

**Hawai'i Climate Change Mitigation and Adaptation Commission**

**An Overview of Various Social Vulnerability Tools for a Climate Ready Hawai'i**

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## ***Background to the Climate Commission’s Need to Measure Climate Change Vulnerability***

In 2019, the Hawai‘i State Climate Commission established a Permitted Interaction Group (PIG) to investigate how climate change impacts inequities within Hawai‘i and to answer the question: “who are the most marginalized and vulnerable groups in Hawai‘i?” After meeting twice, the PIG recommended the development of a social vulnerability index (SVI) tool or framework specific to Hawai‘i.

Social vulnerability describes the social conditions within a community that impact the ability of its residents to adequately respond to hazardous events, such as climate-induced natural disasters. Social indicators that influence vulnerability include income, household size, age demographics, education level, access to a vehicle, etc. Climate indicators that influence vulnerability include proximity to coastline, potential flooding, heat index, etc.

While data for many of these indicators are available nationally, Hawai‘i must localize the social and climate indicators of its statewide index to more comprehensively understand the vulnerability of its residents.

## ***Purpose and Scope***

There are multiple existing SVI tools that demonstrate the climate and social vulnerability of Hawai‘i’s residents through various indicators. This overview discusses the methodologies, limitations, and applicability to Hawai‘i for eight existing tools. This overview aims to provide relevant background, and highlight key best practices, about existing SVI tools to assist in the development of a Hawai‘i-specific SVI tool or framework.

## ***The following social vulnerability tools were evaluated:***

1. [CDC/ATSDR Social Vulnerability Index](#)
2. [O‘ahu Social Vulnerability Index](#)
3. [ALICE Map](#)
4. [Dept. Of Energy’s Low-Income Energy Affordability Data \(LEAD\) Tool](#)
5. [Climate Ready O‘ahu Mapping Tool](#)
6. [FEMA National Risk Index](#)
7. [EPA’s Environmental Justice Screening and Mapping Tool \(EJSCREEN\)](#)
8. [Social Vulnerability Index for Hawai‘i: PURL/NDPTC COVID-19 Survey](#)

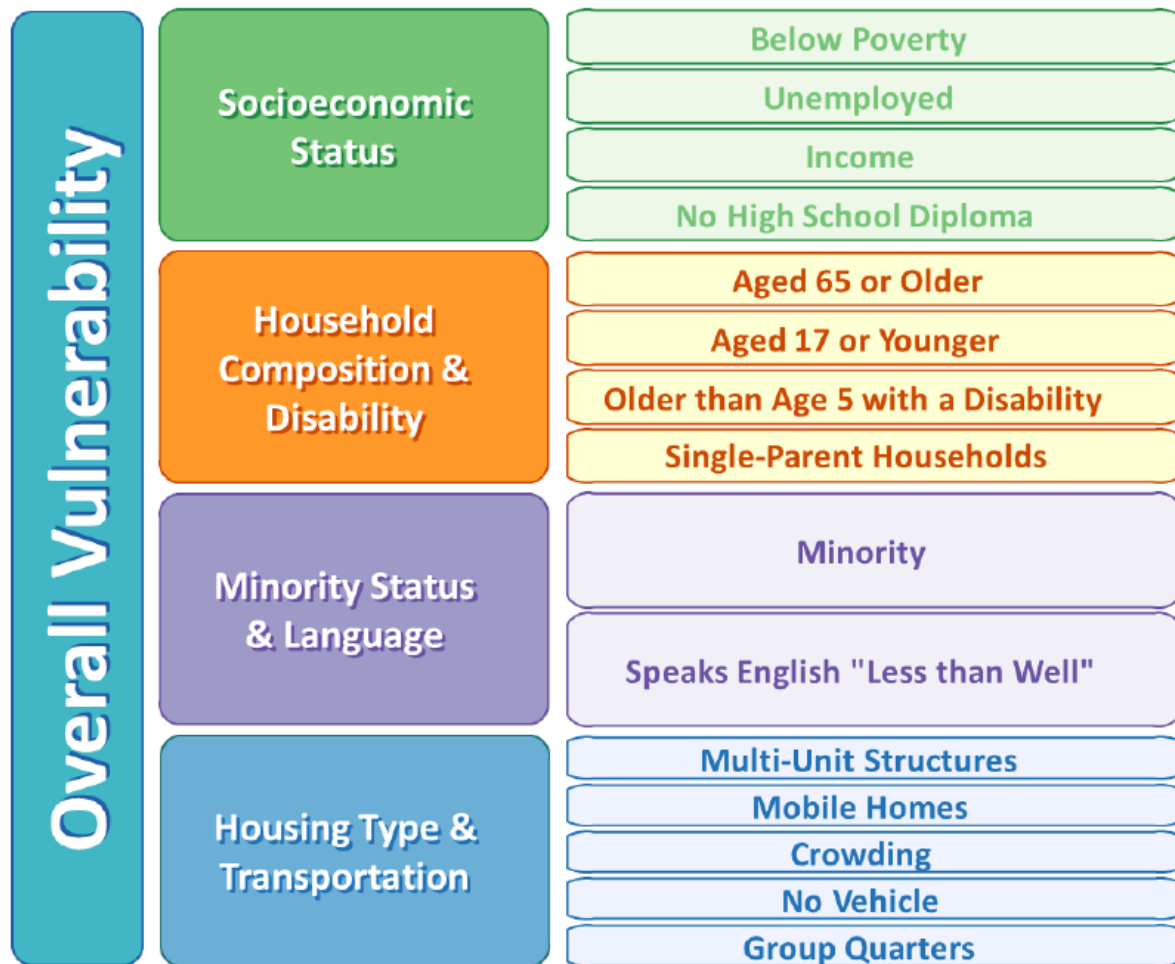
## 1. CDC/ATSDR Social Vulnerability Index

