San Jose State University

SJSU ScholarWorks

Fall 2022

Vulnerable Populations and Flooding: A Bay Area County Public Alert and Warning Case Study

Victoria Castro
San Jose State University

Recommended Citation

<u>Vulnerable Populations and Flooding:</u>

<u>A Bay Area County Public Alert and Warning Case Study</u>

By

Victoria Castro

A Thesis Quality Research Paper

Submitted in Partial Fulfillment

of the

Requirements for the

Master's Degree

in

PUBLIC ADMINISTRATION

Professor Frances Edwards. Ph.D.

Advisor

The Graduate School

San Jose State University

December 2022

Table of Contents

BACKGROUND

Public alerting authorities face crucial challenges in alerting populations during disasters. Emergency managers and alerting authorities have the task of learning and adapting to new public alert and warning systems and technologies that can disseminate alerts and warnings before, during, and after a disaster (Federal Signal Corporation, 2013). This research addresses how four Bay Area counties issue public alerts and warnings to vulnerable populations through the Federal Emergency Management Agency's (FEMA) Integrated Public Alert and Warning System (IPAWS). This research includes data collected from Santa Clara, San Mateo, San Francisco, and Sonoma counties during the 2015-2016 El Niño winter season. By analyzing data from Santa Clara, San Mateo, San Francisco, and Sonoma counties, this research is geared to better understand how current technology is being used, to find innovative ways to provide wider-reaching emergency communication strategies, including community outreach efforts, and plan specifically with vulnerable populations in mind. The data collected was analyzed to serve as a distinct case study of IPAWS implementation across the four counties profiled. For the research, vulnerable populations are defined as the following: homeless individuals, non-English speaking communities, and people with access and functional needs (Fothergill and Peek, 2004; Ballen, 2009). Previous research has found that traditional methods of communication do not effectively reach everyone in these groups, often leaving the most vulnerable groups without the support and information needed during a disaster (Ballen, 2009).

Flooding

Flooding can cause severe water damage to infrastructures, such as buildings, roadways, bridges, and other facilities located in inundation areas. Inundation areas have a higher risk of

hazardous materials entering waterways, as facilities, such as wastewater treatment plants, can experience severe damage to storage tanks and pipelines. Debris from floodwaters can also cause damage when accumulated on bridges and in manufactured culverts, which can lead to increased loads on features, and cause backwater effects and overtopping (City and County of San Francisco, Department of Emergency Management, 2014).

Flooding can also affect normal routine functions in communities and lead to economic losses, as businesses and government facilities are forced to close, utilities, such as water, gas, and sewer services, are disrupted, and communication mechanisms, such as utility poles, are damaged (City and County of San Francisco Department of Emergency Management, 2014). According to the National Oceanic and Atmospheric Administration (NOAA), flooding caused 176 fatalities nationwide in 2015, a dramatic increase from a total of 38 fatalities in 2014 (National Weather Service, 2016).

As reported by FEMA's Flood Insurance Rate Maps (FIRM), California has had a long history of flood cycles, creating an elevated risk of severe flooding. Since February 1954, sixty-three percent of all federally declared disasters in California have involved flooding (California Office of Emergency Services, 2018). In total, these flood disasters have claimed 292 lives, caused 756 injuries, and cost over $4.8 billion in California Office of Emergency Services (CalOES) administered costs for water damages to various private and public infrastructure (California Office of Emergency Services, 2018).

California's flooding vulnerability spreads statewide and is commonly present in densely populated communities (California Office of Emergency Services, 2018). Every county in California experiences flooding and climatological patterns that present challenges to flood mitigation planning (California Office of Emergency Services, 2018). California's diverse

geographical features create several types of floods, such as coastal, riverine, tsunami, seiche, mudslide, levee, lake, fluvial, flash, and alluvial flooding (California Office of Emergency Services, 2018). Since 1992, every county in California has had a state and/or federal emergency declaration at least once for flooding (California Office of Emergency Services, 2018).

Areas that have experienced flooding in the past continue to flood repeatedly, causing great concerns and ongoing challenges for emergency managers and alerting authorities when it comes to issuing flooding alerts. The State of California and FEMA have identified various communities as Repetitive Loss communities, defined by FIRM as communities that have experienced severe flooding in past events and are anticipated to continue experiencing severe flooding (California Office of Emergency Services, 2018). In 2018, Repetitive Loss (RL) communities accounted for an estimated $171 million in payments and represented 8,019 losses on 2,903 properties throughout California (California Office of Emergency Services, 2018).

There has been a steady pattern demonstrating the correlation between RL communities and flooding damages from 2010 to 2013. In 2016, out of the 30,000 RL communities nationwide, 393 were in California (California Office of Emergency Services, 2018). According to the University of California at Davis Center for Watershed Sciences, in 2017, California accounted for an estimated $30 million in total payments to these communities, (California Office of Emergency Services, 2018). Sonoma County, Santa Clara County, and San Mateo County have consistently reported historically high flood-related damages within their jurisdictions, and Sonoma County continues to appear on California's top ten RL Communities list (California Office of Emergency Services, 2018).

Problem Statement

Public alert and warning systems are crucial tools that save lives and protect property in times of emergencies. In the past several decades, natural disasters have struck the nation, and effective public alerts and warnings were not disseminated to all impacted populations, calling into question the effectiveness of emergency communication systems (Wimberley, 2012). As an example, in 2012, when Hurricane Sandy hit the east coast, public alert and warning systems reached those who had access to technological devices. However, emergency managers and alerting authorities faced the challenge of alerting all groups, including the homeless and individuals with access and functional needs, who may not have access to traditional communication methods like television and radio broadcast stations, cell phones, or landlines. In addition, individuals who experience language barriers and limited English language proficiency struggle to fully understand public alerts (Wimberly, 2012).

Locally, emergency and disaster communications have also left some of the most vulnerable populations behind. In 2017, the Coyote Creek flood in Santa Clara County devastated the City of San José. The flooding disproportionately impacted several low-income communities and households with little English proficiency, and there was limited communication between the agencies involved and the communities affected (Wadsworth et al., 2017; Wadsworth and Koehn, 2017). A history of inadequate emergency communications and floodplain mismanagement, and a lack of communication between the City of San José and the Santa Clara Valley Water District, contributed to the disaster (Rogers, 2017), and in February 2017, two consecutive atmospheric rivers led to severe flooding. The Anderson Dam, which is a reservoir, not a flood control dam, - had reached capacity and began to overflow. This event forced 14,000 residents out of their homes, with little time to evacuate (Rogers, 2017). By July

2017, there were still an estimated 200 residents that had not been able to return to their homes and were living in temporary housing (Sykes, 2017). The flooding was particularly devastating in low-income Vietnamese and Hispanic households, and mobile home parks, where there were many senior citizens and/or people with limited English proficiency (Wadsworth et al., 2017; Wadsworth and Koehn, 2017). Improved emergency communications could have provided an opportunity to warn residents and provide notice about the evacuation in multiple languages, which could have potentially avoided the substantial property damage, and the emotional distress caused by prolonged displacement (Alexander, 2020; Sykes, 2017). Drawing from these disasters, this research analyzed how four Bay Area counties issue public warnings, with a particular focus on how they engaged vulnerable populations during crisis communication. By exploring this facet of crisis communication, this research proposes potential solutions to improve communication and engagement with vulnerable populations.

Historical Solutions

CONELRAD

The United States has a documented history of developing and implementing emergency public alert and warning systems dating back to World War II. In 1951, the United States developed the first public alert and warning system titled the Control of Electromagnetic Radiation (CONELRAD). Radio broadcasting stations used CONELRAD to initiate a special sequence and procedures that were designed to warn citizens of possible imminent nuclear attacks. In addition to radio, television broadcasting stations and audible siren systems were adopted into CONELRAD. The system was created as a military defense system that incorporated civil defense mechanisms (Brinson, 20090. Over time, technical difficulties arose from CONELRAD. The design of CONELRAD and the broadcasting aspects were theoretically

simple. Upon learning of an emergency, the Air Defense Command (ADC) would notify the Air

Defense Control Centers (ADCC). ADCCs would then turn to notify key radio and television

stations that were powered by metropolitan broadcasters (Brinson, 2009). The transmission

would remain active until the ADC signaled an "all clear" message (Brinson, 2009). Although

the foundation of the system seemed basic, it was technologically complex. The time-lapse

between getting the stations to transmit and stop broadcasting emergency messages were too

long, which eventually became a challenge. *The New York Times* reported that the time-lapse

was only five minutes but was later reported to be anywhere between five to sixty minutes during

a nationwide test (Brinson, 2009). Unfortunately, the time-lapse issue was never resolved and

CONELRAD officially ended in 1963.

EBS

In 1963, CONELRAD was replaced by the Emergency Broadcasting System (EBS)

which was developed to address the nation with audible public alerts but was not designed or

allowed to target audiences. Originally, the EBS was designed to provide the nation with an

expeditious method of communication and was a critical tool for emergency managers (Moroney

et al., 2013). EBS continuously changed as modern technologies developed. EBS was later

expanded to state and local-level public alert and warning messaging during times of peace; EBS

ran from 1963 through 1997.

EAS

By 1997, the Emergency Alerting System (EAS) was created by the Federal

Communication Commission (FCC), FEMA, and the National Weather Service to replace the

EBS. EAS was designed to address the public within the first ten minutes of an emergency

through presidential addresses. The alert system consists of four aspects: a digitally encoded

header, attention signals, audio announcements, and digitally encoded end-of-message markers. The system provided better incorporation of local public alerts and warnings to radio and television broadcasters and is still in use today. The EAS is used to send warnings through broadcast, cable, satellite, and wireline communication mechanisms to the public and is used with all other means of emergency communications at the local and state levels. Like all previous public alert and warning systems, EAS is constantly improving by ensuring that effective public alerts and warnings are disseminated promptly and reach as many individuals and communities as possible (FEMA, 2015a).

IPAWS

In 2006, President George W. Bush signed Executive Order 13407 which directed the Department of Homeland Security to create a public alert and warning system for the nation (FEMA, 2021b). FEMA was directed to lead the project and adopted a set of standards and protocols that public alerts and warnings would be supported by the newly developed alert system. The public alert and warning system was titled the Integrated Public Alert and Warning System (IPAWS) (FEMA, 2021b). IPAWS is currently in use by the federal government and has modernized and integrated the nation's public alert system infrastructure by integrating EAS and the Command Mobile Alert System (CMAS) structures.

State and local governments have incorporated IPAWS into their existing systems. IPAWS provides emergency managers and alerting officials with an effective system that warns the public about emergencies using the National Oceanic and Atmospheric Administration (NOAA) Weather Radio, Wireless Emergency Alerts (WEA), Emergency Alert System (EAS), and other alerting systems for a single interface (FEMA, 2015a). Approved and authorized local, state, and federal agencies can use IPAWS and incorporate local warning and alert systems to

use the Common Alerting Protocol (CAP) standards and procedures in an emergency (FEMA, 2015a; FEMA, 2021b). As of April 2021, there were over 1,500 IPAWS authorized alerting agencies nationwide, and more than 100 agencies were in the process of getting authorization (FEMA, 2017; FEMA, 2021a). Today, technology has helped change the way public alerts and warnings are issued before, during, and after natural disasters.

WEA

In 2008, the Warning, Alert, and Response Network (WARN) Act established the Wireless Emergency Alerts (WEA) system and officially launched in 2012 (Federal Communications Commission, 2022). In a partnership between FEMA, the Federal Communications Commission (FCC), the National Oceanic and Atmospheric Administration's National Weather Service, and wireless providers, WEA delivers and enhances public alerts and warnings through short emergency alerts that are broadcasted from cell towers and WEA-enables mobile devices (Federal Emergency Management Agency, 2022a). There are five types of WEA alerts: Presidential Alerts- special class alerts sent only during national emergencies, Imminent Threat Alerts- natural or human-made disasters, extreme weather conditions, active shooters, etc., Public Safety Alerts- less severe threats that are not imminent or after an imminent threat, America's Missing: Broadcast Emergency Response {AMBER) Alerts- urgent bulletins for child-abduction cases, and Opt-In Test Messages- tests assessing the capability of state and local officials to send WEAs (Federal Emergency Management Agency, 2022a). In 2019, FEMA required enhancements to WEA capabilities that required wireless providers' capabilities to receive enhanced WEA alerts from IPAWS, upgrades in software used by alerting authorities, and nationwide availability for customers to receive enhanced WEA alerts (Federal Emergency Management Agency, 2022a).

CalPAWS

In California, the Governor's Office of Emergency Services (CalOES) oversees and coordinates the state's emergency preparedness, response, recovery, mitigation, and all homeland security activities (California Office of Emergency Services, 2016). The Public Safety Communications (PSC) serves as CalOES' public alert and warning system for first responders and oversees the 9-1-1 system for the public. PSC aims to preserve and protect the safety and well-being of Californians by delivering reliable public communications and keeping the public connected during emergencies. PCS was developed and implemented in 1947 and is responsible for the design, installation, and maintenance of the state's microwave network and public safety radio communication systems (California Office of Emergency Services, 2016). The PCS is also responsible for the State Emergency Telephone Number Account (SETNA) and the State's 452 Public Safety Answering Points (PSAP), networks that support the delivery of 9-1-1 calls (California Office of Emergency Services, 2016).

California is and has been a national leader in preparing for and responding to emergency events and has incorporated IPAWS into its emergency plans (California Office of Emergency Services, 2016). During the development and implementation phases of IPAWS, FEMA faced coordination and technological challenges, which caused government agencies throughout the United States to hesitate to sign up for the system (Oak Ridge Associated Universities 2014). When the Oak Ridge Associated Universities conducted an early case study on how IPAWS was implemented and practiced in California, the results showed that only half of the counties and cities in California were IPAWS Public Alerting Authorities (Oak Ridge Associated Universities, 2014). This study collected information about how California's public safety officials used IPAWS and the Wireless Emergency Alerts (WEA) systems when issuing alerts. Most

authorized alerting authorities chose not to issue WEA alerts and reported minimal effort to fully implement IPAWS regarding testing, coordination, and public education (Oak Ridge Associated Universities, 2014). California Public Alert and Warning System (CalPAWS), like IPAWS, integrates new and existing public alert and warning systems to provide state and local authorities with a range of capabilities and dissemination communication channels to reach affected communities, such as vulnerable populations who can benefit from the alerts issued.

CalPAWS Strategies

There are several methods and technologies used to deliver public alerts and warnings throughout California (California Office of Emergency Services, 2016). The in-person notification method, commonly referred to as "door-to-door" notifications, is used by uniformed public safety officials to reach populations that are not reachable by their local public alert and warning systems. This practice is labor-intensive and time-consuming.

