Preserve and Protect Our Community

Climate Action Plan for the Pueblo de San Ildefonso

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Pueblo de San Ildefonso

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In memory of Tim Martinez, whose insights were invaluable to the creation of this Climate Action Plan.

Contents

Key Terms

Climate change describes a change in average conditions – such as temperature or rainfall – in a region over a long time period.

Climate change adaptation refers to actions that adjust to or reduce vulnerabilities to observed or projected climate impacts, to help reduce the severity of climate impacts and/or increase the capacity to recover from these impacts. Adaptation could involve strengthening and expanding agricultural technical assistance to help farmers adjust their management practices, providing additional training to emergency responders to increase their preparedness to respond to more frequent and intense extreme events, and designating and improving community cooling centers to provide respite for vulnerable populations during heat waves.

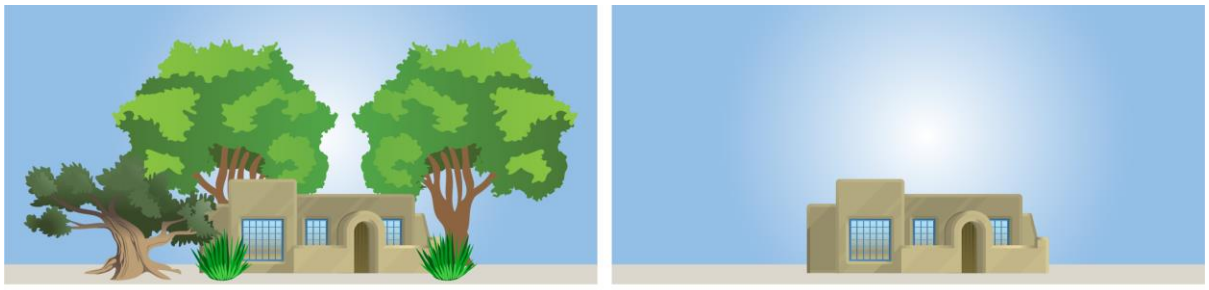
Climate change mitigation refers to actions that reduce or minimize greenhouse gas emissions, or enhance sinks of greenhouse gases, to help reduce the extent of climate change. Mitigation could include actions such as retrofitting buildings to increase their energy efficiency, expanding or promoting public or shared transportation, and developing and incentivizing water *(or Poe)* and energy conservation programs for homes and businesses.

Climate vulnerability assessment is a tool that allows decision-makers to analyze and weigh climate impacts on human and natural systems, and prioritize areas for action.

Global warming is the long-term heating of the Earth's climate system observed since the pre-industrial period (between 1850 and 1900) due to human activities, primarily fossil fuel burning, which increases heat-trapping, greenhouse gas levels in the Earth's atmosphere.

Vulnerability is a condition or factor that makes people or things they value susceptible to or unable to cope with the adverse effects of climate change, including climate variability and extremes. In other words, the Pueblo's vulnerabilities describe the underlying conditions that affect our ability to withstand and cope with climate impacts.

Example of climate change vulnerability and adaptation



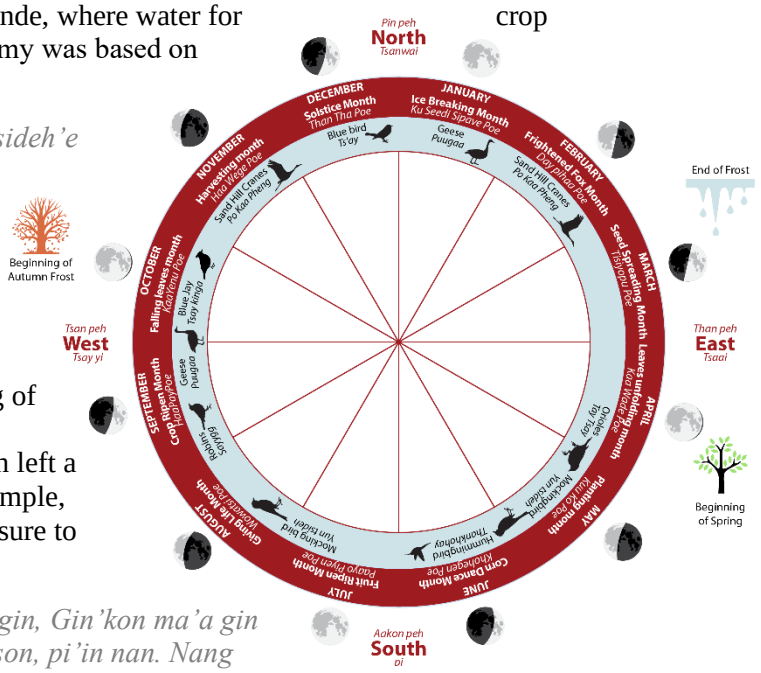
Community A | Community B

Consider Community A and Community B, which have the same vulnerability that exposes them to impacts of extreme heat. To help reduce its vulnerability to heat impacts, Community A installed shade structures and planted trees and vegetation. Community B does not have shade structures and trees. Although both communities have a common vulnerability to extreme heat, Community A has acted and installed shade structures and planted trees to reduce its vulnerability. Although this adaptation action does not reduce temperatures and extreme heat in the community, it does help reduce exposure to extreme heat and enables the community to cope with heat impacts by creating cooler areas.

Project Summary

Pueblo de San Ildefonso
PO' WHO GEH OWINGE (*Where the Water Cuts Through*)

Ancestors of the Pueblo people migrated from Mesa Verde and the Chaco Canyon to occupy the mesa and cliffs of the Pajarito Plateau. Drought and other factors caused the people to migrate to present-day San Ildefonso and settled along the banks of the Rio Grande, where water for crop irrigation was plentiful. Historically, the Pueblo's economy was based on agriculture.



Beginning of Autumn Frost

Climate change affects Pueblo life, including traditional uses of water, birds, animals, plants, wood, clay, deer, rabbit, turkey, and elk; as well as the spiritual well-being of our Pueblo. There are also human impacts due to the proximity of the Los Alamos National Laboratory, which left a legacy of contaminants in the local environment; for example, wildfires, rainfall, and flooding increase the risk of exposure to these contaminants on the Pueblo.

Nan pi'in nan in ge, Ge' taa whan, (Pajarito Plateau) Tsideh'e pin, (Black Mesa) tunyo pin, (Rio Grande River) p'okay'ge. Nang'e Thaa'ego, Phaa'tsa wa, Pin phaa. Nah p'okay'ge de ha di taa ye. P'oe na bah yen. Da' p'oe ami inbe nava.

Na' inbe wo'wahaa'tsi din' pidin'an, Nain'be towa kuu gin, Gin'kon ma'a gin te'e, paa, puu, pindee, daa, p'oe tsideh'e, Tsee'wee'ay, son, pi'in nan. Nang inbin wo'watsi nacha'muu. Los Alamos National Laboratory nako ho' pin k'eweh bugeh. Wen p'oe de yoe'an Na' oepaa p'in k'e weh. Na'e pin'paa, kwan, kwan po. Na'e pin'paa(eeyaa) e'haa'ho, p'oe a suwa de'. Ba'ge na'inbe towa de'haybo.

Through a collaborative approach, the community – including elders, youth, resources managers, and the Tribal Council – identified key aspects of Pueblo life that are critical to preserve and protect and developed a vision for the community. This community vision integrates four aspects of Pueblo life (the four colored quadrants) – traditional activities, traditional places, community heath, and infrastructure and governance – with broad cross-cutting themes that overlap with these aspects of community life that include traditional knowledge, language, income, spiritual heath, water, and food sovereignty (the outer circle). The Pueblo then assessed the vulnerability of each aspect of the community vision and identified adaptation actions that could reduce its vulnerability to climate change.

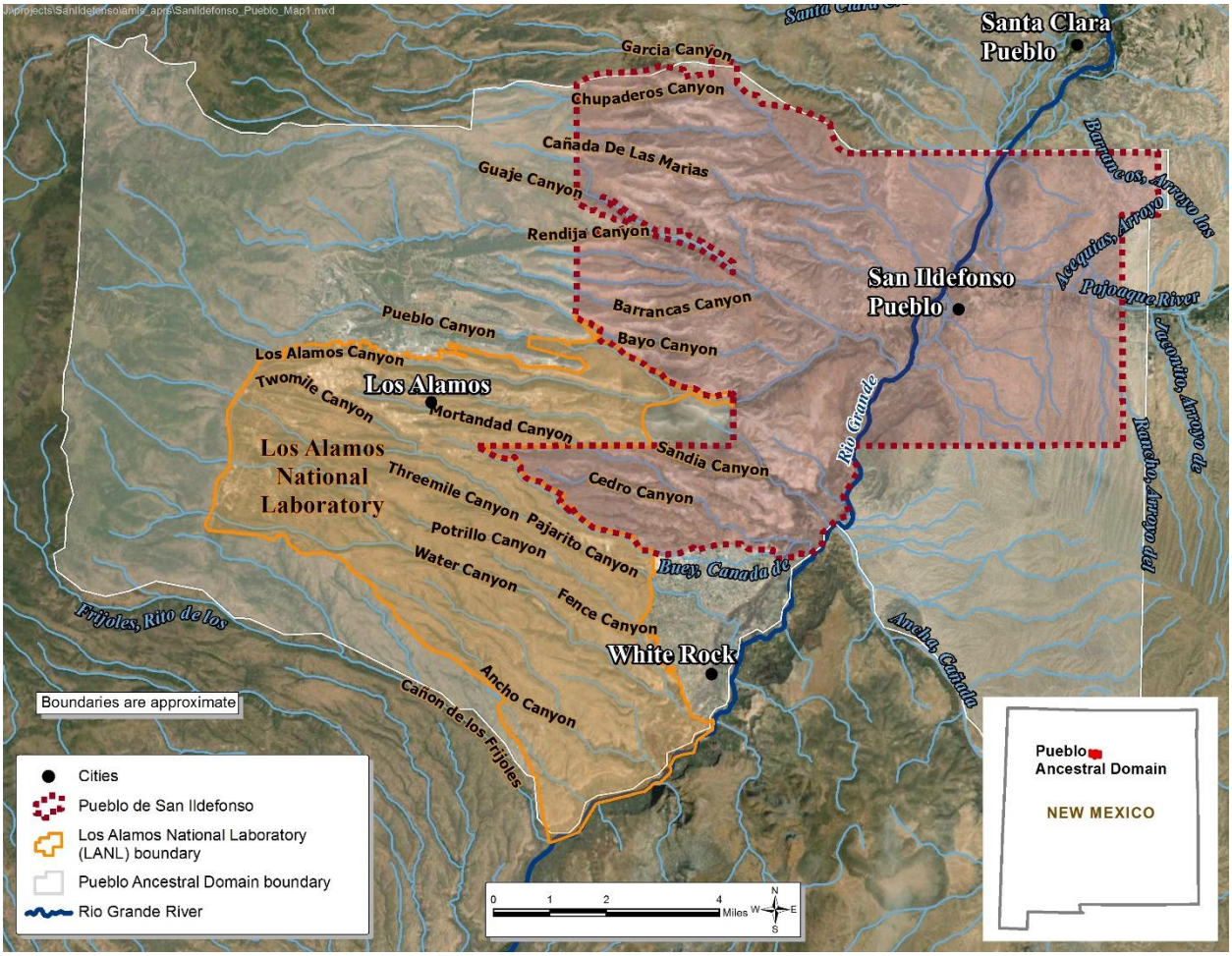
THAA'EGO- Na'inbe Owinge, Kweeyoe, Saydoe, Ayyaa, heda in Than'the'kiieeay, na'inbe un'shaa. Wowa'tsi nacha'muu. Na'inbe Nava ay e'hee ami. Nain'be towa kuu, Nain'be Nan ochu kwiyo, K'uu kwa'yeh, Na'inbe Owinge Ge'hay puwi pidi'ee, hadaa in' Menekana be'kuu, Na'in PO'WHO GEH OWINGE be K'uu, un'shaa de ta'nanmidi.'

Founded in a collective vision for the community, this Climate Action Plan aims to ensure that the Pueblo de San Ildefonso's culture and traditions thrive for future generations.

1. Introduction

The Pueblo de San Ildefonso – *or Po' Woh Geh Owingeh*, which means "where the water cuts through" in Tewa – is located along the Rio Grande at the foot of Black Mesa in New Mexico. Our history dates to 1300 A.D. Beginning around the 1200s, the residents of Mesa Verde migrated south by way of the Pajarito Plateau in search of better water *(or Poe)* sources. By the 1300s, the people from Bandelier moved closer to the Rio Grande, the current location of our Pueblo. Our Pueblo was an agricultural-based economy with a recent resurgence of traditional arts and is especially famous for black-on-black, high-polished pottery. Today, our Pueblo encompasses approximately 30,000 acres, which sits within the larger Ancestral Domain of more than 60,000 acres (Exhibit 1.1). Our Pueblo is listed in the National Register of Historic Places, recognized for its historic and cultural significance, and its important role in the revival of Pueblo ceramics. Our Pueblo has an enrollment of approximately 750 people and is a Tewa-speaking Pueblo.

Exhibit 1.1. Map of Pueblo reservation and Ancestral Domain boundary



Changing climate conditions, including increasing average temperatures as well as more frequent and intense incidences of extreme heat, drought, wildfires, storms, and floods, have implications for our natural resources, livelihoods, and community health. In addition, we face unique challenges because of our proximity to the Los Alamos National Laboratory (LANL). Historical laboratory activities, including development of the atomic bomb, have left a legacy of radionuclides, including plutonium and other contaminants in the local environment. Extreme events such as wildfires, extreme rainfall, and flooding

increase the risk of mobilization and exposure to these contaminants on our Pueblo. For example, heavy rains that fall within the LANL site on drought-affected soils or soils that have been mineralized by wildfires, can erode the soil and transport it downstream toward our Pueblo, carrying along any contaminants attached to the soil particles.

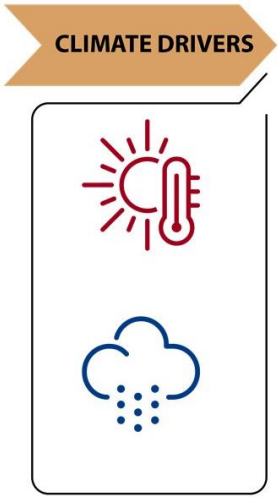
This Climate Action Plan (or Plan) aims to describe the current climate context; understand specific aspects of Pueblo life that are essential components of our identity and how climate change could affect our community vision; and begin to provide a path forward to help sustain our lands, resources, and community health. Founded in our collective vision for our community, this Climate Action Plan aims to ensure that our culture and traditions thrive under future generations. This Plan is a living document that will evolve and expand with new knowledge, data, and evidence about the impacts of climate change on our community, and as new adaptation strategies are identified.

In this Plan, we summarize the climate hazards affecting the Pueblo (Section 2) and detail the climate action planning process for the Pueblo (Section 3). We then walk through the Plan, including a summary of the workshops held with community members to develop a community vision (Section 4), the climate vulnerability assessment process and results (Section 5), and specific climate actions the Pueblo can take to adapt to and mitigate climate change (Section 6). This is followed by a brief description of implementation of climate actions (Section 7), acknowledgements, and references cited in the text.

2. Climate Context

The key climate drivers for the Pueblo and the U.S. Southwest region are temperature and precipitation. Here we describe these climate drivers and the climate hazards that these drivers can induce. Where available, we also include local and regional climatic trends for these drivers and hazards.

Exhibit 2.1. Assessment process diagram



2.1 Climate Drivers

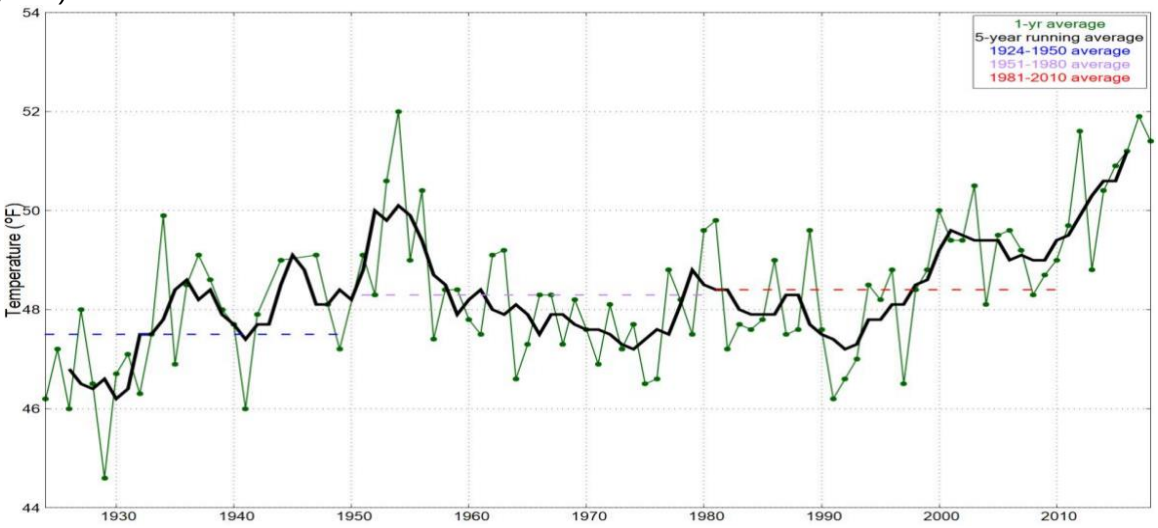
Situated in the Southwest, the Pueblo has a semi-arid climate characterized by abundant sunshine, light precipitation totals, and low humidity. Climate – the long-term, average weather in an area – is largely determined by temperature and precipitation. Identifying climate drivers was the first step in our assessment process (Exhibit 2.1). In this Plan, we refer to temperature and precipitation as climate drivers.

2.1.1 Temperature

In the southwestern United States, the average annual temperature increased 1.6°F between 1901 and 2016 (Vose et al., 2017; Gonzalez et al., 2018). Moreover, the region recorded more warm nights and fewer cold nights between 1990 and 2016, including a 4.1°F increase for the coldest day of the year (Gonzalez et al., 2018). Parts of the Southwest recorded their highest temperatures since 1895, in 2012, 2014, 2015, 2016, and 2017 (Gonzalez et al., 2018). Annual average temperatures for the Southwest are predicted to rise 3.4–4.3°F by mid-century (2036–2065) and 4.4–7.7°F by late century (2071–2100; Vose et al., 2017).

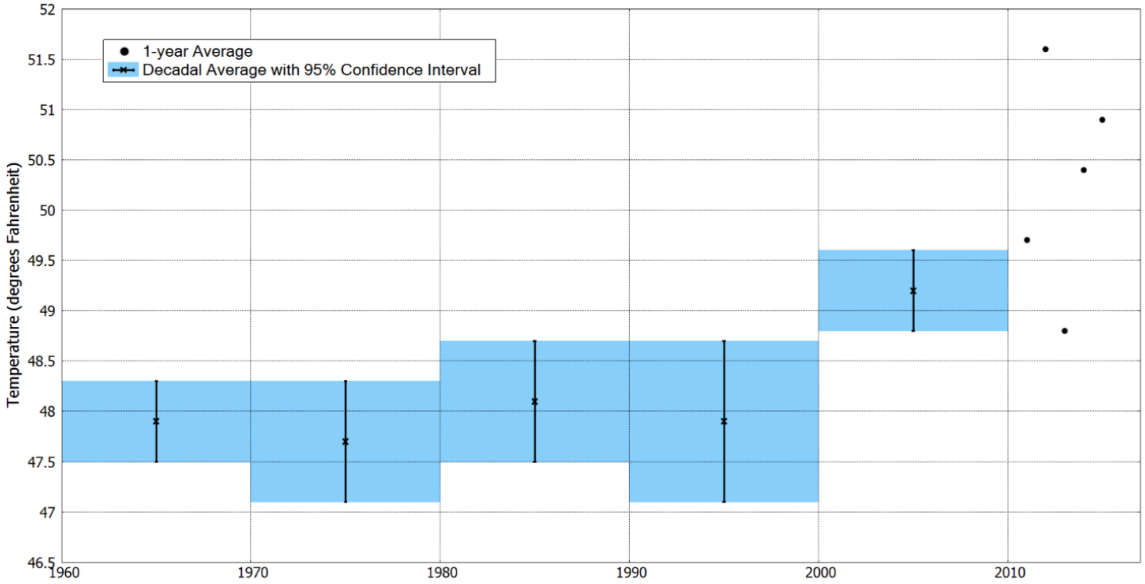
New Mexico is the sixth-fasted warming state in the Nation, with average annual temperatures increasing 0.6°F per decade since 1970 and about 2.7°F over 45 years (Tebaldi et al., 2012). Average temperatures near the Pueblo (recorded at LANL) have increased over the past 15–25 years. Although this is a relatively short period of observation, this increase in temperature is consistent with projections of the National Climate Assessment (NCA; Gonzalez et al., 2018) and the Intergovernmental Panel on Climate Change (IPCC, 2014; Exhibit 2.2). During the 2001–2010 decade, temperatures were approximately 1°F warmer than the previous 40 years, and from 2011 to 2018 temperatures were approximately 2.5°F warmer than 1960–2000 averages (Exhibit 2.3; Bruggeman, 2017; Hansen et al., 2019). Five of the hottest summers on record at LANL have occurred since 2002 (Bruggeman, 2017).

Exhibit 2.2. Temperature history for Los Alamos. One-year averages are displayed in green and five-year running averages are displayed in black. The dashed lines represent long-term averages (25 and 30 years).



Sources: Bruggeman, 2017; Hansen et al., 2019.

Exhibit 2.3. Decadal average temperatures and two times the standard error for Los Alamos from 1960 to 2015



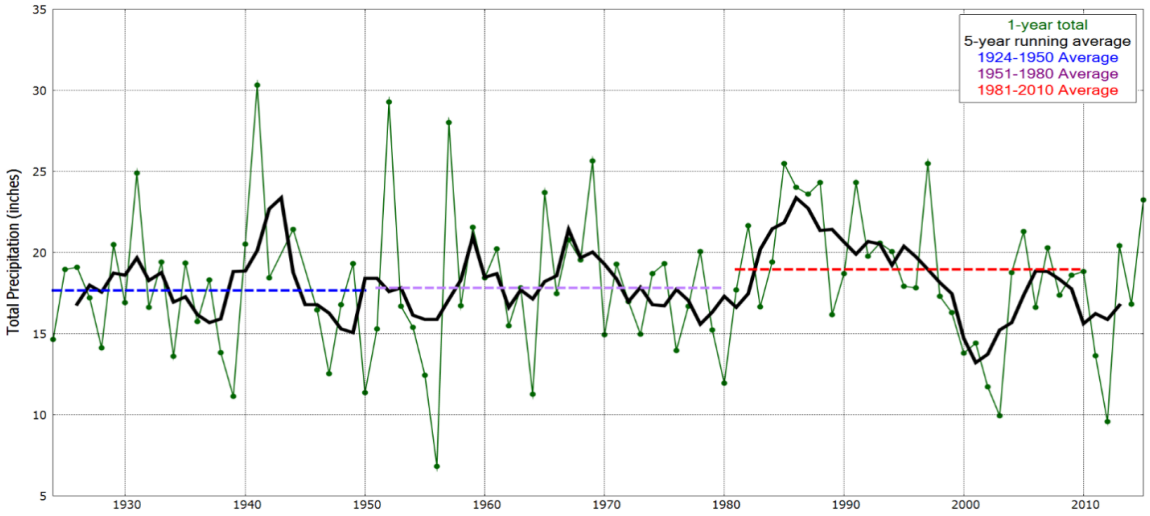
Source: Bruggeman, 2017.

2.1.2 Precipitation

Observed changes in precipitation differ across the seasons. The Southwest has seen a decrease in precipitation, with drying most pronounced during the spring season (Easterling et al., 2017). Similar to observed changes, precipitation is expected to decline in the future, particularly in the spring (Easterling et al., 2017). As temperature increases, winter and spring precipitation may also shift from snow *(or Pho')* to rain *(or Kwan)*. The NCA projects declines in various snow metrics in the western United States, including snow water equivalent (SWE), the number of extreme snowfall events, and the number of snowfall days (Gonzalez et al., 2018).

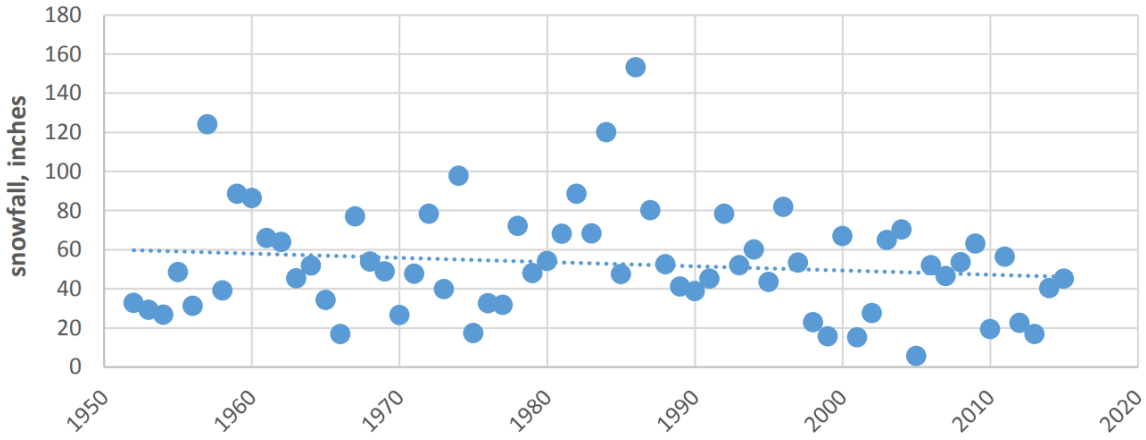
The LANL data are generally consistent with NCA data. While precipitation overall does not show strong trends (Exhibit 2.4), the form of precipitation is changing. In particular, there is a downward trend for snowfall from 1951 to 2015 (Bruggeman, 2017; Exhibit 2.5), and a decreasing length in the snow season (Bruggeman, 2017; Hansen et al., 2019). In addition, as discussed further below, when precipitation does occur as rainfall, the trend is for the rain to come in fewer but more intense storm events that can cause destructive flooding.

Exhibit 2.4. Precipitation history for Los Alamos. One-year averages are displayed in green and five-year running averages are displayed in black. The dashed lines represent long-term averages (25 and 30 years).



Source: Bruggeman, 2017.

Exhibit 2.5. Annual snowfall (July 1–June 1) for Los Alamos (1951–2015)

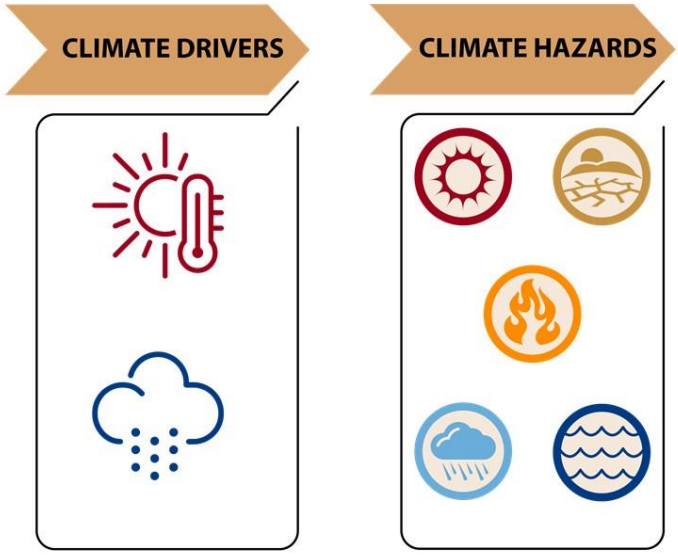


Source: Bruggeman, 2017.

2.2 Climate Hazards

Changes in temperature and precipitation can in turn expose the Pueblo community to hotter temperatures, extreme heat events, droughts, wildfires, storms and flooding, and changes in snowmelt and streamflow. Below we describe these climate hazards and how they may adversely affect the Pueblo community (Exhibit 2.6).