The Agency for Toxic Substances and Disease Registry created the Centers for Disease Control and Prevention Social Vulnerability Index (CDC SVI) to help emergency responders and public health officials identify communities that will most likely need assistance in the event of an emergency. This information guides the allocation of emergency preparedness funds, preparation of supplies, staffing of emergency responders, and prevention efforts.

### *Methodology*

The CDC SVI ranks community vulnerability based on U.S. Census tracts, which are subdivisions of counties. There are 351 census tracts within Hawai'i. The index uses 15 Census data indicators, known as social factors, to develop SVI scores. These social factors are then grouped into four themes. Each census tract receives a SVI ranking for each for the four themes and receives a combined ranking of all four themes. SVI scores range from 0 (lowest vulnerability) to 1 (highest vulnerability), reported as percentile ranking.

The 15 social factors and their related themes are:



Source: CDC SVI 2018 Documentation.

The scores are derived from a statistical method called a Principle Component Analysis and are reported as a percentile ranking on the 0 to 1 scale. For example, Honolulu County has an overall SVI score of 0.472, which represents “low to moderate” level of vulnerability, while Hawai‘i County has an overall SVI score of 0.577, which represents a “moderate to high” level of vulnerability. At the census tract level for Honolulu County, Census Tract 97.01 (representing Waianae) has an overall SVI score of 0.988, which represents a “high” level of vulnerability, while Census Tract 112.01 (representing Kailua), has an overall SVI score of 0.153, which represents a “low” level of vulnerability. It is unclear if the CDC SVI online tool ranks all U.S. census tracts against each other or if they are only ranked against other tracts within their state. However, ArcGIS Online provides datasets that calculate percentile rankings both nationally and for Hawai‘i. The availability of these datasets on ArcGIS Online makes it more convenient to develop a custom statewide SVI tool.

### *Limitations*

The CDC SVI was last updated in 2018 and is not user-friendly. The dataset is very large; and, when selecting a specific county or census tract, it is not clear how to practically interpret the SVI score or parse between the individual theme SVI scores. The ability to layer different social factors or themes is also limited. These issues can be prevented by pulling the CDC SVI dataset from ArcGIS Online and developing customized layers for a statewide index.

### *Remaining Questions*

1. *Are all 15 social factors relevant to Hawai‘i?*
2. *Are appropriate race and ethnic groups included?*
3. *How can unhoused populations be included?*
4. *Is it possible to obtain neighborhood-specific data?*

## 2. O'ahu Social Vulnerability Index

The O'ahu SVI reports social vulnerability only for the island of O'ahu. The proposed statewide vulnerability index would essentially expand the concept of the O'ahu Social Vulnerability Index tool to represent the entire State of Hawai'i.

