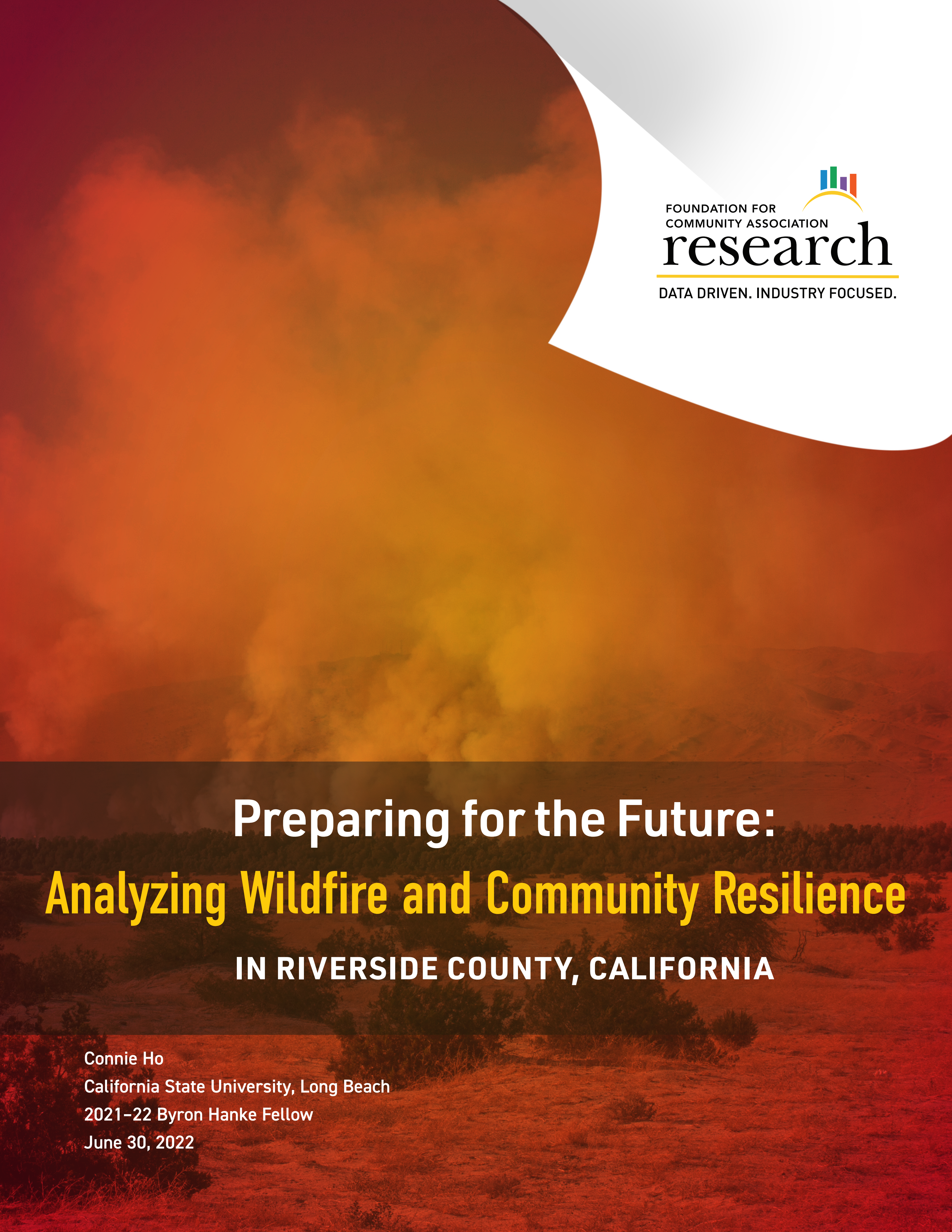

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Preparing for the Future: Analyzing Wildfire and Community Resilience

IN RIVERSIDE COUNTY, CALIFORNIA

Connie Ho

California State University, Long Beach

2021–22 Byron Hanke Fellow

June 30, 2022

Preparing for the Future:
Analyzing Wildfire and Community Resilience in Riverside County, California

Connie Ho
College of Health and Human Services
Department of Public Administration
California State University, Long Beach

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APPENDICES

Part one

1.1 Executive summary

This report covers the current state of community resilience in Riverside County related to the changing climate. It highlights possible policy alternatives for the local community, including homeowners, nonprofits, and governmental organizations, to pursue. It focuses on the increase of wildfires in the Western United States due to climate change. It describes the background of the policy issue and includes the problem statement.

This research is important in highlighting the issue of wildfires and the impact that climate change has in local communities. The methodology included a literature review and annotations of journal articles. The conclusion showed that there are many avenues to continue exploring with this topic.

This paper was completed as part of student work at California State University, Long Beach. The research addresses stakeholders involved in resolving the problem. The paper emphasizes policy alternatives that would be a good solution to help communities move forward.

Key terms: Inland Empire, Riverside County, wildfire, resilience, mitigation, climate change

1.2 Acknowledgements and funding

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Part two: Introduction

Every day, the impact of climate change is felt locally. The Los Angeles Times reported that "extreme heat is one of the deadliest consequences of global warming" with the years between 2010 and 2019 as "the hottest decade on record" for California, where 599 deaths were found to be related to heat exposure (Phillips, A., et al., 2021). According to research completed by the National Institute of Standards and Technology, wildfires are becoming more common around the world, and households are frequently advised to evacuate when these fires threaten nearby communities (Kuligowski, 2021). Since 1980, the United States National Oceanic and Atmospheric Administration has reported an approximately threefold increase in so-called "billion-dollar" natural disasters across the United States (Smith, 2020). Wildfires with over one billion dollars in losses have increased from an average of 1.5 events per decade from 1980–1999 to seven per decade from 2000–2019, costing the nation a cumulative $10 billion and $75 billion (USD) over these two time periods (Smith and Katz, 2013). Due to its dry climate, the Western United States has experienced much of the country's wildfire burning in terms of acreage (Westerling et al., 2006).

The effects can be found in the local economy. A report by CalMatters, a nonpartisan newsroom focused on explaining California politics and policy, found that, while wildfire costs are not tracked, there are some academic studies that have attempted to estimate the costs. In 2020, researchers looked at the nationwide impact of California's 2018 wildfire season and estimated $148.5 billion worth of economic damage via direct capital costs like building loss, health costs like air pollution exposure, and disruptions to regional and national supply chains. University of Southern California research professor Adam Rose, an expert in energy and environmental economics, stated that the cumulative costs in the study were higher than the costs of any disaster in the U.S. between the 9/11 terrorist attacks in 2001 and the ongoing COVID-19 pandemic, minus the costs related to Hurricane Katrina (Gedye, 2021).

This causes irreparable damage for local communities and a report by independent investigative journalism nonprofit ProPublica described it as an "inequality magnifier" and creates a "climate gap." "Every year in the summer we're on high alert," Mike Walsh, deputy director at the Housing Authority of the County of Riverside, told the ProPublica reporting team (Weil, 2021). In addition, the Los Angeles Times noted that projections by researchers with the Climate Impact Lab ranked California as third, behind only Arizona and Texas, in the projections of how deadly an overheating planet will probably be for those in mid-century. The population in areas such as Riverside and Imperial counties could "find themselves in the center of a worsening crisis, as the analysis puts these places in the top 2% of counties nationally for projected increases in heat-related deaths" (Phillips, A., et. al, 2021).

The article "The political effects of emergency frames in sustainability" in the journal *Nature* highlights this discussion on environmental sustainability. In the paper, the authors noted that the emergency frames were employed in response to acute issues, like the response to the wildfires in the Western United States in 2020, or as a strategic tool to mobilize action (Patterson et al., 2021).

The focus of this research paper is to examine the current state of climate resilience in Riverside County and mitigation solutions. It is possible that the region can adapt to the changing weather and migration patterns. The goal of this data and information is to highlight the impact of climate change and how the surrounding area can collaboratively work together to prepare for future emergencies.

Figure 1: Lake Elsinore photo courtesy of the University of California, Los Angeles Newsroom by slworking2/Flickr.

Part three: Background and literature review

On a national level, this issue is of concern. A paper by the Department of Environmental Science and Management of Portland State University and the United States Department of Agriculture Forest Service's Rocky Mountain Research Station highlighted local capacity to coordinate wildfire risk mitigation in 60 communities in the Western United States. The authors, with support from the National Science Foundation, suggested that more investments could be made in community risk planning and multi-jurisdictional risk management networks. In completing the study, they used wildfire simulation modeling and observations from community key-informants located in nine of the 11 states of the western contiguous United States and their surrounding landscapes, including Arizona, California, Colorado, Idaho, Montana, New Mexico, Oregon, Washington, and Utah. The two-step sampling procedure began with identification of counties in the Western United States where recent large wildland fires occurred and then included a snowball sampling process with key informants in each county to identify communities impacted by recent wildfires (Nielsen-Pincus, M. et al., 2019).

In addition, an article in the journal *Forest Ecosystems* detailed that a "one size fits all approach" is not the best strategy for communities as each high-risk landscape will require a different set of actions to manage the loss. The researchers noted that adaptive transformation takes place when public agencies work together with private citizens to change the wildfire suppression model to a more long-term perspective of efficient risk mitigation. Looking at various data sets and reviewing different literature, the group was able to develop conceptual models and draft the manuscript (Calkin, D.E. et al., 2015).

Similarly, a report by property data firm CoreLogic noted that, following the Tubbs Fire of 2017 in Northern California, many homeowners found that their properties were underinsured by hundreds of thousands of dollars, leaving them without enough coverage to rebuild. As a result, CoreLogic noted that "insurers can work with homeowners to regularly reevaluate the reconstruction cost value of a home to reduce the likelihood of underinsurance, as material and labor costs for reconstruction are always changing" (CoreLogic, 2021). The financial impacts are clear that this is a local and national issue.

In addition, the article "Global drought monitoring with drought severity index (DSI) using Google Earth Engine" highlighted research that stated how costly drought can be and how it affects many socio-economic sectors. The authors looked at data from Google Earth Engine, a cloud-based platform that can manage large geo-data sets, to study the statistical median for the drought severity index. This index relates to evapotranspiration, which studies the ecosystem and "analyzes the carbon, water, and energy cycle" (Khan and Gilani, 2021). The authors made the explicit decision to not list the mean of yearly maps, instead opting for the statistical median in their hopes of displaying what they deemed as "cleared and more accurate results" along with details for "almost every country throughout the globe" (Khan and Gilani, 2021). The research demonstrates the need to evaluate sustainable development with climate action and mitigation.

