

The Future of the Frontier

Water, Energy & Climate in America's Most Remote Communities

A report for the National Center for Frontier Communities



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Acknowledgements and Studio Participants

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Executive Summary

This studio project is an analysis of the diverse issues facing the American frontier for the National Center for Frontier Communities (NCFC). This studio expands on the work of the NCFC by examining the demographics and history of the frontier in order to gain an understanding on how remote areas will be affected by climate change, water availability and quality, as well as energy production and distribution.

This report first examines the demographic background of the frontier areas using level two of the Frontier and Remote Area Code methodology, referred to as FAR2, in comparison to the United States as a whole. These areas are determined on a zip code level, and counties with larger proportions of FAR2 areas were studied for this report. The demographic analysis paints a picture of the frontier that is quite unique from the rest of the United States. Following this analysis, profiles of selected counties are described in terms of their history, county-level planning issues, climate change, water and energy issues. These profiles demonstrate the range of issues facing the subject counties as shown in media and data available to the researchers preparing this report.

Graduate students at the Rutgers University Bloustein School of Planning and Public Policy prepared this report. The Bloustein School requires two semesters of real-world planning experience; the authors of this report are students in the Frontier Planning Studio co-taught by Professors Frank and Deborah Popper. With academic and professional backgrounds in design, development and land use policy, the student-authors worked alongside the National Center for Frontier Communities to develop a report framework and methodology that effectively explores frontier planning issues. It is the hope of the Frontier Planning Studio that the information presented here will prove useful for the client organization (NCFC) and bring awareness to the existential issues facing America's frontier communities.

Please note that the profiles prepared in the report were not prepared in conjunction with the areas studied. Representations of the counties studied here are the result of the analysis of written work made available through academic articles, websites, books and other media. This report did not use human subjects in its preparation. Moreover, the representations of these counties are made by the authors and do not reflect the policies or postures of Rutgers University, the NCFC, or any other organization.

Introduction

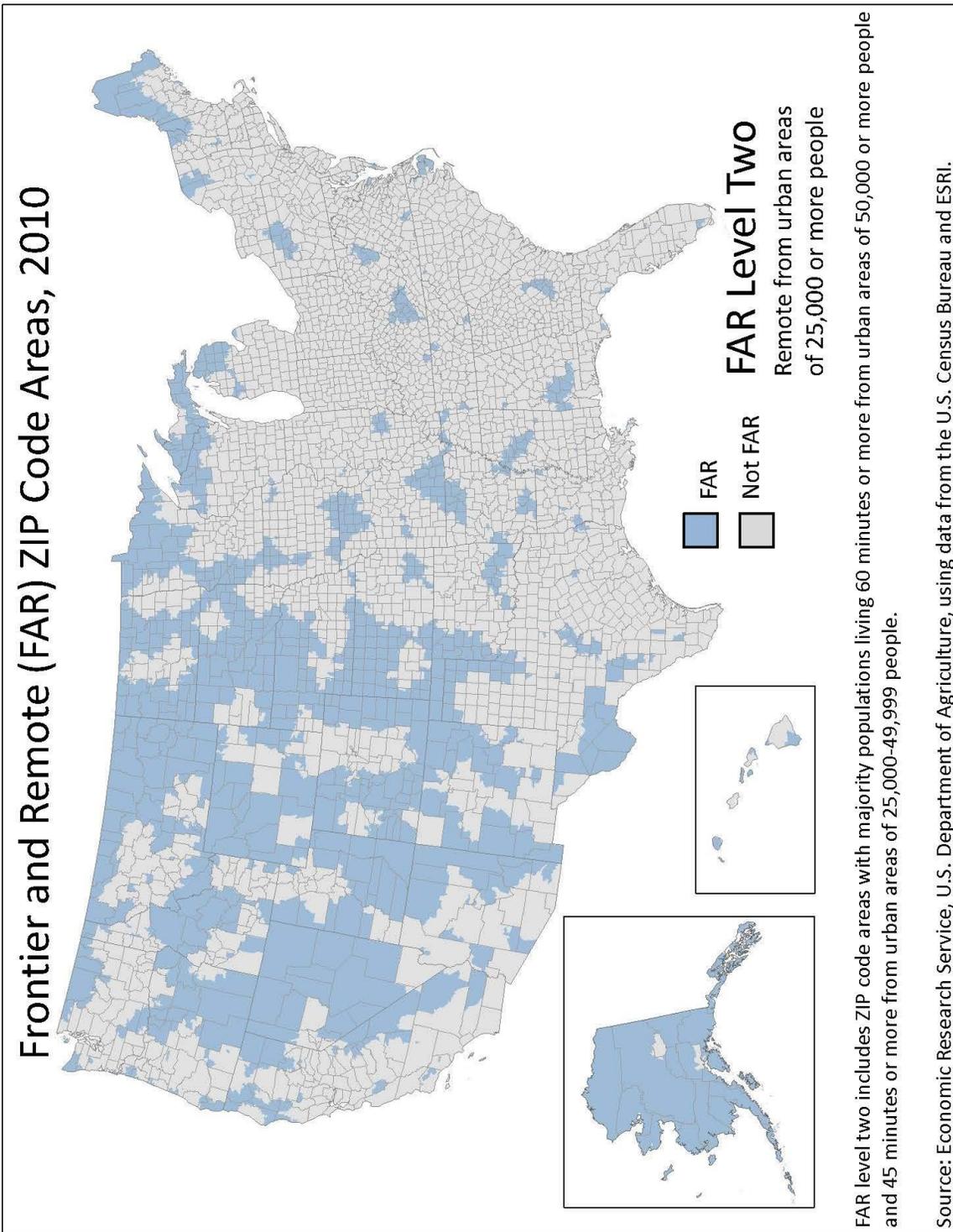
Comprising vast swathes of the interior portion of the continental United States, almost all of Alaska, and numerous islands throughout the United States and its territories, frontier and remote areas are a dominating vision of the American landscape and psyche. The American frontier conjures images of vast deserts and mountains, sweeping prairies, dense forests, and a challenging way of life for the people who live there. But the American frontier is a nuanced and diverse place, socially, geographically, and economically. The frontier encompasses interior counties with farms stretching from horizon to horizon, as well as remote coastal areas with ancient forests at the edge of tall oceanfront cliffs. The frontier's residents range from Native American inhabitants of ancestral lands to transient tourists and young professionals. Economies range from the boom and bust of oil and gas to health and education.

The frontier, as a home and place of business, are hyper-localized in remote regions of the country and exceptionally vulnerable to structural changes to the American economy. Some of these changes dramatically occurred centuries ago, resulting in ghost towns. Certain frontier counties are only recently facing declines, while others are on the path of revitalization. The provision of frontier life is majorly influenced by the availability of three factors: energy, water and climate. This report attempts to profile concerns about each of these factors for the counties studied here.

Demographic Background

Demography

There are several ways of defining the Frontier. Generally, frontier areas are the most geographically isolated and remote area in the United States. Long distances and travel times to cities and very sparsely populated populations reflects this geographic isolation. In fact, travel time has been used as a method to identify "Frontier and Remote (FAR) Area Codes" by the Office of Rural Health Policy (ORHP) and the U.S Department of Agriculture (USDA). In this methodology, four categories are established based on the travel time to towns of different sizes. This report will use the FAR2 Area, which are zip code areas with populations living at least 60 minutes away from urban areas of at least 50,000 people and at least 45 minutes from urban areas of 25,000-49,999 people (See Map 1).



Map 1. Far and Remote Areas (FAR) 2 by ZIP Code (USDA)

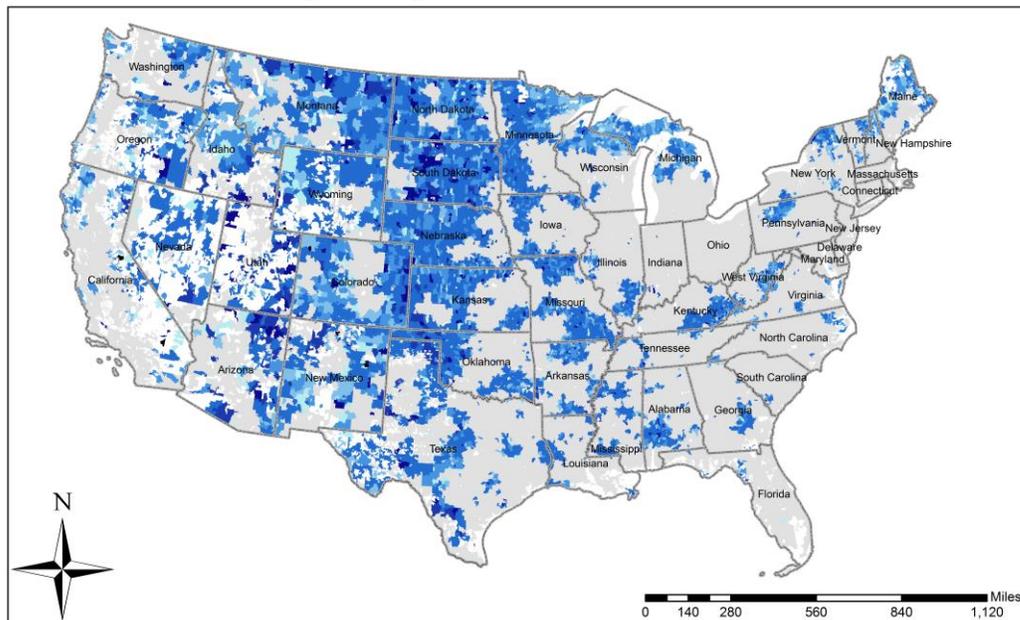
The demography of the frontier areas reflects the diversity of rural areas in the United States. This section analyzes it in terms of age, race, income and education with data based on the U.S. Census Bureau, 2010 Census. The analysis of age focuses on three different age groups: population under 18 years old, population between 19 to 64 years old, and population 65 years or older. Figure 1 displays the spatial patterns of the population less than 18 years old in FAR2 areas (by ZIP Code). The different colors represent the standard deviation from the mean of 21 percent, which means that on average, the percentage of people in the age group under 18 in FAR2 Areas is 21 percent of the total population, which is around 2 percent less than the average for the United States as a whole. As seen in Table 1, the percentage of people under 18 years and the working population (19 to 64 years old) is higher in the United States as a whole. However, the percentage of people aged 65 or more is much higher in FAR2 Areas.

Table 1. FAR2 and U.S. Average Ages

Variable	United States	FAR2 Area
Under 18 Years	23.3%	21%
19 to 64 Years	62.7%	58.2%
65 and Over	14.1%	21%

The following map does not show us any general geographic pattern for the age distribution of the population under 18 years old, it just shows us some regional patterns at best.

Percentage of Population Under 18 in FAR 2 Area



Legend

- State Boundary
- Less than 7.5%
- 7.5% to 15%
- 15% to 20%
- 20% to 30%
- 30% to 35%
- More than 35%
- No Population
- Non Far2 Area
- White color: no-zip-code area

Source: Economic Research Service, U.S. Department of Agriculture; American Community Surveys(2011-2015);www.socialexplorer.com;https://www.census.gov/geo/maps-data/data/tiger.html

Map 2. Population under the age of 18 in FAR2 areas (US Census Bureau)

The young population in the majority of the states vary within the nation. Areas with above average percent of population under 18 seem to correlate with areas with high Native American populations. The percentage of the Native American population in FAR2 Areas is about four times higher than the Native American population in the United States as a whole.

Table 2. Average Native American populations in US and FAR2 regions

Variable	United States	FAR2 Area
American Indian and Alaska Native Alone	0.7%	3.1%

Areas with a smaller percentage of people under the age of 18 can be found in northern Michigan, northern Wisconsin and northern Minnesota, which are popular destinations for retirement, and therefore not surprisingly lacking a younger population. Fifty-eight percent of the population in FAR2 Areas are between 19 to 64 years old. For the United States as a whole this number is 62.7 percent. For FAR2 Areas, it can be stated, that there are only a few areas where the population ages 19-64 years old is more largely represented than for the United States as a whole. One of these areas is Park County, WY. This can be explained by the fact, that Yellowstone National Park is a large employer in the county, attracting many people in the workforce. Another area with a higher population of 19 to 64-year olds, than the mean (for FAR2 Areas), is the Grand Canyon National Park, which can be explained with similar reasons as the Yellowstone case. Areas with a low representation of this age group can be especially found in southern New Mexico and central Nevada. Around 20.5 percent of the population in FAR2 Areas are age 65 and older. In the United States as a whole, the proportion of the population 65 years and older is 14.1 percent. Among the three different age groups, this is the group with the biggest difference between FAR2 Areas and the United States as a whole. Interestingly, in almost all states and their FAR2 areas, there are places where the population 65 years and older represents 48 percent or more of the total population. A high representation of the age group 65 and older tends to correlate with a low representation of those between 19 and 64 years old. As mentioned above, northern Michigan, Minnesota and Wisconsin are known to be primary destinations for retirement or aging in place (in state and regional), and this is reflected in those states high representation of the senior population.

The frontier is racially more diverse than commonly assumed. This diversity reflects itself more on the local level. When aggregated at the national level, it appears demographically homogenous, as seen in Table 3.

Table 3. Foreign-Born Population in US and FAR2 regions

Variable	United States	FAR2 Area
Foreign Born	13.2%	2.47%

At the national level, the percentage of foreign-born population is 13.2 percent. In fact, there are many places in the southern part of Texas, where around 15-30 percent of the population was born outside the United States. The overall pattern displays a larger concentration of foreign-born population in the south and southwest compared to the states located in the north. However, the diversity of the frontier is not primarily the result of

recent migration. The frontier has a diverse history, from the original settlers of the region, the Native American populations that spanned the North and South America continent to the more recent Hispanic settlements dating to about 500 years ago in the southwest United States. The case studies in the following sections will discuss further the importance of diversity, and the challenges and tensions between groups, in the respective counties. Although the frontier reflects diversity, the majority of the population in FAR2 areas is white. In the Great Plains states, more than 80 percent of the population identifies as white. However, in the northern states such as Minnesota and the Dakotas, there are certain areas where only 50 to 60 percent of the population identifies as white. In these areas, there are large Native American Reservations, such as the Great Sioux Reservation in South Dakota and the Flathead Reservation in Montana. In the southern and southwestern states, such as Arizona, New Mexico and Texas, the areas with a white population over 80 percent are less prevalent. In these states, large Hispanic and Native American populations are dominant in many counties.

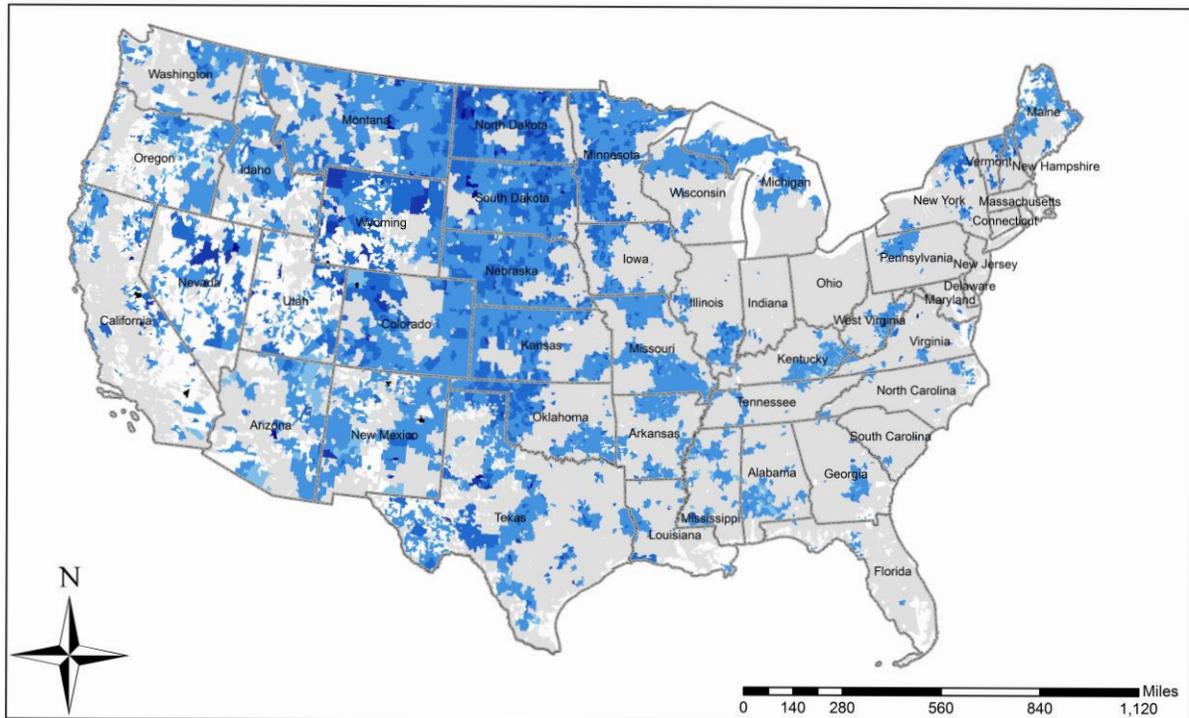
The income level of people residing in the frontier greatly varies between, and within, states as well. As seen in Table 4, the median household income in FAR2 Areas is about \$10,000 less FAR2 in comparison to the United States as a whole.

Table 4. Median Household Income in US and FAR2 regions

Variable	United States	FAR2 Area
Median Household Income	\$53,889	\$44,607

States that profited from the oil boom, such as North Dakota or Montana, have large percentages of their populations earning more than \$65,000 per year. In contrast, in the southern parts of South Dakota, which have not profited from the oil boom, the median income drops to around \$25,000 dollars per year. See map 3 for a spatial representation of this distribution.

Median Household Income Distribution in FAR 2 Area



Legend

- State Boundary
- Less than \$10,000
- \$10,000 to \$25,000
- \$25,000 to \$50,000
- \$50,000 to \$75,000
- \$75,000 to \$100,000
- More than \$100,000
- No Population
- Non Far2 Area
- White color: no-zip-code area

Source: Economic Research Service, U.S. Department of Agriculture; American Community Surveys(2011-2015);www.socialexplorer.com;https://www.census.gov/geo/maps-data/data/tiger.html

Map 3. Median Household Income in FAR2 Areas (US Census Bureau)

FAR2 Areas have a slightly higher percentage of people without a high school diploma compared to the United States as a whole, as displayed in Table 5.

Table 5. Population without a High School Diploma in US and FAR2 Regions

	United States	FAR2 Area
Percentage of individuals without high school Diploma	13.4%	14.10%

The percentage of the population in FAR2 areas without a high school diploma is generally higher in the southern states compared to the northern states.

Climate, Water & Energy

Frontier communities are especially vulnerable to the effects of climate change due to their remoteness, dependence on natural resources, and limited financial and human capital resources. Rising temperatures and the changing climate will play a large role in the future success of these communities. This report focuses on the effects of climate change on water resources, energy and livelihoods for frontier communities, because they are issues that

can be acted upon to prepare for the future.

Though the trends in climate change are similar within the United States, frontier communities will be influenced by these changes differently. Communities with recreation-heavy industries will face shorter tourist seasons due to changes in snow cover, fish populations and higher summer

temperatures. Frontier communities will need to find ways to build up their economies throughout the year. Those dependent on agriculture will find that growing seasons are shifting and water resources may become scarcer. Ranchers and farmers will need to adapt to these changes either by scaling down operations, relocating or finding innovative ways of dealing with these challenges. Energy has been an important economic sector for many frontier areas as well. As coal mining and oil drilling activity decline, these extractive industries will need to adapt to renewable sources.

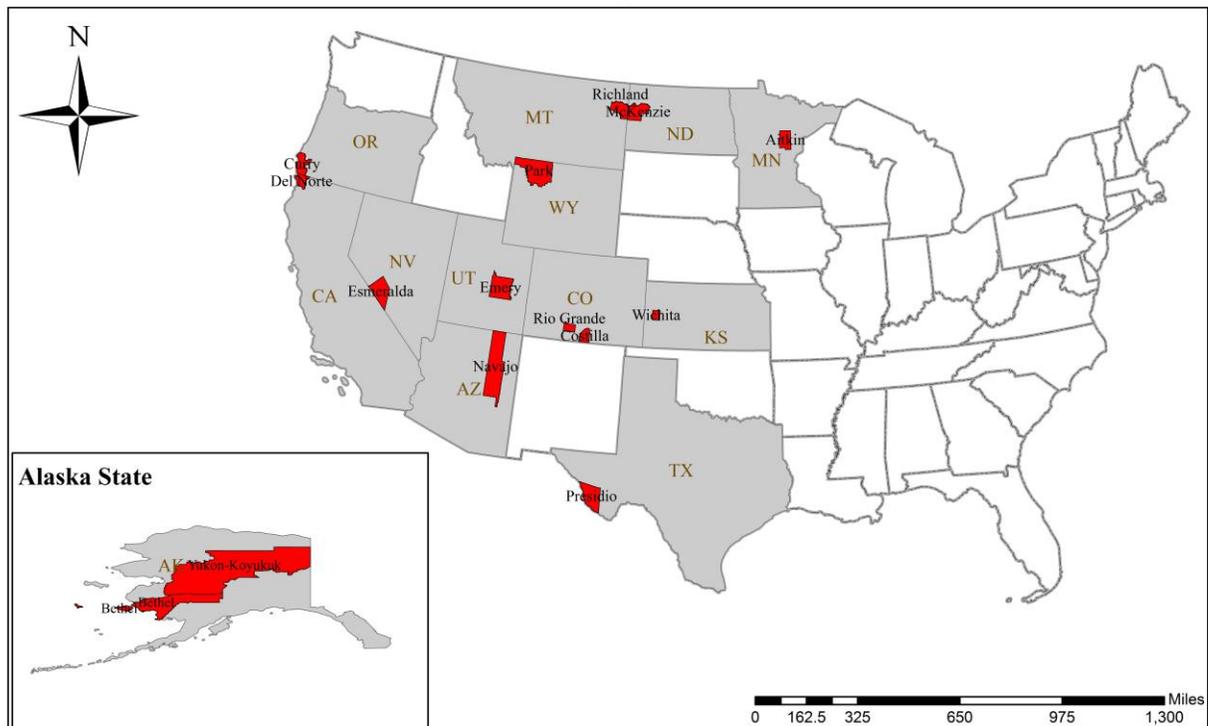
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Case Studies

In order to get a better understanding of the issues that the diverse American Frontier faces, we opted to use a case study analysis of FAR2 counties. Each student selected two frontier communities that have a defining characteristic, for example: high demographic representation by Native American or Hispanic groups, economies based on agriculture or timber production, and high percentage of publicly-owned land. This method of detailed contextual analysis allowed for a deeper understanding of the diverse issues and regional effects associated with living in the frontier. It also enabled this studio to control for local variable differences as the students sought to understand the effects of climate change, facilitating a more complete understanding of frontier issues as a whole. The goal of this approach is to not only provide crucial insights on the issues that face the American Frontier and recommendations to mitigate those issues, but to create avenues for further research by finding gaps in existing data and by asking provoking questions about the current and future status of the frontier and the role it plays in the United States.

Map 4. Locations of Case-Study Counties in the United States

Locations of Case-Study Counties in the U.S.



Legend

- Case-Study Counties
- State Boundary
- Case Study States

Source: Economic Research Service, U.S. Department of Agriculture; American Community Surveys(2011-2015);www.socialexplorer.com;<https://www.census.gov/geo/maps-data/data/tiger.html>

Hispanic & Border County - Presidio County, TX

There's a vastness here and I believe that the people who are born here breathe that vastness into their soul. They dream big dreams and think big thoughts, because there is nothing to hem them in. - Conrad Hilton

I am forced to conclude that God made Texas on his day off, for pure entertainment, just to prove that all that diversity could be crammed into one section of earth by a really top hand. - Mary Lasswell

What you Northerners never appreciate... is that Texas is so big that you can live your life within its limits and never give a damn about what anyone in Boston or San Francisco thinks... A writer can build a perfectly satisfactory reputation in Texas and he doesn't give a damn about what critics in Kalamazoo think. His universe is big enough to gratify any ambition. Same with businessmen. Same with newspapers. Same with everything. - James Michener



Figure 1. A view looking out from Marfa, Texas in Presidio, County.

Geography

Map 5. Location of Presidio County in Texas



Legend

- State Boundary
- Texas
- Presidio County

Source: Economic Research Service, U.S. Department of Agriculture; American Community Surveys(2011-2015);www.socialexplorer.com;https://www.census.gov/geo/maps-data/data/tiger.html

Presidio County is in the Trans-Pecos region of Texas, colloquially known as the Big Bend or the Far West. The county is 3,856 square miles, making it the fourth largest of the 254 counties that comprise the state. To the north, it is bordered by Jeff Davis County, to the east by Brewster County. One hundred thirty-five miles of the Rio Grande demarcate its southern and eastern borders. Across the great river is the Mexican state of Chihuahua. The county's population is largely centered in two towns, Marfa, the county seat, and Presidio.¹

The county is geographically diverse. The north and northwest portions of the county consist of rolling plains that are known to support cattle. Across most of the rest of the county is volcanic rock and desert shrubs, creating a harsh terrain.

This landscape extends over mountains that reach nearly 8,000 feet above sea level, all the way to the cliffs at the edge of the Rio Grande. There are no year-round streams flowing through Presidio, though an extensive network of arroyos flood during the summer.²

Presidio has two major roads that traverse it. The first is US Route 90, which connects San Antonio and Houston through Marfa. The second is US Route 67, which connects Mexico to Texarkana, through Presidio and Marfa. The county also has two railroads. The first crosses through Marfa in the northwest corner of the county, while the second enters the county in the northwest corner and traverses the county through to Mexico.³



Figure 2. A view looking out from Marfa, Texas at dusk.

Demographics

As of 2015, Presidio County had a population of 7,304 people. This makes it the 190th most populated county in Texas. Marfa, the county seat, is home to 27.1 percent of residents and 60.6 percent live in Presidio along the border. The county has a population density of 1.89 people per square mile, ranking it 230th in the state for population density. The median age of residents is 41.0 years. Presidio is notable for its large Hispanic population, as 81.0 percent of the population identifies with said ethnicity. This may help to explain why 82.1 percent of the population can speak Spanish. Additionally, 65.9 percent of the population are natural born US citizens, 9.0 percent are naturalized citizens, and 24.4 percent are not US citizens. A further breakdown reveals that 51.5 percent of the Presidio County residents were born in Texas, 14.4 percent were born in another US state, and 30.8 percent were born in Latin America. Presidio County has very little migration, as just 179 residents (2.4%) moved there from out-of-state in 2015, including 57 from abroad.⁴



Figure 3. The old Palace Theatre in Marfa, Texas now serves as a private residence.

As a frontier county, Presidio struggles with poverty; 21.7 percent of the population is below the poverty level. The median household income in the region is \$32,132. However, for those that identify as Hispanic, the median household income is \$26,462. In contrast, the median household income for the white population is \$59,286. Similarly, unemployment for Hispanic residents is 10.6 percent while 4.7 percent for white residents in September 2016. This frontier county has lower education attainment compared to the rest of Texas; 57.4 percent of residents have a high school diploma and 25.9 percent have a bachelor's degree. Only 10 percent of 18 to 24-year-olds are currently enrolled in college. Interestingly, over 90 percent of the 18 to 24-year-olds currently enrolled in college is male.⁵

History

Presidio County is believed to be the oldest continuously cultivated farmland in Texas, dating back to around 1,500 BC. The area, known as La Junta de los Ríos, was a fertile area along a major north-south trade route and was initially settled by corn farmers. The only historical records from this area are cave paintings, so not much else is known about the region's early history.⁶

Three thousand years after the region's initial settlement, the Spanish Conquistador, Cabeza de Vaca, “discovered” the area. The fertile area, cultivated with corn, beans, gourds and melons, quickly became a destination for Spanish settlers. In 1839, the Chihuahua Trail trade route opened, connecting Chihuahua City, Mexico with Santa Fe, New Mexico through Presidio County. In 1846, the United States annexed Texas and began building forts along the Rio Grande to protect the region and its settlers from attacks by displaced Mexicans and Native Americans. In 1848, the Treaty of Guadalupe Hidalgo established the boundary between Mexico and the United States. Shortly thereafter, the county of Presidio was created with an official population of 0, and was later organized in 1875. At the time of its organization, Presidio County encompassed 12,000 square miles, making it the largest county in the United States. The organization of the county also had the effect of catalyzing the rapid economic development in Presidio County.⁷

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Figure 4. The Presidio County Courthouse in Marfa, Texas. The historic building was constructed in 1886.

In 1880, a local rancher discovered silver in the Chinati Mountains. Through 1942, this was the largest economic driver in the county, over 32 million ounces of silver were mined and sold from Presidio County. At this point in time, Presidio's economy also relied on grain farms and livestock, predominantly sheep. In 1882, the railroad was built through the northeast corner of the county. It was here that the county seat of Marfa was established as a railroad water-stop and as a place to load

livestock for sale. Shortly after, in 1887, the county's lands were split up and incorporated as counties in their own right. Present day Jeff Davis County, Brewster County, Buechel County, and Foley County are all formed from the original Presidio County. At this point, two defining shifts occurred in Presidio. The first was that sometime around 1890, concomitant with the installation of barbed wire fencing, cattle overtook sheep as the livestock of choice. Between 1880 and 1950, the number of cattle increased from under 2,500 heads to over 63,000 heads. The second shift was that in 1914, cotton was first grown in the region. This coincided with the completion of the Elephant Butte Dam – a byproduct of the 1906 Boundary Waters Convention – on the Rio Grande which created reliable irrigation. It also reflected the need to put land into cotton production that was not infested with boll weevil. By 1940, there were over 1,000 cotton farms producing over 7,000 bales of cotton in total.⁸

in 1887, the county's lands were split up and incorporated as counties in their own right. Present day Jeff Davis County, Brewster County, Buechel County, and Foley County are all formed from the original Presidio County.

Today, over 80 percent of the land in Presidio is farms and ranches. The livestock of choice are cattle, sheep, and angora goats. The most common crops are wheat, hay, sorghum, onions, cantaloupes, honeydews and watermelons.⁹ The county also supports a small tourist industry of those traveling to Mexico across the Presidio-Ojinaga International Bridge and to nearby Brewster County's Big Bend National Park. The county seat, Marfa, also draws tourists wishing to experience its hipster art culture and the well-known Marfa Lights. Presidio does not have any major oil and gas extraction industry.¹⁰

Water

Presidio County, along with most border counties, is beholden to international treaties that govern the ways in which the Rio Grande and its tributaries are utilized. At the same time, there are state water regulations with which must be dealt. This section will detail some of the international, state and local issues that affect Presidio County. It will also address some of the proactive planning measures taken up at the state, regional and local levels.