The public address system is another commonly used tool in California. Public address systems are built-in audio announcement systems that can operate in outdoor venues and buildings. This method is effective if audio is intelligible, and messages are written clearly. Public address systems are very efficient in reaching populations that are outdoors and away from devices. Although effective, public address systems are technically demanding.

Like public address systems, public sirens are used as outdoor public alerts. Sirens can be programmed to emit multiple distinctive sounds, but it can be difficult to educate a community to associate specific sounds with alerts. Santa Clara County no longer relies on sirens, and now uses AlertSCC, which is an alerting system that can be disseminated via a mobile device, landline, or email, and is also offered in multiple languages (County of Santa Clara Office of Emergency Management, 2017).

A tone-activated weather radio is another method used by emergency managers and alerting authorities for issuing public alerts. Tone-activated weather radios use old-fashioned portable technology, such as radio pagers and desktop radio receivers, and can be activated when they receive a particular signal (California Office of Emergency Services, 2016).

Other traditional public alerts and warning systems are also used, including radio and television broadcasting, telephone notifications, digital television datacasting, and digital billboard signs that exist alongside major roadways, at mass transit stations, and in other public areas (California Office Emergency Services, 2016). Santa Clara, San Mateo, San Francisco, and Sonoma counties all incorporate several communication methods when issuing public alerts focusing on flooding emergencies.

2015-2016 Winter Flood Season

The National Weather Service's Climate Prediction Center reported that California had a 95% chance of experiencing an El Niño season for the 2015-2016 winter storm season. El Niño weather conditions were strong and thought to have been shaping up to be one of the "fiercest on record" (Kasler, 2015). Current and past El Niño weather conditions cannot accurately predict how many storms, or the amount of rainfall or snow, California will experience within a season, and weather patterns are notoriously unpredictable. El Niño, also known as the Southern Oscillation, is a weather condition that results in a rise in the southern Pacific Ocean's water temperatures (National Weather Service, 2016). This creates increased rainfall across California and other southern-tier states and can result in fewer hurricanes in the Atlantic Ocean and an increase in eastern Pacific hurricanes (National Weather Service, 2016).

California was recorded as having a high probability of abnormal to severe weather patterns deriving from the 2015-2016 El Niño winter storm season (Kasler, 2015). Many cities,

counties, and public agencies prepared for extreme weather conditions, including massive

flooding, because of the NWS Climate Prediction Center reports of a high probability of an El

Niño winter storm season (Kasler, 2015). Santa Clara, San Mateo, San Francisco, and Sonoma

counties have all experienced abnormal, and in some cases, severe, weather patterns from past El

Niño winter storm seasons, and all share the potential of hazardous flooding throughout their

jurisdictions (National Weather Service, 2016).

LITERATURE REVIEW

Technological advances have transformed how emergency managers and alerting authorities disseminate public alerts and warnings during disasters (Collins et al., 2016). However, as new technological advances create new communication mechanisms, challenges simultaneously arise. Emergency managers and alerting authorities have a wide array of communication mechanisms to choose from, and this has become more of a problem than a solution (Palen and Anderson, 2016). As a result, emergency managers and alerting authorities have developed a layered approach to their emergency communication strategies and methods (Chari et al., 2019; Soden and Palen, 2018). A study conducted in 2014 by the Federal Signal Corporation reported that most emergency managers and alerting authorities relied on traditional methods like television, newspapers, and radio as communication platforms for issuing alerts, while only half reported using social media as a communication mechanism (Brady, 2014). Although traditional media is still a communication mechanism for public alerts and warnings in a disaster, social media is now the most efficient method of delivering emergency messages (Collins et al., 2016).

Social media and emergency communications have several positive correlations: it is readily able to disseminate information at a click of a button, allowing emergency managers and alerting authorities to become part of the conversation, and helps create and build resilient communities (Nowell and Boyd, 2010). Although there are several benefits of using social media for emergency communications, early research found that there were still barriers to overcome for the full adoption of social media in emergency communications, such as agency leadership buy-in, sustainability, and technical and access issues (Kapucu, 2008).

Researchers (Kapucu, 2008; Chari et al., 2019; Collins et al., 2016) identified a correlation between social media acceptance with age. Many emergency managers and alerting authorities agree on the benefits of social media as a communications mechanism for emergency communications but dispute the growing use of social media among all ages, as many members of older generations remain skeptical about the technology and its full potential during a disaster (Collins et al., 2016; Chari et al., 2019). Social media allows for the free exchange of information that allows communities to take protective actions during disasters. During Hurricane Sandy, communities were able to coordinate relief efforts, tally the casualties, raise funds, repair damages, and help authorities locate resources for affected areas using social media (Moroney et al., 2013).

The innovative use and integration of recent technologies for real-time responses strengthen the nation's ability to respond to emergencies (Moroney et al., 2013; Benavides, 2013). The IPAWS system's use of new communication technologies ensures rapid dissemination of information to affected communities. All levels of regional and local infrastructure are affected when natural disasters strike, and communities must be prepared to respond and act (Doerfel et al., 2010; Gowan et al. 2015). Despite the increasing interconnection of traditional, social, and digital media, there is no single communication mechanism that will reach all community members at any given time during a disaster (Collins et al., 2016). Public alert and warning systems are intended to help communities become more resilient to natural disasters; therefore, communities must also be active in achieving effective emergency management, including communications. Emergency managers and alerting authorities must investigate multiple communication mechanisms that will reach their community members and, in addition, be able to adapt systems to reach vulnerable populations who may become even

more vulnerable during an emergency (Palen and Liu 2007; Benavides, 2013; Kruger et al., 2018; Peek and Stough, 2010).

With the development of IPAWS, FEMA has helped inform communities of imminent dangers. During the severe weather conditions of Hurricane Sandy in 2012, community members were alerted before the superstorm hit the eastern seaboard (Weinschenk, 2012). Although IPAWS was used during Hurricane Sandy, only three messages were issued through IPAWS as a result of the internet and broadband services becoming early casualties of the storm (Weinschenk, 2012). Despite the low number of alerts issued through IPAWS, many residents followed the warnings and instructions.

The effectiveness of the public alert and warning messages related to Hurricane Sandy is not, however, shared with other emergencies. In 2015, Texas saw extensive flooding that resulted in 21 casualties (Wimberly, 2015). Despite issuing multiple public alerts to communities in flooding zones before the emergency, many residents chose to ignore the warnings and decided to "ride out the storm" (Wimberly, 2015), and research has shown that the readiness gap can cost lives in the event of a disaster (Gowan et al. 2015). Collaborating with vulnerable communities before disasters builds knowledge, and resilience, and reduces the readiness gap (Gowan et al. 2015). Additionally, these measures build a sense of responsibility among community members and build resilience against disasters (Nowell and Boyd, 2010). The technical improvements made to the nation's alert and warning infrastructure have been impressive, however, the education of the public for a safety culture has not, and research shows how vital this aspect of disaster preparedness is (Wimberly, 2015; Gowan et al. 2015; Nowell and Boyd, 2010).

Many challenges arise when attempting to reach vulnerable populations during a disaster. In many cases, a vulnerable population may not have access to or the ability to receive, understand, and react to emergency alerts and warnings (Benavides, 2013; Subervi, 2010; Subervi, 2016). For example, Subervi (2010 & 2016) shows that non-English speakers have fewer broadcasting stations to inform them about emergencies in their neighborhoods compared to the general English-speaking population (Benavides, 2013; Subervi, 2010; Subervi, 2016). The language barrier between emergency managers and alerting authorities and non-English speaking populations also creates a challenge for emergency communications because many emergency managers and public safety officials are not fully equipped or trained to communicate in foreign languages (Subervi, 2010). The lack of multilingual communications may be a major deficiency in emergency communications (Subervi, 2010; Subervi, 2016). Communications studies have consistently pointed out the critical role the media plays during emergencies and highlights the communication gaps between the general media and non-English speaking communities (Benavides, 2013; Subervi, 2010; Subervi, 2016).

Similarly, emergency managers and alerting authorities face challenges with alerting homeless populations. Homeless individuals may have limited or no access to landlines, mobile devices, or the internet, which can hinder the dissemination of emergency alerts and warnings and affect their overall safety and personal emergency preparedness. According to research (Gin et al., 2022), homeless individuals are often the first to become severely impacted by disasters, and communities across the United States often lack in addressing the needs of the homeless population in disaster planning and response. Constraints, such as inadequate funding and staffing, as well as a lack of guidance, contribute to this problem, hindering the building of a resilient community before, during, and after a disaster (Gin et al., 2022).

In addition, emergency managers and alerting authorities also face challenges when attempting to reach individuals with access and functional needs during a disaster. In many cases, individuals with access and functional needs rely on others when performing routine activities (Mullenix, 2015), decreasing their access to the technologies that provide public alerts and warning notifications. Research shows (Kruger et al., 2018) that disasters can harm individuals with access and functional needs, therefore making it critical to incorporate adequate communications, preparedness plans, and responses. There is limited data on adults with disabilities and their ability to engage in emergency preparedness. To better understand the needs and behaviors of individuals with access and functional needs, communication is needed between this population and local officials to incorporate them into emergency planning and response (Kruger et al., 2018).

Overall research remains limited regarding crisis communications and vulnerable populations. Research demonstrates the gap in emergency planning, preparation, and management interest regarding vulnerable populations and their unique communication needs (Wieland et al., 2020; Kruger et al., 2018), which further illustrates a strong need to add to this body of research and find innovative and inclusive ways to support vulnerable populations during disasters.

METHODOLOGY

This study used the managerial audit method to assess the implementation of IPAWS in Santa Clara County, San Mateo County, the City and County of San Francisco, and Sonoma County and uses the 2015-2016 El Niño winter season as baseline data to analyze the implementation. Counties were each assessed on three metrics. The first metric was to identify whether counties were FEMA-approved altering authorized agencies, which allows the agencies to access and use IPAWS. The second metric assessed public outreach efforts that counties conducted towards alerting vulnerable populations during the 2015-2016 El Niño winter season. Lastly, data was collected to determine whether counties had countywide emergency plans addressing communicating with vulnerable populations.

Data sets were collected using online surveys (Appendix A) that targeted Santa Clara County, San Mateo County, Sonoma County, and City and County of San Francisco key emergency management/alerting authorities' personnel. Each county was contacted by phone and/or email to identify the appropriate staff member to complete the voluntary survey. Once the appropriate staff member was identified, a link to the survey was emailed; and key emergency management personnel completed the survey within five weeks. Personnel from three of the counties responded to the request for information, although not through the survey.

This research was given an exemption by the San Jose State University Institutional Review Board because there were no human subjects.

FINDINGS

Based on the methodology described in the previous section, this section details the findings from the voluntary survey and additional research. The findings below were gathered through personal contact and research. Rather than responding to the online survey questions, Santa Clara, San Mateo, and Sonoma counties offered phone interviews or brief email conversations. Additionally, they provided county plans, annexes, and other documents. The City and County of San Francisco's Department of Emergency Management (SFDEM) was unresponsive to the online survey request; however, further research was conducted online to gather additional information. Resources with detailed information were available and gathered from the county's website. County profiles are attached to the end of this study as **Appendix B**. **Table 1** summarizes the county profiles during the 2015-2016 El Niño winter season.

The survey results were inconclusive; officials in most of the targeted counties did not complete the survey; however, that is not to say that the counties were unsupportive or had not made improvements to further support and incorporate their vulnerable populations into their emergency planning efforts since the 2015-2016 El Niño winter season. Many of those who did respond to phone calls and emails offered local data, and available resources, and shared their jurisdiction's emergency plans.

Table 1. 2015-2016 County Profile

	Santa Clara County	San Mateo County	City/County of San Francisco	Sonoma County
Population	1,938,153	771,410	884,363	504,217
Median Household Income	$101, 173	$105,667	$96,265	$71,769
Ethnic Group %*				
White alone, not Hispanic or Latino	32.6%	39.8%	40.8%	63.8%
Hispanic or Latino	26.3%	25.1%	15.3%	26.3%
Asian	34.6%	27.4%	34.5%	3.8%
Black or African America	2.4%	2.3%	5.0%	1.4%
Other: Native Americans, Pacific Islanders, more than one race, or other races	4.1%	5.3%	4.4%	4.7%
Foreign born persons	38.3%	35.6%	34.4%	16.7%
Language other than English spoken at home	52.7%	47.1%	43.9%	25.7%
2015 Homeless Population	6,556	1,772	7,539	3,107
Land Area in Square Miles	1,290.10	448.41	46.87	307.1
Elevation	Sea Level to 4,318ft	Sea Level to 2,629ft	Sea Level to 928ft	Sea Level to 2,600ft

Sources: United States Census 2010, United States Census Bureau Quick Facts, United States Census Bureau American Community Survey, Santa Clara County Homeless Census & Survey: 2015 Comprehensive Report, 2015 San Mateo County One Day Homeless Count and Survey, San Francisco 2015 City Performance Scorecards: Homeless Populations, Sonoma County Point-in-Time Homeless Census & Survey: 2015 Comprehensive Report and United State Geological Survey

*Ethnic origin estimates gathered from the United States Census Bureau Quick Facts and American Community Survey.

Across all four counties examined, there was limited consistent information given or found to accurately display in a table detailing each county's community outreach strategy. The following is information on what was discovered during the research phase of the project through interview data and independent research. The key findings from this research are in the following section.

Key Finding #1

The first key finding was that across the four counties, not every county had official IPAWS Alerting Authority status during the 2015-2016 El Niño season, and only one county used IPAWS during this time. Santa Clara, San Francisco, and Sonoma counties had official IPAWS Alerting Authority status during this time. San Mateo County did not have an official IPAWS Alerting Authority status, though it did establish its status soon after. Santa Clara County was the only county to have issued IPAWS alerts during the research period, while Sonoma County and San Francisco did not issue any IPAWS alerts.

Although three of the four counties had IPAWS alerting authority status, many of the counties profiled used other crisis communications and warning tools instead. Despite insufficient interview data, further research showed that other communication systems were in place for San Mateo County, the only county without IPAWS Alerting Authority status.

San Mateo County

San Mateo County made efforts to increase communication with residents during the 2015-2016 El Niño winter season. For example, the San Mateo County Sheriff's Office of Emergency Services rolled out its updated public alert and warning system SMCAlert, the county's text message, e-mail, or landline alert notification that immediately alerts recipients

about emergencies in real time. In 2015, an estimated 37,000 residents were registered for emergency notifications (Brian Molver, personal communication, October 28, 2016).