3.1 The Great Migration to the Inland Empire

The Community Associations Institute (CAI) Fact Book provides a snapshot of California's population and housing characteristics. The total number of housing units in California from 2015 to 2019 was estimated to be 14,175,976, compared to the U.S. total number of housing units of 137,428,986. The California rate of occupied housing units was estimated to be 92 percent compared to the U.S. rate of occupied housing units of 87.9 percent (Foundation for Community Association Research, 2021).

Figure 2: Inland Empire photo courtesy of California Department of Justice.

In February 2022, a University of California, Los Angeles (UCLA)-led research group announced that they forecasted an increase in the number of days with high risk for fire and that, even in Southern California, wildfire frequency would increase by the end of the century. This research finding followed the trend of California's massive fire seasons from the past few years, with researchers tracking data from more than four decades.

“If you look at the whole state, there’s been a statistically significant upswing in area burned,” said UCLA climate scientist Glen MacDonald, co-author of a paper in the Nature journal *Communications Earth & Environment*, in a statement. “The northern coast and Sierra Nevada are driving that. In the central and south coast, there is no significant trend toward increases in the annual amount of area burned.” The researchers concluded that most of the additional high-risk days would be at the beginning and end of the present-day fire season, which meant that fire seasons would last longer.

The growth and movement of population to the Inland Empire will be directly impacted by the change in climate in Southern California. In 2021, The Wall Street Journal reported that, in 2020, a quarter-million people moved east to the Inland Empire, a “27,000 square-mile swath of Southern California that stretches from the Los Angeles County border to Arizona and Nevada” (Mai-Duc and Overburg, 2021). Reporters Christine Mai-Duc and Paul Overberg described this migratory shift as “shuffling California’s demographics,” as those who moved to the inland desert and mountain regions were mostly middle-class residents while those who stayed in coastal cities such as Los Angeles and San Francisco were more affluent residents or residents who could not afford the move. They wrote that, based on data from the California Association of Realtors, the median figure of a home in August 2020 was $570,000 in Riverside County compared to $830,070 in Los Angeles County and $1.85 million in San Francisco. The writers also reviewed U.S. Postal Service permanent change-of-address data and discovered a net gain of 25,000 households in the Inland Empire that same year while reporting from CoreLogic showed that more home buyers had moved into the Inland Empire in 2020 than any other metropolitan area in the country.

Figure 3: Aerial photo of Riverside courtesy of County of Riverside.

Riverside County is the fourth largest county in California and the 10th largest in the country, covering more than 7,300 square miles (County of Riverside). There are 28 cities in the county, and many have moved to the area in recent years. In "Boomburbs: the rise of America's accidental cities," author Robert Silverman wrote that towns in Riverside County, including Temecula, Hemet, and Murrieta, will all become boomburbs by 2030. Other cities such as Riverside and Moreno Valley will continue to see growth but at a slower rate (Silverman, 2011).

The U.S. Census Bureau stated that the population in Riverside County, as of April 1, 2020, was 2,418,185 people, with 14.8 percent over 65 years of age. In 2019, housing units numbered at 857,148; between 2015 and 2019, there was 66.3 percent owner-occupied housing units between 2015 and 2019 and the median value of owner-occupied housing units was $350,100 (U.S. Census, 2020). The California Association of Realtors reported higher numbers a year later; the median price of existing single-family homes was $586,000 in Dec. 2021 and $590,000 in Jan. 2022, with a 19.1 percent year-to-date change.

In that region, of those surveyed by the U.S. Census Bureau, 41.1 percent stated that they spoke a language other than English at home. In terms of technology connectivity, 92.7 percent of households reported to have access to a computer at home and 86.6 percent reported to have a broadband Internet subscription (U.S. Census, 2020).

The San Diego Union-Tribune reported on the growth of population in that region early on in 2011. Reporter Dave Downey spoke with Marney Cox, chief economist for the San Diego Association of Governments, who described Riverside County as a "magnet for inland-bound people from all racial and ethnic groups who were looking for affordable housing" (Downey, 2011).

Part four: Approach, research methodology and data collection procedures

The Federal Emergency Management Agency (FEMA) website has a variety of online tools to help understand the current climate state of Riverside County.

4.1 About Resilience Analysis and Planning Tool (RAPT) and Community Resilience Indicator Analysis (CRIA)

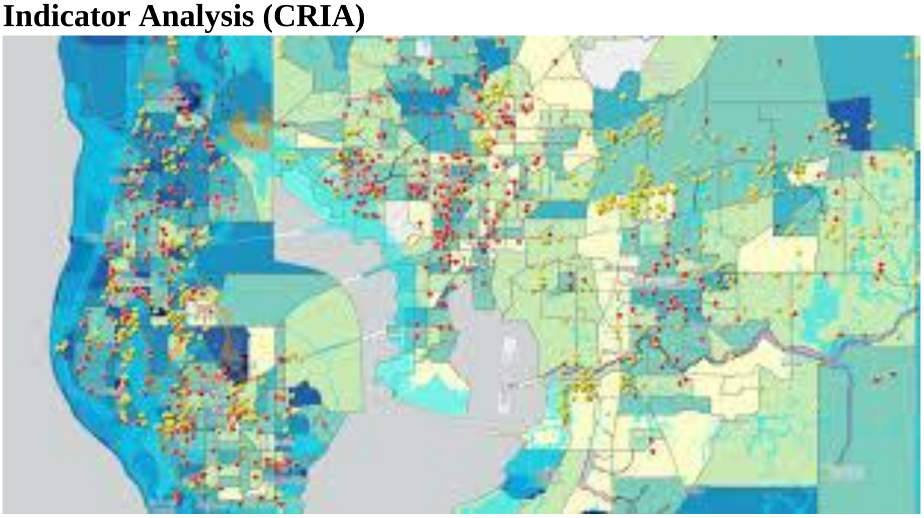


Figure 4: Resilience and Analysis Planning Tool screenshot from the Federal Emergency and Management Agency.

The Resilience Analysis and Planning Tool (RAPT) is a free GIS web mapping tool that looks at the intersections of people, infrastructure, and hazards, such as weather forecasts, historic disasters and estimated annualized frequency of hazard risk (Federal Emergency Management Agency, 2021). The resource provides a data visualization of county, census tract and tribal territory data points pulled from the most recent available U.S. Census Bureau American Community Survey. RAPT can be used by "emergency managers and community partners to visualize and assess potential challenges to resilience" and the data layers include hazards such as seismic and flood risk along with infrastructure information (CRIA Indicators Correlation Analysis).

To provide a data-focused understanding of community resilience, the Federal Emergency Management Agency and Argonne National Laboratory analyzed peer-reviewed research on the area of community resilience, cataloging distinct methodologies, creating and applying a set of criteria for this analysis, identifying specific indicators, and then grouping county-level data in bins to produce various color-coded data maps. They studied counties throughout the United States, identifying 20 commonly used indicators that had an emphasis on population and community issues (CRIA Indicators Correlation Analysis). The community resilience indicators included population-focused areas such as English proficiency, mobility and household income while the community-focused areas highlighted areas like connection to civic and social organizations (RAPT Community Resilience Indicators: Selection Process and Connection to Resilience).

The researchers noted in the community resilience indicators selection process that "individuals with disabilities tend to be more vulnerable to physical, social, and economic challenges" and "having functional, mobility, or access needs can make responding to disasters more challenging, including adapting to extreme circumstances and dealing with the increased stress" (RAPT Community Resilience Indicators: Selection Process and Connection to Resilience).

In addition, English proficiency can help support community resilience as it can improve communication between groups and allow individuals to have improved access to community resources. Specifically, "greater numbers of proficient English speakers can be vital for effective communication interactions in the event of a disaster" and translations of advisories may be scarce in communities where the native language is not English nor Spanish (RAPT Community Resilience Indicators: Selection Process and Connection to Resilience).

According to the Community Resilience Indicators, home ownership is often included as a measure of a community's economic strength and thus is a marker of community resilience. It is also used to reflect residents' level of place attachment to their communities.

Likewise, the Community Resilience Indicators Analysis denotes connection to civic and social organizations as a marker of resilience. This measure indicates the level of community engagement by analyzing the civic infrastructure where residents might support their communities. Participation in civic organizations might be a way for residents to invest in their community, fostering collaborative networking and building relationships. The availability of formal social networks is also important during critical response and recovery times, where resources are mobilized and information is shared.

4.2 About the National Risk Index

The National Risk Index provides a data visualization of risks, including flooding, heat waves and wildfires. Illustrating 18 natural hazards in the U.S., the National Risk Index is a data set and online tool that was designed and built by the Federal Emergency Management Agency in close collaboration with various stakeholders and partners. The National Risk Index uses available source data for natural hazard and community risk factors to create a baseline relative risk measurement for county and census tracts depicted in the U.S.

In a press release, the agency explained how the National Risk Index measures resilience, social vulnerability and expected annual loss. It was developed with a focus on increased risks related to climate change and the need to develop new approaches to reduce those risks. “It is important for people to educate themselves about the severe weather events that can pose a serious threat to their communities,” said Federal Emergency Management Agency Administrator Deanne Criswell (FEMA. 2021).

With the National Risk Index, there is a focus on the potential negative impacts due to natural hazards. The National Risk Index calculates natural hazards (“expected annual loss”), the components that enhance the consequences (“social vulnerability”) and the components that alleviate the consequences (“community resilience”). Using these three components, a composite Risk Index score is calculated along with a hazard type Risk Index score (National Risk Index).

According to the Federal Emergency Management Agency, a community’s score describes “its relative position among all other communities at the same level for a given component. All scores are constrained to a range of 0 (lowest possible value) to 100 (highest possible value)” (National Risk Index).

The National Risk Index has a qualitative rating that

> “Describes the nature of a community’s score in comparison to all other communities at the same level, ranging from ‘Very Low’ to ‘Very High’… To determine ratings, a methodology known as k-means clustering or natural breaks is applied to each score. This

approach divides all communities into groups such that the communities within each group are as similar as possible (minimized variance) while the groups are as different as possible (maximized variance)" (National Risk Index).

The agency notes that a higher expected annual loss, higher social vulnerability and lower community resilience can increase a community's overall risk. The National Risk Index is beneficial as it is a resource that was built by various groups ranging from academia and private industry to local, state and federal government. The National Risk Index rating showed that Riverside County had very high risk compared to the rest of the United States.