It is the International Boundary and Water Commission that is responsible for implementing water treaties between the United States and Mexico. Arguably the two most important international water treaties that have affected the United States-Mexico border are the 1906 Boundary Waters Convention and the 1944 Water Treaty. The former allotted Mexico 60,000 acre feet of Rio Grande water annually. This held except in cases of severe drought, in which Mexico's allotment would be decreased proportionally with the United States' allotment (1906 Convention). To facilitate accurate flow measurement and

delivery, the United States built the Elephant Butte Dam in New Mexico.¹¹ The latter treaty has since rendered the 1906 Boundary Waters Convention null.



Figure 5. Prada Marfa, a permanent land art project by Elmgreen & Dragset modeled after a Prada boutique. It includes authentic luxury goods from Prada's Fall 2005 collection, but will never function as a place of commerce: the door is sealed shut.

The 1944 Water Treaty makes several complicated allotments to both the United States and Mexico. Key among them are that the United States shall receive one-third of the water from six named tributaries or 350,000 acre feet annually, whichever is greater. From an American standpoint, this shift in language has been largely positive, shifting the burden of payment onto Mexico (1944 Treaty). In 2016, for example, Mexico was forced to cede 263,000 acre feet of water to the United States to cover debts from the previous five-years.¹² However, this language also entitles Mexico to a higher percentage of water usage during droughts, which could have negative impacts on the United States.

These treaties have a huge impact on Presidio County. The Rio Grande is the most reliable source of surface water in Far West Texas. Unfortunately, it is in Far West Texas, just before Presidio County, that the Rio Grande is downgraded from a river to a stream. As a stream, the Rio Grande is smaller and less reliable than it is upstream where it is classified as a river. Compounded with droughts and the 1944 Water Treaty which provides first rights to Mexico, the Rio Grande often lacks adequate flow as it passes through Presidio County. For a county that relies so heavily on ranching and farming, the impacts of the reduced and unreliable water source can be disastrous.

In 2008, the Texas Water Development Board held the Far West Texas Climate Change Conference. This conference focused primarily on water issues in the Far West region, which includes the counties of Brewster, Culberson, El Paso, Hudspeth, Jeff Davis, Presidio, and Terrell. It sought to project the water needs of this region by the year 2060. Their findings indicate an 80 percent increase in population, 80 percent of which will be concentrated in El Paso County. Water demands are expected to increase by just 9 percent. This is because the vast majority of water resources go toward irrigation, and there is little room to expand irrigation. The conference expected a water shortage on the order of 250,000 acre feet in 2060. The conference identified several strategies to better water management practices in the region and selected the “Balanced Approach with Moderate Increase in Surface Water.” This includes increases in conservation, reclaimed water use, use of Rio Grande water, and importation of groundwater from Culberson and Hudspeth Counties. The plan is expected to cost almost \$700 million over 50 years. However, the conference report makes note of the already existing robust water infrastructure in the region as key to avoiding devastation due to poor water management. Promisingly, the conference also made many references to climate change. The recommendations section of the conference report, which largely deals with recommendations for future conferences, makes note of several requests for more information and research on climate change and its impacts on the Far West.¹³

Unfortunately, this conference and its regional focus are without weight. The Texas water code exempts municipalities from being regulated by water districts. This means that in Presidio County municipalities like Marfa, water use is essentially unregulated. One of the county’s largest concerns, already materializing, is that local groundwater will be exported unsustainably to other areas, like nearby Midland. Currently, Marfa sells water to oil and gas operations in nearby counties. The Presidio County Underground Water Conservation District is trying to fight this exemption, but has so far been unsuccessful.¹⁴

This is not to say that all Texas water regulations are inadequate. The state’s water plan is based on water levels during the 1950s – the worst drought of the 20th century. This approach is conservative. It is safe politically, for those that believe this standard is either too conservative or not conservative enough. Further, the water planning process in Texas utilizes a consensus-driven approach that is developed on a regional level. This Jeffersonian approach to governance is crucial for such a large state with diverse needs. One notable problem with Texas’ water planning is that, like most planning initiatives, it assumes stationarity. That is, the relative stability of the natural environment. The issues of water flow in Presidio which have been exacerbated by international treaties, as well as recent dendrochronological-based reconstructions of stream flow, counter this narrative and must be adjusted for.¹⁵

Climate

In Presidio, climate change issues are synonymous with water issues. By tying the two issues together, awareness about climate change has increased dramatically. However, there remains a lack of scientific studies on the impacts of climate change on Texas, and Presidio County. This need is not unique; the global models used to predict climate change effects do not have the resolution required to accurately predict effects on small geographies – even predicting changes for a state as large as Texas is difficult with global models. Even so, the global models coupled with local historical data can be used to create accurate

visions of the future. This process was tackled by those in attendance at the Far West Texas Climate Change Conference.¹⁶

The conference yielded interesting information regarding the impacts of climate change on Presidio County and the surrounding region. For example, over the past 100 years, rainfall and temperature have been relatively stable in the area; there are no statistically significant trends. Given this information, the effects of climate change on the Far West are expected to be minimal over the next 50 years. On the other hand, global models forecast drastic increases in temperature coupled with decreases in precipitation. Using these two data sets, researchers at the conference suggested that, over the next 50 years in the Far West, mean temperatures could rise by between 33.8° and 41° Fahrenheit and precipitation could decrease by 10 to 25 percent. This could affect the farm economy of Presidio, which already struggles with droughts, and is near the warm end of suitable temperatures for growing cash crops.¹⁷

The other climate change concerns at the conference focused on the Rio Grande. As the most reliable source of surface water in the area, the effect of temperature on evaporation was noted. However, within the issue of the Rio Grande, the larger concerns were outside of the Far West. While the conference report was ostensibly unconcerned with the susceptibility of Texas to climate change, it was concerned with more northern states like Colorado. The Rio Grande begins its journey in Colorado and many of its tributaries begin in states north of Texas. There is a perceived notion that some areas, for example Colorado's Rocky Mountains, are more susceptible to climate change. Thus, their inability to cope with increased temperatures and decreased precipitation could decrease snowpack, create more winter flooding, and most importantly, reduce the summer flow of the Rio Grande.¹⁸ On the one hand, it is good to see that the conference acknowledges that climate change is a trans-border issue. On the other hand, it appears that this is an attempt to minimize the need for climate change initiatives in Texas.

Energy

Presidio County has a promising record with energy and power. The county is home to a large stretch of the Trans-Pecos Pipeline. The 148-mile pipeline will transport natural gas to local communities along the route, namely communities in Presidio County, and it will also provide natural gas to border areas in Mexico. This will incentivize continued natural gas production in Far West Texas. However, Presidio is not a natural gas producer and will only benefit from cheaper natural gas.¹⁹

The county has recently begun approving plans and building solar plants. These plants (there are at least three), sited around Marfa, Texas, are expected to provide between 30 and 50 megawatts of power each.^{20,21} One megawatt is expected to power roughly 650 homes.²² The bigger benefits of this solar power investment are increased property values, job creation, and an improved utility infrastructure. These solar plants are also each expected to provide over \$10 million in tax revenue to the county.²³

An interesting energy issue in Presidio County is the city of Presidio itself. The city is connected to the Texas power grid through one power line which stretches 60 miles to Marfa. This transmission line was built in 1948 and suffers from regular power outages. To combat this, the city of Presidio built the largest energy storage battery in the United

States. The battery, a four-megawatt sodium-sulfur battery, weighs 32,000 pounds. It is hoped that the battery will be able to store enough energy to outlast the rolling blackouts that plague the city. While it is currently being charged by the aging transmission line that is slated for replacement, the city plans to build wind and solar farms to charge the battery in the future.²⁴ This is a progressive and innovative solution to a unique energy problem.

Hispanic & Non-Border County - Costilla County, CO

Growing up in a very rural and remote area in Colorado's San Luis Valley - one of the poorest counties in the United States - essentially created the framework of values from which I operate. I stand up for the little guy. I fight discrimination at all levels. I fight for an inclusive America. - Ken Salazar

People who come out here have already been through a lot. For a lot of us, there's not much of a home to go back to. - Chloe Everhart

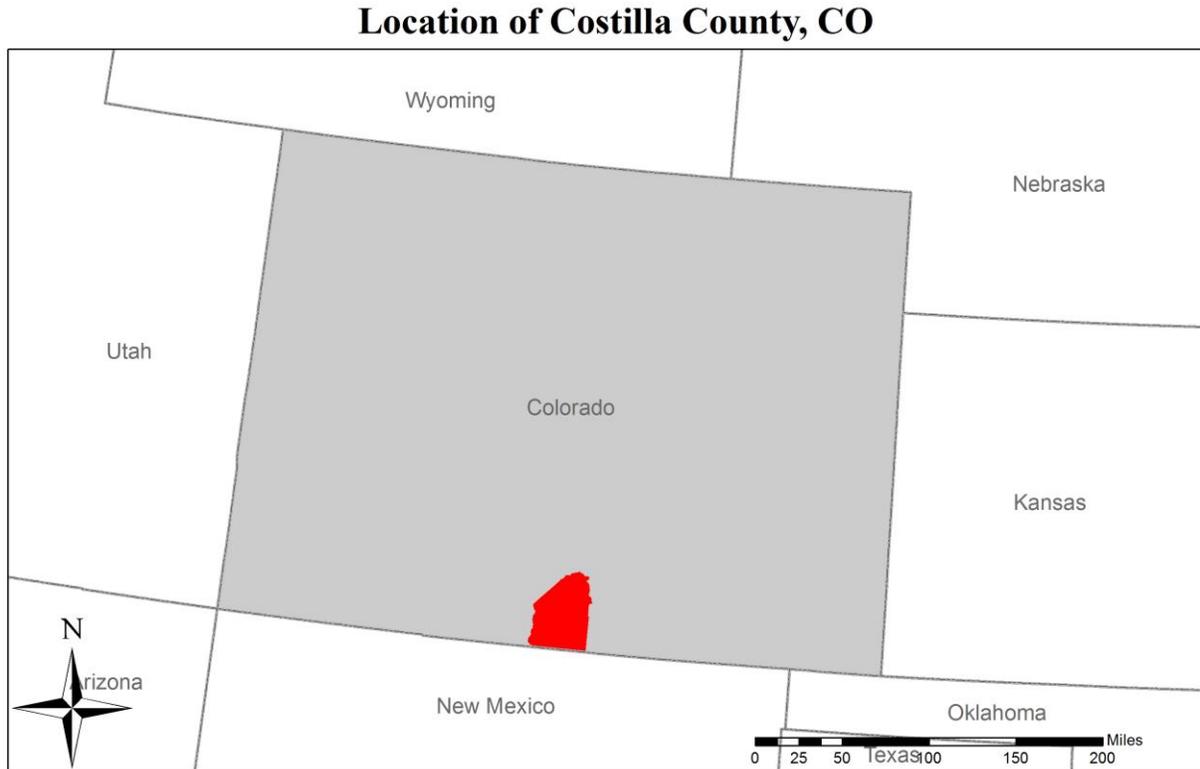
The residents of the valley know that they are in this together, and that the valley has overgrown the water available to us. - Craig Cotton



Figure 6. A view from Fort Garland, Texas across the high alpine desert at Mount Lindsey. The mountain, located in Costilla County, Colorado, is at an elevation of 14,042 feet with a prominence of 1,522 feet.

Geography

Map 5. Location of Costilla County, CO



Legend

- State Boundary
- Colorado
- Costilla County

Source: Economic Research Service, U.S. Department of Agriculture; American Community Surveys(2011-2015);www.social Explorer.com;<https://www.census.gov/geo/maps-data/data/tiger.html>

Costilla County is located in Colorado's San Luis Valley. The county is 1,277 square miles, making it the 39th largest of the 64 counties that comprise the state of Colorado. To the east and northeast, it is bordered by Conejos County and Alamosa County to the east and northeast, respectively, by Huerfano County to the north and northwest, and Taos and Colfax Counties in New Mexico to the south. There are only two incorporated towns in Costilla County: San Luis, the county seat, and Blanca. A majority of the county's population lives outside of these two towns.²⁵

The county is classified as a high alpine desert, meaning it is at a high elevation and receives little precipitation. Its lowest point is 8,400 feet above sea level and local mountain ranges reach heights of 10,300 feet above sea level. As for precipitation, it receives less than eight inches annually.

This combination of harsh conditions has created an arid environment, preventing dense tree growth in the region. That said, the region does have some sparse forested space. The economy in Costilla, which is largely pastoral, must rely on underground aquifers and

mountain reservoirs to meet its water requirements. It also relies on Rio Costilla, a small tributary of the Rio Grande that originates near the southern border of the county.²⁶

Costilla has three major roads that traverse it. The first is Colorado State Highway 159, which connects Taos County, New Mexico (as New Mexico State Road 522) with Fort Garland through San Luis. North of Fort Garland, the highway meets US Highway 160, which connects Tuba City, Arizona, with Poplar Bluff, Missouri. The final major road in Costilla County is Colorado State Highway 142, which connects Romeo, Colorado with San Luis.²⁷ The county has one railroad, the San Luis and Rio Grande Railroad; the 154-mile line is exclusively used for sightseeing.

Demographics

As of 2015, Costilla County had a population of 3,581 people. This makes it the 55th most populated county in Colorado. The county seat of San Luis is home to 17.6 percent of residents and 10.8 percent of residents live in Blanca. It is estimated that over 22 percent of county residents live “off-grid”, with the rest scattered around in unincorporated communities. The county has a population density of 2.92 people per square mile, 50th in the state. The median age of residents is 49.0 years. Costilla is notable for its large Hispanic population, as 64.4 percent of the population identifies with said ethnicity. The majority of county residents, over 92 percent, were born in the United States; just 5.1 percent of the population are not US citizens. Moreover, 52.7 percent of the population speak “only English”, while 45.4 percent of the population can speak Spanish.²⁸ Many of Hispanic residents are descended from settlers that made their homes in Costilla County over 300 or more years ago.²⁹ A majority of Costilla County residents, 61.4 percent, were born in Colorado, 31.2 percent were born in another US state, and just 5.3 percent were born in Latin America. Costilla County has very little migration, as just 89 residents moved there from out-of-state in 2015, including 8 from abroad.³⁰



Figure 7. The Shrine at the Stations of the Cross in San Luis, Colorado.

As a frontier county, Costilla struggles with poverty; 23.7 percent of the population is below the poverty level. The median household income in the region is \$31,321. However, for those that identify as Hispanic, the median household income is \$24,292 compared to a median household income of \$40,947 for whites. Interestingly, the unemployment rate for Hispanic residents is 12.9 percent versus 18.4 percent for white, non-Hispanics. While 75.9 percent of adults have a high school diploma, only 17.9 percent have a bachelor's degree. Over a quarter of (27.4 percent) 18 to 24 year-olds in the county are currently enrolled in college. Enrollment in college is roughly proportionate to county gender demographics, where 52.1 percent of residents are male.³¹

History

Through the discovery of distinct stone tools in the region, it is believed that the area that is now Costilla County has been occupied by humans since 12,000 BC. Not much is known about the people who originally lived and traveled through the area. The earliest documented history of the area places the Ute people, a hunter-gatherer Native American tribe, in Costilla County as early as 1,400 AD.³²

The Spanish Conquistador Coronado may have traveled through it in 1541. Continuing through the 17th and 18th centuries, the Costilla area was traversed by both settlers heading west and by Spanish war parties in search of the Comanche. In 1843, the 22-year-old country of Mexico issued the Sangre de Cristo Grant, a land grant encompassing Costilla's Sangre de Cristo Mountains. In 1851, the town of San Luis, formerly San Luis de la Culebra (Saint Louis of the Snake), was settled by New Mexico residents. San Luis is the oldest continuously inhabited town in Colorado. In 1857, the oldest continuously operated business in Colorado, the R&R Supermarket, was built. Ten years later, the Colorado Territory was established and Costilla County was born as one of the Territory's original 17 counties. This period was a tumultuous time for Costilla County and the surrounding area. Fort Garland was built in 1858 to house Buffalo Soldiers through the late-1800s. These soldiers were tasked with mercilessly killing buffalo across the region in order to force the Ute people – now without their main source of food – onto government reservations.³³

Costilla County has traditionally been a pastoral community. To facilitate this lifestyle, residents of the region built an intricate network of irrigation ditches through the 19th century. These ditches now support many smaller, unincorporated communities in Costilla County. In 1863, residents established La Vega communal grazing commons. La Vega originally extended over 200 square miles and supported the grazing needs of seven villages. La Vega remains the only common grazing area in Colorado and is used for cattle, horses, and mules; however, it now covers just 500 acres. Despite these rural roots, the biggest boom in Costilla occurred around 1870 when gold and silver were discovered in the Sangre de Cristo Mountains. This boom spurred the development of the regional railroad and brought the first non-Hispanic settlers to Costilla. The influx of settlers lasted through 1940 when Costilla's population peaked at 7,533. A slow-down in the mining industry, as well as the automation of farm work, led to Costilla slowly losing population. Today it stands at less than half of its peak population.³⁴



Figure 8. A storefront in San Luis, Colorado.

Today's Costilla economy is largely similar to that of its early history. The common livestock holdings in the area consist of cattle, sheep, goats, chickens and hogs. As for crops, potatoes, hay and haylage, oats, leafy greens, mushrooms and sunflower seeds dominate. As of 2014, when the use of recreational marijuana was legalized in the state, marijuana became a major crop that has become increasingly popular in the region. Costilla County also serves as a tourist destination. The area attracts hunters and fishers, historic railroad enthusiasts, and religious tourists interested in the many historic Spanish churches and monuments that are scattered around the county, like the Stations of the Cross Shrine.³⁵

Finally, the county, in conjunction with billionaire hedge fund manager and conservationist Louis Bacon, plans to build a sawmill near the town of Blanca. This sawmill is expected to employ between 40 and 70 workers and will allow conservationists to sustainably harvest and process timber in Costilla County and nearby counties across the San Luis Valley. Bacon also owns over 250 square miles of land in Costilla which has been set aside for conservation purposes.³⁶



Figure 9. The Stations of the Cross in San Luis, Colorado, a popular destination for religion tourists. This is the fourth of 15 stations, entitled “Jesus meets his Mother, Mary.”

Water

Costilla County relies on water-intensive agriculture to sustain its economy. At the same time, it is technically a desert. The region receives little precipitation annually. This has forced residents to create innovative solutions to fulfill their water needs. Originally, the solution was irrigation trenches that would capture and redirect water flows from nearby rivers. These trenches, called *acequias*, were first built in 1852. *Acequias* hold cultural significance in Costilla County, and have historically been built before a town is settled. They are a form of water commoning, where all landowners along the conduit - the *parciantes* - have collective rights over how the water is allocated and used, as well as how the trenches are maintained.³⁷

*Acequias hold cultural significance in Costilla County, and have historically been built before a town is settled. They are a form of water commoning, where all landowners along the conduit - the *parciantes* - have collective rights over how the water is allocated and used, as well as how the trenches are maintained.*

For the majority of Costilla's history, this method of irrigation has proved to be mostly successful. As water demands increased throughout the 21st century, the irrigation trenches were supplemented with groundwater pumping. Costilla County, along with the rest of the San Luis Valley, sits atop an expansive aquifer.³⁸

In 2002, a multi-year drought began which would decimate Costilla's water supply. The irrigation trenches quickly dried up, stream flow declined, and residents resorted to pumping groundwater to make up the difference. The already over-appropriated system collapsed and many of the regions 6,000 wells stopped pumping water. By 2006, a solution was needed. The Rio Grande Water Conservation District (RGWCD), after an additional six years of planning, implemented a new regulation that would charge users \$75 per acre-foot of groundwater that they used. In turn, this money was used to incentivize farmers to fallow their fields. The plan has been a major success. The largest sub-district in the RGWCD now pumps 33 percent less water, roughly 200,000 acre-feet annually down from 320,000 acre-feet annually. The collected funds have allowed farmers to fallow over 10,000 acres of water-intensive crop land. This plan has been successful for two reasons. First, local farmers and ranchers have been involved in the process of creating the regulations that govern them at every step of the way. And second, Colorado has progressive water laws that gives power to local water districts. In this way, every resident is affected by water regulations and incentivized to contribute in their creation.³⁹



Figure 10. Costilla Crossing Bridge connects Costilla County, Colorado with Conejos County, Colorado over the Rio Grande River. The Thatcher truss bridge was built in 1892 and rehabilitated in 2006.

Climate

In 2008, researchers from the University of Colorado, Colorado State University, and the National Oceanic and Atmospheric Association met to discuss the impacts of climate change on the state of Colorado. The researchers relied on historic trends in Colorado, where mean annual temperatures have increased by roughly 2° Fahrenheit over the past 30 years, and complex global models to predict future climate change in the state.⁴⁰

A key finding by the researchers was that variations in annual precipitation is the main driver of drought conditions in the state. This is troubling given the fact that, while precipitation is expected to remain mostly constant, its seasonal variation is projected to shift. The researchers expect more winter precipitation and less spring and summer precipitation, which could drastically exacerbate drought conditions. Further, the researchers expect that by 2050, there will be between a 10 percent and 20 percent decline in snowpack in the San Luis Valley and other high elevation areas. This equates to between a 6 percent and 20 percent decrease in summer runoff, which could have noticeable impacts on irrigation. The result would be an increased reliance on the already stressed underground aquifer. It could also have impacts on the major rivers in the area that could affect many downstream areas south of Costilla County. The projections also show that mean summer temperatures will increase by 3° F to 7° F by 2050, and mean winter temperatures will increase by 2° F to 5° F over the same time period.⁴¹

In order to improve these projections, the researchers identified four key issues that need to be addressed. First, there needs to be more small-scale climate models created to address the state of Colorado. Because climate models work on a global scale and are judged on their ability to replicate climate statistics, not events, they have limited accuracy at smaller resolutions. Thus, models that capture the complexity of Colorado and the mountainous San Luis Valley are needed to improve predictions. Second, and closely related, there needs to be more Colorado-specific research. There is little climate research that directly addresses the diverse Colorado regions or its water basins; little research has been done on the Rio Grande basin and other local river basins. Third, the causes of drought must be better understood. While drought is superficially a lack of water, there are complicated factors like runoff, precipitation, temperature and water surface area that are not understood well enough to predict and model drought conditions. Finally, consensus must be found among hydrologic projections. Currently, models suggest a large range of possibilities for river flows and stream runoff; the differences in these models must be reconciled.⁴²

Table 6. Challenges Faced by Water Managers and Projected Changes⁴³

Issues	Observed and/or Projected Change
Water demands for agriculture and outdoor watering	Increasing temperatures raise evapotranspiration by plants, lower soil moisture, alter growing seasons, and thus increase water demand.
Water supply infrastructure	Changes in snowpack, streamflow timing, and hydrograph evolution may affect reservoir operations including flood control and store. Changes in the timing and magnitude of runoff may affect function of diversion, storage, and conveyance structures.
Legal water systems	Earlier runoff may complicate prior appropriation systems and interstate water compacts, affecting which rights holders receive water and operations plans for reservoirs.
Water quality	Although other factors have a large impact, “water quality is sensitive both to increased water temperatures and changes in patterns of precipitation” (CCSP SAP 4.3, p. 149). For example, changes in the timing and hydrograph may affect sediment load and pollution, impacting human health.
Energy demand and operating costs	Warmer air temperatures may place higher demands on hydropower reservoirs for peaking power. Warmer lake and stream temperatures may affect water use by cooling power plants and in other industries.
Mountain habitats	Increasing temperature and soil moisture changes may shift mountain habitats toward higher elevation.
Interplay among forests, hydrology, wildfires, and pests	Changes in air, water, and soil temperatures may affect the relationships between, forests, surface and ground water, wildfire, and insect pests. Water-stressed trees, for example, may be more vulnerable to pests.
Riparian habitats and fisheries	Stream temperatures are expected to increase as the climate warms, which could have direct and indirect effects on aquatic ecosystems (CCSP SAP 4.3), including the spread of in-stream non-native species and diseases to higher elevations, and the potential for non-native plants species to invade riparian areas. Changes in streamflow intensity and timing may also affect riparian ecosystems.
Water- and snow-based recreation	Changes in reservoir storage affect lake and rive recreation activities; changes in streamflow intensity and timing will continue to affect rafting directly and trout fishing indirectly. Changes in the character and timing of snowpack and the ratio of snowfall to rainfall will continue to influence winter recreational activities and tourism.
Groundwater resources	Changes in long-term precipitation and soil moisture can affect groundwater recharge rates; coupled with demand issues, this may mean greater pressures on groundwater resources.

Energy

Costilla County has few energy issues. The majority of the county relies on natural gas for heat, though utility gas and wood are also favored in the region.⁴⁴ This is expected to change in the coming years as Costilla County, and the rest of the San Luis Valley, has great potential for harnessing the power of renewable energy.

The San Luis Valley, as a whole, has the highest quality solar resource in the state of Colorado. It is also one of the best solar regions in the country. This has materialized with the construction of four solar plants in the Valley. While no solar plants exist yet in Costilla County, nearby Alamosa County built a 30 MW plant that went online in 2012 and has been hugely successful. Additionally, the San Luis Valley has a few energy-producing geothermal vents that reach temperatures in excess of 300° F. Finally, and specific to Costilla County, there is a growing economy centered on biofuels. As of 2007, Costilla County and the Costilla County Economic Development Council co-operate a small biodiesel plant which can produce up to 600 gallons of fuel per day. The plant purchases locally grown canola and sunflower seeds to produce biofuel and sells the byproduct as livestock feed. Additionally, the County has limited forested areas that are privately owned and sustainably harvested for use as biomass. The area is not suitable for wind power.⁴⁵

The San Luis Valley has a few energy-producing geothermal vents that reach temperatures in excess of 300° F.

In order to incentivize renewable energy development, the state employs several programs and regulations. In 2004, the Colorado approved net metering, a practice that allows users to “bank” renewably produced energy. This allows customers to maximize the value of their produced energy and helps reduce the utility’s system load factor. Colorado also allows community solar gardens. Additionally, local utility companies, notably Xcel Energy, offer extensive rebates to customers who install renewable energy systems. Xcel Energy claims to have paid over \$245 million in incentives to San Luis Valley customers, which translates to the private construction of solar energy that generates over 110 MW of power annually.⁴⁶

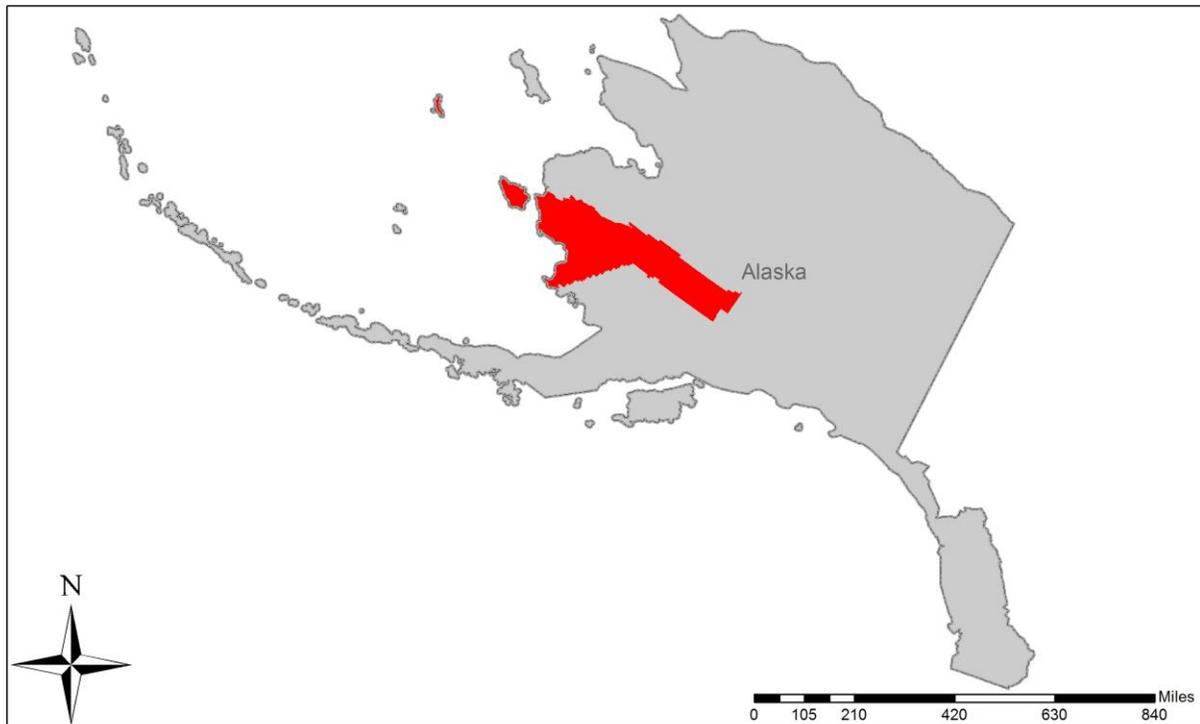
Alaskan-Native County - Bethel and Yukon-Koyukuk Census Areas, AK

One must be wise in knowing what to prepare for and equally wise in being prepared for the unknowable. – Yup'ik tribe



Map 6. Location of Bethel Census Area, AK

Location of Bethel Census Area, AK



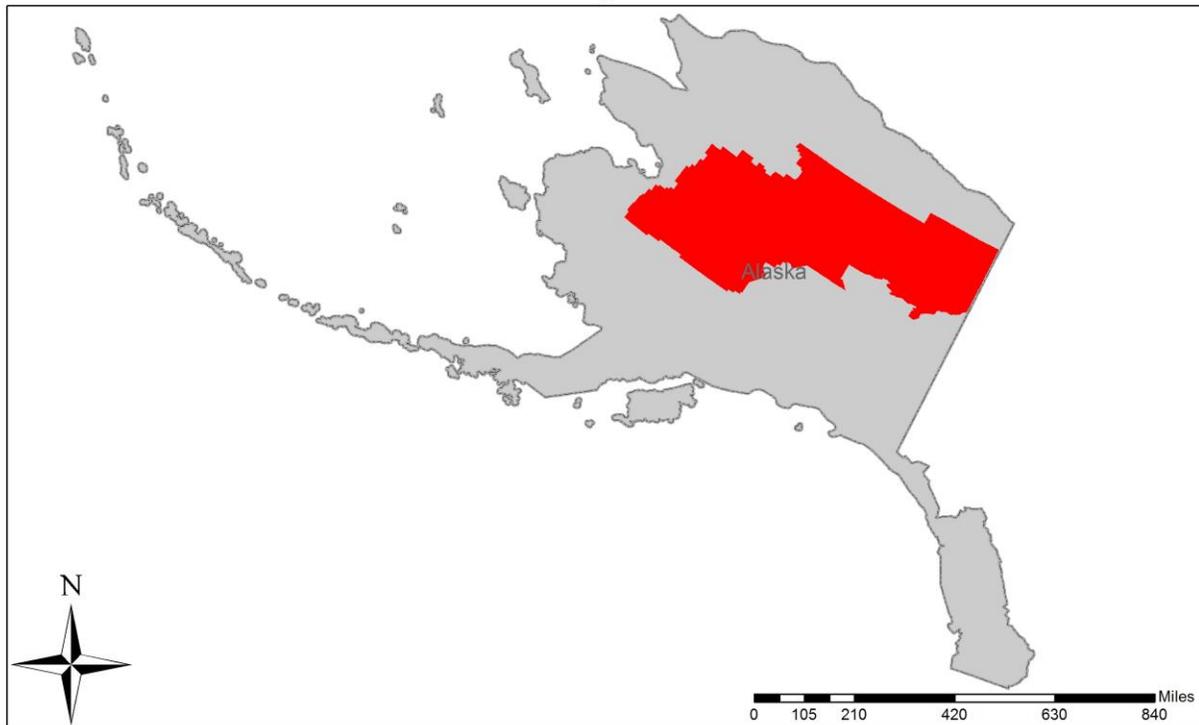
Legend

- State Boundary
- Alaska
- Bethel Census Area

Source: Economic Research Service, U.S. Department of Agriculture; American Community Surveys(2011-2015);www.socialexplorer.com;<https://www.census.gov/geo/maps-data/data/tiger.html>

Map 7. Location of Yukon-Koyukuk Census Area, AK

Location of Yukon-Koyukuk Census Area, AK



Legend

- State Boundary
- Alaska
- Yukon-Koyukuk Census Area

Source: Economic Research Service, U.S. Department of Agriculture; American Community Surveys(2011-2015);www.socialexplorer.com;https://www.census.gov/geo/maps-data/data/tiger.html

Geography

Alaska, the largest state geographically, has an isolated and richly diverse geological and cultural landscape. The state's total population is a little of 738,000 and most of the state is considered FAR2. The state holds 16 National Wildlife Refuges, and 60 percent of all its land is managed by the National Park Service.⁴⁷ The state is divided into boroughs, rather than counties. There are 19 organized boroughs and 1 unorganized borough. Most the state's population resides within the organized boroughs, which make up 43 percent of the of state. Alaska's incorporated cities only cover 2.1 percent of the land. The state's cities are divided into: Home-Rule, First Class, and Second Class cities, with specific legislative functions for each; as well as having demarcations in each for the Unorganized and organized boroughs. The Unorganized Borough is not a political subdivision. The population is meant to pull resources at the local or regional level. The Unorganized Borough's low density necessitates local participation and responsibility in administrative and state programs.⁴⁸ A decentralized government fosters participation and localizes power at a smaller scale. The Unorganized Borough sparse population, many of whom are Native

Alaskan, have distinct cultural norms. The decentralization of power allows increased local autonomy within functions of government.

