The Next Wave in Tsunami Warnings in Humboldt

Released June 9, 2026

SUMMARY

Imagine you are walking near a bay or ocean shoreline in our beautiful county and the ground starts to shake violently. Several minutes later, your phone receives an alert telling you a tsunami is likely. What do you do? Are you in a tsunami hazard zone? Did you think to look at signs to notice whether you entered a tsunami hazard zone?

Humboldt residents are very aware of our vulnerability to earthquakes and tsunamis. But when an earthquake occurs and is sufficiently violent to create tsunami waves, alerting those who are likely to be affected and providing accurate information to allow a safe reaction remains problematic.

If an earthquake is strong enough to trigger a tsunami, the impact of tsunami waves upon the Humboldt coastline depends upon the magnitude and location of the earthquake. For example, the July 2025 earthquake in Russia was strong and generated a tsunami, but its geographic distance from our coastline resulted in a one-foot wave[1] locally. On the other hand, a lesser magnitude earthquake much closer to us could generate much larger tsunami waves.

The alert systems warning Humboldt citizens of possible tsunami effects from an earthquake have evolved over the past few decades. While sirens were used in past decades, none are still functioning, except those in Shelter Cove. The cost to repair and/or replace these inoperative sirens is prohibitive. Cost estimates to purchase, engineer, permit, install, and connect new sirens to an alert system vary depending upon factors such as manufacturer, intended use, location, etc. Total costs can range from $60,000 to $160,000 per siren plus maintenance.

[1] Even a one-foot wave can cause significant damage: KQED: Even small tsunamis can wreak havoc

Of the fifteen sirens that comprised Humboldt's system, six failed in a 2021 test. Five years later, only six remain functional and they are all in Shelter Cove. Replacing and updating the nine inoperative sirens and their support system would range in cost from almost one-half million to one and one-half million dollars.

Sirens are meant primarily to warn people on beaches and outdoors. However, if there are loud noises or the wind is going in the wrong direction and carries the sound away from at-risk zones, the siren may not be heard. The siren sound might not be heard inside of structures.

To be an effective warning system, sirens would need to be installed approximately one mile apart along our salt-laden, high wind coastline. That means a LOT of sirens and a LOT of money.

Tsunami warnings in Humboldt County now rely primarily upon an electronic notification system which delivers urgent messages via phone or text warning of an actual or potential emergency. Following an earthquake, the National Tsunami Warning Center may initiate an alert if the quake is sufficient to generate tsunami waves. Information about the likely size of the waves and where they will likely impact are included in the alert. New technology, if used, could send alerts to locally selected, targeted areas.

If your cellphone settings allow, and you have subscribed to receive emergency alerts, an alert will sound and a message explaining the alert is shown. You can register to receive this alert through the Humboldt County Office of Emergency Services website. While these cellular systems are generally more efficient compared to sirens, there are still drawbacks such as being in a *"dead zone"* where no cell signal is received.

Knowing what to do - stay put or move to higher ground - is critical if you are in a tsunami hazard zone when an earthquake occurs. Signs indicating you are entering or exiting a tsunami hazard zone are posted at the edges of hazard areas. Signs are also posted inside some areas to inform people they are located within a tsunami hazard zone.

There are a number of maps which show areas prone to tsunami inundation. Getting to safety may be as simple as walking a few blocks away from the coastline or bay. For some low-lying areas, specific gathering sites at a higher elevation have been designated.

The biggest problem in Humboldt County is that many people are unaware of whether they are in a tsunami hazard zone at the time of an earthquake and potential tsunami, *and* they don't have a plan regarding what to do. In times of high stress, signs and directions need to be clear about where to go or what to do to be safe.

There are some relatively inexpensive and simple things that can be done to improve our tsunami preparedness and our responses during a tsunami emergency.

Painted or thermoplastic pavement markings located at the boundary of a tsunami hazard zone with the message "Leaving Tsunami Zone" adjacent to a wide blue line horizontally across the pavement have proven highly effective and economical in Oregon, Washington and New Zealand. They quickly and clearly direct people to safety in the event of a tsunami.

A tourist brochure which includes a map of the Old Town area published by the City of Eureka could be updated to indicate tsunami hazard zones at its next publication. The tsunami and safety zones could be color-coordinated to match the California Geological Survey maps which use green to indicate safe and yellow to indicate unsafe zones.

Kiosks in Eureka Old Town could be used to display maps indicating tsunami hazard zones and safe zones when next updated. These could also follow the California Geological Survey green and yellow color scheme.

The City of Eureka recently held a Tsunami Preparedness Workshop for Businesses located within the Eureka Old Town tsunami hazard zone. The Ink People, Eureka Main Street, Wiyot Tribe and the Eureka Cultural Arts District Leadership Council are collaborating on a tsunami art mural project. Both of these activities expand awareness, enhance emergency preparedness, engage the community and reduce risk.

Humboldt County is distinctive. It is one of the most seismically active areas in the nation. It was also the first in the west to have tsunami warning signs. With our pro-active legacy regarding tsunamis, we can be the best in the west at protecting our seismically and tsunami vulnerable communities and the people that visit and live in them.

BACKGROUND

"We gotta head for higher ground, we can't come back until the water goes down" - Johnny Cash

On March 28,1964, a catastrophic tsunami destroyed 29 city blocks of downtown Crescent City in neighboring Del Norte County, killing 11 and causing over seven million dollars in damage. In response, Humboldt County was the first County in California to develop and utilize warning signs for tsunami danger[2] In 2005, the California Department of Transportation requested permission from the Federal Highway Administration for use of standardized tsunami signs in California on a trial basis.[3] In 2023, the signs were permanently approved for statewide use.

Signs approved by Caltrans for tsunami hazard warnings on state highways

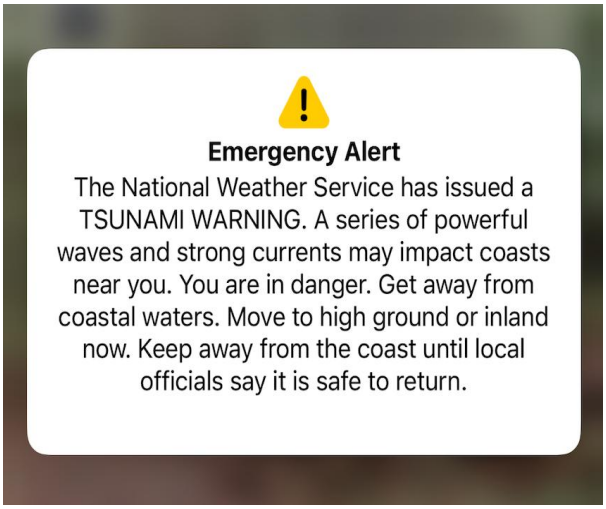
These approved signs were developed by the California Geological Survey, the National Tsunami Hazard Mitigation Program and California Operations of Emergency Services through the California Tsunami Program. The signs are grant-funded by the National Oceanic and Atmospheric Administration's National Tsunami Hazard Mitigation Program.[4]

[2] Warning signs after the 1964 Crescent City Tsunami
[3] Caltrans Request for Permission to Use Tsunami Signage
[4] Grant is covered on page 4 of Sign Funding

Tsunami warning signs are found on streets, highways and along some trails in county, State, and federal parks providing warnings when entering and leaving tsunami hazard zones. Sign placement follows maps which are generated from geological research, seismic activity history and past tsunami events. These maps are based on Geographic Information System (GIS) tsunami hazard mapping programs developed by the California Tsunami Program with its partners.[5] Maps are updated when enough data have been collected to more accurately forecast likely inundated areas.

Local tsunami hazard maps were updated in 2021.[6] Current tsunami maps estimate the areas where waves are likely to make landfall following a near-source 9.0 magnitude event, a very strong earthquake that is estimated to occur once during a 2,400-year span. Taking a conservative approach, map makers then expanded the inundation area shown on the maps to an even higher elevation.

The California Department of Transportation (Caltrans) installs these signs on state highways. County and city public works departments install the signs within their respective jurisdictions in accordance with the GIS tsunami hazard mapping.

