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Climate Change Impacts in Nevada

This fact sheet provides a summary of Climate Change in Nevada, a report written as part of Nevada's State Climate Initiative. The full report is available on the Nevada Climate Initiative website, ClimateAction.nv.gov. Summarized in this fact sheet are specific details about how climate change has already and will continue to impact the state of Nevada and strategies that can be used to prepare for these changes. It highlights historical trends and future projections for some major climate variables and how they may affect public health, water resources, the environment, hospitality and agriculture, with the goal of better informing decision makers and the general public.

OVERVIEW OF HISTORICAL AND PROJECTED TRENDS

The current release of carbon into the atmosphere is unprecedented and more rapid than at any time over the past 56 million years[1,2]. In recent decades, Nevada has witnessed increasing temperatures, extreme droughts, loss of snow, increasing evaporative demand (i.e., atmospheric thirst) and a number of large wildfires. We are observing changes in the present, and best projections indicate that these trends will continue (Table 1).

Climate change has come home.

Just as the current climate varies from place to place in the state, future climate change will also vary for different locations with different impacts on specific communities, economic sectors and ecosystems. The amount of warming that Nevada will face in the future depends on whether greenhouse gas emissions are allowed to continue increasing, or whether they are reduced rapidly over the coming decades. Scientists are extremely confident that greenhouse gas emissions have already caused the earth to warm. More emissions will cause more warming and other changes to climate. Tables 2 - 6 list ways that our changing climate is most likely to affect the lives of Nevadans.

Reducing Climate Change Threats to Nevada

Climate change presents several major challenges for decision makers and the general public. It is important that the implications of climate change are shared with citizens and communities. The most effective way to limit the projected impacts of climate change is to minimize climate changes themselves by lowering emissions. Nevada is actively pursuing reductions in greenhouse gas emissions (mitigation) and is poised to also take on climate change preparedness and adaptation to build the resilience of its economy and communities. Low-risk steps Nevada can take right now to protect itself from the impacts of climate change are outlined in the *What can we do now?* boxes throughout the document.

Table 1. Historical and Future Climate Changes in Nevada

	Historical Trends	Projected Trends and Confidence
Heat and Heat Waves	Temperatures are increasing. Urban areas are warming faster than rural areas.	Average temperatures will rise. Heat waves will increase in frequency and severity. ***HIGH Confidence***
Precipitation	Precipitation has not increased or decreased.	It's not clear how precipitation will change. Some models project more, some less, and some essentially no change, with the average across recent models suggesting a slight increase in precipitation over central and northern Nevada. ***LOW Confidence***
Drought	Increasing evaporative demand due to higher temperatures has worsened droughts.	Drought will increase in frequency and severity, in part due to higher temperatures, even if precipitation remains the same or increases slightly. ***HIGH Confidence***
Loss of Snow	Snowpack decreased between 1955 and 2016.	There will be a shift from snow to rain during the winter, and snow will melt earlier in the winter and spring. ***HIGH Confidence***
Floods	There were no historical trends in flooding.	Flooding will be more frequent owing to a shift from snow to rain and more intense storms, even if precipitation does not increase. ***HIGH Confidence***
Wildfire	Wildfire size and severity have been increasing.	Warmer temperatures will increase wildfire risk. ***HIGH Confidence***

INCREASING HEAT AND HEAT WAVES

In Nevada, average temperatures have been increasing over time. In fact, eight of the 10 warmest years since 1895 have occurred between 2000 and 2020. Although temperatures throughout the state are increasing, the rate of warming is not the same everywhere. Urban areas, for example, are getting hotter faster than rural areas. Average temperatures are expected to increase in all seasons, but the warming is likely to be greatest in the summer and fall. Higher temperatures affect multiple sectors, including public health, agriculture, hospitality, the environment and water resources.

Increasing average temperatures will also lead to more frequent and severe heat waves and hotter days and nights. The term heat wave generally refers to spells of much hotter than normal weather, sufficient to be unpleasant or even unsafe. The number of very warm days—when daytime temperatures exceed 95 F—has already increased across the state, with the largest increases in southern and northwestern Nevada. The severity and number of extremely hot days and warm nights are expected to increase. Extremely high temperatures pose a danger to human life and physical and mental health[3,4], to transportation, the electrical grid[5], ecosystems, livestock, and crops. Extreme heat increases fire risk for some vegetation types[4] and can also negatively impact wildlife[6]. Extreme heat also impacts air quality, as higher temperatures are associated with increased ozone levels[7].