The Unorganized Borough makes up much of the state, but only holds a small percentage of the overall population – around 13 percent. It is comprised of 19 Census areas and numerous towns and villages and is largely home to the state’s native population. There are 280 native villages spread across the land.⁴⁹ Alaska has over 44 million acres of tribal land, and has 129 million acres of forested land – one-fourth of which is controlled by native corporations. Native Alaskans do not live on sovereign land reservations, rather tribal land is cooperatively owned by Native Alaskans; and 12 native corporations hold the subsurface mineral rights to their land.⁵⁰ Native Alaskans make up 14 percent of the state population. They are the second largest ethno-racial group behind Caucasians who make up 60 percent of the population, African Americans 9 percent, and other groups that exist in very small fractions of the overall population. Alaska natives identify within the following tribes: the *Ahtna* tribe, *Aleut* tribe, *Aluutiq* tribe, *Eyak* tribe, *Gwich'in* tribe, *Haida* tribe, *Han* tribe, *Holikachuk* tribe, *Ingalik* tribe (*Degexit'an*), *Inupiaq* (*Inuit*), *Kolchan* tribe, *Koyukon* tribe, *Tanaina* tribe, *Tanana* tribe, *Tlingit* tribe, *Tsimshian* tribe, *Yupik* tribe.⁵¹

Land



Figure 11. Denali, the tallest mountain peak in North America. (Source: Alaska Land Tours via Etsy)

The state has been divided into ecoregions with distinct flora and fauna. The first sub-regions are the Yukon-Kuskokwim Delta and Bristol Bay Lowlands. This coastal subgroup in this region is made of mountainous and volcanic land areas with shrub and lichen land cover. On the south side of the mountains are an extensive network of lakes – home to

rainbow trout and sockeye salmon in the warmer summer months. The valleys are a mix of shrubbery, forests and meadows. Moose, beavers and arctic hares make their homes in these areas. Walruses and sea lions reside on the rocky beaches. The Arctic regions is made up of the Ahklun Mountains and comprises the northern and western portions of the state. Its vegetation consists of: mosses, lichens, sedges and shrubs – and is home to the caribou. The Subarctic region is largely the center of the state, and makes up most the Unorganized Borough. It is made up of bottomland spruce, poplar forests, upland spruce and Birch forests; it is home to caribou, as well. The Cold Oceanic region makes up Alaska’s western peninsula and the Aleutian Islands with lichen, lowland grass areas, low shrubs of willow, birch, alder, and alpine tundra in the hills and mountainous areas. The Marine region is made up of the eastern peninsula. The land is comprised of Sitka spruce trees and in the mountainous regions alpine tundra. The final region is the Warm Continental which has a mix of vegetation’s from the western Kenai Peninsula, Anchorage-Mat-Su urban region, and Bristol Bay.⁵²

Energy



Figure 12. Oil pipeline. (Source: U.S. Energy and Information Administration)

Oil and natural gas make up a large portion of Alaska’s economy. Some of the largest oil fields in the United States are in northern Alaska. Regardless of declines in oil production with maturing oil fields, Alaska remains the leading producer in the U.S. crude oil. The state has several reserves that have not been tapped. Drilling is strictly prohibited in the Arctic National Wildlife Refuge and other protected areas. Alaska is also one of the primary states for natural gas extraction. Unlike other states, most of Alaska’s natural gas extraction is consumed locally. A high percent is pumped back into the oil fields for rejuvenation. Alaska’s coal industry has operated since 1855 – today half of the coal is exported to Asia and South American. The remaining is used in-state by industrial and utility consumers. Hydropower is the state’s primary renewable energy source. The hydropower facilities operate in the southern mountainous portion of the state. The state operates dams as well as run-of-river projects that provide power to rural communities across the state. Remote areas also rely on solar, small scale wind farms, and biomass.⁵³ The organization, Renewable Energy Alaska Project (REAP) is leading the way for

renewables in Alaska. The organization was formed in 2004, and includes more than 80 members whose backgrounds span from: utilities, environmental groups, consumers, businesses, Alaska Native corporations and individuals, as well as a range of government agencies.⁵⁴ The organization has shown how microgrids, operating in Unalakleet, Arctic village and Kodiaks Alpine Lake and other communities can divest from fossil fuels and use renewables on a small scale.⁵⁵

Water



Figure 13. The Hubbard Glacier calving. (Source: Shutterstock/Lee Prince)

Alaska receives 103 days of rainfall per year – annual precipitation is 17 inches; and the state gets 74 inches of snowfall per year. The state’s annual high temperature is 44° Fahrenheit with a low of 30° and an average of 37° F. In the past six years, the temperature across Alaska has increased by 3° F. Alaska holds 11 percent of the world's mountain glaciers, which are increasingly contributing to sea level rise with warming temperatures.

The eastern portion of the state connects to northern Canada, and three sides of Alaska are surrounded by oceans: the Arctic Ocean to the North, Bering Sea to the West, and the Pacific Ocean to the South. The coastline comprises over 43 thousand miles. The Arctic Ocean, Chukchi Sea, and Bering Sea are frozen for much of the year like Alaska’s land. The state’s primary river is the Yukon, which flows out to the Bering sea, and it has more than 20,000 connecting lakes in the region. It’s largest lakes, Iliamna Lake and the Becharof, are in the southernmost region of Alaska.⁵⁶

Native villages are located along the expanses of rivers essential for their subsistence lifestyle comprised of hunting and fishing, and serve as a means of transport. Most villages are only accessible by waterway or air travel. Polluted waterways devastate rural areas. Many villages do not have access to

Native villages are located along the expanses of rivers essential for their subsistence lifestyle comprised of hunting and fishing, and serve as a means of transport. Most villages are only accessible by waterway or air travel.

clean drinking water nor do they have sewage removal. Yearly grants are awarded to villages from the Village Safe Water Program funded through the United States Department of Agriculture (USDA) and United States Environmental Protection Agency (EPA). Beginning in 1994, 70 percent of villages did not have access to safe drinking water and sanitation; today the number has dropped to 37 percent.⁵⁷

Villages & Climate Change

The state expects climate change will increase tourism as well as benefit the agricultural sector. Adversely, though, it will cause severe damage to land and waterways. Eighty percent of Alaska's land cover lies above permafrost, frozen ground located a few feet below the surface. With rising temperatures permafrost is melting, causing soil to sink. These changes will likely have lasting effects on Alaska Natives, many of whom are being encouraged to move; but moving will likely cost them their culture, language, community and way of life. Inland rising temperatures are increasing wildfires; and lakes and ponds are drying up – thawing permafrost increases the speed at which lakes drain.⁵⁸ As the temperature increase it creates a climate where brush and bushes thrive and begin to take over lichen, a food source for caribou – a local staple; and fish are increasingly migrating south, devastating native food supply.⁵⁹



Figure 14. A boat lies upside down on an Alaskan coastline. (Source: Diana Haecker)

The Yukon-Koyukuk Census area, located in the northeast part of the state, understands the effects of climate change all too well. Its land area is 2,300 square miles, much of which is located within a national wildlife refuge. The population is 5,580, and median income is \$38,000.⁶⁰ Twenty-two percent of its population lives under the poverty line. The arctic village, home of the *Gwich'in* people is located within this Census area. The village

population density is low, with 2.5 persons per square mile. There are no roads leading in or out of the arctic village and the population has a subsistence lifestyle. Climate change is increasingly affecting water sources, food sources, land cover and the overall health of the village. The thawing of permafrost, aside from increasing the speed at which lakes drain, creates sewage contamination and salt water intrusion. In the winter months, there has also been a worsening of ice conditions creating an increased safety concern for villagers. Villagers must cross over dangerous patches of ice to hunt, fish and collect timber. Villagers are spending more time indoors, and are finding ways to adapt to precarious hunting and fishing conditions. The coastal regions are making their own concessions as sea levels continue to rise.⁶¹



Figure 15: A fisher and fish share a moment in Alaska's Bristol Bay. (Source: Michael Melford)

Villages in the Bethel Census area, which covers 45,000 square miles are beginning to grapple with the implication of climate change. The Census area's population is a little over 17,000 with a median income is around \$50,000 and 25 percent of its population living below the poverty line. Newtok is home to the *Yup'ik* people. The village is home to 150 persons with a density two per square mile. The village sits to the southwestern shore of the Niglick River. The village is within the Yukon Delta National Wildlife Refuge. It is in the lowland plain of the Yukon-Kuskokwim Delta.⁶² The area is increasingly becoming uninhabitable. Thawing permafrost and rising sea levels are causing damage to roads, homes and other municipal structures, as well as affecting water sources.⁶³

In 2009 the U.S. Government Accountability Office identified 31 Alaskan communities that are at risk of losing their land due to sea level rise; 12 have registered their intent to

relocate. Funding shortfalls are leaving these populations in danger of having to relocate individually. Without aid from the federal government to support villages moving together, villagers could scatter, tearing apart families, communities, culture, and native languages. A local planner who has organized the Newtok Planning Group emphasizes that relocation of tribal villages must be organized and done locally within the community. The role of government as well as outside NGOs is to support with technical assistance and ideally with funding.⁶⁴

In Newtok, the local Planning Council began drafting a relocation plan. The council took a novel approach by requesting federal disaster relief for damage over the past 10 years. While most Federal Emergency Management Agency (FEMA) support is invoked for specific events, local officials state that the federal government regulations do not rule out events spanning multiple years. The community will disappear in three years. It is losing 70 feet of its land per year, will lose its drinking water source in 2017, and airport in 2020. It is estimated to cost \$100 million or more to move the village.⁶⁵

In 2009 the U.S. Government Accountability Office identified 31 Alaskan communities that are at risk of losing their land due to sea level rise; 12 have registered their intent to relocate.

To date efforts have been underway for relocation to Mertarvik. Six homes have been built in the area, though moving is risky without any municipal services and structures. Agencies are reluctant to grant financial resources to the Mertarvik until there is a population residing there; and some regulations restrict them from doing so. Recently a \$3.1 million Hazard Mitigation Grant was awarded from FEMA, which will pay to move 12 homes from Newtok to Merarvik. Once the homes are moved, which house 41 people, local agencies will begin to build municipal structures, such as a school, a post office, and a health care facility. The village is currently waiting the approval of a \$900,000 grant for establishing community services from the United States Department of Housing and Urban Development (HUD) Indian Community Development Block Grant Imminent Threat Program.⁶⁶

Newtok will likely be looked at as a model for further town and village relocation projects. The village which began locally planning for the move in 1994, has pulled financial resources federally, and regionally; as well as garnering technical assistance from local city planners and the Cold Climate Housing Center. The Center has prototyped a housing model for areas with precarious environments due to climate change. The house has a foundation that acts like skis for easy transport across ice. And federally, small changes are occurring to make moving rural villages a more cohesive process. The Denali Commission, a state agency that coordinates federal services in the state, has been set to the task of coming up with a more comprehensive plan for climate change relocation projects.⁶⁷

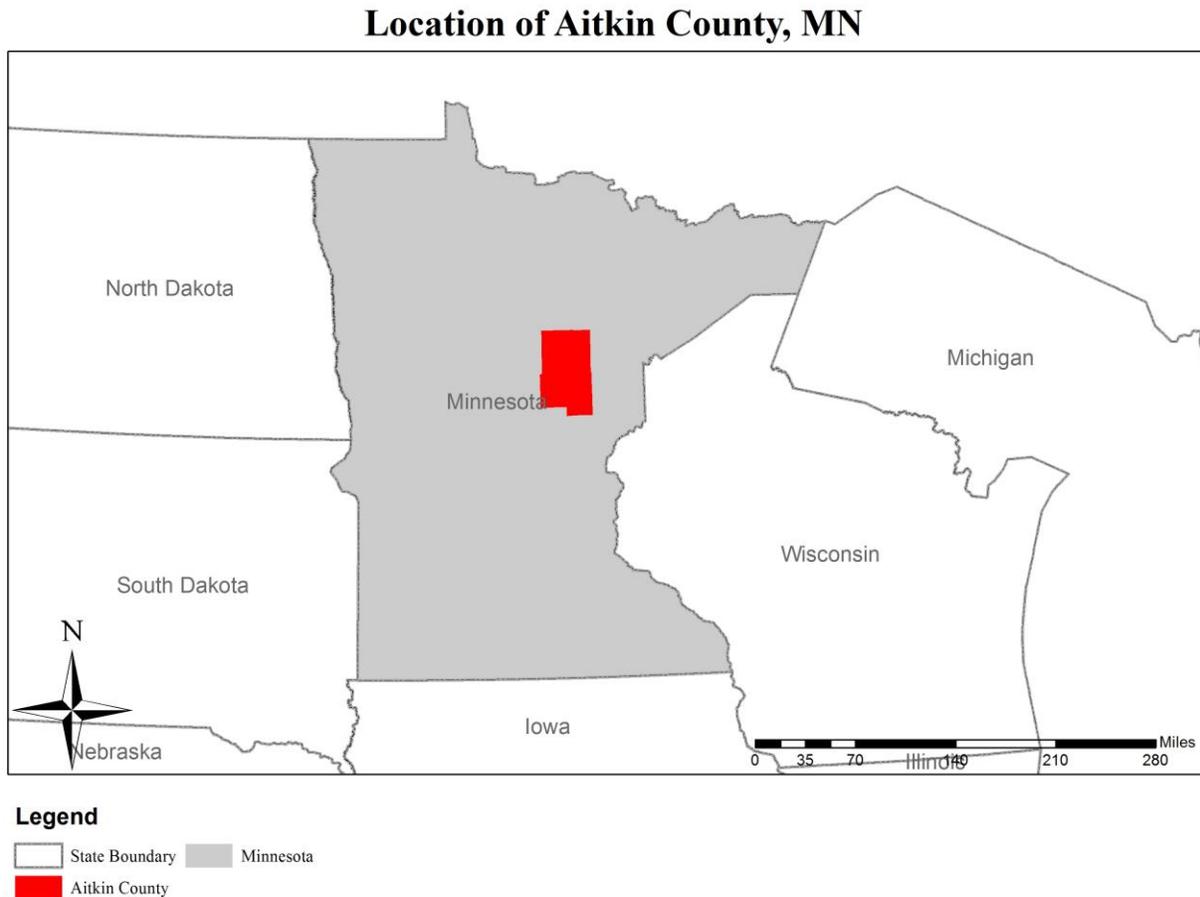


Figure 16. Newtok flood, September 22, 2005. (Source: Stanley Tom/Alaska Division of Community and Regional Affairs)

Four areas have been identified where further research is needed: development of culturally sensitive engagement practices; best practices for cultural preservation through relocation; increased participatory planning among villages and local, regional, and state agencies; and innovation in climate sensitive housing design. To best serve rural communities facing relocation it is also recommended that agencies change regulation prohibiting populations to take residence before municipal structures may be built. Lastly, regional and state policy for the conservation of natural resources are necessary to mitigate climate change.

Retirement & Recreation County - Aitkin County, MN

Map 8. Location of Aitkin County, MN



Source: Economic Research Service, U.S. Department of Agriculture; American Community Surveys(2011-2015);www.socialexplorer.com;https://www.census.gov/geo/maps-data/data/tiger.html

Background

Aitkin County is located in north central northern Minnesota, and its population as of 2015 was 15,702.⁶⁸ Its population density is 8.62 people per square mile, making it eight times less dense than the average population density in Minnesota, and around 10 times less dense than the United States average. The county's population is 94.4 percent white, which is higher than the average for Minnesota (84.6 percent) and the United States as a whole (77.1 percent). The age structure in Aitkin County differs from both Minnesota and the United States. While in Minnesota and in the United States people under 18 represent around 23.5 percent, that number in Aitkin County is 17.5 percent. Likewise, the population between the ages of 18 and 65 constitute around 60 percent, this number in Aitkin County is only around 50 percent. However, the population aged 65 and over is around twice as high in Aitkin County (30.5 percent) compared to the numbers in Minnesota (14.7 percent) and the United States (14.9 percent).⁶⁹ The age statistics in particular hint that Aitkin County is a retirement county with a large senior population.

Health care and social assistance is the largest employer in Aitkin County, shaping its economy as a retirement county. The county has a high net in-migration rate of 7.51 people per 1,000 population. Around 90 percent of the positive migration is domestic. The migration number for Minnesota is only 0.59 people per 1,000 population. According to the U.S. Center for Disease Control in 2014, the death rate in Aitkin County (1,294 per 100,000) is almost twice as high as in Minnesota as a whole. The largest employment sector in Aitkin County are educational services, health care and social assistance (23.6 percent), followed by arts, entertainment, and recreation, and accommodation and food service (14.5 percent).⁷⁰

History

Aitkin County was originally occupied by the Sioux Nation. In the 1600s, there were many battles between the Sioux and the Ojibwa / Chippewa because the area of Aitkin County was seen as a paradise for hunting. In Native American history and belief, the area of Aitkin County is and will always be a rich paradise. Aitkin County was named after William Aitkin, who was an English fur trader. After 1857, Aitkin was designated as a county by the Minnesota Territorial Legislature. The first white settlements in Aitkin County occurred after the establishment of the Northern Pacific Railroad 1871, as the new railroad led to an increase in economic activity and production.⁷¹

County Level Issues

Aitkin County is a very sparsely populated county, even though it is only a two-hour drive from the Twin Cities. The issues that Aitkin County faces may not be evident if only looking at the demographics and economic statistics. The county faces issues regarding the relationship between Native and non-native Americans. The following sections on Climate Change, Water and Energy will analyze potential consequences of these three factors on the issues between Native and non-native Americans, and the implications of climate change and water issues on the economy in Aitkin County. Aitkin County does not have a very diversified economy, therefore negative impacts on tourism and recreation can have significant impacts on the economic status of Aitkin County residents.

Climate Change

Only 47 percent of the people residing in Aitkin County are employed.⁷² This number does not reflect a particularly bad or instable economy in Aitkin County, rather, it reflects the dominance of retired people in Aitkin County, MN. Therefore, Aitkin County is dependent on tourism and on fishing. One fish, the walleye, dominates the tourism industry in the county. The walleye is a freshwater fish which lives in the Mille Lacs Lake (the northern lakeshore is in Aitkin County). Garrison, located in neighboring Crow Wing County, is the so called “Walleye Capital” of the world, promoting its status with a statue of a walleye.⁷³ Considering the major industries, climate change is expected to have a huge impact on the economy in Aitkin County. The Minnesota Department of Natural Resources (DNR) has prohibited walleye fishing in the summer to preserve the walleye population and protect it from high and uncontrolled fishing. The DNR is trying to ensure an adequate fishing season while preserving walleyes. Climate change is also affecting the lives of tullibee, a fish that are crucial for the nutrition of walleye. Tullibeeps live primarily in cold waters, and any increase in water temperatures can significantly affect their wellbeing. The decline of

tullibee will take away the main source of food for walleyes, and this can lead to walleyes eating each other, expediting their extinction.⁷⁴

In 2015, Aitkin County released and published the Aquatic Invasive Species Risk Assessment. Aquatic Invasive Species are defined as plants and animals that are not natives in Minnesota. Zebra mussels are one of the most harmful and wide spread aquatic invasive species currently found in more than 60 lakes in Minnesota. They are particularly harmful because they cling to hard surfaces, such as boats, docks, aquatic plants and water pipes; they can clog water pipes and damage docks and boats. Zebra mussels can affect the economic development and the lives of many inhabitants of Aitkin County. They also have significant negative effects on animals and water plants, because they remove microscopic plankton from water, therefore impairing the nutrition of other aquatic life.⁷⁵

Climate change in Aitkin County and in the area surrounding Mille Lacs Lake does not only have biological implications, it has the potential to raise tensions between Native Americans and non-native fisherman as was the case in the past. The case *Minnesota v. Mille Lacs Band of Chippewa Indians* reflects this conflict very clearly. In this case, the Chippewa Indians claimed that they still had certain fishing, hunting and gathering rights on lands that were ceded to the Federal Government in 1837. The Chippewa Indians had ceded a majority of their lands to the government under the Treaty of St. Peters in 1837 (also known as the "White Pine Treaty"). The treaty states, that "The privilege of hunting, fishing, and gathering the wild rice, upon the lands, the rivers and the lakes included in the territory ceded, is guaranteed to the Indians, during the pleasure of the President of the United States."⁷⁶ However, the state and local governments started taking authority over these areas and ignored these certain rights, to which the Chippewa Indians were still entitled. This led to increased tensions on different levels in Minnesota, Michigan and Wisconsin, which ultimately led to this United States Supreme Court Case. The court ruled in favor of the Chippewa Indians on the March 24, 1999.⁷⁷

The importance of this case lies in the assumption that this treaty is responsible for the decline in the walleye population. The tensions between Native and non-native Americans in central Minnesota over the Mille Lacs Lake have increased noticeably in recent years. Tribal harvesting during certain vulnerable periods of the year is seen as a factor that may have prompted the quick decline in the walleye population. In order to find a balance between conserving the walleye and other vulnerable fishing populations, as well as retaining and respecting treaty rights of Native Americans, the Department of Natural Resources and the Great Lakes Indian Fish and Wildlife Commission (GLIFWC) have been trying to cooperate over the last several years. Stringent regulations are needed to protect the walleye population, which is prompting conflict with the Native Americans about their rights. It might also be difficult to view strict regulations solely focusing on the walleye populations independent from racial, social and cultural prejudice, since the history between Native and non-native Americans has been a story of inequality and tragedy. From a legal perspective, regulations regarding fishing or hunting are only allowed for conservation purposes.⁷⁸



Figure 17. Symbol of the Minnesota Chippewa tribe.

This prevents arbitrary restrictions on Native Americans' rights. However, Native Americans are only allowed to use the usufructuary rights which were given to them in the treaty. In addition, if there is a law or regulation restricting fishing or hunting, Native Americans are required to comply. In 2014, the DNR and GLWFIC agreed on drastically reducing the quotas for sports fishing and for tribal fishing. However, the cooperation between the DNR and GLWFIC also bears a lot of current and potential conflicts. One major point of conflict is the so-called safe harvest level (SHL) calculation of the DNR. The DNR uses a computer model to calculate the safe harvest levels for walleye fishing, which are then published by the DNR. However, there have been accusations of data manipulation towards the DNR, stating that the SHL's are displayed on an unreasonably high level. The harvest levels have experienced different levels, and inaccurate calculations have led to spontaneous regulations on walleyes in the summer season for non-resident and resident sports fishermen. The DNR seems to focus regulations on sports fishermen rather than on Native American fishermen. In fact, from February to May, sport fishing is not allowed (the typical season for sports fishing is from May to the end of February); however, during that time, tribal fishing is not prohibited.⁷⁹

When the aforementioned issues are combined with the climate change issues facing Aitkin County, the conflicts between the Native and non-native Americans have the potential to remain and possibly even increase, especially if the walleye population continues to decrease and if the economy in Aitkin County suffers from that. Considering the fact that Native Americans are more likely to have low incomes, preserving walleyes in order to secure economic stability and secure income might become even more important. As stated above, regulations regarding walleye conservation has to be particularly sensible to ensure, that the historical tensions between the Native and non-native Americans do not dictate the discussion of walleyes and prevent major rules to secure a healthy walleye population.

Water

There are eight major basins in Minnesota, which have smaller units called watersheds. There are seven major watersheds located in Aitkin County: Mississippi Grand Rapids Watershed, Pine River Watershed, St. Louis River Watershed, Mississippi Brainerd Watershed, Rum River Watershed, Kettle River Watershed and Snake River Watershed.

However, most of the lakes in Aitkin County are in the Mississippi Grand Rapids and Mississippi Brainerd Major Watersheds.⁸⁰ While many counties in the western half of the country might experience severe droughts, this problem does not exist in the majority of counties in Minnesota. In fact, frequent flooding's occur and they lead to certain restrictions, ordered by the local governments or the DNR. One of these restrictions are, for example, the implementation of no wake zones in lakes. Boats are required to reduce their speeds and to keep certain headways in order to prevent flooding caused by high speeds on the lake. In 2009, the last Water Management Plan was implemented. This plan has five major areas: 1. Surface Water Management 2. Land Use and Development 3. Groundwater Quality 4. Fish and Wildlife Habitat and 5. Education.⁸¹

Energy

Figure 18 shows us a map of Aitkin County and the energy transmission lines in the County. Other than the Enbridge Pipeline System, which transports crude oil, Aitkin County appears to be completely blank and disconnected from any energy transmission line. A major reason for this lack of connectivity can be attributed to the sparse population in Aitkin County.



Figure 18: Transmission lines in Aitkin County.

Compared to other parts of Minnesota, Aitkin County does not have a considerable number of windmills. This is also due to the fact that the average wind speed in Aitkin County at a height of 30 meter is less than 5 meters per second.⁸² In 2009, there have been efforts to explore the possibilities to use biomass resources available in Aitkin County in order to produce and generate renewable energy. A biomass to bioenergy production system is planned to function as a generator for economic development and sustainable energy use in Aitkin County. The county has interesting geographical and geological features, as it contains both the corn/soybean/wheat regions of the state and the heavily forested areas of the south.⁸³ Viewing the map for solid biomass resources by county, it can be stated that

Aitkin County has resources of around 50 to 100 thousand tons per year, which is lower than the majority of the counties in Minnesota.⁸⁴

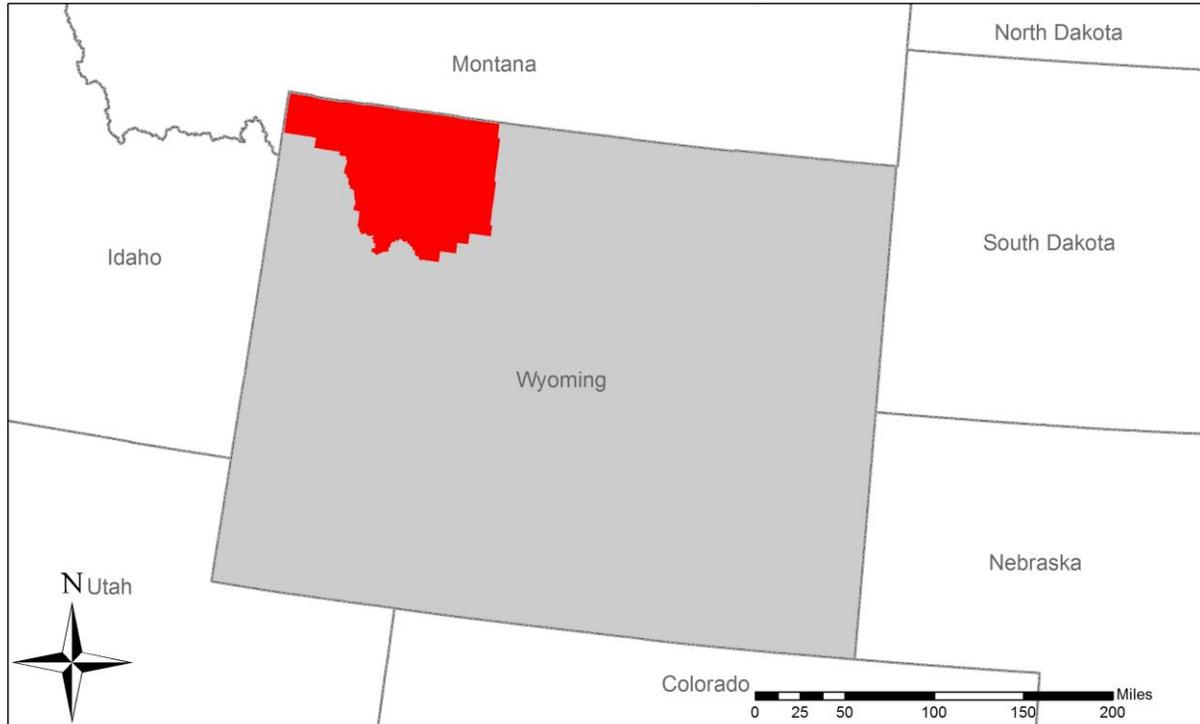
Conclusion

Aitkin County is economically not very diverse, and therefore it is dependent on its fishing industry to secure economic and social stability, as it was described above. Climate change already seems to have a large impact on the decline of the walleye population, which is the number one tourist attraction in Aitkin County. The walleye is very valuable to the people of Aitkin, because it is a source of economic stability, income and employment. The decline in walleye will put enormous challenges on businesses and also on the relationship between Native and non-native Americans. The local government plays a key role in sustaining the walleye population without jeopardizing the economic base for the Native Americans and other populations in Aitkin County. Climate change will have a negative impact on Aitkin County because nature plays a large role in people's everyday activity. Additionally, conflicts over natural resources have the potential to escalate on a social level, especially between Native and non-native Americans.