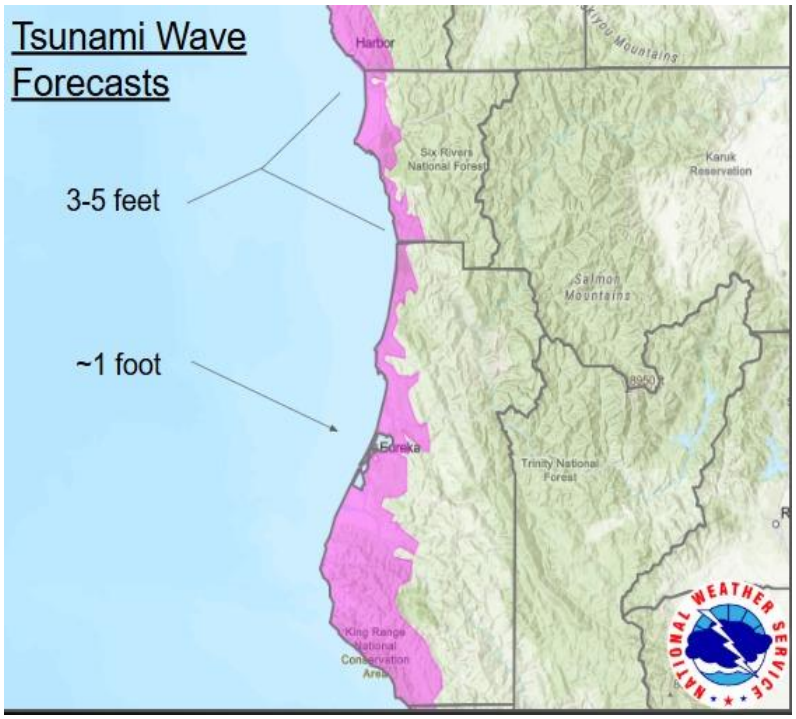


Text of the Emergency Alert sent out on December 5, 2024

Shortly after a 7.0 magnitude earthquake struck off the Humboldt County coastline on December 5, 2024, a wireless emergency alert tsunami warning was sent to cell phones along the coast of California to over 5 million cell phones. Alerts went to phones well outside the proximity of the tsunami hazard zone, including inland communities such as Redding.[7]

[5] Tsunami hazard map development partners include California Geological Survey, California Office of Emergency Services, Tsunami Research Center, University of Southern California and AECOM Technical Services.
[6] Tsunami Maps Updated
[7] Anatomy of a Tsunami Alert

Maps generated by the National Weather Service to show weather impacts were issued during the tsunami warning. These weather-based maps implied that the tsunami hazard zone extended to a 2,000-foot elevation. Confusion resulting from this map led to a mass exodus from areas that were not at risk. Traffic on Highway 101 through Eureka came to a standstill. Emergency vehicles were prevented from using main thoroughfares due to the traffic. Fortunately, only a small, harmless wave reached the Humboldt coastline.



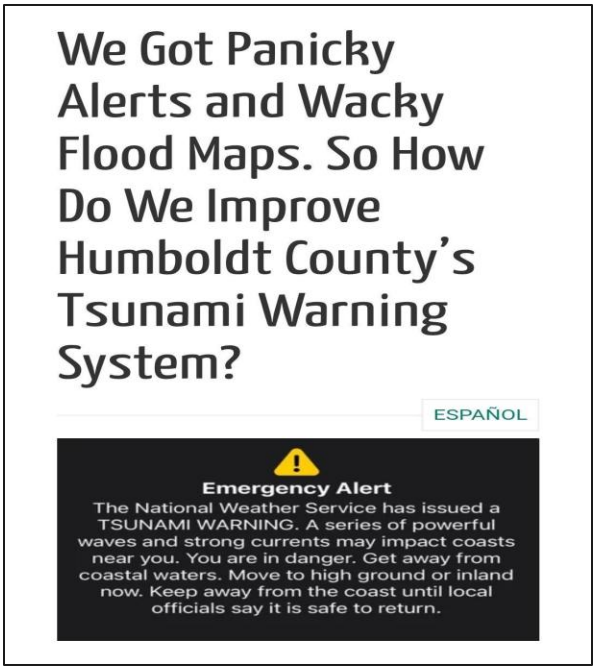
Tsunami hazard zone map based strictly on weather maps (Eureka National Weather Service, as published in the Lost Coast Outpost on December 5, 2024)[8]

On July 29, 2025, another wave of confusion swept Humboldt County after an 8.8 magnitude earthquake struck in Kamchatka, Russia. A tsunami evacuation alert was sent by the National Tsunami Warning Center in Palmer, Alaska,[9] a few hours later. This alert was sent as far inland as Hoopa.

Thereafter, Humboldt County Office of Emergency Services sent out a clarifying local wireless emergency alert advising people to simply stay away from the ocean.[10] This was followed by another confusing alert shortly afterwards from the National Weather

[8] Confusing Tsunami Alerts
[9] National Tsunami Warning Center Maps Distort the Hazard
[10] Second Alert Sent to Clarify

Service, again advising that they were in danger. Residents located in areas out of the tsunami hazard zone did not know which information sources to trust.



Lost Coast Outpost, July 29, 2025.[11]

Local media reflected this confusion as evidenced by this headline in the Lost Coast Outpost article on the event.

The Grand Jury limited its inquiry to the County of Humboldt and the city of Eureka due to the Grand Jury's limited time and the greatest risk being where tourists and populations are concentrated within the zone. It is hoped that other Humboldt County communities will consider the feasibility of these recommendations for their own use.

METHODOLOGY

The Grand Jury gathered information via personal interviews and a review of reports and documents. We reviewed local media articles, and relevant federal, State and local websites, including:

- California Coastal Commission
- California Department of Transportation (Caltrans)
- California Geological Survey
- Federal Emergency Management Agency (FEMA)
- Humboldt County Office of Emergency Services
- National Oceanic and Atmospheric Administration/National Weather Service
- Redwood Coast Tsunami Workgroup

[11] Panicky Alerts

DISCUSSION

Humboldt County has a 110-mile coastline composed of high craggy cliffs, low wetlands, beaches and dunes, estuaries, forest and developed land adjacent to a very active megathrust fault line in the Cascadia Subduction Zone.[12] It has the largest land area in California that falls within tsunami hazard zones. Most of it, however, is undeveloped land including wetlands, forest, pasture, grasslands and beaches.[13] 47,748 acres, or 2.1% of the total area of Humboldt County, lies within the tsunami hazard zone.[14]

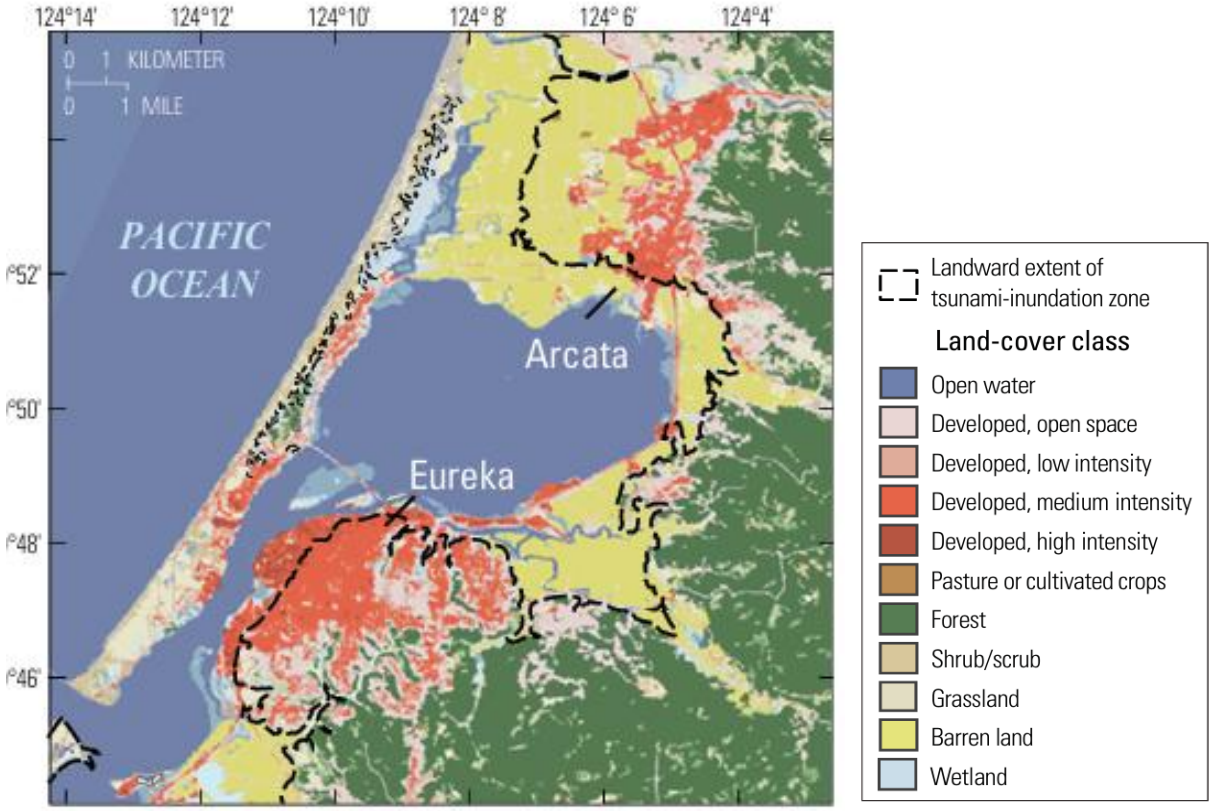
Tsunamis impacting developed land can wipe out infrastructure, government facilities, emergency services and cripple local governments ability to respond.