Exhibit 2.6. Climate Action Plan process diagram

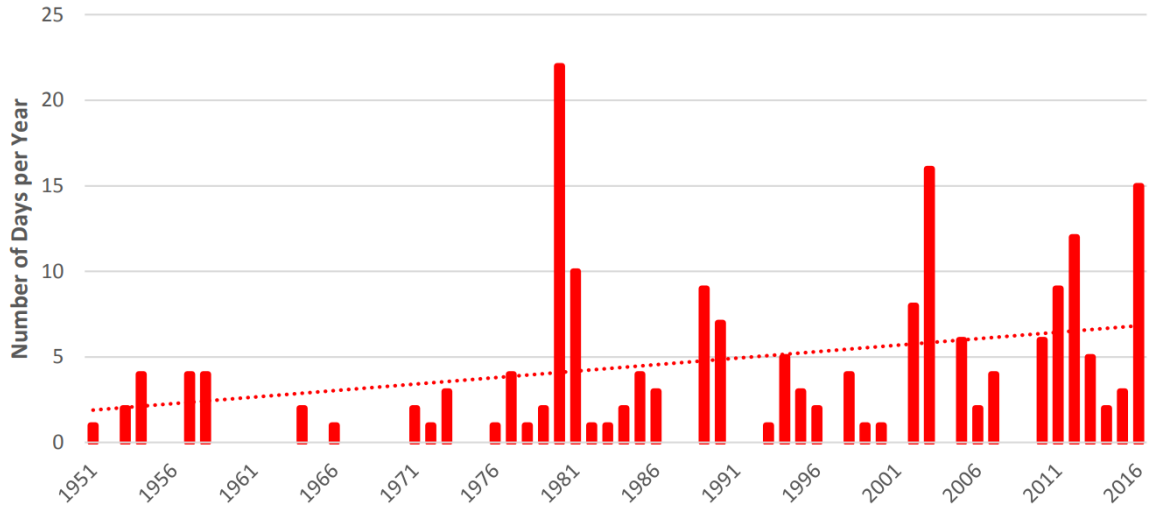


2.2.1 Hotter Temperatures and Extreme Heat Events

The coldest and warmest temperatures of the year have important implications for human health and many sectoral activities, such as agricultural practices and heating, refrigeration, and air conditioning. Throughout the United States, cold extremes have become less severe while warm extremes have increased over the past century (Vose et al., 2017). In the Southwest, the coldest daily temperature of the year has increased by nearly 4°F and the warmest daily temperature of the year has increased by 0.5°F over the past century (Vose et al., 2017). Daily temperatures are projected to continue to increase substantially over the next century. In the Southwest, both the coldest and warmest daily temperatures of the year are expected to increase by approximately 6°F by mid-century. Not only will daytime temperatures increase, but nighttime temperatures and humidity are also projected to increase (Gershunov et al., 2013; Peterson et al., 2013).

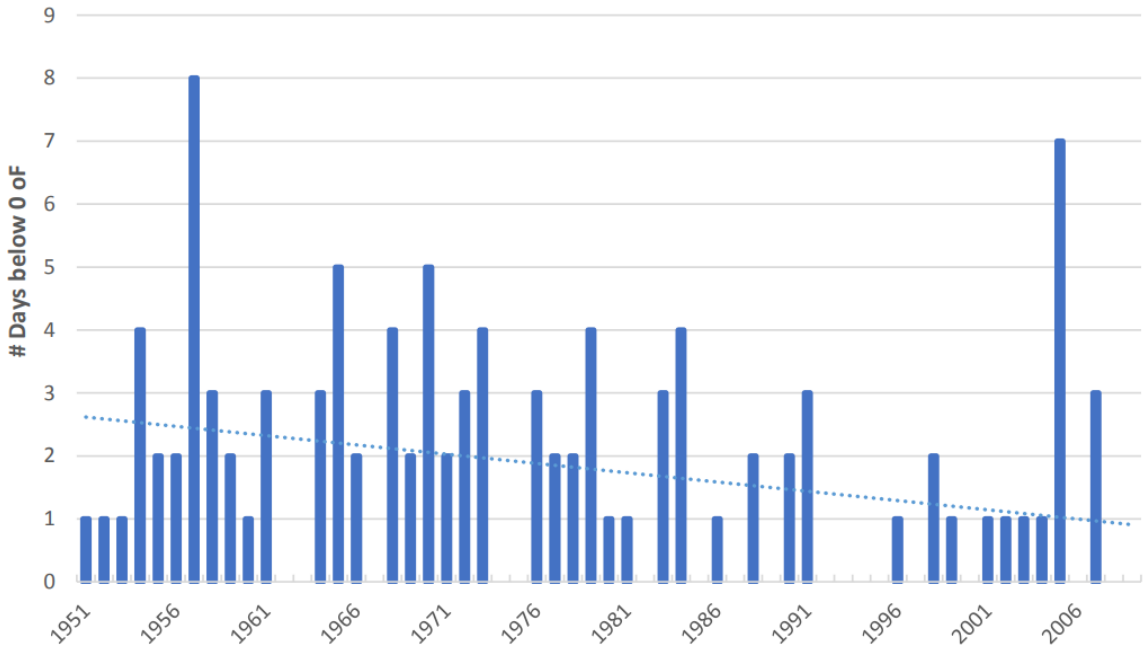
Throughout the United States, historically rare heat events have become increasingly common as global temperatures increase (Peterson et al., 2013; Wobus et al., 2017). Trends near the Pueblo (recorded at LANL) show a positive trend in the number of days with a maximum temperature greater than 90°F (Exhibit 2.7) and a negative trend in the number of days with a minimum temperature less than 0°F (Exhibit 2.8; Bruggeman, 2017). In the Southwest, projections indicate that extreme cold waves and extreme heat waves (5-day, 1-in-10 year events) will have temperature increases of at least 10°F by mid-century (Vose et al., 2017). Extreme heat episodes disproportionately threaten the well-being of vulnerable populations, such as young children and older adults; and people with pre-existing health conditions, such as cardiovascular and respiratory issues. Hotter days and extreme heat events also increase the risk of heat-associated death and reduce labor productivity (Gonzalez et al., 2018).

Exhibit 2.7. Number of days per year with maximum temperatures above 90°F for Los Alamos



Source: Bruggeman, 2017.

Exhibit 2.8. Number of days per year with minimum temperatures less than 0°F for Los Alamos



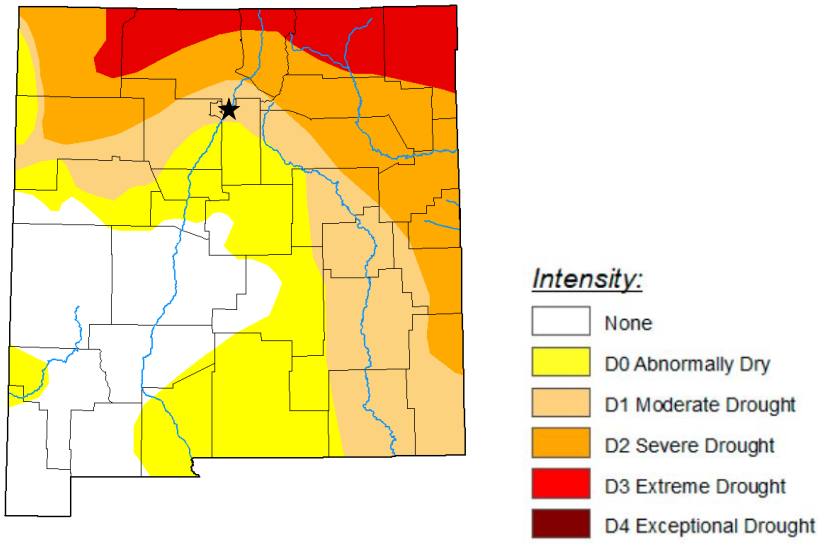
Source: Bruggeman, 2017.

2.2.2 Droughts

Much of New Mexico is currently experiencing drought conditions, with Pueblo lands in a moderate drought (Exhibit 2.9). In New Mexico, the flow of the Rio Grande is an important indicator of drought (Hoerling et al., 2013); on average, New Mexico's portion of the Rio Grande was drier every year from 2009 to 2014 (UCS, 2016).

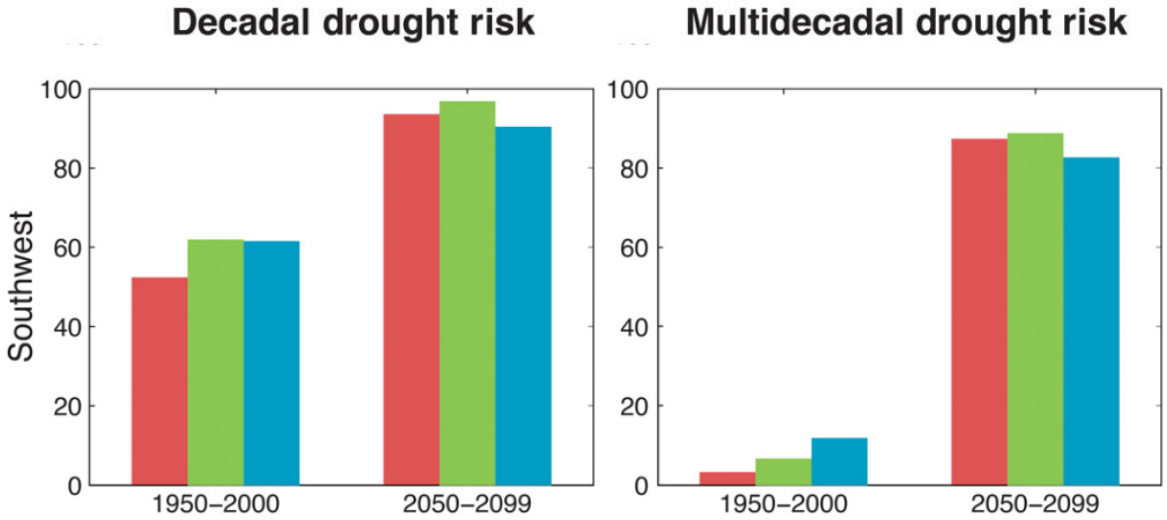
Climate change is expected to result in future droughts in the Southwest and an increased risk of mega-droughts, which are persistent droughts lasting longer than a decade, even if precipitation increases over that period (Gonzalez et al., 2018). Climate models suggest drying during the latter half of the 21st century (2050–2099) in the Southwest (Cook et al., 2015). Drying is largely the result of reduced cold season precipitation and increased evapotranspiration with reduced soil moisture (Cook et al., 2015). By mid- to late century (2050–2099), the risk of droughts will exceed historical periods (1950–2000; Exhibit 2.10), even the most severe mega-drought periods of the Medieval era (Cook et al., 2015).

Exhibit 2.9. New Mexico drought monitor for June 9, 2020 displaying drought intensity. The black star indicates the approximate location of the Pueblo de San Ildefonso.



Source: National Drought Mitigation Center, 2020.

Exhibit 2.10. Risk (percent chance of occurrence) of decadal (11-year) and multidecadal (35-year) droughts in the Southwest, calculated from the multimodel ensemble for the Palmer Drought Severity Index (PDSI; red), SM-30cm (green), and SM-2m (blue). Risk calculations are conducted for two separate model intervals: 1950–2000 (historical scenario) and 2050–2099 (Representative Concentration Pathway, RCP 8.5).



Source: Cook et al., 2015.

Recent droughts have already affected local flora and fauna, resulting in tree mortality and avian population declines (Box 2.1). More frequent, future droughts in the region will occur in a significantly warmer world with higher temperatures than recent historical events. These conditions will further stress natural ecosystems, as well as agriculture. In addition, adaptation to future droughts may be more challenging because of the widespread depletion of nonrenewable groundwater reservoirs in recent years. Historically, these groundwater resources have allowed communities to mitigate drought impacts.

Box 2.1. Impacts of recent droughts on local flora and fauna

Droughts affect the Pueblo's flora and fauna. In combination with higher temperatures and dry winds, droughts have particularly adverse impacts on native plants and avian species.

Observed pinyon tree die-off

Pinyon trees are an important tree species in the Pajarito Plateau (Hansen et al., 2019). As a result of a drought during 2000–2002, 40–80% of the pinyon tree population died between 2002 and 2003 (Exhibit 2.11), with more than 90% of mature pinyon trees decimated by 2005 in the Southwest (Breshears et al., 2009). Overall, more than 2.1 million acres of pinyon-juniper forest and 1.3 million acres of Ponderosa pine forest in Arizona and New Mexico died (Fowler et al., 2015). Severe drought, coupled with high temperatures, made the trees susceptible to insect infestations. The water-stressed trees were unable to produce pine sap to defend themselves against insects, which allowed pine bark beetles to invade them (Jensen, 2005). The combination of dead trees from the bark beetle infestation, higher temperatures, and dry winds subsequently set the stage for megafires in the Pajarito Plateau.

Exhibit 2.11. At study sites in Arizona, Colorado, New Mexico, and Utah, 40–80% of pinyon trees died between 2002 and 2003 (Breshears et al., 2009)

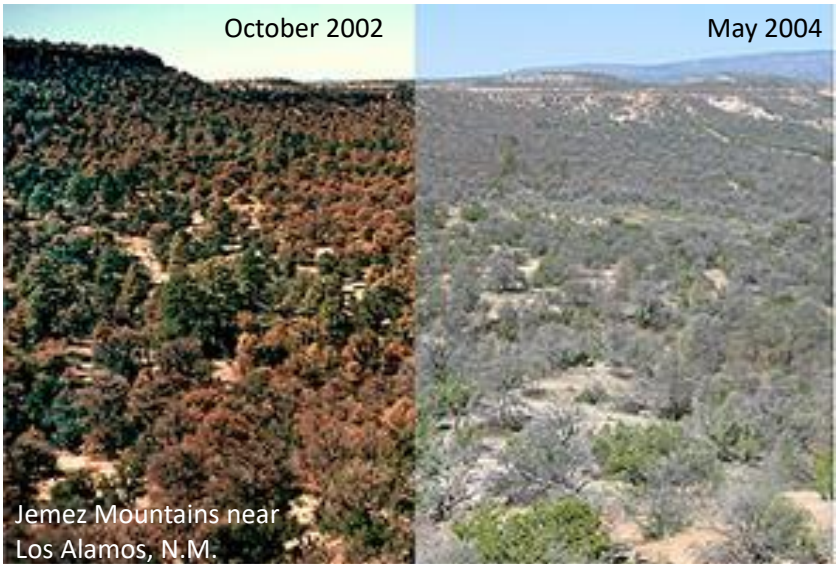


Photo credit: Craig D. Allen, U.S. Geological Survey.

Projected conifer tree mortality

The mortality of forest trees is projected to continue into the 2050s (Williams et al., 2013). The recently accelerating mortality rates are associated with increased temperatures. McDowell et al. (2016, p. 298) stated that "the consequences of such broad-scale change in forest cover are substantial, including massive transfer of carbon to a decomposable pool and changes in the surface energy budget."

Observed avian declines

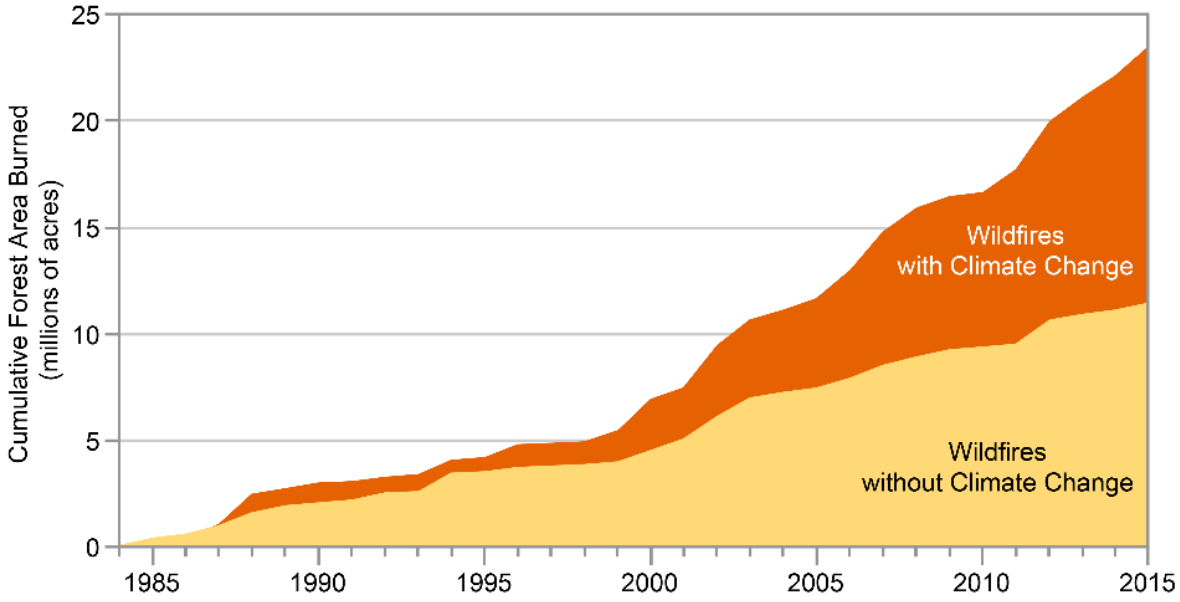
Declines in avian populations have been attributed to tree mortality and fire-prevention tree thinning. Fair et al. (2018) studied pinyon-juniper woodlands on the Pajarito Plateau in north-central New Mexico. Pinyon tree mortality began in 2002 because of the drought and bark beetle infestation. Fair et al. (2018) looked at avian response to tree mortality from 2003 to 2013, and they compared how birds responded in sites that were mechanically thinned in 2002 and 2003 versus sites not thinned. After 2003, the study shows a decline in total bird species richness by 45% and in species abundance by 73%. They found that Piñon mortality may be a significant threat to avian species in the Southwest and tree thinning for fire control may be an added risk to birds. They also associated the declines with climate change impacts (Fair et al., 2018).

2.2.3 Wildfires

As a natural part of Southwest ecosystems, wildfires facilitate the germination of new seedlings and kill pests; however, excessive wildfire can also permanently alter an ecosystem's integrity (Gonzalez et al., 2018). The frequency and intensity of large wildfires is influenced by natural and human factors such as temperatures, soil moisture, humidity, winds, and vegetation density. More intense and frequent wildfires are also associated with other climate hazards such as droughts and drier forest conditions, reduced snowpack and earlier snowmelt, and high winds.

The cumulative forest area burned by wildfires in the western United States has greatly increased between 1984 and 2015, with analyses estimating that the area burned over that period was twice what would have burned had climate change not occurred (Exhibit 2.12; Gonzalez et al., 2018). For wildfires around the Pueblo, acres burned per fire have also increased dramatically over time, with the 2000 Cerro Grande fire burning 43,000–48,000 acres and the 2011 Las Conchas fire burning 154,000 acres (Fowler et al., 2015; Exhibit 2.13). Climate change models project more wildfires across the western United States (Stavros et al., 2014) and the Southwest region (Gonzalez et al., 2018). Fire frequency could increase by 25%, and the frequency of very large fires (greater than 5,000 hectares) could triple (Gonzalez et al., 2018).

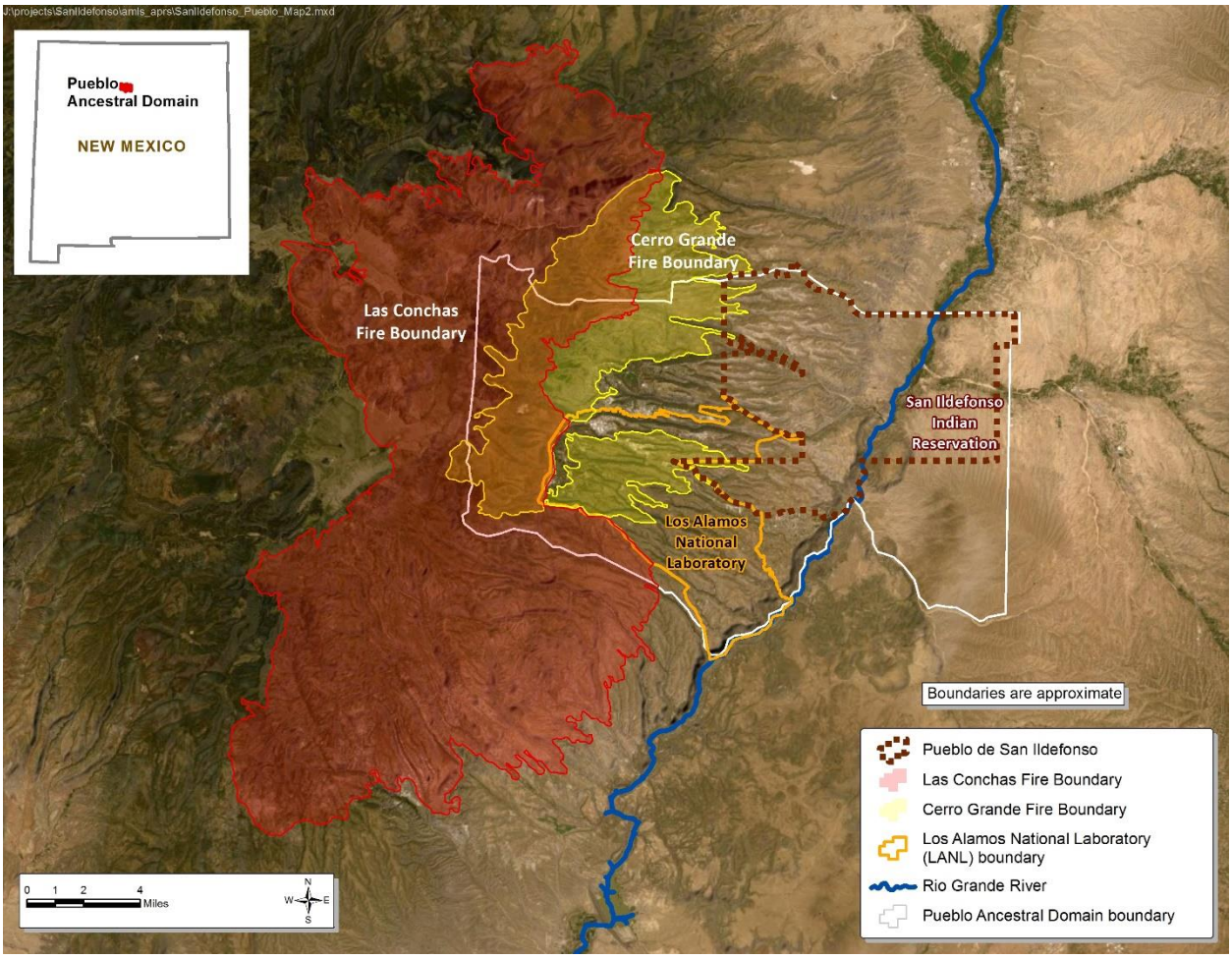
Exhibit 2.12. Wildfires with climate change compared to wildfires without climate change



Source: Gonzalez et al., 2018.

Wildfires can threaten people, homes, roads, and ecosystems; and smoke from these fires can confound other health stressors and cause respiratory illnesses (Box 2.2). Wildfires can also degrade drinking water systems with sediment, acidity, nitrates, and contamination (Gonzalez et al., 2018). Severe wildfires can damage a forest canopy and the plants beneath, and can destabilize the soil. As described in more detail below (Section 2.2.4), post-fire conditions, combined with intense rainfall or rapid snowmelt, can result in increased localized floods and landslides that put critical infrastructure, sacred places, and traditional resources beneath a burned area at risk.

Exhibit 2.13. Boundary of the 2000 Cerro Grande fire that burned 43,000–48,000 acres and the 2011 Las Conchas fire that burned 154,000 acres near the Pueblo



Box 2.2. Wildfire smoke and COVID-19 pandemic

Over the last two decades, wildfires have become more frequent and intense across the western United States, a trend attributed to increased temperatures and decreased precipitation (Gonzalez et al., 2018). The resulting smoke is a mixture of many air pollutants and is often characterized by elevated concentrations of fine particulate matter (or $PM_{2.5}$). Communities impacted by wildfire smoke experience high exposure to $PM_{2.5}$ for days, weeks, or several months. Exposure to wildfire smoke can irritate eyes and respiratory tracts, worsen existing respiratory and cardiovascular conditions, and result in premature deaths.

Recent studies suggest that wildfire smoke is associated with winter-time influenza outbreaks in Montana (Landguth et al., 2020), and biomass burning is associated with influenza cases in New York State (Croft et al., 2020). In addition, a study on the severe acute respiratory syndrome (SARS) coronavirus outbreak in Beijing found that an increased risk of death is associated with increased PM_{10}, which is comprised of $PM_{2.5}$ and other large particles that are inhaled into the lungs (Kan et al., 2015). Based on these studies, there is a potentially dangerous connection between air pollution from wildfire smoke and COVID-19.

Communities can take several actions to protect indoor air quality during a wildfire, even with the COVID-19 pandemic. See Section 6.2.2 for actions communities can take to create safe or clean air spaces that can protect the community from extreme wildfire smoke.

2.2.4 Storms and Flooding

Extreme precipitation events have increased throughout the United States since 1901 (Easterling et al., 2017). In New Mexico, monsoon rains – defined as sudden, intense downpours that last less than one hour – generally occur in July and August and can incite flash floods. Drought and wildfires can also exacerbate flash flooding because very dry and scorched soils have a limited capacity to absorb water *(or Poe)* (Chief et al., 2008).

Although monsoon precipitation and heavy rainfall data near the Pueblo (recorded at LANL) do not demonstrate a significant trend from 1951 to 2015 (Bruggeman, 2017), significant flooding has been associated with the large wildfire events described above. The Cerro Grande fire in 2000 burned lands along the western edge of the Pueblo, as well as large portions of LANL property and forests to the west. The Las Conchas fire in 2011 covered a much larger area overall but did not burn within the LANL property or Pueblo lands (Exhibit 2.13). Loss of vegetation and mineralized soils due to these fires resulted in the reduced ability of watersheds to retain precipitation and increased runoff. The resulting flooding during the subsequent monsoon seasons caused the destruction of habitat and infrastructure. For example, two years after the Las Conchas fire, a 1,000-year rain event occurred in September 2013. Flooding from this rainfall damaged infrastructure, including roads and bridges (Exhibit 2.14; Walterscheid, 2015). The reduced ability of watersheds to retain rainfall and runoff likely exacerbated the effects of this massive flood event. These floods also redistributed contaminant-laden sediments downstream to the Pueblo and into the Rio Grande. After the Cerro Grande fire, Englert and Ford-Schmid (2011) showed an increased movement of plutonium from LANL during storm events, and that most of this plutonium was deposited on Pueblo lands (~ 80%), with a smaller proportion discharging to the Rio Grande (~ 20%). In summary, flooding can damage cultural places and resources, and infrastructure; and pose risks to human health risk through the transport of contaminated sediments from LANL downstream to Pueblo lands and the Rio Grande.

Exhibit 2.14. Flooding in the lower Pueblo Canyon on September 13, 2013

Source: Walterscheid, 2015.