In addition, the Office of Emergency Services updated its planning and mitigation efforts by updating its Flood Annex, held emergency drills and meetings, and began coordinating with outside agencies, such as the county's public works department and California Department of Transportation (CalTrans) to update plans and preparations (San Mateo County Emergency Services Council, 2015). The county also worked with the California Conservation Corps to agree to assist during natural or manmade disasters and conducted public outreach ahead of the El Niño winter season (San Mateo County Emergency Services Council, 2015; Bay Area Urban Areas Security Initiative, 2018). Even though the El Niño winter season did not materialize as expected, the lack of a uniform emergency alerting system, such as IPAWS, could have put many San Mateo County residents at risk of severe weather disasters if severe weather conditions had occurred.

City and County of San Francisco

The City and County of San Francisco also made considerable efforts to increase communication during the 2015-2016 winter season, despite not issuing IPAWS alerts during moderate to heavy rains. San Francisco focused much of its preparedness efforts on ensuring its highest vulnerable residents, the homeless population, had adequate shelter resources available in the event of torrential rains.

The San Francisco Department of Emergency Management (SFDEM) Emergency Response Plan: Communications Annex details the communication methods available to San Francisco in the event of emergencies, which include telephone, radio, data, and internet communications, public information warning systems, and lastly, press releases (City and

County of San Francisco Department of Emergency Management, 2017). The city issued press releases in anticipation of high volumes of rain (San Francisco Health Network, 2015) and detailed the types of hazards residents anticipated to face. Press releases also included information about increased emergency shelter capacity during the winter months of 2015-2016 (City and County of San Francisco Port Commission, 2016).

Additionally, the SFDEM 2015 Annual Report provided an overview of their El Niño preparations that included building upon existing emergency plans, working with city and local utility agencies to develop a comprehensive El Niño Concept of Operations Plan to sustain long-term response and recovery efforts (City and County of San Francisco Department of Emergency Management, 2015, page 6). The report also noted that SFDEM worked with faith-based partners to ensure shelter locations for the city's homeless population and public outreach efforts to residents and businesses to prepare and receive emergency storm warnings, alerts, and other notifications.

Lastly, SFDEM conducted its first-ever public information-focused functional exercise where Public Information Officers (PIO) and alerting officials specifically focused on El Niño flooding scenarios. These kinds of emergency training sessions and exercises allow PIOs and other alerting officials to practice how information is collected, verified, and disseminated to residents and businesses in the event of large and ongoing storms (City and County of San Francisco Department of Emergency Management, 2015, page 6).

Key Finding #2

The second key finding is that during the 2015-2016 El Niño winter season, counties mostly relied on outside organizations for community outreach efforts and did not maximize the use of free social media websites to connect with the public. Although staff interviews for this

project did not provide sufficient details about the organizations and nonprofits that supported community outreach efforts, all counties noted that community outreach was mostly delegated to individual cities and the community-based organizations that support residents in their jurisdictions but still initiated community outreach efforts to assist.

Of the four counties profiled, Santa Clara County's Office of Emergency Services, now Office of Emergency Management, was the most notable example of a county initiating social media for community outreach specifically regarding flooding during the 2015-2016 winter season. The county initiated several social media posts on Facebook and Twitter detailing emergency training and exercises and public information outreach specifically to flood preparations (Kavita Narayan, personal communication, October 14, 2016).

In addition, the 2016 Santa Clara County Multi-Jurisdictional Program for Public Information Annual Report detailed the county's community outreach efforts. The El Niño winter season was an optimal opportunity to prepare county residents for the flooding risks in the community, even during times of severely dry conditions. Santa Clara Valley Water District spent $90 million on flood protection projects in preparation for El Niño (NBC Bay Area, 2015), which included a flood awareness public information campaign between November 2015 to March 2016 to inform the public of the flooding risks the county could experience (Santa Clara County Multi-Jurisdictional Program for Public Information, 2016). Efforts included participating in community events held between October 2015 through February 2016, community presentations, and hands-on sandbag demonstrations across the county to teach residents proper placement to optimize protection (Santa Clara County Multi-Jurisdictional Program for Public Information, 2016).

To further deepen its commitment to increasing disaster preparedness, the Santa Clara County Board of Supervisors introduced resolution BOS-2019-155, adopted on December 10, 2019, designating Collaborating Agencies Disaster Relief Effort (CARDE) as the Santa Clara County operational area official Voluntary Organizations Activate in Disaster (VOAD). VOAD activates volunteers to help communities affected by disasters by bringing together interdisciplinary partners and agencies, including governmental agencies, nonprofit organizations, community and faith-based organizations, and private companies to provide well-rounded support for Santa Clara County residents impacted by disasters. This resolution has been in effect since its introduction.

Key Finding #3

The third finding is that Sonoma and San Francisco counties made efforts to include vulnerable populations in their emergency planning, since the 2015-2016 winter season.

Sonoma County

Sonoma County had limited public information available about its El Niño planning or how it communicated to vulnerable populations about emergencies during the 2015-2016 winter season. Staff interviews did not provide any additional information. Despite the lack of information on public outreach information, Sonoma County made improvements toward bridging the communication gap with vulnerable populations since the 2015-2016 El Niño winter season.

As of March 2022, Sonoma County became the first county in California to incorporate cultural competency in its Emergency Operations Plan, making significant strides in coordination between agencies, jurisdictions, and community-based partners within the county during an emergency (County of Sonoma Administrator's Office, 2022). The plan was developed with feedback from the community as well as local organizations to address and resolve issues

relating to cultural responsiveness. Incorporated items include simultaneous English and Spanish emergency alerts and resources, the inclusion of immigrant and Spanish-speaking community members in future disaster response planning, as well as increased education relating to alert and warning systems for its Spanish-speaking community.

In addition, the updated Emergency Operations Plan eliminated questions regarding immigration status at evacuation shelters and the incorporation of identifiable and trained translators at local assistance centers. These efforts were initiated to minimize miscommunication and increase ease among those seeking shelter during an emergency (Sonoma County Administrator's Office, 2022). As a result of California Senate Bill 160, passed in 2019, counties are required to integrate cultural competency into any new emergency plans (Sonoma County Administrator's Office, 2022), and Sonoma County's Emergency Operations Plan is a notable example of a county fulfilling this requirement, and taking steps towards more inclusive emergency and crisis communications.

City and County of San Francisco

The City and County of San Francisco's Winter Storm and Flood Annex: A Hazard-Specific Response Plan details how the Housing and Human Services Branch provides support for individuals with access and functional needs during storm-related needs. Support includes wellness checks for recipients served through their In-Home Supportive Services program, power stations at shelters where people can charge their mobile devices and other assistive technology devices, and working with city agencies - like the Traffic and Transportation Branch - to ensure that accessible transportation is made available for those who need it (City and County of San Francisco Department of Emergency Management, 2016).

Key Finding #4

The fourth and final key finding is that all counties conduct Point-in-Time surveys for their homeless populations as required by the US Department of Housing and Urban Development every two years. Although this data is collected regardless of the presence of powerful weather phenomena, such as an El Niño winter storm, counties have recognized the importance of this vulnerable population and have used that data to better serve the homeless population's needs by allocating the necessary social services.

The reports measure the prevalence of homelessness in their communities and collect information on individuals using emergency shelters, transitional housing, and individuals living in places not meant for human habitation (County of Santa Clara County, Office of Supportive Housing, 2015a). The data is collected using two methods: a point-in-time count of unsheltered individuals and families experiencing homelessness, and a comprehensive survey sample of people experiencing homelessness. The reports use the U.S. Department of Housing and Urban Development (HUD) definition of homelessness for the point-in-time count. As **Table 2** demonstrates, Santa Clara, San Mateo, San Francisco, and Sonoma counties accounted for 18,974 homeless individuals during the 2015-2016 El Niño winter season.

Table 2. Homeless Populations by County During 2015-2016 El Niño Winter Season

	Santa Clara County	San Mateo County	City/County of San Francisco	Sonoma County	Total
Homeless Population	6,556	1,772	7,539	3,107	18,974

Source: Santa Clara County Homeless Census & Survey: 2015 Comprehensive Report, 2015 San Mateo County Homeless Census and Survey, San Francisco Homeless Point-in-Time Count and Survey Comprehensive Report 215, Sonoma County Homeless Census & Survey: Comprehensive Report 2015.

These reports assist counties by analyzing trends in the size of the homeless population, allowing county services to better understand and meet the needs of this vulnerable population.

In Sonoma County, reports found that the overall homeless population declined since 2011. In 2011, the county counted 4,539 individuals experiencing homelessness (County of Sonoma, Community Development Commission, 2015). In the 2019 survey, Sonoma County reported a total of 2,951 (County of Sonoma, Community Development Commission, 2019). In San Francisco, the reports found that the city had a stable count of homeless people (City and County of San Francisco, Department of Homelessness and Supportive Housing [HSH], 2015). To improve the data on unaccompanied children and youth, an additional youth count is conducted during San Francisco's point-in-time count. In 2015, the report found a total of 853 unaccompanied minors and transitional-aged youth (City and County of San Francisco, Department of Homelessness and Supportive Housing, 2015). Since 2004, San Francisco initiated several actions to reduce the homeless population, which included a 5-year Strategic Plan for Ending Homelessness and a 10-Year Plan to End Chronic Homelessness (City and County of San Francisco, Department of Homelessness and Supportive Housing, 2015).

The reports are designed to meet the requirements put forth by the U.S. Department of Housing and Urban Development (HUD) which helps communities applying for McKinney-Vento Homelessness Assistance funds. The Stewart B. McKinney Homeless Assistance Act (P.L. 100-77) of 1987 (McKinney Act) was the first federal legislation to directly address the safety and well-being of individuals experiencing homelessness (Pavlakis and Duffield, 2017). In addition, the Housing Our People Effectively (HOPE): Ending Homelessness in San Mateo County, commonly referred to as the HOPE Plan, is a result of a lengthy process that began in 2005. The HOPE Plan lays out strategies designed to end homelessness within ten years (San Mateo County, Human Services Agency, 2015).

Santa Clara County

Santa Clara County conducts an annual county-wide Homeless Census and Survey. The 2015 Census and Survey found that there were 6,556 homeless individuals, and 4,627 of them reported being unsheltered, indicating that 71% of these individuals are living in their cars, encampment areas, abandoned buildings, or on the streets (County of Santa Clara, Office of Supportive Housing, 2015). In 2015, Santa Clara County published its Community Plan to End Homelessness, a roadmap to end homelessness over five years from 2015-2020 (County of Santa Clara, Office of Supportive Housing, 2015b).

In addition, Santa Clara County bolstered its crisis and homeless shelters countywide. In September 2015, the Santa Clara County Board of Supervisors issued a press release detailing its commitment to providing shelter for its homeless population. The board proposed an additional 585 beds to the existing 130, including hotel conversions, and support for veterans and families experiencing homelessness (Santa Clara County Board of Supervisors, 2015). As another example, Santa Clara County's County seat, the City of San Jose, implemented the county's first "Shelter Crisis" policy that allowed the suspension of certain safety, building, and health codes in publicly owned facilities as temporary shelters during extreme weather (Aubrey, 2016). In 2019, the City Council voted unanimously to expand the policy to operate every night, during the winter months, to assist the growing homeless population (Nguyen, 2021). The city operates the program, and the nonprofit HomeFirst manages the shelters. Since the policy's implementation during the 2015-2016 winter season, the program has had more than 3,000 residents (Nguyen, 2021).

City and County of San Francisco

Of the targeted counties, San Francisco had the highest population density of homeless people (7,539 individuals within 46.87 square miles) at the time of the 2015-2016 winter season (Table 1). San Francisco's response to the threats of El Niño weather emphasized providing support, housing, and emergency shelter for their homeless population. A press release issued by former Mayor Edwin M. Lee in December 2015 shared the city's mitigation strategies in preparation for El Niño weather conditions. These strategies focused on providing homeless people with shelter and supplies. An additional 1,100 beds were made available that winter, along with meals, blankets, and hygiene kits (San Francisco Health Network, 2015), and Pier 80 was converted to an emergency shelter that winter (City and County of San Francisco Port Commission, 2016). Lastly, Homeless Outreach Teams from Housing Services Agency conducted outreach to homeless populations about emergency shelters, coordinated with voluntary agency assistance, and provided additional support for people with access and functional needs (City and County of San Francisco Department of Emergency Management, 2017).

These county-wide comprehensive homeless population reports demonstrate Santa Clara County's, San Mateo County's, City and County of San Francisco's, and Sonoma County's efforts to account for and incorporate vulnerable populations into their overall county services. There is still, however, limited information available that indicates this data is widely used specifically for emergency planning.

ANALYSIS

Although there were some improvements made in providing emergency and crisis communication support during the 2015-2016 winter season, Santa Clara, San Mateo, San Francisco, and Sonoma counties fell short, which could be attributed to several varied factors. First, the 2015-2016 El Niño season did not materialize as expected in the Bay Area. Second, outreach to the targeted counties in this study did not yield the intended data or outcomes. Most staff who were contacted to be interviewed offered minimal information, most often pointing out resources available online. However, further research offered more information on the different ways the targeted counties approached public outreach, crisis communication, and vulnerable community support leading up to and during the 2015-2016 El Niño winter season.

2015-2016 El Niño Winter Results

Overall, the projected 2015-2016 El Niño winter season did not materialize in Santa Clara, San Mateo, Francisco, or Sonoma counties as anticipated. In the United States, El Niño-related impacts occur during the months of October through March (Halpert, 2014). California experienced overall average rainfall levels during the projected 2015-2016 El Niño winter season (Meyers, 2016). Rainfall amounts varied throughout the state; in the Bay Area and northern California, the total rainfall was average, whereas southern California was still gripped by drought conditions (Meyers, 2016). Flooding hazards in Santa Clara, San Mateo, San Francisco, and Sonoma counties were minor. However, **Table 3** illustrates that counties did experience higher than usual precipitation levels during the 2015-2016 projected El Niño winter season.

Table 3.- County Precipitation Data

County	Oct. 2015	Nov. 2015	Dec. 2015	Jan. 2016	Feb. 2016	Mar. 2016	Total Rainfall 2015-16 Winter Season	Average Annual Precipitation *
Santa Clara Actual	0.28in	3.33in	4.79in	7.73in	1.24in	7.73in	25.1in	-
Santa Clara Monthly Average	0.05in	2.42in	2.23in	4.09in	0.31in	3.96in	-	12.06 in
San Mateo Actual	0.10in	2.42in	5.94in	8.05in	1.23in	8.73in	26.47in	-
San Mateo Monthly Average	0.08in	1.80in	6.83in	7.03 in	1.51in	9.29 in	-	18.59in
San Francisco Actual	0.02in	1.66in	5.19in	7.46in	1.03in	7.20in	22.56in	-
San Francisco Monthly Average	0.09in	1.48in	4.61in	3.02in	3.25in	2.36in	-	18.36 in
Sonoma Actual	0.18in	2.01in	10.11in	12.73in	1.33in	12.23in	38.59in	-
Sonoma Monthly Average	0.09in	1.48in	7.01in	10.87in	0.74in	10.11in	-	31.80 in

Source: NOAA National Centers for Environmental Information Climate Science and Services Division

*Monthly Average and Annual Precipitation data collected from NOAA Climate Data Online NOW Datasets Summary of Monthly Totals: 2000-2022.