In the combined areas of Del Norte, Humboldt and Mendocino Counties, an estimated 21,000 people live within tsunami hazard zones.[15] A majority of the 136,000 (as of 2020)[16] Humboldt County residents live on high marine terraces or inland valleys. Only about 10–15% of the populations of Eureka, Arcata and Trinidad live within tsunami hazard zones. Slightly more than 10% of the developed land in Arcata is within the projected tsunami hazard zone.[17] Tsunami risk in Arcata is mainly in the agricultural lowlands west of town and industrial areas near the bay. Most residential neighborhoods are on higher ground.

Roughly 30% of Eureka's developed land is located within the tsunami hazard zone. Areas inside the zones with the largest population exposed to this risk are in Old Town, the waterfront and Woodley Island. Several thousand residents live within these tsunami hazard zones.

[12] Humboldt County Coastline
[13] Land cover is on page 7 of Humboldt Tsunami Hazard Zones Mostly Undeveloped Land
[14] Acreage is on page 10 of 2.1% of Humboldt County is in Tsunami Hazard Zone
[15] Tsunami Hazard Zone Populations
[16] Humboldt County Population Data
[17] Page 10 of 10% of Developed Land in Arcata is in the Tsunami Hazard Zone

Slightly more than 10% of the developed land in Trinidad is within the projected tsunami hazard zone; most of the town is above inundation elevations.[18] McKinleyville and Fortuna are largely above inundation elevations.[19] Nearly the entire Samoa peninsula, Fields Landing and King Salmon are at higher risk of tsunami inundation, but have lower population densities. In Shelter Cove, most residential areas are safe from a tsunami. Only a small portion of developed land, including the airport, the marina area, beaches and parts of Lower Pacific Drive and Beach Road, and areas west of those roads, are in the tsunami hazard zone. In Orick, tsunami risk is generally limited to the river mouth areas near the Stone and Big Lagoons.



Map and Legend from US Geological Survey (USGS) Community Exposure to Tsunami Hazards in California Scientific Investigations Report 2012–5222 depicting tsunami hazard zone and land-cover data.[20]

[18] Page 10 of 10% of Developed Land in Trinidad is in the Tsunami Hazard Zone
[19] Communities Largely Outside of Tsunami Hazard Zone
[20] See pages 5 and 8 for Maps of the Tsunami Hazard Zone

What matters is where people *are* when a tsunami happens, not where they *live*. Most people are not in their homes 24 hours every day. Many residents living in other parts of the county likely commute to the urban centers of Eureka and Arcata, which are partly in tsunami hazard zones. In addition to the resident population, tourists and travelers can swell the total number of people in Humboldt in the tsunami hazard zone area.

Tourists and travelers at risk in a tsunami event in Humboldt County are likely to be concentrated in Eureka Old Town, downtown, and along Broadway, where most lodging and tourist attractions are located. Local tsunami experts have repeatedly sounded the alarm and have long tried to engage local businesses in tsunami awareness and preparation, but up until this month, with little success.

Now, with renewed focus and effort, the tide is changing. The City of Eureka recently (April 20, 2026) held a Tsunami Preparedness Workshop for Businesses that are located in the Eureka tsunami hazard zone. The press release for the event declared that "[b]usinesses in the tsunami zone play a critical role in protecting employees, customers, and the broader community."[21] City staff and emergency preparedness experts from Humboldt Bay Fire, Eureka Police Department and Community Emergency Response Team met with businesses individually during the workshop. Together, they created a step-by-step tsunami emergency plan tailored to each business that participated. Each business was provided with a Eureka Business Earthquake and Tsunami Toolkit.[22] The City of Eureka plans to offer more of these workshops in the future. The event was at the Wharfinger Building, a Eureka city-owned building in the tsunami hazard zone.

Kudos to the City of Eureka for pursuing and sponsoring this important event that brings private businesses into the tsunami emergency preparedness fold. Are there also emergency evacuation plans for city-owned public venues in the tsunami hazard zone?

[21] Tsunami Workshop for Businesses
[22] Eureka Business Earthquake and Tsunami Toolkit - see APPENDIX A

On March 25, 2026 (less than a month before this Preparedness Workshop), a tsunami drill alert was sent out to just 9,000 people as part of Tsunami Week.[23] Only those who subscribed to the alert and who live in the tsunami hazard zone received the 11:00 a.m. alert. At that moment, the Grand Jury, including some cell phone alert subscribers, was meeting in the Eureka city-owned Adorni Center. Not one juror received a live, real-time alert announcing the tsunami drill. At that moment, the center was busy with people exercising, visiting, working, engaging in sports in the gym - all literally at the bay's edge in the tsunami hazard zone. No one seemed to be aware of the alert or the drill. Jurors asked the Adorni Center management if they had received the alert and they replied they had not. There was no announcement, no evacuation, no response. What if this had been an alert for a real event?

We later learned that although it was announced in the local media that a tsunami drill would be happening and wireless emergency alerts would be sent out to the entire community, it was not communicated that the alerts would be sent only to King Salmon and Samoa Peninsula residents, regardless of where they were physically located at the time of the event.

Experts agree that a large earthquake originating locally is becoming increasingly likely. A near-source magnitude 9.0 Cascadia Subduction Zone earthquake would cause violent ground shaking and would generate a tsunami with estimated wave heights up to 12 meters (39 ft.) in Eureka/Humboldt Bay.[24] If a large earthquake occurred on the megathrust in the Cascadia Subduction Zone and generated a tsunami, Humboldt County residents could have only minutes to move to a safe area. Ground shaking is the best and most reliable warning that a tsunami could arrive in minutes and last over many hours or several days. No other alert system is a more effective warning.

In a distant-source scenario, in which a tsunami could take three or more hours to arrive in Humboldt, a combination of alerts such as cell phone, radio, television and posted warning signs on roadways and paths and tsunami sirens are the most effective.

[23] Tsunami Alert Sent to 9,000 People
[24] Estimated Tsunami Wave Heights from a Cascadia Subduction Zone Megaquake

Sirens

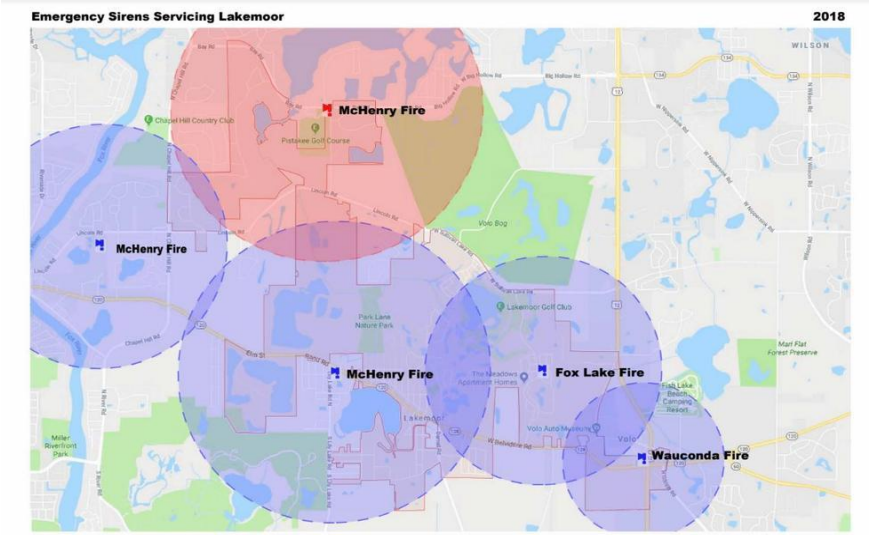
Historically, many residents of Humboldt County have relied on sirens to warn them of an approaching tsunami. But now, such reliance leads to a perilous assumption which can endanger residents.