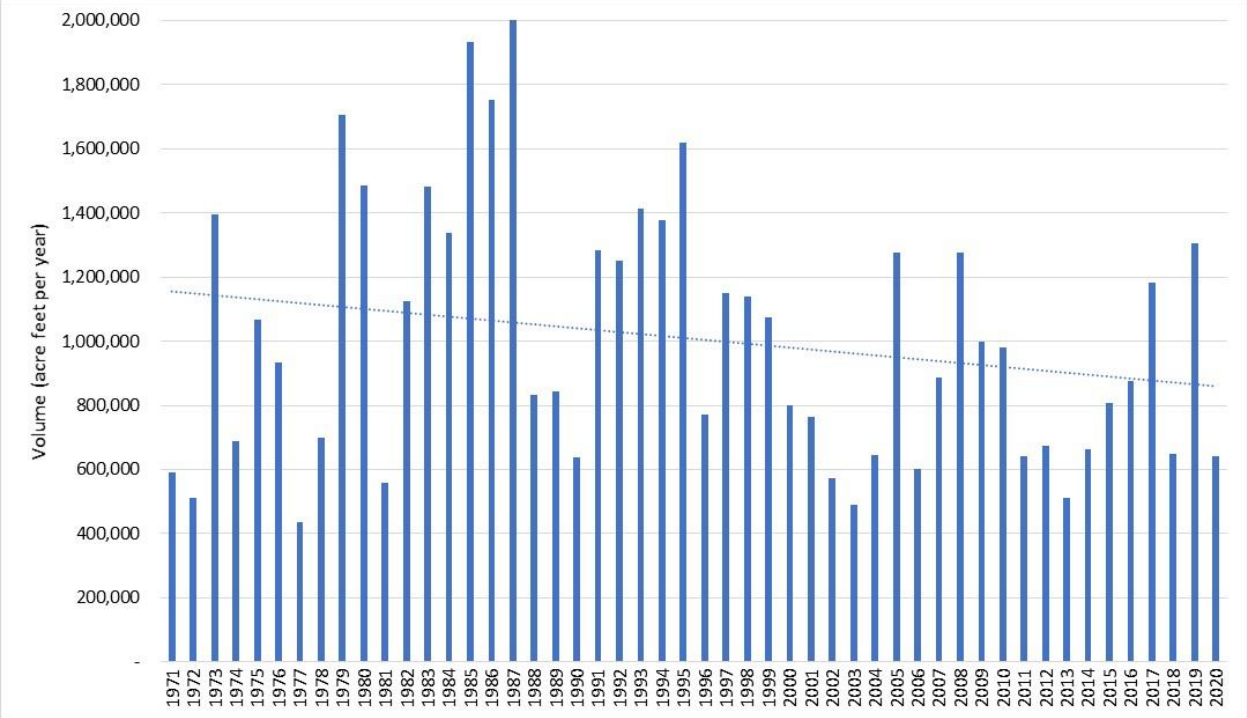
In the Southwest, climate models project an increase in the frequency of heavy downpours and an increase in daily extreme summer precipitation, based on projected increases in water vapor resulting from higher temperatures (Gonzalez et al., 2018). An increase in extreme precipitation may also lead to more frequent and intense flooding events.

2.2.5 Changes in Snowmelt and Streamflow

Increasing temperatures have altered the Southwest's water cycle. Specifically, warm temperatures are occurring earlier in the spring, and precipitation has declined (Gonzalez et al., 2018). These changes, which have decreased the region's snowpack and its water content, have resulted in earlier peaks for snow-fed streamflows and increased the proportion of snow *(or Pho')* to rain *(or Kwan)* (Gonzalez et al., 2018). Warmer temperatures have also been associated with increases in snowline elevation (USGS and Scripps Institution of Oceanography, 2007). Hotter temperatures and

reduced snowpack attributed to climate change have already amplified recent droughts and reduced river flow in the Rio Grande (Lehner et al., 2017; Gonzalez et al., 2018). Water flows in the Rio Grande at the Otowi Bridge gage (USGS 08313000) have trended lower over the last five decades: after rising to an average of 1.4 million acre-feet/year in the 1980s and early 1990s, the volume decreased to approximately 830,000 acre-feet/year during drought years in the 2000s and 2010s (Exhibit 2.15; USBR, 2018). The highest-recorded volume was 2,592,837 acre-feet/year in 1941, and the lowest was 359,480 acre-feet/year in 1956 (USBR, 2018). In the Upper Rio Grande River Basin, researchers (Lehner et al., 2017) found that reduced snowpack reduces river runoff efficiency. They estimate that in years with below-median precipitation and above-median temperatures, low runoff ratios (i.e., the portion of the precipitation that ends up in the river each year, rather than evaporating) are 2.5 to 3 times more likely (Lehner et al., 2017).

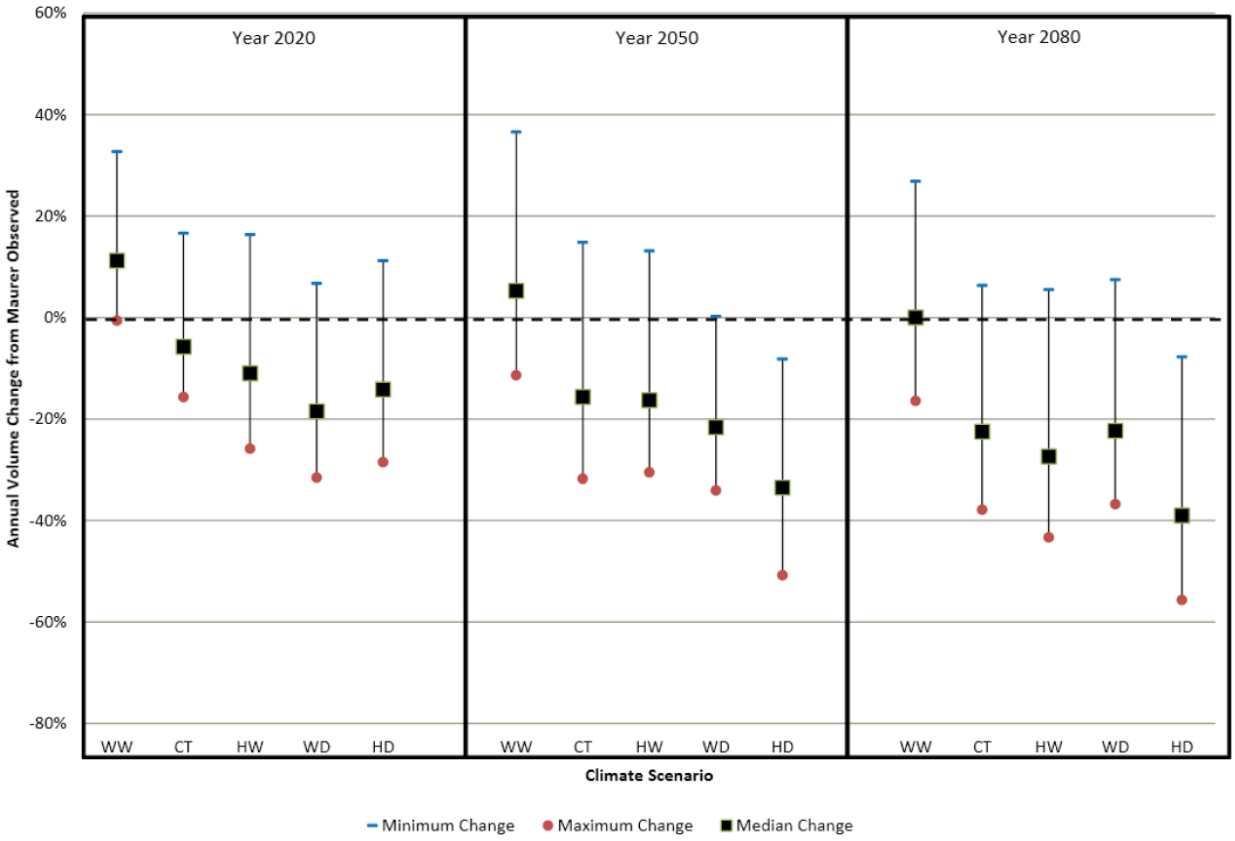
Exhibit 2.15. Historical Rio Grande at Otowi Bridge flows



Source: USGS surface water data for Rio Grande at Otowi Bridge (USGS 08313000), New Mexico; downloaded in 2021.

Projected annual flow of the Rio Grande at the Otowi Bridge gage is generally expected to decrease by 2050 and 2080 under various climate scenarios, compared to current conditions (Exhibit 2.16; USBR, 2018). Climate models project hotter temperatures, which can shift precipitation from snow *(or Pho')* to rain *(or Kwan)* in the mountains. By 2050, colder and higher areas in the Intermountain West are projected to receive more rain *(or Kwan)* in the fall and spring but would likely continue to receive snow in the winter at the highest elevations (Gonzalez et al., 2018). Reduced snowpack and earlier snowmelt in the headwaters of New Mexico's major rivers *(or P'ok'ay)* can reduce water availability throughout the year (Garfin et al., 2014).

Exhibit 2.16. Change in annual volume at Otowi Bridge for various climate scenarios. WW = warmer and wetter conditions, CT = central tendency, HW = hotter and wetter conditions, WD = warmer and drier conditions, and HD = hotter and drier conditions.

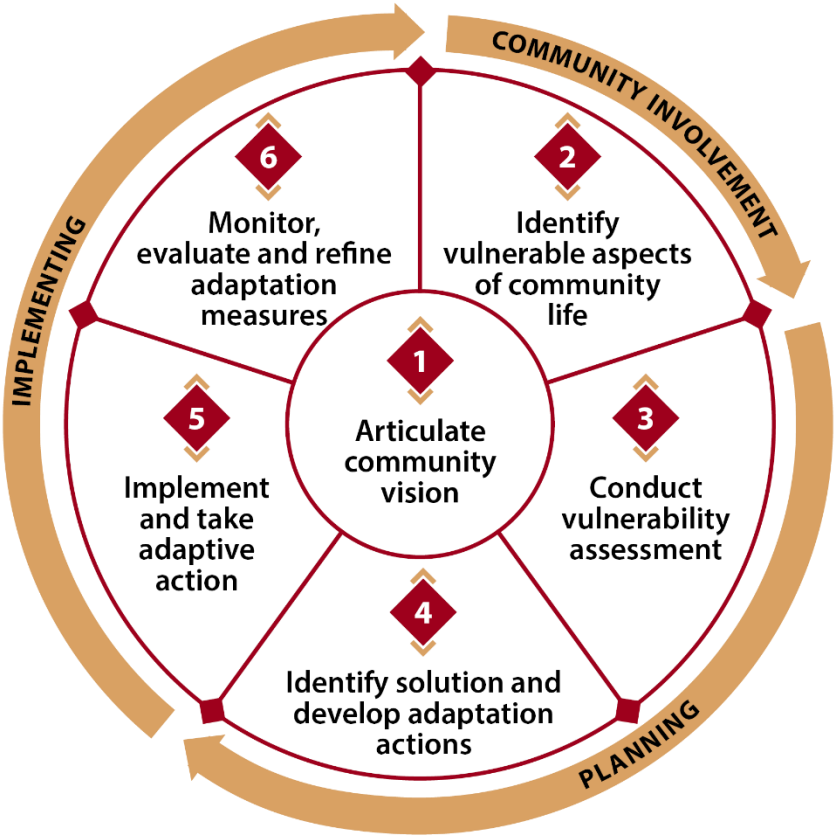


Source: Maurer et al., 2007; as cited in USBR, 2018.

3. Climate Action Planning Process

Our climate action planning process involves three key components – community involvement, planning, and implementing (Exhibit 3.1). This Plan addresses community involvement and the planning process and lays the groundwork for implementation.

Exhibit 3.1. Climate action planning process for the Pueblo de San Ildefonso with descriptions of each step in the process



Community involvement	Through a collaborative process of holding community workshops, our elders, youth, resource managers, and Tribal Council identified key aspects of community life that we want to preserve and protect; and developed a vision for the community that grounds the goals of this Climate Action Plan (*Step 1*). After articulating our vision for the Pueblo community, the elders, youth, resource managers, and Tribal Council identified the resources, such as traditional plants or materials that support each aspect of the vision (*Step 2*). In Section 4, we describe this process for developing our community vision.
Planning	We then assessed the vulnerability of each aspect of our community vision. We evaluated the ***likelihood*** that climate hazards will be realized and affect Pueblo activities, as well as the magnitude of the ***consequences*** of these climate impacts on aspects of our community vision and community life (*Step 3*). Based on the results of the climate vulnerability assessment, we began to identify strategies or actions that could reduce our highest-risk vulnerabilities, and categorized these actions based on their feasibility (*Step 4*). In Section 5, we discuss the results of this climate vulnerability assessment; and in Section 6, we describe the climate adaptation actions.
Implementing	The further evaluation of climate actions – including comparing costs and benefits – facilitates the prioritization for implementing adaptation strategies (*Step 5*). There may be opportunities to combine actions in a way that reduces vulnerabilities across several aspects of community life. Finding synergistic actions can also produce cost savings. After implementation, monitoring outcomes of climate actions and actively seeking community feedback will help us determine whether climate actions are producing desired results, and will enable the community to adaptively manage and refine adaptation actions in the future (*Step 6*). In Section 7, we briefly describe next step, including evaluating climate actions and informing and scoping future implementation.

Community involvement is a key aspect of the Pueblo's climate planning process. From December 2016 through January 2021, several in-person workshops, webinars, and conference calls were held with community members to develop the Pueblo's community vision, assess the Pueblo's vulnerabilities to climate impacts and climate change, and identify and evaluate strategies for adapting to climate impacts (Exhibit 3.2). The Pueblo intends to continue community involvement and collaboration as we continue to evaluate and prioritize actions, and then implement and monitor actions.

Exhibit 3.2. Table of community workshops and meetings held as a part of the climate planning process

Date of workshop/meeting	Community groups involved in outreach activity	Purpose of the workshop/meeting
December 7, 2016*	Department of Environmental & Cultural Preservation (DECP)	Present a process for climate change adaptation planning and initiate the first steps in this process with DECP staff.
November 28, 2018*	Pueblo elders	Engage community groups in discussions of the Pueblo's community vision, and vulnerabilities to climate impacts and climate change; and to begin to identify potential strategies for adapting to climate impacts.
December 4, 2018*	Pueblo youth	
December 5, 2018*	Tribal Council Technical Committee	
December 19, 2018*	Pueblo resource managers	
August 8, 2019†	DECP	Assess the magnitude of the consequences of climate impacts on the community vision and community life.
December 11, 2019†	Community forum	Provide updates on ongoing climate adaptation planning and summarize outcomes from previous workshops with youth, elders, resource managers, and the Tribal Council. Discussed and received community feedback on the community vision, key aspects of the community's lifeways that are vulnerable to climate change, and initial adaptation approaches suggested by the community in earlier workshops.
October 22, 2020‡	Health Department	Identify and evaluate potential actions to reduce vulnerability to climate change (via WebEx meetings and online surveys).
November 12, 2020; January 29, 2021‡	Education Department	
November 18, 2020‡	Pueblo elders	
November 18, 2020‡	Tribal Council	
January 12, 2021‡	Parks and Wildlife (via online survey)	

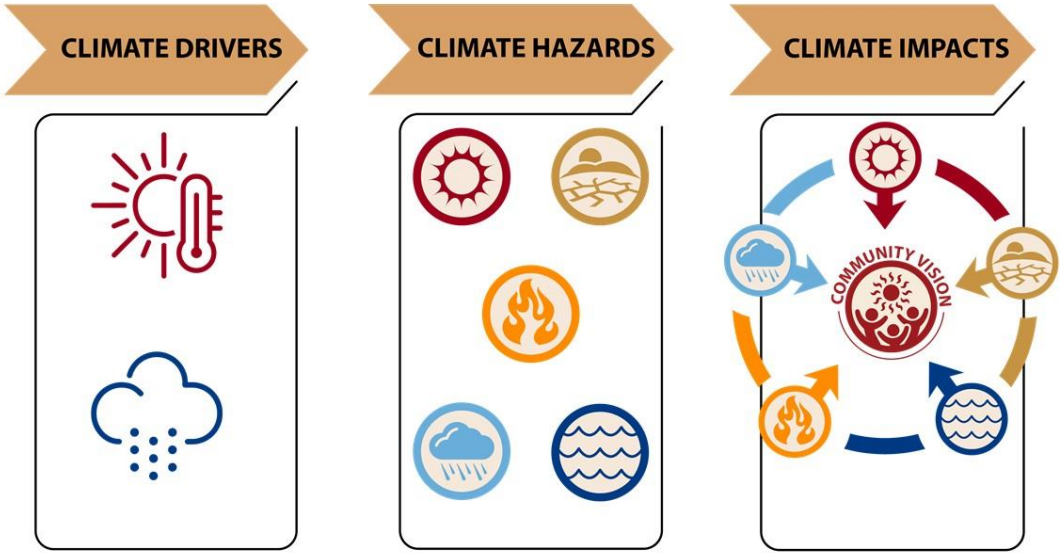
* Results from the community involvement during these workshops/meetings are described in more detail in Section 4.
† Results from the community involvement during these workshops/meetings are described in more detail in Section 5.
‡ Preliminary from the community involvement during these workshops/meetings are described in more detail in Section 6.

4. Pueblo Community Vision

The Pueblo's goal for climate action planning is to preserve and protect the characteristics, conditions, cultural elements, and resources that contribute to our community vision. One important element of the climate action planning process was to define this community vision and specify aspects of the vision that the Pueblo aims to preserve through climate adaptation and resilience actions.

Through a series of workshops with Pueblo community members, we elicited diverse perspectives on aspects of Pueblo life and our vulnerabilities to climate impacts and climate change and developed a community vision that serves as a guiding framework for climate action planning. Identifying the climate impacts on the community vision was the next step in our Climate Action Plan process (Exhibit 4.1). This section describes this collaborative, stakeholder-driven process that the Pueblo conducted to capture a broad range of inputs into the climate action planning process.

Exhibit 4.1. Climate Action Plan process diagram



4.1 Building the Pueblo Community Vision

To build and articulate the Pueblo's community vision, we held a series of community workshops. In a 2016 workshop, DECP staff began to identify multiple aspects of the community vision that are important for the Pueblo to protect and preserve. Additional workshops in 2018 engaged four groups of community members – elders, youth, the Tribal Council technical committee, and resource managers – in further developing and refining the community vision.

Discussions in all five workshops focused on:

- Identifying key aspects of community life (the community vision)
- Identifying the resources necessary to sustain the community vision
- Perceptions about climate impacts on these aspects of the community vision
- Assessments of observed and projected climate vulnerabilities of each aspect of the community vision.

The following sections summarize key activities and outcomes from each community workshop, and describe the step-wise development of the community vision.

4.1.1 DECP Workshop

DECP grouped these aspects into four community vision categories:

- Traditional activities
- Physical health
- Infrastructure
- Traditional places.

Through their discussions, five broader themes on Pueblo community life also emerged.

- Traditional knowledge
- Language
- Income
- Health
- Food sovereignty.

These broad themes interact in complex ways with each aspect of the community vision. The results of the DECP discussion became the foundation of the Pueblo community vision, which the community refined through a series of additional workshops.

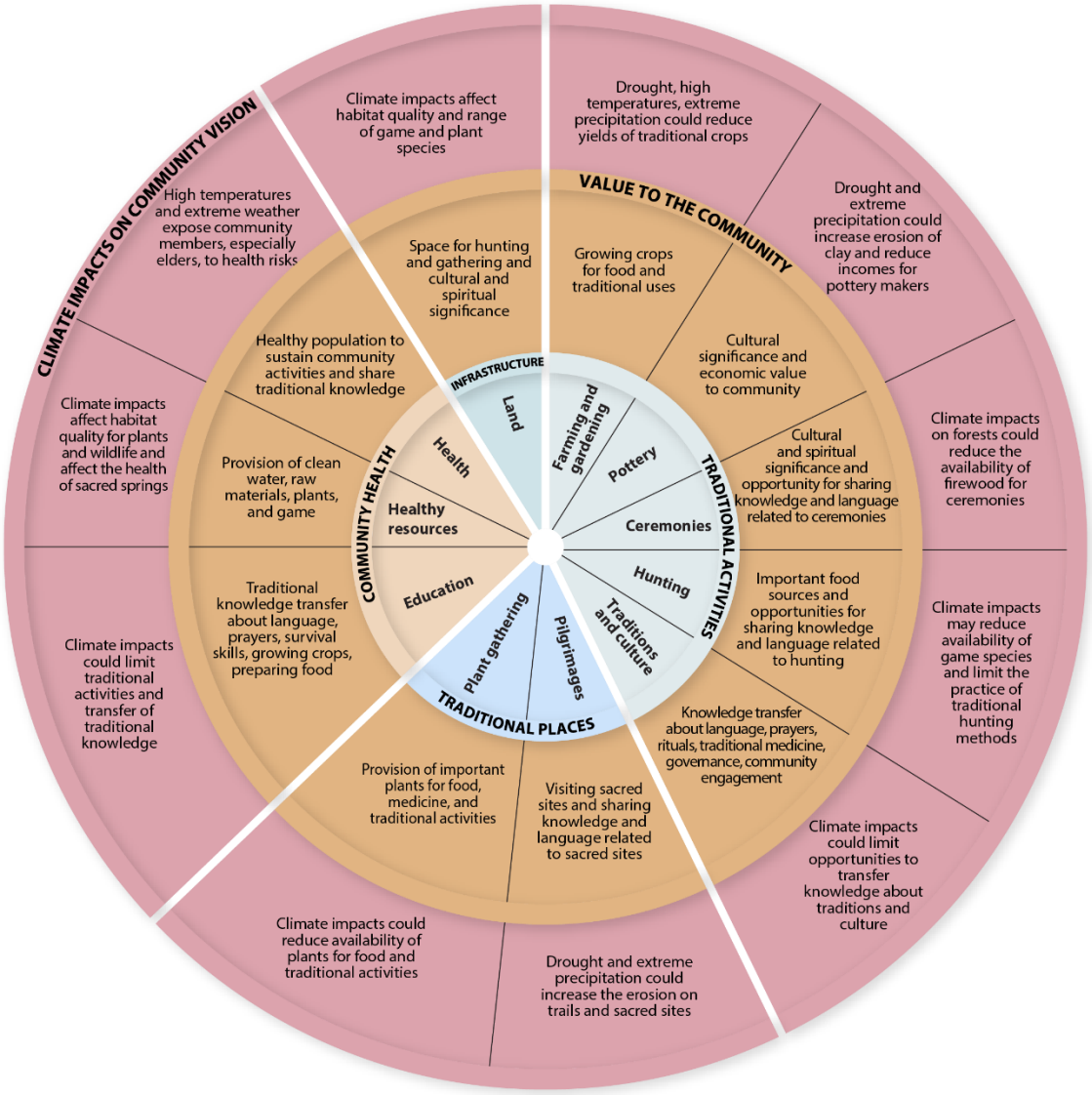
4.1.2 Elder Workshop

Six elders from the community participated in the climate adaptation and resilience planning workshop. We discussed basic concepts of climate change, including viewing a short video about climate change and climate change impacts, and described a process for climate change adaptation planning. We also discussed the importance of community engagement in identifying the Pueblo's vulnerabilities to climate impacts and developing effective and feasible adaptation strategies.

The elders described their vision for their community, the first step of the adaptation planning process. They identified aspects of the community that they value and want to sustain, explained how climate impacts affect these aspects of their community, and described vulnerabilities associated with each community aspect. Exhibit 4.2 summarizes the community aspects and associated vulnerabilities that the elders identified.

The elders described the climate impacts they have already experienced in their community and the changes they have observed (e.g., in the distribution and abundance of bird and plant species, decreases in the variety of fruit trees on Pueblo lands). Birds (e.g., robins, magpies) and plants [e.g., wild spinach, pine nuts *(or Toe'tu)*, herbs] that were abundant when the elders were young are no longer present on Pueblo lands. Participants also noted a change in precipitation patterns; rain falls less frequently, and heavy snowfalls are much rarer.

Exhibit 4.2. Elder workshop outputs: Aspects of the community vision and their value and vulnerabilities

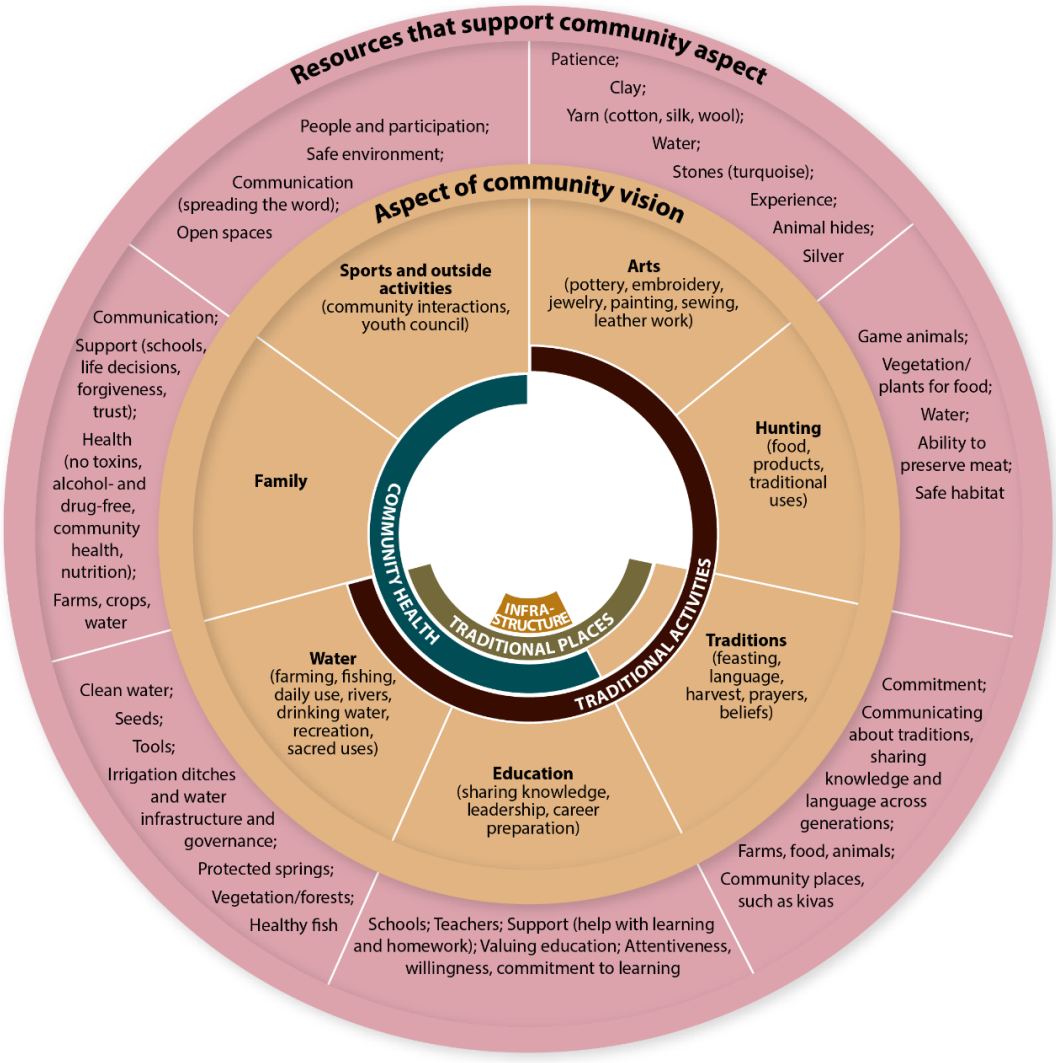


4.1.3 Youth Workshop

Twelve youth participated in the climate adaptation and resilience planning workshop. The workshop began with a discussion about basic concepts of climate change, including viewing the same short video about climate change and climate change impacts. We also discussed key findings from research on climate impacts on the Southwest. We described a process for climate change adaptation planning and the importance of youth engagement in identifying the Pueblo's vulnerabilities to climate impacts, and developing effective and feasible adaptation strategies.

As in the elder workshop, we began the interactive portion of the workshop with a discussion of the youth's vision for their community. We reviewed aspects of the community vision that the elders identified in their workshop, and the youth added their ideas to the community vision. Then the youth described the resources that support and sustain each aspect of their community vision. One particularly insightful addition that the youth made to the community vision is the importance of family and relationships. They described the specific set of resources necessary to build and support healthy, happy families; and the potential impacts of climate change on family health. These contributions helped to further develop the community vision. Exhibit 4.3 summarizes the findings from the youth workshop's discussions about aspects of the community vision.