Public Lands & Recreation County - Park County, WY

Map 9. Location of Park County, WY

Location of Park County, WY



Legend

- State Boundary
- Wyoming
- Park County

Source: Economic Research Service, U.S. Department of Agriculture; American Community Surveys(2011-2015);www.socialexplorer.com;<https://www.census.gov/geo/maps-data/data/tiger.html>

Background

Park County is located in northwestern Wyoming, with a population of 29,228. The age structure of Park County reflects a common pattern seen in frontier communities. The population under 18 years old and the population between 18 to 65 years old is significantly less in Park County than in the state of Wyoming and the nation as a whole. However, the proportion of the population 65 years and over is 20.4 percent, which is approximately six percent higher than the average for Wyoming and the United States. The net positive migration rate in Park County is 0.86 people per 1,000 population, suggesting that the share of people migrating to and from Park County is approximately equal. Interestingly, the net migration rate from outside the United States is positive, while the net migration from within the United States is negative. This pattern could stem from the fact that Yellowstone Park attracts foreign researchers and migrants.⁸⁵

History

The area of what is today Park County, was once occupied by several Native American tribes, namely the Cheyenne, Lakota, Sioux, Crow, Shoshone and Blackfeet. After the Laramie Treaty of 1968, new reservations to the north and to the south were founded. New Native American settlements and arrivals were prohibited. As a result, most of the area became available to white settlements. The first white settlers started to come to Park County after the 1880s. In 1911, Park County was founded; Cody was the designated county seat. The name Cody derives from William Frederick “Buffalo Bill” Cody, an American showman, bison hunter and scout. He was one of the seven founders of the town. A historic landmark, the Buffalo Bill dam, was completed in 1911 and is also named after Buffalo Bill Cody. The history of Cody cannot be mentioned without noting the importance of Buffalo Bill and his influence on the whole area. The town's biggest newspaper, *Cody Enterprise*, was also founded by Buffalo Bill Cody. Buffalo Bill Cody saw a lot of potential in the area of Park County, due to its richness in agriculture, fishing and its strategically good location close to Yellowstone National Park.⁸⁶

Park County also was the venue of a tragedy during the Second World War, as it was home to the Heart Mountain Relocation Center, a place where Japanese citizens or dual-citizens were to report for detention. This relocation center was one of ten in the country. Due to the large numbers of people relocating to the center, it came to resemble a small town with all necessary infrastructure like hospitals, post offices, schools and recreation areas. Today, the majority of the land, including barracks and agricultural equipment, is owned by local farmers who built their homes after the land was sold to them. The Heart Mountain Wyoming Foundation, founded in 1996, aims to memorialize the tragic events and set up research projects to educate and raise public awareness of the tragedies happening during the Second World War.

In Cody, there are two courthouses standing next to each other, which is a curiosity for many tourists. Plans to replace the old courthouse in 1983 led to extensive protests, which lead to the government to keep both courthouses. However, since the local government was vehemently against tearing down the old building, the local government decided to keep the old structure while building the new courthouse. The two courthouses stand side by side, but their architectural styles are very different. While the old courthouse was built in a classical style, the new courthouse resembles the Prairie style of Frank Lloyd Wright.

As mentioned above, tourism has always been an important economic factor for Park County. The county seat Cody has been especially involved in tourism activities, due to its close proximity to the east entrance of Yellowstone National Park and its Buffalo Bill Center of the West, a museum complex of Western art, history, natural, Native American, firearms, and Buffalo Bill history. Park County also advertises itself as a destination for people to relocate and retire, because of its low sales tax (four percent) and due to the fact that Wyoming does not have any income tax.⁸⁷

County Level Issues

More than 50 percent of the land in Park County is part of the Yellowstone National Park, making most of the county designated as public land (Figure 19).



Figure 19. Yellowstone National Park covered with snow.

This is especially important regarding climate change, because these lands are owned by the federal government and regulations regarding climate change or water regulations can have direct implications for the national park and consequently for the whole county. The new administration has given signs of altering previous regulations aimed at environmental preservation and protection. This administration's attempt to revise the Clean Water Act can potentially have severe implications for Yellowstone. The following passages will elaborate on the topic.

Climate Change

The residents of Wyoming are more skeptical of climate change when compared to other states. According to a Yale study, the percentage of people in Wyoming who believe that humans are the cause of climate change is 14 percent less than the national average.⁸⁸ These differences are also seen in the question of how strong the support is for restrictions on carbon dioxide. When discussing climate change and its possible effects on the future, the facts mentioned above will be important to consider in order to give a more realistic evaluation of potential solutions.

As mentioned above, a large share of Park County is covered by Yellowstone Park. Since Yellowstone National Park has very few permanent residents, the effects of climate change

are different from those seen in urban, suburban, or rural areas; however, they are just as challenging and problematic. Yellowstone's climate has been historically monitored, and there have already been noticeable changes in the park. For example, since 1960, there are 30 fewer days of snow on the ground, and the average temperatures in the park are higher now than they were 50 years ago especially during spring time and at night.⁸⁹ The reduction in snowpack and the consequently disturbed patterns of snowmelt will have a large impact on the Greater Yellowstone Ecosystem (GYE). The snowmelt usually begins in February and March, which results in flowing water. An increase in temperature will speed up evaporation, leading to an increase in humidity and moisture. Another new challenge due to climate change is the increase in insect activity. Trees will be more vulnerable to pests because of increased stress from drought, high temperature, fire and more extreme weather conditions. At high levels, warmer temperatures will increase winter survival of pine beetles, posing a larger threat to trees. Fire activity is another factor, which is likely to increase due to an increase of spring and summer temperatures and a decrease in precipitation in the winter.⁹⁰

Water

In 1983, the Greater Yellowstone Coalition was formed. Its goal is to protect and preserve wildlife, land and water at Yellowstone National Park and Grand Teton Park. Their key activities include preserving and protecting the three main rivers flowing out of the park: Missouri, Columbia and Colorado Rivers. The native fish populations in those rivers and streams in Yellowstone are a major focus of this coalition. Yellowstone is the only ecosystem in the world where there are

One issue the coalition is addressing is the damage in watersheds caused by phosphate mining, road building and other factors. These damaged watersheds urgently need repair, as they have become fishless and a huge burden on the ecological system in Yellowstone.

four distinct cutthroat trout species. One issue the coalition is addressing is the damage in watersheds caused by phosphate mining, road building and other factors. These damaged watersheds urgently need repair, as they have become fishless and a huge burden on the ecological system in Yellowstone. The coalition is working to find ways to make companies and corporations, who are responsible for these damages, be responsible for the damages and seek financial compensation from them.⁹¹ The recovery of these streams is not only vital for the ecological system in Yellowstone, but it also provides the basis for the water quality in the region. The quality of the water is protected by stringent regulation set by the government. Especially in the watersheds in this region, the government has had direct influence and control over the protection of the high water quality. However, water quality is also subject to challenges such as recreational activities, road building and atmospheric factors. All waters in Yellowstone are so-called Outstanding Water Resources, which are subject to the largest amount of preservation and protection under the Clean Water Act. Yellowstone Lake is the largest lake at such a high elevation in North America, possessing a coverage of equal to 136 square miles. Its average depth is 139 feet and it has over 12,000,000 acre feet of water.⁹²

Energy

The county has historically been dependent on gas and oil, tourism and agriculture. The presence of many oil fields in the proximity of Park County has led to a large oil network within the county. Coal has also played an important role, even if it is only of local importance.⁹³ Generally, Wyoming has been very conservative on energy issues. This might stem from the dominance of the Republican Party in Wyoming, which is often referred to as one of the most conservative states in the entire country.⁹⁴ One example is the wind tax, which charges \$1 for each megawatt hour of wind generated in the state, which is one of the few taxes in the state. Additionally, there is a new law being debated in Wyoming, which would penalize utilities selling energy produced from wind or solar plants. The penalties would be \$10 for every megawatt-hour sold. In contrary, energy generated from the classical providers such as natural gas, oil or natural gas will not be penalized.⁹⁵

Conclusion

While Park County is not entirely dependent on Yellowstone National Park, accommodations and food service are still the largest economic sector.⁹⁶ Any negative change in Yellowstone Park tourist numbers will have a negative effect on Cody, which is one of the centers for tourists heading to Yellowstone. Climate change already shows its effects on Yellowstone, and the future will show us in what dimensions climate change will reduce tourist numbers in Yellowstone. Park County has alternative economic sectors to compensate for reduced tourist numbers in the short term. However, in the long term, Wyoming's resistance to renewable energy might possibly become a serious problem for economic development. These issues affect many counties in the western part of the country that share their borders with national parks and depend on revenue generated by national parks tourism. Given the negative impacts of climate change, those counties would be advised to set up alternative economic sectors, and not be entirely dependent on tourism.

Native American County – Navajo County, AZ

One does not sell the earth upon which the people walk. – Crazy Horse

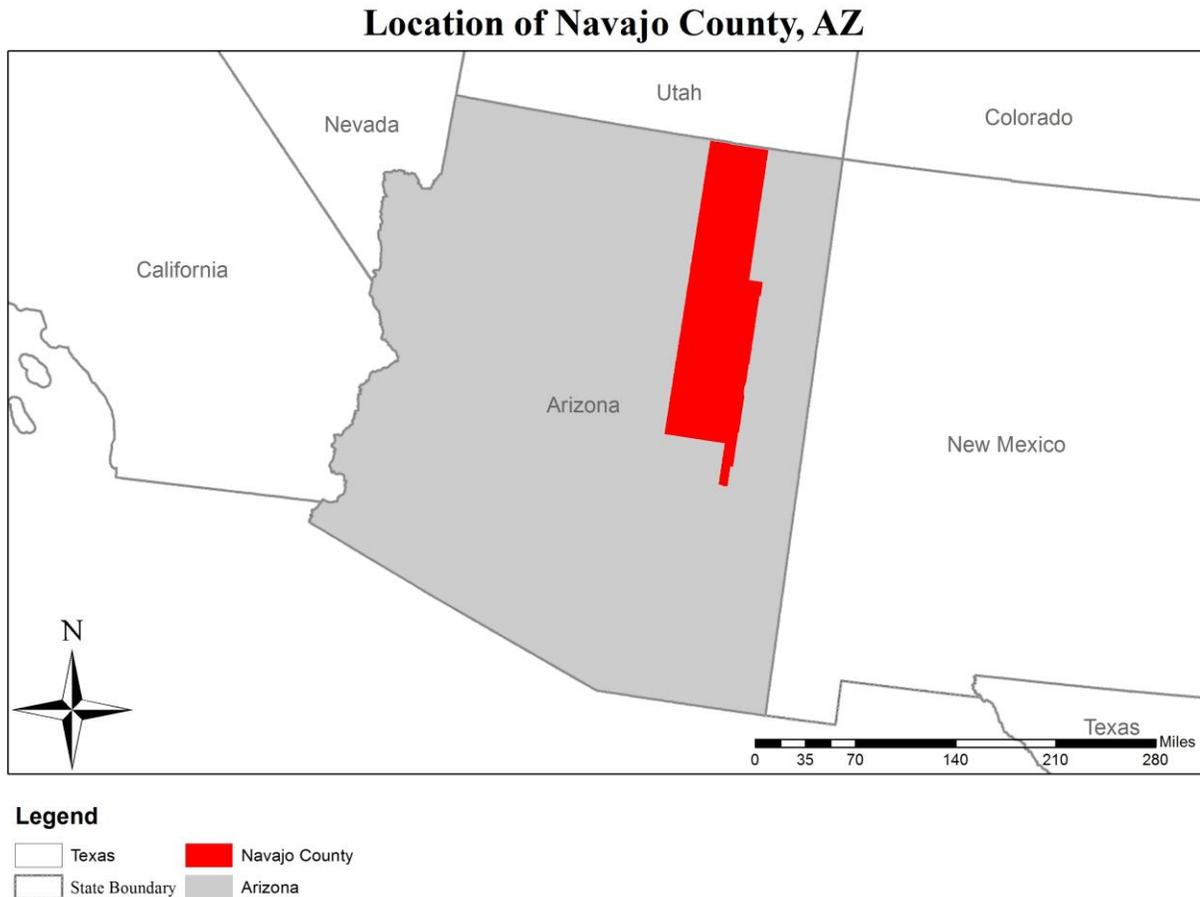
The frog does not drink up the pond in which he lives. – Native American Proverb

We must protect the forests for our children, grandchildren and children yet to be born. We must protect the forests for those who can't speak for themselves such as the birds, animals, fish and trees. – Qwatsinas, Nuxalk Nation



Figure 20. Monument Valley in Navajo County, Arizona.

Map 10. Location of Navajo County, AZ.



Source: Economic Research Service, U.S. Department of Agriculture; American Community Surveys(2011-2015);www.socialexplorer.com;https://www.census.gov/geo/maps-data/data/tiger.html

Background

Navajo County, Arizona, was officially formed in 1895, two years after Arizona Territory joined the U.S. It was previously a part of Yavapai County and later Apache County.⁹⁷ The region's history of settlement can be traced back to the Anasazi people whose remnants can be found in archeological sites around the county. Approximately 66 percent of the county is designated as Indian Reservation land and includes the Hopi Indian Reservation, Navajo Nation and Fort Apache Indian Reservation. Early white settlers included Mormons who migrated from nearby Utah; many settlers also came to the area thanks to the creation of a temporary train station in Holbrook and later a permanent station a few miles away. In 1906, the Petrified Forest — an area near the county seat of Holbrook — was declared a National Monument by Theodore Roosevelt; this declaration increased tourism to the area. Other areas that attract tourism are the Navajo National Monument, the Apache-Sitgreaves National Forest and Monument Valley.

The county currently has a number of major highways running through it including Interstate 40, U.S. Routes 160, 163, 180 and State Routes 77, 87, 98, 99, 260, 264, 277 and 377. It is bordered by San Juan County, Utah as well as Apache, Graham, Gila and Coconino Counties in Arizona. In recent years, Arizona state's population has been growing

and as a result there has been a decrease in the areas that are considered “frontier designated areas” from 2000 to 2010 (see map from the National Center for Frontier Communities, “A Shrinking Frontier”). Despite the state’s recent growth, there are still many regions of the state considered frontier, including a large portion of Navajo County. The population density of the county is 10.8 people per square mile according to the 2010 Census, and the largest city is Show Low with a population of 10,660 people. Aside from the Indian Reservation Land, the U.S. Forest Service and Bureau of Land Management own nine percent of land, the state owns 5.9 percent and 18 percent of land is privately owned.

The basic industries in the county are tourism, coal mining, manufacturing, timber and ranching, and the largest employers are the Cholla Power Plant, the Burlington Northern Santa Fe Railway Company and the Abitibi Consolidated Paper Mill (according to the Navajo County comprehensive plan).



Figure 21. Painted Desert Badlands, Petrified Forest National Park, Arizona (2008)

County-Level Issues

Navajo County has a large Native American population, which is approximately 43.4 percent of the total population. The remaining population is 50.7 percent white and 11.2 percent Hispanic or Latino. These racial characteristics are important for understanding the area because Native American populations tend to be underserved in the United States. The county has a disproportionately high rate of poverty, 28.1 percent, and a high rate of persons without health insurance under 65 years at 15.6 percent. The median household income of \$35,921 is also much lower than the national median income of \$51,939.⁹⁸ These

socioeconomic factors may make the region more vulnerable to climate change and changing weather patterns.

Water

According to the Navajo Water Project, 40 percent of Navajo Americans currently live without water, and they are 67 times more likely than other Americans to live without running water or a toilet.⁹⁹ Areas that receive water often find that their tap water is stagnant and while it meets basic requirements for drinkable water in the United States, the smell and look of the water deters residents from using it.¹⁰⁰ This problem is so widespread in the county that the Navajo County Health Department has issued pamphlets addressing “Common Water Problems & Treatment” with answers as to why “My Water Smells Like Rotten Eggs!”. The pamphlet addresses a variety of common water problems facing the state, including: contamination due to sewage, manure or surface water; decaying organic matter or pollution from surface drainage; iron and manganese sulfide among other issues. The local water resources were also recently affected by a toxic waste spill from the Gold King Mine of Colorado which flowed into the San Juan River.¹⁰¹ Aside from issues of access and contamination, the area is at a high risk for drought. The county receives seven to 16 inches of precipitation annually, which is a small amount to support ranching and farming as a livelihood.¹⁰²

The water issue is not only county-specific, but one that the Navajo Nation as a whole is facing. The Navajo Nation, while concentrated in Arizona, also has reservations in parts of New Mexico and Utah. One comment in the newspaper *Indian Country Today* states that the nation has no policy or plan to regulate water use: “When you live in a big city, there’s always a plan on how much water is being used, and planning for the future. On the Navajo Nation, we don’t have a policy in place that will address the drought, especially when it comes to livestock”.¹⁰³ Navajo County delivers water to many areas of the county. The Arizona Department of Water Resources states that water development challenges on the reservation come from the coordination of multiple agencies, both public and private as well as funding for large infrastructure projects.¹⁰⁴ The county itself currently has a drought plan, but little in terms of a water supply plan—some of this work is being done by a non-profit called Dig Deeper based out of Los Angeles, California.

According to the Navajo Water Project, 40 percent of Navajo Americans currently live without water, and they are 67 times more likely than other Americans to live without running water or a toilet.



Figure 22: Coal Mine Terminal of Black Mesa and Lake Powell Railroad, 2012.

Energy

The U.S. Energy Information Administration (EIA) states that Arizona produces more electricity than the state requires, thus a significant amount of it is supplied to other states in the southwest. Electricity is vital to the state's well-being as it is required to pump drinking and irrigation water from the Colorado River to other parts of the state, including Navajo County.

In Navajo County, coal plays a major role in the economy. The region has the state's only operating coal mine and one of the nation's largest, Kayenta, located in Black Mesa field.

In Navajo County, coal plays a major role in the economy. The region has the state's only operating coal mine and one of the nation's largest, Kayenta, located in Black Mesa field. Coal from this mine is used in the Navajo Generating Station, the second-largest power plant in the state. The mine and the power plant combined employ approximately 750 people.¹⁰⁵ It powers parts of Las Vegas, Phoenix, Tucson and most importantly, the Central Arizona Project canal. This year the power plant is set to close due to cheaper alternatives to power production and will set the Navajo back approximately \$12 million in revenues from income related to the plant. While environmentalists are relieved the coal mine, the plant as well as the pollution associated with it will be gone, many wonder where they will find employment. Renewable energy may be a viable replacement for jobs associated with coal, provided that retraining assistance can be provided. Currently, Arizona has one of the largest solar energy resources of any state and could potentially expand it. Wind-generated

power and geothermal energy are other resources that have not been fully utilized. Plans to transform the coal plant into a geothermal power plant have been stalled due to the complications surrounding building a pipeline and the cost of renovating the plant. According to the EIA, the Navajo Reservation has the highest percentage of homes without electricity, despite being the largest reservation in the country.

The plant's closure poses a threat to economic opportunity in the county and a threat to water access in the area—the Central Arizona Project canal is currently powered entirely by the Navajo Generation Plant.¹⁰⁶ A new source of power will be required to keep the canal running and supplying water to various parts of the state.

Climate

The EPA states that temperatures in the country are getting warmer and for Arizona this means effects on the flow of the Colorado River, desertification, and an increased risk of wildfires.¹⁰⁷ An United States Geological Survey (USGS) study using observations from elders stated that since the 1990s there is more drought and heat, more springs and lakes that have dried up, as well as fewer bees.¹⁰⁸ Declines in water supplies and desertification can greatly impact the quality of life in the state—making certain economic sectors irrelevant and threatening others. Cattle ranching, a major economic sector, will become unsustainable as rangelands turn to desert and heat affects the health of the cattle. The timber industry, another major sector of the county, is also at-risk due to higher temperatures. Also, higher temperatures have the potential to deter tourism from the various attractions in the county including Monument Valley, Petrified Forest National Park, Keams Canyon and the Apache-Sitgreaves National Forest.

Aside from manufacturing, the economic well-being of Navajo County is tied closely to the well-being of the land. Because the region is already economically disadvantaged, it is particularly vulnerable to the effects of climate change as there are few resources to mitigate the effects.

Conclusions & Recommendations

Access to water and employment are the biggest issues faced by Navajo County's frontier communities. With water supplies already sparse, a rise in temperatures will make the supply even sparser. For planning in the county, water resources for the current population must be secured as soon as possible, this may mean developing additional water treatment centers to deal with the water contamination faced by residents. Before any future development occurs, the county must ensure that growth is accompanied by plans that take into account increased water use. The county may need access to grants and additional funding opportunities to make improvements in their water infrastructure. In order to deal with the closure of the Kayenta Coal Mine, the county must look for ways to diversify its economy. One way to deal with the closure is to develop a retraining program to shift workers' knowledge from coal mining to renewable energy. The county could consider ways of producing energy using solar in this program. In order to protect the surrounding environments and developed areas, the county must take the Urban Wildland Interface Code into consideration and avoid developing in fire prone areas as it is a growing risk in Navajo County.

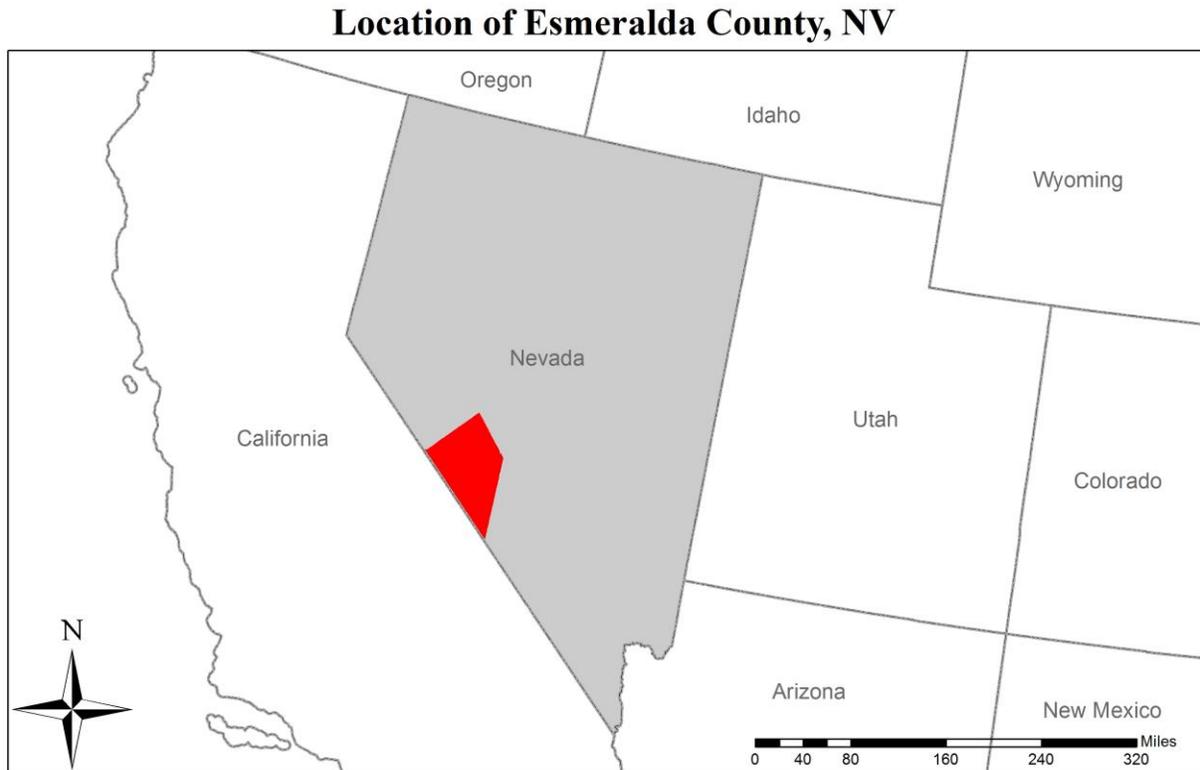
Public Lands County – Esmeralda County, NV

There is no state with more extensive resources than Nevada – Karl Gawell



Figure 23. Esmeralda County Courthouse in Goldfield (Credit: https://en.wikipedia.org/wiki/Esmeralda_County,_Nevada)

Map 11. Location of Esmeralda County, NV

**Legend**

- State Boundary
- Nevada
- Esmeralda County

Source: Economic Research Service, U.S. Department of Agriculture; American Community Surveys(2011-2015);www.social Explorer.com;<https://www.census.gov/geo/maps-data/data/tiger.html>

Background

Nevada’s history is one that can be characterized by fast growth and equally fast decline, and an economy dominated by multiple mining booms and gambling culture.¹⁰⁹ The state’s name comes from Spanish, meaning “snow-capped mountains”, but it is often referred to as the “Silver State”, as many of its first European settlers came to mine silver. Southern Paiute, Northern Paiute, Shoshoni and Washo Indian groups lived in the area that became Nevada prior to white settlement. The first white settlement was founded in 1850 and named Mormon Station.

Despite being the seventh largest state in the nation, 86 percent of Nevada’s land is owned by the federal government—most of which is managed by the Bureau of Land Management (BLM). The state receives most revenues from gambling, and does not tax income, corporations or inheritance. According to the U.S. Census, Esmeralda County’s major industries are agriculture, fishing, timber, farming and mining (30.9 percent), recreation (12.1 percent) and service (12.1 percent). The county’s population is older on average than the United States generally, with 26.2 percent of its population above the age of 65 (U.S. average 14.4 percent) and just 18.9 percent of the population under 18 (U.S. average 22.9

percent). The population of the county is 1.8 percent Black or African American, 4.9 percent Native American and Alaska Native, 21 percent Hispanic or Latino, 0.4 percent Asian and 3.1 percent two or more races; additionally, approximately 14.1 percent of the population is foreign-born.¹¹⁰

Esmeralda County is located on the border of California, near Death Valley National Park in the southwestern part of the state; a portion of the park is within the county's borders. It is also bordered by Nye and Mineral Counties of the state. U.S. Interstate 95 runs through the county, connecting it to both Las Vegas and Reno. State routes 267, 774, 266, 773 and 264 connect the municipalities throughout the county. With a total area of 3,582 square miles and a population of about 1,141 persons, the population density is 0.3 persons per square mile, the lowest in the state and one of the lowest in the nation, according to the 2015 American Community Survey.¹¹¹ This clearly classifies municipalities within the county as frontier communities. The municipalities in Esmeralda County are Dyer, Silver Peak, and the county seat of Goldfield. Most of these communities are unincorporated. The county also features several ghost towns: Balir, Coaldale, Hardluck, Lida, Gold Point and Palmetto.



Figure 24. Ghost Town of Coaldale, NV

Esmeralda County-Level Issues

According to the Esmeralda County Master Plan, economic development and community expansion are difficult to improve upon because of the extent of public land ownership in the state. The Bureau of Land Management (BLM) owns 2,160,098.1 acres of land in the county; whereas only 61,193.1 acres of land is privately owned. This dynamic inevitably leads to tensions between the local people and the federal government. The county’s master plan addresses these concerns in recommendations for the county:

With a total area of 3,582 square miles and a population of about 1,141 persons, the population density is 0.3 persons per square mile, the lowest in the state and one of the lowest in the nation, according to the 2015 American Community Survey.

“Specific challenges regarding the Bureau of Land Management include the frequent BLM personnel changes. BLM personnel are transferred too frequently to really understand and appreciate specific local situations. BLM must notify the County Commissioners and ECLUAC prior to contemplating any land use changes, pursuant to the Esmeralda County Public Land Policy Plan”.¹¹²

Apart from the county’s sensitivity about BLM personnel, the plan addresses the Federal government’s management of their lands directly—with issues referring to cattle grazing, one of the county’s major agricultural assets. According to County Master Plan:

There is too much Federal intervention in the grazing and mining activities of private citizens. Management of wild horses often is to the detriment of ranchers with grazing leases on Federal lands. Wild horse grazing areas should not be expanded, especially if such expansion would reduce ranching access to water or grazing. Overgrazing by cattle also needs to be properly managed.¹¹³

These concerns are tied to an incident that occurred in 2001 when two cattle ranchers, Ben Colvin and Jack Vogt, had 200 cattle confiscated by the BLM after they had refused to pay grazing fees for several years.¹¹⁴ The incident caused a great stir in both Nye and Esmeralda counties, but was not the first in the area. Much of the West has gone through periods of “Sage Brush Rebellions”, where states demand control of federal lands. This issue that is especially pertinent today as the federal government considers releasing land for state control or sale.¹¹⁵

Table 7. Land Ownership in Esmeralda County, NV

Organization	Total Acres	Percent
Bureau of Indian Affairs (BIA)	3,017	0.1%
Bureau of Land Management (BLM)	2,160,098	94.1%
U.S. Forest Service (USFS)	66,688	2.9%
National Park Service (NPS)	3,278	0.1%
Nevada State	360	0.0%
Private	61,19	2.7%
Water	288	0.0%

As of 2005, Esmeralda County's major industries are government, mining, service and trade. Some of the major employers are the County itself, the school district and the Chemetall Foote Company, a company that mines lithium in Silver Peak.¹¹⁶ Another major sector is agriculture—there are 34,606 acres of farmland in the county, which amounts to approximately \$1,791 per acre. The USDA's Agricultural Census shows that more than half of the farms in the county produce \$100,000 or more in sales. According to the U.S. Census, the county's median household income is \$39,271, and the county has a poverty level of 14.7 percent, comparable to the nation's 13.5 percent.