Used alert sirens were donated to Humboldt County by Pacific Gas and Electric in 2006 when the siren system at the Diablo Canyon Power Plant was upgraded.[25] These sirens were installed across our tsunami hazard zone from Orick to Shelter Cove. In 2009, Humboldt County received a federal grant to purchase equipment that would connect the sirens to a remotely activated federal system.[26]

Maintenance of these sirens was not funded to keep them in working order.[27] Only six warning sirens remain functional. The remaining functional sirens are funded, operated and maintained by Shelter Cove - the community they serve.[28] The Humboldt County Office of Emergency Services has stated that the donated sirens are not the county's responsibility. The Humboldt County Board of Supervisors would have to approve additional funding if the non-functioning sirens were to be repaired or replaced, and maintained.

The maximum range of a siren is one mile in each direction. To be effective, one siren should be installed less than every square mile in tsunami hazard zones because coverage is generally circular around the siren.[29] Sirens should be placed so that their coverage overlaps. Wind direction, physical obstructions, or background noise may significantly impact whether a siren can be heard.

[25] Sirens Donated by PG&E; Diablo Canyon decommissioned nuclear power plant sirens to Humboldt
[26] Federal Grant to Connect Sirens
[27] Siren Maintenance not Funded
[28] Shelter Cove Sirens
[29] Siren circular coverage



Example of circular, overlapping siren coverage in Village of Lakemoor, Illinois.[30]

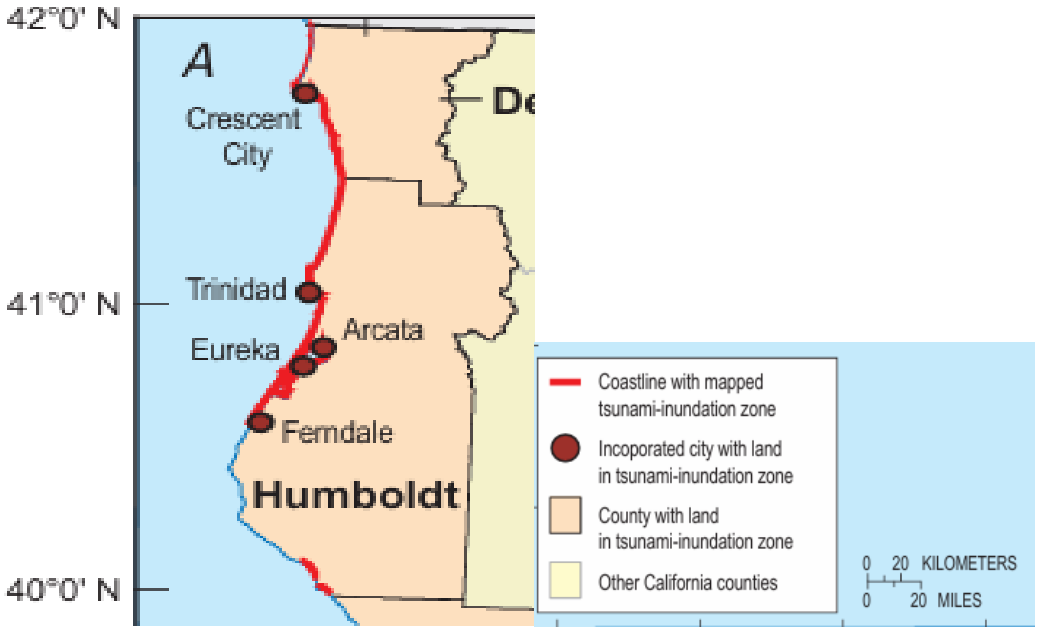
If Humboldt County were to reinstitute the use of tsunami sirens in addition to other alert modalities, using a siren with a one-mile radius range in each direction, it would need to install a siren every two miles along coastal areas that can be accessed within the tsunami hazard zone. That would include

- most of 35 miles of the coastline (18 sirens),
- 38 square miles in the Ferndale/Eel River Basin area (approx.10 sirens),
- 4 square miles in the Humboldt Bay Wildlife Refuge area (1 siren),
- 3 miles along the route from College of the Redwoods to Eureka Old Town area (2 sirens),
- 7 miles from the northern end of Eureka to Arcata and then around the Bay on Hwy 256 to the Peninsula (4 sirens),
- 2.5 miles from Arcata towards the north (1-2 sirens),
- 1 additional siren in the low elevation area inland from Clam Beach, and
- at least 1 additional siren inland in the Elk River estuarial area

for a total of (approximately) a minimum number of 37 sirens.[31]

[30] Circular rage of sirens example

[31] Calculations based on scaled map included in Cal Poly Redwood Coast Tsunami Work Group brochure "How to Survive a Tsunami in Humboldt County California."



Map and legend depicting inundation zones along Del Norte and Humboldt Coastlines.[32] ***Note the vast difference between the inundation zones shown in the above USGS map versus the National Weather Service map on page 6 of this report.***

Sirens can be used for multiple types of warnings such as tornados, nuclear power plant emergencies, and tsunamis. The following chart shows the estimated costs per siren:

Siren Component	**Estimated Costs**
Hardware (speaker array + controller)	$30,000 - $60,000
Installation (pole, lift truck, electrical, trenching, site preparation)	$20,000 - $70,000
Permitting + Engineering	$5,000 - $20,000
Integrated Public Alert & Warning System (IPAWS) integration + testing	$5,000 - $10,000
Estimated total cost per siren	$60,000 - $160,000
Annual Maintenance Cost	$1,000 - $5,000

[32] See page 5 Humboldt/Del Norte Inundation Map

Sirens must be connected to IPAWS. IPAWS is the FEMA nationwide platform that sends authenticated emergency alerts to the public through Wireless Emergency Alert (WEA) and NOAA Weather Radio.

Sirens installed along our coast are likely to be on the higher end of these estimates given the need for tsunami-grade sirens, remote locations, salt and wind factors. In 2023, the city of Port Angeles, Washington, paid $45,000 just to replace a single siren damaged after a car hit the pole it was on.[33]

If Humboldt County were to return to the use of sirens, could it justify only placing sirens in high-risk areas with high populations? If sirens were not placed everywhere they would potentially be needed, who would decide, and how would they decide, where sirens would be used and where they would not?

Installing sirens in just a relatively small area such as Clam Beach, which has a bit over five miles of possible tsunami exposure, would be very expensive. Using the most conservative cost estimates, five sirens would cost the County over a quarter of a million dollars, plus annual maintenance costs to keep the sirens functioning. It could cost nearly $6 million to install all the sirens needed to fully protect our coastal, river and other tsunami risk areas, and this does not include ongoing maintenance costs. Humboldt County simply does not have this money, and grant funding of this magnitude is highly unlikely. The funds could only be raised through additional revenue (i.e., taxes or bonds) or by reducing other county funding. The bottom line is that sirens are cost-prohibitive and are unlikely to ever be installed here again.

Further, sirens have limited effectiveness. Local sirens are activated only after the National Tsunami Warning Center, operated by the National Weather Service in Palmer, Alaska, more than 2,800 miles away, determines that a tsunami risk exists and issues an alert.[34] There are better technologies available that provide more critical real-time information.

[33] Tsunami Replacement Cost
[34] See "Know The Alerts" link at Humboldt County Tsunami webpage

Experts told the Grand Jury about the importance of distinguishing between a near-source event and a distant-source event (an earthquake originating close to our county versus one far away such as the earthquake in July, 2025, in Russia). Sirens cannot provide information regarding when a tsunami wave may reach our coasts and the height of the waves.