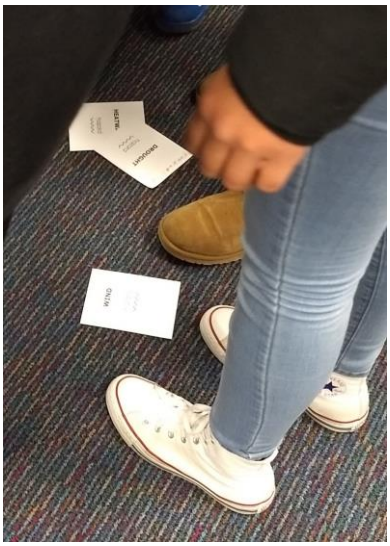
Exhibit 4.3. Aspects of community vision and resources that sustain the community vision



Next, the youth engaged in a group activity to identify the climate hazards they believe are most affecting the Pueblo and its community vision. We created a set of cards, and each card listed a specific climate hazard (e.g., increased temperatures, extreme precipitation, sea level rise, lightning, drought). We spread the cards on the floor, and the youth, through group consensus, removed any cards that they thought were irrelevant to their region or not important to the Pueblo (e.g., sea level rise). Then each participant reviewed the remaining cards and marked the four cards that showed the most important climate hazards to the Pueblo (Exhibit 4.4). After the youth marked the cards, we tallied the results and selected the four hazards that received the most marks. The participants identified the following four climate hazards as most important to their community:

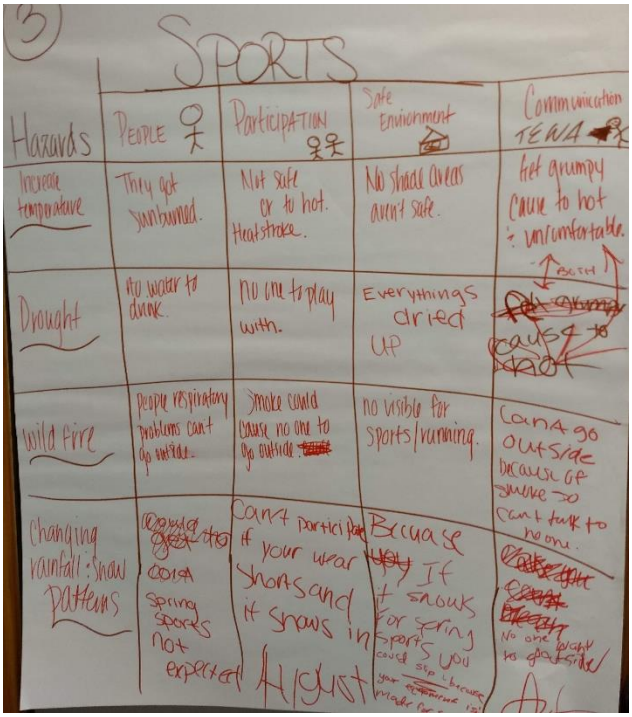
- Increased temperatures
- Drought
- Wildfires
- Changing rainfall and snowfall patterns.

Exhibit 4.4. Pueblo youth participated in an activity to identify the climate hazards that are most important to their community



After identifying the priority hazards, the youth worked in small groups to describe the impacts that each hazard could have on each aspect of the community vision. On flipcharts, the small groups created a matrix that matched each hazard with the four resources that they believe are most important for sustaining the community aspect. Exhibit 4.5 shows two photographs of the matrices that the youth completed on the flipcharts.

Exhibit 4.5. Hazards and resources that affect Pueblo families (left) and youth sports (right)



4.1.4 Tribal Council Technical Committee Workshop

Approximately 10 members of the Tribal Council technical committee participated in the climate adaptation and resilience planning workshop. As in the youth workshop, we first reviewed basic concepts of climate change and key findings from research on climate impacts on the Southwest, and then viewed the same short video about climate change and climate change impacts. Next, we described a process for climate change adaptation planning and the importance of community engagement in this process.

After the elder and youth workshops, we incorporated both groups' ideas into the preliminary representation of the community vision. The technical committee reviewed and validated the community vision, and elaborated on aspects of the community vision that community members had identified in previous workshops. We discussed the broad themes that had emerged during the elders' and youth's discussions of the community vision, and recorded technical committee members' ideas about the value of these aspects to their community and the resources that support each aspect.

The technical committee highlighted additional aspects of the community vision that they believe are important to protect and preserve. This included various aspects of physical health, including access to healthy first foods, adequate physical activity, a substance-free life, and a contaminant-free environment.

To help sustain overall community health, participants also emphasized the importance of mental health – not just physical health – and creating opportunities for community interactions that contribute to mental health. They also noted that economic opportunity has an important influence on mental health, and that it is important to seek out and sustain income-generating activities that support the Pueblo's families.

The technical committee also recognized the value of looking beyond the Pueblo for guidance from and coordination with the larger global community. Seeking these connections could inform and enhance management of the Pueblo's infrastructure and strengthen its system of governance. Sharing this knowledge within the Pueblo community would also require creating a learning "space" that includes both physical gatherings of the community and an open, welcoming, safe environment to exchange knowledge and ideas. Within the Pueblo's lands, the technical committee emphasized the ecological and cultural value of protecting habitats that support wildlife and culturally significant plants.

4.1.5 Resource Manager Workshop

Six of the Pueblo's resource managers participated in the climate adaptation and resilience planning workshop. We framed the discussion similarly to the other workshops by reviewing basic climate change concepts and research on climate impacts on the Southwest. We also reviewed outputs from the four previous workshops, and the preliminary community vision that we developed based on community inputs. The resource managers validated the ideas and outputs that other community members produced during the previous workshops, and they discussed potential vulnerabilities of the specific resources they manage [e.g., plants and trees, water *(or Poe)*, various habitats, infrastructure elements].

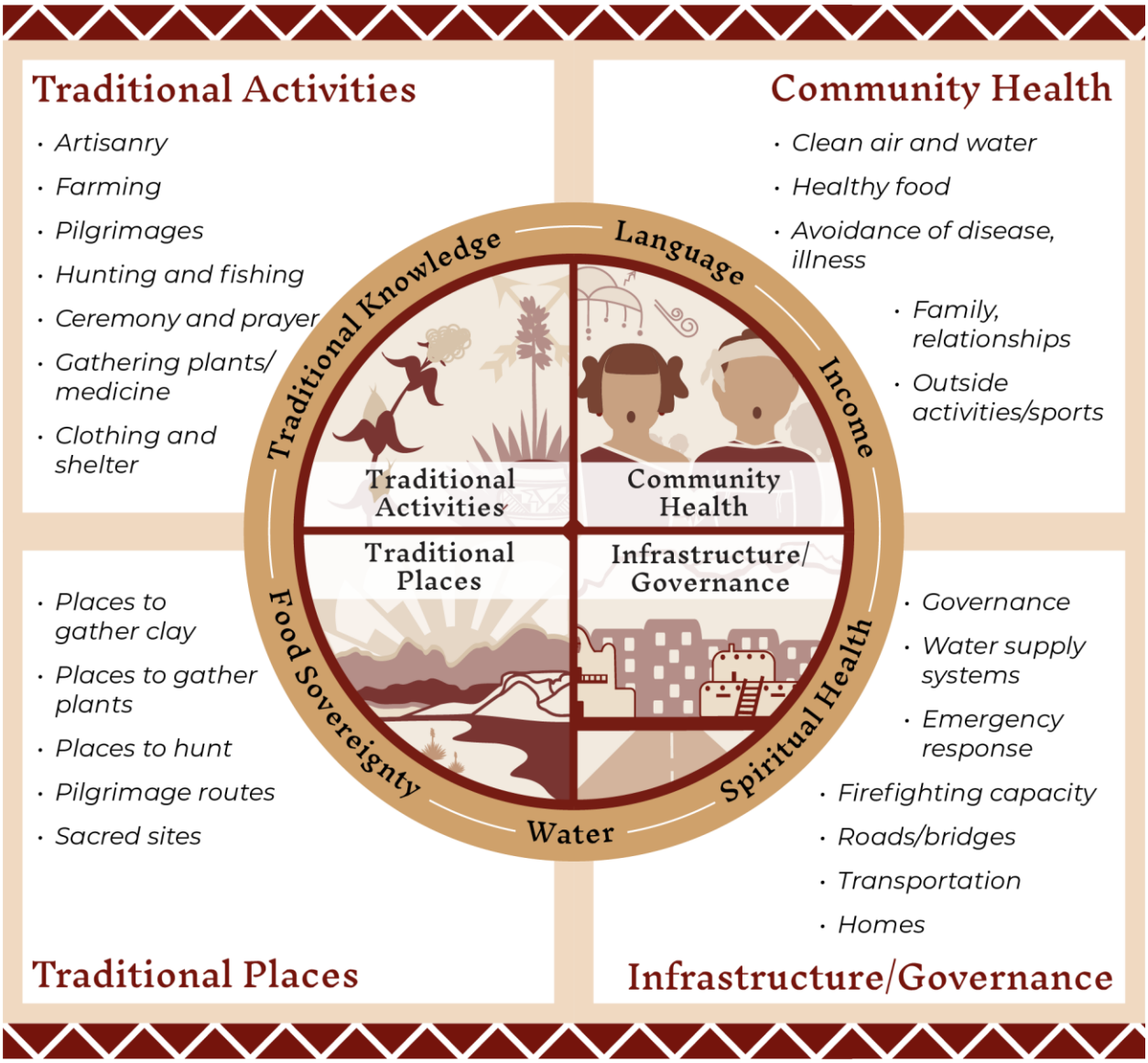
The group discussed specifically the climate impacts on resources that support a healthy traditional diet, which is one important aspect of the community vision. The resource managers discussed some of their existing programs that can help sustain this aspect of the community vision, such as the community garden and the Pueblo's composting project. In addition to noting impacts on natural resources, the resource managers discussed impacts on the Pueblo's physical infrastructure and services. Safe, reliable water and waste management systems and transportation infrastructure are aspects of the community vision that the Pueblo's resource managers strive to protect through their daily work.

4.2 Final Pueblo Community Vision

Exhibit 4.6 presents the community vision that emerged from the workshops. The community vision integrates the four categories of community vision aspects (the four colored quadrants) – traditional activities, community health, infrastructure and governance, and traditional places – with the broad cross-cutting themes that overlap with all aspects of community vision, which include traditional knowledge, language, income, spiritual health, water, and food sovereignty (the outer circle).

Preserving this community vision is the goal of the Pueblo's climate adaptation and resilience planning process. The community vision provides the basis for identifying and prioritizing climate vulnerabilities, and developing adaptation and resilience actions that could help protect and sustain the most important aspects of Pueblo life.

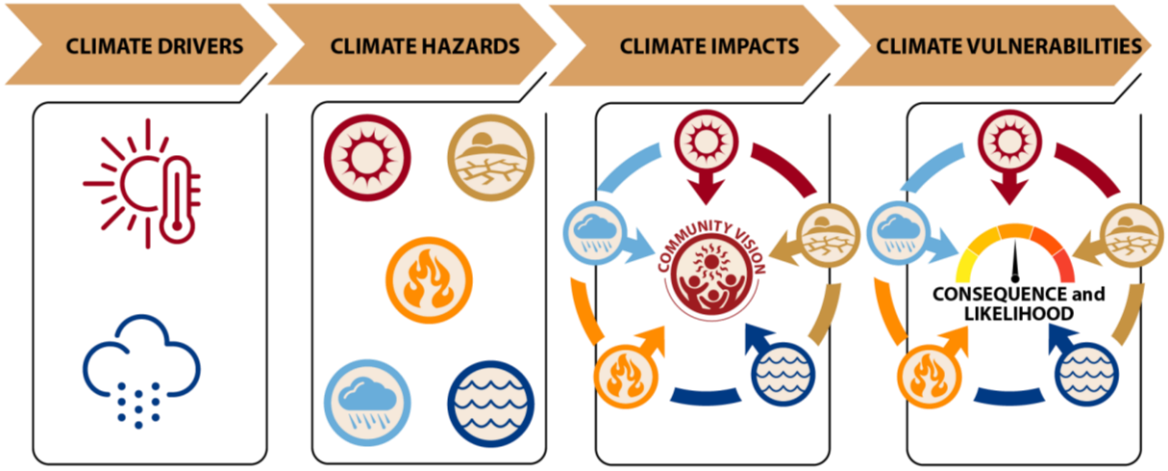
Exhibit 4.6. Pueblo community vision



5. Climate Vulnerability Assessment Process and Results

After developing the community vision in Section 4, we conducted the climate vulnerability assessment. A climate vulnerability assessment is a tool that allows decision-makers to analyze and weigh climate impacts on human and natural systems, and prioritize areas for action. In undertaking this assessment, we took a systematic approach to describing climate hazards relevant to the Pueblo and each aspect of the community vision. We also assessed the underlying conditions that make our Pueblo community vision vulnerable to climate impacts and climate change. In this section, we describe the assessment process and results. After completing the community workshops, identifying high-risk climate vulnerabilities was the next step in our process (Exhibit 5.1). In Section 6, we discuss climate actions that could reduce each of these high-risk vulnerabilities.

Exhibit 5.1. Climate Action Plan process diagram



5.1 Process for Assessing Climate Vulnerability

Once we had a broad understanding of the ways in which key aspects of community life may be vulnerable to climate change, we were able to conduct a focused evaluation of how climate change might affect the Pueblo. We identified potential climate vulnerabilities (Section 5.1.1), assessed the likelihood that these climate hazards will be realized and affect Pueblo activities (Section 5.1.2), assessed the consequences for potential vulnerabilities (Section 5.1.3), and then determined the overall climate risk for these potential vulnerabilities (Section 5.1.4). Section 5.2 provides assessment results, including the high-risk vulnerabilities for key aspects of the community vision.

5.1.1 Identify Potential Vulnerabilities

Using the Pueblo community vision, we identified potential vulnerabilities associated with traditional activities and places, community health, and infrastructure and governance. As described in the Key Terms section, a vulnerability refers to the degree to which a people or things they value are susceptible to and unable to cope with adverse effects of climate change, including climate variability and extremes. For example, one vulnerability that we described through the assessment is related to our sovereignty. As climate impacts have become more frequent and intense, community members have observed that populations of plants used for traditional practices have declined, and their habitat ranges have shifted. Therefore, one vulnerability that affects our ability to gather traditional plants is that sovereignty is constrained to Pueblo lands and "the range of traditional plants, animals, and other resources may shift beyond the Pueblo's borders with changing environmental and climatic conditions." Exhibit 5.2 lists the aspects of the Pueblo's community vision and vulnerabilities that we identified through the assessment process.

Exhibit 5.2. Potential vulnerabilities associated with each key aspect of the community vision

Community aspect	Vulnerability
Traditional activities and places  	**Traditional pottery:** Traditional pottery making utilizes materials from the Pueblo's local lands *(or Nan)*. Making pottery requires access to clay, sand, ash, plants (for pigments), and other materials.
	Ceremony and prayers: Traditional ceremonies and prayers *(or Yuu su)* utilize the Pueblo's local plants and animals.
	Sacred places (e.g., sacred springs): Continued existence of sacred places, such as sacred springs, depends on sustained groundwater levels.
	Culturally important places: Emergency responders need to be able to access all areas of the Pueblo and the Pueblo's Ancestral Domain during an emergency; culturally important places may be present within a future emergency response location.
	Income: Some families in the Pueblo depend on income from selling their pottery and other traditional artistry work to tourists.
	Gathering traditional foods: Traditional foods include plants that community members gather on Pueblo lands.
	Gathering traditional medicine: Traditional medicine utilizes specific plants that grow on Pueblo lands.
	Growing traditional crops: Traditional crops are most productive under specific climate conditions.
	Hunting: Traditional diets depend on the availability of game for hunting, and hunting depends on the availability of forage for game animals.
	Traditional buildings and extreme events: Community and traditional buildings, such as kivas, experience damage during extreme weather events.
	Heating and cooling of traditional buildings: Heating, cooling, and ventilation systems are limited in community and traditional buildings.
	Fishing: Traditional diets include fish in local streams and rivers; fishing requires clean water to provide suitable habitat.
	Traditional leatherwork: Traditional leatherwork utilizes materials from the Pueblo's local lands; and leatherwork requires access to game animals for hides *(or Ko'wha)*.
	Pilgrimage routes: Pilgrimage routes pass through areas that are prone to erosion from flooding and runoff events.
Community health 	**Clean air:** Elders and other community members who are ill or have compromised respiratory systems may be especially susceptible to health problems associated with poor air quality.
	Water supply: The community relies on local groundwater and surface water sources for a sufficient source of drinking water, and water for other domestic and business uses.
	Youth outdoor activities: Outdoor activities and sports are an important means for Pueblo youth to interact and build relationships, to sustain physical health and well-being, and to make exercise a healthy habit. Pueblo youth and community members engaged in outdoor activities and sports are exposed to heat or poor air quality.
	Vector-borne diseases: Community members may be susceptible to vector-borne diseases associated with warmer temperatures, such as the West Nile or Zika virus, malaria, or other communicable diseases.
	Hardship stress: Families and communities experience stress when they face financial hardship (e.g., due to loss of pottery sales when fewer tourists visit the Pueblo, or wildfires and other extreme events).
	Traditional practices stress: Families and communities experience stress when they cannot carry out traditional and daily practices because of impacts that disrupt their daily routines and make traditional practices difficult or unsafe.
	Heat stress: Elders and community members who are ill or have compromised immune systems may be especially susceptible to heat stress associated with warmer temperatures.
	Extreme weather stress: Families and communities experience stress during extreme weather events.
	Outdoor community activities: Many community activities and interactions occur in outdoor community spaces exposed to environmental conditions.
	Community youth gardens: The Pueblo's community youth garden is an important cultural teaching tool.
	Home air quality: Homes do not have a way to reduce air pollution, such as air filters.

Community aspect	Vulnerability
Infrastructure and governance 	**Critical (non-transportation) infrastructure:** Critical infrastructure, such as water supply systems, are located in areas prone to flooding or wildfires.
	Sovereignty: Sovereignty is constrained to Pueblo lands; the range of traditional plants, animals, and other resources may shift beyond the Pueblo's borders with changing environmental and climatic conditions.
	Pueblo departments: Pueblo departments are compartmentalized from each other; managing community resources will require work across these departments.
	Firefighting: Firefighting requires firefighters from outside of the community, and the availability of and access to water supplies to fight the fires.
	Roads and bridges: Roads, bridges, and evacuation routes are located in areas prone to flooding or wildfires.
	Historical places: Historical places, such as Edith Warner's House at Otowi and Don Juan Playhouse, are located in areas prone to flooding or wildfires.
	Transportation infrastructure: Existing transportation infrastructure (e.g., roads, bridges) is in disrepair and more vulnerable to further damage.
	Bridges and culverts: Bridges and culverts are designed to standards that are based on a lesser storm intensity.
	Home heating and cooling: Most homes do not have adequate heating and cooling.
	Home improvement resources: Some community members do not have financial resources to make necessary home improvements.
	Homes and extreme events: Some homes are located in areas prone to flooding or wildfires.

5.1.2 Assess the Likelihood for Potential Vulnerabilities

After identifying potential vulnerabilities, we assessed the likelihood that climate hazards will occur and affect Pueblo activities, and matched climate hazards to the potential vulnerabilities that they can affect. We used best available science from published literature and best professional judgement from our contractor, Abt Associates, to assign a score for the likelihood that each climate hazard will be realized and affect Pueblo activities. For example, hotter temperatures and extreme heat events are increasing at the Pueblo and are projected to continue to increase substantially over the next century. Hotter days and extreme heat events will affect agricultural activities and disproportionately threaten the well-being of vulnerable populations, such as young children and elders; and people with pre-existing health conditions, such as community members with cardiovascular and respiratory issues. Because climate hazards associated with higher temperatures – increased annual average temperatures, and increased intensity and frequency of extreme heat events – are likely to occur and affect the Pueblo community and activities, we assigned these climate hazards a high likelihood score (Exhibit 5.3). On the other hand, cold extremes have become less severe and may not have a significant effect on the Pueblo community. Because the climate hazards associated with extreme cold temperatures – increased intensity and frequency of extreme cold events – are less likely to occur and affect the Pueblo community and activities, we assigned these climate hazards a low likelihood score (Exhibit 5.3).

Exhibit 5.3. Likelihood that climate hazards will be realized and affect Pueblo activities

Climate hazard symbol	Climate hazard	Likelihood
	Increased annual average temperatures	High
	Increased intensity of extreme heat events	
	Increased frequency of extreme heat events	
	Earlier peak snowmelt	
	Earlier peak streamflow	
	Increased intensity of wildfire	Medium-to-high
	Increased frequency of wildfire	
	Increased intensity of rainfall	
	Increased frequency of rainfall	
	Reduced snowpack (annual SWE)	
	Increased interannual intensity of drought events	Medium
	Increased interannual frequency of drought events	
	Increased variance in interannual precipitation amounts	
	Increased intensity of localized flooding events	
	Increased frequency of localized flooding events	
	Decrease in total annual streamflows	
	Increased intensity of winter storms	
	Landslides	Low-to-medium
	Increased intensity of extreme cold events	Low
	Increased frequency of extreme cold events	
	Increased frequency of winter storms	
	Increased frequency of ice storms	

Notes: We did not match all vulnerabilities to the climate hazards defined in Section 2.2. In addition, the likelihood that several climate hazards – such as changes in wind patterns, hail events, and lightning patterns – will be realized and affect Pueblo activities remains uncertain; these climate hazards are not included in this exhibit.

Next we matched climate hazards to the potential vulnerabilities that they affect. Most potential vulnerabilities were associated with more than one climate hazard. For example, gathering and utilizing materials from the Pueblo's local plants and animals for traditional ceremonies and prayers could be affected by all climate hazards. Higher temperatures, extreme heat, and droughts could shift the geographic range of native plants and animals used in traditional ceremonies and prayers outside of the current boundaries of the Pueblo and the Pueblo's Ancestral Domain. Extreme events, such as wildfires and storms and flooding, could damage and destroy or limit access to native plants and animals. Because all of these climate hazards could affect our ability to carry out traditional ceremony and prayers, we assigned all climate hazards to the traditional ceremonies and prayers vulnerability statement. On the other hand, since extreme heat is the primary climate hazard that affects vulnerability related to limited cooling and heating in Pueblo homes, we matched only extreme heat to this vulnerability statement.

5.1.3 Assess the Consequence for Potential Vulnerabilities

After matching climate hazards to vulnerabilities, DECP staff scored potential vulnerabilities based on the magnitude of their consequence. We defined *consequence* as the severity of impact on key aspects of the community vision, should the potential vulnerability occur. Based on the understanding of the consequence of each potential vulnerability, the DECP assigned each potential vulnerability a consequence score:

- A ***high magnitude of consequence score*** meant that if the potential vulnerability occurred, key aspects of the Pueblo de San Ildefonso community vision would be significantly impacted.
- A ***medium magnitude of consequence score*** meant that if the potential vulnerability occurred, key aspects of the Pueblo de San Ildefonso community vision would be moderately impacted.
- A ***low magnitude of consequence score*** meant that if the potential vulnerability occurred, key aspects of the Pueblo de San Ildefonso community vision would suffer no major effect.

We also added a medium-to-high score and a low-to-medium score to allow for additional variability in scoring across climate vulnerabilities.

As an example, the traditional pottery vulnerability statement received a high magnitude of consequence score because pottery is considered an expression of the Pueblo's cultural identity, and an impact on the ability to gather clay and other material used in pottery making would compromise the cultural identity of the Pueblo. In contrast, the traditional leatherwork vulnerability statement received a low magnitude of consequence score because this form of artisanry is less-widely practiced in current times. In addition, leatherwork artisans can purchase materials from other sources if they no longer have access to game species for leatherwork, without affecting the Pueblo's cultural identity.

5.1.4 Determine the Overall Climate Risk for Potential Vulnerabilities

Finally, we combined the likelihood score and the consequence score, to determine the overall climate risk for each potential vulnerability. For each potential vulnerability, we assigned a consequence score. We then assigned a score to each climate hazard associated with that vulnerability. We averaged the consequence score with each climate hazard likelihood score to derive a "climate risk score." If a potential vulnerability is affected by multiple climate hazards, we then selected the highest risk score as the "overall climate risk score" for that vulnerability. For example, we assigned a high consequence score to culturally important places' potential vulnerability to impacts of emergency response activities. Because emergency responders request access to Pueblo lands to respond to emergency events, the main climate hazards associated with this vulnerability are wildfires (increased intensity and frequency) and flooding (increased intensity and frequency). We then averaged the consequence and likelihood scores to develop a risk score, and selected the highest risk score as the overall climate risk (Exhibit 5.4).

Exhibit 5.4. Example of a vulnerability assessment scoring process

Vulnerability	Consequence score	Climate hazard	Climate hazard likelihood score	Climate risk score	Overall climate risk score (highest climate risk score)
Culturally important places: Emergency responders need to be able to access all areas of the Pueblo, the Pueblo's Ancestral Domain, and LANL during an emergency; culturally important places may be present within a future emergency response location.	High	Increased intensity of wildfire	Medium-to-high	High	High
		Increased frequency of wildfire	Medium-to-high	High	
		Increased intensity of flood events (localized flooding)	Medium	Medium-to-high	
		Increased frequency of flood events (localized flooding)	Medium	Medium-to-high	

5.2 Vulnerability Assessment Results for Key Aspects of the Community Vision

We present results of the vulnerability assessment organized by key aspects of the community vision: traditional activities and places (Section 5.2.1), community health (Section 5.2.2), and infrastructure and governance (Section 5.2.3).

5.2.1 Traditional Activities and Places

Traditional activities and places are essential components of the Pueblo's community vision. During the workshops, the community identified the resources needed to maintain several traditional activities and places, as well as the vulnerabilities of these resources to climate change. Using the community vision as a guide, the Pueblo identified and prioritized 15 potential climate vulnerabilities for traditional activities and places. Exhibit 5.5 lists the potential vulnerabilities for traditional activities and places and describes how they affect the Pueblo's ability to preserve the community vision. Exhibit 5.5 also lists the likelihood that the climate hazards that are associated with these vulnerabilities will be realized and affect Pueblo activities and presents the overall climate risk ranking. Most of the vulnerabilities associated with traditional activities and places rank at least medium-to-high risk (73%), with six of the 15 vulnerabilities considered high-risk (40%). Throughout the remaining sections of the document, we categorize three of the six high-risk vulnerabilities as traditional activities, and three as traditional places.

The three highest-risk vulnerabilities for traditional activities from the list provided in Exhibit 5.5 include:

Traditional pottery. Traditional pottery making utilizes materials from the Pueblo's local lands *(or Nan)*. Making pottery requires access to clay, sand, ash, plants (for pigments), and other materials.

Ceremony and prayers. Traditional ceremonies and prayers *(or Yuu su)* utilize the Pueblo's local plants and animals.

Growing traditional crops. Traditional crops are most productive under specific climate conditions and success of these crops depends on the transfer of traditional agricultural knowledge.

The three highest-risk vulnerabilities for traditional places from the list provided in Exhibit 5.5 include:

Sacred places (e.g., sacred springs). Continued existence of sacred places, such as sacred springs, depends on sustained groundwater levels.

Culturally important places. Emergency responders need to be able to access all areas of the Pueblo and the Pueblo's Ancestral Domain during an emergency; culturally important places may be present within a future emergency response location.

Wildfires. Wildland fires can damage or destroy the Pueblo's built environment and sacred places and can make it impossible or unsafe to carry out cultural practices.