In addition to issues with land ownership, the state finds itself with a limited water supply, which may be affected by future climate trends. The county master plan states that any future growth must be in accordance with the amount of water available, stressing that local citizens and officials know best practices of water management for the area. Water, climate and energy problems will be addressed in more detail in the following sections.

Water

The state's climate is semi-arid to arid.¹¹⁷ Esmeralda County's average rainfall is three inches a year and the state as a whole is the driest (in terms of annual rainfall) state in the country.¹¹⁸ According to the USGS, the county is in two hydrographic regions and basins—the Central region and the Death Valley Basin. There are no major bodies of water with average flows more than 10 cubic feet per second (cfs); whatever surface water is available is limited and vital to the county's agriculture, mining and water supply. Springs are used more often than surface water for supplying people and industries in the county. Because of the limited surface water available and the low rainfall, Esmeralda County is particularly vulnerable to drought. The USDA designated all counties in the state as drought-affected in 2002 and from 2004 to 2009.¹¹⁹

Since water is essential not only for the population, but for mining, agriculture and wildlife in the county, it is an issue that needs to be monitored and addressed appropriately. Though economic growth can play a vital role in the success of the county, it will inevitably put stress on the water supplies. Lithium mining is particularly water intensive. The demand for lithium in Nevada will be on the rise due to the construction of a new Tesla Gigafactory in Washoe County. Ranchers and farmers are dependent on these water sources for survival. Without a healthy supply of water, neither crops or livestock will have a viable means of survival.

Not only is drought a hazard in the state, but as with other dry regions, flash floods and water runoff are predicted to be a more prevalent issue in the area. This can cause water stagnation, making mosquitos more likely in the area. This has the potential for health risks and can act as a deterrent for potential tourists to the area.¹²⁰



Figure 25: The Chemetall Foote Lithium Operation in Clayton Valley, Esmeralda County, Nevada. (2010)

Energy

Electricity in the county is provided by two large companies—NV Energy and Valley Electric Association (VEA) according to the Rural Desert Southwest Brownfields Coalition. NV Energy provides power primarily using natural gas, however it does have two locations outside of Las Vegas which use renewable energy. There are no generating stations in the county of Esmeralda, and most of the power from this company is generated using natural gas at Fort Churchill, outside of Reno.¹²¹ VEA, on the other hand, is a cooperative that does not actually generate electricity, but bargains for the lowest cost based on wholesale purchases. The VEA website states that they provide service to 45,000 people in the surrounding area from their location of Pahrump, Nevada, in Nye County. The VEA serves rural communities specifically, ensuring that they have access to reliable sources of power.¹²²

According to the Rural Desert Southwest Brownfields Coalition, the county has plenty of potential for renewable energy production, including geothermal, solar and wind (see appendix for map of potential areas).¹²³ The BLM has a Solar Energy Program that seeks to simplify the process of developing solar fields on federal lands. The Millers solar energy zone (SEZ) is located in Esmeralda County, Nevada, and has 16,534 acres for potential development. Despite these efforts, there are no current project applications for this area of the county. This is a potential project the county could take on to develop energy for the region and provide jobs.¹²⁴

Aside from being rich in renewable energy potential, Nevada is rich in various minerals which have been the economic support of the state since its founding. Esmeralda County is

home to the only lithium mine in the United States. It is operated by a company called Chemetall Foote in Clayton Valley. With support from Harry Reid (D-Nevada), the plant received \$28.4 million in a federal stimulus grant from the Department of Energy to expand its capacity and build a geothermal power plant so it could become self-sufficient for energy.¹²⁵ Although the plant has provided a large economic boost to the area, lithium mining is also very water intensive. The balance of economic development and environmental sustainability is one which many frontier counties must deal with.

The balance of economic development and environmental sustainability is one which many frontier counties must deal with.

Climate

Esmeralda's climate is arid with low annual precipitation rates. Most of the county is open basins surrounded by mountains, the county is east of the Sierra Nevada Mountain Range. Nevada as a whole is blocked from precipitation from the Sierra Nevada Mountains that create a rain shadow effect, stopping wind and moisture from moving past the range. Average temperatures in winter months are from 25°F to 47°F and 76°F to 92°F in summer months. According to the United State Environmental Protection Agency, the state has warmed by two degrees Fahrenheit in the past century and will continue to do so—this can cause a decrease in water flow and an earlier snowmelt that could have serious impacts on the state overall. The decrease in water supply will negatively affect ranchers as well as farmers. The rising temperature can have an adverse effect on cattle and cows, making them produce less milk. Rising temperatures with a decreased water supply can also have an impact on wildfire likelihood: "On average, about five percent of land in Nevada has burned per decade since 1984" (Redsteer). Wildfires have adverse effects on air quality and health as well as infrastructure and buildings.

These environmental changes have significant impacts not only on the health of the people in the community, but on the economic health of it as well. Esmeralda County attracts visitors for its outdoor recreation including camping, hunting, fishing and hiking in areas such as Inyo National Forest and Death Valley National Park (forestry). Higher temperatures, poor air quality or risk of wildfires may deter this tourism from the region.

Conclusions

In order to prepare Esmeralda County, Nevada, for climate challenges brought on by rising temperatures, special attention must be paid to water availability and mining. Lithium mining provides a big economic boost to the county and the state as a whole. Lithium mined in Esmeralda County will find its way north to the Tesla Gigafactory in Sparks, Nevada, which is also a large industry in the state. Though the economic impacts are great, the water resources required are also large. Esmeralda County needs to ensure that resources for mining, agriculture and human consumption are adequate. This includes planning for any future development. Esmeralda County also finds development difficult due to the ownership of federal lands in the area. The county would benefit from clear communication with the BLM and other federal lands management organizations.

Energy: Oil County - Richland County, MT & McKenzie County, ND

We have always been dreamers in Montana. – Brian Schweitzer

Montana should come with a surgeon general warning that it's addictive. The sky is big and blue, and the air is always fresh and crisp and scented with pine. There's a frontier spirit, but also a calmness, beauty in the landscape that slows your pulse. – Robin Beilman

I was born in a very small town in North Dakota, a town of only 350 people. I lived there until I was 13. It was marvelous advantage to grow up in a small town where you knew everyone. – Warren Christopher

I have always said I would not have been President had it not been for my experience in North Dakota. – Theodore Roosevelt

Map 12. Location of Richland County, MT

Location of Richland County, MT



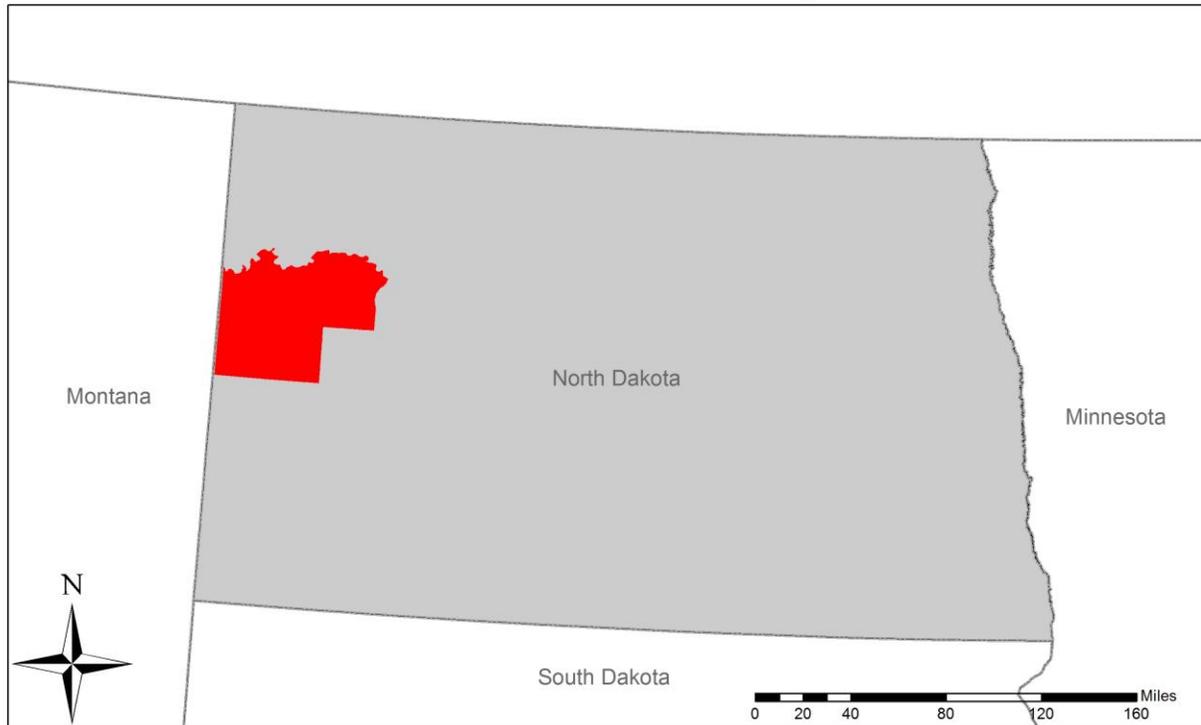
Legend

-  State Boundary
-  Montana
-  Richland County

Source: Economic Research Service, U.S. Department of Agriculture; American Community Surveys(2011-2015);www.socialexplorer.com;<https://www.census.gov/geo/maps-data/data/tiger.html>

Map 13. Location of McKenzie County, ND

Location of McKenzie County, ND



Legend

- State Boundary
- North Dakota
- McKenzie County

Source: Economic Research Service, U.S. Department of Agriculture; American Community Surveys(2011-2015);www.socialexplorer.com;https://www.census.gov/geo/maps-data/data/tiger.html

Background

Richland County, Montana, and McKenzie County, North Dakota, lie adjacent to one another in the northeast and northwest regions of each state, respectively and two counties south of their states' northern borders with the Canadian province of Saskatchewan. As of the 2015 edition of the American Community Survey (ACS), Richland County had a population of 11,132, or 5.3 per square mile. The County seat is Sidney, with a population of 6,216 and home to over half of Richland County residents. McKenzie County's population is 9,615 (as of 2015) but one of the country's fastest-growing since the last U.S. Census. Just five years earlier, McKenzie was home to 6,360 residents, meaning the population grew over 51 percent from 2010 to 2015.

Richland County also experienced significant growth. Its 2015 population represented a 14 percent increase over what was recorded just five years earlier for the decennial census - a growth rate almost six times higher than the state's overall growth. The story of this growth underlies the very feet of Richland and McKenzie County residents - specifically, the oil-rich Bakken Formation. The Bakken Formation is best-known for spurring the energy boom in North Dakota, but its effect on Richland County's economy has been almost

as large in recent years, bringing with it all the prosperity - and long-term uncertainty - of any other energy boom.

First, the prosperity: 2015 ACS estimates pegged Richland County's median household income at \$65,084, a number not only significantly above the state and national median, but more than *double* the \$32,110 county median figure measured in the 2000 decennial census. (This is a massive increase even accounting for inflation: according to the Consumer Price Index's inflation calculator, \$32,110 in 2000 is equivalent to just over \$44,000 in 2015 dollars.) Conversely, poverty levels in the county are relatively low: 11.4 percent of Richland residents lived below the poverty line as of the 2015 ACS, a lower figure than both Montana and the nation overall, and a decrease from 15.8 percent as measured by the ACS just three years earlier. McKenzie County's median income, \$72,794, is even higher, as was its increase over 2000 (\$29,342, or \$40,624 in 2015 dollars).

Richland's population is overwhelmingly white, even more so than the population of Montana as a whole, which is itself significantly whiter than the overall U.S. population. As of the 2015 ACS, Richland was 94.6 percent white, compared with 89.2 percent overall in Montana. Richland also had a significantly lower proportion of Native Americans and Alaska Natives - Montana's largest racial/ethnic minority group - than the state as a whole (2.3 percent vs. 6.5 percent). McKenzie is also predominantly white, though less so than Richland (78.3 percent, as of 2015). This owes largely to a much larger American Native Americans/Alaska Native population (17.8 percent, though this represented a decrease from over 22 percent as of 2010).

County Issues

When browsing the website of the *Sidney Herald*, a newspaper serving Richland's county seat of Sidney and the surrounding area, the top sub-section the reader sees in the paper's "News" section is titled "Oil Activity." This should be no surprise, given the importance of the oil boom the Richland County's economy. The *Herald* hints at both the costs and benefits of a boom, not only for Richland County but North Dakota as well, given its proximity, many *Herald* stories cover events in the latter state. One brief item from January 2016 reports what seems to be good news on the surface - lower crime in Divide County, North Dakota - but notes that the drop is tied directly to slowdown in oil-related economic activity in the county. The Divide County sheriff, it briefly notes, "recently cut two positions." Other items range from the prosaic - a December 2015 report that Bakken investment activity remains robust - to more colorful, a February 2016 report on Williston, N.D., banning strip clubs.

Climate



Figure 26: Stenehjem family barn in McKenzie County. (Credit: Tim Evanson)

In May 2015, the United States Department of Agriculture (USDA) released a climate vulnerability report for the Northern Plains region, consisting of Colorado, Montana, Nebraska, North Dakota, South Dakota, and Wyoming. The report notes that the Northern Plains region has over 140 million acres of pasture/rangeland, a third of the overall U.S. total. While energy increasingly dominates the county's economy, Richland typifies this concentration of pasture. According to a 2007 county report on projected future growth, agriculture is by far the top land use in Richland, with over 90 percent of the county's land area used for farms and ranches. In all, per the 2012 Census of Agriculture, Richland has nearly 1.3 million acres of farmland that accounted for over \$139 million in product sales in 2012. McKenzie County is similarly farm-heavy: as of 2012, it had over 1 million acres of farmland accounting for over \$114 million in sales.

According to a 2007 county report on projected future growth, agriculture is by far the top land use in Richland, with over 90 percent of the county's land area used for farms and ranches.

That \$139 million and the products whose sales constitute it may be in for drastic changes in the coming decades if the USDA vulnerability assessment's predictions come true. Greenhouse-gas-driven climate change is projected to raise temperatures in the region by 2-4°F by 2050, which the assessment in turn projects will result in increased springtime precipitation, but also increases in drought and heat waves. Increased precipitation will lead to increased production, but the assessment also predicts "increased abundance...of

weeds and invasives [sic]" as well as more frequent droughts, which are already proving to be an issue in the region, and could at least partially negate increased productivity.

According to the 2007 Richland County economic development report, Richland County is Montana's top producer of sugar beets, oats and safflower. It is also a major producer of corn, for both grain and silage (fourth and third in the state as of 2007, respectively), a top-ten producer of spring wheat in Montana, and a major cattle producer, as well. Sugar beets grow in temperate climates, and even a significant rise in temperature, will likely still leave Richland County as a habitable zone for harvesting them. However, a 1951 study by the University of California-Berkeley's Albert Ulrich noted that "the maximum amount of sucrose is produced at a lower night temperature than the maximum beet root growth," which suggests rising temperatures could adversely impact the productivity of future yields. Additionally, more frequent drought conditions could impact conditions for cattle, as well as overall conditions, for ranch land.

Energy



Figure 27: Oil pump jack in McKenzie County. (Credit: Tim Evanson)

Richland County's relatively high level of wealth can be tied directly to its status as an energy juggernaut: the USDA's Economic Research Service classified Richland County as "mining dependent" as of 2015. 2014 county business patterns data from the U.S. Census bears this out: as of that year, 14.3 percent of all workers in the county worked in the fields of mining, quarrying, or oil/gas extraction. Nationally, the proportion is 0.63 percent, meaning that a given worker in Richland County is almost 23 times as likely to work in one

of those fields as a worker picked at random from the overall U.S. employee pool. McKenzie County was almost no different: 13.8 percent of workers there worked in mining/quarrying/oil and gas extraction as of 2014.

While this mining explosion drove the relatively high levels of prosperity in Richland and McKenzie counties, future prospects in each county are much murkier. Oil prices currently sit at approximately \$54 per barrel, barely half of what they were even three years ago. Aside from first-order effects on the oil industry (a June 2016 article in the *Wall Street Journal* is one of many now calling the oil boom an "oil bust"), the decline is hurting the many other industries that emerged to support the burgeoning economy in Richland, McKenzie, and elsewhere in the Bakken field.

A 2016 *Reuters* story detailing North Dakota's recent struggles (described as "a humbling comedown") tells the story of a postal service business, thriving just three years before, now struggling to stay afloat. Other scenes described in the story border on dystopic: "hundreds of empty apartments," declining salaries both inside and outside the oil industry, and state oil tax receipts declining by 70 percent. Such scenes are likely to become more widespread so long as Richland and McKenzie counties remain so dependent on extractive industries.

Employment numbers paint a mixed picture. According to data from the Bureau of Labor Statistics, mining and logging employment in Montana was down four percent from a year ago, as of February 2017, and six percent in North Dakota over the same timeframe. In both cases, the decline in mining/logging outpaced overall state trends: overall employment in North Dakota fell just 0.7 percent from February 2016 to 2017, and overall employment in Montana *increased* by 2.4 percent. It should be noted that the 12-month mining decreases were far more severe in both Montana and North Dakota as of last September, but this may have more to do with seasonal effects than a true industry rebound.

Water

The National Drought Mitigation Center at the University of Nebraska-Lincoln keeps a list of "Drought-Related USDA Disaster Declarations" by county. The USDA judges these counties particularly susceptible to drought for a given growing season, and therefore invites them to apply for emergency loans. For the 2016 growing season, both Richland and McKenzie counties were placed on this emergency list.

While both counties are judged mining-dependent, as mentioned above, agriculture plays a significant role in both county economies, making potential drought conditions especially concerning. As of the 2012 agricultural census, the counties combined to produce over \$250 million in farming-related sales (approximately two-thirds from crops and one-third from livestock), estimated at more than \$225,000 per farm. Drought conditions could imperil these totals, and assuming the overall trend of a declining oil industry continues, this could have disastrous effects for the economy of each county. As the many stories on the Bakken oil decline show, the fall of even one major wealth-generating industry can imperil massive economic gains. If something similar were to happen to agriculture or ranching in the region, the long-term viability of both Richland and McKenzie counties would be in doubt.

Conclusions

While falling oil prices and increased drought risks are disquieting signs for Richland and McKenzie's economic future, they need not be fatal. Increasing probability of drought conditions does not necessarily mean less water. The USDA's Northern Plains climate assessment projected an *increase* in spring precipitation by the end of the century. Climate change does, however, mean the water supply could be more volatile, and in Montana's case, an EPA assessment from last year predicted that a warming climate will likely mean less water for areas of the state that depend on melting snow for their supply. This, however, is likely to be more relevant for the western half of Montana than the eastern half, where Richland County is located. North Dakota, meanwhile, may have less availability concerns, but will likely see increased flood risks, as per a similar EPA report.

Richland County's growth plan, adopted in September 2015, outlines three primary goals and objectives for future economic development: 1) Continue developing a sustainable and diversified economic base; 2) Support existing businesses through expanding ... infrastructure; and 3) Expand the county's production of high-value crops and potential value-added industries. Similarly, McKenzie County's most recent comprehensive plan, adopted in 2016, "recognizes the need to diversify [the county's] economic base." It identifies Calgary, Alberta and Houston, Texas, as major cities that, while energy-reliant, have built much more sustainable economies. Like Richland County, McKenzie County's plan places strong emphasis on ensuring the long-term sustainability of the energy industry. However, McKenzie places more emphasis on tourism than Richland, and less on agriculture. This, though, may be because McKenzie County's plan has an agricultural element separate from the economic development element. That agricultural element counts among its goals to conserve farmland, enhance the county's ranching industry, and "preserv[ing] the county's agricultural heritage and economy."

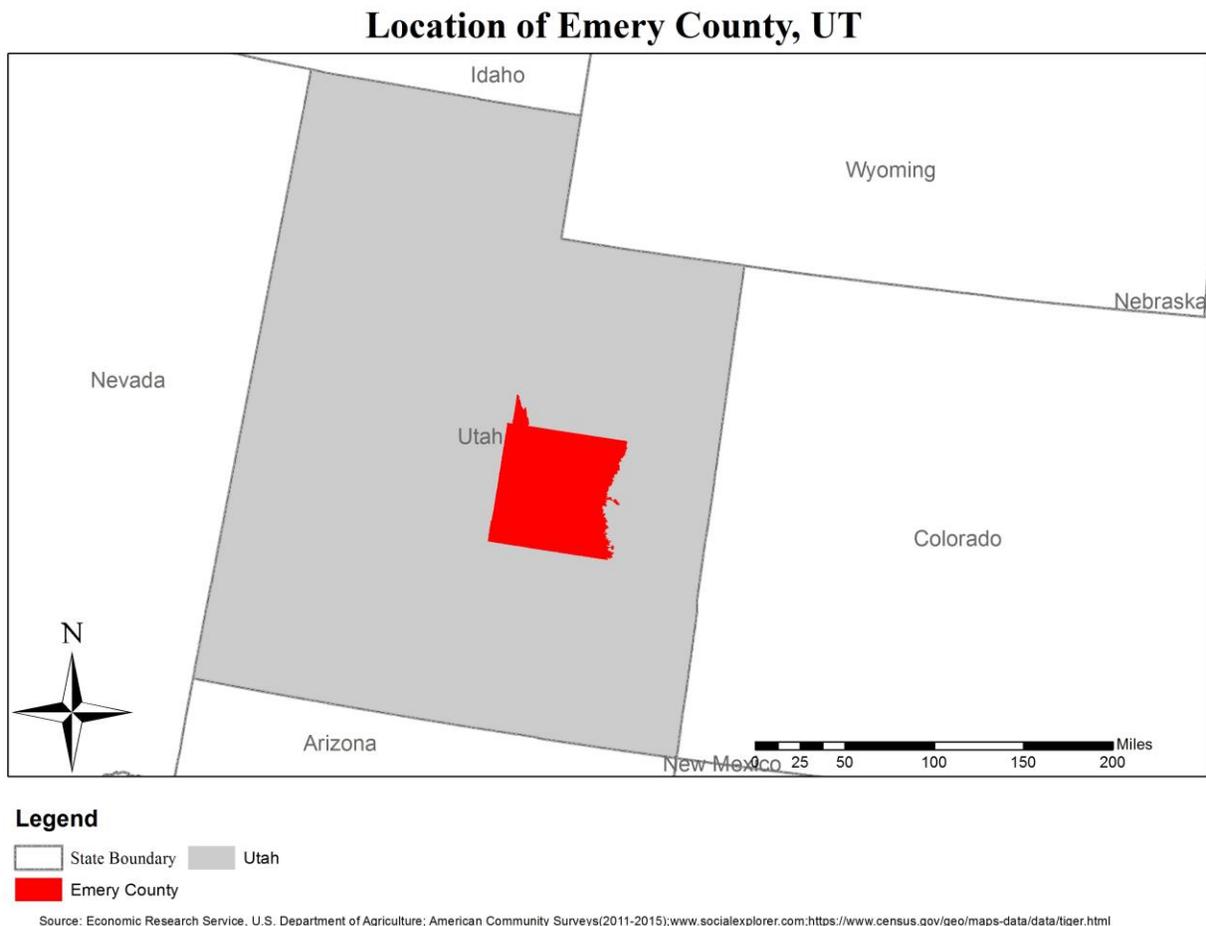
Given McKenzie County's expanding economy and population in recent years, as well as the general volatility of the extraction industry, the county should move beyond trying to *maintain* its agricultural industry and attempt to *expand* it. Agriculture is the county's dominant land use, and the industry is much less prone to busts than energy. However, the counties must each make every effort to care for their water, because without an adequate supply to fund agricultural activities, the industry risks becoming more volatile in the future itself. Of course, this water supply will depend in part on the effects of climate change, which stand to be exacerbated by future extractive activity. While the fact that the counties are in different states may make this difficult, McKenzie and Richland might consider cross-county partnerships to enhance future development. Given the recent reliance of both on the energy industry and the historical - and potentially future - reliance of both on agriculture, the counties may be able to collaborate in productive ways to sustain each industry. McKenzie County's plan mentions the need to "promote and market the County's agricultural products within ... the greater region." Perhaps a partnership with Richland County, itself a significant producer of agricultural products, could pay off. In many ways, the futures of Richland and McKenzie Counties are intertwined. Formally acknowledging this through economic partnerships could extend each county's period of prosperity, and ensure each will be prepared if and when the oil industry ceases to be a driver of growth.

Energy: Coal County - Emery County, UT

Utah is America's best place for business because Utahns make it their business to succeed - and we have the track record to prove it. – Gary Herbert

Utah today remains a battleground for land-use policies. – Stewart Udall

Map14. Location of Emery County, UT.



Background

Sitting in the center of Utah, one county removed from the state's eastern border with Colorado, Emery County is a longtime mining hotbed. Similar to Richland and McKenzie counties, Emery County faces an uncertain economic future, but without the benefit of a recent boom to stay afloat. As of the 2015 American Community Survey, it was home to 10,728 residents, a population of just 2.4 people per square mile. Unlike Richland and McKenzie counties, its population has remained static in recent years; the 2010 decennial census pegged Emery's population at 10,976. If anything, the population is slowly falling: its estimated 2016 population was 10,216, a decline of 4.8 percent from a year prior and almost 7 percent from 2010.

Emery County's population is also older than Utah's as a whole. While the average age of Emery County residents (32.8 years old as of the 2010 census) is significantly lower than the U.S. average, this figure is three years older than the average in Utah, an unusually young state overall. Like the surrounding states, Emery County is overwhelmingly white, to an even greater degree than the rest of Utah; 94 percent of Emery County residents identified themselves as white only, in the 2010 census. Income is also more modest in Emery County than in the oil boom counties of the northern plains at \$49,787 as of the 2015 American Community Survey. While a nominal increase over the \$45,726 median recorded for the 2000 census, the 2015 figure is significantly lower in real terms when considering inflation.

County Issues

Emery County's population and income, which are each static at best and declining at worst, are no surprise considering its residents historically built their wealth through coal mining, an industry experiencing a decades-long decline that may be irreversible regardless of President Donald Trump's pledges to revitalize it. The *Emery County Progress*, the local newspaper, is peppered with items like the public notice that ran on March 21, 2017, about three upcoming abandoned mine reclamation projects in the county.

The county's challenges ultimately come back to finding a way forward less dependent on coal mining. The County's general plan, first adopted in 1996 and most recently revised in 2016, acknowledges this, but also provides room for optimism through "well-planned and well-managed recreational development," as well as "innovative new industries and the established agricultural base," particularly in the latter through "value-added agriculture".¹²⁶ Some recommendations are more familiar: the report notes that "the County desires to expand and support retail businesses."

Climate

Emery County found itself in the news recently thanks to a study by the Yale Program on Climate Change Communication about belief in global warming. The program mapped adults' belief in the phenomenon nationally by county, with a national average of 70 percent of adults saying they believe global warming is happening. In Emery County, however, just 49 percent of adults said they believe global warming is happening, tied for the lowest figure of any county in the country. Emery County's result was so atypical that Cable News Network (CNN) sent reporter John Sutter there to interview residents about their opinions on climate change. The local newspaper, the *Progress* ran a story on Sutter's visit.

Emery County residents' skepticism is understandable when viewed through the perspective of self-interest. The impact of coal usage on climate change is a major driver in the industry's decline, and the likely result is that many Emery County residents see climate change as less a long-term threat to the planet and more as a near-term threat to their livelihood. Indeed, Sutter recounted some of his conversations with Emery County residents to the *Progress*: "Some of the people have said they think it's a conspiracy of people trying to make money off of it. Some say it's politics and wanting to kill the coal industry." Climate skepticism is also correlated with more conservative political views, and Emery County's deep-red status no doubt plays a role in residents' belief - or lack thereof -

in global warming. Donald Trump received nearly 80 percent of Emery County's votes in the 2016 presidential election, and Emery County's Congressional district has been represented by a Republican since 1997.

Still, Emery County officials must account for potential impacts of a warming climate on both critical area industries and the lives of residents. According to a 2016 EPA assessment, Utah has warmed approximately two degrees in the last century. The assessment also includes a map showing warming by region nationally, and Emery County falls within the region of Utah that has warmed the most over that time. Beyond further declines in the coal industry, this level of warming will also impact agriculture, which could be critical as Emery County takes the first steps toward a post-coal economy. The EPA's report singles out the effects rising temperatures have on cows: they “cause them to eat less, grow more slowly, and produce less milk.”



Figure 28: Little Grand Canyon in Emery County. (Credit: Greg Willis)

This could stand to negatively impact both Emery County's livestock industry (per the 2012 Census of Agriculture, almost two-thirds of Emery County's farming revenues came from livestock sales) and livestock grazing. Warming may also have an impact on the landscapes of Emery County, which could in turn impact tourism, another potential key future revenue stream for Emery County. This impact may not necessarily be negative, but it is nevertheless an impact for which county officials should account in future planning.

Energy

"Coal has been a part of the fabric of Utah for 161 years," wrote reporter Amy Joi O'Donoghue in a 2015 *Deseret News* series on coal, and nowhere is this truer than Emery County. Exact numbers from 2014 County Business Patterns census data are not available, but based on its most conservative estimates, over 10 percent of county employees work in mining, quarrying, and/or oil and gas extraction. This would outpace the national concentration of workers in the industry by a factor of more than 15, but the tide may be turning. The same *Deseret News* feature noted that Emery County's Deer Creek Mine, the last unionized mine in the state, closed in 2015, costing 182 workers their jobs.

If it is at all possible for some of those workers to make a living elsewhere in the energy sector, Emery County is willing to try. The County General Plan advocates "wise utilization of all existing and potential (i.e. renewable energy, rare earth elements) natural resources within the county." If renewable energy firm Onyx Renewable Partners has its way, Emery County will soon add solar to its energy portfolio. According to a March 21, 2017, item in the *Progress*, Onyx executive Luigi Resta recently visited the area and talked with officials about the possibility of obtaining tax abatements. Such a deal is far from official, the *Progress* article reported that a Community Reinvestment Area would need to be created before even deciding whether to award tax abatements, but that the county is receiving interest at all suggests potential in the energy sector beyond the traditional coal.

Water

Unlike McKenzie and Richland Counties, Emery County was not on the USDA disaster declaration list for 2016. However, much of the state of Utah has been subject to drought conditions in recent years. The state was recently declared drought-free for the first time since 2011, per a March 2017 report, and it took an unusually wet winter to end those conditions statewide.¹²⁷ As recently as last year, the University of Nebraska-Lincoln's National Drought Mitigation Center reported drought conditions impacting a sheep ranch and hay farm in Emery County. Given that the EPA's 2016 climate change assessment for Utah projected a long-term decline in water supply for the state, it is easy to imagine drought conditions returning, and further impacting Emery County businesses.

