

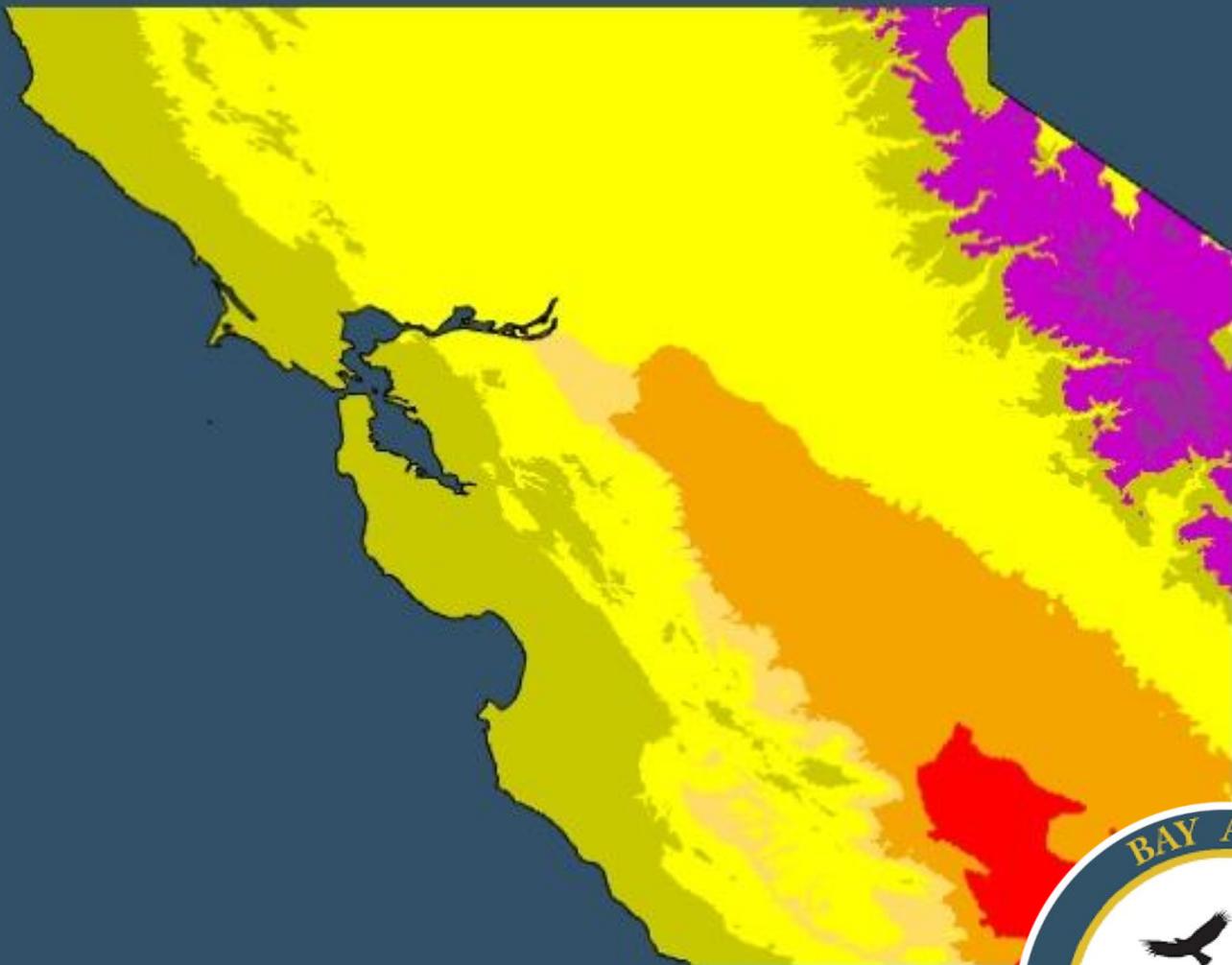
# Bay Area UASI

## Regional Vulnerability Report

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Equitable Community Resilience Project

October 2024





This document was prepared under a grant from the Federal Emergency Management Agency (FEMA) Grant Programs Directorate, U.S. Department of Homeland Security (DHS), Regional Catastrophic Preparedness Grant Program (RCPGP). Content does not necessarily represent the official position or policies of FEMA's Grant Programs Directorate or the U.S. Department of Homeland Security.



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# Executive Summary

This Regional Vulnerability Report, a component of the 2023-2024 Equitable Community Resilience (ECR) Project, assesses natural hazard and climate change exposure and potential impacts in Bay Area communities, and identifies factors that influence a community’s vulnerability to these hazards. Through this analysis, a number of trends and commonalities were uncovered.

This Report is designed for local jurisdictions and communities to support the development of grant applications with regional data and trends as well as to inform future community resilience planning efforts.

## Key Findings

### Regional Risk and Resilience

Three factors—Hazard Exposure, Social Vulnerability, and Community Capacity—interact to provide a picture of the region’s risk and resilience.

### Bay Area Risk and Vulnerability By the Numbers

**3** Bay Area counties with “Very High” Risk Scores

**12** of 12 counties in the Bay Area for whom earthquake is the greatest hazard risk

**65** Bay Area census tracts whose hazard exposure, social vulnerability, and community capacity characteristics result in a total risk score of 99.5 or greater

**317,631** Population in these 65 census tracts at highest risk

### Hazard Exposure

Top five hazard risks for the Bay Area region:

1. Earthquake
2. Drought
3. Riverine Flooding
4. Wildfire
5. Heat Wave

The expected annual loss to the region from an earthquake is 19 times higher than the next most impactful hazard.

### Social Vulnerability

One Bay Area county—Monterey County—ranks “Very High” in Social Vulnerability. Three others—Napa, Santa Cruz, and Solano Counties—rank “Relatively High”.

Social Vulnerability is influenced by a socioeconomic, household, and demographic characteristics.

### Community Capacity

11 of 12 Bay Area counties have “Very High” or “Relatively High” Community Capacity (or Resilience) scores. One county—Monterey County—has a “Relatively Low” Community Capacity score.

Community Capacity is influenced by cultural, social, economic, and built environment factors.

## Regional Trends and Gaps

Through an assessment of the three above factors that influence a community’s risk and resilience, this Report identifies 65 Bay Area census tracts whose hazard exposure, social vulnerability, and community capacity characteristics result in a total risk score of 99.5 (out of 100) or greater.

These 65 most vulnerable communities share common characteristics and challenges, including:

<p><b>High exposure to impacts of climate change</b></p>	<p>While earthquake is the top hazard risk facing the Bay Area, these communities exhibit higher risk to riverine and coastal flooding than the region as a whole. These impacts are expected to increase as effects of climate change continue.</p>
<p><b>Higher rates of poverty and unemployment</b></p>	<p>The most vulnerable communities in the region have lower median incomes and a much higher than average percentage of the population living in poverty. There is also lower educational attainment and higher unemployment rates.</p>
<p><b>Limited access to information</b></p>	<p>These communities generally have more non-English speaking residents and a lower rate of English proficiency. Inadequate access to timely and relevant information—in multiple languages and formats—about risks, preparedness, and recovery strategies can leave these communities unprepared.</p>
<p><b>Disproportionate impacts of the region’s housing crisis</b></p>	<p>Many more people these communities live in cost-burdened housing units, defined as shelter costs exceeding 30% of household income. Additionally, these communities have a higher percentage of occupied housing units that have more people than rooms.</p>
<p><b>Greater “dependent” populations</b></p>	<p>These communities have larger “dependent populations”, defined as people under the age of 18 or age 65 and greater.</p>



## Background and Project Overview

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The Bay Area Urban Areas Security Initiative (UASI) represents a region of 8 million people, a geographical footprint of 12 counties, and the three densely populated urban cities of Oakland, San Francisco, and San Jose. Every year, California faces numerous large-scale emergency incidents that disproportionately impact diverse populations living in socioeconomically disadvantaged communities, including those in the Bay Area.