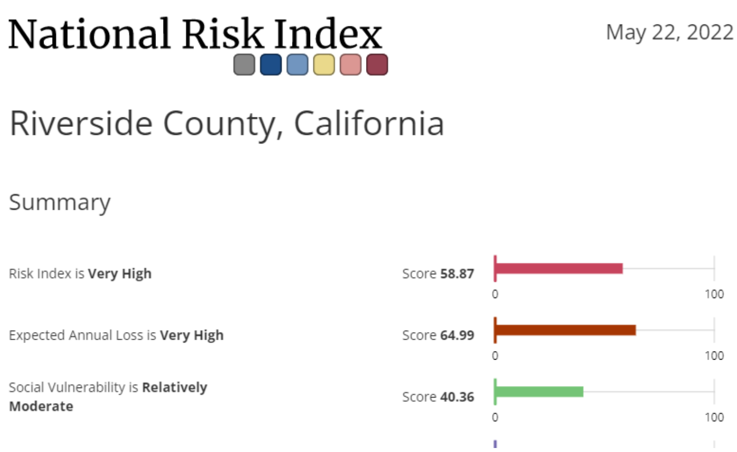


Figure 5: Summary of National Risk Index report of Riverside County.

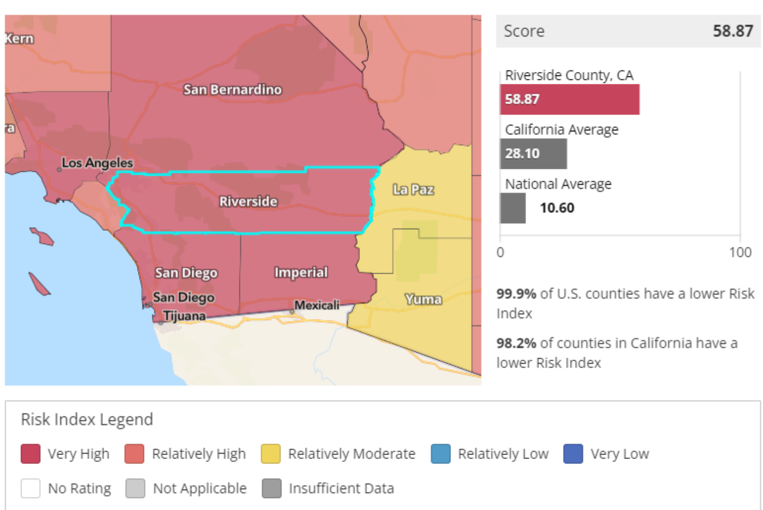


Figure 6: National Risk Index report of Riverside County.

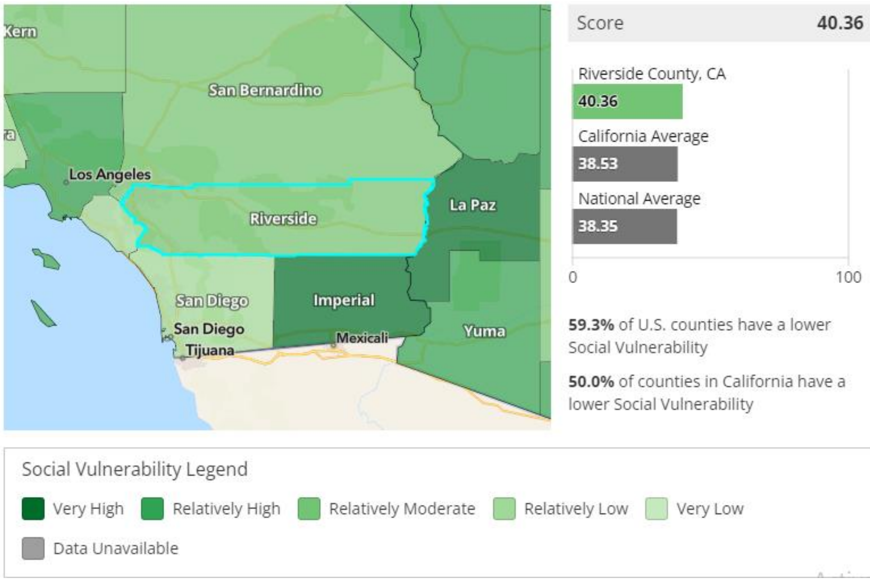


Figure 7: National Risk Index on social vulnerability of Riverside County.

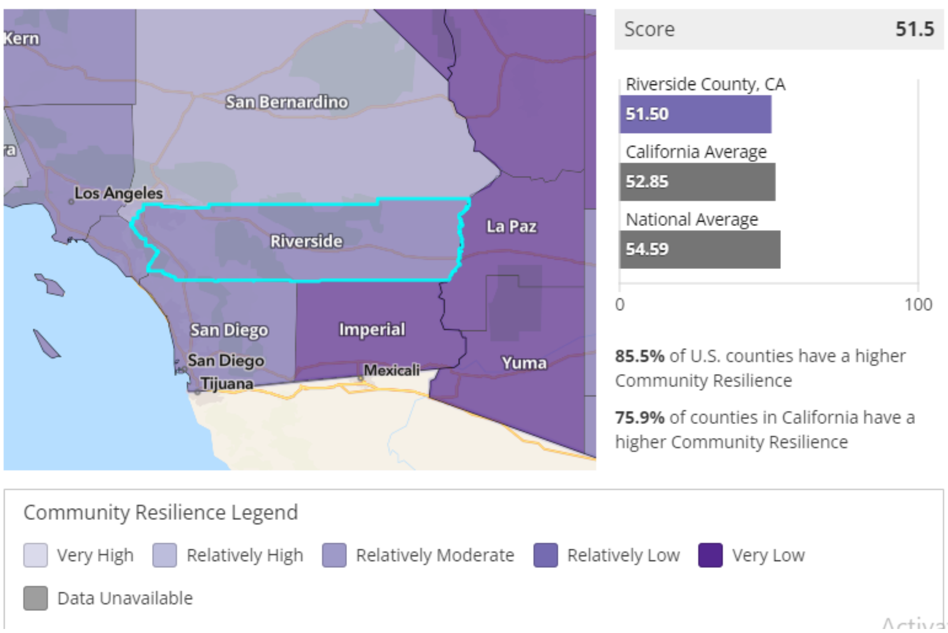


Figure 8: National Risk Index on community resilience of Riverside County.

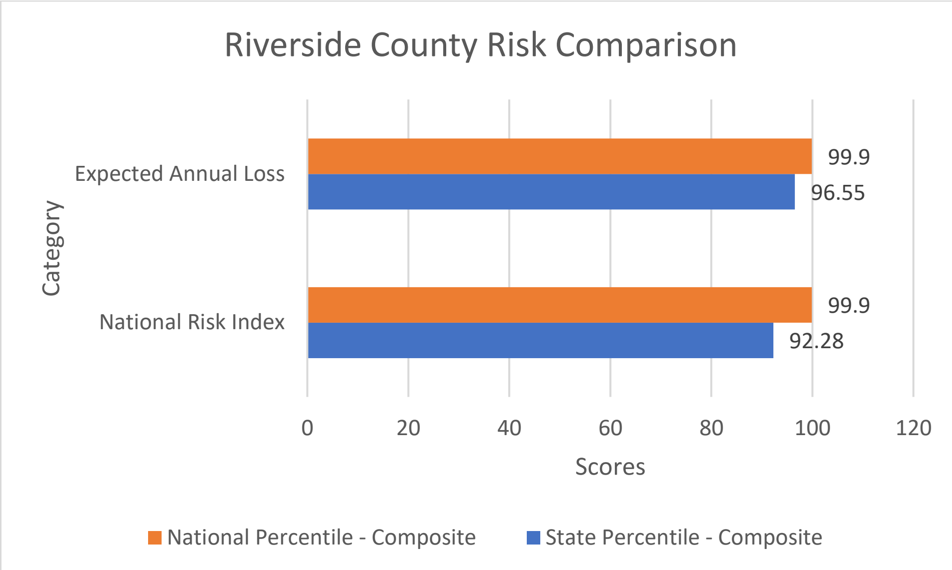
The social groups in Riverside County are found to have a relative moderate susceptibility to the adverse impacts of natural hazards when compared to the rest of the country. The communities in Riverside County have a relatively low ability to prepare for anticipated natural hazards, adapting to changing conditions and withstanding and recovering from disruptions when compared to other areas in the U.S. (National Risk Index).

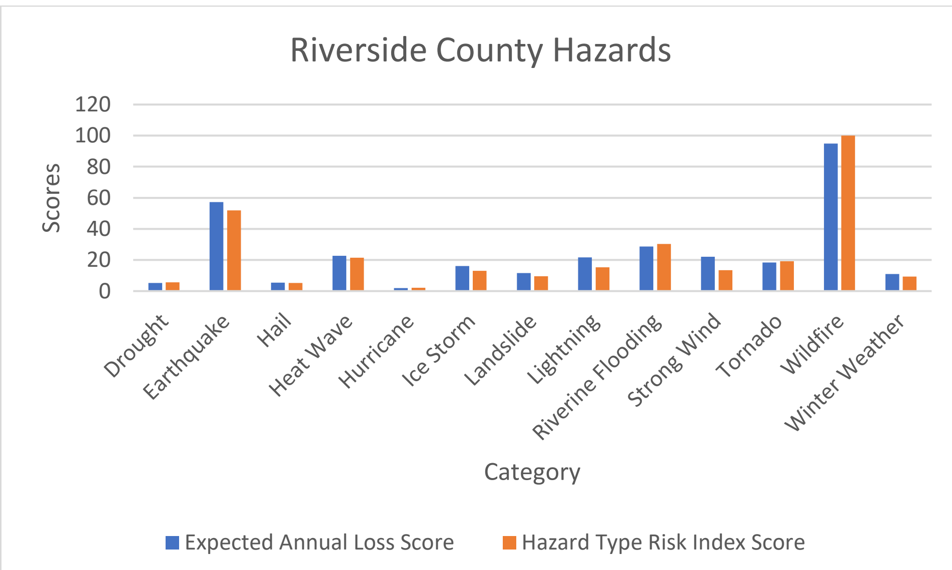
Part five: Findings

Figure 9: Riverside County image courtesy of Bureau of Land Management.