Emery County's General Plan includes a section on water resources, and several objectives aimed at protecting both the quality and quantity of the county's water supply. The plan acknowledges the county "is experiencing over-utilization pressures as well as political pressures on its water resources," and vows to "resist any method of taking without compensation." In particular, it notes that "the demand for western Emery County water greatly exceeds the supply," unsurprising given that a statewide map of drought conditions indicates that only the western part of Emery County was experiencing drought as of 2016. The plan mostly deals in generalities, though it does specify that "any water interrupted by mining, subsidence, etc. shall be replaced in quality, quantity, kind, and/or compensated for."

Recommendations & Conclusions

Emery County's economy must make changes to remain viable in the coming years and decades, and those in the county seem to understand this. As in Richland and McKenzie counties, mining employment in Emery County is currently declining significantly; mining employment numbers for February 2017 were 10 percent lower than a year earlier, per U.S. Bureau of Labor Statistics (BLS) data. However, one should not paint too dire a picture of the county's future, either. The same BLS report showed February 2017 unemployment in Emery County at just 3.1 percent, significantly lower than the 4.8 percent reported when the closing of the Deer Creek Mine was announced in December 2014. (It should also be noted that 4.8 percent, while higher than Utah's overall rate at the time of 3.6 percent, is hardly a catastrophic number itself.)

While coal mining is likely not Emery County's key to a prosperous future, the other industries elucidated in the county plan, including tourism and agriculture, do hold the potential to take at least some of the place of coal's decline. And Emery County's potential as a renewable energy hub, seemingly confirmed by Onyx's interest in doing business there, is especially intriguing - there may be a way for the county to retain an energy-intensive economy going forward, as well. The county must proceed with caution, however, and carefully weigh potential costs and benefits to ensure that any tax abatements awarded to companies do not amount to giveaways. While Emery County faces many challenges moving forward, it is not currently in a dire situation and must be judicious in awarding incentives to corporations.

Finally, Emery County officials must seriously consider potential future effects of climate change, particularly on county water supply. Without using the words "global warming" or "climate change," the County Plan does this to an extent, noting the strain on county water resources, the importance of increasing and enhancing storage areas, and the continued importance of education on water conservation techniques. While Utah recently escaped drought status, so long as long-term climate trends continue, drought conditions are likely to do the same. Adequate water supply is critical for serving an increased population of both permanent residents and tourists, as well as sustaining agricultural growth. Agriculture and tourism will almost certainly be two critical prongs of Emery County's economic future, and their future - as the county's as a whole - cannot be written without accounting for the effects of climate change.

Resource Extraction – Coastal County: Del Norte County, CA & Curry County, OR

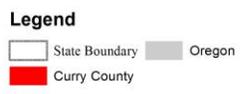
“Nothing is more priceless and more worthy of preservation than the rich array of animal life with which our country has been blessed.” – Richard M. Nixon, Statement on Signing the Endangered Species Act of 1973

“Lonely as a cloud / In the Golden State / The coldest winter that I ever saw / Was the summer that I spent” – “Jumpers”, Sleater-Kinney



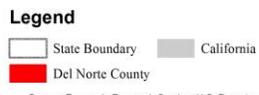
Figure 29: Battery Point Lighthouse in Del Norte County (Credit: Greg Willis)

Map 15. Location of Curry County, OR



Source: Economic Research Service, U.S. Department of Agriculture; American Community Surveys(2011-2015);www.socialexplorer.com;https://www.census.gov/geo/maps-data/data/tiger.html

Map 16. Location of Del Norte County, CA



Source: Economic Research Service, U.S. Department of Agriculture; American Community Surveys(2011-2015);www.socialexplorer.com;https://www.census.gov/geo/maps-data/data/tiger.html

Geography

Approximately midway between the borders of Canada and Mexico on the American Pacific Coast, the counties of Del Norte County, California, and Curry County, Oregon, are two of the country's coastal frontier outposts. These counties are located adjacent to each other, roughly 300 miles north of San Francisco and 250 miles south of Portland. In Curry County, more than 91 percent of the population lives in what the U.S. Department of Agriculture refers to as a "FAR2" area – meaning zip codes that are at least a 45-minute drive away from an urban area with approximately 25,000 to 49,999 residents and more than an hour from an urban area with more than 50,000 people. More than 82 percent of Curry County's land area falls within the FAR2 area. In Del Norte, more than 94 percent of residents live in a FAR2 area, which itself comprises approximately 60 percent of the County's land area. The areas are small in both size and population; together, the counties represent only 1.2 percent of the combined land area in Oregon and California, and only 0.12 percent of the combined 2010 populations of those states.

Del Norte County has an estimated population of 27,788 residents in 2015 and is the northernmost county on the California coast with approximately 40 miles of Pacific Ocean coastline. It is bordered to the north by Curry County in Oregon, to the south by Humboldt County, and to the east by Siskiyou

The Smith River is a rarity for being the only river in California without a dam within its watercourse.

County. Its major settlements are clustered along highways U.S.-101 and U.S.1-99 and include Crescent City and Smith River. Almost all of the county is mountainous and heavily forested. Portions of the Redwood National Forest are found in the county, in addition to the Smith River National Recreation Area, Jedediah Smith Redwoods State Park, Del Norte Coast Redwoods State Park, Tolowa Dunes State Park, and the Lake Earl State Wildlife Area. The Klamath and Smith Rivers also run through the county, with the Smith River being part of the National Wild and Scenic River Program. The Smith River is a rarity for being the only river in California without a dam within its watercourse.

Curry County, Oregon is home to 22,388 residents and is the southernmost coastal county in the state. Brookings, Gold Beach, and Port Orford are the major settlements in the County, with Gold Beach being the county seat. Curry County is bordered to the south by Del Norte County, to the east by Josephine County, and to the north by Coos and Douglas Counties. Like its neighbor to the south, Curry County is predominantly forested and mountainous, though it has considerably more logging operations and barren terrain. The Rogue River-Siskiyou National Forest forms much of the eastern half of the County, which has approximately 75 miles of Pacific Ocean frontage. The Rogue and Chetco flow through the County along with numerous other intermittent streams. Both river systems are part of the National Wild and Scenic River program.

History

Del Norte County History and Overview

The Tolowa and Yurok peoples initially settled Del Norte County more than 2,000 years before white settlers moved into the area in the 1800s and removed the Native Americans. The Native Americans were then forcibly settled in two separate reservations in 1855 and in 1862 before finally being removed to the Hoopa Valley Reservation in Humboldt County in 1870. As of 2015, the American Community Survey estimates only 1,484 Native Americans (or 5.3 percent of the County's total population) remain in Del Norte County.



Figure 30: Crescent City, Ca., circa 1900s.

Whites were initially drawn to Del Norte County for prospecting, as gold had been discovered in the Trinity River in 1850. Crescent City was planned in 1853 and developed as a port of entry for the area. Throughout the latter half of the 1800s, the logging and mining industries defined economic activity in the County. A fishing industry developed in Crescent City, and a salmon fishery was active in the first few decades of the twentieth century. As shown in the table on the following page, Del Norte County's population expanded considerably when the price of commodities (particularly lumber and fish) increased. These boom periods occurred between the 1920s and 1930s, and then again between the 1940s and 1950s. However, declining commodity prices had large effects on the County's economy due to its initial dependency on fishing and lumber.¹²⁸ By the later quarter of the twentieth century, the creation of Redwood National Park and institution of new logging regulations dealt a critical blow to the County's lumber resources

The California Department of Correction and Rehabilitation has stated that there are approximately 2,700 male inmates housed at the prison as of 2013.

market. In addition, fish kills (brought upon by warmer water) have contributed to declining populations of fish – particularly salmon – and resulted in strict fishing restrictions to the waters around the Del Norte Coast.

During the boom periods, the population growth rate in Del Norte County exceeded that of both California and the United States as a whole. Yet during the economic transition period, the County initially lost 18 percent of its population before increasing to nearly 100 percent of its 1970 population. After the lumber bust in the 1960s, the economy and population have rebounded, with tourism and related services supplanting the resource extraction industry. Currently, the County has reduced its dependency on commoditized natural resources. In 1989, the Supermax Pelican Bay State Prison opened in Del Norte County, providing jobs in the state government sector. The California Department of Correction and Rehabilitation has stated that there are approximately 2,700 male inmates housed at the prison as of 2013. The Prison has provided a stable source of government jobs for area residents.

Table 8. Del Norte County Land Ownership

Owner	Acreage	Percent
USDA Forest Service	411,764	60.2%
Privately owned land	192,357	28.1%
Del Norte County	26,414	3.9%
California Department of Parks and Recreation	25,000	3.7%
Tribes (Yurock)	15,000	2.2%
National Park Service	6,500	1.0%
California Department of Fish and Game	5,624	0.8%
Tribes (Rancheria)	692	0.1%
Crescent City Harbor District	150	0.0%
Total	683,500	
Source: 2011 National Hazards Mitigation Plan		

Land ownership in Del Norte County, as shown in the above table, is predominantly public. The USDA Forest Service owns the majority of land in the County, totaling more than 400,000 acres. Private land ownership accounts for more than a quarter of the county's land area, while other public entities and Native American tribes own a total of 11.7 percent of the land in the County. State holdings include the Tolowa Dunes State Park, Jedediah Smith Redwood State Park, and Del Norte Coast Redwoods State Park.

Curry County History and Overview

Like its southern neighbor, Curry County first received attention from white settlers because of the discovery of gold nearby and valuable lumber resources. However, the Chetco, who lived along their namesake river and the Pacific Ocean, had long been settled in the area that would become Curry County. The Chetco made innovative use of the region's natural resources without farming, instead relying on trapping, gathering, and the ocean's plentiful marine resources for food. The Chetco built canoes and houses, and the elderly were reported to live to 80 or 90 years old. By the early 1850s, whites had pushed the Chetco out to reservations (a process undertaken parallel with Del Norte County) and continued forced assimilation projects into the mid-20th century.¹²⁹

Early development by white colonizers was concentrated along the coastal areas due to the difficulty in navigating overland to the Curry County coast.¹³⁰ As in Del Norte County, gold was discovered in the County's beaches and along its rivers, heralding an early turn towards resource extraction (particularly mining). Like Del Norte County, the County has ridden the wave of booms and busts commensurate with the fluctuating commodities market.



Figure 31: Wreck of the Mary D Hume (Gold Beach, Ore.)

Table 9. Curry County Land Ownership

Owner	Acreage	Percent
USDA Forest Service	614,243	58.9%
Privately owned land	350,546	33.6%
Bureau of Land Management	67,463	6.5%
Oregon Parks and Recreation	7,475	0.7%
Oregon Department of State Lands	2,389	0.2%
Local Government	165	0.0%
Total	1,042,281	
Source: 2010 National Hazards Mitigation Plan		

Like Del Norte County, the USDA Forest Service is the majority owner of Curry County's land area. Private interests own approximately one-third of the County, which is slightly higher than that of Del Norte County. The State of Oregon owns a smaller share of lands (approximately 1.2 percent of the County as a whole) concentrated along U.S. Highway-101. These holdings include Humbug Mountain State Park, Cape Blanco State Park, and Floras Lake State Natural Area.

Table 10. Population Change in Subject Counties, States, and Country (1900-2015)

Year	Del Norte County, CA	% Change	Curry County, OR	% Change	CA % Change	OR % Change	US % Change
1900	2,408		1,868				
1910	2,417	0.4%	2,044	9.4%	60.1%	62.7%	21.0%
1920	2,759	14.1%	3,025	48.0%	44.1%	24.6%	15.0%
1930	4,739	71.8%	3,257	7.7%	65.7%	33.4%	16.2%
1940	4,745	0.1%	4,301	32.1%	21.7%	43.9%	7.3%
1950	8,078	70.2%	6,048	40.6%	53.3%	14.9%	14.5%
1960	17,771	120.0%	13,983	131.2%	48.5%	18.1%	18.5%
1970	14,580	-18.0%	13,006	-7.0%	27.0%	26.6%	13.3%
1980	18,217	24.9%	16,992	30.6%	18.6%	21.5%	11.5%

Year	Del Norte County, CA	% Change	Curry County, OR	% Change	CA % Change	OR % Change	US % Change
1990	23,640	29.8%	19,327	13.7%	25.7%	25.5%	9.8%
2000	27,507	16.4%	21,137	9.4%	13.8%	14.9%	13.2%
2010	28,610	4.0%	22,364	5.8%	10.0%	9.3%	9.7%
2015 (est.)	27,788	-2.9%	22,338	-0.1%	5.1%	5.2%	2.5%

Sources: RIHS.org, State of Oregon Office of Economic Analysis, US Census

County-Level Issues

Economic Development

Del Norte and Curry Counties each have challenges with economic development characteristic of other frontier communities. The Counties have enjoyed relative prosperity during boom times for certain resources, and have struggled when the booms goes to bust. For example, in the years between 1980 and 1989, the number of jobs in the wood products industry dropped 65.5 percent from 1,450 workers to 500 workers. In Del Norte County, healthcare/social services, retail, and food/accommodations trades make up the majority (nearly 70 percent) of private sector jobs in the County in 2015. Close to 60 percent of jobs in Curry County are comprised of the same in 2015. Both Counties have significant portions of their workforce in the government. In Del Norte, public workers account for close to one-third (32.7 percent) of the workforce, while in Curry County they account for close to one-fifth (19.4 percent). In Del Norte County, the higher proportion can be attributed to the Pelican Bay State Prison facility. A 1990 Study for Del Norte County found that tourism development had been hampered by weather, access difficulties, and the lack of tourist infrastructure.¹³¹

In Curry County, the poverty level in 2016 was 16.6 percent, whereas the poverty level in Del Norte County was 21.8 percent. With a median household income of \$40,847 in Del Norte and \$40,884 in Curry County, the Counties are poorer than the United States as a whole (with a poverty level of 15.5 percent and median household income of \$53,889) as well as their respective states. Curry County recognizes the need to diversify its economy as reflected in Goal Nine of the Curry County Comprehensive Plan. The policies set forth in the plan aim to protect the forest products industry while simultaneously promoting tourism and a diversified “local commercial enterprise”. Curry County has a higher percentage of its workforce in the manufacturing and construction sectors than Del Norte County.



Figure 32: The Klamath River.

Table 11. Employment Statistics in Selected Counties

Class of Worker	Del Norte County		Curry County	
	Count	Percentage	Count	Percentage
Civilian employed population 16 years and over	8,612	8,612	7,930	7,930
Private wage and salary workers	4,905	57.0%	5,366	67.7%
Government workers	2,815	32.7%	1,541	19.4%
Self-employed in own not incorporated business workers	858	10.0%	1,023	12.9%
Unpaid family workers	34	0.4%	0	0.0%

Difficulties with economic development can also be demonstrated by the lack of commuting and economic activity between counties. In Curry County, the vast majority (89.8 percent) of residents worked in the County itself, while the percentage was even higher in Del Norte County (93.4 percent). Respectively, only 8.2 percent and 5.1 percent of workers worked outside of their states. This indicates that the accessibility to areas outside of the counties may be constrained, that the counties have adequate jobs for working residents, and/or that the economies of the counties are particularly localized.

Public Finance

Both Curry and Del Norte Counties receive federal funds from the U.S. Department of Agriculture Forest Service under the Secure Rural Schools (SRS) and Community Self-Determination Act of 2000, which was most recently authorized in 2015. These funds are considered payments in lieu of taxes (PILT) resulting from the large percentage of government land holdings in these counties. According to the 2015 Congressional Research Service report on SRS, the U.S. Department of Agriculture's Forest Service began sharing revenues from timber sales and recreation fees with host counties of National Forests in 1908. A number of revenue-sharing arrangements between the federal and local governments persisted through the 20th century until the late 1980s, when a combination of factors (including wildlife protection, industry factors, procedural requirements) led to the decline of federal timber sales. Short-term budget appropriations to 17 National Forests in the Pacific Northwest commenced in 1993 and were known as "owl payments" because they were compensation resulting from habitat protection for the endangered spotted owl. The Secure Rural Schools law replaced these programs in 2000, and was instituted as an optional payment. Instead of receiving a quarter of revenues available from receipt sharing, counties could receive a payment equivalent to the average of the three highest payments under the previous system that occurred between FY1986 and FY1999. According to the report, this resulted in higher payments than under previous arrangements. However, a failure to authorize the SRS law would result in a reversion to the previous receipt-sharing formula. In 2017, the *Statesman's Journal* reported that the law had once again expired, and threatened to reduce SRS funding to Oregon from \$86.4 million to \$7 million.

The 11 years between 2005 and 2016 have seen substantial decreases in the amount of funding transferred to governments in both counties, as well as throughout the states with Proclaimed National Forests (PNFs). During this time, the total size of the National Forest system increased by 0.3 percent - roughly 551,000 acres – to 190.1 million acres. The National Forest System within Del Norte County, which consists of the Six Rivers and Siskiyou National Forests, has decreased slightly in acreage between 2005 and 2015. The size of Six Rivers National Forest decreased by more than 13,000 acres, or 3.1 percent. Forest holdings in Del Norte County within the Siskiyou National Forest have fallen by 1,718 acres or 5.2 percent. By 2015, the size of Six Rivers National Forest in Del Norte County was approximately 406,746 acres, while Siskiyou's acreage in the County totaled 31,542 acres. A larger portion of Siskiyou National Forest is found in Curry County, where the holdings of the National Forest have increased by 0.2 percent (or 1,152 acres) to 561,087 acres. Despite comprising the majority of each county's land area, Forest Service holdings in Del Norte County comprise only 2 percent of California's system, and Forest Service holdings in Curry County comprise only 3.7 percent of Oregon's system.

The key impact from the Forest Service's holdings in Curry and Del Norte Counties is the payments received by governments in the respective counties. These payments have fallen precipitously during the 11-year period between 2005 and 2015. Total payments received by Del Norte County have fallen by nearly two-thirds (\$2.2 million) from \$3.3 million in 2005 to \$1.1 million in 2015. In Curry County, declines were steeper. During the same period, payments declined by 68 percent, or \$4.2 million, representing a decrease from \$6.3 million to \$2 million over a period of 11 years. These decreases echoed similarly-proportioned decreases in both California (with declines of 60 percent) and Oregon (with declines of 70 percent). These declines represented a loss in revenue of \$47.3 million and \$126 million

over 11 years, respectively according to the U.S. Department of the Interior County Payments.

The declines felt in California and Oregon were symptomatic of larger payment declines in the SRS System. Payments distributed under the system dropped by more than \$214.1 million (or 46 percent) to \$251.59 million by 2015. These declines can be attributed to reduced payments built into the reauthorizations. According to the Stanford Spatial History Project, transition payments between 2008 and 2010 resulted in “fiscal havoc” in rural Oregon that resulted in severe budget emergencies in 11 counties, and two near-bankruptcies.

The decreasing amount of revenue resulting from uncertainty in the SRS program and other federal government funds presents problems for both counties, who must be faced with levying higher taxes, cutting sources of revenue, or seeking additional funding sources.

Climate and Natural Hazards

Both counties are subject to serious natural hazards resulting from the region’s climate (described in the following section) as well as geologic make-up. The Natural Hazards Mitigation Grant Plan (HMGP) for each county identified the following hazards for which the counties are at risk: coastal erosion, drought, earthquake, flooding, landslide, tsunami, wildfire and windstorm.

The Curry County Steering Committee for the HMGP found that the County has a high vulnerability to coastal erosion, with between 1-10 percent of the population or regional assets affected by a major disaster. Several portions of the County – particularly Nesika Beach, Dawson Tract, Otter Point State Park, and Harris Beach State Park – are at higher risk for erosion due to their location. However, much of the coastline is not densely populated, and significant portions are preserved from development.

The California Department of Public Health and the University of California-Davis produced a Climate Change and Health Profile Report of Del Norte County in 2017. In the report, several climate projections were made under the high emissions scenario and discussed for their impacts on current and future residents of the County:

- *Temperature* is expected to increase by between two and five degrees in January by 2100, and by between three and six degrees in July 2100.
- *Precipitation* is forecast to decrease by five to seven inches in areas with heavy rainfall (over 80 inches per year)
- *Sea Level* is expected to rise 66 inches, though this bucks the current trend of stable or decreasing sea level as measured by tide gauges
- *Heat waves* are expected to occur only slightly more frequently
- *Snowpacks* are expected to decrease to “almost zero” by the 2090s. The Hazard Mitigation Plan for Del Norte County identified rising snowlines resulting from increased temperatures to contribute to peak storm runoff, increasing the potential for flood events.
- *Wildfire risk* is expected to increase substantially, with the projected frequency expected to increase eight-fold in some portions of the county.

Wildfires are likely the hazard with the highest potential for increased damage and severity resulting from climate change. Due to the amount of woodlands contained within, much of the land area in both counties is at significant risk for wildfire. Significant wildfires affecting the counties occurred in 1868, 1936, 1987, and 2002, and wildfires are most likely to occur during the summer months. Both counties have adopted Community Wildfire Protection Plans in response to the high risk that wildfires pose. These risks are heightened by limited road access, which can make evacuations and fire operations more difficult.



Figure 33: Harris Beach, Oregon.

Energy

By nature of their remoteness, both Curry and Del Norte Counties have developed energy infrastructure to serve their own residents. The mountainous terrain in the eastern portion of the counties make transmission of utility services difficult and expensive, and the customer base is relatively low compared to areas to the north and south. As a result, both counties are absent of the large transmission lines that are a familiar site on the frontier, rural and suburban landscapes.

Despite their similarities, Curry and Del Norte Counties have separate approaches to the provision of electric service. The Coos-Curry Electric Cooperative provides electric service to Curry County residents through a unique cooperative, member-owned system. Coos-Curry

Electric Cooperative is part of a larger, regional cooperative with members throughout the West. According to the Cooperative, nearly all of the electricity generated comes from hydroelectric facilities in the Federal Columbia River Power System. On the other hand, Del Norte's electric service is provided by Pacific Power, which is a subsidiary of Berkshire Hathaway Energy. Pacific Power's energy generation sources are more diversified, and as of 2015 are comprised of 72 generating plants. The majority of Pacific Power's electric generation plants are hydroelectric facilities, followed by wind, coal, natural gas, and geothermal. Despite the smaller number of total plants, coal plants generate the majority (63 percent) of electric supply, followed by natural gas (14.7 percent) and hydroelectricity (8.3 percent). No significant electric generation facilities are located in either county, except for a biomass facility in Curry County. As a result, the counties are largely dependent on electricity generated (and transmitted) from locations outside of county.

The counties are not served by natural gas as a heating source, resulting in the use of electricity or fuel oil for heating. According to the U.S. Energy Information Administration, no major pipelines pass through either county. In California, intrastate natural gas pipelines pass through Humboldt County (just south of Del Norte County), and the inter- and intra-state Northwest Pipeline runs just east of Curry County in Oregon. In light of the energy boom of the 2000s and 2010s, coastal areas near Del Norte and Curry Counties were eyed for potential expansion of facilities serving the industry. Liquefied natural gas (LNG) terminals in Coos Bay and Warrenton, Oregon (both located north of Curry County) were proposed and subsequently cancelled in 2016. According to some reports, the proposed Coos Bay facility operators – whose proposal was rejected by the Federal Energy Regulatory Commission – intend to re-file in the near future. At the time, there are no reports of similar facilities for either Del Norte or Curry Counties. The lack of infrastructure in the area and the forbidding topography are likely the biggest contributors to the lack of energy trading facilities.

Water

Unlike many frontier and western areas, Curry County and Del Norte County each receive plentiful rainfall and have a relatively stable water supply. Del Norte County is unique in California for its precipitation and water resources. According to a map of Average Annual Precipitation from 1961-1990, the vast majority of the county receives between 75 and 100 inches of rain per year, while some portions of the county receive in excess of 100 inches. No other region in California receives as much rain. In Oregon, the western half of the state receives considerably more rainfall than the eastern half of the state. Despite being in the rainiest region of Oregon, Curry County receives an exceptional amount of rain, with much of the County receiving in excess of 100 inches, and a small portion of the County receives more than 180 inches/year. This precipitation falls into the region's streams and waters, providing the counties with a relatively stable source of water via precipitation.

Del Norte County as a whole is one of the least intensive water users in the state. Of the counties in California, Del Norte County withdraws the third-lowest amount of water (13.67 mg/d). On a per capita basis, however, the County's water withdrawals per 1,000 residents place it at the 13th-lowest, behind the more urbanized counties of San Francisco and Los Angeles. In broader terms, Del Norte County represented 0.1 percent of the state's population and only 0.04 percent of the state's total water usage in 2010. Just over 70 percent of withdrawals in the County result from agriculture-related uses, and 21.1 percent

resulting from public supply uses.¹³² In light of water shortages across the state, Del Norte's water resources have led to tension between the County and the state government. Senate Bill 88, which passed in 2015 in response to drought conditions, was controversial in the County because of the reporting standards it required of water diverters. In 2016, the County petitioned the State Water Resources Control Board asking for exemptions or alternatives to the regulations as applied to Del Norte County. In letters, the County cited it's being unaffected by the latest drought and its relative excess of water supply compared to its withdrawals as reasons for its exemption from the reporting standards. This sentiment was further reflected in a 2016 article in the region's newspaper, *The Triplicate*, reported ire from residents as being subject to the same water regulations in place across the state despite the region's high precipitation totals.

Similar to Del Norte County, Curry County withdraws a relatively low amount of water compared to the rest of Oregon. Users in Curry County withdrew only 21.2 mg/d – the third lowest amount of any county in Oregon. On a per capita basis, Curry County withdraws the 14th-lowest amount, placing it near the middle of the pack in terms of Oregon Counties. By comparison, Curry County comprises 0.6 percent of the state's population but only 0.3 percent of its water withdrawals. Nearly half of the withdrawals of water in the County (9.53 mg/d) result from irrigation, while only 2.77 mg/d and 2.83 mg/d result from public supply and domestic use, respectively.¹³³

Conclusions

In light of the challenges and issues facing the Counties, a picture emerges of Del Norte and Curry Counties as resource-rich but economically-poor frontier areas. The heydays of economic exuberance resulting from natural resources extraction were particularly short-lived, and never resulted in the kind of sustainable economic development that supported nearby urban areas to the north and south. As a result, the counties have shifted to service, health/education, and public administration economies. This can reflect a lack of outside investment, as these kinds of industries result from servicing existing populations. Tourism has continued to play an important economic role considering the unique ecological and recreational assets in the region. However, the same qualities that make economic development so difficult (particularly difficulties in access) also keep the tourism industry from growing more.

Tourism has continued to play an important economic role considering the unique ecological and recreational assets in the region.

The natural resources enjoyed by the counties are unique within their respective states, and are the results of a rainy climate conducive to sustaining lush forests and fisheries. The counties are relatively comfortable in their self-sufficiency of water and energy resources. However, these qualities may not be as sustainable as imagined, with high temperatures, increased risk of wildfires, and potentially declining rainfall totals posed as likely threats resulting from climate change in these counties. This will have significant repercussions on the region's natural resources, as water supplies though stable and sustaining may prove to not be so.

Planning Questions

- 1) In light of increasing populations to the south and north, is negative or zero economic growth a desirable outcome? If slow growth is desired, in what ways are the counties equipped to deploy growth management efforts? 2) What alternative revenue streams will be available to support government functions in light of declining transfers from the federal government?
- 3) Is the water supply sufficient to withstand potential decreases in precipitation resulting from climate change?
- 4) With limited land in private ownership, is zoning sufficient to accommodate future growth? Will the tax base grow (or shrink) to match the services being provided?
- 5) Are permitting requirements in place to handle for large-scale energy infrastructure and transmission siting?
- 6) In the event of shrinking federal land holdings, how will the Counties control land development on privatized or leased public lands?

Rio Grande County, CO & Wichita County, KS

Colorado is an oasis, an otherworldly mountain place. – Brandi Carlile

When I think of Kansas, I think of family. – Trai Byers



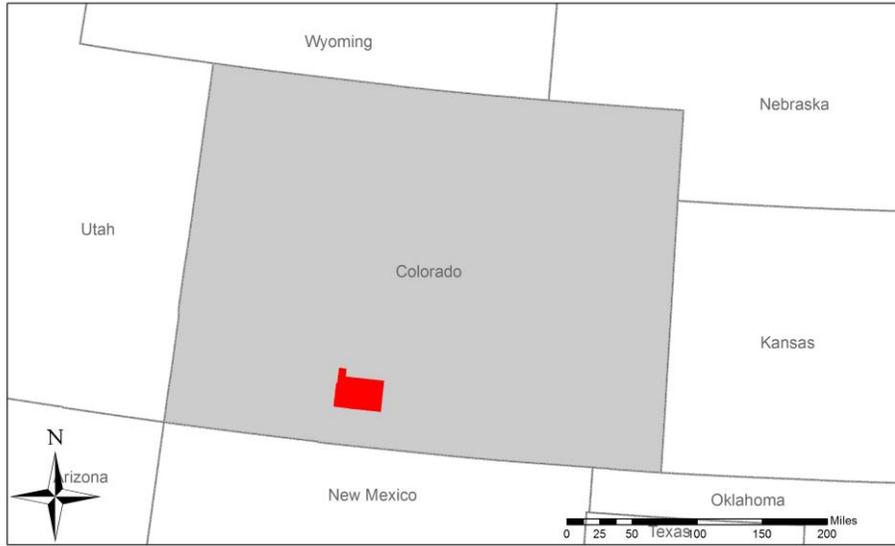
Figure 34: Del Norte Peak in Rio Grande National Forest (Credit: DrunkDriver – Own work, CC BY-SA 3.0 <https://commons.wikimedia.org/w/index.php?curid=25245419>)



Figure 35: Wichita County Court House (Credit: Amodramus - Own work, CC0, <https://commons.wikimedia.org/w/index.php?curid=38881692>)

Map 16. Location of Rio Grande County, CO

Location of Rio Grande County, CO



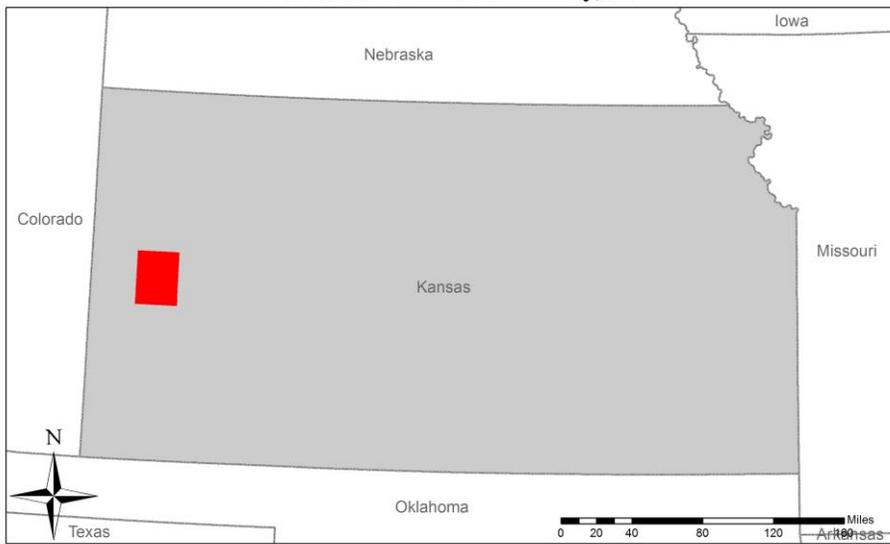
Legend

- State Boundary
- Colorado
- Rio Grande County

Source: Economic Research Service, U.S. Department of Agriculture, American Community Surveys(2011-2015);www.socialexplorer.com/https://www.census.gov/geo/maps-data/data/tiger.html

Map 17. Location of Wichita County, KS

Location of Wichita County, KS



Legend

- State Boundary
- Kansas
- Wichita County

Source: Economic Research Service, U.S. Department of Agriculture, American Community Surveys(2011-2015);www.socialexplorer.com/https://www.census.gov/geo/maps-data/data/tiger.html

History and Geography

Wichita County is located in the western part of Kansas. The county has a total area of 719 square miles. The county seat is Leoti, which is located in the middle of Wichita, and is also the only city in the County.