To support regional resilience, the Bay Area UASI was awarded Regional Catastrophic Preparedness Grant Program (RCPGP) funding through the Federal Emergency Management Agency (FEMA) for the **2023-2024 Equitable Community Resilience (ECR) Project**. The grant has aimed to build regional capacity to manage catastrophic incidents by improving preparedness and resilience. It included a deliberate focus on equity, climate resilience, and readiness, particularly among disadvantaged communities and vulnerable individuals who are often disproportionately impacted by disasters and climate change.

### Project Goals

The Bay Area UASI recognizes that resilience efforts are ever-evolving and dynamic and reflect each community's underlying vulnerabilities that challenge them. The goal of the 2023-2024 Bay Area UASI ECR Project was to enhance equitable readiness and resilience to disasters in the Bay Area, focusing on the unique needs of disadvantaged communities and vulnerable individuals. It aimed to amplify and elevate diverse voices, as well as remove barriers, to enable equitable outcomes.

### Local Roadmaps to Community Resilience

With its Local Roadmap to Community Resilience (LR2CR) component, the project aimed to provide a replicable process and tools that can be used by communities across the region, available as part of the LR2CR Toolkit. During the 2023-2024 ECR Project, 10 communities developed a Local Roadmap to Community Resilience using the process and activities outlined below. Participants included nonprofit, faith-based, and community-based organizations, voluntary and community organizations active in disaster (VOADs/COADs), support service organizations, and various local government agencies. This Report integrates findings from the LR2CR process in these 10 communities.

Developing an LR2CR follows an established process where communities can become more resilient by understanding risks through self-assessment and analyzing hazards, exposures, vulnerabilities, and capacities. The process is action-orientated in that it



supports communities moving from understanding risks to identifying preparedness and risk reduction action plans and/or projects. The method and development of the Local Roadmap to Community Resilience is based on the International Federation of Red Cross and Red Crescent Societies (IFRC) model, referred to as the [Enhanced Vulnerability and Capacity Assessment \(EVCA\)](#).

The four milestones each jurisdiction completed to develop their Local Roadmap to Community Resilience included: **(1) Prepare; (2) Assess; (3) Plan; and (4) Document and Share.**

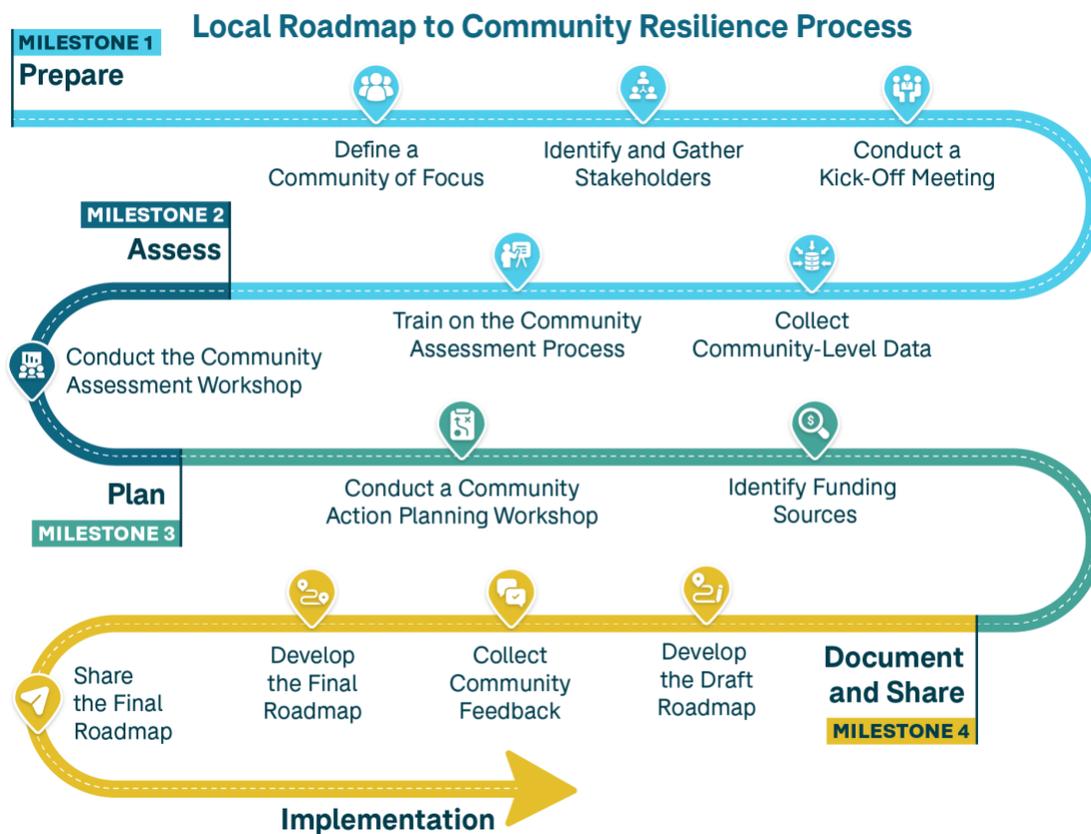


Figure 1: LR2CR Process



# Regional Vulnerability Report Introduction

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## Purpose

Coming out of the 2023-2024 ECR Project, this Regional Vulnerability Report is designed to present and summarize:

- Natural hazard and climate change exposure and potential impacts in Bay Area communities.
- Factors influencing a community’s vulnerability to hazards and climate change, as well as their capacity to address them.
- Trends and commonalities related to equitable community resilience among Bay Area communities.
- Strategies and best practices for improving community readiness throughout the region.

### Regional Resilience Tool

This Report is a companion to the [Bay Area UASI Regional Resilience Tool](#), which consolidates a number of data sets to provide a comprehensive picture of vulnerability and resilience. It presents numerous demographic and risk characteristics in the 12-county Bay Area Region at both the Census tract and county levels.

This Report is designed for local jurisdictions and communities to inform grant applications with regional data and trends, provide information on strategies and best practices to address equity and climate justice, and supplement future LR2CR processes in Bay Area communities.

## Definitions

This project relied on a set of common definitions for terms often used in emergency management and community planning efforts. As such, this report also uses the below accepted definitions.

### Capacity

The combination of all the strengths, attributes, and resources available within a community to manage and reduce disaster risks and strengthen resilience.

### Community

The “Whole Community” refers to individuals, community-based organizations, faith-based organizations, as well as law enforcement, fire, medical response, local government and private sector.