In February 2021, the Associated Press reported that the Federal Emergency Management Agency had calculated the risk for every county in America for 18 types of natural disasters, including earthquakes, hurricanes, tornadoes, floods, among other hazards. They stated that the top 10 riskiest areas in the country included Riverside County; this finding was based on calculations by 80 experts over six years. The focus on the tool was to educate “homeowners and renters and communities to be more resilient,” said Federal Emergency Management Agency representative Mike Grimm to the publication (Borenstein, 2021).

Part six: Discussion





The charts show the hazards facing Riverside County. There is high expected annual loss and elevated risk. Both figures are in the over 90-points section and are at the top of the national percentile. In addition, there are a multitude of hazards facing the region related to the considerable risk and high expected annual loss including wildfire, earthquake, and heatwaves. Based on the information gathered, the climate situation is dire but there are actions that can be taken at the local level to help mitigate the impact and stress of climate change.

6.1 Redhawk, California

Data from the State of California's Governor's Office of Emergency Services is useful in determining hazards more granularly. MyHazards is an Internet-mapping tool for the California public that helps highlight natural and man-made hazards in a specific area to show community members how to reduce personal risk (Hazard Mitigation). Redhawk is a planned community in the city of Temecula and the county of Riverside. Data from MyHazards shows that the community of Redhawk (area code 92592) is outside of a fire hazard zone but is near an area of earthquake hazard. Precautions should be taken; specifically residents are encouraged to use mitigation checklists and information to reduce injuries, protect life, as well as reduce damages to homes and properties. The state responsibility areas surrounding zip code 92592 though appear to have moderate to very high risk of fire hazards; the state responsibility areas are areas that the State of California is financially responsible for the prevention and suppression of wildfires (MyHazards).

6.2 Sun City, California

Sun City, also located in Riverside County, is a planned community with zip codes 92585 and 92586 in the city of Menifee. Using MyHazards, an Internet-mapping tool for the California public that helps highlight natural and man-made hazards in a specific area, it is helpful to see how community members can reduce their personal risk. Like Redhawk, Sun City is located outside of a fire hazard zone. It looks to be near areas that are considered moderate to very high risk of fire hazard state responsibility areas; these areas include land that the State of California is financially responsible for the prevention and suppression of wildfires (MyHazards). The areas are, however, in or near an area of low hazard flooding and steps and mitigation checklists and information may be useful in reducing injuries, protecting life, and reducing any damages to homes and property.

6.3 Policy Alternatives

Based on the information provided above from journal articles and media stories, here are a few possible policy options for stakeholders and community members to consider.

Policy alternative one: Making data more accessible to homeowners and policymakers.

In an interview with The Wall Street Journal, Jeff Hebert, president of economic development and real estate consulting firm HR&A Advisors, noted that while there are varying levels of risks with different regions and cities, not many communities have access to a granular level of data.

"It needs to be democratized for better decision-making both in local and metropolitan government and at the scale of the property. Climate-risk data needs to be at your fingertips. As a homeowner who is looking to buy a home, you should be able to have access to the data that matches the profile of your community: flood risk data, extreme heat data, fire hazard, mudslides," said Hebert in the 2020 article "Climate-Proofing Homes for Extreme Weather Ahead." "If we look into the future, particularly with the advancement in [artificial intelligence], what would be wonderful is if we were in a place where we had rapidly updated data—on a year-to-year basis would be amazing. Looking at the modeling of impacts moving forward, you may be moving from area to area inside a city" (Morenne, 2020).

Policy alternative two: Promoting the use of sustainable materials

In a “Future of Everything: Home” section story by The Wall Street Journal, Illya Azarof, an associate professor of architectural technology, discussed the need to retrofit buildings, 80 percent of which will remain in the coming years. A “minimum standard is going to be high insulation rates which reduce your energy usage and protect you from extreme heat. New materials like aerogel [a fire-retardant material used to insulate spacecraft] give promise to fire suppression. One challenge is that some materials we currently use, like reinforced concrete, are carbon-intensive. How can we use carbon-intensive materials and aim for a sustainable future?” (Morenne, 2020).

Policy alternative three: Harnessing community groups

This understanding of the social implications of climate change is necessary when considering community preparedness. Matthew R. Auer of the University of Georgia, in a *Sustainability Science* article “Considering equity in wildfire protection,” has noted the power of neighborhood- and household-level multi-actor, multi-scale networks to tap educational resources, technical assistance, and limited funding, to help with wildfire safety. These networks can help homeowners mitigate risks and he cited an example of the Hidden Springs homeowners’ association, a common interest development, in Idaho that performed essential wildfire management functions at the neighborhood level. The Hidden Springs planned community adopted several wildfire mitigation measures that later became part of Ada County Zoning Ordinance. He emphasized the need for further study on whether this polycentric approach could be adapted to communities that might be more rural, at-risk, and limited in resources to harden homes or organize for burden-sharing.

The Center for American Progress, an independent nonpartisan policy institute, also released a report in 2017 that detailed a framework for local action on climate change. The group recommended investing in resilient infrastructure and nature-based solutions that could "withstand more extreme weather and flood risks, curb carbon pollution, and provide economic and other benefits to residents" and "work closely with community groups to prepare for more extreme weather emergencies and disasters in a changing climate, including heat waves" (Kelly, C., et al., 2017). These steps would help reduce extreme weather risks while creating resilient and sustainable communities.

The Community Association Institute's Statistical Reviews from 2012 to 2020 highlighted the community associations found in California. The state was found to have 49,520 associations with 13.9 percent associations in state as percent of all associations, 65.8 percent association homes as percent of all owner-occupied homes, and 36.1 percent of association homes as percent of all occupied homes (Foundation for Community Association Research, 2021). According to the Foundation for Community Association Research, nationally, 25 to 27 percent of the U.S. population lives in community associations with $9.2 trillion value of homes in community associations (Foundation for Community Association Research, 2021).

A sizable portion of California lives in associations (14,160,000) with 36 percent of the state's total population. According to the Foundation for Community Association Research, nationally community associations contributed $306 billion, including volunteer time, real estate taxes, home improvements, and housing services (Foundation for Community Association Research, 2021). The Community Association Institute's Statistical Review also included details on association board membership. Many individuals participate in a board and/or committee (473,500). The value of the board and committee time amounts to $647,200,000 (Foundation for

Community Association Research, 2021). These groups could be mobilized to help in the preparation for any emergencies related to climate change.

Additionally, the Foundation for Community Association Research found that there was a total of 2,400,000 community association-elected members of boards of directors and appointed committee members who provided 97,600,000 volunteer hours of service annually, performing governance, community, and related services (Foundation for Community Association Research, 2021). These volunteer leaders could be important resources for disseminating important climate change-related information to other community members.

Policy alternative four: Fireproofing houses and communities

In a story by The Wall Street Journal, Jon Trapp, an assistant chief at Red Lodge Fire Rescue in Montana, described the need to prepare homes in high-risk areas. He has commented that there are steps individuals can take to protect their homes and take ownership of the situation.

"When a fire comes, embers are raining down. You would then want to have a roof that is noncombustible, a metal roof or an asphalt shingle roof. You have materials that are fire-resistant that you can side your home with [like cement board, stucco and masonry]. There are some [homeowners'] associations that mandate that you will construct your home with these materials and that you will do cleaning around your homes, and that is becoming more and more accepted," said Trapp in the article. "If you're able to create open areas, [widen] roads and water resources, like a pond or buried water tanks, for firefighting … then you won't see those entire subdivisions leveled, like we saw with the Paradise fire in California" (Morenne, 2020).

Community members can be resourceful and work together to prepare for these wildfire incidents.

In addition, The New York Times reported that experts recommend small steps including removing leaves and debris from gutters, replacing items like vents with mesh screens, among other maintenance items. “We have good science that shows that homes that have been retrofitted or built in this way are more likely to survive wildfires,” said Susie Kocher, a forestry adviser with the University of California Cooperative Extension, in the piece (Choi-Sagrin, 2021). These are practices that can be done on a regular or seasonal basis to prepare homes for wildfire destruction.

Policy alternative five: Providing subsidies

A study in the journal *Natural Hazards* titled “Multi-hazard climate risk projections for the United States” has highlighted the overall effects of the changing climate. The authors investigated future climate risk for the entire contiguous United States at the county level with a climate risk index that combined multiple hazards, exposures, and vulnerabilities. The climate risk projection they performed was for the mid-century (2040-2049), the 2040s, which allowed them to look at uncertainties related to the demographic projection at the end of the century. Their aim was to provide information that could be beneficial to planners in reducing hazard exposure to climate-related events or protecting vulnerable populations. The researchers found that “high exposure and vulnerability drive high climate risk in California counties” (KC et al., 2021). They cited the National Oceanic and Atmospheric Administration’s (NOAA) 2019-billion-dollar disaster report that stated, from 1980 to 2019, drought/heat waves claimed around 3,000 lives. The authors pointed out that both rural and urban counties are at future risk and state that the "impact of disaster events translates in terms of loss of lives accompanied by economic loss." They believe it is challenging to know exactly the balance point between economic loss and loss of lives, recommending further risk assessments. When homes and properties are at risk, there is a financial incentive to improve the home and property.

Providing financial incentives can change people's habits and perceptions. A National Program called Firewise USA, co-sponsored by the U.S. Forest Service and the nongovernmental National Fire Protection Association (NFPA), is of interest as it is rooted in congressional legislation. The program spans multiple levels of collaborators and U.S. Congress directs the U.S. Forest Service to redistribute a portion of revenues for fire-resistant home construction and landscaping and other wildfire-related education or wildland fire mitigation assistance activities (Auer, 2021). This program could be a model for others in the Western United States. Multiple levels and groups are involved in the education and resources provided to encourage changes in individual behavior with wildfire mitigation. In addition, there is a clear redistribution of the work done in land and housing management which might make it a more palatable choice for individuals.

California resident Melanie Light was featured in *The Wall Street Journal* story that mentioned the Firewise USA program. She organized her neighborhood, and more households became involved during the coronavirus (COVID-19) pandemic as they had more free time at home. "A lot of neighbors don't even know each other here. It's super private and secluded," she said in the article. "The Firewise program really brought people together in our neighborhood" (Friedman, 2022). She was hopeful that her local municipality would be able to help continue the work they had done as in-person work and travel had slowed the pace of neighborhood organizing following the initial wave of interest during the COVID-19 pandemic.

Collaborative partnerships between different entities are needed to produce and sustain this type of community advocacy. The Wall Street Journal reported in April 2022 that the California Department of Insurance announced regulations in February 2022 that would require insurance companies to "take fire-mitigation efforts into account when setting home insurance prices, including community-wide efforts. These new measures were introduced to encourage communities to take action to reduce wildfire risk (Friedman, 2022).