Exhibit 5.5. Assessment for traditional activities and places

Vulnerability	Consequence to community vision if the vulnerability occurred	Likelihood that climate hazards that could impact this vulnerability will be realized and affect Pueblo activities	Overall climate risk
Traditional pottery. Traditional pottery making utilizes materials from the Pueblo's local lands *(or Nan)*. Making pottery requires access to clay, sand, ash, plants (for pigments), and other materials.	**High**. c	Clay, sand, ash, plants, and other materials could be affected by many climate change hazards. Higher temperatures and extreme heat and drought can dry out materials and may shift the geographic range of plants, while wildfires and extreme precipitation and flooding can damage and destroy collection places and affect the community's access to those places.	If artisans no longer have access to materials for traditional pottery due to climate hazards, the community will be negatively affected. Therefore, the overall vulnerability for traditional pottery is **high**.
Ceremony and prayers. Traditional ceremonies and prayers *(or Yuu su)* utilize the Pueblo's local plants and animals.	**High.** A loss of the Pueblo's local plants and animals used in ceremony and prayers *(or Yuu su)* would significantly impact the Pueblo. This could lead to lost cultural knowledge, and changes in the Pueblo's identity and language.	A wide range of plants and animals from the Pueblo are used in traditional ceremonies and prayers *(or Yuu su)*, and all climate hazards could affect these plants and animals. Climate hazards may shift the seasonal life cycles, abundances, and geographic range of these local plants and animals.	Changes in access to local plants and animals used in traditional ceremonies and prayers *(or Yuu su)* would negatively affect the community and could affect the Pueblo's identity and language. Therefore, the overall vulnerability for ceremony and prayers *(or Yuu su)* is **high**.
Growing traditional crops. Traditional crops are most productive under specific climate conditions and success of these crops depends on the transfer of traditional agricultural knowledge.	**Medium-to-high.** The Pueblo is traditionally an agrarian society; impacts to agriculture on Pueblo lands could affect the community's efforts to revitalize farming techniques through tradition, culture, and language. The lower productivity of traditional crops, such as green chili *(or tis'dee)*, squash, melons, and corn *(or Zhuu)*, would affect the community's lifeway and the cultural identity of the Pueblo.	All climate hazards could affect the productivity of traditional crops cultivated by community members. Some traditional crops, such as corn *(or Zhuu)*, may be harder to grow as temperatures increase and rainfall patterns change. Extreme events – including droughts, storms and flooding, wildfires, hail, and wind – can significantly damage or destroy crops.	Because the community's lifeway and cultural identity as an agrarian society could be affected by climate hazards, the overall vulnerability for growing traditional crops is **High**.

Vulnerability	Consequence to community vision if the vulnerability occurred	Likelihood that climate hazards that could impact this vulnerability will be realized and affect Pueblo activities	Overall climate risk
Sacred places (e.g., sacred springs). The continued existence of sacred places, such as sacred springs, depends on sustained groundwater levels.	**Medium-to-high.** The existence of sacred places, such as sacred springs, is culturally important for the community. Places affected by climate change (e.g., changes in water quality or flow) may no longer be visited by the community, leading to a loss in cultural practices, knowledge, language, and traditional ways, with implications for the Pueblo's identity.	All climate hazards could affect sacred places important to the community. In the example, shifts in seasonal flows can affect the community's ability to access places as well as the quality of the groundwater springs.	Changes in access to sacred places would negatively affect the community and could change the Pueblo's identity and language. Therefore, the overall vulnerability for sacred places is **high**.
Culturally important places. Emergency responders need to be able to access all areas of the Pueblo and LANL during an emergency; culturally important places may be present within a future emergency response location.	**High.** Emergency responders do not have knowledge about historic or culturally important artifacts on Pueblo lands. During emergency events, responders often request access through San Ildefonso Pueblo lands to respond to incidents and undertake recovery efforts, which often result in disturbance to culturally important areas.	Extreme events – such as wildfires and flooding – require emergency response efforts during and after these events.	During wildfires and flooding events, emergency responders often require access through San Ildefonso Pueblo lands to respond to incidents and undertake recovery efforts, which result in disturbance to culturally important areas. Therefore, the overall vulnerability for culturally important places is **high**.
Wildfires. Wildland fires can damage or destroy the Pueblo's built environment and sacred places and can make it impossible or unsafe to carry out cultural practices.	**Medium-to-high.** The existence of sacred places is culturally important for the community. Places affected by wildfires may no longer be visited by the community, leading to a loss in cultural practices, knowledge, language, and traditional ways, with implications for the Pueblo's identity.	Sacred places and cultural important buildings located in the urban-wildfire interface can also be damaged by wildfires, which are becoming more intense and frequent with climate change.	Destruction or changes in access to sacred places would negatively affect the community and could change the Pueblo's identity and language. Therefore, the overall vulnerability for wildfires is **high**.
Income. Some families in the Pueblo depend on income from selling their pottery and other traditional artistry work to tourists.	**Medium.** Reduced numbers of tourists coming to the Pueblo to purchase traditional artistry work will significantly impact individuals who depend on tourism for their livelihoods.	Extreme events – including extreme heat events, wildfires, droughts, and reduced snowpack – could significantly affect the number of tourists` coming to the Pueblo. Wildfires and flooding could result in road closures that limit access to the Pueblo, while reduced snowpack could limit the number of skiers who frequently travel to Pueblo lands in the winter.	Because some families' livelihoods, but not all, could be affected by reduced tourism to Pueblo lands, the overall vulnerability for income is **medium-to-high**.

Vulnerability	Consequence to community vision if the vulnerability occurred	Likelihood that climate hazards that could impact this vulnerability will be realized and affect Pueblo activities	Overall climate risk
Gathering traditional edible plants. Traditional foods include plants, including parts or products of plants, which community members gather on Pueblo lands *(or Nan)*.	**Medium.** A loss of local plants on Pueblo lands could reduce the community's ability to prepare traditional foods. Reduced gathering activities could lead to lost cultural knowledge about traditional foods and language related to traditional foods.	Most climate hazards could affect plants gathered by community members for traditional foods. Wildfires, storms and flooding, and droughts can devastate culturally significant plants gathered by the community, while shifts in seasonal cues can disrupt the life-cycle timing of important plants.	Some community members, but not all, gather local and prepare traditional foods. Therefore, the overall vulnerability for gathering traditional edible plants is **medium-to-high**.
Gathering traditional medicine. Traditional medicine utilizes specific plants, including parts or products of plants, which grow on Pueblo lands *(or Nan)*.	**Medium.** A loss of local medicinal plants on Pueblo lands could reduce the community's ability to prepare traditional medicines. Reduced gathering activities could lead to lost cultural knowledge and language related to traditional medicines.	Similar to *gathering traditional edible plants*, most climate hazards could affect the medicinal plants gathered by community members. See the *gathering traditional edible plants* vulnerability above for more detail.	Some community members, but not all, gather local and prepare traditional medicines. Therefore, the overall vulnerability for gathering traditional medicine is **medium-to-high**.
Hunting. Traditional diets depend on the availability of game for hunting, and hunting depends on the availability of forage for game animals.	**Medium.** Pueblo members hunt game species on traditional hunting grounds. Some Pueblo members depend on the availability of game for a subsistence diet, while others hunt as a traditional practice. The loss of forage for game animals could reduce habitat quality and could lead game animals to migrate to locations outside of Pueblo lands.	Game species traditionally hunted for food may be affected by all climate hazards. Warmer and drier conditions may alter critical habitats, and food and water sources for game species could shift the geographic range of these game species. Milder winters can also increase disease in game species.	If climate impacts affect habitat quality and availability of forage, game species could migrate to areas outside of Pueblo lands, and community members who depend on game for food could lose access to these species. However, community members could seek other locations for hunting outside of Pueblo lands to harvest game for food. The overall vulnerability to impacts on hunting is **medium-to-high.**
Traditional buildings and extreme events. Community and traditional buildings, such as kivas, experience damage during extreme weather events.	**Low-to-medium.** If damaged by extreme events, the community will need to repair community and traditional buildings using materials from Pueblo lands, as well as materials from other sources.	Extreme events – including extreme heat, wildfires, storms and flooding, wind, and hail – can damage or destroy critical community and traditional buildings.	If traditional buildings are damaged or destroyed by extreme events, the community can use materials on Pueblo lands or substitute materials to make repairs. Therefore, the overall vulnerability for traditional buildings and extreme events is **medium-to-high**.

Vulnerability	Consequence to community vision if the vulnerability occurred	Likelihood that climate hazards that could impact this vulnerability will be realized and affect Pueblo activities	Overall climate risk
Heating and cooling of traditional buildings. Heating, cooling, and ventilation systems are limited in community and traditional buildings.	**Low-to-medium.** Some community members, including elders and ill individuals, are especially vulnerable to extreme heat and cold. These individuals generally seek shelter in climate-controlled buildings during extreme temperature events. In addition, these individuals may be vulnerable to smoke or dust in traditional buildings (e.g., kivas) due to poor ventilation.	Extreme temperatures and smoke from fires can cause harmful conditions in buildings without proper heating, cooling, and ventilation systems. This can have direct impacts on health and well-being of the community, especially the most vulnerable populations.	Although exposure to extreme heat and smoke or dust in traditional buildings in limited or mitigated, it can have a direct impact on the health and well-being of the community. Therefore, the overall vulnerability for heating and cooling of traditional buildings is **medium**.
Fishing. Traditional diets include fish in local streams and rivers *(or P'ok'ay)*; fishing requires clean water and appropriate water temperatures.	**Low.** Fishing on Pueblo lands is primarily for recreation, although some Pueblo members fish for subsistence. Pueblo members can generally substitute fish caught in local streams and rivers *(or P'ok'ay)* for other traditional foods.	Fishing requires clean water to provide suitable habitat. Many climate hazards can affect water quality by warming stream temperatures. Heavy rainfall and localized flooding and landslides can transport contamination and pollutants into waterways.	Traditional diets no longer depend on fishing and substitutes are available. Therefore, the overall vulnerability for fishing is **medium**.
Traditional leatherwork. Traditional leatherwork utilizes materials from the Pueblo's local lands. Leatherwork requires access to game animals for hides *(Ko'wha)*.	**Low.** Pueblo members hunt game species on traditional hunting grounds; however, for leatherwork, the Pueblo artisans have transitioned to purchasing leather as it is less critical to the Pueblo's cultural identify than pottery.	Game species traditionally hunted for traditional leatherwork may be affected by all climate hazards. Warmer and drier conditions may shift the geographic range of these game species. Milder winters can also increase disease in game species.	Game species may be negatively affected by climate change; however, if artisans no longer have access to game species for leatherwork, they can purchase materials from other sources. Therefore, the overall vulnerability for traditional leatherwork is **medium.**
Pilgrimage routes. Pilgrimage routes pass through areas prone to erosion from flooding and runoff events.	**Low.** Pilgrimage routes are not highly used by the community. Therefore, if erosion or other impacts limit access to pilgrimage routes, the community would not be significantly impacted.	Access to pilgrimage routes could be limited by increased frequency and intensity of rainfall events, localized flooding events, and landslides. These events could also damage or destroy these routes.	Because pilgrimage routes are not highly used by the community and climate hazards are less likely to affect these routes, the overall vulnerability for pilgrimage routes is **low-to-medium**.

5.2.2 Community Health

Community health is an important part of building the Pueblo's resilience to climate impacts. During the workshops, the community identified healthy resources, including the provision of clean water, raw materials, plants, and game, as well as the vulnerabilities of these resources to climate change. Using the community vision as a guide, the Pueblo identified and prioritized 13 potential climate vulnerabilities for community health. Exhibit 5.6 lists these climate vulnerabilities for community health and describes how they affect the Pueblo's ability to preserve the community vision. Exhibit 5.6 also lists the likelihood that the climate hazards that are associated with these vulnerabilities will be realized and affect Pueblo activities and provides the overall climate risk ranking. Most of the vulnerability statements were ranked at least a medium-to-high risk (92%), with six of the 13 vulnerability statements considered a high risk (46%).

The six highest-risk vulnerabilities for community health from the list provided in Exhibit 5.6 include:

Clean air. Elders and other community members who are ill or have compromised respiratory systems may be especially susceptible to health problems associated with poor air quality.

Water supply. The community relies on local groundwater and surface water sources for a sufficient source of drinking water, and water for other domestic and business uses.

Youth outdoor activities. Outdoor activities and sports are an important means for Pueblo youth to interact and build relationships, to sustain physical health and well-being, and to make exercise a healthy habit. Pueblo youth and community members engaged in outdoor activities and sports are exposed to heat or poor air quality.

Traditional practices stress. Families and communities experience stress when they cannot carry out traditional and daily practices because of impacts that disrupt daily routines and make traditional and ceremonial practices difficult or unsafe.

Mobilization of contaminants. The Pueblo faces potential human health impacts due to its proximity to LANL. Extreme events may increase the risk of mobilization of contaminants onto the Pueblo.

Exposure to chemicals and health. Cumulative effects of chemical exposure and climate impacts may increase potential negative health impacts to community members.

Exhibit 5.6. Assessment for community health

Vulnerability	Consequence to community vision if the vulnerability occurred	Likelihood that climate hazards that could impact this vulnerability will be realized and affect Pueblo activities	Overall climate risk
Clean air. Elders and other community members who are ill or have compromised respiratory systems may be especially susceptible to health problems associated with poor air quality.	**High**. Air is a sacred space, and it is critical to the health of the community and future generations. Air pollution can lead to respiratory infections and aggravate existing heart and lung conditions in community members. It can also damage plant life, including lowering crop yields.	Higher temperatures associated with climate change can increase ozone and other hazardous pollutants, and lead to an increase in allergens. Increased wildfire length, intensity, and severity can elevate $PM_{2.5}$ and other pollutants, causing acute public health effects.	Clean air is critical to the health of the Pueblo, and climate hazards could reduce the Pueblo's air quality. Therefore, the overall vulnerability for clean air is **high**.
Water supply. The community relies on local groundwater and surface water sources for a sufficient supply of drinking water, and water for other domestic and business uses.	**High.** The Pueblo currently relies on the Pojoaque Basin Aquifer for household water supply, and the Rio Grande for traditional pottery, livestock grazing, and subsistence farming. In the future, the Pueblo will also rely on surface water from the Rio Grande as a household water supply source.	Groundwater and surface water resources are at risk due to drought and decreased snowpack. These resources are also at risk of contamination from prior and ongoing contamination from LANL operations.	Water supply is critical to the Pueblo's health and economy, and climate hazards could reduce the quantity and quality of the Pueblo's water supply. Therefore, the overall vulnerability for water supply is **high**.
Youth outdoor activities. Outdoor activities and sports are an important means for Pueblo youth to interact and build relationships, to sustain physical health and well-being, and to make exercise a healthy habit. Pueblo youth and community members engaged in outdoor activities and sports are exposed to heat or poor air quality.	**Medium-to-high.** Outdoor activities and sports are important to the Pueblo, particularly for youth to interact and build relationships, sustain physical health and well-being, and make exercise a healthy habit. Several afterschool and summer programs for youth include outdoor recreational activities.	Increased temperatures and extreme heat episodes disproportionately threaten vulnerable populations, including youth. More intense and severe wildfires can elevate air pollutants, affecting youth's ability to recreate and conduct outdoor activities.	Increased temperatures and extreme heat episodes and wildfire can affect youth's ability to engage in outdoor activities and sports, which is critical to building relationships, sustaining physical health and well-being, and making exercise a healthy habit. Therefore, the overall vulnerability for youth outdoor activities is **high**.
Traditional practices stress. Families and communities experience stress when they cannot carry out traditional and daily practices because of impacts that disrupt daily routines and make traditional practices difficult or unsafe.	**Medium-to-high.** Culture and the need for traditional practices are important to the Pueblo. An inability to carry out traditional and daily practices can increase stress for members of the community.	Other potential mental health impacts are less well-understood, but could include distress associated with environmental degradation, and anxiety and despair with not being able to carry out traditional and daily practices.	Environmental degradation and climate change can affect the Pueblo's ability to carry out traditional and daily practices, which is of importance to many members of the community. Therefore, the overall vulnerability for traditional practices stress is **high**.

Vulnerability	Consequence to community vision if the vulnerability occurred	Likelihood that climate hazards that could impact this vulnerability will be realized and affect Pueblo activities	Overall climate risk
Mobilization of contaminants. The Pueblo faces potential human health impacts due to its proximity to LANL. Extreme events may increase the risk of mobilization of contaminants onto the Pueblo.	**High.** Historical laboratory activities, including development of the atomic bomb, have left a legacy of plutonium and other radionuclides in the local environment, including sediments, soils, surface water, and other natural resources. The Pueblo is concerned with being able to continue their traditional practices due to the potential health risks associated with the use of contaminated natural resources.	Extreme events such as wildfires, extreme rainfall, and flooding may increase the risk of mobilization and exposure to contaminants on the Pueblo from the LANL.	Proximity to LANL in combination with an increase in extreme weather events, such as wildfires and flooding, may increase exposure to harmful contaminants that are mobilized from the LANL site. Therefore, the overall vulnerability for mobilization of contaminants is **high**.
Exposure to chemicals and health. Cumulative effects of chemical exposure and climate impacts may increase potential negative health impacts to community members.	**Medium-to-high.** Pueblo members are also exposed to household and other chemicals with potential human health impacts. The Pueblo is concerned potential health risks associated with exposure to chemicals.	The combined effects of health stressors are sometimes referred to as "cumulative effects." Climate hazards may exacerbate the impacts of chemical exposure on human health.	The total health impacts from multiple stressors may be greater than those predicted for a single stressor because the health impacts of these stressors may be additive or, in some cases, synergistic (i.e., greater than the sum of individual health impacts). Therefore, the overall vulnerability for exposure to chemical and health is **high**.
Vector-borne diseases. Community members may be susceptible to vector-borne diseases associated with warmer temperatures, such as West Nile virus, malaria, Zika, or other communicable diseases.	**Medium.** New Mexico is vulnerable to vector-borne diseases, with West Nile virus the top mosquito-borne disease and spotted fever rickettsiosis the top tick-borne disease (CDC, 2018).	Climate can influence the distribution and occurrence of vector-borne diseases. Higher temperatures can lengthen the season and increase the geographic range of vectors and pathogens. Increased rainfall and flooding can allow breeding to occur more quickly.	Although the Pueblo has not had significant problems with vector-borne diseases, its members are vulnerable to these diseases. Therefore, the overall vulnerability for vector-borne diseases is **medium-to-high**.

Vulnerability	Consequence to community vision if the vulnerability occurred	Likelihood that climate hazards that could impact this vulnerability will be realized and affect Pueblo activities	Overall climate risk
Extreme weather stress. Families and communities experience stress during extreme weather events.	**Medium.** Members of the Pueblo are exposed to extreme weather events such as flooding, heat waves, and wildfires. Health consequences of exposure to extreme events can increase levels of anxiety, cause post-traumatic stress disorder, and result in maternal complications for Pueblo members (CDC, 2020).	Extreme weather events can increase mental health problems among people with no history of mental illness and those at risk of the illness (CDC, 2020).	As extreme weather events increase in severity and frequency, some members of the Pueblo are vulnerable to extreme weather stress. Therefore, the overall vulnerability for extreme weather stress is **medium-to-high**.
Heat stress. Elders and community members who are ill or have a compromised immune system may be especially susceptible to heat stress associated with warmer temperatures.	**Medium.** Members of the Pueblo are exposed to extreme heat, which can increase the incidences of depression and mental illness and increase rates of mortality. Most community members have the tools to provide respite from extreme heat (e.g., cold water, fans, air conditioning).	Some patients with mental illness are susceptible to heat (e.g., suicide rates rise with high temperatures, and dementia is a risk factor for hospitalization and death during heat waves; CDC, 2020).	As extreme heat events increase in severity and frequency, some members of the Pueblo are vulnerable to heat stress. Therefore, the overall vulnerability for heat stress is **medium-to-high**.
Hardship stress. Families and communities experience stress when they face financial hardship (e.g., due to loss of pottery sales when fewer tourists visit the Pueblo, or wildfires and other extreme events).	**Medium.** As a result of climate change and other stressors, members in the community could lose financial security and experience family economic hardship.	All climate hazards can result in hardship stress (e.g., wildfires or flooding can reduce the number of tourists to the Pueblo, which can result in fewer sales for traditional pottery and crafts and increase hardship stress).	Climate hazards can result in hardship stress, resulting in lost financial security and family economic hardship. Therefore, the overall vulnerability for hardship stress is **medium-to-high**.

Vulnerability	Consequence to community vision if the vulnerability occurred	Likelihood that climate hazards that could impact this vulnerability will be realized and affect Pueblo activities	Overall climate risk
Outdoor community activities. Many community activities and interactions occur in outdoor community spaces exposed to environmental conditions.	**Low-to-medium.** Outdoor community activities and interactions, such as farmers markets and traditional activities, are important to the Pueblo. However, it is possible to move most community activities and interactions to indoor locations on Pueblo lands.	Extreme weather events – such as heat, wildfire, and flooding – can reduce the community's ability to undertake activities and interactions in outdoor spaces (e.g., extreme heat could make it unbearable to hold the farmers market outdoors).	Although climate hazards can reduce the community's ability to undertake activities and interactions in outdoor spaces, it is possible to move most community activities and interactions to indoor locations on Pueblo lands. Therefore, the overall vulnerability for outdoor community activities is **medium-to-high**.
Community youth gardens. The Pueblo's community youth garden is an important cultural teaching tool.	**Low-to-medium.** The Pueblo had a community youth garden to teach youth how to grow and cultivate traditional foods. Although this is an important project for Pueblo youth, it has been inactive in recent years.	All climate hazards could affect the productivity of traditional crops cultivated by community members. Some traditional crops, such as corn *(or Zhuu)*, may be harder to grow as temperatures increase and rainfall patterns change. Extreme events – including droughts, storms and flooding, wildfires, hail and wind – can significantly damage or destroy crops.	All climate hazards could affect the cultivation of traditional crops; however, youth participation in community gardens has been somewhat limited in recent years. Therefore, the overall vulnerability for community youth gardens is **medium-to-high**.
Home air quality. Homes do not have a way to reduce air pollution, such installing indoor air filters.	**Low.** Although some homes in the Pueblo's historic district have combustion sources (e.g., stoves, heaters, fireplaces) but do not have air filters, most of the homes on Pueblo lands are built with new building materials, furnishings, and appliances; and have adequate ventilation.	High temperature and humidity levels can increase concentrations of some indoor air pollutants, which can trigger indoor asthma. Heavy wildfire smoke and ash can enter homes through ventilation and infiltration, posing immediate health risks. Flood water can also make indoor air quality unhealthy; inhaling mold can cause adverse health impacts, including allergic reactions.	Most homes on Pueblo lands are constructed with high-quality building materials and have adequate ventilation. Therefore, the overall vulnerability for home air quality is **medium**.

5.2.3 Infrastructure and Governance

Infrastructure and governance are an important part of building the Pueblo's resilience to climate impacts. During the workshops, the community identified the importance of infrastructure and governance, including land, and the vulnerabilities of these resources to climate change. Using the community vision as a guide, the Pueblo identified and prioritized 11 potential climate vulnerabilities for infrastructure and governance. Exhibit 5.7 lists these climate vulnerabilities for infrastructure and governance and describes how they affect the Pueblo's ability to preserve the community vision. Exhibit 5.7 also lists the likelihood that the climate hazards that are associated with these vulnerabilities will be realized and affect Pueblo activities and provides the overall climate risk ranking. Most of the vulnerability statements were ranked at least a medium-to-high risk (79%), with 4 of the 11 vulnerability statements considered high risk (36%).

The four highest-risk vulnerabilities for infrastructure and governance from the list provided in Exhibit 5.7 include:

Place-based culture. Pueblo members are bound culturally to the land and limited in many ways to the boundaries of the Pueblo's reservation the range of traditional plants, animals, and other resources may shift beyond the Pueblo's borders with changing environmental and climatic conditions.

Pueblo departments. Pueblo departments are compartmentalized from each other; managing community resources will require work across these departments.

Critical (non-transportation) infrastructure. Critical infrastructure, such as water supply systems, are located in areas prone to flooding or wildfires.

Firefighting. Firefighting requires firefighters from outside of the community, and the availability of and access to water supplies to fight the fires.

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Exhibit 5.7. Assessment for infrastructure and governance

Vulnerability	Consequence to community vision if the vulnerability occurred	Likelihood that climate hazards that could impact this vulnerability will be realized and affect Pueblo activities	Overall climate risk
Place-based culture. Pueblo members are bound culturally to the land and limited in many ways to the boundaries of the Pueblo's reservation the range of traditional plants, animals, and other resources may shift beyond the Pueblo's borders with changing environmental and climatic conditions.	**Medium-to-high.** For many traditional activities, it is critical to gather plants and resources from Pueblo lands or the Pueblo's Ancestral Domain. Therefore, shifts in the range of plants, animals, and other resources outside of Pueblo lands will affect traditional activities and practices, which would also limit opportunities to share traditional knowledge between elders and youth.	All climate hazards could shift the ranges of plant and animal species and change the distribution and population density of wildlife species, which would limit opportunities to continue traditional pottery, undertake ceremonies and prayers, and visit sacred places.	Sovereignty is limited to Pueblo lands. As climate hazards shift the range of traditional plants, animals, and other resources outside of Pueblo lands, the community will not be able to practice traditional activities in the same way as they have historically. Therefore, the overall vulnerability for sovereignty is **high**.
Pueblo departments. Pueblo departments are compartmentalized from each other; managing community resources will require work across these departments.	**Medium-to-high.** Pueblo departments often work in silos, with limited interdepartmental collaboration and consultations.	Climate change is a multi-faceted problem that transcends departmental boundaries, administrative levels, and sectors. All climate hazards could affect the working relationship between Pueblo departments and require more collaboration and coordination.	Pueblo departments often work in silos; however, climate change is a multi-faceted problem that requires collaboration and coordination among the departments. Therefore, the overall vulnerability for Pueblo departments is **high**.
Critical (nontransportation) infrastructure. Critical infrastructure (e.g., water supply systems) is located in areas prone to flooding or wildfires.	**High.** The Pueblo has critical infrastructure located in areas prone to flooding and wildfire, such as sewer and electricity lines.	Flooding can damage canyon-bottom utility lines, culverts and storm drain inlets along roads, sewer lines, ponds, and fencing and retaining walls; while wildfires can damage water facilities, electricity and gas lines, and other critical infrastructure. Flooding and wildfires are becoming more intense and frequent with climate change.	Some of the Pueblo's critical infrastructure is located in areas prone to flooding and wildfires, which are increasing in intensity and frequency. Therefore, the overall vulnerability for critical infrastructure is **high**.
Firefighting. Firefighting requires firefighters from outside of the community, and the availability of and access to water supplies to fight fires.	**Medium-to-high.** The San Ildefonso Pueblo does not have a dedicated fire department or station on Pueblo lands, and wildfires can quickly overwhelm the regional firefighting capacity. Firefighting also requires the availability of and access to water supplies to fight fires.	Most climate hazards could affect the availability of resources to fight wildfires. Water supplies could be limited by hotter temperatures and droughts, storms and flooding, and changes in snowmelt and streamflow.	Firefighting requires ample resources from outside Pueblo lands – including personnel, equipment, and water. Most climate hazards could affect the availability of resources to fight wildfires. Therefore, the overall vulnerability for firefighting is **high**.

Vulnerability	Consequence to community vision if the vulnerability occurred	Likelihood that climate hazards that could impact this vulnerability will be realized and affect Pueblo activities	Overall climate risk
Transportation infrastructure. Existing transportation infrastructure (e.g. roads, bridges) is in disrepair and more vulnerable to further damage.	**Low-to-medium.** The transportation infrastructure on Pueblo lands is relatively good. The State maintains the major transportation infrastructure on Pueblo lands, which is designed to withstand local weather and climate.	Most climate hazards could affect the transportation infrastructure. Heavy rains and flooding can delay traffic and construction activities and weaken or wash out soil and culverts that support roads and bridges. Higher temperatures can cause pavements to soften and expand, creating rutting and potholes.	Although road conditions are good on Pueblo lands, climate hazards can affect the transportation infrastructure. Therefore, the overall vulnerability for the transportation infrastructure is **medium-to-high**.
Bridges and culverts. Bridges and culverts are designed to standards that are based on a lesser storm intensity.	**Low-to-medium.** Similar to the transportation infrastructure vulnerability, the condition of bridges and culverts on Pueblo lands is relatively good. The State maintains the major transportation infrastructure, including bridges and culverts on Pueblo lands, which are designed to withstand local weather and climate.	Heavy rainfall, storms, and changes in snowmelt and streamflow could affect bridges and culverts. Heavy rains and flooding can weaken or wash out culverts that support roads and bridges.	Although bridges and culverts are in good condition on Pueblo lands, heavy rainfall and storms can wash out or weaken them. Therefore, the overall vulnerability for bridges and culverts is **medium-to-high**.
Roads and bridges. Roads, bridges, and evacuation routes are located in areas prone to flooding or wildfires.	**Medium**. On Pueblo lands, some roads, bridges, and evacuation routes are located in areas prone to flooding or wildfires. In addition, the main evacuation route from Los Alamos transects Pueblo lands, which can become congested during evacuations due to wildfires or flooding.	Flooding and wildfires, which are becoming more intense and frequent with climate change, can damage canyon-bottom roads and bridges located in flood zones and the urban-wildfire interface. In addition, evacuation routes can become congested during flooding and wildfires, increasing dangers to residents on Pueblo lands.	Flooding and wildfires, which are becoming more intense and frequent with climate change, can damage canyon-bottom roads and bridges located in flood zones and in the urban-wildfire interface. Therefore, the overall vulnerability for roads and bridges is **medium-to-high**.