### Disaster

A disruption in the community involving human, material, economic or environmental losses or impacts, which exceeds the ability of the community to manage the event using its own resources.

### Exposure

People, property, and systems located in areas with hazards, making them vulnerable to potential harm/loss.

### Hazard

Natural or man-made sources or causes of harm and difficulty.

### Resilience

A community’s ability to prepare for, adapt to, and recover from hazards.

### Risk

The potential for damage, loss, or other impacts created by the interaction of hazards with the community. Risk is often expressed in relative terms such as high, medium, low.

### Vulnerability

The conditions determined by physical, social, economic and environmental factors or processes that increase the likelihood of a community to experience the impacts of hazards.

## Data Sources

The following data sources were consulted in the development of both this Report and the Regional Resilience Tool.

Data Tool (click the text to access via a link)	Description
<a href="#">Climate and Economic Justice Screening Tool (CEJST)</a>	Identifies “disadvantaged” communities (census tracts) nationwide and assigns them one or more “categories of burden” (e.g., climate change, legacy pollution, workforce development) based on how much burden each tract experiences compared to other tracts across the country.
<a href="#">National Risk Index (NRI)</a>	Shows which communities are most at risk to 18 types of natural hazards and uses data regarding expected annual losses to individual natural hazards, social vulnerability and community resilience, to assign a Risk Index.
<a href="#">Community Disaster Resilience Zones (CDRZ)</a>	Identifies census tracts which are most at risk from the effects of natural hazards and climate change.



Data Tool (click the text to access via a link)	Description
<a href="#">Resilience Analysis and Planning Tool (RAPT)</a>	Identifies infrastructure and demographic characteristics that may be driving local community risk.
<a href="#">Social Vulnerability Index (SVI)</a>	Presents demographic and socioeconomic factors (such as poverty, lack of access to transportation, and crowded housing) that adversely affect communities that encounter hazards and other community-level stressors.
<a href="#">Climate Risk and Resilience Portal (ClimRR)</a>	Provides science-based climate projections for specific points, addresses, census tracts, and counties.
<a href="#">Grant Equity Threshold Tool (GETT)</a>	Provides grant applicants with an easy-to-use tool for calculating the percentage of their population that live in CEJST disadvantaged communities, CRDZ-designed zones, and Community Resilience Challenges Index (CRCI) bins.
<a href="#">Climate Mapping for Resilience and Adaptation (CMRA)</a>	An interactive application that provides statistics, maps, and reports on climate conditions for every county and how common climate hazards are projected to change over the next several decades.

Table 1: Regional Resilience Tool Data Sources

Additional information about these data sources, including their strengths and limitations, can be found in Appendix A.

## Factors Influencing Community Risk and Resilience

Assessing the current state of the Bay Area’s risk and resilience requires exploration of three factors across the region:

- Hazard Exposure
- Social Vulnerability
- Community Capacity

This section discusses each of these factors at the regional and county level. Then, the following section will analyze how each of these factors interact to provide a comprehensive picture of community risk, defined as the potential for damage, loss, or other impacts created by the interaction of hazards with the community’s vulnerability and capacity.



## Hazard Exposure/Expected Annual Loss

### Measuring Hazard Exposure

One method to determine a community’s exposure to natural hazard risk is to assess the Expected Annual Loss (EAL) for each type of natural hazard that could impact Bay Area communities. EAL represents the average economic loss in dollars resulting from these hazards each year. It is calculated for each hazard type and quantifies loss for three consequence types: buildings, people, and agriculture.

### Risks by County

FEMA’s [National Risk Index](#) provides an EAL for each county and assigns a “rating” that represents the county’s relative level of expected losses each year in comparison to all other counties across the nation.

As depicted in the table that follows, earthquake is the top hazard risk facing the Bay Area as a whole. In fact, the EALs from an earthquake are 19 times higher than the next most impactful hazard (drought). The top eight natural hazard risks for the Bay Area region are:

1. Earthquake
2. Drought
3. Riverine Flooding
4. Wildfire
5. Heat Wave
6. Coastal Flooding
7. Tornado
8. Landslide

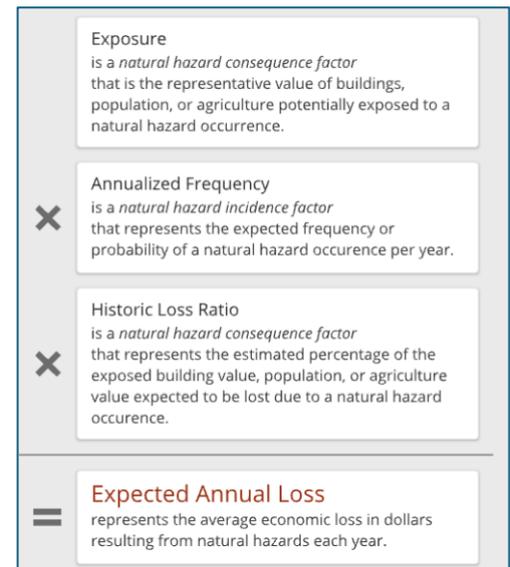


Figure 2: EAL Formula



	Earthquake		Drought		Riverine Flooding		Wildfire	
	Expected Annual Loss	Rating	Expected Annual Loss	Rating	Expected Annual Loss	Rating	Expected Annual Loss	Rating
Alameda	\$1,178,189,305.66	Very High	\$5,853,074.84	Relatively High	\$16,403,623.34	Relatively High	\$6,731,673.59	Relatively High
Contra Costa	\$566,466,572.16	Very High	\$10,774,430.79	Relatively High	\$8,420,627.70	Relatively High	\$5,828,403.91	Relatively Moderate
Marin	\$85,368,320.90	Relatively High	\$780,052.34	Relatively Moderate	\$28,231,042.58	Relatively High	\$2,436,547.51	Relatively Moderate
Monterey	\$148,896,191.74	Relatively High	\$17,876,568.79	Relatively High	\$15,116,494.45	Relatively High	\$7,834,254.82	Relatively High
Napa	\$78,206,449.76	Relatively High	\$85,116,690.77	Very High	\$10,638,252.60	Relatively High	\$4,110,262.26	Relatively Moderate
San Benito	\$56,913,652.21	Relatively High	\$568,099.18	Relatively Moderate	\$647,275.09	Relatively Low	\$3,315,152.65	Relatively Moderate
San Francisco	\$300,947,722.46	Relatively High	\$2,081,313.33	Relatively Moderate	\$2,202,961.36	Relatively Moderate	\$10,745.89	Very Low
San Mateo	\$408,011,459.28	Very High	\$9,920,833.42	Relatively High	\$2,328,532.33	Relatively Moderate	\$2,378,014.00	Relatively Moderate
Santa Clara	\$1,201,001,768.77	Very High	\$1,124,041.04	Relatively Moderate	\$1,301,681.36	Relatively Moderate	\$8,439,204.35	Relatively High
Santa Cruz	\$149,330,344.04	Relatively High	\$1,932,724.33	Relatively Moderate	\$4,810,188.36	Relatively Moderate	\$10,020,498.60	Relatively High
Solano	\$157,504,450.24	Relatively High	\$42,755,729.67	Very High	\$1,057,036.97	Relatively Low	\$1,519,934.78	Relatively Moderate
Sonoma	\$235,257,494.19	Relatively High	\$57,293,388.95	Very High	\$22,065,068.85	Relatively High	\$16,959,526.12	Relatively High
<b>Regionwide Total</b>	<b>\$4,566,093,731.41</b>		<b>\$236,076,947.47</b>		<b>\$113,222,784.98</b>		<b>\$69,584,218.46</b>	