According to the NOAA National Center for Environmental Information Stores, Event Database, there was a storm series in January 2016 that produced heavy rainfall and minor flooding throughout the greater San Francisco Bay Area and Monterey Bay Area. The storm hit the region on Wednesday, January 6, 2016. The storm caused three distinct flooding events in San Francisco and Sonoma counties. In San Francisco, the California Highway Patrol reported several flooding events at the on and off ramps on U.S. Route 101, with water ranging from 1 to

3 feet deep. Flooding included Interstate-80 at 7th Street, Silver Ave, and South Van Ness Ave (National Centers for Environmental Information, 2020). According to the database, the storm caused coastal flooding southbound on U.S. Route 101 between State Route 1 and Marin City. In Sonoma County, the City of Sebastopol experienced flooding on Pleasant Hill Road at Mitchell Court, causing the roadway to completely flood (National Centers for Environmental Information, 2020). Even though the January 2016 storm series caused minor flooding, both San Francisco and Sonoma counties did not use IPAWS to issue any public alerts or warnings. Limited IPAWS implementation negatively impacted emergency communications in these two counties. Additionally, San Mateo County was in the process of finalizing its IPAWS alerting authority during this time, which meant that it could not send an IPAWS alert to its residents, even if warranted. Although no lives were lost, alerts could have increased trust in a public alert and warning system in the event of a more dire disaster.

IPAWS Alerting Authority Status During the 2015-2016 El Niño Winter Season

During the 2015-2016 El Niño winter season, Santa Clara, San Francisco, and Sonoma had official IPAWS alerting authority status. San Mateo County was the only jurisdiction that did not have official alerting authorization. Since the 2015-2016 El Niño winter season, however, San Mateo County has officially attained alerting authority status (Federal Emergency Management Agency, 2021b). Outreach to the targeted counties in this study did not yield the intended data or outcomes, as the profiled counties did not provide sufficient detail during initial survey requests, or subsequent requests for more information. However, further research has indicated that this can partially be attributed to the lack of prioritization or proper training resources available for alerting authorities (United States Government Accountability Office, 2020).

Since the 2015-2016 El Niño winter season, the United States Congress has enacted the Integrated Public Alert and Warning System Modernization Act, which focused on modernizing the system to ensure under all conditions, the President, federal agencies, and state, tribal, and local governments can use the system and alert the population on disasters, as well as the dissemination of timely and effective warnings (The Integrated Public Alert and Warning System Modernization Act, 2015). FEMA was directed to adapt and incorporate future technologies to ensure direct communication with the public and improve the ability of remote areas to receive alerts as well as promote local and regional partnerships to enhance community preparedness and response (The Integrated Public Alert and Warning System Modernization Act, 2015).

Despite FEMA's continual work to improve IPAWS, provide training resources, and integrate new alerting technologies, there continues to be a communications gap between alerting authorities and the public during disasters (United States Government Accountability Office, 2020). In 2020, the United State Government Accountability Office was asked to review the federal response to recent natural disasters, which included trends in IPAWS usage, and actions FEMA had taken to modernize IPAWS and increase its adoption (United States Government Accountability Office, 2020). Though FEMA continuously worked to improve IPAWS, the report found that FEMA did not document the next steps or plans that focused on educating or training alerting authorities on how to improve the usage of the alerting system (United States Government Accountability Office, 2020).

Public Communication and Outreach During the 2015-2016 El Niño Winter Season

To analyze the effectiveness of the targeted counties' outreach and communication, this research draws from region-wide strategic plans set in place in 2012 by the Bay Area Urban Areas Security Initiative (UASI), 3 years before the 2015-2016 El Niño winter season. This

research analyzed the targeted counties' 2015-2016 El Niño preparation and response by referring to the strategic plan established by the Bay Area UASI's framework. The Bay Area UASI's Emergency Public Information and Warning Strategic Plan for 2012-2017 (Bay Area Urban Areas Security Initiative, 2012) established guiding principles for Bay Area jurisdictions to consider when considering emergency and crisis communications. Key strategies that were identified in the plan are listed below:

- Agencies should increase communication exercises, training, and system testing to occur on a recurring, regular basis to assure smooth operations in the event of an emergency,

- Emergency public information should be integrated region-wide instead of jurisdiction or county-specific messaging,

- Public warning messages need to be pre-vetted, available in multiple languages, consistent across agencies, assume a low reading level, and have evidence-based messaging,

- To ensure that a maximum number of people see the message, emergency managers and PIOs must also take into consideration the needs of those with access and functional needs, to ensure that everyone has access to and can understand the message; and

- Messages need to be delivered across every platform to reach the most people. Relatedly, there needs to be ample funding prioritized for marketing, communication, and public education.

The guidelines established community engagement norms to implement region-wide, focusing on engaging residents through public awareness, education, and inclusion of those with access and functional needs, and limited English proficiency. Communicating emergency alerts and warnings to able-bodied English speakers is not an issue for most Bay Area counties.

However, vulnerable populations, such as those with access and functional needs, homeless people, and people with limited English proficiency, will be isolated from crisis communications (Bay Area Urban Areas Security Initiative, 2012, pg. 52-53). Building stronger relationships with nonprofits will help reach broader communities, particularly high-risk populations that are most likely to rely on nonprofit organization support. The Strategic Plan highlights that Collaborating Agencies Responding to Disasters (CARD) has successfully helped nonprofit organizations integrate public awareness, education, and emergency response training for their clients and staff (Bay Area Urban Areas Security Initiative, 2012).

Lastly, press releases and media coverage are invaluable resources for spreading awareness and are cost-free, especially when budget limitations hinder the successful implementation of the strategies listed above (Bay Area Urban Areas Security Initiative, 2018). The Strategic Plan offers public education templates, instructions for incorporating social media, television, radio, and mobile communication for different scenarios, recommendations for those with pets, those with access and functional needs, and lastly, messaging strategies. Given the priorities established in 2012, the four targeted counties did achieve some goals, but not all. The following sections will break down each county's response and communication plan.

Local governments have the primary responsibilities of pre- and post-disaster preparedness and recovery (Federal Emergency Management Agency, 2022b). Following this precedent, Santa Clara, San Mateo, and Sonoma counties relied on cities and their external partners to conduct community outreach efforts specifically to vulnerable populations for flood preparations during the 2015-2016 El Niño winter season. Counties did, however, lead efforts to better prepare and incorporate vulnerable populations into subsequent county flooding emergency planning.

Santa Clara County

Santa Clara County anticipated low to moderate flooding during the 2015-2016 El Niño winter storm season near Coyote Creek and Guadalupe River areas within the City of San Jose. Darrell Ray, Emergency Management Specialist at the Santa Clara County Office of Emergency Services, explained through an email conversation that while the county assisted cities and towns with flood preparedness, they did not specifically lead community outreach efforts. The 15 jurisdictions in Santa Clara County generally have their community initiatives and the county serves a coordinating role as the lead agency for the Operational Area, and as the official IPAWS agency (Darrell Ray, personal communication, October 6, 2016). The county primarily relied on the responsible parties, such as the county's flood control agency, Santa Clara Valley Water District, to engage in outreach efforts to engage the public in general flooding preparedness and to conduct more hands-on outreach to identified vulnerable populations (Kavita Narayan, personal communication, October 28, 2016).

In 2017, Santa Clara Valley Water District published a flood report that went into detail about its outreach campaign. The Santa Clara Valley Water District sent mailers, posted on social media, and participated in media interviews in anticipation of potential flooding (Santa Clara Valley Water District, 2017). However, at the time the report was published, the water district stated that the responsibility to issue an evacuation order lay with the City of San Jose. That same year, the Santa Clara Valley Water District and the City of San Jose adopted a joint Emergency Action Plan (EAP) to avoid communication failures going forward (Santa Clara Valley Water District, 2022). The joint EPA guides Santa Clara Valley Water District and the City of San Jose on how to communicate and make decisions during storm and flooding events (Santa Clara Valley Water District, 2022). The plan does not specifically mention any support or

guidance for supporting homeless populations, those with access and functional needs, or information regarding support for those with English as a second language. The water district defers to the City of San Jose for communicating directly with residents, which could explain why these specific populations were not called out in the joint EAP (Santa Clara Valley Water District, 2022).

Santa Clara County did not have a specific communications plan or annex targeting vulnerable populations (Darrell Ray, personal communication, October 6, 2016), but it did have the Flooding Annex that includes tips on how to work with vulnerable populations as part of their emergency operations plan (EOP) (County of Santa Clara County, Office of Emergency Services, 2017). Santa Clara County Office of Emergency Services, alongside Santa Clara County Public Health and Santa Clara County fire departments, developed a detailed Vulnerability Index based on the Social Vulnerability Index that was created by the Agency for Toxic Substance and Disease Registry (County of Santa Clara County, Office of Emergency Services, 2017). The goal of the index is to include social vulnerability in operational planning to better assess the locations and needs of vulnerable populations of Santa Clara County during the mitigation, preparedness, response, and recovery phases of an emergency and disaster. Additionally, the 2017 county EOP identifies health and social services included in the county's core capabilities, especially during the recovery phase of any disaster, and states that the Social Services Agency will collaborate with the American Red Cross to ensure shelters comply with the requirements in the Americans with Disabilities Act of 1990 (County of Santa Clara County, Office of Emergency Services, 2017).

Santa Clara County was the most notable example of a county that took into consideration the needs of its non-English speaking population, by providing messaging in

English, Spanish, Tagalog, Mandarin, and Vietnamese (Bay Area Urban Areas Security Initiative, 2018). Santa Clara County also worked closely with its county seat, the City of San Jose, to increase emergency shelters for those impacted by El Niño weather conditions (Aubrey, 2016). Considering that Santa Clara and San Francisco have the highest rates of foreign-born residents living in their counties, and the highest rates of languages other than English spoken at home, it demonstrates that these counties have more resources readily available to support these key vulnerable populations by providing collateral, resources, and information in multiple languages. Interestingly, San Mateo County has a sizable population (47.1%) that speaks a language other than English at home but does not offer quite as many resources in multiple languages (**Table 1**).

Sonoma County

Brent Blaser, the former Emergency Coordinator for the County of Sonoma Fire & Emergency Services, stated via an email conversation that even though the 2015-2016 El Niño winter season did not materialize, the county did facilitate a meeting to coordinate information between cities, departments, and other agencies to build overall situational awareness (Brent Blaser, personal communication, October 16, 2016). Blaser stated that Sonoma County Fire & Emergency Services, later renamed the Department of Emergency Management, relied on the National Weather Service to issue public alerts and warnings relating to flooding events. Sonoma County did, however, engage in community outreach efforts specific to flood preparedness and vulnerable populations, specifically the homeless population.

In 2015, the Sonoma County Board of Supervisors adopted the Homelessness Winter Weather Response Plan in preparation for the 2015-2016 El Niño winter season. The plan expanded services and public outreach efforts to minimize illness and death among the homeless

population during severe winter weather, including flooding (County of Sonoma, Board of Supervisors, 2015). A large majority of the county's homeless population settles along the banks of the Russian River (County of Sonoma, Board of Supervisors, 2015). The Russian River was expected to flood more than usual due to the forecasted 2015-2016 El Niño winter season (Brent Blaser, personal communication, October 16, 2016). Under this plan, the county would create a "Code Blue" advisory to the public which would be issued during periods when temperatures were projected to drop below 38 degrees Fahrenheit, and when heavy rainfall was expected, to help keep the homeless population safe (County of Sonoma, Board of Supervisors, 2015). The plan was developed for the 2015-2016 El Niño winter weather projections because of the 2014-2015 winter season flooding when the county experienced 5.9 inches of rain during 24 hours (Mason, 2014) in Healdsburg on December 10-12, 2014 (County of Sonoma Emergency Management, 2022). The advisory requests that homeless service agencies prepare and expand the number of beds and open warming facilities to proactively assist the homeless population (County of Sonoma, Board of Supervisors, 2015). The plan overall supports the Sonoma County Emergency Operations Plan shelter and care resources for the homeless population within the county (County of Sonoma, Board of Supervisors, 2015).

San Mateo County

San Mateo County, although not an official IPAWS alerting authority at the time of this research, made efforts to work with its residents, community-based organizations, and local jurisdiction. In September 2015, the San Mateo County Emergency Services Council (ESC) began discussing the countywide efforts to mitigate damages predicted by the El Niño winter season. Cities provided residents with sandbags, cleared drains in local roadways, and worked with CalTrans to clear drains within their jurisdictional boundaries (San Mateo County

Emergency Services Council, 2015). In January 2016, the ESC discussed communication and outreach strategies. The Sheriff's Office coordinated communication and messaging strategies to share within county jurisdictions, and used social media sites, particularly Nextdoor, to encourage more people to sign up for the then-new SMCAlert.

However, aside from the comments about rolling out IPAWS and SMCAlert, little information was shared about communicating directly with residents and community members. The lack of community engagement is reflected in the enrollment numbers. In January 2016, the San Mateo County Emergency Services Council rolled out SMCAlert and had an estimated 37,000 people register for notifications (Brian Molver, personal communication, October 28, 2016), which was 5% of the total county population (San Mateo County, Emergency Services Council, 2016). As of January 2021, that number is up from 5% to 14% (San Mateo County, Civil Grand Jury, 2021). Notably, the ESC did not debrief the El Niño weather event response following the 2015-2016 winter season, but the county did embark on updating/creating their Multi-Jurisdictional Hazard Mitigation Plan, which was released in 2017, and updated in 2021 (San Mateo County Executive Office, 2021).

Additionally, the San Mateo County Sheriff's Office did not make significant progress in several key strategies. Two key strategies - conducting communication exercises and CERT training sessions - did not occur during the 2015-2016 winter season (San Mateo County Sheriff's Office of Emergency Services, 2015b). Additionally, the San Mateo County Sheriff's Office of Emergency Services did not publish the county's Emergency Alert System Plan in a timely matter. As a result, the Emergency Alert System Plan, which had been in draft mode for over two years at that point, was transferred from the Sheriff's Office to the County Manager's Office in 2020 (San Mateo County, Civil Grand Jury, 2021).

