



Oregon Tsunami Evacuation Wayfinding Guidance

Oregon Office of
Emergency Management



Department of Geology
And Mineral Industries



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Background

Tsunamis are usually generated by great subduction zone earthquakes when the ocean floor is rapidly uplifted during the earthquake. The tsunami wave from a local subduction zone earthquake will arrive at the coast in approximately 10-20 minutes, and tsunami waves will continue to arrive periodically for several hours. When the shaking stops, people must immediately move inland to high ground. It is critical that residents and tourists know the landward extent of the local tsunami inundation zone used on evacuation brochures, their evacuation routes, and the nearest safe zones.

The most visible way to educate the public is to use wayfinding signage that guides the public to safety. According to Webster's Dictionary, *wayfinding* is defined as, "the process or activity of ascertaining one's position and planning and following a route." It is imperative that coastal communities provide clear and consistent wayfinding signage to residents and visitors alike. People will need to be able to move quickly uphill and inland after the ground stops shaking. Proper use of wayfinding signage will help people evacuate safely and quickly no matter the time of day or weather conditions. This guidance document is a starting point for communities developing their own wayfinding system. There are more resources listed at the end of the document.

There are several categories of tsunami signs available:

- tsunami hazard zone,
- tsunami evacuation route,
- tsunami assembly site,
- and entering/leaving tsunami hazard zone.

Each of these are examined in more detail throughout this document.

Several of these signs were originally created in Oregon, while others have been adapted from elsewhere. The tsunami hazard zone and evacuation route signs have been adopted for use by the Pacific states of the National Tsunami Hazard Mitigation Program steering group (Alaska, California, Hawaii, Oregon, and Washington). Other Pacific Rim countries have also either adopted or adapted the signs for their use. To insure consistency of sign placement, the following guidelines were developed for each of the signs. Installation of tsunami signs on state highways must be approved and coordinated with the Oregon Department of Transportation (ODOT).

Government entities can order all signs from the ODOT Sign Shop (503-986-2805). Also contact ODOT for guidelines on sign installation (post size, attachment methods, etc.).

Contact Oregon Office of Emergency Management (503-378-2911) for further information on tsunami evacuation wayfinding, and the Oregon Department of Geology and Mineral Industries (541-574-6658) for sign styles and locations (e.g. blue lines painted on roads, “Entering-” and “Leaving Tsunami Hazard Zone” signs and locations, and You are Here evacuation signs

Tsunami sign placement guidelines

Designing your evacuation route

As your community moves forward to create safe and useful evacuation routes, there are some key things to consider. Begin the process by consulting with the Oregon Department of Geology and Mineral Industries (DOGAMI) and Oregon Emergency Management to identify and locate the best routes to high ground based on the most recent mapping and modeling.

Working with community stakeholder groups, prioritize the routes based on population and level of risk. Develop a public education and outreach program to let the public know more about the routes and how to practice their routes to high ground.

It is important to understand that at the time of the earthquake, the objective of every person is to immediately head to their nearest safety destination (or *escape point*) on high ground, and not necessarily designated Assembly Area sites shown on evacuation maps. The reason is that in many communities these Assembly Areas may not necessarily be the closest safety destination for many residents and tourists. As a result, when educating the public it is important to emphasize that the first objective is to survive the tsunami. This can be achieved by evacuating to the nearest high ground escape point.

Since local tsunami waves will be catastrophic in the first 6 hours and will last at least 12 hours after the start of earthquake shaking, evacuation to the nearest designated Assembly Area site should not be attempted until a minimum of 12 hours has passed. When re-entering the tsunami inundation zone the public will need to adopt a 'cautionary re-entry' approach. This approach will vary based on the unique characteristics of each community and in particular on how spread out and isolated the public will be. In all likelihood, an official all clear may not come from community leaders, but could be disseminated via NOAA weather radio. Regardless, knowing when and how to re-enter the inundation zone must be part of any education and

outreach messaging undertaken in each community. Post-tsunami help will likely be provided at designated Assembly Area sites first.

Community route planning should therefore account for the entire route from beach to nearest safety destination (high ground escape point). Every route should ideally have a destination assembly point or collection area. These should be clearly distinguished from official post-tsunami assembly areas where caches or amenities have been stored, and post disaster response planning will be targeted first. Having clearly defined assembly areas will aid in post-tsunami response as people will know to go there after the event.

Along the route, there will be decision points such as intersections. There should be clear line-of-sight signage or route markers so that the person evacuating always knows which direction to go, even in low light.