In addition, in the paper "Considering equity in wildfire protection," author Matthew Auer wrote:

> "As some insurance carriers cease underwriting homeowners' insurance in wildfire-prone areas, property owners can be expected to shoulder more costs for home hardening. The equity implications of who pays to fireproof homes and neighborhoods will intensify as wildfire risks multiply in areas beyond the comparatively wealthier wildland–urban interfaces (WUI) of the Pacific coastal states. Systems of polycentric governance, consisting of problem-solving actors who collaborate across jurisdictional and geographical boundaries, can help make wildfire mitigation more equitable. Polycentric governance institutions already help communities adapt to destructive wildfire in the United States. Lessons learned from these institutions must be tailored to poor and marginalized communities in harm's way–with a sense of urgency."

It is clear from his analysis that the financial burden is going to be on property owners. The equity issue will be at play as it will affect people at all income brackets and levels. It is important to determine how best to help communities develop solutions in a quick and future-oriented manner that also takes equity into consideration.

Part seven: Conclusion

"It's not if your place is going to burn, it's when." These words were spoken by Nicholas Holiday of Burnt Ranch, California, in an interview with The New York Times (Mitaru, 2021). The article highlighted Holiday and other residents who are having to adapt to the increasing number of wildfires. Based on these interviews and other reporting, climate change, notably the increase in wildfires, is a pressing societal issue.

This paper has highlighted a few challenges facing the Riverside County area. There are environmental concerns but there are resources and policy alternatives available to work through these difficulties. The study may be limited in the data provided so more investigation should be done to better understand future options available.

In an interview with New York Magazine, fire historian Stephen Pyne said, "If we think about adding up all the ways we're using fire, we're creating the fire equivalent of an ice age" (Rosa-Aquino, 2021). Pyne described how the U.S. fire community has developed a national cohesive strategy for wildland fire that includes milestones to "create fire-adapted communities, create fire-resilient landscapes, and develop a workforce capable of implementing these goals" (Rosa-Aquino, 2021); nationally groups can live with wildfire, but there is a need to tackle climate change before mitigating the risk of fires that lead to economic loss.

More needs to be done in terms of studying the infrastructure damage wreaked by wildfires. A study by Stanford researchers on water use and drought-related conservation behavior found that "cities all over the world are expanding at rapid rates, and there are many different ways for them to develop" including having city planners and water managers work together to "develop cities of the future that house an increasingly large portion of the population and meet the wide-range of sustainability-oriented goals" (Seipp, Agrawal, Ajami, 2020). It is critical to address these 21st century challenges by looking at current housing policies and building regulations.

Based on the above research, the stakeholders affected by recent wildfires include homeowners and those in vulnerable communities. Researchers at the University of California, Irvine, and University of California, Davis, also found that certain “areas not only sustained three times more wildfire on average, but also tended to be characterized by higher rates of poverty, unemployment, and vacant housing, as well as higher proportions of low-income residents and residents without college degrees” (Masri et al., 2021). There is a concern that those areas affected most by burns had larger proportions of elderly residents and the authors of the paper recommended that policymakers and state agencies study this issue more closely to determine necessary allocation of resources in an equitable manner (Masri et al., 2021).

These local governmental authorities are also stakeholders in the wildfire impact discussion. In a recent *New York Times* article, Marin County Fire Battalion Chief Graham Groneman advised residents to invest in home hardening to modify a home so that it would be more fire-resistant with “defensible space rather than heavy machinery” (Mitaru, 2021) and his department has proactively worked collaboratively with property owners. Similarly, property intelligence firm CoreLogic recommended city planners “work with local municipalities, counties, or state agencies to better understand area-specific mitigations” to encourage community participation (CoreLogic, 2021).

More than ever, communities of all shapes and sizes, ranging from local municipalities to common interest communities, are asked to come together to find solutions to environmental issues. The purpose of this study was to build upon previous research on wildfire impact and climate change readiness in the Western United States. With the described background, problem statement, and stakeholders, this societal issue of increase in wildfires due to climate change is a multilayered, multifaceted challenge. More research should be done related to this topic to identify solutions. Specifically, studying alternative solutions and evaluation criteria will bring more clarity in terms of options to pursue for the greater good.

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Appendix one

Riverside County Statistics

Data provided from the Resilience Analysis and Planning Tool (RAPT)

Population (2016)	2,189,641
Building Value ($)	200,479,775,000.00
Agriculture Value ($)	931,982,000.00
Area (sq mi)	7,206.33
National Risk Index - Score – Composite	58.87
National Risk Index - Rating – Composite	Very High
National Risk Index - National Percentile – Composite	99.90
National Risk Index - State Percentile – Composite	98.28
Expected Annual Loss - Score – Composite	64.99
Expected Annual Loss - Rating – Composite	Very High
Expected Annual Loss - National Percentile – Composite	99.90
Expected Annual Loss - State Percentile – Composite	96.55
Expected Annual Loss - Total – Composite	404,903,002.82
Expected Annual Loss - Building Value – Composite	350,657,030.11
Expected Annual Loss - Population – Composite	7.04
Expected Annual Loss - Population Equivalence - Composite	53,472,503.20
Expected Annual Loss - Agriculture Value – Composite	773,469.51
Social Vulnerability – Score	40.36
Social Vulnerability – Rating	Relatively Moderate
Social Vulnerability - National Percentile	59.36
Social Vulnerability - State Percentile	50.00
Social Vulnerability – Value	0.51
Community Resilience – Score	51.50
Community Resilience – Rating	Relatively Low
Community Resilience - National Percentile	14.58
Community Resilience - State Percentile	24.14
Community Resilience – Value	2.58
Avalanche - Number of Events	

Avalanche - Annualized Frequency	
Avalanche - Exposure - Building Value	
Avalanche - Exposure – Population	
Avalanche - Exposure - Population Equivalence	
Avalanche - Exposure – Total	
Avalanche - Historic Loss Ratio – Buildings	
Avalanche - Historic Loss Ratio – Population	
Avalanche - Historic Loss Ratio - Total Rating	Not Applicable
Avalanche - Expected Annual Loss - Building Value	
Avalanche - Expected Annual Loss – Population	
Avalanche - Expected Annual Loss - Population Equivalence	
Avalanche - Expected Annual Loss – Total	
Avalanche - Expected Annual Loss Score	
Avalanche - Expected Annual Loss Rating	Not Applicable
Avalanche - Hazard Type Risk Index Score	
Avalanche - Hazard Type Risk Index Rating	Not Applicable
Coastal Flooding - Number of Events	
Coastal Flooding - Annualized Frequency	
Coastal Flooding - Exposure - Building Value	
Coastal Flooding - Exposure – Population	
Coastal Flooding - Exposure - Population Equivalence	
Coastal Flooding - Exposure – Total	
Coastal Flooding - Historic Loss Ratio – Buildings	
Coastal Flooding - Historic Loss Ratio – Population	
Coastal Flooding - Historic Loss Ratio - Total Rating	Not Applicable
Coastal Flooding - Expected Annual Loss - Building Value	
Coastal Flooding - Expected Annual Loss – Population	
Coastal Flooding - Expected Annual Loss - Population Equivalence	
Coastal Flooding - Expected Annual Loss – Total	
Coastal Flooding - Expected Annual Loss Score	
Coastal Flooding - Expected Annual Loss Rating	Not Applicable
Coastal Flooding - Hazard Type Risk Index Score	
Coastal Flooding - Hazard Type Risk Index Rating	Not Applicable

Cold Wave - Number of Events	0.00
Cold Wave - Annualized Frequency	0.00
Cold Wave - Exposure - Building Value	0.00
Cold Wave - Exposure – Population	0.00
Cold Wave - Exposure - Population Equivalence	0.00
Cold Wave - Exposure - Agriculture Value	0.00
Cold Wave - Exposure – Total	0.00
Cold Wave - Historic Loss Ratio – Buildings	0.00
Cold Wave - Historic Loss Ratio – Population	0.00
Cold Wave - Historic Loss Ratio – Agriculture	0.01
Cold Wave - Historic Loss Ratio - Total Rating	No Rating
Cold Wave - Expected Annual Loss - Building Value	0.00
Cold Wave - Expected Annual Loss – Population	0.00
Cold Wave - Expected Annual Loss - Population Equivalence	0.00
Cold Wave - Expected Annual Loss - Agriculture Value	0.00
Cold Wave - Expected Annual Loss – Total	0.00
Cold Wave - Expected Annual Loss Score	0.00
Cold Wave - Expected Annual Loss Rating	No Expected Annual Losses
Cold Wave - Hazard Type Risk Index Score	0.00
Cold Wave - Hazard Type Risk Index Rating	No Rating
Drought - Number of Events	1,540.00
Drought - Annualized Frequency	42.54
Drought - Exposure - Agriculture Value	826,413,421.78
Drought - Exposure – Total	826,413,421.78
Drought - Historic Loss Ratio – Agriculture	0.00
Drought - Historic Loss Ratio - Total Rating	Very Low
Drought - Expected Annual Loss - Agriculture Value	33,793.58
Drought - Expected Annual Loss – Total	33,793.58
Drought - Expected Annual Loss Score	5.17
Drought - Expected Annual Loss Rating	Relatively Low
Drought - Hazard Type Risk Index Score	5.70
Drought - Hazard Type Risk Index Rating	Relatively Low
Earthquake - Number of Events	

Earthquake - Annualized Frequency	0.01
Earthquake - Exposure - Building Value	200,479,775,000.00
Earthquake - Exposure – Population	2,189,641.00
Earthquake - Exposure - Population Equivalence	16,641,271,600,000.00
Earthquake - Exposure – Total	16,841,751,375,000.00
Earthquake - Historic Loss Ratio – Buildings	0.00
Earthquake - Historic Loss Ratio – Population	0.00
Earthquake - Historic Loss Ratio - Total Rating	Relatively Moderate
Earthquake - Expected Annual Loss - Building Value	205,442,070.30
Earthquake - Expected Annual Loss – Population	6.54
Earthquake - Expected Annual Loss - Population Equivalence	49,681,637.46
Earthquake - Expected Annual Loss – Total	255,123,707.76
Earthquake - Expected Annual Loss Score	57.24
Earthquake - Expected Annual Loss Rating	Very High
Earthquake - Hazard Type Risk Index Score	51.85
Earthquake - Hazard Type Risk Index Rating	Relatively High
Hail - Number of Events	4.00
Hail - Annualized Frequency	0.11
Hail - Exposure - Building Value	200,479,775,000.00
Hail - Exposure – Population	2,189,641.00
Hail - Exposure - Population Equivalence	16,641,271,600,000.00
Hail - Exposure - Agriculture Value	931,982,000.00
Hail - Exposure – Total	16,842,683,357,000.00
Hail - Historic Loss Ratio – Buildings	0.00
Hail - Historic Loss Ratio – Population	0.00
Hail - Historic Loss Ratio – Agriculture	0.00
Hail - Historic Loss Ratio - Total Rating	Very Low
Hail - Expected Annual Loss - Building Value	102.75
Hail - Expected Annual Loss – Population	0.00
Hail - Expected Annual Loss - Population Equivalence	10,725.60
Hail - Expected Annual Loss - Agriculture Value	90.99
Hail - Expected Annual Loss – Total	10,919.34
Hail - Expected Annual Loss Score	5.46