Since the 2015-2016 projected El Niño winter season, San Mateo County has initiated projects and programs aiming to build resilient communities, including planning for vulnerable populations. In 2017, the San Mateo County Civil Grand Jury was surveyed to help law enforcement agencies fulfill their responsibility for protecting residents, including individuals with language barriers. The report concentrated on county regions where languages other than English were spoken by large groups of residents. These areas represent over 84% of residents who self-reported as not speaking English "very well," and reflect 72.6% of the county's overall population (San Mateo County, Civil Grand Jury, 2017). The cities of Daly City, East Palo Alto, Redwood City, San Bruno, City of San Mateo and South San Francisco, unincorporated areas of San Mateo County, and areas served by the Sheriff, which include Portola Valley, San Carlos, and Woodside, represent multilingual communities. As illustrated in **Table 4**, on average, 46.5% of the population in these areas speaks a second language other than English at home (San Mateo County, Civil Grand Jury, 2017).

Table 4.- 2016-2017 San Mateo Grand Civil Jury

City	Population	# of Individuals Speaking a Language Other Than English at Home				%
		Spanish	Chinese	Tagalog	Other	
Daly City	102,605	17,659	13,744	24,561	9,952	64.2%
East Palo Alto	28,597	14,931	267	204	2,832	63.8%
Redwood City	78,241	24,325	1,925	830	5,068	41.1%
San Bruno	41,581	8,354	2,638	2,699	5,455	46.0%
City of San Mateo	98,601	19,066	6,243	2,568	11,794	40.2%
South San Francisco	64,630	16,307	5,329	6,966	6,990	54.2%
Areas served by the Sheriff**	114,515	18,686	1,122	7,095	9,076	31.4%
Total	**528,770**	**119,328**	**31,268**	**44,923**	**51,167**	**46.5%**

Source: Chart from 2016-2017 San Mateo County Civil Grand Jury report, "English Is Not Our Only Language: Are Local Law Enforcement Agencies Providing Multilingual Access to Outreach Programs", 2017, p. 4.

*Areas include unincorporated San Mateo County as well as the cities and towns of Half Moon Bay, Millbrae, San Carlos, Portola Valley, and Woodside.

In January 2017, the San Mateo County Civil Grand Jury published a report that touched on the need to increase the county's social media presence and traditional media outreach, including newspapers, local access tv, and local businesses and residents in a variety of languages to reflect the population (San Mateo County Civil Grand Jury, 2021). In 2020, San Mateo County only outsourced translations in Spanish, compared to Santa Clara County which outsourced translations into Spanish, Tagalog, Mandarin, and Vietnamese (San Mateo County Civil Grand Jury, 2021). In addition, across San Mateo County special district partners, there is inconsistent use of social media, communication strategies, and platforms making it difficult to maintain consistent messaging strategies during an emergency (San Mateo County Civil Grand Jury, 2021).

Most recently, San Mateo County has successfully incorporated community engagement into its emergency preparedness planning, which can lead to a shared responsibility among

community members, and could build community resiliency. In March of 2021, San Mateo County's Office of Emergency Services launched a campaign to update the Multijurisdictional Local Hazard Mitigation Plan that incorporates the community's participation (San Mateo County Manager's Office, 2021). San Mateo County's Office of Emergency Services led the effort and actively coordinated with all county jurisdictions, regional special districts, and county departments to update the Multijurisdictional Local Hazard Mitigation Plan (San Mateo County Manager's Office, 2021). The Multijurisdictional Local Hazard Mitigation Plan is a regional and cross-jurisdictional effort to reduce risk from natural and man-made disasters, including earthquakes, flooding, extreme heat, and landslides. The plan assesses the county's hazard vulnerability and identifies actions to help jurisdictions mitigate the impacts, such as injuries, property damage, and community disruption (San Mateo County Manager's Office, 2021). The plan benefited from engaging and promoting their efforts in communities with higher counts of individuals with language barriers, such as East Palo Alto, the coast side, and north county, which will continue to assist in building community resiliency within vulnerable populations.

City and County of San Francisco

In the months leading up to the 2015-2016 winter season, San Francisco made substantial efforts to communicate with its residents to prepare for El Niño weather conditions. The San Francisco Department of Emergency Management's 2015 Annual Report offers details about the efforts to prepare residents for El Niño conditions. The department worked collaboratively with faith-based partners to ensure housing would be available for their homeless community during severe weather events (City and County of San Francisco, Department of Emergency Management, 2015). In addition, San Francisco also piloted its first-ever public information-focused exercise in which PIOs explored El Niño scenarios, which is congruent with the regional

strategies identified in 2012 (Bay Area Urban Areas Security Initiative, 2012). PIOs practiced collecting information, the verification process of received information, and dissemination to residents and businesses in the event of severe storms (City and County of San Francisco, Department of Emergency Management, 2015). Lastly, in December 2015, the San Francisco Port Commission authorized two temporary shelters located at Pier 80 Shed A and Pier 29 in anticipation of an El Nino winter season (City and County of San Francisco Port Commission, 2016). The Port Commission coordinated with the Human Services Agency and Public Works staff, as well as the non-profit HOPE SF, on community outreach efforts (City and County of San Francisco Port Commission, 2016).

Over the years, San Francisco has kept comprehensive data about seniors and adults with disabilities. The Older Americans Act (OAA) and the Older California Act require the San Francisco Department of Aging and Adult Services (DAAS) to conduct a community needs assessment every four years to determine the needs for services and programs (San Francisco Department of Aging and Adults Services, 2016). According to the 2016 DAAS report, Assessment of the Needs of San Francisco Seniors and Adults with Disabilities, 54% of San Francisco's population over the age of 60 years old speaks a primary language other than English (San Francisco Department of Aging and Adults Services, 2016). Of this population with limited English proficiency, 66% speak Chinese, 11% Spanish, 7% Russian, 5% Tagalog and 3% Vietnamese (San Francisco Department of Aging and Adults Services, 2016).

In addition, the city has approximately 35,145 residents between the ages of 18 and 59 who self-report having a disability (San Francisco Department of Aging and Adults Services, 2016). Half of this population reported having cognitive disabilities, which include memory, concentration, physical, mental, or cognitive problems (San Francisco Department of Aging and

Adults Services, 2016). It is important to note that the disability data provided by the DAAS is not complete and does not truly reflect all of San Francisco's disability populations as the data is on a self-reported basis (San Francisco Department of Aging and Adults Services, 2016). Stigma and cultural differences regarding physical and mental disabilities can affect the rates of self-reporting. Despite these limitations, the data can be interpreted as indicative of population trends and helps provide critical insight into San Francisco's vulnerable populations, and can be incorporated into the city's emergency planning. Although these efforts are positive changes, there is still a lot more that counties can do to incorporate vulnerable populations into emergency planning, for a more comprehensive and inclusive approach.

Emerging Technology and Social Media

The world of public alerts and warnings is a field that is constantly developing, and because of this, it is crucial for emergency managers and alerting authorities to stay abreast of changes in recent technologies and products available. With the availability of recent technological advances and media, such as social media, mobile phones, and personal devices like tablets, emergency managers and alerting authorities are now able to issue life-saving public alerts and warnings on current events, closing the communications gap during disasters. Technology will continue to evolve and benefit alerting capabilities for public alerts and warnings. Emerging technologies allow users to transmit emergency alerts and warnings through mobile devices with SMS messages, email, or other web-based platforms, including social media, and support different language needs (White, 2018; Titan Health & Security Technologies, 2018). However, one major disadvantage of these technologies is that counties and local agencies must have the ability to pay for these private sector services.

Social media can bridge the communication gaps with emergency managers, alerting authorities, and the public during a disaster. Social media provides widely used and easily accessible platforms such as Facebook, Twitter, and Nextdoor. These platforms offer effective, alternative communication channels that assist emergency managers and alerting authorities in communicating with the public. Social media has been proven to play a vital role in developing public alerts and warnings, increasing the speed at which public awareness is raised (Van den Hurk, 2013), and jumps geographical and cultural barriers. This feature allows people to connect, engage and share information on a global scale (Van den Hurk, 2013).

While research on social media, online networks, and crisis communications during disasters continues to grow, social media has changed the narrative during disasters. Social media has altered the ways that community members seek and share information before, during, and after a disaster. In the event of a disaster, the power of social media becomes apparent. For example, during Hurricane Sandy in 2012, social media was used as a driving source of public information (Van den Hurk, 2013). Like Twitter, Facebook offers emergency managers another communication platform to communicate with the public during a disaster. In 2014, Facebook debuted its Safety Check tool when Typhoon Ruby hit the Philippines (Metz, 2016).

Lastly, Nextdoor is a Facebook-style, hyper-local social network site for community members to communicate with their neighbors, local businesses, and government agencies on a variety of topics such as crime, safety, lost pets, resources/services, and emergencies (Shueh, 2014). In April of 2014, San Francisco partnered with Nextdoor to disseminate public alerts and warnings. The partnership was the first standalone partnership for Nextdoor with a municipal department of emergency management in the United States (Shueh, 2014). Local municipalities and jurisdictions often use Nextdoor to disseminate information and local alerts. Social media

can offer the first line of defense for communities leading up to, during, and after a disaster. This platform can serve as a channel for community members to access and activate bridging and linking ties, and in future disasters, accelerating life-saving communications, if used effectively (Page-Tan, 2021; Eriksson and Olsson 2016).

Social media is not a managed system, so disinformation can also be shared. While the crowd-sourcing nature of social media suggests that it would be self-correcting, the corrections take time, which can lead users to take incorrect actions. During disasters, disinformation can be life-threatening. For example, during the 2020 SCU fire, a social media user messaged readers to take a different route than that recommended by the fire department's messaging, and people were driven into the flames and fire lines (Edwards, et al. 2022). Therefore, public agencies must have a robust social media monitoring program to quickly correct misinformation.

However, not everyone has equal access to, or the ability to use social media. Page-Tan (2021) investigated the associations between measures of bonding, bridging, and linking social capital and rates of hyper-local communications through social media in the 2014 Napa Valley Earthquake. Page-Tan found that communities that had existing social ties were more likely to engage in Nextdoor's platform in times of disasters and normalcy. In this study, social capital was defined as capturing the "networks, norms, and social trust that facilitate cooperation for mutual benefit (Page-Tan, 2021)". In many cases, people and communities with strong social capital benefit more during a disaster and experience higher levels of community support as compared to people and communities with weak or no social capital (Page-Tan, 2021; Palen and Anderson, 2016; Desmond and An, 2015). The correlation between social capital and access to social media provides insight into the role social media plays during a disaster. As social media continues to become more popular, emergency managers and alerting authorities continue to

examine and identify different social media platforms as instrumental communication tools during a crisis. Social media offers a means for community members and government agencies to communicate and receive critical information at every stage of a disaster (Page-Tan, 2021).

Social media continues to change the landscape of emergency management and crisis communication during disasters, and several natural disasters, like Hurricane Sandy and the Napa Valley Earthquake, proved to be a vital source of critical, life-saving information. Like many recent technologies, there is always a risk with social media. Social media can be unpredictable, misleading, and often outpace real-time updates (Page-Tan, 2021; Guskin, 2012). Social media is an open and fast-moving environment. During Hurricane Sandy, some widely shared information turned out to be false or misleading (Guskin, 2012). Over time, social media has become an integral part of society, connection, and communication, and emergency management organizations continue to evolve their communication plans to support the changing communication needs, namely by incorporating social media into emergency plans, and PIO checklists.

Social media has become woven into the cultural fabric of society and has the capacity to act as a bridge between emergency managers and the public, which should encourage emergency managers to shift their communications plans to meet the changing needs of society (Guskin, 2012; Eriksson and Olsson 2016; McMillan and Lorion 2020). However, efforts to control social media's constant flow of information is a daunting task. The use of the internet to disseminate information will not meet the needs of everyone, but neither will traditional methods. Traditional methods, as highlighted in many of the case studies offered in this report, have routinely left vulnerable populations feeling abandoned, lost, or forgotten, and social media can provide an additional outlet for information and support. Incorporating social media into emergency

planning and crisis communications has become an effective and efficient way to save lives and build resiliency in communities that have access to technology to receive messages. The National Incident Management System Basic Guidance for PIOs (Federal Emergency Management Agency, 2020) offers detailed guidance on ways to incorporate social media communication into emergency planning, signaling its importance in crisis communications.

However, it must be noted that social media is dependent on technologies that have failed in disasters. Few communities have telephone landlines anymore, and voice-over internet protocol (VOIP) systems require power and internet service. During the CZU fire in 2020, many mountain communities in Santa Cruz County were without power due to the widespread destruction of the local power grid. Cell towers burned down, and radio repeaters were destroyed. Communities were left with only amateur radio as a means for getting information about unfolding events (Edwards, et al., 2022). Thus, successful emergency messaging requires layering and redundancy to ensure that the community is served.

Santa Clara, San Mateo, San Francisco, and Sonoma counties' emergency operation plans all identified using social media as public awareness and crisis communication tools; however, counties should take into consideration that poor, homeless, immigrant, and non-English-speaking communities may still not be able to access technology-based messaging from social media, suffering the same barriers as they do with traditional media.

Since social media is an open-source system, community members can also post information, which may be incorrect, misleading, and dangerous. Social media has transformed the public relations industry from a top-down into a two-way street, forever altering how news is reported on. However, as illustrated by San Mateo County's PIO Checklist (Brian Molver, personal communication, October 28, 2016), emergency management organizations are actively

monitoring social media for false or misleading information shared online. Despite these efforts, however, language barriers, accessibility issues, and economic barriers remain.

Shared Responsibility and Community Capacity Building for Crisis Communication

Despite the benefits of using social media for crisis communications, vulnerable populations still struggle to access social media, and some researchers argue that there is too much emphasis placed on the importance of social media (Palen and Anderson, 2016; Eriksson and Olsson, 2016), particularly when there are many who do not have reliable access to the internet. Scholars are continuously analyzing social media as a useful social sensing tool for strengthening situational awareness in community disaster resiliency (Wang et al., 2019). Research has found that prioritizing social media for crisis communications during disasters adds complexity to the dissemination of information (Samuels, 2020). The digital divide has largely been attributed to social inequality between communities that have access to technology and the internet and those that do not have reliable access to the same resources. (Samuels, 2020). In many cases, communities of lower socioeconomic groups are more likely to lose internet access due to power outages. Many of these community members use free Wi-Fi hotspots located in public places, such as places of employment or cafes; however, these hotspots are not reliable or even available during a disaster (Samuels, 2020).

Government agencies use public communication as a platform to educate and inform about natural hazard risks, such as floods, fires, and earthquakes, that are geared to help communities understand the importance of, and how to, prepare for emergency events (Johnston et al., 2020). In many cases, community members do not prepare for emergencies until a disaster is present, even if they are aware of the imminent potential risk (Johnston et al., 2020).

Communication plays a key role during emergencies, crisis preparedness, and response (Johnston et al., 2020). Sharing information allows for transparent governance and results in increased trust, support, and overall positive sentiments from community members. Public mistrust in government is a well-documented phenomenon, and it impacts how the public perceives public communication, making it imperative to build a strong relationship between the public and governmental agencies before a disaster occurs (French, 2011; Baer et al., 2019).