	Heat Wave		Coastal Flooding		Tornado		Landslide	
	Expected Annual Loss	Rating	Expected Annual Loss	Rating	Expected Annual Loss	Rating	Expected Annual Loss	Rating
Alameda	\$1,352,208.08	Relatively Moderate	\$875,558.24	Relatively Low	\$2,198,340.16	Relatively Moderate	\$317,479.90	Relatively High
Contra Costa	\$2,645,169.02	Relatively High	\$188,681.26	Relatively Low	\$1,291,507.11	Relatively Low	\$232,345.48	Relatively Moderate
Marin	\$371,643.16	Relatively Moderate	\$3,801,318.27	Relatively Moderate	\$220,117.96	Very Low	\$770,102.47	Very High
Monterey	\$634,248.87	Relatively Moderate	\$62,725.66	Relatively Low	\$368,442.19	Relatively Low	\$987,450.01	Very High
Napa	\$205,205.20	Relatively Low	\$188,863.15	Relatively Low	\$191,138.45	Very Low	\$328,352.83	Relatively High
San Benito	\$215,402.74	Relatively Low	Not Applicable		\$87,414.29	Very Low	\$21,900.00	Relatively Low
San Francisco	\$482,149.65	Relatively Moderate	\$120,777.12	Relatively Low	\$590,196.29	Relatively Low	\$164,742.51	Relatively Moderate
San Mateo	\$1,541,208.32	Relatively Moderate	\$1,626,572.66	Relatively Moderate	\$568,585.97	Relatively Low	\$452,577.99	Relatively High
Santa Clara	\$4,149,887.83	Relatively High	\$1,001,237.26	Relatively Moderate	\$1,656,579.16	Relatively Low	\$320,954.09	Relatively High
Santa Cruz	\$227,572.61	Relatively Low	\$17,591.36	Very Low	\$212,599.35	Very Low	\$1,535,420.03	Very High
Solano	\$2,840,448.36	Relatively High	\$680,779.80	Relatively Low	\$650,592.84	Relatively Low	\$122,400.00	Relatively Moderate
Sonoma	\$182,647.37	Relatively Low	\$204,199.07	Relatively Low	\$148,061.27	Very Low	\$502,986.45	Relatively High
<b>Regionwide Total</b>	<b>\$14,847,791.19</b>		<b>\$8,768,303.84</b>		<b>\$8,183,575.02</b>		<b>\$5,756,711.76</b>	

Figure 3: EALs for Bay Area Counties



## Social Vulnerability

Social vulnerability is the susceptibility of a community to the adverse impacts of natural hazards, including death, injury, loss, or disruption of livelihood. A community’s social vulnerability is influenced by a variety of factors, including demographic characteristics, socioeconomic characteristics, household characteristics, housing availability and type, and access to transportation, among others. The degree to which a community exhibits certain social conditions, including high poverty, low percentage of vehicle access, or crowded households, may affect that community’s ability to prevent suffering and loss in the event of disaster.

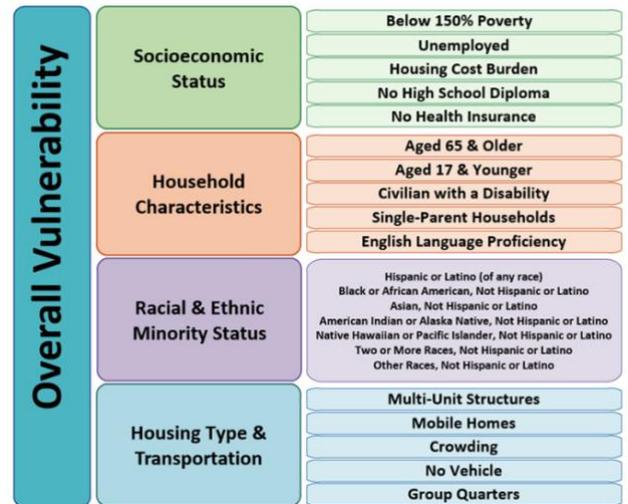


Figure 4: Four SVI Themes

### Measuring Social Vulnerability

The Centers for Disease Control and Prevention/Agency for Toxic Substances and Disease Registry (CDC/ATSDR) has developed a [Social Vulnerability Index \(SVI\)](#) using data from the 5-year American Community Survey. The SVI is grouped into four themes, each of which can affect a community’s ability to prepare for, mitigate, respond to, and recover from hazards and shocks:

- Socioeconomic status
- Household characteristics
- Racial and ethnic minority status
- Housing type and transportation

### Characteristics Influencing Social Vulnerability by County

Below is a snapshot of these factors for the 12-county Bay Area.



**SOCIOECONOMIC STATUS**

	Median Income	Percentage of the Population Below 150% Poverty	Percentage of Population Unemployed	Percentage of Housing Cost Burdened Units	Percentage of the Population 25+ Without a High School Diploma	Percentage of the Population 25+ Without Insurance
<b>Alameda County</b>	122,488	14.3	4.7	25.7	11.2	4.3
<b>Contra Costa County</b>	120,020	13.7	5.5	24.8	10.1	5
<b>Marin County</b>	142,019	11.2	4.5	23.7	6.4	3.2
<b>Monterey County</b>	91,043	22.2	5.1	32.8	27	9.4
<b>Napa County</b>	105,809	13	4.5	27.2	14.5	5.9
<b>San Benito County</b>	104,451	17	7.5	28.4	18.1	6.5
<b>San Francisco County</b>	136,689	15.7	4.7	22.7	11.4	3.6
<b>San Mateo County</b>	149,907	10.4	4	21.3	9.6	3.8
<b>Santa Clara County</b>	153,792	11.6	4.2	21.1	11.3	4.2
<b>Santa Cruz County</b>	104,409	18.8	6.1	28.1	11.7	5.2
<b>Solano County</b>	97,037	15.2	5.9	28.4	11.3	5
<b>Sonoma County</b>	99,266	14.6	4.6	28.7	10.9	6

