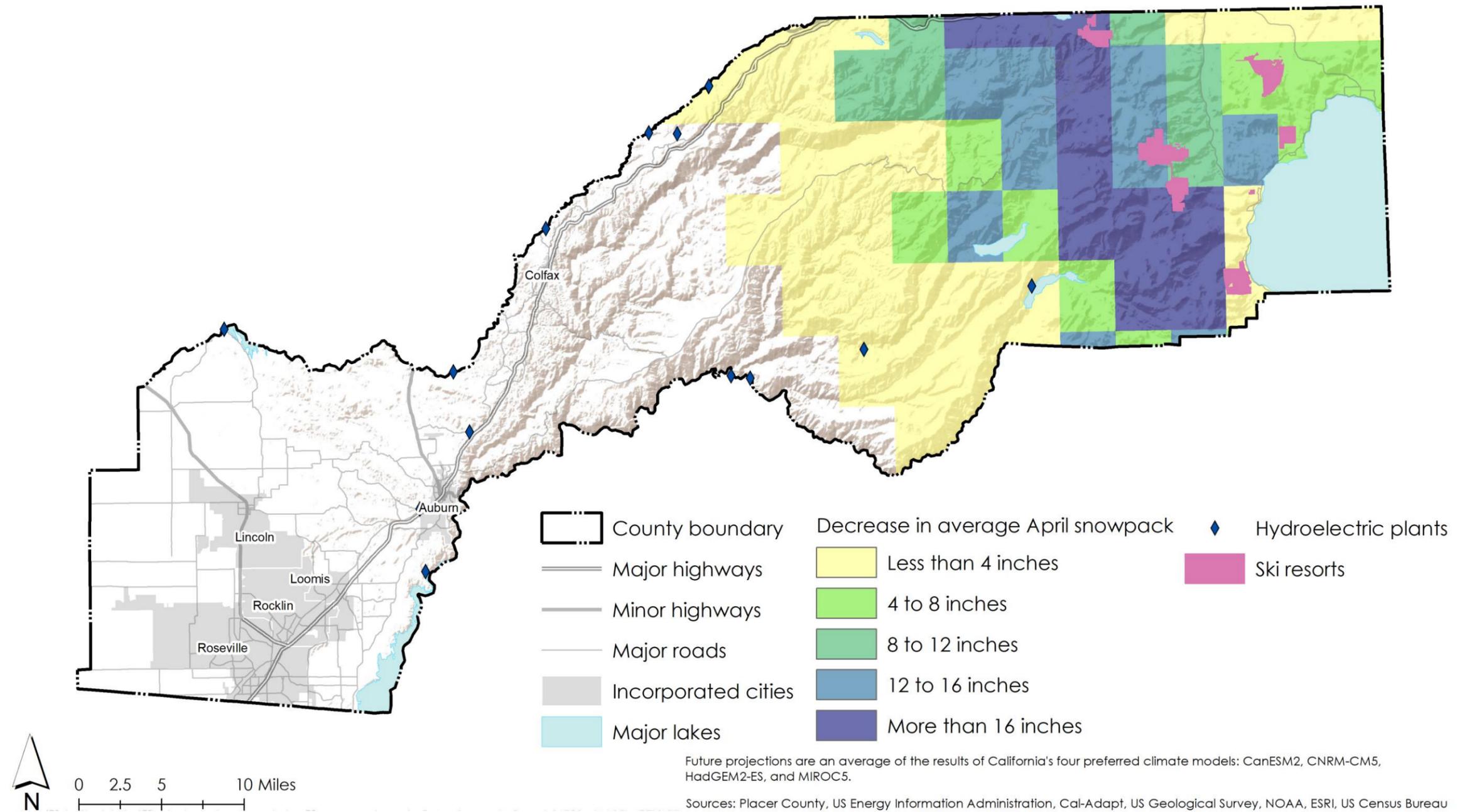
Government Facilities and Wildfire Risk



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Map 18

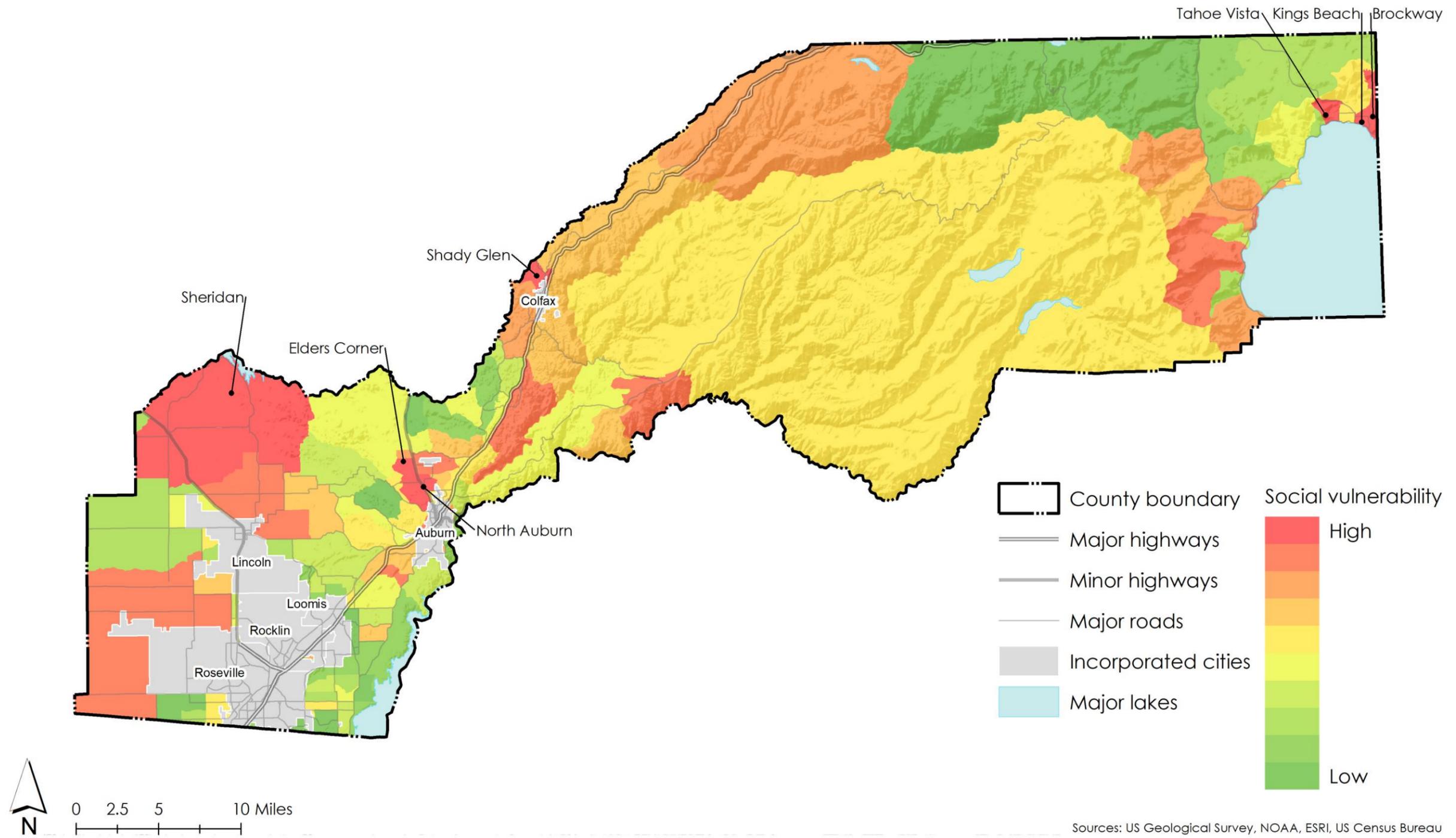
Changes in Average April Snowpack, 1994-2013 to 2070-2099 (RCP 8.5), and Water-Dependent Facilities



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Map 19

Social Vulnerability Index



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Appendix 1: Complete Vulnerability Assessment Results

This table shows the vulnerability score for each sensitivity, for each relevant exposure. As discussed in the main body of the vulnerability assessment, vulnerability is ranked on a scale from V1 to V5:

- V1: Minimal vulnerability
- V2: Low vulnerability
- V3: Moderate vulnerability
- V4: High vulnerability
- V5: Severe vulnerability

TABLE A-1: FULL VULNERABILITY ASSESSMENT RESULTS

SENSITIVITIES	AGRICULTURE AND FORESTRY HAZARDS	AVALANCHE	DROUGHT	EXTREME HEAT	FLOODING	FOG	HUMAN HEALTH HAZARDS	LANDSLIDES	SEVERE WEATHER	SEVERE WINTER WEATHER	WILDFIRE
Populations											
Children				V4			V3				V3
Homeless persons				V5	V3		V5		V4	V4	V2
Households in poverty		V3	V4	V4	V5		V4	V4	V2	V5	V4
Outdoor workers	V4			V4			V2		V3	V3	V3
Persons in mobile homes				V3	V4			V3	V4	V3	V4
Persons in overcrowded households				V2			V2				
Persons with chronic health problems		V3		V4	V3		V4	V2	V3	V2	V3
Persons with disabilities		V3		V3	V3		V3	V3	V3	V2	V3
Persons with limited English proficiencies	V3	V2		V2	V1			V1		V1	V2
Persons without access to lifelines		V3		V3	V4		V3	V3		V4	V3
Renters				V1	V1			V3	V1	V1	V1