If a near-source event occurs, such as the anticipated magnitude 9.0 Cascadia Subduction Zone earthquake, tsunami waves could impact our shores in less than ten minutes. The time delay between the earthquake occurring, and the earthquake data being received, evaluated, and reacted to by the federal agency sending out tsunami warnings could be several minutes. Such an earthquake has the potential to result in substantial infrastructure damage which could affect the ability of sirens to receive notification and sound a warning.

Only a tsunami resulting from an earthquake far from us, which would take hours or even days to reach our shores, would allow enough time to activate a siren.

Community Tsunami Warning Approaches

Sirens, maps, signs, and street markings are tools that have been used to warn people, direct them to safety, and minimize injuries and fatalities. Regardless of the size of an earthquake, if a tsunami warning is issued, everyone within the tsunami hazard zone should move to higher ground as soon as possible. Most importantly, everyone should know their zone.

To address tsunami threats, communities typically begin by creating hazard maps. Next, communities typically install tsunami hazard signage such as “Entering Tsunami Zone,” “Leaving Tsunami Zone,” and “Tsunami Evacuation Route.” Community education and evacuation drills are then periodically conducted. After these phases are established, forward thinking at-risk communities have taken the next step: they added paint or thermoplastic decals to road and highway pavement to indicate evacuation routes and/or tsunami safety zones. These tsunami lines are painted across streets at

scientifically predicted locations that are at the highest inundation levels, guiding visitors and community members quickly to safety.

A civic employee in Wellington, New Zealand, paints a sign with a wide blue line on pavement crossing the street. The sign includes a graphic of a tsunami wave and the words "Tsunami Safe Zone". (Photo courtesy of Mark Coote: www.markcoote.com)

In Eureka Old Town, some of which is in the tsunami hazard zone, only a few tsunami signs exist. How do residents and especially visitors know if they are in a tsunami hazard zone? How do visitors who have never experienced a tsunami alert know which way to run, especially in flat, low-lying areas where uphill isn't always obvious or apparent?

Wellington, New Zealand, is at the forefront of using tsunami pavement signage, followed by cities in Oregon such as Cannon Beach, Florence, Coos Bay, Reedsport, and Gold Beach, and some coastal areas in Washington State. This is a logical next step for California communities which are at high risk of tsunamis.

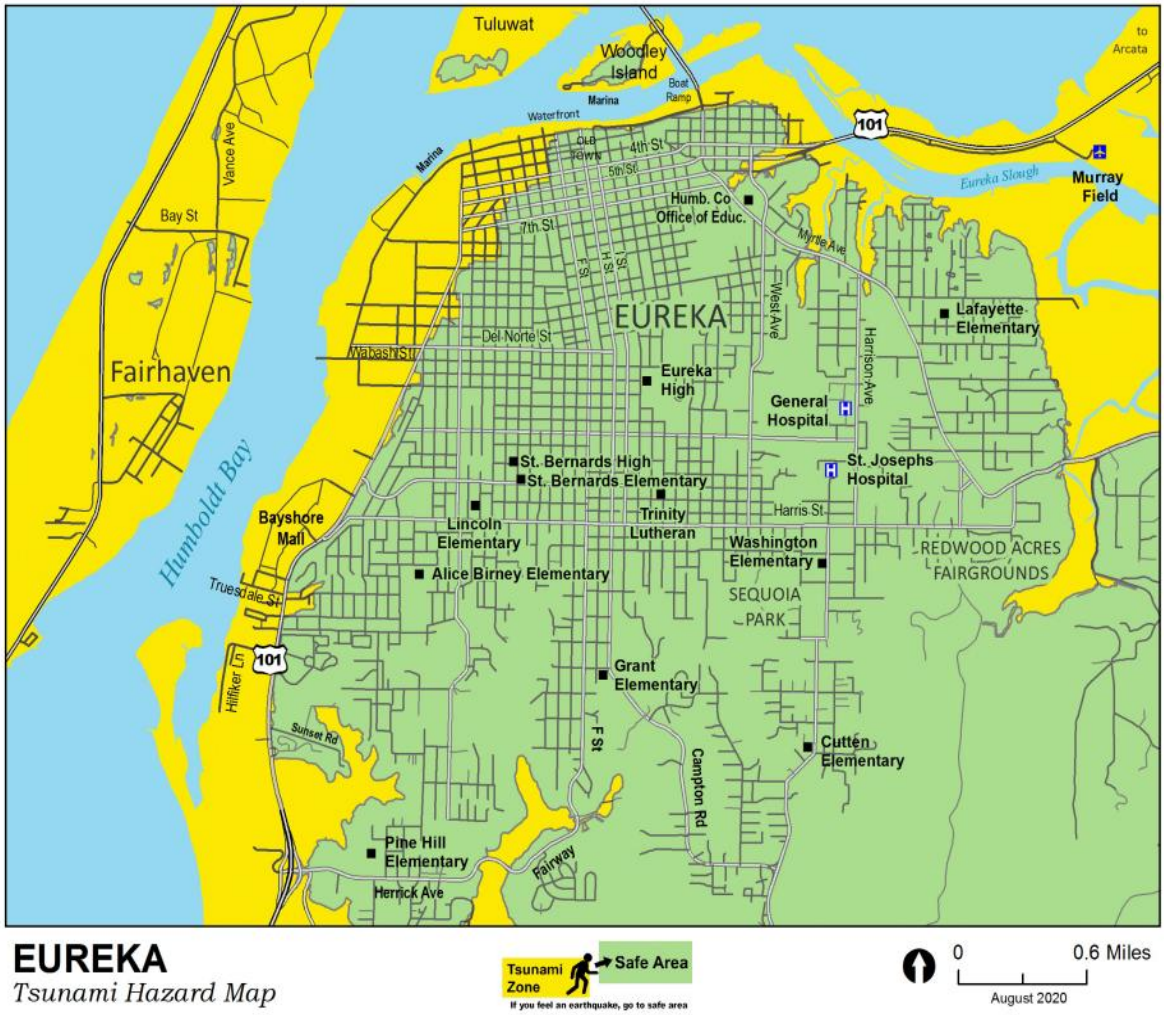
On the West Coast of the United States, Humboldt County was first to use tsunami warning signs on roadways. But Crescent City in Del Norte County, being the most at-risk California community, has been ahead of all other communities in its tsunami assessment, preparations and community education.

The Cascadia Subduction Zone runs from Northern Vancouver Island in Canada to Cape Mendocino in California.

The geography of Humboldt County and Humboldt Bay is significantly different from Crescent City's, resulting in a much lower tsunami risk. However, the risk for Humboldt can be substantial. Most at risk in Humboldt County are King Salmon, Fields Landing, and the Samoa Peninsula. Eureka is at risk, but the vulnerable waterfront areas are a narrow band; the majority of Eureka is within the scientifically and historically projected safe zone of a 2,400-year tsunami event. Most development in downtown and Old Town are outside the tsunami hazard zone. One need only walk a few blocks away from the waterfront to safety.

Most of Arcata's vulnerable areas are in pastureland or undeveloped areas.

Residents and visitors often don't know if they are in a tsunami hazard zone. 98% of county residents live safely beyond the tsunami hazard zone and do not have to leave during a tsunami alert. If you happen to be in a tsunami hazard zone when the alert is issued, remember the mantra "Don't drive, walk." Keeping roads open and accessible to emergency services is critical to reach affected areas with emergency needs. Most people will have plenty of time to walk a few blocks out of the danger zone. Know your zone.



California Geological Survey map of Eureka area showing tsunami and safe zones.[35]

[35] California Geological Survey Tsunami Hazard Zones See also interactive map at CGS Tsunami Map

Pavement tsunami warning signs have proven very effective when combined with vertical signage, education and drills. It is especially cost-effective, and communicates quickly and simply where safety lies. The pavement warnings can be seen in the daytime even in heavy traffic by both drivers and pedestrians.

Pavement signs communicate essential emergency safety information even when digital sources or cell phone services are unavailable or are not working.

Examples of vertical and pavement tsunami warning and evacuation signs in New Zealand, Japan and Oregon.