Vulnerability	Consequence to community vision if the vulnerability occurred	Likelihood that climate hazards that could impact this vulnerability will be realized and affect Pueblo activities	Overall climate risk
Historic places. Historic places, such as Edith Warner's House at Otowi and the Don Juan Playhouse, are located in areas prone to flooding or wildfires.	**Medium.** The Manhattan Project had a profound impact on the Pueblo de San Ildefonso. Several historic buildings and places associated with this project are on Pueblo lands, including Edith Warner's tearoom located at Otowi and the Don Juan Playhouse.	Similar to roads and bridges, historic places located in flood zones and the urban-wildfire interface can also be damaged by these events, which are becoming more intense and frequent with climate change.	Flooding and wildfires, which are becoming more intense and frequent with climate change, can damage historic places located in flood zones and in the urban-wildfire interface. Therefore, the overall vulnerability for historic places is **medium-to-high**.
Home heating and cooling. Most homes do not have adequate heating and cooling.	**Low.** Although some homes in the Pueblo's historic district do not have adequate heating and cooling, most of the homes on Pueblo lands are built with adequate heating and cooling.	Changes in temperatures can result in thermal discomfort in homes without adequate cooling and heating; however, extreme or prolonged periods of heat and cold events can result in excess death, particularly for elders or vulnerable community members without adequate cooling and heating systems.	Although extreme temperatures can be dangerous for elders and vulnerable community members without adequate heating and cooling, most of the homes on Pueblo lands are built with adequate heating and cooling. Therefore, the overall vulnerability for home heating and cooling is **medium.**
Home improvement resources. Some community members do not have financial resources to make necessary home improvements and upgrades.	**Low.** Although some community members do not have the financial resources to make home improvements and upgrades, most of the homes on Pueblo lands are built with new materials and community members have adequate financial resources to make home improvements and upgrades.	Extreme events can affect homes (e.g., high-intensity rainfall and high winds can damage roofs, and homes can be ruined by flooding and wildfires). Upgrades to existing homes can ensure they remain habitable during extreme heat and cold events, be reoccupied more quickly after flooding and wildfires, and consume less water.	Although extreme events can affect homes, most community members have adequate financial resources to make home improvements and upgrades to increase their home's resiliency to those events. Therefore, the overall vulnerability for home improvement resources is **medium.**
Homes and extreme events. Some homes are located in areas prone to flooding or wildfires.	**Low.** Although some homes on Pueblo lands are located in flood zones and in the wildfire-urban interface, homeowners tend to take mitigation actions to remove debris and vegetation from around their homes. Therefore, homes on Pueblo lands have not been impacted by flooding or wildfires in recent history.	Homes can be destroyed or damaged by flooding or wildfires.	Although homes can be destroyed or damaged by flooding or wildfires, homeowners generally undertake mitigation actions to remove debris and vegetation from around their homes. Therefore, the overall vulnerability for homes and extreme events is **low-to-medium.**

6. Climate Actions

After completing the climate vulnerability assessment in Section 5, we developed actions to adjust or reduce vulnerabilities to observed or projected climate impacts, and to reduce or minimize greenhouse gas emissions. In this section, we describe the process of developing and evaluating climate actions and our results. This Plan will continue to evolve and expand with new knowledge and additional input from the Pueblo community, departments, and the Tribal Council, as well as with new data and evidence about the impacts of climate change.

6.1 Process for Developing and Evaluating Climate Actions

During the workshops and other outreach activities, community members began to identify potential actions to increase the Pueblo's resilience to climate change to address both climate adaptation and climate mitigation. As described in the Key Terms section, the community can respond to climate change in two main ways:

Taking actions to reduce or minimize greenhouse gas emissions, or enhance sinks of greenhouse gases, to help reduce the degree of climate change. Mitigation could include actions such as retrofitting buildings to increase their energy efficiency, expanding or promoting public or shared transportation, and developing and incentivizing water (*or Poe*) and energy conservation programs for homes and businesses.

Taking actions to adjust to or reduce vulnerabilities to observed or projected climate impacts, to help reduce the severity of climate impacts and increase the capacity to recover from these impacts. Adaptation could involve strengthening and expanding agricultural technical assistance to help farmers adjust their management practices, providing additional training to emergency responders to increase their preparedness to respond to more frequent and intense extreme events, and designating and improving community cooling centers to provide respite for vulnerable populations during heat waves.

The Pueblo is focusing primarily on meeting climate adaptation and resilience goals. However, the Pueblo community has also expressed interest in developing and implementing actions that can also help mitigate climate change. Actions that restore and conserve natural resources are particularly effective for contributing to both mitigation and adaptation goals. For example, restoring riparian habitats through revegetation and streambank stabilization can help capture carbon by reducing soil loss and improving soil health. This type of restoration work can also help the Pueblo adapt to and reduce vulnerability to extreme precipitation and flooding by increasing the capacity of the riparian environment to slow streamflow and absorb water.

During community workshops and discussions, the community identified climate adaptation actions for vulnerabilities that they believed posed the greatest threats to the community vision. These actions aim to protect the Pueblo's community vision and community members against increasing climate variability and climate change and build capacity to recover from climate impacts. The Pueblo evaluated the climate actions using the set of criteria developed by the community:

- **Effectiveness**: The extent to which the adaptation action successfully addresses the climate change impact and achieves the intended outcome.
- **Technical feasibility**: The level of technical complexity of the adaptation action, and the ability of the Pueblo to manage technical aspects of implementing the adaptation action.
- **Cultural feasibility**: Compatibility of the adaptation action with traditional and cultural values, and incorporation of traditional knowledge in the design or implementation of the adaptation action.
- **Community support**: The level of support and acceptance for this adaptation action within the Pueblo community, Pueblo departments, and the Tribal Council.
- **Cost**: The cost to administer and implement the adaptation action relative to the cost of other adaptation actions.
- **Feasible implementation timeline**: The length of time necessary to implement the adaptation action.
- **Timeline for benefits return**: Once an action is implemented, the length of time necessary to achieve benefits.
- **Addresses adaptation *and* mitigation goals**: Whether the action addresses both adaptation and mitigation goals.

Section 6.2 describes the climate actions for high-risk vulnerabilities.

6.2 Climate Actions Identified by the Pueblo

The Pueblo identified climate actions for vulnerabilities that they believed posed the greatest threats to the community vision. These climate actions aim to reduce high-risk vulnerabilities, as identified in Section 5. We describe these adaptation actions in greater detail for traditional activities (Section 6.2.1), traditional places (Section 6.2.2), community health (Section 6.2.3), and governance and infrastructure (Section 6.2.4); and then present mitigation-focused adaptation actions (Section 6.2.5). Climate actions are listed by high climate-risk vulnerability in order of priority; priority is based on the evaluation of each action using the evaluation criteria described above (Section 6.1). These climate actions will evolve with new knowledge, data, and evidence about the impacts of climate change on the community vision, as well as with additional input from Pueblo departments and the community.

6.2.1 Climate Actions for Traditional Activities

The Pueblo identified climate actions for vulnerabilities that pose the greatest threats to traditional activities, as defined in the community vision. Climate actions are listed by high-risk vulnerability in Exhibit 6.1 in the Pueblo's order of priority, as determined by evaluating each action using the criteria described in Section 6.1. The appendix provides more detail on the ranking of each climate action.

Exhibit 6.1. Climate actions identified by the Pueblo for traditional activities

High climate-risk vulnerability	Identified climate action
Traditional pottery	Restore and protect critical areas from erosion and aridity by revegetating native grasses and plants to help sustain their availability for future use in traditional activities.
	Teach community members, particularly Tribal youth, about gathering clay and volcanic ash to ensure the transfer of traditional knowledge and sustainable practices.

Exhibit 6.1. Climate actions identified by the Pueblo for traditional activities

High climate-risk vulnerability	Identified climate action
Ceremony and prayers	Restore and enhance habitat on the Pueblo to attract game, birds, and other wildlife; and re-establish populations of native plants in least-vulnerable and most-suitable areas or refugia.
	Share traditional knowledge about natural resources used in ceremonies and prayers, and teach Pueblo youth to identify resources and strengthen their stewardship of these resources in traditional settings, such as in the kiva or a Tewa language class.
Growing traditional crops	Maintain traditional agricultural knowledge by developing a resilient farm plan that can support the transfer of knowledge from elders to youth and for future generations.
	Establish a seed bank to preserve seeds of culturally significant plants.
	Improve the community garden to grow culturally important plants to strengthen the Pueblo's food sovereignty and provide an alternative plant source for ceremonies and prayers.

Traditional pottery

Restore and protect critical areas from erosion and aridity by revegetating native grasses and plants to help sustain their availability for future use in traditional activities.

Pueblo community members gather plants and other resources from locations across the Pueblo. These resources are important for traditional foods, medicines, artisanry, and other traditional activities. Climate impacts, such as drought, heavy rains, and floods, have degraded some landscapes that provide habitat to these resources, and threaten the heath and long-term survival of their populations. Restoring these landscapes and enhancing their ability to withstand and recover from climate impacts could help protect resources for traditional uses.

The Pueblo could initiate this adaptation work by assessing areas that provide critical habitat for important resources and identifying areas that have experienced the most-extensive climate impacts. After prioritizing areas for restoration, the Pueblo could engage elders and other community members to identify native species to replant and restore to these areas. In some areas, it may also be necessary to install simple structural elements to help slow runoff from rain and snow events, reduce soil erosion, and help retain moisture during droughts. The Pueblo could use these restoration projects as an opportunity to transfer traditional knowledge about plants, animals, and other resources, and their roles in traditional activities; elders and youth could work together to select culturally important species and restore those species to their native habitats on the Pueblo.

Teach community members, particularly Tribal youth, about gathering clay and volcanic ash to ensure the transfer of traditional knowledge and sustainable practices.

Pottery is an important part of the Pueblo's identity and economy. Traditional pottery is considered an expression of the Pueblo's cultural identity, and an impact on the ability to gather clay and other material used in pottery making would compromise the cultural identity of the Pueblo. In addition, pottery sales generate revenue for the Pueblo and increase tourism to the Pueblo. Impacts from climate change are expected to impair the Pueblo's access to materials for traditional pottery making: flooding may threaten access to places to collect clay; forest fires may impact the quality of clay available due to embers deposited at those places; and the loss of vegetation due to climate impacts such as fires, habitat shifts, and drought could cause loss of wood for firing pottery.

Today, many Pueblo elders and cultural leaders retain the traditional knowledges and practices about site location and sustainable gathering of clay and volcanic ash. This knowledge has not been thoroughly documented for future generations. Sharing this knowledge, particularly with Tribal youth, will help enhance the Pueblo's ability to withstand and recover from climate impacts on pottery-making resources.

The Pueblo could design community member workshops for this knowledge transfer or incorporate it into existing workshops.

Ceremony and prayers

Restore and enhance habitat on the Pueblo to attract game, birds, and other wildlife; and re-establish populations of native plants in least-vulnerable and most-suitable areas or refugia.

A wide range of plants and animals from the Pueblo are used in traditional ceremonies and prayers, and a loss of the Pueblo's local plants and animals could lead to lost cultural knowledge and change the Pueblo's identity and language. Habitat restoration and enhancement within Pueblo boundaries or in nearby areas that are accessible to Pueblo members could attract game, birds, wildfire, and native plants used in ceremonies and prayers to ensure their existence into the future.

To ensure the Pueblo has access to culturally significant resources used in prayers and ceremonies, the Pueblo could seek to preserve existing habitat with culturally important resources and restore degraded habitat. Incorporating culturally significant knowledge from Pueblo elders can ensure these actions are effective and successful. Pueblo elders can guide the community in identifying culturally significant species used in ceremonies and prayers that may have shifted their habitats because of changing climate conditions. The Pueblo could prioritize areas for restoration given elders' knowledge on native species to replant.

Share traditional knowledge about natural resources used in ceremonies and prayers, and teach Pueblo youth to identify resources and strengthen their stewardship of these resources in traditional settings, such as in the kiva or a Tewa language class.

The Pueblo community gathers frequently for traditional celebrations, ceremonies, and other community events. These community gatherings provide an opportunity for elders to share their traditional knowledge with the rest of the community, especially Pueblo youth. The Pueblo could dedicate a community gathering, or a series of community gatherings, to teach Pueblo youth about the natural resources that are important for traditional activities.

The Pueblo has many options for designing these knowledge-transfer activities. The community could establish a new series of gatherings or workshops that would involve elders in leading lessons about natural resources and their importance to the Pueblo's activities and culture, or adding a brief lesson to the beginning of existing events or workshops. These knowledge-transfer activities could be conducted in a traditional setting, such as in the kiva or a Tewa language class. Ideally, elders and youth would have an opportunity to visit important habitats together, to see resources in their natural habitat and form.

Growing traditional crops

The history, tradition, and culture of the Pueblo are tied to the land, as the Pueblo people are an agricultural-based community, with traditional practices closely tied to the seasons, astronomical patterns, and observations of wildlife patterns. The Pueblo originally grew corns, beans, and squash, known as the Three Sisters, and later added melons, cilantro, and chili, through waffle gardens and row farming. In addition, the people collected plants for traditional foods and medicines, ceremonies, and prayers. The Pueblo is currently replicating this traditional practice with our Farm Calendar (Exhibit 6.2).

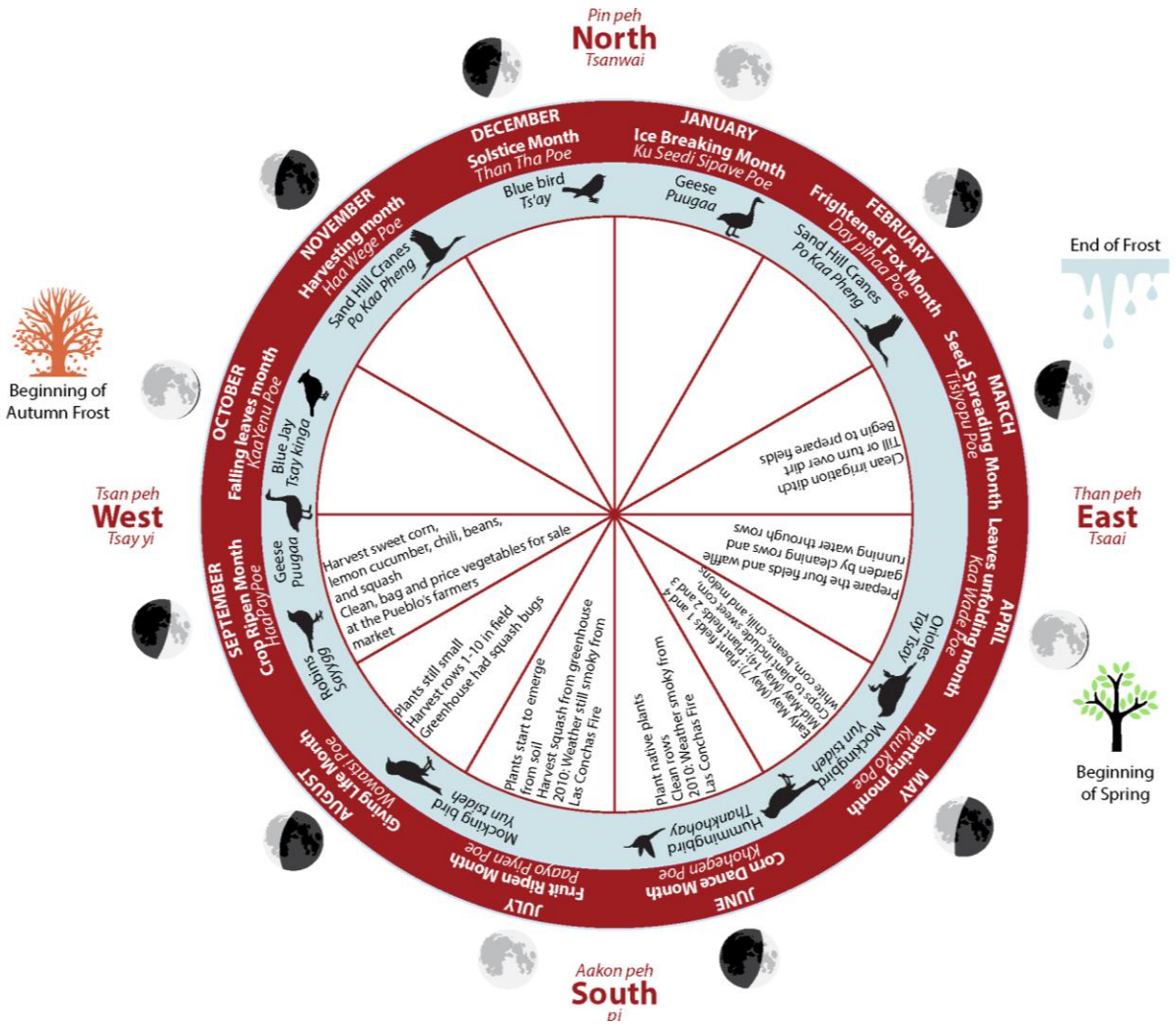


Exhibit 6.2. The Pueblo people traditionally tracked cycles of the moon, migrations of birds and animals, and patterns in the stars to determine when to prepare, plant, tend, and harvest crops. The Pueblo currently is replicating this traditional practice with our Farm Calendar.
Source: Tim Martinez, DECP.

Maintain traditional agricultural knowledge by developing a resilient farm plan that can support the transfer of knowledge from elders to youth and for future generations.

The Pueblo has experienced a decline in knowledge on growing and making traditional foods, youth interest in farming, and use of language related to traditional farming activities. In addition, limited access to fresh, locally grown fruits and vegetables has negatively affected the health of many Pueblo residents. Climate change is expected to further impair the Pueblo's ability to grow and cultivate traditional crops (e.g., extreme events, such as intense precipitation or wildfire, can result in a partial or complete loss of planted crops, while shifts in seasonal cues can disrupt the lifecycle timing of important plants). Climate change, however, could also provide an opportunity to build a more resilient agricultural system (e.g., the community could revive traditional dryland farming techniques developed by the Pueblo's ancestors).

Today, many Pueblo elders and cultural leaders retain the traditional practices they learned as children (e.g., how to watch moon cycles and natural migration patterns to decide when to plant and harvest), but this knowledge has not been captured in a way that can be transmitted to future generations. The Pueblo has begun a project to (1) document the traditional agricultural knowledge of the Pueblo elders, including

climate-resilient traditional agricultural practices (e.g., waffle gardens and other dryland farming techniques); (2) develop a Resilient Farm Plan, through a youth-accessible platform, to pass the traditional agricultural knowledge from elders to today's Pueblo youth and future generations; and (3) begin to disseminate the traditional agricultural knowledge to today's Pueblo youth to help preserve important cultural traditions and strengthen resilience to climate impacts. The Pueblo will use the Resilient Farm Plan to continue its work to teach youth and young adults to respect their culture and traditions through farming, which would engage community elders and members in a cooperative project that demonstrates how the results benefit them personally, and the Pueblo as a whole.

Establish a seed bank to preserve seeds of culturally significant plants.

Seed banks can be used to preserve the genetic diversity of plants that are culturally significant to the Pueblo. A seed bank stores seeds at low temperatures and moisture levels to preserve seeds that are otherwise maintained in situ. Because climate change and associated extreme weather could lead to the loss of culturally significant plants in the field, preserving seeds of these plants in a seed bank would mitigate some of their potential to be lost.

Improve the community garden to grow culturally important plants to strengthen the Pueblo's food sovereignty and provide an alternative plant source for ceremonies and prayers.

Limited access to fresh, locally grown fruits and vegetables has negatively affected the health of many Pueblo residents. Climate change could compound access to first foods and issues related to food sovereignty[1] by affecting the productivity of traditional crops that community members cultivate; and the plants community members traditionally gather for food, medicine, ceremonies, and prayers. Extreme events could devastate culturally significant plants, while shifts in seasonal cues can disrupt the life-cycle timing of important plants. Improving the community garden (e.g., growing culturally important plants, providing space for education and learning, creating a more sustainable agricultural system) can strengthen the Pueblo's food sovereignty and provide a plant source for ceremonies and prayers if they are no longer available on Pueblo lands.

The Pueblo Farm program has a community garden and hoop house (Exhibit 6.3). The hoop house contains starter plants for the community garden and family farms, as well as cold weather crops that can be available year-round. The Pueblo could expand these facilities to grow and protect culturally important plants for foods, medicines, and traditional uses, such as planting gourds for the corn dance or other dances. In the future, the Pueblo may not be able to gather the traditional plants used for ceremonial purposes; instead, it may be necessary to start growing these plants in a community garden. Community gardens can also provide additional education and learning – a place where elders can teach youth about culturally important food items and how they are grown to be resilient to drought, harvested, and prepared for eating. Classes or programs could also focus on climate-resilient ways to prepare and plant agricultural fields, such as demonstration waffle gardens.

1. Food sovereignty is the right to healthy and culturally appropriate food produced in traditional agricultural systems that are ecologically sound and sustainable.


Exhibit 6.3. Pueblo Farm program's community garden (left) and hoop house (right)

In addition, maintaining the greenhouse and hoop are essential to preserving these plants as they provide an environment for culturally significant plants that is less susceptible to climate impacts than field conditions. To maintain the community garden and hoop house, it is important to have a Pueblo member dedicated to planting, weeding, and harvesting. This could involve paying a dedicated gardener, possibly by selling some of the produce grown in the garden, or by giving some of the produce to community members who volunteer to work in the community garden.

6.2.2 Climate Actions for Traditional Places

The Pueblo identified climate actions for vulnerabilities that pose the greatest threats to traditional places, as defined in the community vision. Climate actions are listed by high-risk vulnerability in Exhibit 6.4 in the Pueblo's order of priority, as determined by evaluating each action using the criteria described in Section 6.1. The appendix provides more detail on the ranking of each climate action.

Exhibit 6.4. Climate actions identified by the Pueblo for traditional places

High climate-risk vulnerability	Identified climate action
Sacred places (e.g., springs)	Develop a plan to improve understanding of groundwater levels around the Pueblo's sacred springs.
	Enhance water retention and facilitate groundwater recharge to protect and maintain sacred springs and other water sources.
	Implement erosion control measures, such as rock steps or terraced wooden erosion barriers, along routes to sacred places.
Culturally important places	Work with emergency responders to identify how Pueblo staff can accompany emergency responders on Pueblo lands.
	Evaluate emergency response systems to identify actions to limit impacts to culturally important places during response efforts.
	Develop and share a map of areas that are off limits to emergency managers (without disclosing details about sacred or cultural information) and/or that are accessible, where emergency managers can travel on the Pueblo.
Wildfires	Work with members of the Pueblo, including youth and elders, and other partners to develop a study plan focused on landscape management practices to best protect the Pueblo against wildfire-related impacts.
	Develop and implement a fire mitigation program throughout the Pueblo. Build community awareness about strategies to reduce fire risk to homes and community structures, and engage community members in fire-mitigation activities.
	Implement fire mitigation practices around all culturally important and critical infrastructure.

Sacred places

Develop a plan to improve understanding of groundwater levels around the Pueblo's sacred springs.

Located in the arid Southwest, water is a revered resource for the Pueblo and central to many cultural practices and essential needs. Drought and other changes in hydrological cycles affect infiltration rates and recharge to groundwater aquifers, which adversely affects surface water bodies sustained by groundwater, including springs. At the Pueblo, springs are important water sources for the community and wildlife, critical to supporting native vegetation, and sacred places for the Pueblo community. Habitat restoration and protection of areas directly surrounding springs and upland groundwater recharge areas can help protect and maintain springs, thus sustaining local ecosystems and cultural ways of life.

To improve understanding of groundwater levels around the Pueblo's sacred springs, the Pueblo developed a plan to understand the benefits of restoration activities on Pueblo springs. The plan outlines several tasks that, if funded, would (1) restore areas directly surrounding springs on Pueblo lands using a combination of traditional ecological knowledge and western ecology, (2) conduct collaborative planning and problem-solving between the Pueblo and various government agencies to identify groundwater recharge areas at higher elevations for aquifers that feed the springs and assess the need for actions to enhance or protect infiltration in the recharge areas, and (3) conduct monitoring to evaluate the success of spring restoration and adaptively manage the restoration activities.

Enhance water retention and facilitate groundwater recharge to protect and maintain sacred springs and other water sources.

Several groundwater springs in the area are traditionally important sacred places for the Pueblo. Changes in hydrological cycles due to climate change and other changing conditions can affect water quality and infiltration rates to aquifers and springs. Protecting sacred springs can include actions such as protecting groundwater recharge areas at higher elevations that ultimately feed the springs and protecting habitats in the immediate vicinity of the springs.

Protecting groundwater recharge areas at higher elevations can help maintain groundwater levels that in turn sustain the springs. These activities could include restricting development and creating hard surfaces in recharge areas, and restoring habitat and vegetated land cover to encourage infiltration of precipitation into soil that then percolates into groundwater. Watershed management practices can also slow the transport of water through the landscape, which increases water retention and storage, and facilitates groundwater recharge for springs and the aquifer. Ecosystems that retain water can also provide a buffer against periods of high rainfall and flooding, and water storage can maintain water levels for periods of water shortages and droughts. The Pueblo could work with federal and state partners, where appropriate, to protect and restore forested areas with native vegetation in the headwater of canyons that run from the Jemez Mountains east to the Rio Grande; create buffer zones along rivers, creeks, and canyon areas; and create water storage areas to improve water infiltration and control flooding.

In addition, the Pueblo could take action in the immediate vicinity of the springs themselves (e.g., removing invasive vegetation, such as tamarisk trees that are known to lower shallow groundwater levels, and replacing it with native vegetation). Protecting areas around springs can prevent contamination by people (and their domesticated animals) who are unaware of the springs' locations. Springs can be protected with fencing and by constructing paths to deter the community from making their own paths. These activities can ensure that the Pueblo community can visit and use the sacred places for traditional and cultural practices.

Implement erosion control measures, such as rock steps or terraced wooden erosion barriers, along routes to sacred places.

Various impacts of climate change, including flooding, frequent rain events, vegetation loss, and changes in temperature, can dramatically increase erosion. Erosion along routes to sacred places can cause the breakdown of these paths and prevent access to these places. Protecting these routes to sacred places is imperative to maintaining traditional and cultural practices. To reduce erosion, the Pueblo could install erosion control measures, such as rock steps or terraced wooden erosion barriers. Rock steps can control erosion by allowing water to move through the soil without being obstructed, while constricting potential soil movement. Terraced wooden erosion barriers prevent erosion by shortening long slopes along trails into a more level series of steps, which reduces runoff that erodes soil.

Culturally important places

Work with emergency responders to identify how Pueblo staff can accompany emergency responders on Pueblo lands.

Wildfires and floods are increasing in frequency and severity due to climate change. It is important to ensure that emergency responses to extreme events on the Pueblo are timely and respect culturally important places. One way to ensure that wildfire response is efficient without disturbing culturally significant areas is for Pueblo staff to accompany emergency responders on Pueblo lands. The Pueblo could designate a Tribal emergency manager to serve as a liaison to emergency responders. Pueblo staff could accompany emergency responders during an emergency and could also preemptively accompany emergency managers around Pueblo lands before an emergency occurs to show them appropriate routes to take that avoid culturally sensitive locations.

Evaluate emergency response systems to identify actions to limit impacts to culturally important places during response efforts.

Climate change has the capacity to increase the severity and frequency of emergencies such as wildfire and flooding. In response to this higher potential for emergencies on Pueblo lands, it is important that the Pueblo evaluate and provide feedback on current emergency response systems of neighboring resource and land managers to limit impacts to culturally important places. Actions could include developing maps of areas that emergency responders should avoid (discussed further below), designating Pueblo staff to accompany emergency responders on Pueblo lands (discussed further below), training multiple Pueblo staff in emergency response to ensure availability of personnel in the event of an emergency, and conducting emergency response drills.