### *Methodology*

The O'ahu SVI is very similar to the CDC SVI, and both tools utilize U.S. Census data. The O'ahu SVI shares the same social factors as the CDC SVI; but, when a census tract is selected in the O'ahu SVI tool, it reports details about these social factors indicators while the CDC SVI tool does not display the data for individual indicators. The O'ahu SVI reports additional indicators to the 15 social factors reported by the CDC, such as specific minority race and ethnicity. These additional indicators are obtained through Census data and it appears both tools could report these Census-derived indicators but only the O'ahu SVI tool has chosen to do so.

The O'ahu SVI expands on the CDC SVI methodology by adding an additional "exposure to hazards" theme to the four CDC SVI themes. This additional theme is incorporated into an Oahu-specific Socioeconomic Vulnerability Index (SOVI) score, but it is not clear exactly how the SOVI score is derived or reported. Although a Principle Component Analysis is used, it is unclear how all variables are weighted in terms of importance to the overall SOVI score (See slide 24 of their index presentation). The following indicators comprise the "exposure to hazards" theme:

- Tsunami Evacuation Zones
- Combines Flood Zones
- Hurricane Storm Surge
- Sea Level Rise Exposure Area (SLR-XA) (3.2FT)

### *Limitations*

The specific "exposure to hazards" indicators are not displayed within the mapping tool. This makes it difficult to compare specific census tracts based on their Tsunami Evacuation Zones, Flood Zones, Hurricane Storm Surge, or SLR-XA. These indicators are imbedded within the data since they are used to generate the SOVI score, so they should be more accessible to better facilitate comparisons across census tracts.

Race and ethnicity indicators should be localized in a statewide vulnerability index to accurately represent the demographics of Hawai'i. The O'ahu SVI tool contains various Non-Hispanic indicators (labeled Non-Hispanic 1-4), but these indicators are poorly labeled and do not clearly describe the race and ethnicities that they represent.

Although this tool addresses some hazards, it fails to include additional environmental-and climate change-related indicators, such as the heat island effect, tsunami risk, or landslide risk, which are all relevant to Hawai'i.

#### *Remaining Questions*

1. *Is it possible to report vulnerability at a more granular level than census tract?*

### 3. [ALICE Map](#)

**Note: The ALICE Map tool is currently down on the system's website (as of 9/10/21)**

ALICE (Asset Limited, Income Constrained, Employed) describes people whose income exceeds the federal poverty line but are still living paycheck-to-paycheck. This distinction is important because it describes the financial reality for many people in Hawai'i. According to Aloha United Way's "ALICE: A Study in Financial Hardship in Hawai'i", forty-two percent of Hawai'i's households were struggling to get by pre-COVID-19, and fifty-nine percent of households faced severe financial hardship by the end of 2020<sup>1</sup>. ALICE populations are among the most vulnerable in Hawai'i because their financial situations inhibit resiliency in the face of natural disasters or major life events. A statewide vulnerability index must incorporate ALICE data, in addition to Census poverty data, because this data will more accurately depict the lived experience and understanding of economic vulnerability in Hawai'i.

#### *Methodology*

The ALICE tool contains the following indicators:

- Total households
- Poverty (%)
- ALICE (%)
- Above Alice Threshold (%)
- Internet Access

These indicators are not reported based on census tracts; instead, this tool is more granular and reports data by Census County Division (CCD) and Census Designated Place (CDP). CCDs are subdivisions of a county used by the Census Bureau to present data, and include places like North Hilo, Lihue, and Spreckelsville. They have no legal or governmental functions and their boundaries are determined by common features and well-known local names. They are used when minor civil divisions (MCDs), like townships, are unsatisfactory for data collection and reporting. CDPs are concentrations of populations used only for the Census, and include places like Mokeleia, Pearl City, Hawaiian Acres. They also have no legal status and their name must be recognized and used in daily communication by residents of the community. Hawaii is the only state without incorporated cities and therefore the only state to use CDPs in its city population list.