Signs can be painted onto the pavement, which is very inexpensive initially, but must be inspected regularly and repainted every few years to remain effective. If painted, highly reflective paint that can be seen both day and night should be used. Alternatively, thermoplastic signs, plastic signs applied using heat, though initially more expensive, can last five to ten years. Thermoplastic signs can be made of a tar-based substance that is applied with a purpose-specific primer and propane torch or infrared heater, bonding the sign to the pavement providing durability and longevity. They can be made using glass beads embedded in the coating to provide night reflectivity.

Sign location must be carefully determined and strategically placed based on current scientific modeling and mapping of the maximum possible wave run up. Humboldt County's tsunami map was updated by the California Geological Survey in 2021 using improved data and modeling techniques. Significantly, the updated modeling, based on a magnitude 9.0 local Cascadia Subduction Zone earthquake, reduced the projected inundation area, moving it closer to the shoreline. Typically, a city or county safety manager would select the most effective, strategic and accurate placement of the "blue line" pavement signs on non-state roadways.

For our local roadways, the Humboldt County Office of Emergency Services provides the hazard mapping for locating the markings, while Caltrans is responsible for determining location and installation of tsunami pavement markings on state roadways.

City or county roadway signs in Humboldt County must be approved by traffic engineers within their jurisdiction, while state roadway signs must be approved by Caltrans engineers. All signs, including painted pavement or decal signs, must meet the requirements set forth in the Manual on Uniform Traffic Control Devices (MUTCD), which regulates all United States official road markings.[36]

There are some hurdles which must be overcome if such signage were to be employed anywhere in Humboldt County. There is no specific section in the MUTCD covering tsunami pavement signage. However, this may be allowed under MUTCD section

[36] Full manual: MUTCD

1B.05 as experimental signage by following the prescribed procedures in that section.[37] This section controls non-standard signs or markings that have proven effectiveness. An application for use of experimental signage must be submitted to the Federal Highway Administration and federal approval granted. Both Oregon and Washington have met these requirements and successfully employed pavement tsunami-related markings.

Tsunami warning markings could be permitted under a different MUTCD section.[38] Local traffic engineers may approve deviations from the MUTCD under Section 3B.20 if safety and justification for the exception are proven.

Horizontal pavement tsunami hazard signs are typically blue and white. MUTCD reserves the color blue on pavement to indicate parking for disabled persons, but it does allow for blue to be used in approved experimental signage as has been done in Oregon and Washington with their “blue line” tsunami pavement markings.

Vertical signs can blend into the background and be missed due to “sign blindness” or panic, while pavement signs are ever-present visual reminders to visitors and community members. Pavement signs increase awareness of the environment and how and where people can move to safety. If a large earthquake were to occur in our area, everyone needs to get to safety immediately. The blue line is an intuitive communication that does not require language skills; this is important in areas that frequently host a large number of tourists or visitors, particularly those that do not read English. The simplicity of this message - one side of the line = danger; the other side = safety - can save lives when seconds matter.

Vertical tsunami warning signs are also found along some trails in county, state, and federal parks warning users when entering and leaving tsunami hazard zones. Pavement markings can also be used on paved trails.

[37] See page 6 for MUTCD Experimental signage
[38] See page 575 for MUTCD Section Covering Street Markings

Signs and markings are an effective and inexpensive method for communicating tsunami hazard zone boundaries.

A blue line tsunami marking on paved trail with vertical tsunami hazard zone sign at the trail edge.

Electronic Notification Systems

Tsunami warnings in Humboldt County currently rely primarily upon an electronic notification system which delivers urgent messages via phone or text warning of an actual or potential emergency. Following an earthquake, the National Tsunami Warning Center in Alaska may initiate an alert if the quake is sufficient to generate tsunami waves. The alert will take the form of a warning, an advisory, a watch, or an informational statement depending on earthquake magnitude, location, depth, and water-level data. Information about the likely size of the waves and where they will likely impact are included in the alert.

National Weather Service chart showing definitions for tsunami alerts.[39]

Cell phone users can register to receive emergency wireless alerts through the Humboldt County Office of Emergency Services site. If cellphone settings allow, an alert will sound and a message explaining the alert is shown. According to the official Humboldt County Tsunami webpage, "Alerts are sent automatically via Wireless Emergency Alert (WEA), when an earthquake of magnitude 7.1 or greater occurs in a coastal area."[40]

A big problem for Humboldt County is the multiple occurrences of federally issued tsunami alerts that were generated from out of state and included vast areas that were not actually at any risk. These caused extensive and unnecessary evacuations and traffic jams which blocked emergency vehicles. Because of the repeated inaccurate federal agency generated alerts, the community could be at risk of suffering from alert fatigue. This is dangerous because in the event of a real hazard or danger, lives may be lost. People who have been affected by incorrect and inconsistent alert messaging may not take real dangers seriously.

[39] National Weather Service Tsunami Alerts
[40] Humboldt County Tsunami webpage

Humboldt County cannot modify alerts from these systems, which are controlled by the National Weather Service, a federal agency. Humboldt County can issue more accurate alerts but these additional alerts could contribute to the confusion. Nonetheless, there are steps local governments can take to counter some of this confusion and minimize panic. These include:

- Painting tsunami warnings on roadway pavement indicating the tsunami hazard zone boundary;
- Placing tsunami warnings and tsunami maps on kiosks;
- Coordinating local maps with the California Geological Survey maps;[41] and
- Installing a locally-controlled wireless alert system.[42]

Improvements to emergency warning systems accelerated after Hurricane Katrina, when President George W. Bush established a new program to modernize and integrate existing systems.[43]

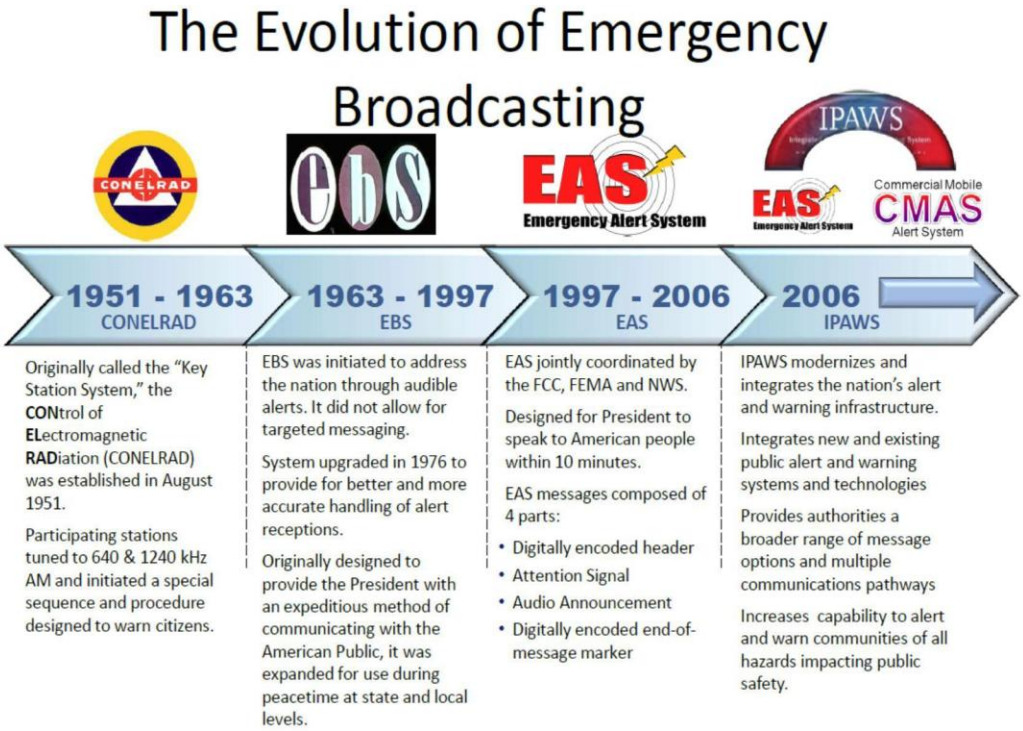


Image from https://en.wikipedia.org/wiki/Integrated_Public_Alert_and_Warning_System

[41] Geological Survey maps use yellow to show tsunami danger zones and green to show safe zones.
[42] Example of a locally controllable wireless alert system
[43] Integrated Public Alert and Warning Systems

Modern enhanced warning technology now enables locally controlled messaging based on geolocation, (the technology of determining the real-world physical location of a device such as a smartphone), including features such as integration with IPAWS, two-way communications, and automatic translation.