Develop and share a map of areas that are off limits to emergency managers (without disclosing details about sacred or cultural information) and/or that are accessible, where emergency managers can travel on the Pueblo.

To ensure timely response in the event of wildfires or other hazards that does not disturb sacred or cultural places, the Pueblo could develop maps of Pueblo residences, structures, and infrastructure to share with emergency responders. The maps should highlight utility infrastructure, essential facilities, populations with access or function needs, hazards information, evacuation areas, and acceptable routes for emergency responders. The acceptable routes, corridors, or areas that emergency responders can use should avoid sacred or cultural places. Highlighting these acceptable routes will avoid the need to reveal details about sacred or cultural places. The Pueblo can also highlight areas that are off-limits to emergency responders on the maps.

Wildfires

Work with members of the Pueblo, including youth and elders, and other partners to develop a study plan focused on landscape management practices to best protect the Pueblo against wildfire-related impacts.

With increased potential for wildfires due to climate change, it is important for the Pueblo to study, understand, and plan for wildfires. To understand the most-appropriate, landscape management practices to protect the Pueblo from wildfires and their impacts, the Pueblo could develop a study plan of best landscape management practices. This plan could be developed collaboratively with community members, including youth and elders. Involving community members in planning is important for a plan's success, as it will identify community needs, prioritize high-hazard areas, and incorporate community knowledge into planning. It will also instill a sense of ownership of the plan among community members, resulting in a greater sense of responsibility to reduce wildfire risk. The inclusion of community knowledge will also ensure cultural concerns are addressed and that the plan is accurate and responsive.

Develop and implement a fire mitigation program throughout the Pueblo. Build community awareness about strategies to reduce fire risk to homes and community structures, and engage community members in fire-mitigation activities.

To mitigate the risk of fire to structures and community members, the Pueblo could develop a comprehensive fire mitigation program that incorporates codes and permitting to reduce fire risk, evacuation plans, land use planning and management, fire protection infrastructure, equipment, emergency response personnel, and education and outreach.

Codes and permitting can greatly reduce the risk of fire to homes and community structures (e.g., the Pueblo could adopt ordinances that regulate development in high-hazard areas). The Pueblo could also require that new construction meet specified standards for fire resistance or that fire prevention staff need to sign off on all permits for new construction in high-risk, fire areas. Other requirements the Pueblo could implement relating to codes is requiring setbacks from wood piles or other potential ignition sources; and developing landscaping guides and a list of native, fire-resistant plants for landscaping designs. Evacuation plans for at-risk areas and evacuation drills can reduce the risk of danger to Pueblo members. Land use planning should incorporate fuel management programs. A fire management program could incorporate infrastructure improvements, such as efforts to relocate structures out of fire hazard areas, maintaining roads to allow access by emergency vehicles, or installing water storage facilities. The fire management program could also incorporate equipment and resources that mitigate the potential impacts of fire on community members, such as air-quality filtration systems for vulnerable populations needing to shelter in place. The fire management program could also involve developing emergency response positions.

Education and outreach are also important components of a fire management plan that builds community awareness about strategies to reduce the fire risk to homes and engage community members in fire-mitigation activities. Outreach could include making community members aware of laws surrounding open burning and fireworks, developing training programs or events to teach community members how to reduce fire risk to their homes, creating outreach programs about evacuation routes and procedures, distributing wildland fire information, and promoting the use of weather radios in schools and homes.

Implement fire mitigation practices around all culturally important and critical infrastructure.

The Pueblo could incorporate many strategies to mitigate the risk of fire around culturally important and critical infrastructure. Many components of the fire mitigation plan discussed in the previous section would reduce the risk to culturally important and critical infrastructure, including codes and permitting, land use planning, and infrastructure improvements. Additionally, the Pueblo could identify, develop, implement, and enforce other mitigation actions such as fuel breaks and reduction zones for potential

wildland fire-hazard areas. Fuel management programs are also important to reducing the risk to culturally important and critical infrastructure, and the Pueblo should investigate and apply new and emerging fuel management techniques.

6.2.3 Climate Actions for Community Health

The Pueblo identified climate actions for vulnerabilities that pose the greatest threats to community health, as defined in the community vision. Climate actions are listed by high-risk vulnerability in Exhibit 6.5 in the Pueblo's order of priority, as determined by evaluating each action using the criteria described in Section 6.1. The appendix provides more detail on the ranking of each climate action.

Exhibit 6.5. Climate actions identified by the Pueblo for community health

High climate-risk vulnerability	Identified climate action
Youth outdoor activities	Plant native trees or shrubs and install shade structures to increase canopy cover and create shade over recreational areas, such as the playground, fishing pond, and baseball field.
	Move outdoor activities, such as youth sports or community gatherings, to designated indoor spaces during periods of poor air quality.
Clean air	Limit outdoor and recreational activities during periods of poor air quality.
	Use or advance an existing alert system to warn the community about poor air-quality days and extreme events.
	Establish an air-quality monitoring system for the Pueblo.
	Install climate control and air filtration systems in the Pueblo's gym and other facilities to create a safe space that can protect the community from extreme heat and wildfire smoke, and accommodate year-round indoor sports and activities.
	Encourage community members to create cool and clean air spaces at home that can reduce exposure to extreme heat and wildfire smoke.
Water supply	Evaluate and develop water supply sources.
	Develop a community awareness and outreach program to promote strategies for water conservation.
Traditional practices stress	Seek out family counseling resources and provide materials to families on the Pueblo.
	Establish other opportunities for the community to connect, including increased access to internet and broadband to increase communication.
Mobilization of contaminants	Consider ways to adapt Tribal lifeways to minimize exposure to contaminants and climate hazards, and then conduct outreach to communicate the risks of mobilization to contaminants on the Pueblo and adaptation measures through flyers/bulletin, social media, and community events.
	Coordinate and consult with LANL on adaptation planning and implementation within the LANL facility, to reduce contaminated runoff to Pueblo lands.
	Monitor for increased exposure to contaminants on the Pueblo.
Exposure to chemicals and health	Reduce other stressors, such as removing household chemicals and improving home ventilation.
	Install and maintain air filtration systems or air purification systems in their homes to reduce exposure to air pollution.

Youth outdoor activities

Plant native trees or shrubs and install shade structures to increase canopy cover and create shade over recreational areas, such as the playground, fishing pond, and baseball field.

As heat waves become more intense and frequent, heat-related illnesses can affect people's ability to self-regulate and can compound ancillary cardiovascular or respiratory conditions. Extreme heat and limited shade can make simple activities hazardous to people's health. Erecting shade structures or planting trees

in heavily used areas of the Pueblo – such as the playground, the fishing pond, and baseball field and around the gym – can help reduce heat exposure and lower surface temperatures. For immediate relief from extreme heat, the Pueblo may decide to construct shade structures in the short-term. Over the long-term, planting native, drought-resistant trees can reduce heat exposure, lower surface temperatures, and provide ancillary benefits such as improved air quality, wildlife habitat for birds and other species, and windbreaks. The Pueblo will need to plan for the maintenance of both shade structures and tree plantings.

Move outdoor activities, such as youth sports or community gatherings, to designated indoor spaces during periods of poor air quality.

Climate change is likely to increase the frequency and severity of heat waves. During heat waves, air quality often worsens. Extreme heat and stagnant air trap emitted pollutants, which can increase ground-level ozone and PM. Ozone and PM are associated with acute health impacts, such as coughing, inflamed airways, and chronic effects (e.g., asthma, increased diabetes risk, heart attacks, stroke).

Health impacts from pollution worsen over extended periods of exposure, so it is important for the Pueblo to plan to move outdoor activities, such as youth sports or community gatherings, to designated indoor spaces during periods of poor air quality. Additionally, deep breathing from exercise worsens the health impacts of poor air quality, so it is especially important to relocate youth sports indoors when the air quality is poor. The Pueblo should consider moving outdoor activities indoors when the Air Quality Index (AQI) for ozone is above 100, which is the unhealthy range for sensitive groups. The Pueblo should identify indoor locations for these types of activities during periods of poor air quality.

Clean air

Limit outdoor and recreational activities during periods of poor air quality.

Climate change is likely to increase the frequency and severity of heat waves, which are associated with poor air quality and air-quality related illnesses. In addition, PM from wildfires can degrade air quality in nearby areas and at broad geographic scales, which can cause or exacerbate respiratory or cardiac illnesses. In areas near contaminated sites, wildfires can also burn vegetation and soils that are sequestering hazardous contaminants, which can lead to contaminant mobilization and transport offsite via ash or PM (i.e., “dust”). During periods of poor air quality, we can provide guidance on the safety of outdoor activities – such as sporting events, the farmers market, and Pueblo traditional activities for youth, elders, and other sensitive groups. If the air quality is unhealthy, we can inform community members to limit outdoor and recreational activities.

Use or advance an existing alert system to warn the community about poor air-quality days and extreme events.

The COVID-19 pandemic led the Pueblo to set up an alert system that immediately sends information to the community, including information on distributions of food and medical supplies, and emergency communications. This alert system can also be used to notify elders and other vulnerable populations about poor air quality from wildfire smoke and other harmful pollutants, and inform the community about extreme heat waves or dangerous weather conditions. These alerts can provide information about the risks and preparedness actions to take to ensure the safety of the community.

The alert system could also function as an early warning system to provide information to community members that will allow them to prepare for and respond to extreme weather and climate events. The early warning system would use existing climate and weather services to notify people when potential hazards could impact the Pueblo or surrounding area. A key aspect of an early warning system is having a plan in place for the community to respond to different hazards; the Pueblo is currently developing an Emergency Response Plan that would serve that function. In addition, hazard maps could provide information about potential hazards for specific areas on the Pueblo and evaluation routes.

Establish an air-quality monitoring system for the Pueblo.

Pueblo members have voiced concerns about air quality because of our proximity to LANL, a potential source of exposure to radionuclides and other air contaminants, and because of increased wildfire events that result in greater exposure to wildfire smoke. Pueblo members are exposed to degraded air quality to a greater extent than the public because of extended periods of time spent outdoors engaged in our traditional and cultural practices. Further, we have limited ability to avoid contamination because of our place-based culture, fixed reservation boundaries, and socioeconomic disparities.

Therefore, the Pueblo is interested in establishing an air-quality monitoring program to understand air-quality risks to our community's health and welfare. In this program, we could install ambient air samplers to measure levels of airborne radionuclides emanating from LANL operations and a PM sensor network, such as PurpleAir, to monitor dust and smoke concentrations near Pueblo housing areas. This air-quality monitoring system, which will better characterize the magnitude and extent of air-quality problems, can allow us to continue to develop data-driven strategies to minimize exposure to and protect the health of the community.

Install climate control and air filtration systems in the Pueblo's gym and other facilities to create a safe space that can protect the community from extreme heat and wildfire smoke, and accommodate year-round indoor sports and activities.

Identifying, designating, and, if needed, retrofitting Pueblo buildings to create safe spaces can protect community members from smoke and other harmful pollutants during wildfire events and keep community members cool during extreme heat events. In the case of extreme heat, access to air conditioning can prevent heat-related morbidity and mortality; however, many community members have limited access to air conditioning or may choose not to operate their air-cooling unit because of high electricity costs during peak heat hours. In addition, exposure to wildfire smoke can lead to eye and respiratory tract irritation, exacerbate existing respiratory and cardiovascular conditions, and result in premature death. Creating safe spaces can provide a comfortable and safe environment for community members.

The Pueblo could install central air filtration/climate control systems in the Pueblo's gym, as well as the library or senior center to create clean air shelters and cooling centers where elders, community members with existing respiratory conditions, and other vulnerable community members could shelter overnight or over an extended period to provide temporary relief from wildfire smoke or extreme heat. These spaces can also provide safe areas for Pueblo members to recreate or undertake other indoor activities (e.g., a gym retrofit could create a cooled space that could accommodate indoor sports and activities for youth and other community members year-round). In addition, a gym retrofit might incorporate a solar energy system to reduce energy bills and greenhouse gas emissions. Installing a solar energy system will require a careful assessment of the space available to install solar panels and the amount of power needed.

These spaces do lead to congregation, which may increase the risk of spreading contagious diseases such as COVID-19. Therefore, clean air shelters and cooling centers should implement practices to limit the transmission of COVID-19, such as verbal screenings and temperature checks before entering shelters, physical distancing, the use of masks within shelters, and proper cleaning and disinfection.

Encourage community members to create cool and clean air spaces at home that can reduce exposure to extreme heat and wildfire smoke.

The Pueblo could provide information and resources that reduce the community's exposure to extreme heat and wildfire smoke. Educating the community and communicating prevention information before and during an extreme event can reduce illnesses and deaths. Information could include tips to reduce exposure to heat or wildfire smoke; symptoms of excessive heat or smoke exposure; and available community resources, such as the location of safe spaces on the Pueblo, assistance programs to borrow

fans or air-conditioning units, and utility assistance programs to pay for high electricity costs during peak heat events. Wildfire preparedness information might also encourage community members to create a clean air space in their homes – such as a bedroom with an attached bathroom – that can reduce exposure to wildfire smoke. Information can be communicated through the Pueblo's alert system, monthly bulletins, or other methods.

The Pueblo could also distribute resources to vulnerable community members – such as fans and air-conditioning units – as well as safety kits that include hydration tablets, sunblock, appropriate respiratory masks, or other personal protective equipment. These safety kits could also include the information described above.

Water supply

Evaluate and develop water supply sources.

Groundwater and surface water resources are at risk due to drought and decreased snowpack, as well as risk of contamination from prior and ongoing contamination from LANL operations. Currently, there are three sources of domestic groundwater at the Pueblo de San Ildefonso: (1) the community water supply system from the two Black Mesa wells, (2) private domestic wells, and (3) the Totavi (LA-5) well (which presently only supplies the Pueblo's gas station). The Pueblo assessed future water sources and management of that water to help us understand the planned additional supplies resulting from the Aamodt Litigation Settlement Agreement, as described in the Pojoaque Basin Regional Water System (RWS) Final Environmental Impact Statement (FEIS), and options for additional water sources to support future economic expansion and provide added resiliency to drought or water shortages. The Pueblo is scheduled to receive water from the RWS by 2025. The assessment considered options before and after the RWS water is delivered.

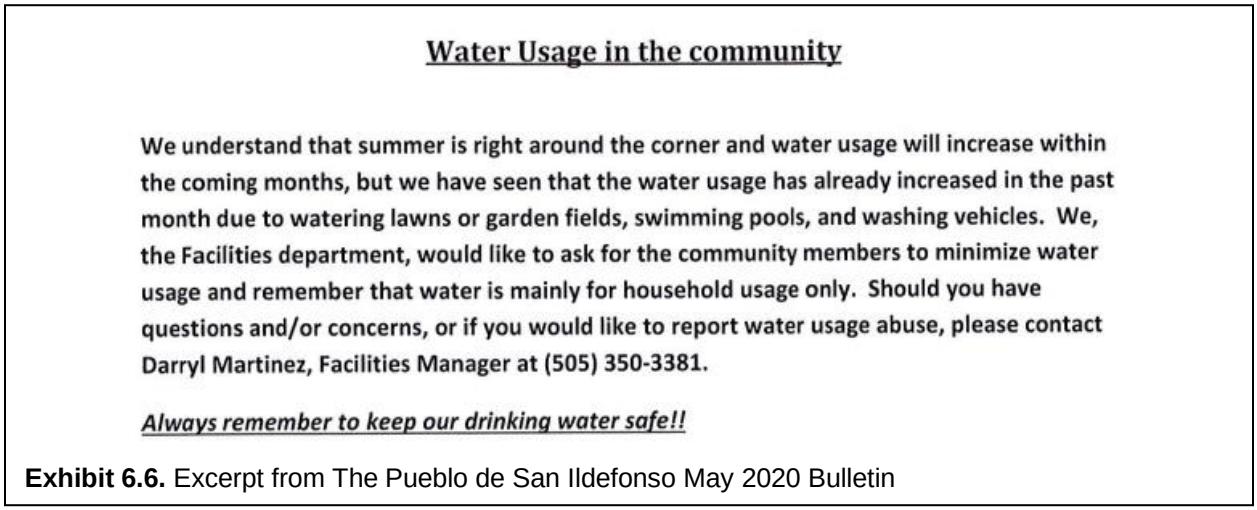
Between now and 2025, the Pueblo could consider additional emergency sources of water should water from the Black Mesa wells become unavailable or unusable. This might include increasing the available storage of water in tanks by rehabilitating existing storage tanks on the Pueblo and connecting them to the current water distribution system. After the RWS water is available to the Pueblo, the Black Mesa wells will be used for emergency water supply, which will provide the Pueblo with additional resiliency should some adverse event affect the RWS water supply. The Pueblo could consider investing in an additional reliable source of water to provide resiliency during drought or water shortage and the potential for population growth and economic expansion, such as the expanded use of water from the Totavi well or arsenic treatment for the Pajarito wells (Travers et al., 2022).

Develop a community awareness and outreach program to promote strategies for water conservation.

Water is a revered resource for the Pueblo and central to many of its cultural and essential needs. Water conservation is critical to maintaining the Pueblo's traditions and meeting basic needs, particularly as water sources become scarcer over time. As climate change affects the availability of water, water conservation actions can reduce daily water use, while information can educate the community on the importance of reducing water use and provide water conservation tips. Information about water usage and water conservation can raise community awareness. The Pueblo's monthly bulletins often provide reminders about minimizing water use for watering lawns or garden fields (Exhibit 6.6). These reminders could be expanded to provide helpful tips on water conservation strategies. An outreach strategy can highlight options to replace standard appliances with water-conserving appliances – such as low-flow toilets – that can reduce daily water use. If installed in Pueblo buildings, signage accompanying the low-flow toilet or other water-conserving appliance can describe the water savings benefits of the upgrade, which can help educate the community about water conservation actions. There may also be funding options to help incentivize community leaders and members to switch from standard to low-flow and water-saving technologies. In addition, there are best management practices for conserving water that the

community can adopt (e.g., installing rainwater harvesting tanks and transforming lawns to a landscape with local brush and vegetation that are adapted to low-water conditions) to reduce water use.

The Pueblo could also evaluate opportunities to hire or recruit a facilities staff or youth member to volunteer or be hired as a summer intern water conservation coordinator. Implementing a water conservation coordinator would, for example, serve to design and implement water saving plans, raise community awareness, and provide outreach opportunities. Funding opportunities to hire a facilities staff member to serve in this role or allow for a youth member to apply for paid annual or summer internships can incentivize community interest and participation. Conversely, even staffing this position as a volunteer role would draw community interest, especially in the case of youth, when trying to make impressions that will serve them in their future. An example activity that a water conversation coordinator may undertake includes organizing and planning a "Water Conservation Day (or Week)," focused on the importance of water, the ways in which it is sacred to their community, challenges that have reduced water availability, and ways the community can help ensure safe water is conserved and available to future generations.



Water Usage in the community

We understand that summer is right around the corner and water usage will increase within the coming months, but we have seen that the water usage has already increased in the past month due to watering lawns or garden fields, swimming pools, and washing vehicles. We, the Facilities department, would like to ask for the community members to minimize water usage and remember that water is mainly for household usage only. Should you have questions and/or concerns, or if you would like to report water usage abuse, please contact Darryl Martinez, Facilities Manager at (505) 350-3381.

Always remember to keep our drinking water safe!!

Exhibit 6.6. Excerpt from The Pueblo de San Ildefonso May 2020 Bulletin

Traditional practices stress

Seek out family counseling resources and provide materials to families on the Pueblo.

Climate change can have negative impacts on both mental and physical health by creating stress, which can exacerbate existing mental illness or lead to development of new illnesses, such as depression and anxiety. Climate change can disrupt social, economic, and environmental determinants of mental health, introduce stress related to an uncertain future, and disrupt traditional systems, contributing to acculturation. More frequent and severe extreme weather events resulting from climate change can contribute to stress disorders, depression, anxiety, and grief. Long-term climate impacts can result in the loss of cultural resources, contributing to a host of negative community mental health outcomes.

To mitigate the potential for negative mental health outcomes in the community, the Pueblo could take action to improve mental health. Materials from local family counseling on healthy adaptive coping behaviors, as well as materials highlighting the availability of counseling and mental health resources, could be distributed to families on the Pueblo. Distributing these resources can both create awareness within the community surrounding mental health services and normalize mental health treatment. If funding was available, the Pueblo could create a position within the Health and Human Services Department dedicated to community well-being and mental health.

Establish other opportunities for the community to connect, including increased access to internet and broadband to increase communication.

Loss of cultural resources or traditional practices due to climate change can weaken social and community bonds. The Pueblo has strong cultural traditions and a sense of community, which is necessary for community well-being. With the potential loss of certain cultural resources or practices due to climate change threatening this sense of community well-being, the Pueblo could seek to strengthen community bonds through additional opportunities for the community to connect. These opportunities could come in the form of new, in-person community cultural activities or through virtual community-building activities, such as Zoom calls led by senior community members. To enhance the ability for the community to connect, especially with youth who are increasingly using technology as a primary form of communication, the Pueblo could take efforts to increase access to internet and broadband services. Ensuring that every community member can connect virtually could greatly enhance the sense of community within the Pueblo, especially when cultural activities are disrupted.

Mobilization of contaminants

Consider ways to adapt Tribal lifeways to minimize exposure to contaminants and climate hazards, and then conduct outreach to communicate the risks of mobilization to contaminants on the Pueblo and adaptation measures through flyers/bulletin, social media, and community events.

If specific exposure pathways, such as gathering traditional plants, are identified/confirmed through monitoring efforts, then the Pueblo can consider adapting Tribal lifeways to minimize that exposure. This could include spatial and/or temporal changes in the Pueblo's use of resources to avoid the highest contamination levels. For example, if traditional plants growing in a particular area have higher contaminant levels due to runoff patterns, community members could gather plants less frequently from that area and instead use plants from other areas or explore whether those plants can be cultivated. To reduce cumulative health impacts from multiple stressors, adapting Tribal lifeways to reduce contaminant exposure could also be considered in tandem with adaptation measures related to other climate hazards, such as reducing time spent outdoors during extreme heat or poor air-quality events. These adaptation measures could consider ways to maintain traditional practices and social interactions, even if those activities cannot occur in their usual settings.

Education and outreach are critical to the success of this approach. To make decisions to protect themselves and their families, community members should be informed about the risks associated with contaminant mobilization and adaptation measures they can implement to reduce their exposure to contaminants. Outreach to the community could occur through flyers or bulletins, on social media, or at community events. The content of these messages could include straightforward explanations of how contaminants are mobilized on the Pueblo, the risks posed by contaminant exposure, who may be most susceptible to the effects of contaminant exposure due to combined effects from other climate hazards, and ways to adapt Tribal lifeways to reduce exposure.

Coordinate and consult with LANL on adaptation planning and implementation within the LANL facility, to reduce contaminated runoff to Pueblo lands.

The combined effects of future increases in wildfires and floods may increase the transport of contaminants from the LANL site onto Pueblo lands by first releasing contaminants that are sequestered in vegetation (wildfires) or soils, and then washing contaminated soils and water on the Pueblo (floods). U.S. Department of Energy policy requires consultation with Tribes affected by their facilities, and defines consultation with Tribal governments as "providing for mutually agreed protocols for timely communication, coordination, cooperation, and collaboration to determine the impact on traditional and cultural ways of life, natural resources, treaty and other federally reserved rights involving appropriate tribal officials and representatives throughout the decision-making process, including final decision-making and action implementation as allowed by law, consistent with a government to government

relationship" (DOE, 2009). The Pueblo could call on LANL to meaningfully engage in planning and implementing climate resiliency actions that would reduce contaminated runoff on Pueblo lands. This could include further efforts to stabilize wetlands in the Pueblo Canyon where LANL has already implemented some stabilization actions and possibly other strategies, such as construction of infiltration trenches and bioretention basins. It could also include engaging with LANL on coordinated forestry management practices to reduce the risk and intensity of future wildfires.

Monitor for increased exposure to contaminants on the Pueblo.

The Pueblo's proximity to LANL, in combination with an increase in extreme weather events such as wildfires and flooding, may increase community members' exposure to harmful contaminants that may be mobilized from the LANL site. The health effects of this contaminant exposure may be exacerbated for community members already impacted by direct effects of climate change, such as extreme heat or reduced air quality (Martinez et al., 2021). Community members may be exposed to contaminants through various media, including water, soil, and food. For example, runoff after extreme precipitation events could convey contaminants from the LANL site into surface water or groundwater sources that the Pueblo relies on for drinking water or irrigation. Gathered plants may become contaminated if they are grown in contaminated soil. Community members could also be exposed to contaminated soil when participating in various outdoor activities. Targeted sampling to fill in gaps on contaminant levels in different media (e.g., gathered plants, soils in certain locations) could help the Pueblo better understand and reduce the risks posed by exposure to contaminants.

Exposure to chemicals and health

Reduce other stressors, such as removing household chemicals and improving home ventilation.

In addition to mitigating exposure to contaminants mobilized from the LANL site, the Pueblo can also protect community members' health by reducing cumulative exposure to contaminants from multiple sources (e.g., cleaning products and other household chemicals worsen indoor air quality). These products can leave lingering fumes and residues, exposing people to potentially harmful or irritating chemicals. Other sources of indoor air pollution include combustion appliances, tobacco products, and building materials. Indoor air is often much more polluted than outdoor air, and poor indoor air quality can affect the comfort and health of community members and increase their risk of health problems, compounding other health effects related to climate change.

The Pueblo could take multiple actions to reduce these other stressors. The Pueblo could educate community members about the risks associated with household chemical products and how to find and use safer alternatives to these products. The Pueblo could also encourage community members to eliminate smoking indoors and consider transitioning away from combustion appliances.

Install and maintain air filtration systems or air purification systems in their homes to reduce exposure to air pollution.

Many Pueblo homes, particularly older homes, do not have adequate ventilation or filtration systems. Although eliminating or reducing sources of indoor pollution is often the most effective way to improve indoor air quality (described above), the Pueblo can also assist community members with improving ventilation in their homes. For example, the Pueblo could provide funding, education, and assistance about using or installing exterior exhaust fans in kitchens and bathrooms; improving home heating, ventilating, and air conditioning systems and associated filters; and opening windows and doors as outdoor air quality and temperature allow.

6.2.4 Climate Actions for Governance and Infrastructure

The Pueblo identified climate actions for vulnerabilities that pose the greatest threats to governance and infrastructure, as defined in the community vision. Climate actions are listed by high-risk vulnerability in Exhibit 6.7 in the Pueblo's order of priority, as determined by evaluating each action using the criteria described in Section 6.1. The appendix provides more detail on the ranking of each climate action.

Exhibit 6.7. Climate actions identified by the Pueblo for governance and infrastructure

High climate-risk vulnerability	Identified climate action
Place-based culture	Build on the farm program to develop a self-supporting and self-sustaining agricultural system that can ensure food sovereignty – the right of Pueblo people to health and culturally appropriate food using sustainable and ecologically sound methods.
	Establish agreements with other Pueblos and communities to obtain access to natural resources as the range of traditional plants and animals shift with changing environmental and climate conditions.
	Acquire climate refugia areas (e.g., via land purchase) to ensure traditional natural resources in the future.
	Enhance government-to-government relationships with state and federal agencies to inform resilience planning and collaborate on implementing resilience actions.
Pueblo departments	Convene regular meetings with representatives from each Pueblo department to identify specific issues that would benefit from cross-departmental coordination.
	Implement a coordinated effort to identify and assign department-specific duties.
Firefighting	Review and assess systems for communicating and coordinating with firefighters outside of the Pueblo.
	Establish water supply or temporary water storage structures for fire suppression.
Critical infrastructure	Implement fire mitigation practices around all critical infrastructure.
	Incorporate resiliency measures into future wastewater treatment system upgrades and expansions.
	Build drought and flood resiliency into irrigation ditch and canal upgrades on the Pueblo.
	Develop maps of potential utility hazards and key infrastructure.