#### *Limitations*

It is challenging to combine ALICE data with data from the tools organized by census tract because the ALICE indicators are not reported by census tract. The raw ALICE metadata matches indicators, CCDs, and CDPs to a "GeoID", but it is currently unclear how these "GeoIDs" correlate to census tracts or how they are organized and streamlined within ArcGIS Online.

#### *Remaining Questions*

1. *Is it possible to connect ALICE metadata to census tracts?*



#### 4. [Dept. Of Energy's Low-Income Energy Affordability Data Tool](#)

Known as LEAD, this tool visualizes and compares the energy burden (% of total income spent on energy needs) and average annual dollar amount spent on energy for census tracts and counties across Hawai'i and the country. LEAD allows users to filter these comparisons based on Area Median Income, percentage of Federal Poverty Level, household energy fuel type, and resident building age and type. These energy data are relevant to a statewide vulnerability index because they explain where a significant portion of household finances are being spent as the State transitions into a clean energy economy to combat climate change.

##### *Methodology*

Data are sourced from U.S. Census Bureau's American Community Survey 2016 Public Use Microdata Samples (5-Year Average, 2012-2016) and are calibrated to U.S. Energy Information Administration's electric utility (Survey Form-861) and natural gas utility (Survey Form-176) data.

##### *Limitations*

For Hawai'i, Area Median Income and the Federal Poverty Level, two metrics used in this tool, are not necessarily intuitive for comparison across census tracts and counties. Households can have incomes well above the federal poverty level and still struggle financially, so relying on these metrics to understand financial vulnerability may not be the best option for the statewide index.

## 5. Climate Ready O'ahu Mapping Tool

The Climate Ready O'ahu Mapping Tool geospatially overlays climate change-related indicators on the island of O'ahu. The statewide vulnerability index could combine the climate indicators listed below with the indicators used in the O'ahu SVI and CDC SVI as they are pertinent statewide.

### *Methodology*

This tool gathers data from the City and County of Honolulu, State, and Federal government sources. Unlike the index tools that generate specific vulnerability scores, this mapping tool simply displays climate indicators on the map of O'ahu. These indicators include:

- Coastline
- Community Plan Area
- Special Management Area
- Shoreline Change Rates
  - Historical & Future
- SLR-XA
  - Potential flooded highways
  - All hazards
  - Passive flooding
  - Annual high wave flooding
  - SLR 6ft
- Heat Index
- Tree Canopy Land Cover

This tool is helpful because it can overlay any combination of these indicators on the map, allowing the user to better understand connected or compounding factors influencing climate vulnerability.

### *Limitations*

This tool does not organize O'ahu by census tracts. A statewide index tool would need to match these climate indicators to their appropriate census tracts to generate a more accurate understanding of Hawai'i's social and climate vulnerabilities. Additionally, the specific data sources for each climate indicator is unclear.

## 6. [FEMA National Risk Index](#)

### *Methodology*

Data are sourced from the U.S. Census and the Federal Emergency Management Agency (FEMA). Risk can be displayed by either census tract or county. The following are hazard indicators relevant to Hawai'i:

- Coastal flooding
- Drought
- Earthquake
- Hail
- Heatwave
- Hurricane
- Landslide
- Lightning
- Riverine Flooding
- Strong Wind
- Tornado
- Tsunami
- Volcanic Activity
- Wildfire

The FEMA indicators generate an overall risk index, a social vulnerability index, a community resilience score, and display expected annual financial and population loss for each county and census tract.

The FEMA National Risk Index also includes measure of Community Resilience, which is defined as the “ability of a community to prepare for anticipated natural hazards, adapt to changing conditions, and withstand and recover rapidly from disruptions”. Community Resilience is inversely proportional to the measure of risk, which means that communities with high community resilience scores have lower Risk Index scores.

### *Limitations*

Natural disaster risks may vary greatly within the counties and census tracts of which they are assigned. For example, the risk of landslides may be acutely relevant to residents living near or on a mountain; but, that risk may be less relevant to coastal residents within the same census tract or county. It is worth investigating if a statewide index could characterize natural disaster risk at a more granular level than county or census tract.

## 7. EPA's Environmental Justice Screening and Mapping Tool (EJSCREEN)

EJSCREEN provides additional needed data about environmental health risk factors. For many communities, close proximity to waste disposal facilities or roadways present a greater, more consistent, risk to human health and safety than the risk of unpredictable natural disasters.