Wichita County was established on December 24, 1886 and was named for the Wichita Indians. In 1885 the county had only seven houses, but population grew rapidly by 1887 due to land speculation. Leoti was involved in the bloodiest county seat fight in the history of the American west, with a town called Coronado. Leoti also had a fight with another candidate for county seat called Farmer City. After Leoti won these fights, Coronado and Farm City became ghost towns.¹³⁴

Rio Grande County, Colorado is located in the entrance of the San Luis Valley. The area of the county is 913 square miles, and it is a popular place to vacation due to its scenic landscape. Monte Vista, Del Norte, and South Fork are the three municipalities within the county which have developed along the Rio Grande river historically.¹³⁵

The Clovis and Yuma Native American people originally lived in the San Luis Valley 10,000 years ago. Through the 1700s, Utes became the dominant force in the region. The area was then settled and governed by Spaniards until 1820, when Mexico claimed independence from Spain. Under the governance of Mexico, the government tried to use land grants to attract former Spanish to settle there. However, their attempts were not very successful due to threats from Native Americans.¹³⁶

Following the Mexican-American War, the San Luis Valley came under control of the United States. Secured by the strong American military, the settling process went very smoothly. The Homestead Act of 1862 and the Colorado's mining boom encouraged the settlement of a huge population in this area.¹³⁷

Gold was first discovered at the base of the San Juan Mountains in 1870, which drove the development of railways connecting the bustling communities there with the rest of Colorado and New Mexico.¹³⁸

During the first quarter of the twentieth century local agriculture started thriving along with the rapid development of Monte Vista, the major city in the county. However, local economies, especially agricultural economies, were deeply affected by the Great Depression during the 1930s.¹³⁹

Under President Franklin D. Roosevelt's New Deal, many public works projects were planned and constructed, which assisted the recovery of the economy. U.S. Highway 160, built in 1936, provided Rio Grande County the connection to the national markets, which drove the rapid population growth. For example, the population of Rio Grande County grew to over 12,000 in 1940, which was even more than the population in 2015 (11,745).¹⁴⁰ Today, the economy of Rio Grande County is reliant on agriculture. Its main agricultural products are potatoes, wheat and barley. The water source for irrigation mainly comes from the Rio Grande River. However, precipitation is very low across the County.¹⁴¹

Demographics

The population in both counties is very low and decreasing in recent years. Rio Grande County, Colorado, had a population of 11,745 in 2015, while Wichita County, Kansas, had only 2,204 residents. Both counties lost population from 2000 to 2010, per U.S. Census data. Male and female populations in both counties are very similar. Both counties are majority white and have relatively high Hispanic/Latino populations: in Rio Grande County, the proportion of Hispanic population is 44.2 percent, which was much higher than the national average (17.1 percent). The median household income in Rio Grande County was around \$15,000 less than the U.S. level (Table 1). However, Wichita County had a higher median income than national level. Both counties have significant agricultural sectors, and Wichita County is classified as “farming-dependent” according to the U.S. Department of Agriculture (Table 2).

Table 12. Demographics of Selected Counties

Statistics	United States		Rio Grande County, Colorado		Wichita County, Kansas	
	Count	Rate per 1,000 Pop.	Count	Rate per 1,000 Pop.	Count	Rate per 1,000 Pop.
Total Population	316,515,021		11,745		2,204	
Population Density (Per Sq. Mile)	89.6		12.9		3.1	
Area (Land)	3,531,905.35		911.96		718.57	
Male	155,734,280	49.2%	5,810	49.5%	1,150	52.2%
Female	160,780,741	50.8%	5,935	50.5%	1,054	47.8%
Under 18 Years	73,683,825	23.3%	2,844	24.2%	647	29.4%
18 to 34 Years	74,250,323	23.5%	2,252	19.2%	442	20.1%
35 to 64 Years	123,965,396	39.2%	4,577	39.0%	736	33.4%
65 and Over	44,615,477	14.1%	2,072	17.6%	379	17.2%
White Alone	197,258,278	62.3%	6,233	53.1%	1,509	68.5%
Black or African American Alone	38,785,726	12.3%	53	0.5%	0	0.00%
American Indian and Alaska Native Alone	2,078,613	0.7%	124	1.1%	2	0.1%
Asian Alone	16,054,074	5.1%	44	0.4%	7	0.3%
Native Hawaiian & Other Pacific Islander Alone	499,531	0.2%	16	0.1%	0	0.0%
Some Other Race Alone	638,429	0.2%	9	0.1%	0	0.0%
Two or More Races	6,968,165	2.2%	79	0.7%	40	1.8%
Hispanic or Latino:	54,232,205	17.1%	5,187	44.2%	646	29.3%
Median Household Income (2015 Inflation Adjusted Dollars)	\$53,889		\$39,672		\$57,171	
Foreign Born:	41,717,420	13.2%	830	7.1%	341	15.5%
Income in 2015 below poverty level	8,761,164	11.3%	476	15.3%	54	9.4%
	Count	Rate per 1,000 Pop.	Count	Rate per 1,000 Pop.	Count	Rate per 1,000 Pop.
Net Migration	1,150,528	3.59	-102	-8.81	-17	-7.85
Natural Increase	1,360,891	4.25	22	1.9	6	2.77

Table 13. Number of Farms in Rio Grande County, CO

	2012	2007	Change %
Number of Farms	265	323	- 18
Land in Farms (acres)	463,779	519,858	- 11
Average size (acres)	1,750	1,609	+ 9
Market value of Products sold	\$624,800,000	\$448,731,000	+ 39

Table 14. Agriculture in Rio Grande County, CO

	State Rank	U.S. Rank
Total value of agricultural products sold	6	62
Value of livestock, poultry, and their products	6	39
Cattle and calves	2	Na
Hogs and pigs	7	69

Table 15. Number of Farms in Wichita, KS

	2012	2007	Change %
Number of Farms	377	390	- 3
Land in Farms (acres)	185,489	178,908	+ 4
Average size (acres)	492	459	+ 7
Market value of Products sold	\$106,491,000	\$85,360,000	+25

Table 16. Agriculture in Wichita, KS

	State Rank	U.S. Rank
Total value of agricultural products sold	15	1109
Value of crops including nursery and greenhouse	9	685
Vegetables harvested, all	1	47
Potatoes	1	18
Barley for grain	1	57

Climate Change

The United States Environmental Protection Agency (EPA) produced climate-change reports for each state in the U.S. in 2016.¹⁴² In the Kansas report, several facts reflected the impact of the climate change to Kansas State:

- Kansas's temperature increased at least half a degree in the past century.
- The soil is drier.
- Rainstorms are more intense, as result, the floods are more severe.
- Winter will be warmer, and summers are likely to be increasingly dry and hot.

For the Rio Grande County, the University of Wisconsin-Milwaukee made a report called "Climate Change Impacts on Hydropower in the Rio Grande River Basin." in 2013.¹⁴³ This report predicts that climate change will reduce water availability, alter peak flow periods, increase chances of encountering extreme weather events, change precipitation patterns, and increase temperature in the Rio Grande Basin. In fact, the average temperature in the Upper Rio Grande Basin has already increased, by roughly 1.6° F from 1971 to 2011. This report also predicted that at the end of 21st century, the temperature will increase 4 to 6° F in the Upper Rio Grande Basin. Moreover, precipitation is predicted to decrease by 2.3 to 2.5 percent.

Water Issues

Based on the U.S. Drought Monitor Map in March 7, 2017, both Wichita and Rio Grande Counties were located in a drought area.¹⁴⁴ Wichita County was even located in the severe drought area. By checking the Drought-Related USDA disaster declarations by county, we found that there was a drought-related disaster record in that document for Wichita County, indicating a significant issue there.

The loss of water supply is a severe problem in the Rio Grande Basin due to increases in temperatures and decreases in precipitation. One-third of surface water of Rio Grande Basin is projected to vanish by the end of this century.

The loss of water supply is a severe problem in the Rio Grande Basin due to increases in temperatures and decreases in precipitation. One-third of surface water of Rio Grande Basin is projected to vanish by the end of this century. The federal Upper Rio Grande Impact Assessment also discusses the following potential impacts of the decreases in water supply:

- The reservoir water storage throughout the water management system is projected to decrease.
- Less hydropower will be generated through the dam or other hydropower facilities.
- Flood control operations would be needed more often in the future due to the projection that floods will become more extreme due to climate change.
- The concentration of pollution will increase due to a decrease in surface water and precipitation.

U.S. Drought Monitor

March 7, 2017

(Released Thursday, Mar. 9, 2017)

Valid 7 a.m. EST

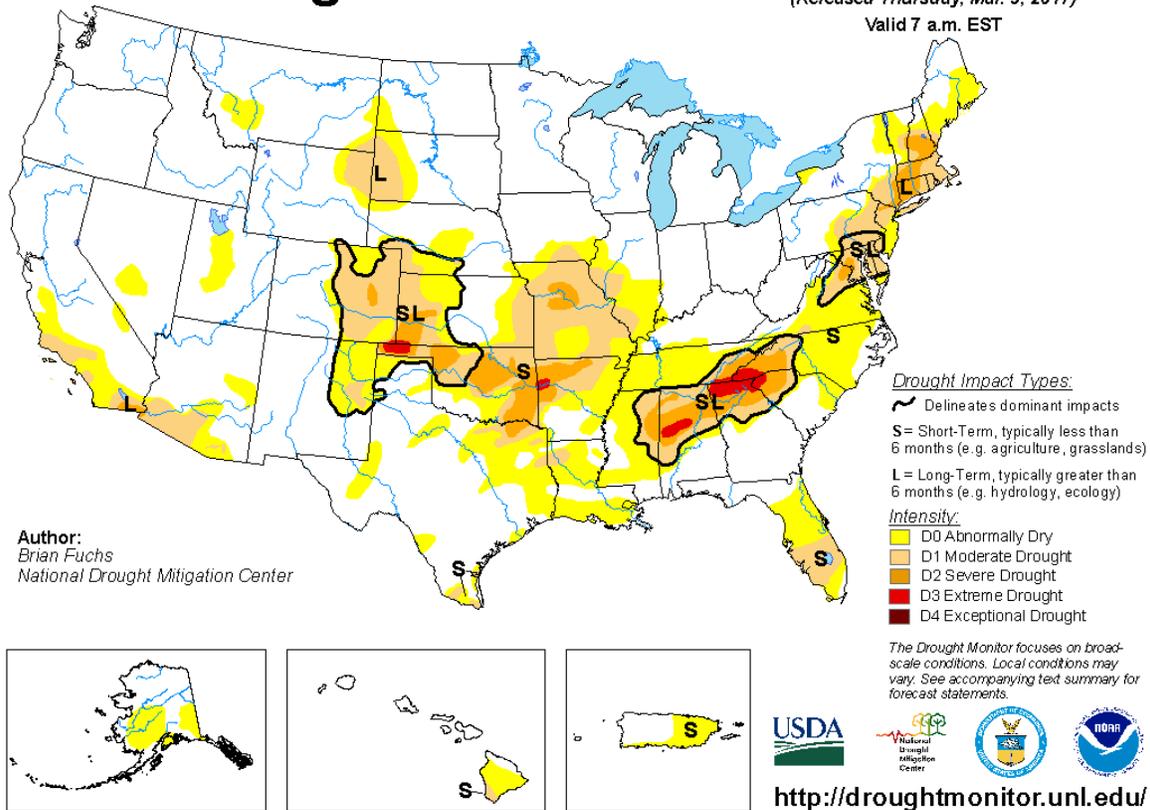


Figure 36: U.S. drought monitor map, as of March 7, 2017. (Source: National Drought Mitigation Center/USDA)

Energy

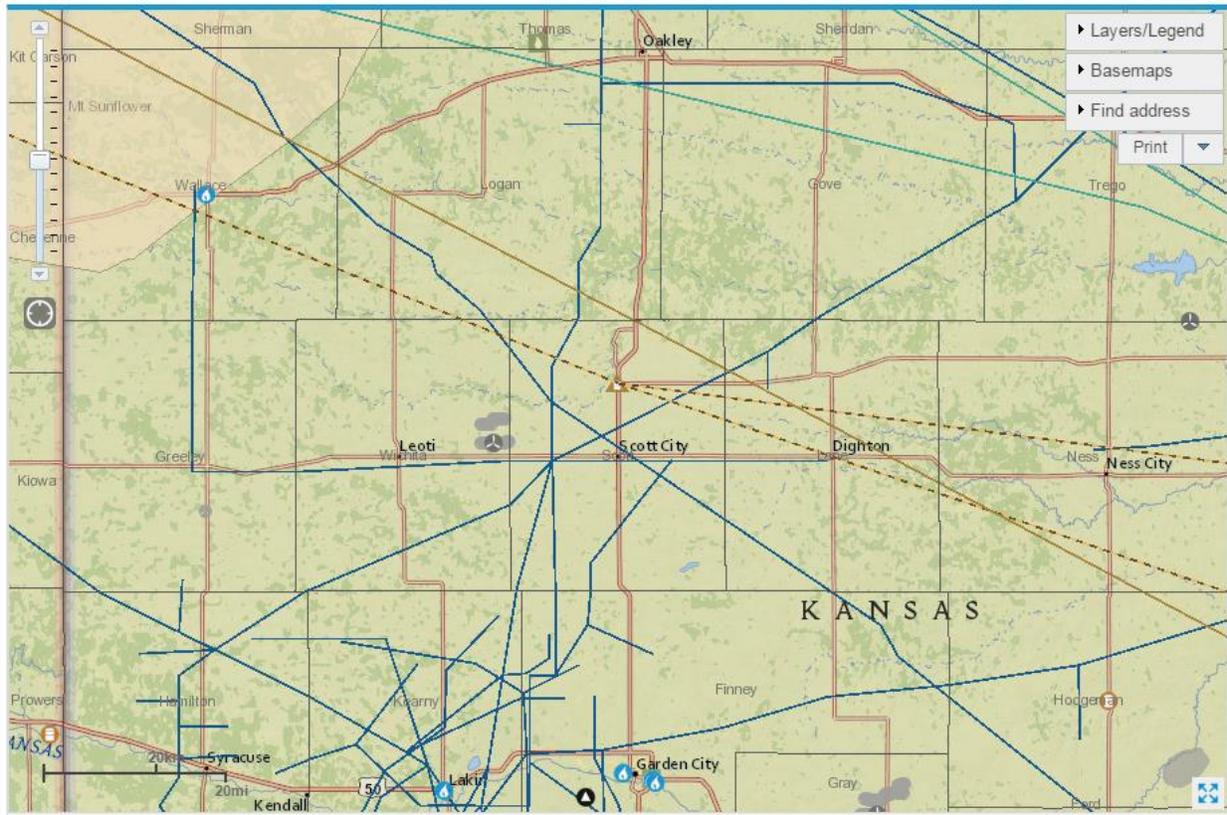
Wichita County, Kansas

According to the U.S. State profiles and Energy Estimates, there is only a wind power plant in Wichita County.¹⁴⁵ The biggest energy provider in Wichita County is Wheatland Electric Co-Op Inc.



Figure 37: Central Plains wind farm. (Credit: <http://www.windpowerengineering.com/construction/projects/westar-energy-to-lower-customer-costs-by-adding-more-kansas-wind-energy/>)

Map 16. U.S. State profiles and Energy Estimates Map – Wichita, KS



Rio Grande County, Colorado

As mentioned above, less water supply will harm the productivity of hydropower dams in the Rio Grande basin. Lower water supply will result in lower reservoir levels, and this will reduce hydropower production.

FULL REPORT - Discussion and Conclusion

This report has attempted a broad study of issues facing frontier communities. The counties studied encapsulate the diversity of geographies and issues facing the frontier. Despite these differences, many of the same trends are visible in these areas, even as they are manifest differently and on varying scales. These issues are divided into two categories: existing threats and prospective challenges.

Existing threats include economic issues and the day-to-day realities and provision of services on the frontier. Prospective challenges include how the current standard of living and economic activity will or will not be maintained in the future. Prospective challenges include climate change, which may affect current conditions to some degree but may not represent a day-to-day concern for frontier residents. Nonetheless, existing conditions and planning efforts today will shape the frontier of tomorrow.

Existing threats include economic issues and the day-to-day realities and provision of services on the frontier. Prospective challenges include how the current standard of living and economic activity will or will not be maintained in the future.

In the counties studied, economic concerns most heavily informed existing threats. Much of the frontier has been losing population over the past several decades, and the frontier itself has been shrinking in size. Many of the counties were historically resource extraction-based but their economies have since transitioned. Some counties hold on to resource extraction in some semblance, including the agricultural counties. In the forested counties, federal landownership and historic logging operations' contributions to local economies have decreased and been replaced with service economies (including medical) and public administration. In mid-western counties, economies built upon fossil fuels face issues with significant short-term infrastructure investment and job activity, followed by declines that mirror more global shifts in the fossil fuel markets. Many of the counties have ridden the wave that is distinctive of boom and bust resource-based economies.

Climate change is a key prospective challenge that will inform how existing services and resources (such as energy and water) are provided to counties. Across the counties, the largest threat from climate change appears to be changes in precipitation. On a micro or county level, it is difficult to model exactly how future precipitation events and totals will change. However, there is a likelihood that climate change results in less precipitation to areas already starved for moisture. This will result in a lower volume of aquifer recharge, less water available for human and ecological use, and protracted legal fights about how declining water resources are allocated. Areas that have previously relied on higher precipitation totals may have to transition to more strict water conservation measures, and industries may have to relocate or close in areas where precipitation and water availability is already precarious. Moreover, lower water volumes will result in declining reservoir levels, thereby affecting electricity generation and disrupting water supplies for counties relying on reservoirs for electricity and water. The potential for increased droughts will have a significant - though not yet discernible - effect on frontier communities.

The intersection of climate change and economic concerns is a major complicating factor for addressing and understanding climate change in frontier areas. Residents and businesses in these counties may be inclined to view these challenges as zero-sum. In many cases, the predicted effects of climate change may simply not be pronounced enough to have an economic impact felt by those in the frontier areas. Short-term changes in weather patterns may be accounted for as cyclical, even if these changes occur with greater frequency and severity. In the meantime, existing economic practices (such as fossil fuel extraction or large groundwater withdrawals) may not be desirable or even possible under future climate conditions. To curtail either action would result in significant economic consequences, even if the performance of those activities contributes to or will be exacerbated by climate conditions. In much of the frontier where incomes are low and unemployment and out-migration is high, the potential to lose economic activity is a very tangible concern.

The potential for increased droughts will have a significant - though not yet discernible - effect on frontier communities.

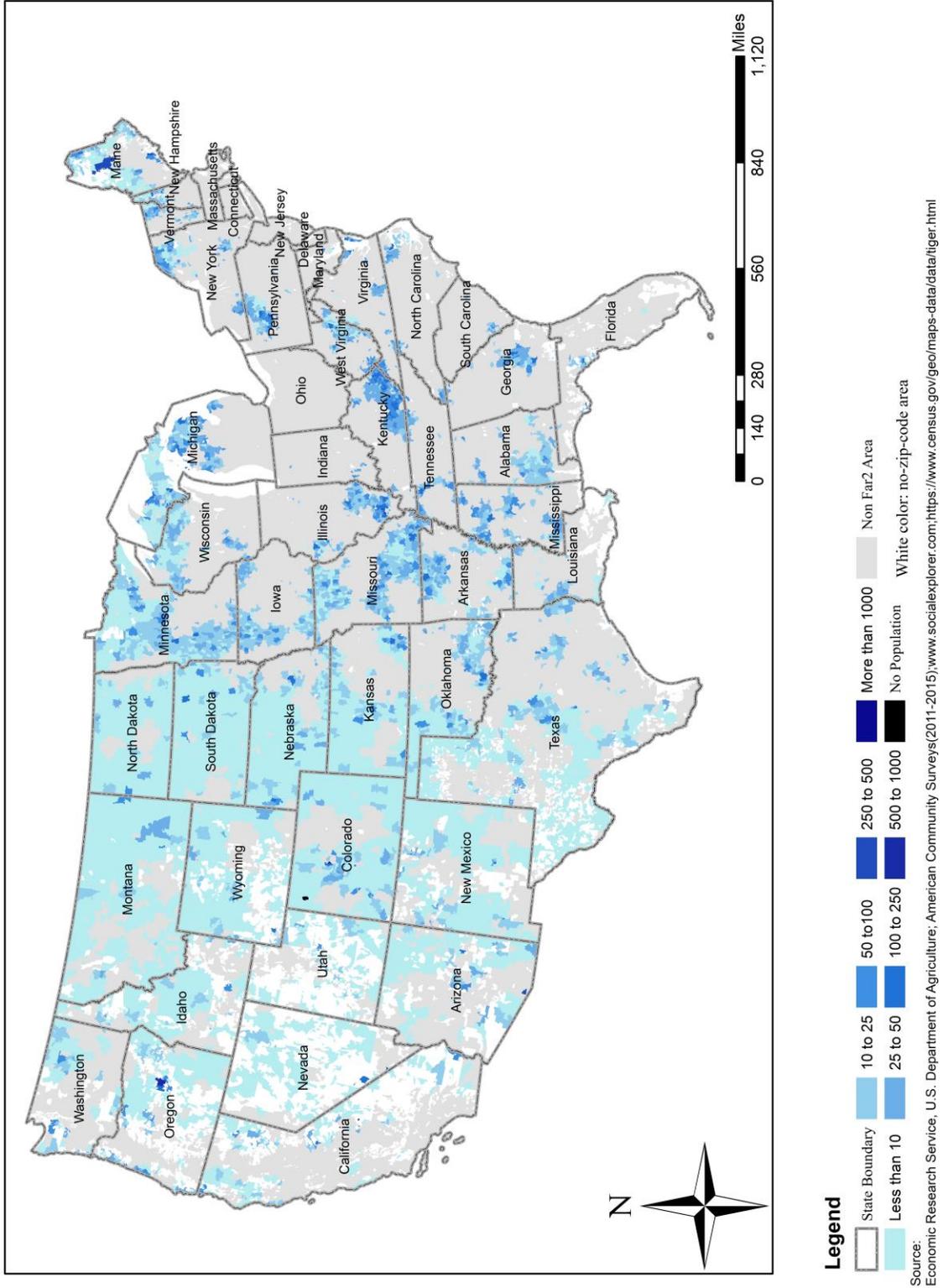
Some counties have mitigated their vulnerability to climate change by diversifying their economies and turning to less intensive tourism or service industries. These industries come with their own set of challenges, ranging from the provision of infrastructure to the declining services available for communities facing de-population. Economies that have made the transition away from resource extraction to other industries are not necessarily out of the woods with regard to facing the existential threats of frontier communities. In a number of cases, it is possible that a shift in a region's dependence to another industry simply forestalls inevitable decline rather than truly rejuvenating a region and catalyzing growth.

The American frontier faces challenges not altogether different from those facing the more urbanized portions of the country. Economic downturns, de-population, and environmental degradation are not necessarily problems unique to the American frontier. However, the effects are felt perhaps more acutely on the frontier and receive less attention than that of other regions. This presents a challenge to those who make the frontier their home and place of business: in the face of existential threats to the land and the economy, how should the frontier adapt? Given the diversity of geographies documented here, the answer cannot be monolithic.

The American frontier faces challenges not altogether different from those facing the more urbanized portions of the country. Economic downturns, de-population, and environmental degradation are not necessarily problems unique to the American frontier.

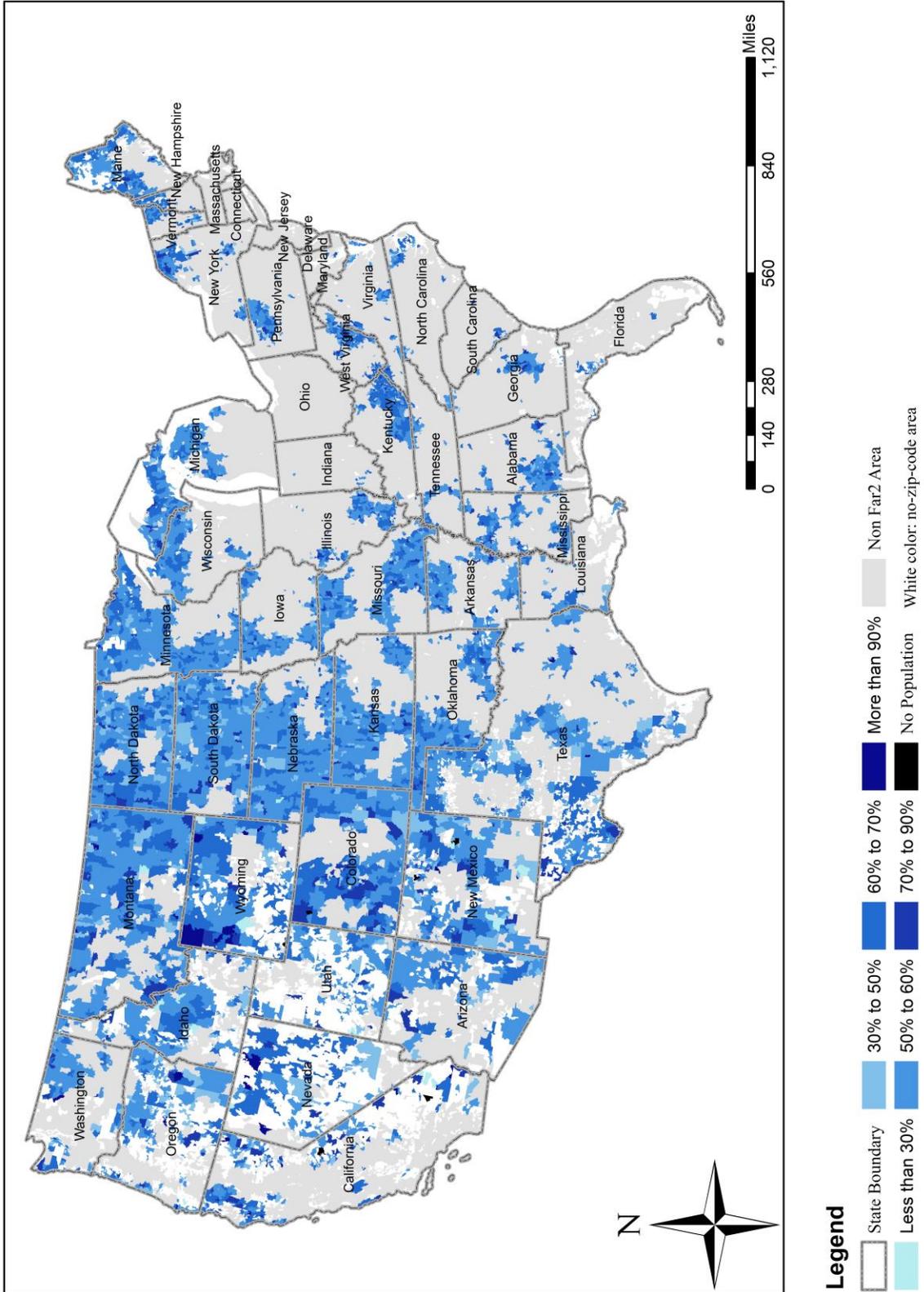
Appendix

Population Density in FAR 2 Area (People per Square Mile)



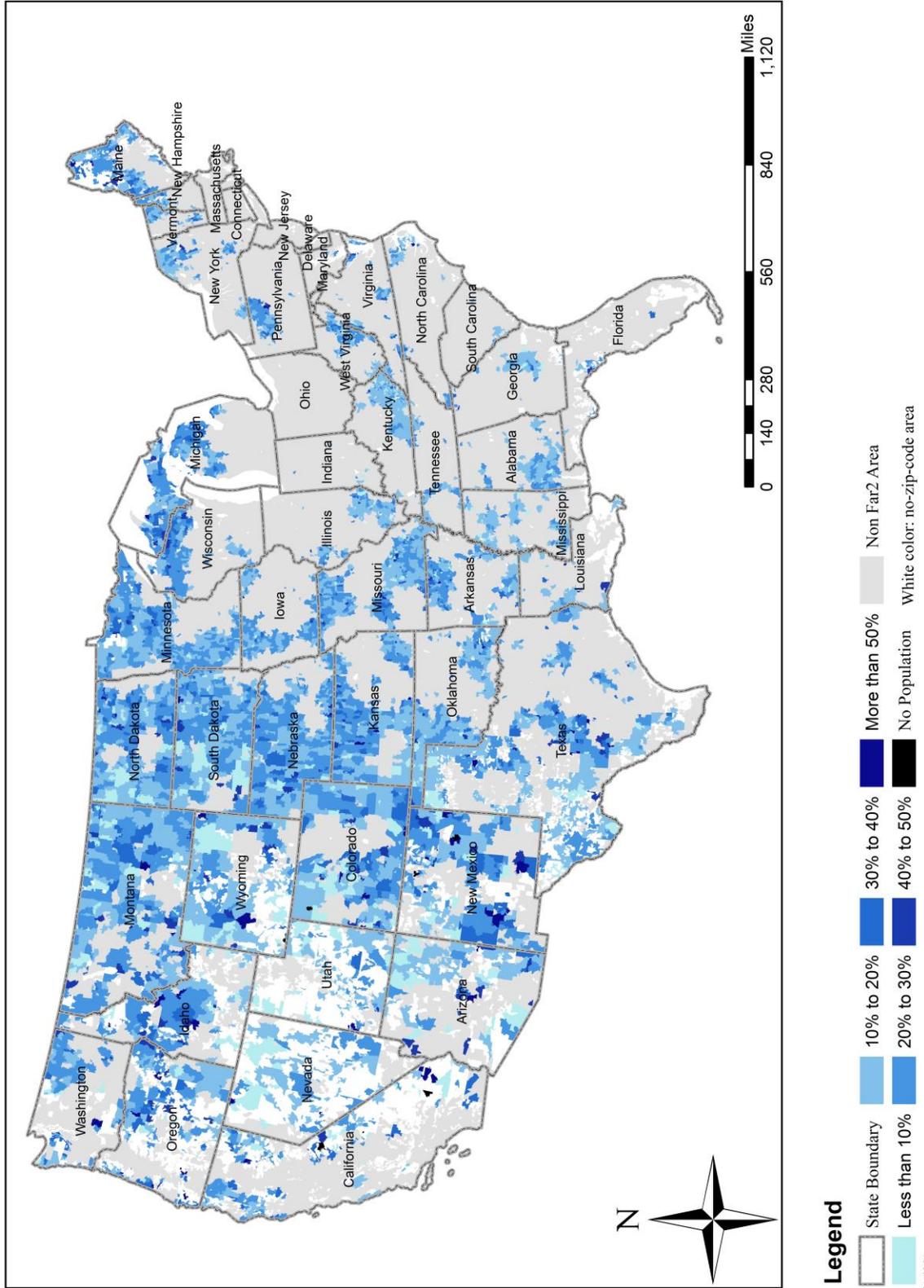
Additional Map 1. Population density in FAR2 areas (US Census Bureau)