SENSITIVITIES	AGRICULTURE AND FORESTRY HAZARDS	AVALANCHE	DROUGHT	EXTREME HEAT	FLOODING	FOG	HUMAN HEALTH HAZARDS	LANDSLIDES	SEVERE WEATHER	SEVERE WINTER WEATHER	WILDFIRE
Senior citizens		V3		V5	V3		V3	V3	V3	V3	V5
Senior citizens living alone		V5		V5	V4		V4	V4	V4	V4	V5
Undocumented persons	V4			V3	V2		V3	V2	V3	V3	

Infrastructure

Access roads		V3	V4		V5			V4		V4	V5
Biking and hiking trails	V2	V3	V3		V2			V4	V2	V1	V4
Bridges		V1			V4			V3	V4		
Communication facilities		V3		V2	V1			V4	V2		V3
Electrical substations		V2		V2	V1			V3	V2		V2
Electrical transmission lines	V1			V3	V3			V4	V3	V3	V3
Flood control infrastructure					V1			V1	V2		
Major roads and highways	V2	V3		V1	V2			V3	V3		V2
Natural gas facilities									V2		
Natural gas transmission pipes								V2			
Power plants				V3	V1			V4	V2		V3
Rail lines		V3		V2	V3			V3	V3	V2	V2
Water and wastewater treatment plants			V2	V1	V3				V2		V3

Buildings and facilities

Airports				V1					V1	V1	V3
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SENSITIVITIES	AGRICULTURE AND FORESTRY HAZARDS	AVALANCHE	DROUGHT	EXTREME HEAT	FLOODING	FOG	HUMAN HEALTH HAZARDS	LANDSLIDES	SEVERE WEATHER	SEVERE WINTER WEATHER	WILDFIRE
Businesses		V3		V2	V2			V2	V3	V1	V3
Community facilities				V2	V2			V2	V3	V1	V4
Community and regional parks	V3	V3	V2	V1	V1			V2	V2		V4
Government offices				V2	V2				V3	V1	V3
Homes	V4	V3		V2	V3			V4	V4	V2	V4
Medical facilities				V2	V2				V1	V1	V1
Public safety buildings		V2		V2	V1			V2	V3	V1	V3
Schools				V3	V3			V2	V3	V2	V3

Economic assets

Farms, orchards, and vineyards	V3		V4	V5	V4	V3			V4	V3	V1
Livestock	V3		V4	V5	V2				V3	V2	V2
Major employers		V2	V3	V3	V2				V2	V1	V3
Outdoor recreation		V3	V1	V4	V2	V2	V3	V2	V2	V4	V4
Pastures			V3	V3	V1						V1
Rice-growing areas	V3		V5	V3	V4						
Ski resorts	V2	V2	V5	V3	V1			V4	V4	V3	
State and national protected lands	V4	V1	V3	V3				V2	V2		V4
Timberlands	V4		V4	V4				V2	V3		V3
Water recreation sites			V5	V1				V2			

SENSITIVITIES	AGRICULTURE AND FORESTRY HAZARDS	AVALANCHE	DROUGHT	EXTREME HEAT	FLOODING	FOG	HUMAN HEALTH HAZARDS	LANDSLIDES	SEVERE WEATHER	SEVERE WINTER WEATHER	WILDFIRE
Ecosystems											
Chaparral	V2		V3	V2							V3
Conifer forests	V5	V2	V4	V5					V2	V1	V5
Grasslands	V2		V3	V2							V4
Mountain meadows and scrub	V1	V2	V4	V4						V1	V1
Valley and riparian woodlands	V2		V3	V2					V2		V3
Wetlands	V1		V3	V3							
Services											
Communication		V2		V3	V1				V4	V1	V3
Emergency medical response		V2		V2	V2	V2	V2	V3	V2	V2	V2
Energy delivery		V2	V2	V4	V1	2		V2	V3	V3	V3
Freight and shipping		V2		V1	V1	V2		V3	V2	V1	V1
Public safety response		V2		V2	V3	V2		V3	V2	V2	V3
Water and wastewater services			V3	V1	V1				V1	V2	

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Acronyms and Abbreviations

ACS: American Community Survey

APG: California Adaptation Planning Guide

Cal EMA: California Emergency Management Agency (now the California Office of Emergency Services, or Cal OES)