### *Methodology*

Like most of these tools, EJSCREEN sources data from the U.S. census. Environmental data are sourced from the EPA itself. EJSCREEN contains the following environmental indicators:

- National-Scale Air Toxics Assessment (NATA) Air Toxics Cancer Risk
- NATA Respiratory Hazard Index
- NATA Diesel Particulate Matter (PM)
- Air PM
- Ozone
- Traffic Proximity and Volume
- Lead Paint
- Proximity to Risk Management Plan (RMP) sites
- Proximity to Hazardous Waste Facilities
- Wastewater Discharge Indicator (Stream Proximity and Toxic Concentration)

EJSCREEN contains the following demographic indicators:

- Percent Low-Income
- Percent People of Color
- Less than High School Education
- Linguistic Isolation
- Individuals Under Age 5
- Individuals Over Age 64

This index does not combine the environmental factors into a cumulative environmental score, but each environmental indicator is given its own environmental justice index (EJ index) per location. The “demographic index” is based on the average of two demographic indicators, Percent Low-Income & Percent Minority, and is used to calculate each environmental indicator’s EJ index:

EJ Index =

(The Environmental Indicator)

X (Demographic Index for Block Group – Demographic Index for US)

X (Population count for Block Group)

Source: Environmental Justice Indexes in EJSCREEN – How the EJ Index Works. 2021.

*Limitations*

The “demographic index” formula may not be entirely applicable to Hawai‘i given the State’s unique racial and ethnic makeup. This “demographic index” then determines the EJ index, so neither index may be useful for Hawai‘i.

*Remaining Questions*

*Should the statewide vulnerability index include an EJ index score?*

## 8. Social Vulnerability Index for Hawai'i: PURL/NDPTC COVID-19 Survey

In March 2020, The University of Hawai'i at Mānoa's Pacific Urban Resilience Lab (PURL) and the National Disaster Preparedness Training Center (NDPTC) released an online survey to understand the spread of COVID-19 throughout Hawai'i. Survey questions sought to understand people's physical symptoms, their movement, and social distancing practices. This vulnerability index was developed to geospatially understand how different socioeconomic variables affect the spread and vulnerability of COVID-19 across Hawai'i.

### *Methodology*

This SVI builds off of the CDC's SVI. Some variables from the CDC's SVI were removed because they were determined to not be risk factors for COVID-19 (see table below).

**Comparison of Variables Included in the CDC SVI and the Hawaii SVI for COVID-19**

Variable	Theme	CDC SVI	Hawaii SVI for COVID-19
Poverty	Theme 1 Socioeconomic Status	✓	✓
Unemployment		✓	
Per capita income estimate		✓	
No high school diploma		✓	✓
Aged 65 or Older	Theme 2 Household Composition & Disability	✓	✓
Aged 17 or Younger		✓	
Older than Age 5 with a Disability		✓	
Single-Parent Households		✓	
Minority	Theme 3 Minority Status & Language	✓	✓*
Speaks English "Less than Well"		✓	✓
Multi-Unit Structures	Theme 4 Housing Type & Transportation	✓	✓
Mobile Homes		✓	
Crowding		✓	✓
No Vehicle		✓	✓
Group Quarters		✓	✓

\*In place of minority status, the Hawaii SVI for COVID-19 assessed a single minority group, the native Hawaiian and other Pacific Islanders group.

Source: Social Vulnerability Index for Hawai'i

### *Limitations*

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When selecting a specific census tract, there are a lot of data points provided that are not clearly explained or intuitive for novice users of geospatial mapping tools. These data points should avoid using abbreviations in their descriptions.

#### *Remaining Questions*

*This tool includes purple map points that indicate survey respondents who reported being Pacific Islander. This is useful because Hawai'i Department of Health data has shown that Pacific Islanders are contracting COVID-19 at rates disproportionately higher than population demographics. How can the statewide SVI incorporate unique features that specify demographic variables and vulnerabilities of high interest?*

## Reference

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i “ALICE: A Study in Financial Hardship in Hawai’i”. <https://www.unitedforalice.org/Hawaii>