Hail - Expected Annual Loss Rating	Very Low
Hail - Hazard Type Risk Index Score	5.28
Hail - Hazard Type Risk Index Rating	Very Low
Heat Wave - Number of Events	885.00
Heat Wave - Annualized Frequency	8.61
Heat Wave - Exposure - Building Value	200,177,388,484.25
Heat Wave - Exposure – Population	2,186,148.35
Heat Wave - Exposure - Population Equivalence	16,614,727,435,907.93
Heat Wave - Exposure - Agriculture Value	924,104,970.47
Heat Wave - Exposure – Total	16,815,828,929,362.65
Heat Wave - Historic Loss Ratio – Buildings	0.00
Heat Wave - Historic Loss Ratio – Population	0.00
Heat Wave - Historic Loss Ratio – Agriculture	0.00
Heat Wave - Historic Loss Ratio - Total Rating	Very Low
Heat Wave - Expected Annual Loss - Building Value	779.19
Heat Wave - Expected Annual Loss – Population	0.05
Heat Wave - Expected Annual Loss - Population Equivalence	392,968.94
Heat Wave - Expected Annual Loss - Agriculture Value	421,509.53
Heat Wave - Expected Annual Loss – Total	815,257.67
Heat Wave - Expected Annual Loss Score	22.65
Heat Wave - Expected Annual Loss Rating	Relatively Moderate
Heat Wave - Hazard Type Risk Index Score	21.47
Heat Wave - Hazard Type Risk Index Rating	Relatively High
Hurricane - Number of Events	0.00
Hurricane - Annualized Frequency	0.01
Hurricane - Exposure - Building Value	200,479,775,000.00
Hurricane - Exposure – Population	2,189,641.00
Hurricane - Exposure - Population Equivalence	16,641,271,600,000.00
Hurricane - Exposure - Agriculture Value	931,982,000.00
Hurricane - Exposure – Total	16,842,683,357,000.00
Hurricane - Historic Loss Ratio – Buildings	0.00
Hurricane - Historic Loss Ratio – Population	0.00
Hurricane - Historic Loss Ratio – Agriculture	0.00

Hurricane - Historic Loss Ratio - Total Rating	Very Low
Hurricane - Expected Annual Loss - Building Value	845.97
Hurricane - Expected Annual Loss – Population	0.00
Hurricane - Expected Annual Loss - Population Equivalence	539.88
Hurricane - Expected Annual Loss - Agriculture Value	2,768.97
Hurricane - Expected Annual Loss – Total	4,154.83
Hurricane - Expected Annual Loss Score	2.00
Hurricane - Expected Annual Loss Rating	Very Low
Hurricane - Hazard Type Risk Index Score	2.10
Hurricane - Hazard Type Risk Index Rating	Very Low
Ice Storm - Number of Events	0.00
Ice Storm - Annualized Frequency	0.01
Ice Storm - Exposure - Building Value	200,479,775,000.00
Ice Storm - Exposure – Population	2,189,641.00
Ice Storm - Exposure - Population Equivalence	16,641,271,600,000.00
Ice Storm - Exposure – Total	16,841,751,375,000.00
Ice Storm - Historic Loss Ratio – Buildings	0.00
Ice Storm - Historic Loss Ratio – Population	0.00
Ice Storm - Historic Loss Ratio - Total Rating	Very Low
Ice Storm - Expected Annual Loss - Building Value	17,577.42
Ice Storm - Expected Annual Loss – Population	0.00
Ice Storm - Expected Annual Loss - Population Equivalence	28,495.68
Ice Storm - Expected Annual Loss – Total	46,073.10
Ice Storm - Expected Annual Loss Score	16.13
Ice Storm - Expected Annual Loss Rating	Relatively Low
Ice Storm - Hazard Type Risk Index Score	13.10
Ice Storm - Hazard Type Risk Index Rating	Relatively Low
Landslide - Number of Events	30.00
Landslide - Annualized Frequency	0.08
Landslide - Exposure - Building Value	48,946,524,314.28
Landslide - Exposure – Population	487,640.09
Landslide - Exposure - Population Equivalence	3,706,064,657,070.55
Landslide - Exposure – Total	3,755,011,181,384.84

Landslide - Historic Loss Ratio – Buildings	0.00
Landslide - Historic Loss Ratio – Population	0.00
Landslide - Historic Loss Ratio - Total Rating	Very Low
Landslide - Expected Annual Loss - Building Value	3,468.51
Landslide - Expected Annual Loss – Population	0.00
Landslide - Expected Annual Loss - Population Equivalence	10,276.89
Landslide - Expected Annual Loss – Total	13,745.40
Landslide - Expected Annual Loss Score	11.65
Landslide - Expected Annual Loss Rating	Relatively Low
Landslide - Hazard Type Risk Index Score	9.62
Landslide - Hazard Type Risk Index Rating	Relatively Low
Lightning - Number of Events	97.00
Lightning - Annualized Frequency	4.39
Lightning - Exposure - Building Value	200,479,775,000.00
Lightning - Exposure – Population	2,189,641.00
Lightning - Exposure - Population Equivalence	16,641,271,600,000.00
Lightning - Exposure – Total	16,841,751,375,000.00
Lightning - Historic Loss Ratio – Buildings	0.00
Lightning - Historic Loss Ratio – Population	0.00
Lightning - Historic Loss Ratio - Total Rating	Very Low
Lightning - Expected Annual Loss - Building Value	4,655.62
Lightning - Expected Annual Loss – Population	0.01
Lightning - Expected Annual Loss - Population Equivalence	95,196.68
Lightning - Expected Annual Loss – Total	99,852.30
Lightning - Expected Annual Loss Score	21.76
Lightning - Expected Annual Loss Rating	Relatively Moderate
Lightning - Hazard Type Risk Index Score	15.30
Lightning - Hazard Type Risk Index Rating	Relatively Low
Riverine Flooding - Number of Events	161.00
Riverine Flooding - Annualized Frequency	6.71
Riverine Flooding - Exposure - Building Value	5,754,356,112.63
Riverine Flooding - Exposure – Population	59,164.34
Riverine Flooding - Exposure - Population Equivalence	449,648,958,491.58

Riverine Flooding - Exposure - Agriculture Value	90,058,803.73
Riverine Flooding - Exposure – Total	455,493,373,407.93
Riverine Flooding - Historic Loss Ratio – Buildings	0.00
Riverine Flooding - Historic Loss Ratio – Population	0.00
Riverine Flooding - Historic Loss Ratio – Agriculture	0.00
Riverine Flooding - Historic Loss Ratio - Total Rating	Very Low
Riverine Flooding - Expected Annual Loss - Building Value	8,807,038.25
Riverine Flooding - Expected Annual Loss – Population	0.37
Riverine Flooding - Expected Annual Loss - Population Equivalence	2,812,991.81
Riverine Flooding - Expected Annual Loss - Agriculture Value	312,246.94
Riverine Flooding - Expected Annual Loss – Total	11,932,277.00
Riverine Flooding - Expected Annual Loss Score	28.77
Riverine Flooding - Expected Annual Loss Rating	Relatively High
Riverine Flooding - Hazard Type Risk Index Score	30.27
Riverine Flooding - Hazard Type Risk Index Rating	Relatively High
Strong Wind - Number of Events	10.00
Strong Wind - Annualized Frequency	0.29
Strong Wind - Exposure - Building Value	200,479,775,000.00
Strong Wind - Exposure – Population	2,189,641.00
Strong Wind - Exposure - Population Equivalence	16,641,271,600,000.00
Strong Wind - Exposure - Agriculture Value	931,982,000.00
Strong Wind - Exposure – Total	16,842,683,357,000.00
Strong Wind - Historic Loss Ratio – Buildings	0.00
Strong Wind - Historic Loss Ratio – Population	0.00
Strong Wind - Historic Loss Ratio – Agriculture	0.00
Strong Wind - Historic Loss Ratio - Total Rating	Very Low
Strong Wind - Expected Annual Loss - Building Value	76,088.46
Strong Wind - Expected Annual Loss – Population	0.02
Strong Wind - Expected Annual Loss - Population Equivalence	117,998.53
Strong Wind - Expected Annual Loss - Agriculture Value	535.32
Strong Wind - Expected Annual Loss – Total	194,622.31
Strong Wind - Expected Annual Loss Score	22.14
Strong Wind - Expected Annual Loss Rating	Relatively Low

Strong Wind - Hazard Type Risk Index Score	13.50
Strong Wind - Hazard Type Risk Index Rating	Relatively Low
Tornado - Number of Events	20.00
Tornado - Annualized Frequency	0.46
Tornado - Exposure - Building Value	200,479,775,000.00
Tornado - Exposure – Population	2,189,641.00
Tornado - Exposure - Population Equivalence	16,641,271,600,000.00
Tornado - Exposure - Agriculture Value	931,982,000.00
Tornado - Exposure – Total	16,842,683,357,000.00
Tornado - Historic Loss Ratio – Buildings	0.00
Tornado - Historic Loss Ratio – Population	0.00
Tornado - Historic Loss Ratio – Agriculture	0.00
Tornado - Historic Loss Ratio - Total Rating	Very Low
Tornado - Expected Annual Loss - Building Value	717,887.44
Tornado - Expected Annual Loss – Population	0.02
Tornado - Expected Annual Loss - Population Equivalence	151,070.88
Tornado - Expected Annual Loss - Agriculture Value	724.71
Tornado - Expected Annual Loss – Total	869,683.03
Tornado - Expected Annual Loss Score	18.33
Tornado - Expected Annual Loss Rating	Relatively Moderate
Tornado - Hazard Type Risk Index Score	19.28
Tornado - Hazard Type Risk Index Rating	Relatively Moderate
Tsunami - Number of Events	
Tsunami - Annualized Frequency	
Tsunami - Exposure - Building Value	
Tsunami - Exposure – Population	
Tsunami - Exposure - Population Equivalence	
Tsunami - Exposure – Total	
Tsunami - Historic Loss Ratio – Buildings	
Tsunami - Historic Loss Ratio – Population	
Tsunami - Historic Loss Ratio - Total Rating	Not Applicable
Tsunami - Expected Annual Loss - Building Value	
Tsunami - Expected Annual Loss – Population	