Cal EPA: California Environmental Protection Agency

CAL FIRE: California Department of Forestry and Fire Protection

CEC: California Energy Commission

CNRA: California Natural Resources Agency

CO₂: carbon dioxide

CO₂e: carbon dioxide equivalent

CWHR: California Wildlife Habitat Relationships

GHG: greenhouse gas

IPCC: Intergovernmental Panel on Climate Change

PG&E: Pacific Gas and Electric Company

PCCP: Placer County Conservation Program

RCP: Representative Concentration Pathway

RV: Recreation vehicle

SMUD: Sacramento Municipal Utility District

Glossary

100-year flood: A flood that has a 1 percent chance (one in 100) of occurring in any given year (USGS 2016).

500-year flood: A flood that has a 0.2 percent chance (one in 500) of occurring in any given year (USGS 2016).

Adaptation: Adjustments to natural and human systems in response to actual or expected changes in climate conditions, to reduce the harmful effects of actual or expected changes (CNRA and Cal EMA 2012).

Adaptive capacity: The ability of a sensitivity to recover from and adequately adapt to the effects of climate change, including climate-related hazards (CNRA and Cal EMA 2012).

Carbon dioxide (CO₂): A colorless, odorless gas produced by natural and human processes, including burning fossil fuels. The most common greenhouse gas and the single greatest contributing gas to climate change (EIA 2017).

Carbon dioxide equivalent (CO₂e): A unit used to measure the combined emissions from multiple types of greenhouse gas based on their individual global warming potentials (EIA 2017).

Climate change: A long-term change in the average meteorological conditions (such as temperature, precipitation, and wind) in an area. It can be caused by natural or human factors, but in this report, refers to the rapid human-caused climate change that is currently occurring (IPCC 2012).

Community asset: A valued feature of a community that may be harmed by climate change. Community assets may include buildings and facilities, key services, ecosystems, economic drivers, and infrastructure (CNRA and Cal EMA 2012).

Downscaling: The process of determining small-scale information from a larger-scale data set, allowing for more accurate and locally specific data (IPCC 2012).

Exposure: The effects of climate change, such as changes to the frequency or intensity of a hazard event (CNRA and Cal EMA 2012).

Flash flood: A dangerous type of flood that occurs very quickly, with little warning. Flash floods are usually a result of sudden, intense precipitation.

Flood plain: The area that may be affected by a flood, usually named by the type of flood that can occur there (e.g. a 100-year flood plain).

Greenhouse gas (GHG): A gas that can accumulate in the atmosphere, where it traps heat close to the Earth's surface. While some level of these gases is necessary to

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maintain a comfortable temperature on Earth, an increased concentration traps additional heat, resulting in climate change. Greenhouse gases can be emitted through both natural and human processes (IPCC 2012).

Impact: In the context of climate adaptation, the effects (especially the negative effects) of a hazard or other conditions associated with climate change (CNRA and Cal EMA 2012).

Lifeline: A basic necessity that enables people to connect to others outside of their homes and to obtain goods, services, and information. Examples include access to telecommunication or an effective mode of transportation (CNRA and Cal EMA 2012).

Linguistic isolation: Having little or no ability to communicate in the language or languages that are commonly spoken in a community.

Model: A representation of the climate system, such as a virtual simulation, that is used to study climate and simulate climatic conditions (IPCC 2012).

Onset: The period of time in which exposures begin to occur (CNRA and Cal EMA 2012).

Representative Concentration Pathway (RCP): A scenario of future GHG emission levels and rates, categorized by the average increase in thermal radiation levels (IPCC 2014).

Resilience: The ability to resist harm and recover from hazards (CNRA and Cal EMA 2012).

Risk: The chance that a hazard event or other negative effect will occur.

Sensitivity: A population or community asset that may be negatively affected by climate change (CNRA and Cal EMA 2012).

Snowpack: Snowfall that accumulates in cold mountain areas and remains frozen for a long period. In California, snowpack in the Sierra Nevada provides a large amount of water to the state during the summer and early autumn months as it melts.

Threat: The potential of a hazard to do harm to sensitivities.

Vulnerability: The overall susceptibility of a population or community asset to be harmed by climate change. It is a function of both the risk of the hazard and the threat that the hazard poses to the sensitivity. A vulnerability may refer to a specific weakness or other feature of a sensitivity that may increase the threat faced from a hazard.

Vulnerable population: A group of people with a shared characteristic that may make them more susceptible to the harmful effects of climate change. Vulnerable populations may be defined by their age, physical or mental health, socio-economic characteristics, or other factors.

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