Urban heat islands occur in developed areas that retain heat, especially at night, leading to higher temperatures relative to more rural, non-developed surrounding areas. We are already seeing the effects of urban heating in Reno and Las Vegas. Although urban heat islands are not caused by global greenhouse gas emissions, urban heating is expected to continue, leading to warming in cities beyond what is seen in regional climate projections.

The amount of warming that Nevada will face in the future depends on whether greenhouse gas emissions continue to grow or whether they are reduced rapidly over the coming decades. Projections of warming range from 4 F - 6 F throughout Nevada in the near term (the next few decades), but long-term (the last few decades of the 21st century) changes depend on society's emissions-related choices today. Nevada will experience greater warming with higher emissions.

What can we do now to reduce the impacts of climate change on public health in Nevada?

- Manage green space and increase reflective surfaces in Nevada's cities to reduce the heat island effect which will lessen the impact of heatwaves on communities.
- Increase public education efforts around how to reduce exposure to heat and wildfire smoke.
- Improve outreach to ranchers and farmers about community assistance and insurance programs designed to mitigate the economic impact of drought, which can increase stress, negatively affecting mental and physical health in rural communities.

Table 2. Impacts of Heat and Heat Waves in Nevada

Public Health	Increasing heat wave frequency and severity would increase the risk of illness, hospitalization and death. Heat waves have also been associated with more preterm births. Longer growing seasons could contribute to a longer allergy season.
Water Resources	Higher temperatures lead to increased evaporative demand, which reduces water levels. Higher temperatures and lower water levels can lead to poor water quality.
Environment	Warmer temperatures will make current habitats unsuitable for some plant and animal species. There could be negative impacts on wildlife, including higher mortality and even some local extinctions.
Recreation and Hospitality	Higher temperatures could make outdoor recreation less pleasant or safe and might deter summertime visits to Nevada.
Agriculture and Ranching	Increasing temperature can negatively affect the health of farmers and ranchers. Heat also impacts livestock health and milk production. There could be negative impacts on plant health and crop production. Warmer temperatures and longer growing seasons provide opportunities to grow new crops but may also benefit invasive species and pests.

PRECIPITATION AND DROUGHT

As the driest state in the nation, Nevada is particularly vulnerable to changes in water supply that are expected as temperatures warm in Nevada and across the West. Las Vegas and Reno rely on water supplies that come primarily from mountains outside of Nevada—in the Upper Colorado River Basin and the Sierra Nevada, but local rain and snow feed the streams, springs and wells that many rural communities, farms and ranches rely on. Reliable water supply is critical for maintaining human health, energy supply, and productive agriculture, as well as healthy rangelands, forests and riparian zones.

What can we do now to reduce the impacts of climate change on water resources in Nevada?

- Maintain and, where feasible, enhance water-, land- and flood-management practices and upgrade infrastructure to better accommodate future climate extremes and impacts.
- Consider and test options for slowing stream discharges, which would hold water in basins longer and slow passage from the uplands to the basin floors.
- Fill weather and climate monitoring gaps in Nevada to provide information critical to recognizing, measuring and ultimately managing climate changes.

Nevada's precipitation already varies substantially from year to year, which makes climate projections of future precipitation difficult to interpret with confidence[8,9]. Moreover, some models predict more precipitation, some less, and some almost no change. The average across many recent climate models, however, suggests a possible small increase in average precipitation across all but the southern tip of Nevada in the near term. Even if average precipitation does increase, there will still be dry years.

Despite these uncertain projections of precipitation, drought is fairly likely to increase in intensity and frequency because of higher temperatures. With no change in precipitation (or even an increase), higher temperatures alone will lead to a change from snow to rain, which reduces the amount of water we can store in winter snowpack for use later in the year. High temperatures also lead to more evaporative demand. Evaporative demand—the atmospheric thirst driven by temperature, wind, humidity and solar radiation—plays an important role in droughts and can be particularly impactful in arid places such as Nevada[10] (Table 3). When evaporative demand is higher than normal, soils dry out faster and vegetation becomes drier, leading to increased fire risk and degraded ecosystems. Over the past 40 years, evaporative demand has strongly increased in Nevada, with the fastest increases in the west-central part of the state. Recent precipitation shortages, combined with increasing evaporation, have already led to hydrologic (water supply) droughts being more common since the start of the 21st century. Climate projections indicate this trend will continue through the end of the 21st century.