Tsunami - Expected Annual Loss - Population Equivalence	
Tsunami - Expected Annual Loss – Total	
Tsunami - Expected Annual Loss Score	
Tsunami - Expected Annual Loss Rating	Not Applicable
Tsunami - Hazard Type Risk Index Score	
Tsunami - Hazard Type Risk Index Rating	Not Applicable
Volcanic Activity - Number of Events	
Volcanic Activity - Annualized Frequency	
Volcanic Activity - Exposure - Building Value	
Volcanic Activity - Exposure – Population	
Volcanic Activity - Exposure - Population Equivalence	
Volcanic Activity - Exposure – Total	
Volcanic Activity - Historic Loss Ratio – Buildings	
Volcanic Activity - Historic Loss Ratio – Population	
Volcanic Activity - Historic Loss Ratio - Total Rating	Not Applicable
Volcanic Activity - Expected Annual Loss - Building Value	
Volcanic Activity - Expected Annual Loss – Population	
Volcanic Activity - Expected Annual Loss - Population Equivalence	
Volcanic Activity - Expected Annual Loss – Total	
Volcanic Activity - Expected Annual Loss Score	
Volcanic Activity - Expected Annual Loss Rating	Not Applicable
Volcanic Activity - Hazard Type Risk Index Score	
Volcanic Activity - Hazard Type Risk Index Rating	Not Applicable
Wildfire - Number of Events	
Wildfire - Annualized Frequency	0.01
Wildfire - Exposure - Building Value	14,296,621,674.66
Wildfire - Exposure – Population	149,635.07
Wildfire - Exposure - Population Equivalence	1,137,226,511,671.95
Wildfire - Exposure - Agriculture Value	352,868,770.11
Wildfire - Exposure – Total	1,151,876,002,116.71
Wildfire - Historic Loss Ratio – Buildings	0.40
Wildfire - Historic Loss Ratio – Population	0.00
Wildfire - Historic Loss Ratio – Agriculture	0.00

Wildfire - Historic Loss Ratio - Total Rating	Very Low
Wildfire - Expected Annual Loss - Building Value	135,586,413.83
Wildfire - Expected Annual Loss – Population	0.02
Wildfire - Expected Annual Loss - Population Equivalence	162,226.93
Wildfire - Expected Annual Loss - Agriculture Value	1,799.46
Wildfire - Expected Annual Loss – Total	135,750,440.22
Wildfire - Expected Annual Loss Score	94.99
Wildfire - Expected Annual Loss Rating	Very High
Wildfire - Hazard Type Risk Index Score	100.00
Wildfire - Hazard Type Risk Index Rating	Very High
Winter Weather - Number of Events	232.00
Winter Weather - Annualized Frequency	1.04
Winter Weather - Exposure - Building Value	193,204,479,087.72
Winter Weather - Exposure – Population	2,086,702.14
Winter Weather - Exposure - Population Equivalence	15,858,936,280,659.67
Winter Weather - Exposure - Agriculture Value	679,533,632.51
Winter Weather - Exposure – Total	16,052,820,293,379.89
Winter Weather - Historic Loss Ratio – Buildings	0.00
Winter Weather - Historic Loss Ratio – Population	0.00
Winter Weather - Historic Loss Ratio – Agriculture	0.00
Winter Weather - Historic Loss Ratio - Total Rating	Very Low
Winter Weather - Expected Annual Loss - Building Value	102.36
Winter Weather - Expected Annual Loss – Population	0.00
Winter Weather - Expected Annual Loss - Population Equivalence	8,373.93
Winter Weather - Expected Annual Loss - Agriculture Value	0.00
Winter Weather - Expected Annual Loss – Total	8,476.29
Winter Weather - Expected Annual Loss Score	10.96
Winter Weather - Expected Annual Loss Rating	Very Low
Winter Weather - Hazard Type Risk Index Score	9.26
Winter Weather - Hazard Type Risk Index Rating	Relatively Low
National Risk Index Version	November 2021

Seismic Hazard

Acceleration Value (where the higher the value, the higher the hazard): 60

Earthquake hazard map showing peak ground accelerations having a 2 percent probability of being exceeded in 50 years, for a firm rock site.

Seismic Hazard

Acceleration Value (where the higher the value, the higher the hazard): 80

Earthquake hazard map showing peak ground accelerations having a 2 percent probability of being exceeded in 50 years, for a firm rock site.

County Population: 2,411,439

<u>Community Resilience Indicator Analysis</u>

Percent Age over 65: 14.12%

Percent with a Disability: 11.56%

Percent without High School Diploma: 17.96%

Percent Unemployment: 7.50%

Percent Lacking Health Insurance: 8.80%

Percent Households with Limited English Proficiency: 8.12%

Median Households Income: $67,005

Percent of Mobile Homes: 8.76%

Percent of Owner Occupied Housing: 57.22%

Percent of Single Parent Households: 17.09%

Vacant Rental Rate: 4.80%

Percent of Households without a Vehicle: 4.15%

Income Inequality (GINI Index): 0.46

Percent of Religious Adherents: 44.40%

Health Diagnosing and Treating Practitioners per 1,000: 13.42

Public School per 5,000: 1.08

Hotels/Motels per 5,000: 0.56

Social and Civic Organizations per 10,000: 0.30

Hospitals per 10,000: 0.08

Population Change as a Standard Deviation: 0.75

Aggregate Resilience Indicator: -0.11

Percent of Owner-Occupied Housing Units: 57.22%

63.8 percent of homes in the United States are occupied by the owner.

Percent Households with Limited English: 8.12%

4.4 percent of U.S. households are considered to have limited English proficiency, where no member 14 years or older speaks only English or speaks English "very well."

Percent of Population with a Disability: 11.56%

12.6 percent of the U.S. population has a disability.

Individuals with disabilities include those with the following conditions: serious difficulty hearing, seeing, walking, and/or dressing; serious difficulty because of a physical, mental, or emotional condition.

Appendix two

Definitions

California Office of Emergency Services (CAL OES): The agency responsible for overseeing and coordinating emergency preparedness, response, recovery and homeland security activities within the state of California.

Hazard mitigation planning: Planning that can reduce the loss of life and property by minimizing the impact of disasters.

Inland Empire: Southern California section that stretches from the Los Angeles County border to Arizona and Nevada.

MyHazards: A tool for the public to discover hazards in their area (earthquake, flood, fire, and tsunami) and learn steps to reduce personal risk.

Resilience Analysis and Planning Tool (RAPT): RAPT is a free GIS web map to help community leaders examine census data, infrastructure locations, and hazards.

U.S. Census Bureau: Serve as the nation's leading provider of quality data about its people and economy.

Appendix three: Steps to using the Resilience Analysis Planning Tool

The Resilience Analysis Planning Tool (RAPT) is a free tool available on the Federal Emergency Management Agency's (FEMA) website. According to the organization, it is a free GIS web map that showcases census data, infrastructure locations, and hazards. Details such as real-time weather forecasts, historic disasters and estimated annualized frequency of hazard risk can also be found. Community leaders and emergency manners can use the tool for emergency preparedness initiatives. Here are steps to using RAPT (information as of May 2022):

1. Visit fema.gov/RAPT.

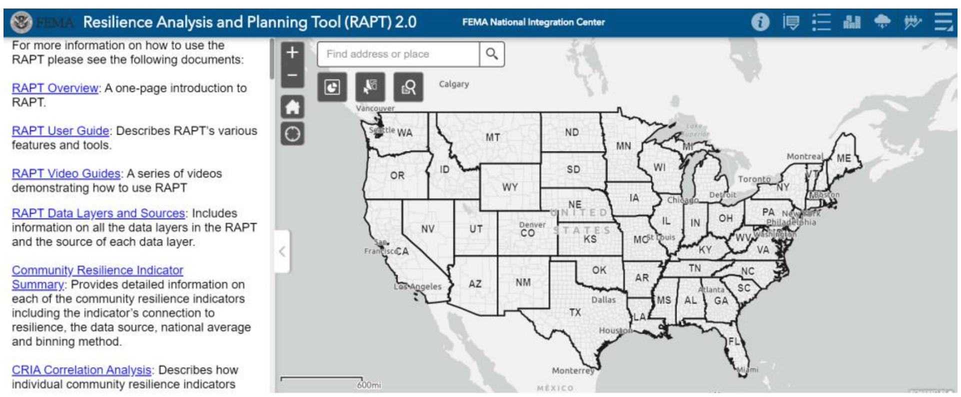

Figure 10: Image courtesy of Resilience Analysis Planning Tool.

2. Accept the user agreement that shows up on the initial splash page; user agreement acceptance is required each time when using the tool.
3. The page will open with a description of the tool and links to resources such as a user guide, how-to videos, and data layers and sources.
4. Click the top icons at the navigation bar that will show access to a frequently-accessed-questions; a legend of layers; and community infrastructure points. Click the county indicators icon to see the layers of available for county-level data, including data for the

community resilience indicator layers. Click the basemap gallery to see different versions of the map including a streets map and satellite gallery imagery.

Figure 11: Image courtesy of Resilience Analysis Planning Tool.