Table 2: Bay Area Socioeconomic Status Influence on Social Vulnerability

**HOUSEHOLD CHARACTERISTICS**

	Total Population	Population 65 or Older	Percent of Population 65 or Older	Population Under 18	Percent of Population Under 18	Percentage of the Population with a Disability	Percentage of the Population Ages 5+ with Limited English Ability
<b>Alameda County</b>	1,663,823	231,186	13.9	341591	20.6	9.2	7.6
<b>Contra Costa County</b>	1,162,648	181,578	15.8	260191	22.7	11.2	6
<b>Marin County</b>	260,485	57,834	22.3	51974	20	8.9	3.6
<b>Monterey County</b>	437,609	59,061	13.6	113350	26.2	8.9	17.1
<b>Napa County</b>	137,384	26,610	19.2	28555	20.6	12.2	7.3
<b>San Benito County</b>	64,753	7,812	12.7	15844	25.7	10.2	8.7
<b>San Francisco County</b>	851,036	138,157	15.8	117363	13.4	10.1	10.9
<b>San Mateo County</b>	754,250	123,817	16.2	156769	20.5	8.2	6.9
<b>Santa Clara County</b>	1,916,831	259,988	13.5	421988	21.9	8.1	8.8
<b>Santa Cruz County</b>	268,571	44,913	16.4	52286	19.1	11.5	6.7
<b>Solano County</b>	450,995	69,968	15.7	98625	22.2	12.1	4.8
<b>Sonoma County</b>	488,436	97,461	19.6	97601	19.6	11.7	5.4

Table 3: Bay Area Household Characteristics Influence on Social Vulnerability



**RACIAL AND ETHNIC MINORITY STATUS**

	White, not Hispanic or Latino (%)	Black/African American, not Hispanic or Latino (%)	Hispanic or Latino (%)	Asian, not Hispanic or Latino (%)	Native Hawaiian or other Pacific Islander, not Hispanic or Latino (%)	Two or More Races, not Hispanic or Latino (%)	Racial Minority Population (%)
<b>Alameda County</b>	30.60	10.10	22.20	31.00	0.80	4.60	69.40
<b>Contra Costa County</b>	42.60	8.20	25.80	17.20	0.50	5.20	57.40
<b>Marin County</b>	70.60	2.10	16.10	5.70	0.80	4.40	29.40
<b>Monterey County</b>	29.50	2.40	59.00	5.60	0.50	2.80	70.50
<b>Napa County</b>	51.80	2.00	34.10	7.50	0.50	3.60	48.20
<b>San Benito County</b>	33.40	0.80	60.10	2.60	0.50	2.60	66.60
<b>San Francisco County</b>	39.80	4.90	15.20	34.00	0.50	5.00	60.20
<b>San Mateo County</b>	38.60	2.20	24.10	29.00	1.20	4.20	61.40
<b>Santa Clara County</b>	30.60	2.30	25.10	37.40	0.50	3.80	69.40
<b>Santa Cruz County</b>	56.90	1.00	33.60	4.70	0.50	3.30	43.10
<b>Solano County</b>	37.20	13.30	26.80	15.10	0.90	5.70	62.80
<b>Sonoma County</b>	62.50	1.50	27.00	4.20	0.50	3.60	37.50

Table 4: Bay Area Racial and Ethnic Minority

**HOUSING TYPE AND TRANSPORTATION**

	Percentage of Housing in Structures with 10 or more Units	Percentage of Housing Units that are Mobile Homes	Percentage of Occupied Housing Units with More than Rooms	Percentage of the Population Without Vehicle Access	Percentage of Population Living in Group Quarters
<b>Alameda County</b>	22.3	1.2	7.9	9.3	1.9
<b>Contra Costa County</b>	12.8	1.6	5	5.3	0.9
<b>Marin County</b>	12.8	1.2	4.5	4.3	2.8
<b>Monterey County</b>	10.4	4.6	13.6	4.3	4
<b>Napa County</b>	9.8	6.4	5.9	5	2.9
<b>San Benito County</b>	2.6	4.4	7.7	2.7	0.4
<b>San Francisco County</b>	38.1	0.1	6.7	30.8	2.3
<b>San Mateo County</b>	20.6	1.1	7.6	5.2	1.3
<b>Santa Clara County</b>	22.6	2.9	8.1	5.3	1.9
<b>Santa Cruz County</b>	8.7	6.2	6.8	5.2	4.8
<b>Solano County</b>	9.5	2.8	5.6	4.7	2.4
<b>Sonoma County</b>	9.7	4.6	5	4.8	1.7

Table 5: Bay Area Housing Type and Transportation Influence on Social Vulnerability



## Community Capacity (or Resilience)

Community Capacity is the ability of a community to prepare for anticipated natural hazards, adapt to changing conditions, and withstand and recover rapidly from disruptions. (Capacity is sometimes also referred to as Resilience.)

One method for measuring Community Capacity is the [University of South Carolina's Hazards and Vulnerability Research Institute \(HVRI\)'s Baseline Resilience Indicators for Communities \(HVRI BRIC\)](#). The HVRI BRIC uses data from the American Community Survey 2020 to assess the following factors that influence a community's capacity to manage its hazard exposure and vulnerabilities.

Factor	Definition	Example Characteristics
Human Well-Being, Cultural, and Social	Physical attributes of a community's population, as well as its values and belief systems	Educational attainment equality, pre-retirement age, personal transportation access, communication capacity, English language competency, non-special needs populations, health insurance, mental health support, food security, access to physicians
Economic and Financial	The community's economic assets and livelihoods	Homeownership, employment rate, racial/ethnic income inequality, non-dependence on primary/tourism sector employment, gender income inequality, business size, large retail with regional/national distribution, federal employment
Infrastructure, Built Environment, and Housing	Buildings and infrastructure within a community	Sturdier housing types, temporary housing availability, medical care capacity, evacuation routes, housing stock construction quality, temporary shelter availability, school restoration potential, industrial re-supply potential, high-speed internet infrastructure
Institutional and Governance	A community's access to resources and the power to influence their distribution	Mitigation spending, flood insurance coverage, governance performance regimes, jurisdictional fragmentation, disaster aid experience, local disaster training, population stability, nuclear accident planning, crop insurance coverage)
Community Capacity	Social networks and connectivity among individuals and groups within a community	Volunteerism, religious affiliation, attachment to place, political engagement, citizen disaster training, civic organizations
Environmental and Natural	A community's natural resource base and environmental conditions	Local food supplies, natural flood buffers, energy use, perviousness, water stress

Table 6: Factors Influencing Community Capacity



# Community Risk Analysis

This section analyzes how each of above factors (Hazard Exposure/Expected Annual Loss, Social Vulnerability, and Community Capacity) interact to in order provide a comprehensive picture of community risk.

## Risk Index

### Measuring Risk

The National Risk Index uses an equation that combines scores for Expected Annual Loss due to natural hazards, Social Vulnerability, and Community Capacity (or Resilience) to assign a Risk Index Score and a Risk Index Rating.

$$\begin{array}{l}
 \text{Expected Annual Loss} \\
 \times \text{ Social Vulnerability} \\
 \div \text{ Community Resilience} \\
 \hline
 = \text{ Risk Index}
 \end{array}$$

Figure 5: Risk Index Formula

**Risk Score:** A community's Risk Score represents its percentile ranking among all other communities across the country. For example, if a county's Risk Score is 92.22, then that county's risk is greater than 92.2% of all US counties.

**Risk Rating:** The Risk Rating is a qualitative rating that describes the community in comparison to all other communities, from "Very Low" to "Very High."

### County-Level Risk Rating

Three counties in the Bay Area have **Very High** risk scores: Alameda County, Contra Costa County, and Santa Clara County.