Table 3. Drought Impacts in Nevada

Public Health	Increased dust due to drying has impacts on respiratory illness. Drought has been shown to impact mental health.
Water Resources	Droughts lead to lower water supply and reduced water quality. They also increase demand for agricultural and household use, further stressing water resources.
Environment	Drought can negatively impact plant health and growth and can increase the potential for plant mortality. Low water levels and reduced plant growth can stress wildlife.
Recreation and Hospitality	Drought can limit many recreational opportunities, from snow sports to fishing and rafting.
Agriculture and Ranching	During drought, some water rights may not be fulfilled. Crop production may be reduced. Drought can reduce forage quantity and decrease range condition. These can lead to reductions in the use of federal lands for grazing and increased hay feeding and water hauling.

SNOW LOSS AND SNOW MELT CHANGES

With higher temperatures, more of the storms will bring rain instead of snow, even at high altitudes. In the near term, between 5% and10% more of the precipitation is anticipated to fall as rain rather than snow. Basins around Lake Tahoe and in northwestern Nevada are projected to experience 10% to15% more rain rather than snow. Less snow and earlier snowmelt affect water management in Nevada, as snow serves as a natural reservoir that slowly provides water to downstream ecosystems, agricultural land and communities. The loss of snow also has implications for winter recreation, which would impact quality of life for many residents and recreational tourism in Nevada.

With less precipitation falling as snow, and with snowpack melting earlier due to the warming winters, the amount of water in the snowpack on April 1—the time of year when snowmelt normally peaks—is projected to decline 30% to 50% by the end of century in most basins in the state[11]. These changes are already being observed across the northern parts of the state and across the West[12,13,14,15].

What can we do now to reduce the impacts of climate change on the environment in Nevada?

- Restore damaged ecosystems so that they are more resilient to changing climate.
- Undertake forest thinning and prescribed fires to lessen wildfire risk.
- Maintain diverse habitats and migration corridors so that wildlife have access to water, shade and escape from wildfires.

Warming would also mean longer growing seasons for native plants and agricultural crops alike, by anywhere from about three to six weeks in most basins in the near term. However, if precipitation falls as rain rather than snow, the state's highlands and riparian areas will be drier by the time summer arrives[16,12]. By the end of the century, the timing and amount of surface-water are expected to be increasingly out of sync with irrigation demands, further challenging water management in Nevada.

Table 4. Impacts of Snow Loss on Nevada

Public Health	Precipitation coming as rain rather than snow will increase flood risk.
Water Resources	Currently, snowpack acts as a natural reservoir. A smaller snowpack that melts earlier means reduced water storage capacity.
Environment	Smaller snowpacks that melt earlier could lead to a longer summer dry season. Desert terminal lakes in Nevada will likely have lower lake levels and increased salinity, endangering fisheries and culturally sensitive species, such as the Cui-ui in Pyramid Lake.
Recreation and Hospitality	Reduced snowpack could decrease recreation and tourism related to snow sports. Less snow also means lower summer streamflow and reservoir levels, which may affect outdoor recreation, such as boating, rafting, fishing and camping.
Agriculture and Ranching	Less snow would lead to an earlier and longer irrigation season and also to reduced irrigation supply due to lack of water availability. Earlier snowmelt could also lead to reductions in rangeland production.

SEVERE FLOODING

While well known as the driest state, Nevada has experienced many catastrophic floods. Because a warmer atmosphere can carry more water[17,18], the most extreme storms are expected to become even more extreme. For example, projected near-term and long-term changes in peak annual runoff rates (the maximum daily runoff rate occurring during the average year) are projected to increase more than 25% to 50% above historical peak rates across much of the state, especially in and around many mountain ranges.