To build trust and increase the effectiveness of crisis communications, there must be a shared sense of responsibility between government agencies and members of the community; historically, communities have been characterized as passive receivers of government communications (Johnston, 2020; Nowell and Boyd, 2010). In this context, shared responsibility means that the local government and community members (individuals, households, communities, businesses, etc.) are equal partners in disaster preparedness. Shared responsibility in the prevention, preparation for, response to, and recovery from natural disasters guides the message strategy for preparedness communication across government agencies for community members (Johnston et al., 2020; Nowell and Boyd, 2010). Although shared responsibility is not always equal or balanced, it takes advantage of all levels in building resilience within communities (Johnston, 2020; Chari et al., 2019). The ability to connect emergency managers and alerting authorities to communities as they manage disasters, communicate, and work with each other shifts the power and responsibility back to community members, who also need to do their share of emergency preparedness for disasters.

Building capacity for community disaster resilience requires integrating and coordinating the skills and perspectives of diverse stakeholders, which include businesses, residents, vulnerable populations, and subject matter experts (Wells et al., 2013). Governments need to

emphasize the importance of community engagement to facilitate shared responsibility; for residents to take responsibility for their preparedness and safety during disasters. Research has shown that strong communication and cooperation are key factors in disaster response (Hoffman, 2010; Oliver-Smith, 1999; Casagrande et al., 2015; Faas, 2017). A local agency's ability to engage the communities they serve, in the process of building risk communication strategies, before a disaster, has been shown to be more successful than other passive mitigation strategies in building disaster preparedness (Prior and Eriksen, 2013; Palen and Liu, 2007).

In many cases, preparedness communication is simply informational, characterized as a one-way communication platform, with limited opportunity for community feedback or input. (Johnston et al., 2020). The ability of public communication and public agencies to build stronger social networks, a sense of community, and a sense of shared responsibility increases the effectiveness of disaster communication. When individual residents have a sense of shared responsibility for their safety, crisis communications become more effective. While the role of crisis communication is crucial to a community's ability to anticipate, respond to and withstand a disaster, the sense of community responsibility is central to how residents or communities anticipate, understand, prepare for, and respond to disasters.

Community preparedness is supported by effective communication that helps residents build the capacity and resilience to be prepared, and provides a reflection of risks associated with hazards (Johnston et al., 2020). Various stakeholders participate in emergency communications, which include levels of government, emergency services, non-profits, and community organizations. However, research shows (Brown and Westaway, 2011) that limited community involvement can be detrimental to crisis communication. Brown and Westaway (2011) state that disaster-related resources extend beyond the public sector communication system (often

characterized by its one-directional platform), and should include people, community support, equipment, materials, and supplies available at the community level.

San Mateo County has successfully incorporated community engagement in its emergency preparedness planning and that can lead to a shared responsibility among community members in the event of future emergencies. In March of 2021, San Mateo County's Office of Emergency Services launched a campaign to update the Multijurisdictional Local Hazard Mitigation Plan that incorporates the community's participation throughout most of its eight phases. Community participation includes public input and feedback, and the use of ArcGIS StoryMap—an evolving and interactive virtual mapping software that incorporates maps, text, photos, and videos submitted by the public (San Mateo County, County Manager's Office, 2021). San Mateo County's Office of Emergency Services led the effort and is actively coordinating with all county jurisdictions, regional special districts, and county departments to update the Multijurisdictional Local Hazard Mitigation Plan. The project was completed in September of 2021, and the plan ensures that the county and its partners remain eligible for pre- and post-disaster mitigation project grant funding from FEMA's Hazard Mitigation Assistance programs and the new Building Resilient Infrastructures and Communities (BRIC) program. San Mateo County's efforts are a great example of a local government entity supporting community engagement and promoting shared responsibility among its residents.

Most recently, San Mateo County, Santa Clara County Fire Department, and the City and County of San Francisco partnered with Zonehaven, a third-party software that outlines neighborhoods within participating jurisdictions into evacuation zones (Wynkoop, 2021). Zonehaven offers real-time updates, and evacuation routes and allows local emergency services to alert the public about imminent emergencies impacting their neighborhoods through

emergency alert notifications and social media platforms (Wynkoop, 2021). San Mateo was one

of the first to partner with Zonehaven's platform (Wynkoop, 2021). During the 2020 CZU

Lighting Complex fire, San Mateo and Santa Cruz counties used the software that resulted in the

evacuation of more than 70,000 residents (Wynkoop, 2021).

CONCLUSION

Despite the overwhelming predictions, the 2015-2016 El Niño winter weather did not materialize as anticipated, causing no catastrophic flooding events. Santa Clara County, San Mateo County, City and County of San Francisco, and Sonoma County operate their own public alert and warning systems, but only Santa Clara, San Francisco, and Sonoma counties had official IPAWS Alerting Authority status during the 2015-2016 winter season. San Francisco and Sonoma experienced minor flooding events, however, IPAWS was not used to issue public alerts or warnings. Counties relied on outside organizations, such as their respective municipalities or faith-based organizations, to engage in community outreach efforts but counties did, to a certain extent, incorporate vulnerable populations into their emergency planning.

Santa Clara County developed a detailed Vulnerability Index based on the Social Vulnerability Index that was created by the Agency for Toxic Substance and Disease Registry that better assesses the locations and needs of vulnerable populations before, during, and after a disaster for all county jurisdictions.

Sonoma County created a Homelessness Winter Weather Response Plan in preparation for the 2015-2016 El Niño winter season, expanding services and public outreach efforts to minimize illness and death among the homeless population during severe winter weather, by partnering with local homeless shelters to increase beds and resources in the community.

Additionally, all four counties produce a comprehensive homeless point-in-time survey every two years accounting for their homeless populations, which provides ample data for future opportunities to meaningfully address the homeless population and their needs in emergency planning.

San Francisco's Department of Aging and Adult Services conduct a community needs assessment every four years to determine the needs for services and programs, including vulnerable populations. However, it is important to note that San Francisco's Department of Aging and Adult Services community needs assessment does not determine the need for emergency response.

All these plans offer critical insight into their vulnerable populations and how to better assess their needs for social services that could be incorporated into emergency planning efforts.

As the systems of public alerts and warnings continue to develop, emergency managers and alerting authorities must stay abreast of changes in new technologies and products available to better incorporate alerts and warnings for all populations. Although emerging technology and social media offer emergency managers and alerting authorities the ability to bridge the communication gap during disasters, there needs to be a balance that will attempt to incorporate as many residents as possible and vulnerable populations to create resilient communities and begin to truly close the communication gap.

Future research should further analyze vulnerable populations, specifically those who are homeless, non-English speaking individuals, and those with access and functional needs. Particularly, future research should focus on the correlation between social media activity of vulnerable populations before, during, and after a disaster, and further examine the barriers and limitations for these populations. Research from the past decade has revealed that vulnerable populations typically use social media less than the general public during a disaster (Samuels, 2020).

An additional opportunity for future research is to explore the factors that contribute to certain populations being overrepresented on social media during a disaster. The absence of

representation of vulnerable populations on social media during disasters is concerning and

should be accounted for and planned for during disaster preparations and planning.

Lastly, as counties continue to expand their outreach and communication efforts to

include web-based platforms and social media services such as Zonehaven, future research could

explore the effectiveness of these platforms, and how successfully they are integrated into

emergency planning; and study the rate of use among residents in the identified hazard potential

zones.

References

Aubrey, R. (2016, February 19). San Jose's "Shelter Crisis" policy for the homeless makes an impact. *San José Spotlight*. Retrieved January 2021, from: https://www.sanjoseinside.com/opinion/san-joses-shelter-crisis-policy-for-homeless-makes-an-impact/

Alexander, D. (2020, February 22). Three Years Later, Coyote Creek Flood Victims Still Fighting for Justice. *San José Spotlight*. Retrieved May 2021, from: https://sanjosespotlight.com/three-years-later-coyote-creek-flood-victims-still-fighting-for-justice/

Baer, R. D., Weller, S. C., & Roberts, C. (2019). The role of regional cultural values in decisions about hurricane evacuation. *Human Organization*, *78*(2), 133-146. https://doi.org/10.17730/0018-7259.78.2.133

Ballen, D. (2009, March). *Vulnerable Populations*. Federal Emergency Management Agency. Retrieved 2017, from: https://training.fema.gov/hiedu/docs/ballen%20-%20vulnerable%20populations.pdf

Bay Area Urban Areas Security Initiative. (2018). *Public Information & Warning Mass Notification Seminar Summary Report*. Constant Associates. http://bayareauasi.org/sites/default/files/resources/MassNotification-Seminar_Summary_Final.pdf

Bay Area Urban Areas Security Initiative. (2012). *Bay Area Emergency Public Information and Warning Strategic Plan.* Bay Area Urban Areas Security Initiative. http://bayareauasi.org/sites/default/files/resources/Bay%20Area%20UASI%20EPIW%20Strategic%20Plan_0.pdf

Benavides, D. A. (2013). Four major disaster occurrences and the Spanish language media: a lack of risk communication. *Disaster Prevention and Management*, *22*(1), 29–37. https://doi.org/10.1108/09653561311301952

Brady, M. (2014, June 17). Obstacles to Promoting Emergency Preparedness & Community Awareness. *PA TIMES Online*. Retrieved 2017, from: https://patimes.org/obstacles-promoting-emergency-preparedness-community-awareness/

Brinson, S. (2009). CONELRAD on the front line of Cold War defense. *Media, War & Conflict*, *2*(3), 339-357. https://doi.org/10.1177/1750635209345200

Brown, K. & Westaway, E. (2011). Agency, capacity, and resilience to environmental change: Lessons from human development, well-being, and disasters. *Annual Review of Environment and Resources*, *36*(1), 321–342. https://doi.org/10.1146/annurev-environ-052610-092905

California Governor's Office of Emergency Services. (2018). *California State Hazard Mitigation Plan.* State of California. https://www.caloes.ca.gov/office-of-the-director/operations/recovery-directorate/hazard-mitigation/state-hazard-mitigation-planning/

California Governor's Office of Emergency Services. (2015). *California Emergency Services Act 8550 California Government Code*. State of California. https://www.caloes.ca.gov/wp-content/uploads/Legal-Affairs/Cal-OES-Yellow-Book.pdf

California Governor's Office of Emergency Services. (2016). *California Public Alert and Warning Plan.* State of California. http://calalerts.org/documents/calpaws/01California-State-Warning-Plan.pdf

Casagrande, D.G., McIlvaine-Newsad, H., & Jones, E. C. (2015). Social networks of help-seeking in different types of disaster responses to the 2008 Mississippi River floods. *Human Organization*, *74*(4), 351–361. https://doi.org/10.17730/0018-7259-74.4.351

City and County of San Francisco Department of Emergency Management. (2014). *Hazard Mitigation Plan: An element of the CCSF Emergency Management Program.* City and County of San Francisco. https://sfdem.org/sites/default/files/FileCenter/Documents/2474-CCSF%202014%20HMP%20redacted.pdf

City and County of San Francisco Department of Emergency Management. (2015). *2015 Annual Report.* City and County of San Francisco. https://sfdem.org/sites/default/files/Documents/2015%20SFDEM_Annual_Report_Final.pdf

City and County of San Francisco Department of Emergency Management. (2016). *Emergency Response Plan: Winter Storm & Flood Annex A Hazard-Specific Response Plan.* City and County of San Francisco. https://sfdem.org/sites/default/files/Winter%20Storm%20and%20Flood%20Annex%20200160818%20Final.pdf

City and County of San Francisco Department of Emergency Management. (2017). *Emergency Response Plan ESF #2: Communications Annex.* City and County of San Francisco. https://sfdem.org/ftp/uploadedfiles/DEM/PlansReports/ESF2-Communications.pdf

City and County of San Francisco Department of Homelessness and Supportive Housing. (2015). *San Francisco Homeless Point-In-Time Count & Survey Comprehensive Report 2015.* Applied Survey Research. https://hsh.sfgov.org/wp-content/uploads/2016/06/2015-San-Francisco-Homeless-Count-Report_0-1.pdf

City and County of San Francisco Port Commission. (2016). *Minutes of the Meeting April 12, 2016.* City and County of San Francisco. https://sfport.com/sites/default/files/Executive/Docs/Commission/Minutes/M04122016.pdf

Chari, R., Petrun Sayers, E. L., Amiri, S., Leinhos, M., Kotzias, V., Madrigano, J., Thomas, E. V., Carbone, E. G., & Uscher-Pines, L. (2019). Enhancing community preparedness: an inventory and analysis of disaster citizen science activities. *BMC Public Health*, *19*(1), 1356–1356. https://doi.org/10.1186/s12889-019-7689-x

Collins, M., Hynes, W., & Madden, M. (2016). Communication in a disaster - the development of a crisis communication tool within the S-HELP project. *Journal of Decision Systems*, *25*(sup1), 160–170. https://doi.org/10.1080/12460125.2016.1187392

County of Santa Clara, Office of Emergency Services. (2017). *Flood Annex: Hazard-Specific Annex to the County of Santa Clara Emergency Operations Plan*. County of Santa Clara. https://emergencymanagement.sccgov.org/sites/g/files/exjcpb261/files/For%20Partners/2018-02-01%20Flood%20Annex%20Submittal%20Draft.pdf

County of Santa Clara, Office of Supportive Housing. (2015a). *Santa Clara County Homeless Point-In-Time Census and Survey: 2015 Comprehensive Report*. Applied Survey Research. https://news.sccgov.org/sites/g/files/exjcpb956/files/SantaClaraCounty_HomelessReport_2015_FINAL.pdf

County of Santa Clara, Office of Supportive Housing. (2015b). *Community Plan to End Homelessness*. Destination: Home. County of Santa Clara.

https://osh.sccgov.org/sites/g/files/exjcpb671/files/Community%20Plan%20to%20End%20Homelessness%20in%20Santa%20Clara%20County.pdf

County of Santa Clara Office of Emergency Management. (2017). *County of Santa Clara Emergency Operations Plan.* County of Santa Clara. https://emergencymanagement.sccgov.org/sites/g/files/exjcpb261/files/For%20Partners/Santa-Clara-County-OES-Emergency-Operations-Plan-2017-01_0.pdf

County of Sonoma, Administrator's Office. (2022). *Sonoma County Emergency Operations Plan first in the state to incorporate cultural competency* [Press release]. https://sonomacounty.ca.gov/sonoma-county-emergency-operations-plan-first-in-state-to-incorporate-cultural-competency-x116612#:~:text=Santa%20Rosa%2C%20CA%20%E2%80%93%20March%2022,state%20to%20incorporate%20cultural%20competency

County of Sonoma, Board of Supervisors. (2015). *County Activates Cold Weather Response: The "Code Blue" advisory calls for expanded shelter beds and warming facilities.* [Press release]. https://sonomacounty.ca.gov/Board-of-Supervisors/Press-Releases/2015/County-Activates-Cold-Weather-Response-December-13-2015/

County of Sonoma, Community Development Commission. (2015). *Sonoma County Homeless Point-In-Time Census & Survey Comprehensive Report 2015*. Applied Survey Research. https://sonomacounty.ca.gov/Main%20County%20Site/General/Sonoma/Sample%20Dept/Divisions/Housing%20Authority/Services/A%20Service/_Documents/SonomaCounty_HomelessReport_2015-10%2029%2015.pdf

County of Sonoma, Community Development Commission. (2019). *Sonoma County Homeless Point-In-Time Census & Survey Comprehensive Report 2019*. Applied Survey Research. https://sonomacounty.ca.gov/Main%20County%20Site/General/Sonoma/Sample%20Dept/Divisions/Housing%20Authority/Services/A%20Service/_Documents/2019HIRDReport_SonomaCounty%20071119.pdf

County of Sonoma, Emergency Management. (2022). *Sonoma County - Emergencies and*

Disasters Since 2002. County of Sonoma. https://sonomacounty.ca.gov/administrative-

support-and-fiscal-services/emergency-management/organization/emergency-operations-

center/recent-events

County of Sonoma Fire and Emergency Services Department. (2017). *2016 Sonoma County*

Operational Area Hazard Mitigation Plan. County of Sonoma.

https://sonomacounty.ca.gov/PRMD/Long-Range-Plans/Hazard-Mitigation/

Desmond, M., & An, W. (2015). Neighborhood and network disadvantage among urban renters.