	Expected Annual Loss	Social Vulnerability	Community Resilience	Risk Index
<b>Alameda County</b>	Very High	Relatively Moderate	Very High	Very High
<b>Contra Costa County</b>	Very High	Relatively Moderate	Relatively High	Very High
<b>Marin County</b>	Relatively High	Relatively Low	Very High	Relatively High
<b>Monterey County</b>	Relatively High	Very High	Relatively Low	Relatively High
<b>Napa County</b>	Relatively High	Relatively High	Relatively High	Relatively High
<b>San Benito County</b>	Relatively Moderate	Relatively Moderate	Relatively High	Relatively Moderate
<b>San Francisco County</b>	Relatively High	Relatively Moderate	Very High	Relatively High
<b>San Mateo County</b>	Relatively High	Relatively Low	Very High	Relatively High
<b>Santa Clara County</b>	Very High	Relatively Low	Relatively High	Very High
<b>Santa Cruz County</b>	Relatively High	Relatively High	Relatively High	Relatively High
<b>Solano County</b>	Relatively High	Relatively High	Very High	Relatively High
<b>Sonoma County</b>	Relatively High	Relatively Moderate	Relatively High	Relatively High

Table 7: Bay Area County-Level Risk Ratings



## Most Vulnerable Communities

Using the above methodology from the National Risk Index and selecting for census tracts with a risk score of 99.5% or higher (meaning census tracts that are in the top 0.5% for total risk in the US), the Bay Area includes **65** of the most vulnerable census tracts, representing a population of **317,631**.

The map below (next page) depicts these 65 census tracts; a list of their census tract numbers and risk scores is in Appendix B.

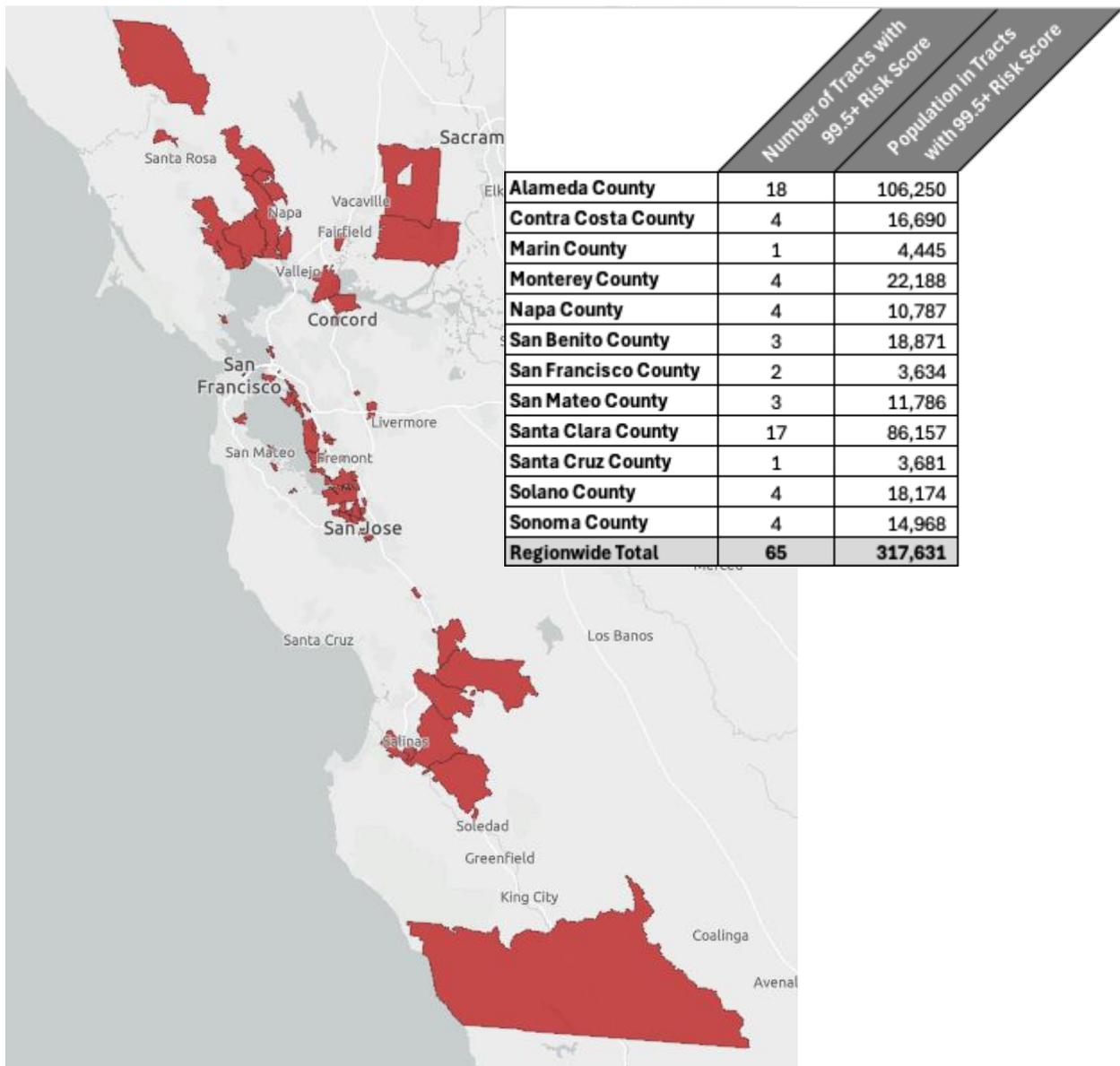


Figure 6: Most Vulnerable Census Tracts in the Bay Area



## Trends and Commonalities

Analyzing the region as a whole, and specifically the 65 Bay Area census tracts whose hazard exposure, social vulnerability, and community capacity characteristics result in a total risk score of 99.5 or greater, reveals a number of trends and commonalities.

### Hazard Exposure

As expected, these 65 communities have very high exposure to hazards, as represented by higher-than-average EAL to people, buildings, and agriculture from hazard impacts. However, while the earthquake hazard represents the highest EAL across the region, for many of these 65 vulnerable census tracts, riverine and coastal flooding present greater risk. These flooding exposures and risks are only expected to increase as impacts to a changing climate become more widespread.

### Social Vulnerability

As discussed above, specific characteristics of a community's population affect its vulnerability to hazards and disasters. In the Bay Area, one county (Monterey County) has "Very High" social vulnerability, while three counties (Napa County, Santa Cruz County, and Solano County) have "Relatively High" social vulnerability.

In assessing the social vulnerability of the four "Very High" and "Relatively High" Bay Area counties, as well as the 65 census tracts with total risk scores of 99.5 or greater, the following trends are observed:

- Lower median incomes and a much higher than average percentage of the population living in poverty.
- Lower educational attainment and higher unemployment rates.
- Many more people living in cost-burdened housing units, defined as shelter costs exceeding 30% of household income.
- A higher percentage of occupied housing units that have more people than rooms.

Additionally, these communities share certain demographic characteristics, including:

- A much larger racial minority population.
- A larger dependent population, defined as people under the age of 18 or age 65 and greater.
- Many more non-English speakers and people with limited English ability.