5. Click the raincloud icon to see the GIS layers of flood hazard zones and risk estimates from the National Risk Index.

Appendix four: Redhawk Planned Community

MyHazards Map

Zip code 92592

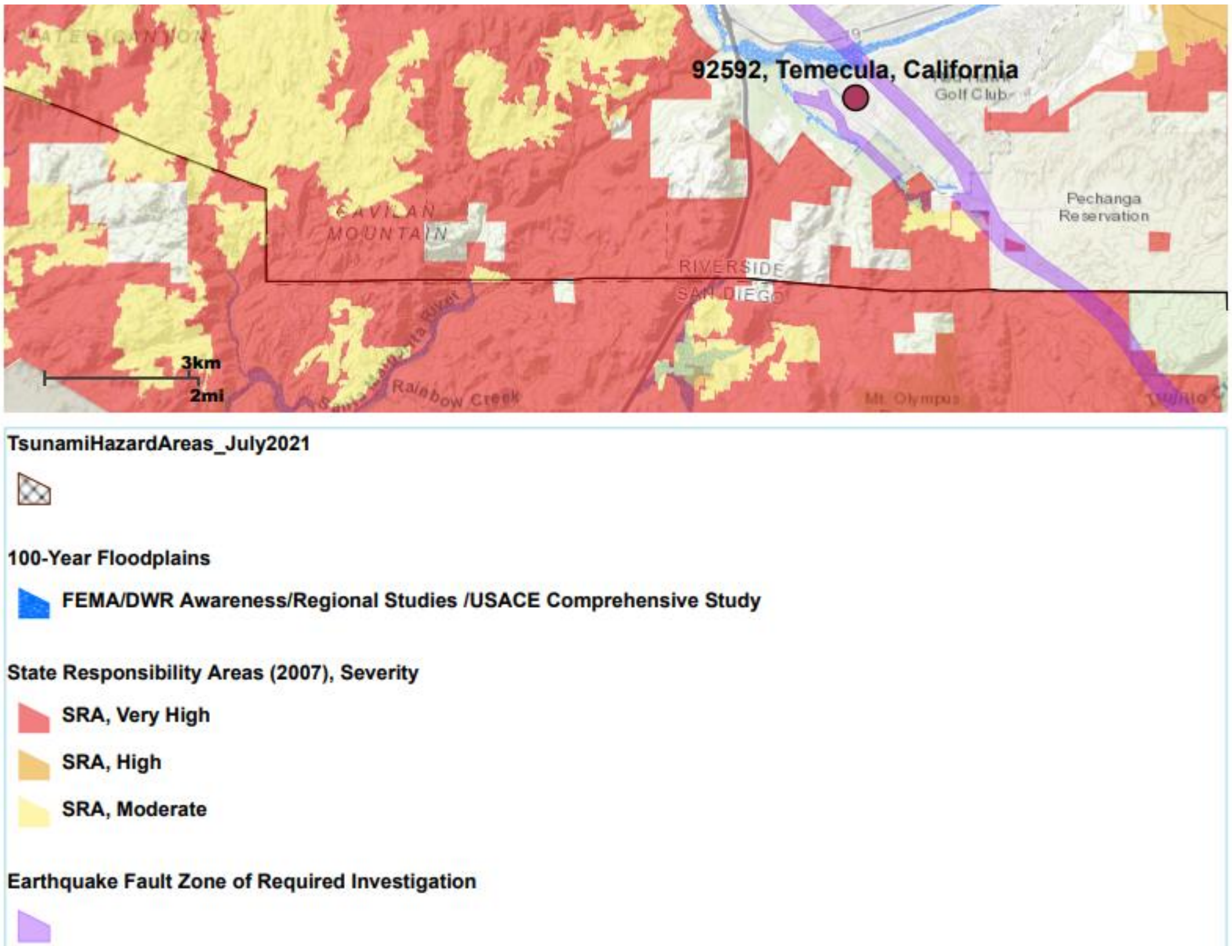

Figure 12: Image courtesy of MyHazards.

Appendix five: Sun City Planned Community

MyHazards Map

Zip code 92585

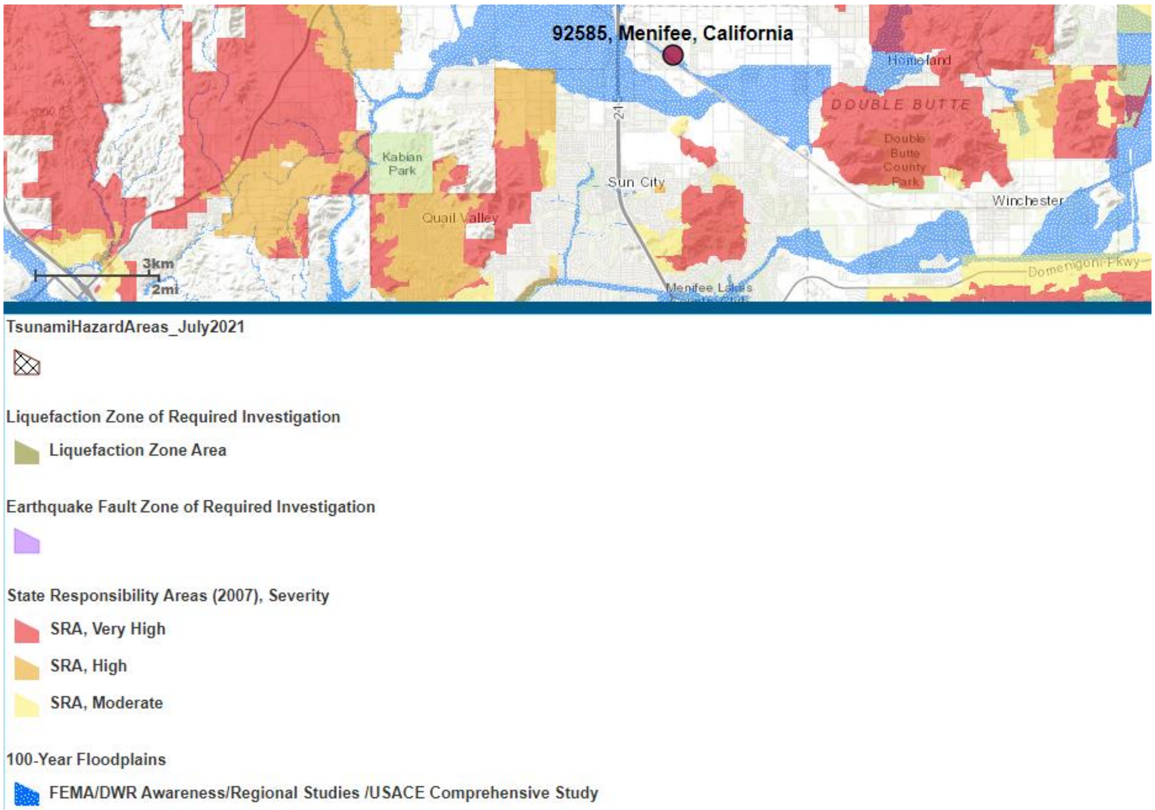

Figure 13: Image courtesy of MyHazards.

Appendix five (Cont.):

Sun City Planned Community

MyHazards Map

Zip code 92586

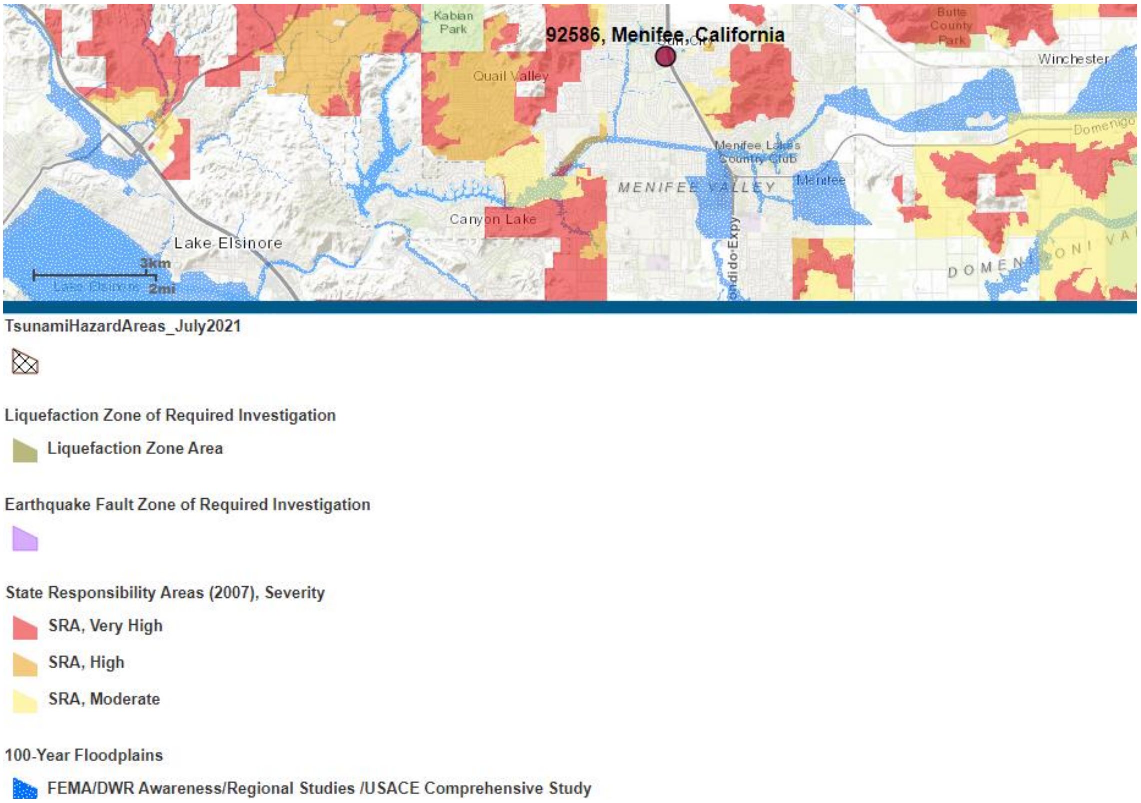

Figure 14: Image courtesy of MyHazards.

Appendix six: Biographies

About Connie Ho

Connie Ho completed a master's program in public administration at California State University, Long Beach (CSULB). She received a dual B.A. degree in English and International Studies from the University of California, Irvine, and a certificate in water utility science from Santiago Canyon College. She was awarded the Foundation for Community Association Research's Byron Hanke Fellowship and the Government Finance Officers Association Minorities in Government Finance Scholarship. Further inquiries regarding this paper can be sent to connie.ho@student.csulb.edu.

About Teresa Puente

Teresa Puente has spent her career reporting on immigration and Latino issues in the U.S. and has also reported extensively from Mexico. Puente, an assistant professor at California State University, Long Beach (CSULB), teaches News Reporting and Ethics, Social Media Communication and Bilingual Magazine Reporting & Production, which publishes the Spanish-language magazine *Dig En Español*. She also is faculty adviser to the CSULB student chapter of the National Association of Hispanic Journalists and faculty adviser to 22 West Media.
Puente holds an MFA in creative writing from Columbia College Chicago and a bachelor's degree with a double major in journalism and political science from Indiana University-Bloomington.

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