Table 5. Flooding Impacts in Nevada

Public Health	Increased flooding would lead to greater risks to public safety, private property and public infrastructure, as well as decreasing water quality.
Water Resources	Flooding leads to decreased water quality and may limit the ability to capture rainwater and runoff for water supply, if too much water arrives too fast.
Environment	Increased flooding can increase erosion and water contamination. Pollution and sediment can have immediate effects on fish and other river and lake organisms. The increased erosion can also damage riparian habitats.
Recreation and Hospitality	Flooding in urban centers and tourist destinations can impact visitation. Road closures due to flood and debris flow risk following wildfire may limit travel within the state.
Agriculture and Ranching	Flooding can increase erosion and soil loss, harm or contaminate crops, and damage water-holding and confinement structures.

WILDFIRE RISK AND INVASIVE SPECIES

Fire is controlled by weather, topography and fuels. Climate influences both weather and fuels. In Nevada, four of the five years with the largest area burned have occurred since 2005 (considering the consistent records collected since 1985). Both wet and dry conditions can increase fire risk due to the interplay between vegetation production during wet periods and vegetation drying during dry periods. For example, when a wet winter is followed by a dry spring and summer, the wet winter promotes the growth of grasses and other fine fuels, and the subsequent dry spring and summer results in the drying and curing of those fuels. These fuels

What can we do now to reduce the impacts of climate change on agriculture and ranching in Nevada?

- Evaluate and connect existing tools and drought-planning guidance for Nevada ranchers and farmers.
- Enhance and expand current efforts of producers and researchers working toward sustainable grazing management and crop production in water-scarce environments.
- Encourage rangeland resilience and prevent overgrazing.
- Assess what drought-tolerant or low-water-use crops can be grown successfully in Nevada and the market outlooks for those crops.
- Evaluate irrigation efficiency improvements.
- Improve drought monitoring to better inform application of existing drought policies and drought remedies.

are then primed for easy fire spread if an ignition occurs. This dynamic between the production and curing of fuels suggests that seasonal droughts can be a larger factor than multiyear droughts in Nevada and the Great Basin[19].

In Nevada, increased fire frequency promotes the establishment and success of invasive species such as cheatgrass and red brome. The proliferation of these invasive species provides quick-burning fuels that contribute to the start and spread of fire, which furthers the spread of more invasive species[20,21].

In addition to wildfire's direct risk to public safety, residential and commercial property, infrastructure, business operations, and livestock health and safety, wildfire can pose widespread risks to public health. Smoke from wildfires can travel hundreds of miles, impacting the health of Nevadans well beyond the immediate threat from the fire itself[22]. Wildfire smoke is associated with respiratory issues and hospitalization, especially for the elderly and children under four[23]. Emergency room visits for those with asthma increase as a result of wildfire smoke as well[24]. Power shutoffs aimed at reducing the risk of wildfire ignition can pose hazards to those who rely on electricity for medical devices and can economically impact families and businesses.

What can we do now to reduce the impacts of climate change on recreation and hospitality in Nevada?

- Support efforts that help the snow-sports industry plan for lower-snow skiing conditions and a longer non-snow recreation season.
- Encourage wildfire readiness and defensible space planning for businesses, as well as homes.
- Pursue research that will help predict the timing of snowmelt and seasonal forecasts of extreme events such as heat waves to better inform tourism and recreation planning.

Table 6. Wildfire Impacts in Nevada

Public Health	Increases in wildfire smoke decrease air quality, leading to increases in respiratory illness, hospitalizations and emergency room visits.
Water Resources	The risk of debris flows and erosion can increase after wildfire, leading to reduced water quality, changes in water supply, risks to public safety and economic losses.
Environment	Fire can lead to loss of native sagebrush and cheatgrass expansion, further increasing wildfire risk. Wildfire can increase erosion and sedimentation into watersheds, as well as negatively impacting wildlife.
Recreation and Hospitality	Increased fire risk and smoke may lead to loss of tourism and recreation during fire season, as well as business closures and electricity shutoffs during extreme fire weather.
Agriculture and Ranching	Fire can cause direct infrastructure, livestock, forage and crop losses. Wildfire-induced changes in vegetation cover, including noxious weeds, can reduce forage production or quality. Federal grazing lands may be temporally or permanently closed due to fire. Wildfire smoke poses health hazards to those who work outdoors and can be harmful or fatal for livestock.

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