These enhanced warning systems, if implemented, would enable the Humboldt County OES to configure local geolocations specific to our tsunami hazard zones and target distinct messages for each. For example, Shelter Cove's alert could tell people in the tsunami hazard zone to go to the fire station, while Eureka's alerts could direct people to walk to 3rd street.[44, 45]

Rather than alert people based on their physical location during the April tsunami alert drill, subscribers to the Humboldt Alert[46] system were targeted by their residential address. With recent technological advancements now allowing alerts based on geolocation, this was a missed opportunity to alert people who were in the tsunami hazard zone at the time the alert went out.

The current wireless alert system used by Humboldt County may have geolocation capability, but is not being consistently utilized. Geolocation should be used so that specific at-risk areas can be alerted, without simultaneously alerting those not at risk. If the current system does not have geolocation capability, the County should explore alternatives that do.

Maps

The City of Eureka publishes a tourist brochure which includes a map of the Old Town and greater Eureka area. The current map does not indicate tsunami hazard zones. For its next publication, the map could be updated to indicate tsunami hazard zones, coordinated with the California Geological Survey maps using green to indicate safe and yellow to indicate unsafe zones.

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[44] Regroup Emergency Alerts
[45] Everbridge Natural Disaster Management
[46] Humboldt Alert System

Kiosks in Eureka Old Town could be used to display maps indicating tsunami hazard zones and safe zones when next updated. These could also use the California Geological Survey green and yellow markings.

Murals

Many tsunami-prone communities use murals as a way not only to remember disasters that have occurred in the past but also to warn new visitors about local hazards. Crescent City has a long history of tsunami damage. As recently as July 30, 2025, a tsunami caused over $1 million in repair costs to the harbor. Tourists and residents alike can take a half mile self-guided "Tsunami Walking Tour", starting at the Crescent City Del Norte County visitors center and ending near the "SeaQuake Brewery." The tour highlights the 1964 disaster, where waves over 20 feet impacted 29 city blocks causing a minimum of $15 million of damage (1964 dollars).[47] Art murals depicting Crescent City's tsunami history can be found in downtown areas close by.

Crescent City mural by muralist Art Mortimer depicting images from the 1964 Crescent City tsunami.[48]

[47] 1964 tsunami costs
[48] Crescent City mural of 1964 tsunami

A ceramic mosaic mural, showing the relationship between a tsunami near Crescent City's sister city Rikuzentakata, Japan, and a boat driven by the tsunami to Crescent City's shore, was created by local artists and installed in Crescent City.

Sister city representatives from Crescent City and Rikuzentakata, Japan, by a mural of the tsunami wave and beached Japanese boat from the Japan 2011 earthquake.[49]

In 2013, The Art Center College of Design, located in Pasadena, offered a course under their "Design Matters Art Center Project"[50] to create media for conveying the dangers of tsunamis to the public. Project co-partners included:

- California Emergency Management Agency
- Center for Research on Environmental Decisions
- National Weather Service
- Rand Corporation
- UCLA Center for Public Health and Disasters
- Washington Emergency Management

This is a great example of how agencies, corporations and professional schools can work together to help save lives and educate the community.

[49] Crescent City sister city tsunami mural
[50] Design Matters Art Center Project

The City of Eureka is currently planning a tsunami art mural project with The Ink People, Eureka Main Street, Wiyot Tribe and the Eureka Cultural Arts District Leadership Council. The project is focused in the cultural arts district in Old Town. This area has the highest population density in the tsunami hazard zone as well as the most visitors to the city.

Funding

If "blue line" pavement warning signs, or updating the Eureka City visitor maps or kiosks to include tsunami hazard zones, are considered, several potential funding sources could cover the majority of the costs:

- Hazard Mitigation Grant Program[51] This program is administered by FEMA through the California Office of Emergency Services.
    - Funding is made available for disaster related projects which includes planning, studies and evacuation signage. Accessing money through this source requires that there be a federal emergency disaster declaration, after which an entity (such as a city) can file a Notice of Interest with California Office of Emergency Services for funding to mitigate a future occurrence. This funding usually requires a 25% local funding match to the 75% federal contribution.
    - Newer data and modeling have changed the tsunami hazard zone risk boundaries. An application to adjust signage and add new pavement markings consistent with the new map might be approved as a risk reduction measure.
- Building Resilient Infrastructure and Communities[52] This federal grant program, also administered by FEMA, focuses on hazard prevention and mitigation projects. Local governments can apply for grants which can be used to fund both planning and construction of tsunami evacuation pavement markings. The cost

[51] FEMA Hazard Mitigation Grant Program
[52] FEMA Building Resilient Infrastructure and Communities Program

for adjacent vertical signs, based on the new, updated and relocated tsunami hazard zones can be included.

- Flood Mitigation Assistance[53] This is an additional source administered by FEMA that funds projects that reduce risk of flood damage. Projects that combine tsunami hazard risk mitigation with flood risk mitigation might be eligible for funding under this program.
- Education and Outreach Grants These grants are administered by NOAA's National Tsunami Hazard Mitigation Program.[54] Funding may be provided for tsunami education and hazard assessment. Washington State has obtained funding through this grant program for mapping and evacuation walk maps. An application could be made for funding community education and outreach associated with a tsunami "blue line" pavement marking or other tsunami preparedness projects.

Possible funding sources for an enhanced wireless alert warning system include:

- Next Generation Warning System Grant Program[55] This is a FEMA grant program intended to enhance alert and warning capabilities and improve resiliency of emergency alert and warning systems.
- Cal OES Next Generation Warning System Grant Program[56] The purpose of this state grant program is to enhance public safety in California by implementing alert and warning solutions that deliver timely emergency information to the public and help protect critical infrastructure.

[53] FEMA Flood Mitigation Assistance Grant Program
[54] NOAA/NWS Tsunami Activities Grants Application Process for Local Governments and Tribes
[55] Next Generation Warning System Grant Program
[56] Cal OES Next Generation Warning System Grant Program

CONCLUSION

There are many avenues that can be pursued that will reduce risks, save lives, educate the public, and increase awareness of tsunami hazards in Humboldt County.

The City of Eureka is taking a new approach to increase public awareness and emergency preparedness. Thanks to the City's efforts and the opportunities it recently offered in its Tsunami Preparedness Workshop for Businesses, tsunami emergency preparedness is being embraced by a growing number of community-oriented local businesses in the Old Town tsunami hazard zone. Businesses that participated now have a step-by-step tsunami emergency plan. Experts had long called for business engagement in tsunami emergency preparation as a vital component for community safety.

This tsunami preparedness workshop model could be used to train staff and users of municipal public venues that are within tsunami hazard zones, for those that have not already received the training.

Sirens were a mainstay for decades, providing audible alerts in the event of a tsunami. They are, however, extremely expensive. Newer technologies provide a cost-effective way to reach more people, while at the same time giving them more information than a siren alone could convey.

Wireless technology can send alerts to cell phones based on the geographic location of the phone itself. New alerting systems allow local OES teams to target audiences much more granularly and send alerts specifically to pre-determined areas.

Tsunami "blue line" safety zone pavement markings are one proven, highly effective and logical next step for Humboldt County's tsunami preparedness. Highly visible, intuitive pavement markings, placed on city and county-maintained roadways and paved trails are easily understood even in moments of panic, and can reduce future risks, and with little cost. Grant opportunities can further reduce costs.

The “blue line” educates and reminds both residents and visitors of the unique maritime nature of our community and what its proximity to the ocean can mean. Knowledge, awareness and education relieve unfounded fears and reinforce a sense of safety and security - “Knowledge is power.”

Current Eureka Old Town kiosks can be used to provide added emergency information for visitors by including maps with color-coded tsunami hazard and safe zones, in coordination with California Geological Survey maps’ color-coding. This could be done the next time the kiosks are renovated or updated. Likewise, the City of Eureka visitors map of Old Town, when republished, could include indications of the tsunami hazard and safe zones by using matching yellow and green colored areas.