### Community Capacity

While 11 of the 12 Bay Area counties have "Very High" or "Relatively High" community capacity (or resilience) scores, community capacity in the Bay Area's most vulnerable



communities is general lower than for the region as a whole. Shared factors negatively affecting these communities' capacity to prepare for, mitigate the impacts of, respond to, and recover from natural hazards and the impacts of climate change include:

- Inadequate access to resources and the power to influence their distribution, largely due to historical and structural discrimination (e.g., redlining).
- Older, more vulnerable, building stock and built environment infrastructure.
- Lower rates of insurance (health, homeowner/renter, flood, earthquake).
- Limited training and education on hazard and climate change risks and protective action information, often due to the unavailability of this information in preferred languages and formats.



## Gaps and Barriers to Equitable Community Resilience

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Community resilience in the face of natural hazards involves both a community's sensitivity to disaster and its potential to bounce back. A failure to integrate equity into resilience considerations results in unequal recovery and disproportionate impacts on vulnerable populations, which has long been a concern in the Bay Area.

**Economic Constraints:** Limited financial resources can restrict access to necessary infrastructure improvements, emergency supplies, and recovery assistance.

**Lack of Access to Information:** Inadequate access to timely and relevant information—in multiple languages—about risks, preparedness, and recovery strategies can leave communities unprepared.

**Social Inequality:** Marginalized groups often experience systemic inequalities, such as discrimination or lack of political representation, which can impede their ability to advocate for resources and support.

**Insufficient Infrastructure:** Poor infrastructure, such as inadequate housing, transportation, and utilities, can exacerbate the impacts of disasters and hinder recovery efforts.

**Limited Education and Training:** A lack of knowledge and training on disaster preparedness and climate adaptation can leave communities vulnerable and less able to respond effectively.

**Health Vulnerabilities:** Communities with high rates of chronic illness or limited access to healthcare may face greater risks during disasters and recovery efforts.

**Environmental Degradation:** Degraded ecosystems can increase vulnerability by reducing natural buffers against disasters, such as floodplains and forests.

**Cultural Barriers:** Cultural beliefs and practices can influence perceptions of risk and response strategies, sometimes complicating disaster preparedness efforts.

**Political and Institutional Barriers:** Ineffective governance, lack of coordination among agencies, and insufficient funding for resilience initiatives can hinder effective disaster management.

**Psychosocial Factors:** Trauma and mental health issues resulting from previous disasters can affect community cohesion and the ability to mobilize for preparedness and recovery.



## Appendix A: Data Tools and Visualizers Overview

Data Tool (and Link)	Description	Recommended Uses	Strengths	Limitations	Inputs to Data Tool
<a href="#">Climate and Economic Justice Screening Tool (CEJST)</a>	Identifies “disadvantaged” communities (census tracts) nationwide and assigns them one or more “categories of burden” (e.g., climate change, legacy pollution, workforce development) based on how much burden each tract experiences compared to other tracts across the country	To identify disadvantaged communities (census tracts) and understanding the burdens they face	<p>Brings together a number of data sources to provide a comprehensive picture of the challenges faced by communities, from traffic to lead exposure to proximity to dangerous industrial sites</p> <p>Federal agencies and grant programs are required to use CEJST to help identify disadvantaged communities that will benefit from programs included in the <a href="#">Justice40 Initiative</a></p>	<p>Because of the assigned definitions of burden and potentially arbitrary “cut-off” points, some census tracts that face significant climate, environmental, and economic challenges are not identified in the tool as disadvantaged areas</p> <p>The tool does not consider race or age, even though these demographic factors lead to disproportionate impacts of climate change and natural disasters</p> <p>Tool uses census tract boundaries and population data from 2010; these may have changed in the 2020 census</p>	<p><a href="#">National Risk Index</a>, 2014-2021</p> <p><a href="#">American Community Survey</a>, 2015-2-19</p> <p>Additional sources are used to identify specific categories of burden; they can be reviewed <a href="#">here</a></p>



Data Tool (and Link)	Description	Recommended Uses	Strengths	Limitations	Inputs to Data Tool
<a href="#">National Risk Index (NRI)</a>	Shows which communities are most at risk to 18 types of natural hazards and uses data regarding expected annual losses to individual natural hazards, social vulnerability and community resilience, to assign a Risk Index	<p>To understand hazard risk and exposure in communities and prioritize efforts accordingly</p> <p>To support mitigation planning, hazard mitigation assistance, and risk communication</p>	<p>Expected annual loss, social vulnerability, and community resilience information is available at both county and Census tract levels</p> <p>Best for use as a tool for broad, statewide and nationwide comparisons</p>	<p>Nationwide datasets used as inputs are in many cases not as accurate as locally available data</p> <p>Because the NRI considers property market values when determining exposure and potential losses, it assigns higher risk ratings to wealthier communities</p>	Includes source data from 91 entities, which can be found <a href="#">here</a>
<a href="#">Community Disaster Resilience Zones (CDRZ)</a>	Identifies census tracts which are most at risk from the effects of natural hazards and climate change	<p>To identify CRDZ-designated zones, as they will be prioritized for targeted federal support, such as increased cost-share for resilience and mitigation projects</p> <p>As a user-customized tool to visualize any datasets on an ArcGIS platform</p>	Additional data sources (publicly available or specific local datasets) can be easily added to CRDZ viewer to create a customized tool for research and analysis	The methodology used to identify a CDRZ census tract differs from the methodology used by CEJST to identify a disadvantaged census tract	<p><a href="#">National Risk Index (NRI)</a></p> <p><a href="#">Climate and Economic Justice Screening Tool (CEJST)</a></p> <p>CDC's <a href="#">Social Vulnerability Index (SVI)</a></p>



Data Tool (and Link)	Description	Recommended Uses	Strengths	Limitations	Inputs to Data Tool
<a href="#">Resilience Analysis and Planning Tool (RAPT)</a>	Identifies infrastructure and demographic characteristics that may be driving local community risk	To identify at-risk infrastructure assets in a community  To understand and analyze community demographics that affect resilience to climate change and natural hazards	Includes over 100 preloaded layers including community resilience indicators from peer-reviewed research, the most current census demographic data, infrastructure data, and data on weather, hazards, and risk  Includes easy to use analysis tools, the ability to add in data from other sources, and print and download functions	Not all data layers are available at the census tract or tribal level	<i>Demographic Data:</i> <a href="#">American Community Survey</a>  <i>Infrastructure Data:</i> <a href="#">Homeland Infrastructure Foundation-Level Data (HIFLD)</a>  <i>Hazards Data:</i> Numerous sources from the National Weather Service (NWS), the National Oceanic and Atmospheric Administration (NOAA), the US Geological Survey (USGS), and others, available <a href="#">here</a>



Data Tool (and Link)	Description	Recommended Uses	Strengths	Limitations	Inputs to Data Tool
<a href="#">Social Vulnerability Index (SVI)</a>	Presents demographic and socioeconomic factors (such as poverty, lack of access to transportation, and crowded housing) that adversely affect communities that encounter hazards and other community-level stressors	To understand overall social vulnerability (SVI score) and make comparisons across census tracts, counties, states, and nationwide	Uses 16 variables grouped under 4 areas of social vulnerability: socioeconomic status, household characteristics, racial and ethnic minority status, and housing type and transportation	The tool is updated every 2 years, and census tracts are updated every 10 years; this can affect year-over-year comparisons of a given community's social vulnerability	<a href="#">American Community Survey</a>