Place-based culture

Build on the farm program to develop a self-supporting and self-sustaining agricultural system that can ensure food sovereignty – the right of Pueblo people to health and culturally appropriate food using sustainable and ecologically sound methods.

As discussed in Section 6.2.1, limited access to fresh, locally grown fruits and vegetables has negatively affected the health of many Pueblo residents. Climate change could compound issues related to food sovereignty by affecting the productivity of traditional crops that community members cultivate; and the plants community members traditionally gather for food, medicine, ceremonies, and prayers. Building an on the farm program that develops a self-supporting agricultural system can strengthen the Pueblo's food sovereignty and ensure access to healthy first foods. Elements to this program might include developing nurseries and upgrading irrigation systems for water loss. Developing nurseries can allow the Pueblo to grow and protect more culturally important plants and upgrading irrigation systems can allow the Pueblo to improve current crop yields and ensure the persistence of culturally important food sources.

Establish agreements with other Pueblos and communities to obtain access to natural resources as the range of traditional plants and animals shift with changing environmental and climate conditions.

The Pueblo has a well-established history of working with federal and state agencies and surrounding communities toward common goals. The Pueblo already has agreements with several federal agencies – including the Santa Fe National Forest, LANL, and the Bandelier National Monument – to allow the Pueblo community to collect plants, including parts or products of plants, and mineral resources for noncommercial traditional and cultural uses. As climate change shifts the range of plant and animal species and changes the distribution and population density of wildlife species, these agreements will be critical to sustaining Pueblo access to traditional plants and minerals, as well as sacred places. The Pueblo can consider establishing additional agreements with other communities and landowners to secure access to natural resources.

In addition, the Pueblo works with surrounding landowners to restore landscapes, enhance wildlife management practices, and protect and preserve access to and ceremonial use of sacred places and traditional use areas. Maintaining and expanding federal, state, and Pueblo partnerships will support the effective implementation of adaptation actions and regional resilience. LANL, for example, is located upstream of the Pueblo, and any adaptation or resilience actions taken within the LANL facility can directly affect the Pueblo. Therefore, coordinating with LANL and providing input on adaptation actions could benefit the Pueblo. The Pueblo can provide input on proposed flood control measures on LANL lands, provide guidance for LANL's selection of native seeds, and evaluate LANL's stream or forest restoration plans. Coordinating on adaptation actions could potentially allow the Pueblo to leverage costs, such as collaborating with LANL to purchase and plant vegetation across the two properties, focusing on culturally important, native species, and taking advantage of bulk or wholesale rates. The Pueblo can consider options, such as regular meetings or collaborating on funding opportunities, to work closely with LANL and other federal, state, and Pueblo partners to implement regional adaptation actions that could affect Pueblo lands and the community.

Acquire climate refugia areas (e.g., via land purchase) to ensure traditional natural resources in the future.

Climate change refugia are areas that remain relatively buffered from contemporary climate change over time and enable persistence of valued physical, ecological, and socio-cultural resources. These areas are often surrounded by wetlands, riparian zones, rock glaciers, talus slopes, large bodies of water, or forest canopies. These physical characteristics allow areas to develop unique micro-climate conditions that are buffered from regional and global climate change. Access to climate change refugia can ensure persistence of local natural resources in a future where resource access may be uncertain. The Pueblo could make land purchases of climate refugia areas to safeguard traditional natural resources in the future, such as traditional plants, fish, and pottery materials. Along with purchasing these land areas, the Pueblo would also need to implement strategies to manage the climate refugia to decrease stressors and protect them from disturbance.

Enhance government-to-government relationships with state and federal agencies to inform resilience planning and collaborate on implementing resilience actions.

Tribal governments are sovereign, self-governing entities, responsible for the health, safety, and welfare of their citizens and communities. Tribal governments have government-to-government relationships with state and federal agencies, and federal agencies have an obligation for consultation with Tribal Nations. Strong government-to-government relationships can increase resilience on both Pueblo lands and state and federal lands. The Pueblo's Ancestral Domain extends onto lands owned by the LANL, the U.S. Forest Service's Santa Fe National Forest, and the National Park Service's Bandelier National Monument, and the Pueblo has a close, working relationship with each of these entities. The Pueblo also regularly works with the State of New Mexico and is currently serving as an advisor to the New Mexico State

Climate Change Task Force to ensure climate strategies minimize negative effects on cultural properties and sites across the State. These types of government-to-government relationships can help to inform resilience planning on State and Pueblo lands. There may also be opportunities to collaborate on implementing resilience actions moving forward.

Pueblo departments

Convene regular meetings with representatives from each Pueblo department to identify specific issues that would benefit from cross-departmental coordination.

Climate change is a complex problem that requires cross-departmental collaboration. For example, developing strategies and actions to address multiple climate hazards, such as wildfires and flooding, might require collaboration between the Natural Resources Department, which focuses on protecting, preserving, and managing the Pueblo's land, and the DECP to ensure actions protect and preserve the Pueblo's cultural resources. To promote collaboration across departments, the Pueblo could establish a system for regular information sharing about specific issues. This might include regular meetings with representatives from each Pueblo department to share information and resources relevant to climate change and adaptation, and to work through and implement collective solutions to adapt to and manage the impacts of extreme events. It could also include appointing staff in each department to be responsible for managing cross-department coordination on each issue. As funding for climate change efforts becomes available, the departments should work together and with the Tribal Council and the community to determine how to allocate and implement projects to ensure an effective and efficient use and management of climate funds.

Implement a coordinated effort to identify and assign department-specific duties.

Pueblo departments have begun a coordinated effort to identify and assign specific department duties. Part of this might include mainstreaming adaptation actions[2] into Pueblo departments' existing policies, plans, and programs. "Mainstreaming" refers to the process of fully integrating an adaptation action into existing policies, plans, and programs. For example, as the Pueblo currently conducts extensive programming for Tribal youth, the Education Department could integrate climate change adaptation concepts into the school curriculum – in classroom or outdoor lessons, assignments, and student projects. Teachers may need to spend time developing new lessons and preparing instruction materials (potentially using this Climate Action Plan as a teaching resource). To mainstream priority adaptation action, Pueblo departments may consider:

- Which department should lead this action now and in the future?
- Which existing programs or projects could best integrate this action into their existing scope and activities?
- Which specific staff position(s) or Tribal member(s) should be responsible for managing and sustaining this action over time? Do these individuals currently have the time and necessary skills to manage this action, or does the Pueblo need to recruit additional staff and/or community members to help manage this action?
- When the initial implementation funding ends, how will the Pueblo continue to fund this adaptation action? For example, could the Pueblo's annual budget fund this action in the future? Does the Pueblo need to pursue a multi-year grant or other funding source to sustain this action?

2. "Mainstreaming" refers to the process of fully integrating an adaptation action into existing policies, plans, and programs. This is an important step in the adaptation planning process because it helps ensure that adaptation does not occur as a discrete, finite project or initiative, but as an ongoing process that becomes a part of regular roles, responsibilities, and cultural norms. Mainstreaming is critical to sustaining adaptation progress – and investments in adaptation – over time.

- How will the Pueblo assess the success of the adaptation action? Which staff/community members will be responsible for monitoring success and developing and recommending adaptive management approaches to help ensure that the action makes progress toward adaptation goals?

Mainstreaming is an important step in the adaptation planning process because it helps ensure that adaptation does not occur as a discrete, finite project or initiative, but as an ongoing process that becomes a part of Pueblo departments, existing roles and responsibilities, and cultural norms.

Firefighting

Review and assess systems for communicating and coordinating with firefighters outside of the Pueblo.

The Pueblo has identified a need to better communicate and coordinate with firefighters outside of the Pueblo. For example, road names on the Pueblo have changed in recent years and are difficult for firefighters outside the Pueblo to understand. An updated map of Pueblo residences, structures, and infrastructure should be created and shared with emergency responders. Homes and facilities could be numbered based on their distance from road intersections, a common practice that helps firefighters and other emergency responders find a specific address. In addition, emergency responders often access traditional areas or sacred or cultural places of the Pueblo to undertake wildfire mitigation efforts or respond to wildfires and other hazards. A map could also potentially include general information about areas that are off limits to emergency managers without disclosing details about sacred or cultural places, or conversely could delineate accessible areas where emergency managers can travel on the Pueblo. The Pueblo should also have a liaison to help emergency responders find homes or facilities on the Pueblo and help increase communication between the Pueblo and firefighters.

Establish water supply or temporary water storage structures for fire suppression.

Establishing short-term storage tanks can supply water for fire protection needs. Through the RWS, one new, short-term water storage tank will be constructed at El Rancho (576,000 gallons). In addition, additional water sources could be used for firefighting (e.g., two wells located on the west side of the Rio Grande – Pajarito Well #1 and Pajarito Well #2 – were completed in 1980 at depths of 140 and 160 feet). The Pueblo relied on these wells as water sources until the U.S. Environmental Protection Agency decreased the arsenic maximum contaminant level (MCL) from 50 ug/L to 10 ug/L in 2001, which took effect in 2006. As the Pueblo could not find a cost-effective option to sufficiently reduce arsenic concentrations in the wells, they were taken offline (Travers et al., 2022). Although these wells cannot be used for a water supply without treatment, they could be used for fire suppression efforts. Rehabilitation of these wells, and possibly others, could provide water for fire suppression purposes.

Critical infrastructure

Implement fire mitigation practices around all critical infrastructure.

As discussed in Section 6.2.2, The Pueblo could incorporate many strategies to mitigate the risk of fire around critical infrastructure, including codes and permitting, land use planning, and infrastructure improvements. Additionally, the Pueblo could identify, develop, implement, and enforce other mitigation actions such as fuel breaks and reduction zones for potential wildland fire hazard areas. Fuel management programs are also important to reducing the risk to critical infrastructure, and the Pueblo could investigate and apply new and emerging fuel management techniques.

Incorporate resiliency measures into future wastewater treatment system upgrades and expansions.

Most homes within the Pueblo boundary use septic systems with tanks that discharge effluent rich in nitrogen-based compounds and other contaminants into the ground, which could eventually reach the water supply aquifer (USBR, 2018). In addition, as the existing system exceeds its life cycle and has

greater demand with projected population growth, facilities will fail more frequently and will require more maintenance (USBR, 2018). The Pueblo is currently evaluating options to connect homes without community sewer service to a wastewater treatment system. The Pueblo could upgrade the existing system and expand the collection system to homes that currently do not have community sewer service; or the Pueblo could pump its sewage to the Pueblo of Pojoaque's existing wastewater treatment facilities, which have capacity to treat more wastewater. Either option will help eliminate the use of lagoons and septic systems as a primary means of wastewater treatment.

As the Pueblo evaluates options to treat wastewater, it can also consider ways to build resiliency into the system. The Pueblo can assess and respond to new risks, such as climate extremes and opportunities during the planning process. For example, the U.S. Environmental Protection Agency's Climate Resilience Evaluation & Awareness Tool (CREAT) allows utilities and communities to evaluate the potential impacts of climate change on their water and wastewater services, and to evaluate adaptation options to address these impacts using both traditional risk assessment and scenario-based decision-making. Several communities, including several Tribes, have used this tool to develop water and wastewater utility resilience strategies and priorities. A flexible and iterative approach to designing, implementing, and maintaining the system can result in robust decision-making that builds operations that are successful regardless of the challenges faced by a utility.

Build drought and flood resiliency into irrigation ditch and canal upgrades on the Pueblo.

Restoring native vegetation around cement-lined irrigation ditches could provide multiple benefits to surrounding habitat and the Pueblo's water supply. Revegetation of disturbed areas around irrigation ditches can reduce flood impacts by slowing the overland flow of water and increasing water infiltration capacity. This will also help prevent soil erosion and sedimentation of irrigation ditches, which can reduce their capacity over time. Revegetating areas around irrigation ditches with native grasses and shrubs can also provide shade and reduce evaporative losses from the ditches. It is important to select species that do not have extensive root systems that could damage the lined ditches. It is also important to use only native species that are adapted to the dry conditions of New Mexico; non-native species can be detrimental because their root systems can draw large amounts of water from the ditches, reducing water availability for irrigation.

Develop maps of potential utility hazards and key infrastructure.

As described above, the Pueblo has identified a need to develop maps of Pueblo residences, structures, and infrastructure to share with emergency responders for wildfires and other hazards. This map could be expanded to include information about:

- **Utility infrastructure** (e.g., electric utility infrastructure, water and wastewater utility infrastructure, irrigation canals and ditches, the Otowi river gage, communications towers).
- **Essential facilities** (e.g., government administration buildings, medical clinics, community facilities, public works facilities).
- **Population areas with access or function needs** (e.g., senior population or community members with medical conditions or mobility impairments).
- **Hazards information** (e.g., floodplains or areas that experience erosion, landslides, high wind, severe winter weather, wildfires).
- **Evacuation areas** for the community (e.g., the location of cooling shelters for extreme heat days; clean air shelters for days with high smoke and other harmful pollutants; evacuation routes for wildfires, landslides, or other extreme events).
- **Acceptable routes, corridors, or areas** for emergency responders to use on the Pueblo without disclosing details about sacred or cultural places.

The Pueblo is currently developing an Emergency Response Plan; this hazards map could be incorporated into that plan. Future climate risks should also be included in the initial and updates to the Emergency Response Plan.

6.2.5 Mitigation-Focused Climate Actions

High climate risk vulnerability	Identified climate action
Mitigation-focused	Pursue use of renewable energy sources, including evaluating opportunities to implement solar technology on the Pueblo.
	Explore opportunities for green transportation around the Pueblo.

Pursue use of renewable energy sources, including evaluating opportunities to implement solar technology on the Pueblo.

Transitioning from fossil-fuel powered energy sources to renewables sources such as solar will reduce greenhouse gases and make the Pueblo more resilient to climate change. Communities served by only one power source have limited resilience. Incorporating redundancy into overall systems, such as adding solar panels, can reduce risks to the community's power systems.

The Pueblo could take a phased or stepped approach to transitioning to renewable energy sources. As a first step, the Pueblo could conduct a feasibility study for transitioning to solar energy. A feasibility study would consider the Pueblo's overall energy needs for the year and throughout the day; which buildings' electricity needs should be offset by solar; and the available locations for siting solar energy, including opportunities for both roof- and ground-mounted solar energy systems. The analysis would include evaluating which buildings could accommodate solar systems and whether there would be land suitable for siting solar arrays. In addition, the study would consider existing utility rate structures, incentives for excess generation, and available financing mechanisms to determine whether the installation of solar energy systems is feasible. This analysis will consider the Pueblo's other objectives, such as the preservation of critical natural resources and culturally important areas. Existing tools that could be used in this feasibility analysis include the National Renewable Energy Laboratory's System Advisor Model to determine the net present value, the payback period, and the electricity output of each system. Different solar system sizes could be assessed using this tool, and then a preferred option could be selected by the Pueblo. Including battery storage as a part of the solar system could also be assessed as a part of the feasibility study.

The next steps of this climate action would involve securing funding and implementation of the preferred solar system size. There are several potential funding opportunities to assist the Pueblo, such as the U.S. Bureau of Indian Affair's (BIA's) Energy and Mineral Development Program. The Pueblo could consider these funding options as a part of its next steps.

Explore opportunities for green transportation around the Pueblo.

Implementing transportation initiatives to decrease single-occupancy vehicle trips can help reduce greenhouse gas emissions and improve local air quality by decreasing the amount of carbon monoxide, nitrogen oxide, volatile organic compounds, and PM emitted from the vehicle's exhaust system. The Pueblo community could evaluate sustainable transportation options by conducting a survey to ascertain community transportation needs. The survey would consider commuting distance and locations, the number of people traveling to each location, and the cost of commuting each day. These data would help the Pueblo determine which transportation solutions best fit its needs, such as transit (e.g., buses), carpooling, vanpooling, or carsharing, while also reducing greenhouse gas emissions.

The Pueblo could also develop a tool to prioritize the conversion of existing fleet vehicles to electric vehicles. The tool would consider several factors, such as age; replacement, operations, and maintenance

costs; mileage; and emissions of current fleet vehicles. Based on the tool, the Pueblo could prioritize replacement of the existing fleet with clean, electric vehicles. Next steps of this climate action would involve conducting research on potential funding opportunities for the Pueblo to "green" its fleet.

7. Climate Implementation

This Climate Action Plan describes the process and results for developing our community vision, assesses the vulnerability of each aspect of our community vision, and identifies and evaluates actions that could reduce our highest-risk vulnerabilities. As a living document, the Pueblo will continue to develop and reevaluate these resiliency actions. In addition, the Pueblo has already started to implement these high-priority resilience actions:

- Maintain traditional agricultural knowledge by developing a resilient farm plan that can supports the transfer of knowledge from elders to youth and future generations with BIA funding.
- Develop a study plan focused on landscape management practices to best protect the Pueblo against wildfire-related impacts, with support from the Southwest Climate Adaptation Science Center.
- Evaluate and develop water supply sources using DECP funding.

The Pueblo is also in the process of seeking external funding to implement several other adaptation actions. Implementation of adaptation actions includes monitoring outcomes of climate actions and actively seeking community feedback to determine if climate actions are producing desired results and enable the community to adaptively manage and refine climate actions moving forward.

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We hope to honor all of the above with this living document, and we look forward to sustained community involvement and collaboration as we continue to evaluate and prioritize adaptation actions and implement and monitor actions.

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Appendix: Evaluation of Adaptation Actions

Exhibit A.1. Evaluation of traditional activity adaptation actions

Vulnerability	Adaptation Actions	Effectiveness	Technical feasibility	Cultural feasibility	Community support	Cost	Feasible implementation timeline	Timeline for benefits return	Addresses mitigation and adaptation	Total score
Pottery. Traditional pottery-making utilizes materials from the pueblo's local lands. Making pottery requires access to high-quality clay, sand, ash, plants (for pigments), and other materials.	Restore and protect critical areas from erosion and aridity by revegetating native grasses and plants to help sustain their availability for future use in traditional activities.	5	4	5	5	3	4	4	5	**35**
	Teach community members, particularly Tribal youth, about gathering clay and volcanic ash to ensure the transfer of traditional knowledge and sustainable practices.	4	5	5	5	1	5	5	3	**33**
Ceremony and prayers. Traditional ceremonies and prayers utilize materials from the pueblo's local plants and animals.	Restore and enhance habitat on the Pueblo to attract game, birds, and other wildlife; and re-establish populations of native plants in least-vulnerable and most-suitable areas or refugia.	4	4	5	5	3	4	4	5	**34**
	Share traditional knowledge about natural resources used in ceremonies and prayers, and teach Pueblo youth to identify resources and strengthen their stewardship of these resources in traditional settings, such as in the kiva or a Tewa language class.	4	5	5	5	1	5	5	1	**31**
Growing traditional crops. Traditional crops are most productive under specific climate conditions and success of these crops depends on the transfer of traditional agricultural knowledge.	Maintain traditional agricultural knowledge by developing a resilient farm plan that can support the transfer of knowledge from elders to youth and for future generations.	4	5	5	5	5	5	5	3	**37**
	Establish a seed bank to preserve seeds of culturally significant plants.	5	4	5	5	2	4	5	2	**32**
	Improve the community garden to grow culturally important plants to strengthen the Pueblo's food sovereignty and provide an alternative plant source for ceremonies and prayers.	5	4	5	5	2	4	5	1	**31**

Exhibit A.2. Evaluation of traditional places adaptation actions

Vulnerability	Adaptation Actions	Effectiveness	Technical feasibility	Cultural feasibility	Community support	Cost	Feasible implementation timeline	Timeline for benefits return	Addresses mitigation and adaptation	Total score
Sacred places (e.g., sacred springs). Continued existence of sacred places, such as sacred springs, depends on sustained groundwater levels.	Develop a plan to improve understanding of groundwater levels around the Pueblo's sacred springs.	5	5	5	5	3	4	3	5	**35**
	Enhance water retention and facilitate groundwater recharge to protect and maintain sacred springs and other water sources.	5	4	5	5	2	4	4	5	**34**
	Implement erosion control measures, such as rock steps or terraced wooden erosion barriers, along routes to sacred places.	5	4	5	5	3	4	4	2	**32**
Culturally important places. Emergency responders need to be able to access all areas of the Pueblo and the Pueblo's Ancestral Domain during an emergency; culturally important sites places may be present within a future emergency response location.	Work with emergency responders to identify how Pueblo staff can accompany emergency responders on Pueblo lands.	3	4	5	5	5	5	5	1	**33**
	Evaluate emergency response systems to identify actions to limit impacts to culturally important places during response efforts.	3	5	5	5	4	5	4	1	**32**
	Develop and share a map of areas that are off limits to emergency managers (without disclosing details about sacred or cultural information) and/or that are accessible, where emergency managers can travel on the Pueblo.	4	4	5	5	3	5	5	1	**32**
Wildfires. Wildland fires can damage or destroy the Pueblo's built environment and sacred places and can make it impossible or unsafe to carry out cultural practices.	Work with members of the Pueblo, including youth and elders, and other partners to develop a study plan focused on landscape management practices to best protect the Pueblo against wildfire-related impacts.	5	5	5	5	3	4	3	5	**35**
	Develop and implement a fire mitigation program throughout the Pueblo. Build community awareness about strategies to reduce fire risk to homes and community structures, and engage community members in fire-mitigation activities.	4	5	5	5	4	5	4	1	**33**
	Implement fire mitigation practices around all culturally important and critical infrastructure.	4	5	5	5	4	5	4	1	**33**

Exhibit A.3. Evaluation of community health adaptation actions

Vulnerability	Adaptation Actions	Effectiveness	Technical feasibility	Cultural feasibility	Community support	Cost	Feasible implementation timeline	Timeline for benefits return	Addresses mitigation and adaptation	Total score
Youth outdoor activities. Outdoor activities and sports are an important means for pueblo youth to interact and build relationships, to sustain physical health and well-being, and to make exercise a healthy habit. Pueblo youth and community members engaged in outdoor activities and sports are exposed to heat or poor air quality.	Plant native trees or shrubs and install shade structures to increase canopy cover and create shade over recreational areas, such as the playground, fishing pond, and baseball field.	5	5	5	5	4	5	3	4	**36**
	Move outdoor activities, such as youth sports or community gatherings, to designated indoor spaces during periods of poor air quality.	5	3	4	5	4	5	5	3	**34**
Clean air. Elders and other community members who are ill or have compromised respiratory systems may be especially susceptible to health problems associated with poor air quality.	Limit outdoor and recreational activities during periods of poor air quality.	5	5	4	5	5	5	5	3	**37**
	Use or advance an existing alert system to warn the community about poor air-quality days and extreme events.	4	5	5	5	5	5	5	1	**35**
	Establish an air-quality monitoring system for the Pueblo.	5	4	5	5	2	4	5	3	**33**
	Install climate control and air filtration systems in the Pueblo's gym and other facilities to create a safe space that can protect the community from extreme heat and wildfire smoke, and accommodate year-round indoor sports and activities.	5	4	5	5	2	4	5	3	**33**
	Encourage community members to create cool and clean air spaces at home that can reduce exposure to extreme heat and wildfire smoke.	5	4	5	5	3	4	5	1	**32**
Water supply. The community relies on local groundwater and surface	Evaluate and develop water supply sources.	5	4	5	5	3	4	4	5	**35**

Vulnerability	Adaptation Actions	Effectiveness	Technical feasibility	Cultural feasibility	Community support	Cost	Feasible implementation timeline	Timeline for benefits return	Addresses mitigation and adaptation	Total score
water sources for sufficient source of drinking water and water for other domestic and business uses.	Develop a community awareness and outreach program to promote strategies for water conservation.	3	4	5	5	4	4	4	2	**31**
Traditional practices stress. Families and communities experience stress when they cannot carry out traditional and daily practices because of impacts that disrupt daily routines and make traditional and ceremonial practices difficult or unsafe.	Seek out family counseling resources and provide materials to families on the Pueblo.	3	5	5	5	5	5	5	1	**34**
	Establish other opportunities for the community to connect, including increased access to internet and broadband to increase communication.	3	4	5	5	2	4	5	1	**29**
Mobilization of contaminants. The Pueblo faces potential human health impacts due to its proximity to LANL. Extreme events may increase the risk of mobilization of contaminants onto the Pueblo. ceremonial practices difficult or unsafe.	Consider ways to adapt Tribal lifeways to minimize exposure to contaminants and climate hazards, and then conduct outreach to communicate the risks of mobilization to contaminants on the Pueblo and adaptation measures through flyers/bulletin, social media, and community events.	3	5	5	5	5	5	5	2	**35**
	Coordinate and consult with LANL on adaptation planning and implementation within the LANL facility, to reduce contaminated runoff to Pueblo lands.	5	5	5	5	2	5	5	2	**34**
	Monitor for increased exposure to contaminants on the Pueblo.	4	4	5	5	3	5	5	2	**33**
Exposure to chemicals and health. Cumulative effects of chemical exposure and climate impacts may increase potential negative health impacts to community members.	Reduce other stressors, such as removing household chemicals and improving home ventilation.	5	5	5	5	4	5	5	1	**35**
	Install and maintain air filtration systems or air purification systems in their homes to reduce exposure to air pollution.	5	3	5	5	2	5	5	2	**32**

Exhibit A.3. Evaluation of community health adaptation actions

Vulnerability	Adaptation Actions	Effectiveness	Technical feasibility	Cultural feasibility	Community support	Cost	Feasible implementation timeline	Timeline for benefits return	Addresses mitigation and adaptation	Total score
Place-based culture. Pueblo members are bound culturally to the land and limited in many ways to the boundaries of the Pueblo's reservation the range of traditional plants, animals, and other resources may shift beyond the Pueblo's borders with changing environmental and climatic conditions.	Build on the farm program to develop a self-supporting and self-sustaining agricultural system that can ensure food sovereignty – the right of Pueblo people to health and culturally appropriate food using sustainable and ecologically sound methods.	5	5	5	5	3	5	4	5	**37**
	Establish agreements with other Pueblos and communities to obtain access to natural resources as the range of traditional plants and animals shift with changing environmental and climate conditions.	4	5	5	5	5	4	5	1	**34**
	Acquire climate refugia areas (e.g., via land purchase) to ensure traditional natural resources in the future.	5	5	5	5	1	4	3	5	**33**
	Enhance government-to-government relationships with state and federal agencies to inform resilience planning and collaborate on implementing resilience actions.	4	5	5	5	4	4	3	1	**31**
Pueblo departments. Pueblo departments are compartmentalized from each other. Managing community resources will require work across Pueblo departments.	Convene regular meetings with representatives from each Pueblo department to identify specific issues that would benefit from cross-departmental coordination.	4	5	5	5	5	5	5	1	**35**
	Implement a coordinated effort to identify and assign department-specific duties.	4	5	5	5	5	5	5	1	**35**
Firefighting. Firefighting requires firefighters from outside of the community, and the availability of and access to water supplies to fight fires.	Review and assess systems for communicating and coordinating with firefighters outside of the Pueblo.	4	5	5	5	5	5	5	1	**35**
	Establish water supply or temporary water storage structures for fire suppression.	4	5	5	5	3	5	5	1	**33**
	Implement fire mitigation practices around all critical infrastructure.	5	5	5	5	2	4	5	1	**32**
Critical infrastructure. Critical infrastructure, such as water supply systems, are	Incorporate resiliency measures into future wastewater treatment system upgrades and expansions.	5	5	5	5	4	5	5	1	**35**
	Build drought and flood resiliency into irrigation ditch and canal upgrades on the Pueblo.	5	4	5	5	4	5	5	1	**34**

Vulnerability	Adaptation Actions	Effectiveness	Technical feasibility	Cultural feasibility	Community support	Cost	Feasible implementation timeline	Timeline for benefits return	Addresses mitigation and adaptation	Total score
located in areas prone to flooding or wildfires.	Develop maps of potential utility hazards and key infrastructure.	5	4	5	5	4	5	5	1	**34**
	Build on the farm program to develop a self-supporting and self-sustaining agricultural system that can ensure food sovereignty – the right of Pueblo people to health and culturally appropriate food using sustainable and ecologically sound methods.	4	4	5	5	4	4	5	1	**32**