Percentage of Population from 19 to 64 in FAR 2 Area



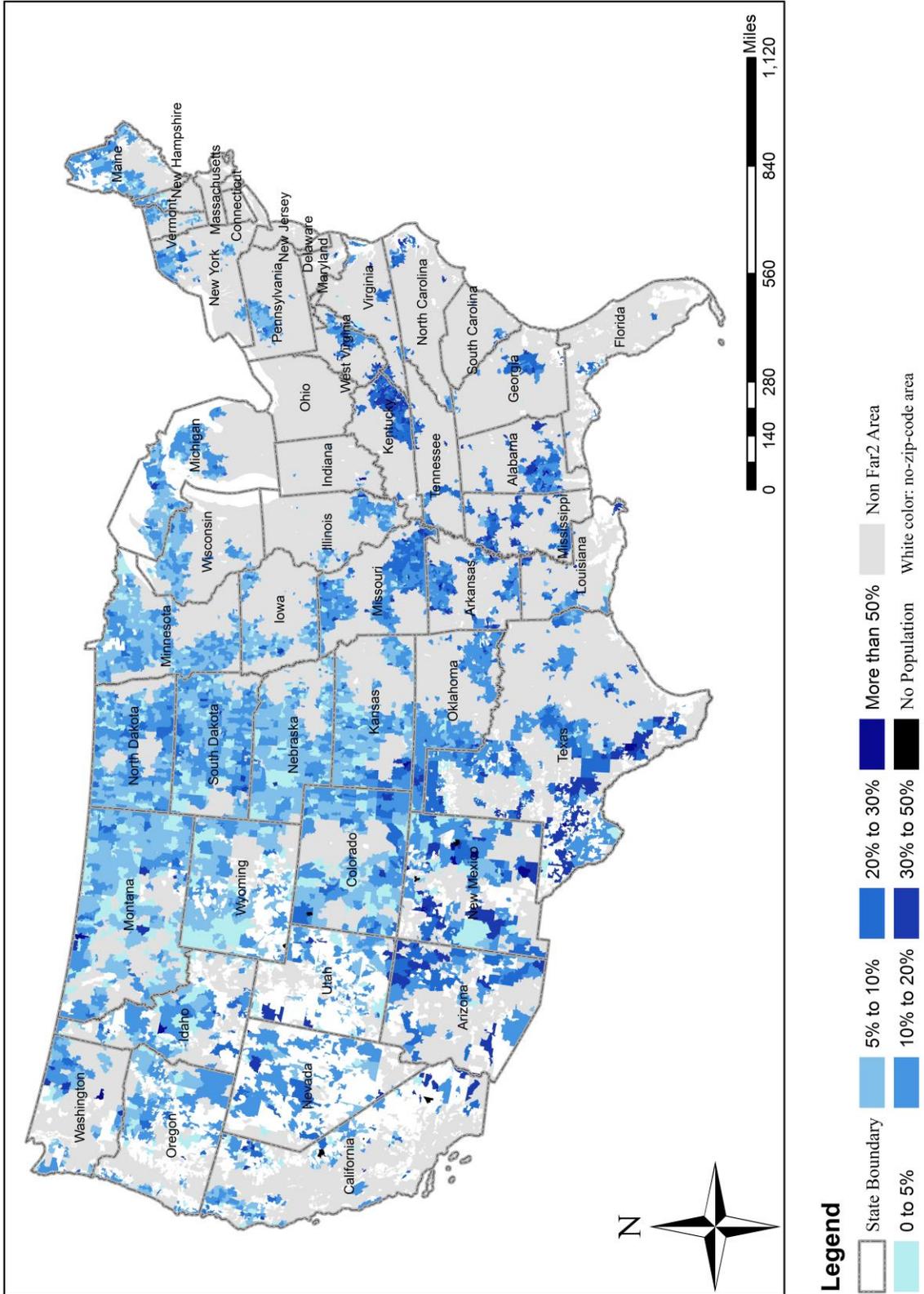
Additional Map 2. Population of the age from 19 to 64 in FAR2 areas (US Census Bureau)

Percentage of Population over 65 in FAR 2 Area



Additional Map 3. Population over the age of 65 in FAR2 areas (US Census Bureau)

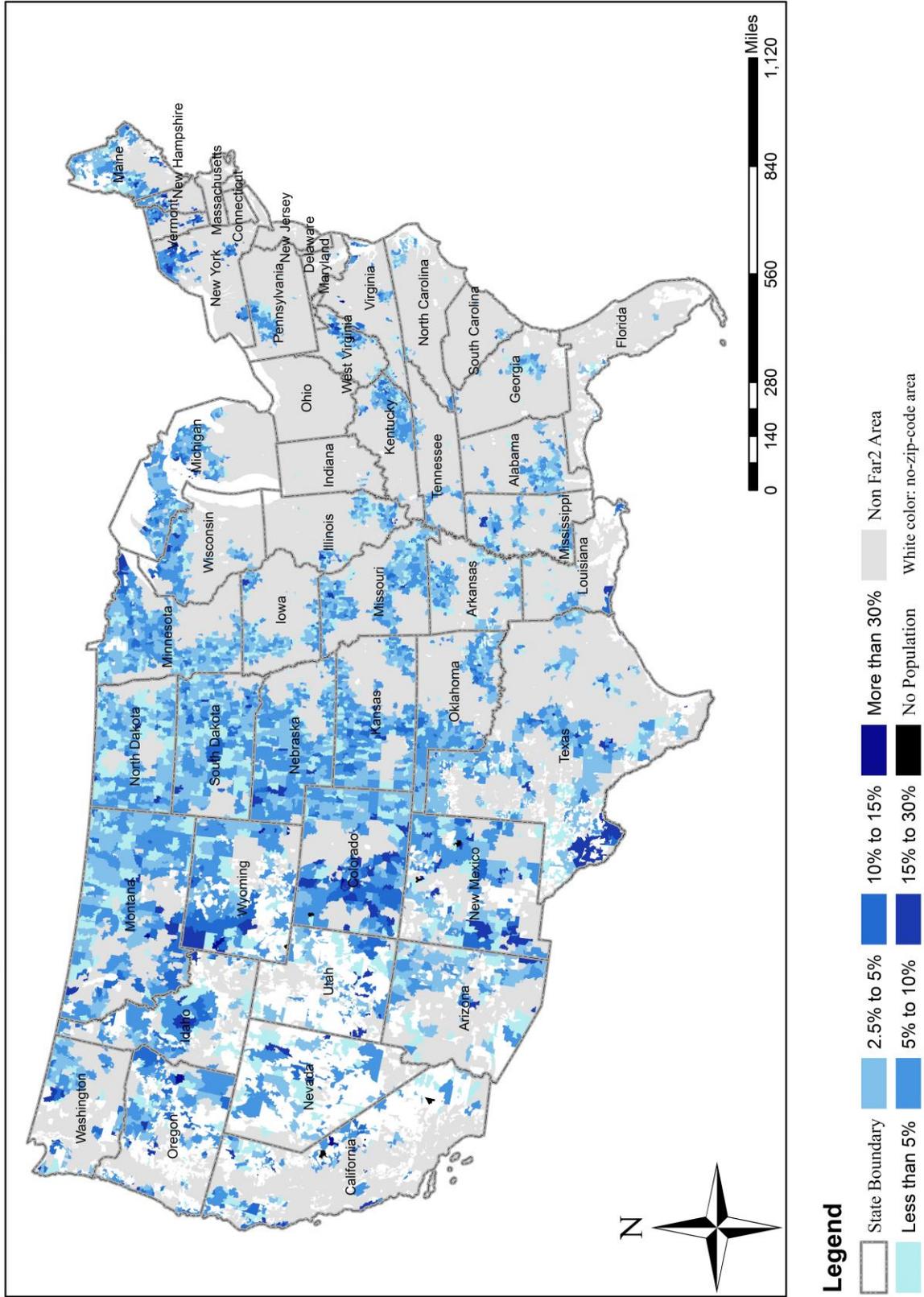
Percentage of Population without a High School Diploma in FAR 2 Area



Source: Economic Research Service, U.S. Department of Agriculture; American Community Surveys (2011-2015); www.social Explorer.com; <https://www.census.gov/geo/maps-data/data/tiger.html>

Additional Map 4. Population without a High school diploma in FAR2 areas (US Census Bureau)

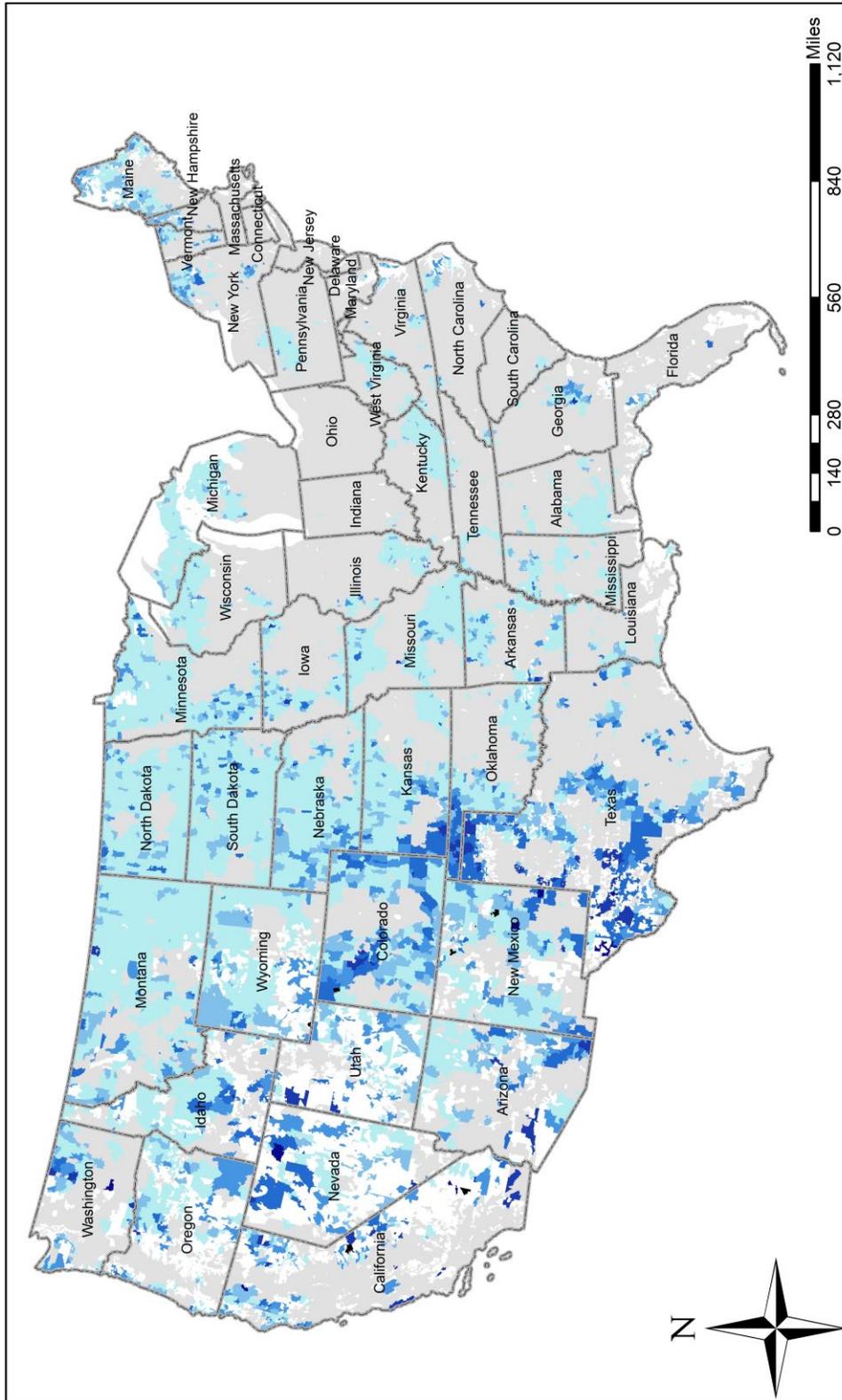
Percentage of Population with a Master or higher Degree in FAR 2 Area



Source: Economic Research Service, U.S. Department of Agriculture; American Community Surveys (2011-2015); www.socialexplorer.com; <https://www.census.gov/geo/maps-data/data/tiger.html>

Additional Map 5. Population with a master degree or higher in FAR2 areas (US Census Bureau)

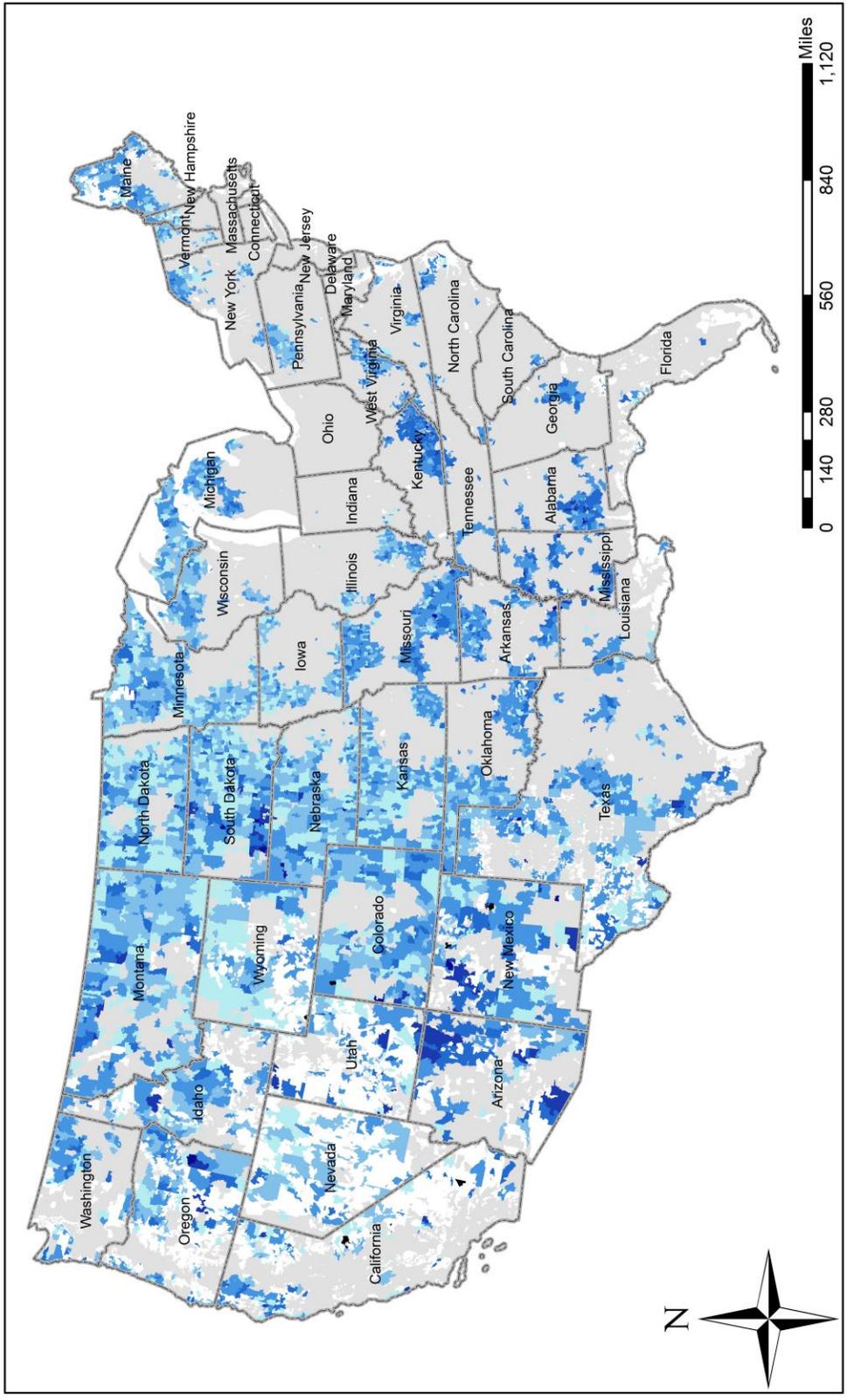
Percentage of Foreign-born Population in FAR 2 Area



Source: Economic Research Service, U.S. Department of Agriculture; American Community Surveys(2011-2015);www.socialexplorer.com;https://www.census.gov/geo/maps-data/data/tiger.html

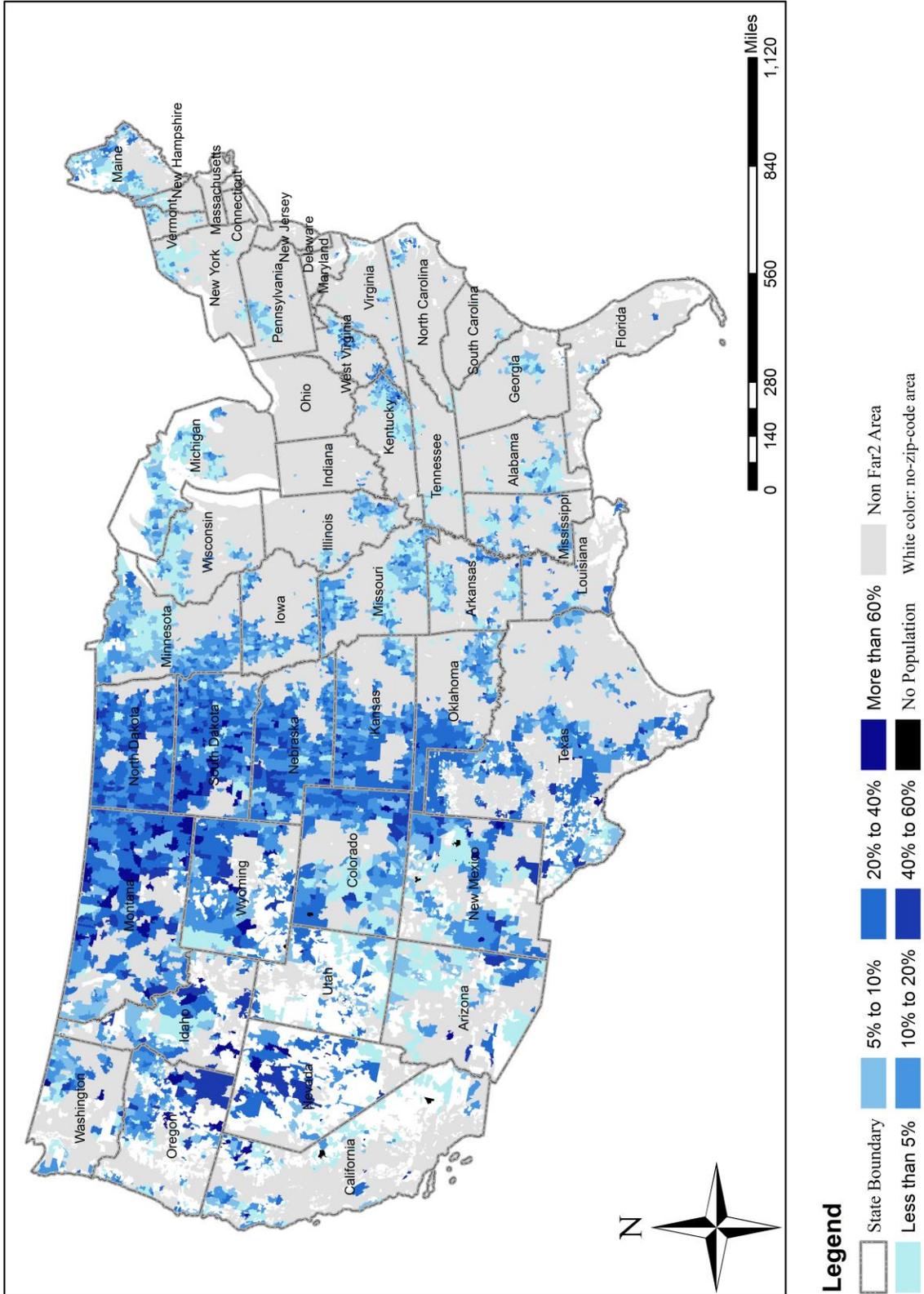
Additional Map 6. Foreign-born population in FAR2 areas (US Census Bureau)

Percentage of Families Below the Poverty Level in FAR 2 Area



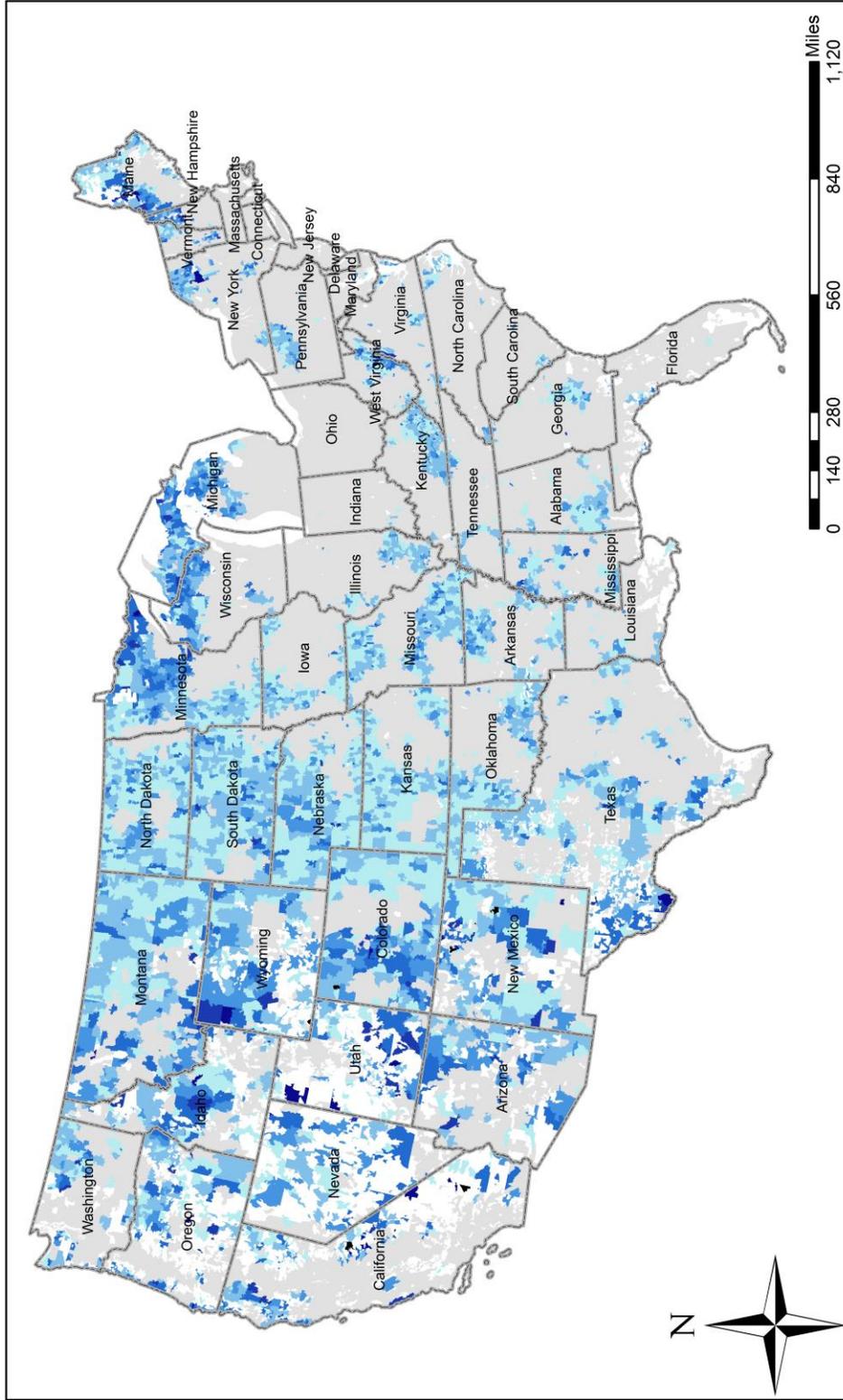
Additional Map 7. Families below poverty level in FAR2 areas (US Census Bureau)

Percentage of Workforce in the Agriculture Industry in FAR 2 Area



Additional Map 8. Workforce in the Agriculture industry in FAR2 areas (US Census Bureau)

Percentage of Workforce in the Entertainment Industry in FAR 2 Area



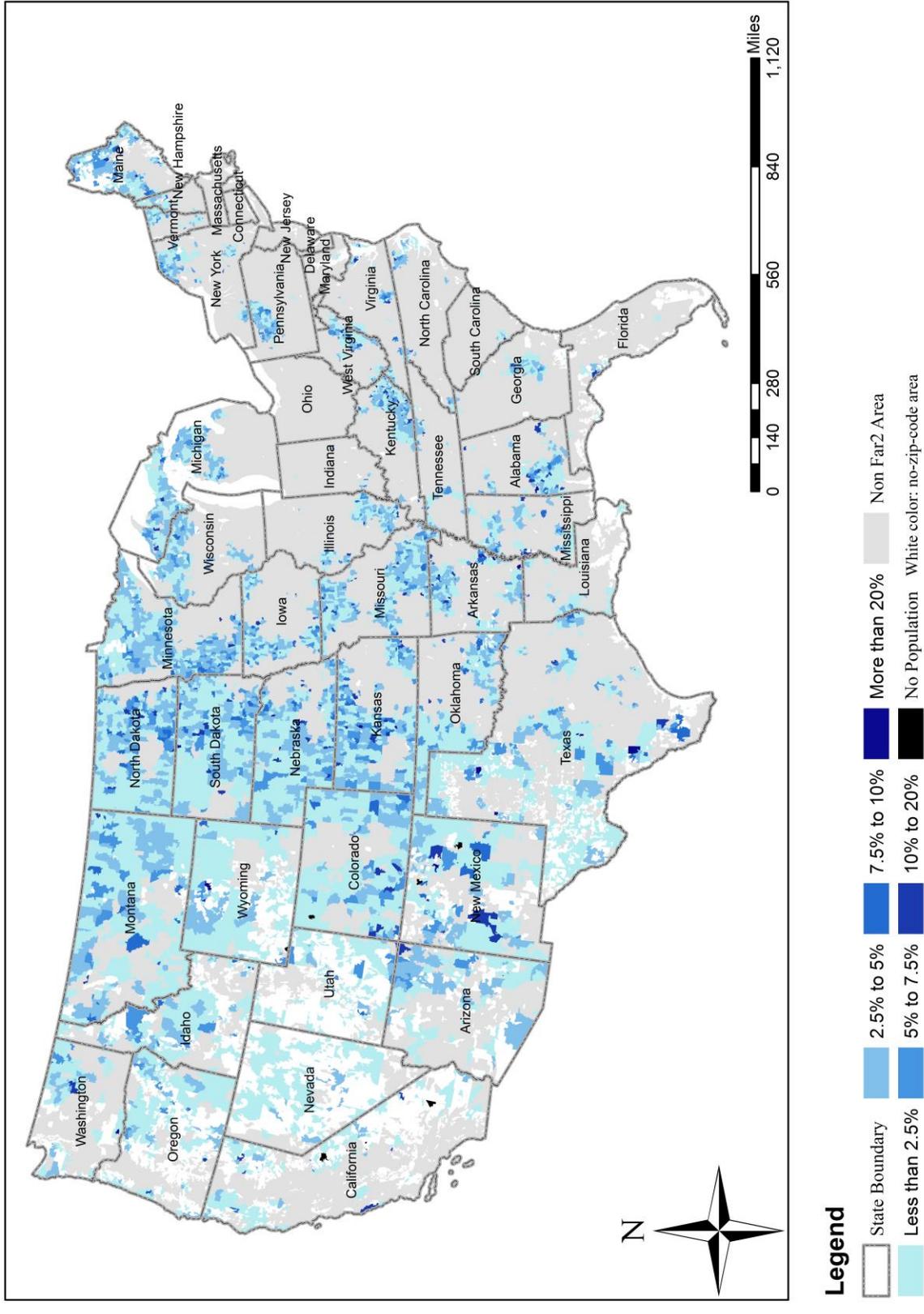
Legend

-  State Boundary
-  Less than 5%
-  5% to 10%
-  10% to 15%
-  15% to 30%
-  30% to 50%
-  More than 50%
-  Non Far2 Area
-  No Population
-  White color: no-zip-code area

Source: Economic Research Service, U.S. Department of Agriculture; American Community Surveys (2011-2015); <https://www.socialexplorer.com>; <https://www.census.gov/geo/maps-data/data/tiger.html>

Additional Map 9. Workforce in the entertainment industry] in FAR2 areas (US Census Bureau)

Percentage of Workforce in the Healthcare Industry in FAR 2 Area



Additional Map 10. Workforce in the Health care industry in FAR2 areas (US Census Bureau)

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