Data Tool (and Link)	Description	Recommended Uses	Strengths	Limitations	Inputs to Data Tool
<a href="#">Climate Risk and Resilience Portal (ClimRR)</a>	Provides science-based climate projections for specific points, addresses, census tracts, and counties	To understand project impacts of climate change, including increases in temperature, heat index, winds, wildfires, and precipitation	ClimRR models over 60 climate variables to present climate change projections  Includes basic infrastructure layers, and data from ClimRR can be combined with RAPT data to contextualize local-scale climate projections  The <a href="#">ClimRR Report Generator</a> is an easy way for users to get all available historical and future climate information for a specific location (address, latitude/longitude, etc.)	Does not address projected sea level rise in given climate change scenarios	Argonne National Laboratory Climate Projections, available <a href="#">here</a>



Data Tool (and Link)	Description	Recommended Uses	Strengths	Limitations	Inputs to Data Tool
<a href="#">Grant Equity Threshold Tool (GETT)</a>	Provides grant applicants with an easy-to-use tool for calculating the percentage of their population that live in CEJST disadvantaged communities, CRDZ-designed zones, and Community Resilience Challenges Index (CRCI) bins	To help grant applicants demonstrate how their projects support the Justice40 Initiative by focusing efforts on disadvantaged communities and Tribal Lands	An easy way for grant applicants to demonstrate that proposed projects and activities meet (or exceed) the 40 percent threshold established by the Justice40 Initiative to provide benefits to disadvantaged areas  Provides shapefiles that can be exported and included with grant application submissions  GETT data can be added to RAPT for additional community demographic analysis	Because the tool is largely designed for and targeted to grant applications, it should be used in conjunction with other tools in this matrix to understand risk, vulnerability, and hazards	<a href="#">Climate and Economic Justice Screening Tool (CEJST)</a>  <a href="#">Community Disaster Resilience Zones (CDRZ)</a>  <a href="#">Community Resilience Challenges Index (CRCI)</a>



Data Tool (and Link)	Description	Recommended Uses	Strengths	Limitations	Inputs to Data Tool
<a href="#">Climate Mapping for Resilience and Adaptation (CMRA)</a>	An interactive application that provides statistics, maps, and reports on climate conditions for every county and how common climate hazards are projected to change over the next several decades	To help understand if and how people, property, and infrastructure could be exposed to changing climate-related hazards, including extreme heat, drought, wildfire, flooding, and coastal inundation	Provides an option for customizable, downloadable reports to documenting past, present, and projected conditions related to common climate hazards  Allows users examine the intersection of climate data with other information products such as CEJST and Building Code Adoption Tracking	Like most climate projections, values reported in the tool are 30-year averages; users should pay attention to the full range of projections and consider even the most extreme projections as plausible	<a href="#">US Census Mapping Files, 2019</a>  <a href="#">Scenarios for the National Climate Assessment</a>  <a href="#">NOAA Coastal Digital Elevation Models</a>  <a href="#">National Levee Database</a>  <a href="#">FEMA National Flood Hazard Layer</a>  <a href="#">Building Code Adoption Tracking</a>

Table 8: Data Tools and Visualizers Overview



## Appendix B: Census Tracts with Risk Scores of 99.5 or Greater

County	Census Tract	Population	Risk Score
Alameda	441503	7,763	99.99
	437101	7,532	99.99
	432400	6,279	99.92
	409000	4,872	99.92
	438203	4,200	99.91
	441525	1,629	99.91
	422000	4,080	99.81
	440301	7,129	99.81
	428700	4,751	99.77
	437200	8,696	99.73
	450743	8,515	99.72
	450102	8,660	99.65
	402900	1,917	99.64
	433200	7,578	99.63
	406100	5,839	99.59
	441923	6,275	99.58
407300	3,891	99.53	
433400	6,644	99.51	
Contra Costa	345111	5,990	99.85
	327001	3,394	99.75
	315000	3,434	99.62
	378000	3,872	99.50
Marin	112202	4,445	99.66
Monterey	014500	4,963	99.88
	010606	7,859	99.86
	011400	3,082	99.69
	014800	6,284	99.61
Napa	201500	1,703	99.98
	201200	4,700	99.96
	201005	2,587	99.85
	201102	1,797	99.78
San Benito	000100	5,421	99.70
	000400	6,748	99.62
	000200	6,702	99.59
San Francisco	011700	1,905	99.92
	033201	1,729	99.81
San Mateo	602300	4,208	99.97
	609100	1,647	99.58
	608025	5,931	99.50
	505006	11,908	99.98
Santa Clara	505202	7,692	99.97
	504602	2,056	99.95
	500901	4,011	99.94
	512602	3,531	99.92
	505010	4,315	99.90
	504318	7,427	99.89
	503122	4,108	99.88
	505100	4,616	99.84
	500800	4,641	99.83
	504322	5,505	99.82
	511609	3,453	99.73
	508708	4,653	99.71
	504509	5,600	99.65
	503121	4,758	99.61
	512311	4,123	99.60
505007	3,760	99.58	
Santa Cruz	110401	3,681	99.46
Solano	253300	2,516	99.95
	252102	3,991	99.69
	253501	6,248	99.60
	252402	5,419	99.52
Sonoma	154100	3,364	99.89
	150100	2,148	99.84
	150612	4,449	99.77
	152702	5,007	99.73

Table 9: Census Tracts with Risk Scores of 99.5 or Greater



## Appendix C: Acronyms and Abbreviations

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<b>ATSDR</b>	Agency for Toxic Substances and Disease Registry
<b>BRIC</b>	Baseline Resilience Indicators for Communities
<b>CDC</b>	Centers for Disease Control and Prevention
<b>CDRZ</b>	Community Disaster Resilience Zones
<b>CEJST</b>	Climate and Economic Justice Screening Tool
<b>ClimRR</b>	Climate Risk and Resilience Portal
<b>CMRA</b>	Climate Mapping for Resilience and Adaptation
<b>COAD</b>	Community Organization Active in Disaster
<b>CRCI</b>	Community Resilience Challenges Index
<b>ECR</b>	Equitable Community Resilience
<b>EVCA</b>	Enhanced Vulnerability and Capacity Assessment
<b>FEMA</b>	Federal Emergency Management Agency
<b>GETT</b>	Grant Equity Threshold Tool
<b>HIFLD</b>	Homeland Infrastructure Foundation-Level Data
<b>HVRI</b>	Hazards and Vulnerability Research Institute
<b>IFRC</b>	International Federation of the Red Cross and Red Crescent Societies
<b>LR2CR</b>	Local Roadmap(s) to Community Resilience
<b>NOAA</b>	National Oceanic and Atmospheric Administration
<b>NRI</b>	National Risk Index
<b>NWS</b>	National Weather Service
<b>RAPT</b>	Resilience Analysis and Planning Tool
<b>RCPGP</b>	Regional Catastrophic Preparedness Grant Program
<b>SVI</b>	Social Vulnerability Index
<b>UASI</b>	Urban Areas Security Initiative
<b>VOAD</b>	Voluntary Organization Active in Disaster