Sociological Science, *2*, 329-350. https://doi.org/10.15195/v2.a16

Doerfel, M. L., Lai, C. H., & Chewning, L. V. (2010). The evolutionary role of

interorganizational communication: Modeling social capital in disaster contexts. *Human*

Communication Research, *36*(2), 125–162. https://doi.org/10.1111/j.1468-

2958.2010.01371.x

Edwards, F., Liu, K., Hughes, A., Gao, Z., Goodrich, D., Barner, A., and Herrera, R. (2022). *Best*

Practices In Disaster Public Communications: State Of The Practice In Communicating

Information, Building Trust And Compelling Action, Using Traditional And Social

Media; And Developing A Cell Phone App. San Jose, CA: Mineta Transportation

Institute. In press.

Eriksson, M., & Olsson, E. K. (2016). Facebook and Twitter in crisis communication: a

comparative study of crisis communication professionals and citizens. *Journal of*

Contingencies and Crisis Management, *24*(4), 198-208.

https://doi.org/10.1111/1468-5973.12116

Faas, A. J. (2017). Enduring cooperation: time, discipline, and Minga practice in

disaster-induced displacement and resettlement in the Ecuadorian Andes. *Human*

Organization, *76*(2), 99–108. https://doi.org/10.17730/0018-7259.76.2.99

Federal Communications Commission. (2022). Wireless Emergency Alerts (WEA). Federal

Communications Commission. https://www.fcc.gov/consumers/guides/wireless-

emergency-alerts-wea

Federal Emergency Management Agency. (2015a). *Emergency Alert System.* United States

Department of Homeland Security.

https://www.fema.gov/emergency-managers/practitioners/integrated-public-alert-warning-system/public/emergency-alert-system

Federal Emergency Management Agency. (2015b). *The Evolution of Public Emergency Broadcasting.* United States Department of Homeland Security. https://www.fema.gov/pdf/emergency/ipaws/ipaws_the_evolution_of_emergency_broadcasting.pdf

Federal Emergency Management Agency. (2017). *Alerting Authorities*. United States Department of Homeland Security. https://www.fema.gov/emergency-managers/practitioners/integrated-public-alert-warning-system/public-safety-officials/alerting-authorities

Federal Emergency Management Agency. (2020). *National Incident Management System Basic Guidance for Public Information Officers.* United States Department of Homeland Security. https://www.fema.gov/sites/default/files/documents/fema_nims-basic-guidance-public-information-officers_12-2020.pdf

Federal Emergency Management Agency. (2021a). *Integrated Public Alert & Warning System*. United States Department of Homeland Security. https://www.fema.gov/emergency-managers/practitioners/integrated-public-alert-warning-system

Federal Emergency Management Agency. (2021b). *Alerting Authorities*. United States Department of Homeland Security. Retrieved April 3, 2021, from: https://www.fema.gov/emergency-managers/practitioners/integrated-public-alert-warning-system/public-safety-officials/alerting-authorities

Federal Emergency Management Agency. (2022a). *Wireless Emergency Alerts*. United States Department of Homeland Security. https://www.fema.gov/emergency-managers/practitioners/integrated-public-alert-warning-system/public/wireless-emergency-alerts

Federal Emergency Management Agency. (2022b). *Local Disaster Recovery Managers Responsibilities.* United States Department of Homeland Security. https://www.fema.gov/emergency-managers/national-preparedness/frameworks/community-recovery-management-toolkit/recovery-planning/local-disaster-recovery-managers-responsibilities

Federal Signal Corporation. (2013). Emergency Communication Challenges: New Technologies

    Address Obstacles. *PA Times Online.* Retrieved 2017, from:

    https://patimes.org/emergency-communication-challenges-technologies-address-

    obstacles/

Fothergill, A. & Peek, L. A. (2004). Poverty and disasters in the United States: A review of

    recent sociological findings. *Natural Hazards (Dordrecht)*, *32*(1), 89–110.

    https://doi.org/10.1023/B:NHAZ.0000026792.76181.d9

French, E. P. (2011). Enhancing the legitimacy of local government pandemic influenza planning

    through transparency and public engagement. *Public Administration Review*, *71*(2),

    253-264. https://doi.org/10.1111/j.1540-6210.2011.02336.x

Gin, L., Levine, C. A., Canavan, D., & Dobalian, A. (2022). Including homeless populations in

    disaster preparedness, planning, and response: A toolkit for practitioners. *Journal of*

    Public Health Management and Practice, *28*(1), E62-E72.

    https://doi.org/10.1097/PHH.0000000000001230

Gowan, M. E., Sloan, J. A., & Kirk, R. C. (2015). Prepared for what? Addressing the disaster

    readiness gap beyond preparedness for survival. *BMC Public Health*, *15*(1), 1139–1139.

    https://doi.org/10.1186/s12889-015-2440-8

Guskin, E. (2012, November 6). *Hurricane Sandy and Twitter*. Pew Research Center.

    https://www.pewresearch.org/journalism/2012/11/06/hurricane-sandy-and-twitter/

Halpert, M. (2014, June 12). United States El Niño Impacts. *ENSO Blog,* National

    Oceanic and Atmospheric Administration.

    https://www.climate.gov/news-features/blogs/enso/united-states-el-ni%C3%B1o-

    impacts-0

Hoffman, S. (2010). Of increasing concern: Disaster and the field of anthropology. *Anthropology*

    News (Arlington, Va.), *51*(7), 3–4. https://doi.org/10.1111/j.1556-3502.2010.51703_2.x

Integrated Public Alert and Warning System Modernization Act of 2015, Publ. L. No. 114-143

    (2015). https://www.congress.gov/bill/114th-congress/senate-bill/1180

Johnston, K. A., Taylor, M., & Ryan, B. (2020). Emergency management communication: The

    paradox of the positive in public communication for preparedness. *Public Relations*

    Review, *46*(2), 101903. https://doi.org/10.1016/j.pubrev.2020.101903

Kapucu, N. (2008). Collaborative emergency management: better community organising, better

public preparedness and response. *Disasters*, *32*(2), 239–262.
https://doi.org/10.1111/j.1467-7717.2008.01037.x

Kasler, D. (2015, September 15). Forecasters see 95% chance of El Niño this winter. *The Sacramento Bee*. Retrieved 2017, from:
https://www.sacbee.com/news/california/water-and-drought/article34656051.html

Kruger, J., Hinton, C., Sinclair, L. B., & Silverman, B. (2018). Enhancing individual and community disaster preparedness: Individuals with disabilities and others with access and functional needs. *Disability and Health Journal*, *11*(2), 170–173.
https://doi.org/10.1016/j.dhjo.2017.12.005

L'Heureux, M. (2014, May 5). *What is the El Niño–Southern Oscillation (ENSO) in a nutshell?* National Oceanic Atmospheric Administration.
https://www.climate.gov/news-features/blogs/enso/what-el-ni%C3%B1o%E2%80%93southern-oscillation-enso-nutshell

Mason, C. (2014). Significant flooding in central Healdsburg (w/video). *The Press Democrat.* Retrieved 2020, from https://www.pressdemocrat.com/article/news/significant-flooding-in-central-healdsburg-w-video/

McMillan, & Lorion, R. P. (2020). Sense of community, pathway to, or bridge from alienation? *Journal of Community Psychology*, *48*(6), 1706–1714. https://doi.org/10.1002/jcop.22406

Metz, C. (2016, November 10). The Inside Story of How Facebook Is Transforming Disaster Response. *Wired.* Retrieved 2017, from: https://www.wired.com/2016/11/facebook-disaster-response/

Meyers, R. (2016, March 7). Is El Niño Finally Ending California's Drought? *The Atlantic*. Retrieved 2017, from:
https://www.theatlantic.com/science/archive/2016/03/rain-bay-area-el-nino-california-drought/472482/

Moroney, P., Knepper, H. J., & Godfrey, C. J. (2013, April 12). The New Emergency Alert A-Z: From Amber Alerts to Zombie Apocalypse. *PA Times Online*. Retrieved 2017, from: https://patimes.org/emergency-alert-a-z-amber-alerts-zombie-apocalypse/

Mullenix, E. (2015, September 22). The Role of Local Officials in Emergency Management. *PA Times Online*. Retrieved 2017, from:
https://patimes.org/role-local-officials-emergency-management/

National Centers for Environmental Information. (2020). *Stores Events Database* [Data set].
National Oceanic Atmospheric Administration.
https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=ALL&beginDate_mm
=01&beginDate_dd=01&beginDate_yyyy=2016&endDate_mm=12&endDate_dd=30&e
ndDate_yyyy=2016&county=SAN%2BFRANCISCO%3A75&hailfilter=0.00&tornfilter
=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

National Centers for Environmental Information. (2022). *U.S. Monthly Climate Normals
(1981-2010).* National Oceanic and Atmospheric Administration.
https://www.ncei.noaa.gov/access/metadata/landing-
page/bin/iso?id=gov.noaa.ncdc:C00822

National Weather Service. (2016, May 13). *2015 Flash Flood/River Flood Fatalities*. National
Oceanic Atmospheric Administration.
https://www.weather.gov/media/hazstat/flood15.pdf

NBC Bay Area. *El Niño Preps: Santa Clara Co. Spends $90M on Flood Protection* [Video file].
(2015, October 26). Retrieved from https://www.nbcbayarea.com/on-air/as-seen-on/el-
nino-preps_-santa-clara-co_-spends-_90m-on-flood-protection_bay-area/124920/

Nguyen, T. (2021, December 17). Where can San Jose residents warm up this winter? *San José
Spotlight.* Retrieved 2021, from: https://sanjosespotlight.com/where-can-san-jose-
homeless-residents-warm-up-this-winter-overnight-warming-shelters/

National Centers for Environmental Information. (2022) Climate Data NOW Online Datasets
Summary of Monthly Precipitation Totals: 2000-2022 [Data set]. National Oceanic and
Atmospheric Administration. https://www.weather.gov/wrh/Climate?wfo=mtr

Nowell, B. & Boyd, N. (2010). Viewing community as responsibility as well as resource:
deconstructing the theoretical roots of psychological sense of community. *Journal of
Community Psychology*, *38*(7), 828–841. https://doi.org/10.1002/jcop.20398

Oak Ridge Associated Universities. (2014). *The Integrated Public Alert and Warning System:
Current Practices and Perceptions of California Jurisdictions*. Report prepared for The
California Governor's Office of Emergency Services.
http://calalerts.org/documents/calpaws/Attachment-I-2014-IPAWS-Adoption-Study.pdf

Oliver-Smith, A. (1999). What is a Disaster? Anthropological Perspectives on a Persistent

Question. In S. Hoffman & A. Oliver-Smith (Eds.), *The Angry Earth: Disaster in Anthropological Perspective* (pp. 18-34). Routledge.

Page-Tan, C. (2021). An analysis of social media use and neighbor-assisted debris removal in Houston following Hurricane Harvey. *International Journal of Disaster Risk Reduction*, *63*, 102450. https://doi.org/10.1016/j.ijdrr.2021.102450

Palen, L. & Anderson, K. (2016). Crisis informatics—New data for extraordinary times. *Science (American Association for the Advancement of Science), 353*(6296), 224–225. https://doi.org/10.1126/science.aag2579

Palen, L., & Liu, S. (2007). Citizen communications in crisis: anticipating a future of ICT-supported public participation. *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, 727–736. https://doi.org/10.1145/1240624.1240736

Pavlakis, A. & Duffield, B. (2017). The Politics of policy in the McKinney–Vento Homeless Assistance Act: Setting the agenda for students experiencing homelessness. *The Urban Review*, *49*(5), 805–831. https://doi.org/10.1007/s11256-017-0422-0

Peek, L.& Stough, L. M. (2010). Children with disabilities in the context of disaster: A social vulnerability perspective. *Child Development*, *81*(4), 1260–1270. https://doi.org/10.1111/j.1467-8624.2010.01466.x

Prior, T., & Eriksen, C. (2013). Wildfire preparedness, community cohesion, and social ecological systems. *Global Environmental Change 23*(6), 1575-1586. http://dx.doi.org/10.1016/j.gloenvcha.2013.09.016

Rogers, P. (2017, March 04). San José Flood: Feds Refused to Fund Project That Would Have Saved Rock Springs Neighborhood. *Mercury News*. Retrieved 2017, from: https://www.mercurynews.com/2017/03/04/san-jose-flood-feds-refused-to-fund-project-that-would-have-saved-rock-springs-neighborhood/#:~:text=More%20than%20a%20decade%20ago,and%20refused%20to%20fund%20it

Samuels, C. (2020, July 22). How to Address Big Tech Equity Challenges. *Education Week*. Retrieved 2020, from https://www.edweek.org/technology/how-to-address-big-tech-equity-challenges/2020/07

San Francisco Department of Aging and Adult Services. (2016). *Assessment of the Needs of San Francisco Seniors and Adults with Disabilities Part II: Analysis of Needs and Services*.