Eureka’s widespread reputation for its many art murals, a magnet for tourists, could be turned to advantage as a tool bringing public awareness of local tsunami hazards to visitors as well as residents. A consortium of local agencies already engaged in this project are applauded and encouraged to bring it to fruition.

FINDINGS

The Humboldt County Civil Grand Jury finds that:

F1: The City of Eureka exhibits foresight in assisting local businesses in the tsunami hazard zone to become tsunami prepared by sponsoring the Tsunami Preparedness Workshop for Businesses, improving safety and reducing risk.

F2: The Ink People, Eureka Main Street, Wiyot Tribe and the Eureka Cultural Arts District Leadership Council are collaborating on an educational tsunami art mural project to bring tsunami awareness to visitors and residents alike, increasing safety.

F3: Humboldt County tsunami sirens are costly, inadequately funded, and nearly all are non-functional, leaving large tsunami hazard zone areas without siren coverage. **(R1)**

F4: “Blue line” markings that indicate "Leaving Tsunami Zone" have proven effective and economical in drawing public awareness to where safety lies in the event of a tsunami, providing quick, instantly understandable emergency directions and reducing risks. **(R2)**

F5: Local printed tourist maps do not indicate tsunami hazard zone boundaries; this is a missed opportunity to educate visitors where the tsunami hazard zones are. **(R3)**

F6: Eureka Old Town kiosks do not include maps with color-coded tsunami hazard and safe zones; this is a missed opportunity to educate visitors where the tsunami hazard zones are. **(R4)**

F7: Alaska-based federally operated tsunami wireless alert systems have historically been targeted to overly broad areas of the west coast, resulting in local false alarms, confusion and needless panic. **(R5, R6, R7)**

F8: Current Humboldt Alert wireless messages are sent based on residential addresses rather than using geolocation technology to pinpoint the actual physical location of the person’s phone. This can result in people who do not live in a tsunami hazard zone missing an alert during an actual tsunami event. **(R5, R6, R7)**

RECOMMENDATIONS

The Humboldt County Civil Grand Jury recommends that:

R1: The Humboldt County Sheriff direct the Program Manager of the Humboldt County Office of Emergency Services to further publicize that Humboldt County’s outdated siren system will not be replaced or expanded. This should be completed by the conclusion of Tsunami Week, 2027. **(F3)**

R2: The Eureka City Council direct the City Manager and city staff to, as time and resources allow, apply for eligible grant funding for a “blue line” project to be engineered and installed in Eureka. Grant applications should be submitted during the next feasible grant cycle. **(F4)**

R3: The Eureka City Council direct the City Manager and city staff to update the visitors map to include color-coded tsunami hazard and safe zones, in coordination with California Geological Survey maps color-coding. We recommend this be done the next time the maps are updated and reprinted. **(F5)**

R4: The Eureka City Council direct the City Manager and city staff to update the kiosks to include maps with color-coded tsunami hazard and safe zones, in coordination with California Geological Survey maps color-coding. We recommend that this be done the next time the kiosks are renovated or updated. **(F6)**

R5: The Humboldt County Sheriff direct the Program Manager of the Humboldt County Office of Emergency Services to assess its current local wireless alert system for geolocation functionality and report to the Sheriff by September 30, 2026. **(F7, F8)**

R6: If geolocation is available on the current alert system used by Humboldt County, the Humboldt County Sheriff direct the Program Manager of the Humboldt County Office of Emergency Services to implement geolocation by Tsunami Week, 2027. **(F7, F8)**

R7: If the current local wireless alert system does not have the ability to send alerts based on geolocation, the Humboldt County Sheriff direct the Program Manager of the Humboldt County Office of Emergency Services to compare the current system to other systems which provide geolocation capability, evaluate available funding, and submit a report on the outcome of that research to the Sheriff by December 31, 2026. **(F7, F8)**

RESPONSES

Pursuant to California Penal Code sections 933 and 933.05, each entity or individual named below must respond to the enumerated Findings and Recommendations within specific statutory guidelines.

Responses to Findings shall be either:

- The respondent agrees with the finding; or
- The respondent disagrees wholly or partially with the finding, in which case the response shall specify the portion of the finding that is disputed and shall include an explanation of the reasons therefor.

Responses to Recommendations shall be one of the following:

- The recommendation has been implemented, with a summary regarding the implemented action; or
- The recommendation has not yet been implemented, but will be implemented in the future, with a time frame for implementation; or
- The recommendation requires further analysis, with an explanation and the scope and parameters of an analysis or study, and a time frame for the matter to be prepared for discussion by the officer or head of the agency or department being investigated or reviewed, including the governing body of the public agency where applicable. This time frame shall not exceed six months from the date of the publication of the Grand Jury report; or
- The recommendation will not be implemented because it is not warranted or is not reasonable, with an explanation therefor.

REQUIRED RESPONSES - WITHIN 60 DAYS

The Humboldt County Sheriff

(F3, F7, F8, R1, R5, R6, R7)

REQUIRED RESPONSES - WITHIN 90 DAYS

The Eureka City Council

(F1, F4, F5, F6, R2, R3, R4)

INVITED RESPONSES

The Humboldt County Civil Grand Jury also invites the following entities or individuals to respond:

The Humboldt County Office of Emergency Services Program Manager

(F3, F7, F8, R1, R5, R6, R7)

Responses are to be sent to both:

The Honorable Judge Timothy A. Canning
California Superior Court for Humboldt County
825 5th Street, Eureka, CA 95501

The Humboldt County Civil Grand Jury
PO Box 657; Eureka, CA 95502 A

Reports issued by the Grand Jury do not identify individuals interviewed. Penal Code section 929 requires that reports of the Grand Jury not contain the name of any person or facts leading to the identity of any person who provides information to the Grand Jury.

APPENDIX A

Eureka Business
Earthquake & Tsunami Toolkit

Post this envelope in your business.

Business Name: _____

Address: _____

Created on: April 20, 2026

IF YOU FEEL STRONG SHAKING (20+ SECONDS):
EVACUATE IMMEDIATELY. Do not wait for alerts. Move to high ground on foot.

During Earthquake

DROP. COVER. HOLD ON. Protect yourself first, then assist others.

After Shaking Stops

CALL OUT: "EVACUATE TO HIGH GROUND NOW"

- Leave immediately on foot
- Do not delay for belongings
- Take this envelope
- If possible, post "EVACUATED" signage (inside envelope) on door

Evacuate

Primary route: _____

Alternate route: _____

Assembly area: _____

Do Not Return

Do not go back inside for any reason. Wait for offical ALL CLEAR before returning.

Important

This envelope contains your full emergency plan. Grab it on your way out.

CITY OF EUREKA CALIFORNIA

Earthquake & Tsunami Plan

Business Name:
Address:
Located in Tsunami Zone? Yes ☐ No ☐

Hazard Understanding

A local earthquake may:

- Last longer than 20 seconds
- Be followed by a tsunami within ~10 minutes
- Disable alerts, power, and communication

DECISION RULE: If shaking is strong or long, EVACUATE IMMEDIATELY

Evacuation Plan

Fill text here

Roles & Responsibilities

Fill text here

Updated 4/2026, City of Eureka

Earthquake & Tsunami Plan

Business Name:
Address:
Located in Tsunami Zone? Yes ☐ No ☐

What could go wrong?

- What if exit is blocked?
- What if it's dark and chaotic?
- What if you are at full capacity?

Communication

After reaching safety:

- Who should be contacted?
- List contact information
- What will your roll call process be?

Go Bag

Location (must be within 5 seconds of exit):
Contents:

- Employee list with phone numbers
- Flashlight
- First aid kit
- Phone charger
- Whistle

Earthquake & Tsunami Plan

Business Name:
Address:
Located in Tsunami Zone? Yes ☐ No ☐

Accessibility Plan

- How will you assist those with mobility needs, non-english speakers, children and the elderly?

Final Check

- Route is clear and realistic ☐
- Assembly area confirmed outside zone ☐
- Roles assigned ☐
- Go-bag location set ☐
- Staff can explain plan ☐

POST ENVELOPE IN YOUR BUSINESS WITH COVER PAGE FACING OUT, REST OF PLAN IN ENVELOPE TO BE TAKEN DURING AN EMERGENCY.

Updated 4/2026, City of Eureka