City and County of San Francisco.
https://www.sfhsa.org/about/reports-publications/older-adults-and-people-disabilities-plans-and-reports

San Francisco Health Network. (2015, December 14). *Mayor Lee and City Agencies Announce Temporary Shelter System and City Preparations for expected El Niño Storms.* [Press release].
https://sfhealthnetwork.org/press-release-mayor-lee-and-city-agencies-announce-temporary-shelter-system-and-city-preparations-for-expected-el-nino-storms/

San Mateo County Manager's Office. (2021). *Multijurisdictional Local Hazard Mitigation Plan*. San Mateo County.
https://www.smcgov.org/ceo/2021-multijurisdictional-lhmp

San Mateo County Civil Grand Jury. (2017). *English Is Not Our Only Language: Are Local Law Enforcement Agencies Providing Multilingual Access to Outreach Programs?* The Superior Court of California.
https://www.sanmateocourt.org/documents/grand_jury/2016/multilingual_access.pdf

San Mateo County Civil Grand Jury. (2021). *Where's The Plan for San Mateo County Emergency Alert System?* The Superior Court of California.
https://www.sanmateocourt.org/documents/grand_jury/2020/SMC%20Alert%20System.pdf

San Mateo County Human Services Agency. (2015). *2015 San Mateo County Homeless Census and Survey.* San Mateo County.
https://www.smcgov.org/hsa/one-day-homeless-count-reports

San Mateo County Sheriff's Office of Emergency Services. (2015a). *San Mateo County Hazard Vulnerability Assessment: Appendix to the Emergency Operations Plan.* San Mateo County. https://hsd.smcsheriff.com/sites/default/files/downloadables/2%20-%20Hazard%20Vulnerability%20Assessment.pdf

San Mateo County Sheriff's Office of Emergency Services. (2015b). Attachment 2nd Quarter Oct–December 2015. San Mateo County.
https://hsd.smcsheriff.com/sites/default/files/2016/January/Attachment%20A%202nd%20Quarter%20Oct-%20Dec%202015.pdf

San Mateo County Emergency Services Council (2015, September 17). *Emergency Services*

Council Meeting Minutes September 17, 2015.
https://hsd.smcsheriff.com/sites/default/files/2016/January/ESC%20Sept%2017%2C%20
2015%20Meeting%20Minutes%20Reviewed%20and%20Revised.pdf

San Mateo County Emergency Services Council. (2016, January 21). *Emergency Services Council Meeting Minutes January 21, 2016.*
https://hsd.smcsheriff.com/sites/default/files/2016/April/ESC%20January%2021%2C%2
02016%20Meeting%20Minutes.pdf

San Mateo County Executive Office. (2021). *2021 Multijurisdictional Local Hazard Mitigation Plan*. San Mateo County. https://www.smcgov.org/ceo/2021-multijurisdictional-lhmp

San Mateo County Office of Education. (2022). *The Big Five Community Packet 2021-22: Immediate Action Emergency Response for School.* San Mateo County.
https://www.smcoe.org/assets/files/For%20Schools_FIL/Safe%20and%20Supportive%20
Schools_FIL/School%20Safety_FIL/The%20Big%20Five%20School%20Community%2
0Packet.pdf

Santa Clara County Board of Supervisors. (2015). *Santa Clara County Seeks to Increase Homeless Shelter Capacity in Race Against El Niño*. [Press release].
https://district2.sccgov.org/sites/g/files/exjcpb921/files/09.14.15%20-
%20Santa%20Clara%20County%20Seeks%20to%20Increase%20Homeless%20Shelter
%20Capacity%20in%20Race%20Against%20El%20Ni%C3%B1o.pdf

Santa Clara County Multi-Jurisdictional Program for Public Information 2015. (2016). *Annual Report for FY16 (July 2015 to June 2016)*. County of Santa Clara.
https://www.losaltosca.gov/sites/default/files/fileattachments/city_manager/page/33211/2
016_ppi_annual_report.pdf

Santa Clara Valley Water District. (2017). *Flooding Report: Coyote Creek, Uvas Creek, San Francisquito Creek and West Little Llagas Creek January and February of 2017*. Santa Clara Valley Water District.
https://www.valleywater.org/sites/default/files/2017%20Flood%20Report.pdf

Santa Clara Valley Water District. (2022). *Valley Water and City of San Jose Joint Emergency Action Plan for Severe Storm and Flood Response in City of San Jose.* Santa Clara Valley Water District. https://fta.valleywater.org/dl/F8Op9ndfVY

Scalia, G., Francalanci, C. & Pernici, B. (2021). CIME: Context-aware geolocation of

emergency-related posts. *Geoinformatica 26*, 125–157 (2022).

https://doi.org/10.1007/s10707-021-00446-x

Shueh, J. (2014, April 29). *San Francisco Partners with Nextdoor for Emergency Alerts*.

Government Technology.

https://www.govtech.com/public-safety/san-francisco-partners-with-nextdoor-for-emergency-alerts.html

Soden, R. & Palen, L. (2018). Informating crisis: Expanding critical perspectives in crisis

informatics. *Proceedings of the ACM on Human-Computer Interaction*, *2*(CSCW), 1–22.

https://doi.org/10.1145/3274431

Subervi, F. (2010). *The Achilles Heel in Emergency Communications: The Deplorable*

Policies and Practices Pertaining to Non-English Speaking Populations. Center for the

Study of Latino Media & Markets; Texas State University.

https://www.diversitypreparedness.org/~/media/Files/diversitypreparedness/Achilles%20

Heel%20in%20Emergency%20Communications.ashx?la=en

Subervi, F. (2016). Do Spanish-language broadcast media serve a changing America? *The*

Communication Crisis in America, And How to Fix It (pp. 95–105).

https://doi.org/10.1057/978-1-349-94925-0_7

Sykes, D. (2017, July). *2017 Coyote Creek Flood After Action Review and Improvement*

Recommendations Report. City of San José.

http://sanjose.granicus.com/MetaViewer.php?view_id=&event_id=2696&meta_id=6464

47

Titan Health & Security Technologies, Inc. (2018, November 30). *Titan HST Emergency*

Communication System Utilized to Safe-Guard 86th Annual Rockefeller Center

Christmas Tree Lighting. [Press release]. https://www.prnewswire.com/news-releases/titan-hst-emergency-communication-system-utilized-to-safe-guard-86th-annual-rockefeller-center-christmas-tree-lighting-300758078.html

United States Census Bureau. (2010). *United States Census 2010*. United States Census

Bureau. https://www.census.gov/programs-surveys/decennial-census/decade.2020.html

United States Census Bureau. (2022). *United States Census 2020.* United States Census

Bureau. https://www.census.gov/programs-surveys/decennial-census/decade/2020/2020-census-main.html

United States Census Bureau. (2022). *Quick Facts*. United States Census

      Bureau. https://www.census.gov/quickfacts/fact/table/US/PST045221

United States Census Bureau. (2022). *American Community Survey*. United States Census

      Bureau. https://www.census.gov/programs-surveys/acs

United States Government Accountability Office. (2020) *Agencies Need to Address Pending*

      Applications and Monitor Industry Progress on System Improvements. United States

      Government Accountability Office. https://www.gao.gov/assets/gao-20-294.pdf

Van den Hurk, A. M. (2013). *Social Media Crisis Communications: Preparing for, Preventing,*

      and Surviving a Public Relations #FAIL. Pearson Education, Inc.

      http://ptgmedia.pearsoncmg.com/images/9780133353884/samplepages/0133353885.pdf

Wadsworth, J., & Koehn, J. (2017, March 01). Floodgate: How the Water District and City's

      Comedy of Errors Became a Local Tragedy. *San Jose Inside*.

      https://www.sanjoseinside.com/news/investigative-reports/floodgate-new-details-on-

      how-the-water-district-city-officials-failed-the-residents-of-san-jose/

Wadsworth, J., Koehn, J., & Pulcrano, D. (2017, March 15). Still No Answers: Residents

      displaced by last month's flood disaster in San Jose are still searching for answers while

      the city and water district assign blame. *Metro Active*. Retrieved 2017, from:

      https://www.metrosiliconvalley.com/still-no-answers/

Wang, Z., Lam, N. S., Obradovich, N., & Ye, X. (2019). Are vulnerable communities digitally

      left behind in social responses to natural disasters? An evidence from Hurricane Sandy

      with Twitter data. *Applied Geography (Sevenoaks)*, *108*, 1–8.

      https://doi.org/10.1016/j.apgeog.2019.05.001

Weinschenk, C. (2012, November 20). Hurricane Sandy and EAS-CAP. *Broadband Technology*

      Report.

      https://www.broadbandtechreport.com/docsis/article/16444987/hurricane-sandy-and-

      eascap

Wells, K. B., Springgate, B. F., Lizaola, E., Jones, F., & Plough, A. (2013, September).

      Community engagement in disaster preparedness and recovery: A tale of two cities – Los

      Angeles and New Orleans. *Psychiatric Clinics of North America*, *36*(3), 451-466.

      https://doi.org/10.1016/j.psc.2013.05.002

White, R. D. (2018, August 24). Fires, floods, and other calamities fuel this app's popularity. *LA*

Times. https://www.latimes.com/business/la-fi-emergency-app-20180824-story.html

Wieland, M., Asiedu, G. B., Lantz, K., Abbenyi, A., Njeru, J. W., Osman, A., Goodson, M., Ahmed, Y., Molina, L. E., Doubeni, C. A., & Sia, I. G. (2020). Leveraging community engaged research partnerships for crisis and emergency risk communication to vulnerable populations in the COVID-19 pandemic. *Journal of Clinical and Translational Science*, *5*(1), e6. https://doi.org/10.1017/cts.2020.47

Wimberly, R. (2012). CMAS/WEA Used Extensively for Hurricane Sandy. *Emergency Management.*
http://www.emergencymgmt.com/emergency-blogs/alerts/CMASWEA-Used-Extensively-for-103112.html

Wimberly, R. (2015). Extensive Emergency Alerts, Yet Still Many Deaths from the Flooding in Texas. *Emergency Blog. Emergency Management.*

Wynkoop, O. (2021, July15). San Mateo County residents encouraged to "know your zone" during an evacuation. *The Daily Journal.* Retrieved January 2022, from:
https://www.smdailyjournal.com/news/local/san-mateo-county-residents-encouraged-to-know-your-zone-during-an-evacuation/article_28439d12-e5d0-11eb-a39b-a3be9da4c336.html

Appendix A - Qualtrics Software Voluntary Survey Questions

1. Please state your name, title, and agency.

2. Does the county have an emergency alerting system?

3. What is the percentage of county residents signed up to the county's emergency alerting system? If this question does not apply, please respond N/A.

4. How does the county promote their emergency alerting system? Please specify all outreach methods utilized.

5. Does the county have Federal Emergency Management Agency's Integrated Public Alert and Warning System (IPAWS) alerting authority status?

6. Has the county used IPAWS for flooding alerts in the last five years?

7. If so, was IPAWS activated during the 2015-2016 El Niño winter season for flooding events?

8. How did the county prepare for the 2015-2016 El Niño winter season?

9. Did the county expect to experience flooding from the 2015-2016 El Niño winter season?

10. Does the county have emergency plans in place for their vulnerable populations? For this study, vulnerable populations are defined as individuals who are homeless, individuals who have access and functional needs, and individuals with language barriers.

11. Did the county engage in any community outreach efforts for vulnerable populations in preparation for the 2015-2016 El Niño winter season and potential flooding? Please specify all outreach methods utilized.

12. If so, were the county's community outreach efforts specific to El Niño flooding concerns? Please specify all outreach methods utilized. If this question does not apply to the county, please respond N/A.

13. In the event of catastrophic flooding, were there designated shelter buildings for vulnerable populations?

14. Will you have the capacity for a post interview in regards to the outcomes of this survey?

15. Thank you for your response. If you have any questions, please contact Victoria Castro through email: Victoria.castro02@sjsu.edu or phone: (209) 499-6495.

Appendix B - County Profiles

City and County of San Francisco

The City and County of San Francisco borders San Mateo County to the south, the Pacific Ocean to the west, and the San Francisco Bay to the north and east. San Francisco has an approximate population of 815,201(United States Census Bureau, 2020). San Francisco is a home-rule city and county, enacting a City Charter to have supreme authority over all municipal affairs (City and County of San Francisco, Department of Emergency Management, 2014). San Francisco has a moderate flooding probability (City and County of San Francisco, Department of Emergency Management, 2014).

County of Santa Clara

Santa Clara County is located adjacent to the San Francisco Bay. As of the 2020 Census, the county had an estimated 1.9 million residents (United States Census Bureau, 2020) Ninety-two percent of the population live in the county's fifteen cities, however, unincorporated areas account for a sizable portion (County of Santa Clara County, Office of Emergency Management, 2017). Santa Clara County has a moderate flooding probability (County of Santa Clara County, Office of Emergency Management, 2017). Guadalupe River and Coyote Creek drain the adjacent mountains, and between them caused four federally declared floods in the 1990s (County of Santa Clara County, Office of Emergency Management, 2017). The Alviso neighborhood is adjacent to the southern end of San Francisco Bay and is subject to tidal flooding through the New Chicago Marsh (Frances Edwards, personal communication, December 8, 2021).

County of Sonoma

Sonoma County is located north and east of Marin County, south of Mendocino County, and west of Solano, Lake, and Napa counties. As of 2020, the county had a population of 488,863 (United States Census Bureau, 2020) and one-third of this population lives in unincorporated areas (County of Sonoma, Fire and Emergency Services Department, 2017). A significant amount of the population lives in incorporated cities and towns and the urban corridor of Highway 101 (County of Sonoma, Fire and Emergency Services Department, 2017). Flooding in Sonoma County occurs more frequently than any other natural hazard (County of Sonoma, Fire and Emergency Services Department, 2017). Since 1991, the county has had twenty-four Governor Proclaimed State of Emergencies, eighteen of which have been winter storm and flood-related (County of Sonoma, Fire and Emergency Services Department, 2017). The county

has a historically high frequency, high probability, and high impact of floods, primarily due to the presence of the Russian River (County of Sonoma, Fire and Emergency Services Department, 2017).

San Mateo County

San Mateo County is located southwest of the San Francisco Bay, and east of the Pacific Ocean. San Mateo County has an estimated area of 741 square miles and 292 miles of waterways (San Mateo County Sheriff's Office of Emergency Services, 2015a). The population is estimated at 737, 888 (United States Census Bureau, 2020) and 91% of the population lives within the twenty incorporated cities, while nine percent of the population lives in unincorporated areas (San Mateo County Sheriff's Office Homeland Security Division Office of Emergency Services, 2015). The county has eight landforms: ocean beach, coastal foothills, coastal terrace, upper valley, bayside foothills, mountains, bayside plains, and bayside marsh and mudflats. The county has a low to moderate flooding probability (San Mateo County Sheriff's Office Homeland Security Division Office of Emergency Services, 2015).