Tsunami sign placement guidelines

The most visible way to educate the public about escape routes and shelters is to post signs. Where available, sign placement should be guided by evacuation (Beat the Wave) modelling results that have been completed by DOGAMI. These data can be found on the Oregon Tsunami Clearinghouse web site¹. Additional guidance information may be found in local 'Tsunami Evacuation Facilities Improvement Plans (TEFIP)' that is being spearheaded by the Department of Land Conservation and Development agency in consultation with local communities².

Unfortunately, there is no clear guidance for what is the ideal spacing of signage. What is evident from efforts implemented around the world is that evacuation routes should be clearly marked with appropriate signage along the entire route (e.g. Figure 1). Such signage need to be installed in advance of the event and will need to be maintained into perpetuity. Funding to assist this effort may be obtained through DOGAMI and OEM, via the National Tsunami Hazard Mitigation Program (NTHMP).

¹ <http://www.oregongeology.org/tsuclearinghouse/beatthewave.htm>

² <https://www.oregon.gov/LCD/OCMP/Pages/TsunamiGuideIntro.aspx>

Wayfinding signage should reflect an end-to-end plan that incorporates signage in high traffic areas such as State Parks or public waysides (Figure 1, top left). Signs should also be visible from the beach. The example in Figure 1 (top right) is a beach stair access in Cannon Beach, with additional signage established on posts along the evacuation route. Appropriate signage may also include signs painted on roads or the footpath, and may include additional information such as distance to safety (Figure 1, bottom left). Finally, a leaving tsunami sign may be used to define the point at which one reaches the nearest safety destination and leaves the tsunami inundation zone (Figure 1, bottom right). Such signage should include Spanish translation.

Effective sign placement and spacing is a function of visibility (line of site, lighting (day vs night vs fog), the presence of vegetation, and curves in the road or trail) and the ability of the person to read the text. In road engineering, it is well established that *icons are much easier to comprehend and understood* compared with text, and hence can be interpreted further away. In general, 3" size text can be viewed by the average person ~100 ft away; text of this size is most easily read at ~30 ft from the sign. For 6" size text, the signs can be read ~200 ft away, while easy readability is at ~60 ft. These data suggest that signs are probably best spaced ~60 ft apart (if the goal is to read the text), but may be as much as 100- 200 ft apart given the use of a combination of text and icons.

As noted previously, visibility under different conditions is a major consideration. Since the above readability values are based on the average person under ideal conditions, communities should be mindful of the fact that wayfinding signage need to be visible in both daylight and at night. The worse-case situation is almost certainly a Cascadia event occurring at night, which suggests that signs will probably need to be spaced more closely together. Consideration of other means to illuminate signs should also be evaluated. For example, signs painted on pathways could utilize fluorescence, while signs on post could incorporate solar panels and energy efficient LEDs. In all cases, the placement of signs along given evacuation routes should be carefully evaluated to ensure the correct spacing and messaging.



Figure 1. An end-to-end evacuation route plan consists of (A) 'You are here' signage and route guidance for high traffic sites; (B) Guidance signage established at the start of the route used in Cannon Beach and visible from the beach, as well as signage on posts along the route (C). Signage may also be painted on roads or footpaths with distance to safety identified (D). Finally, signage indicating that you have reached your safety destination (escape point) and have left the inundation zone needs to be identified along every evacuation route (E).

Tsunami evacuation route signs

Signs that identify the evacuation route could incorporate both vertical signage placed on signposts, as well as signs painted on a road or pathway (Figure 1). A new addition characteristic of Japanese signage is the inclusion of a distance to safety, in addition to the arrow. This is an approach that should be incorporated in evacuation wayfinding signage for the Oregon coast. Examples from Japan include signs affixed to conventional posts (Figure 2), and painted on roadways (Figure 3). Other approaches have utilized solar panels and lights (e.g. LEDs) to illuminate the evacuation route at night (Figure 4).



Figure 2. Examples of evacuation routes signs affixed to posts.



Figure 3. Examples of “You are Here” signage attached to posts, as well as painted on roadways and paths. Note the inclusion of distances on the signage, which help inform people how far they are to safety.



Figure 4. Use of solar panels help to illuminate signs during night time.

(source: Fraser and others, 2012)

Tsunami hazard zone

This sign should be placed at locations within the tsunami hazard zone as defined by local evacuation maps, detailed tsunami inundation maps or, if these are not available, tsunami hazard maps used to implement Oregon Revised Statutes 455.446 and 445.447³. The statutes limit construction of critical and essential structures in the mapped tsunami inundation zone.

The sign comes in two sizes: 22 1/2" x 18" and 30" x 24". The size needed depends on where you plan to install the sign. It is important that the sign be visible, especially when located in areas where many people congregate (beaches, parks, and developed waterfronts).

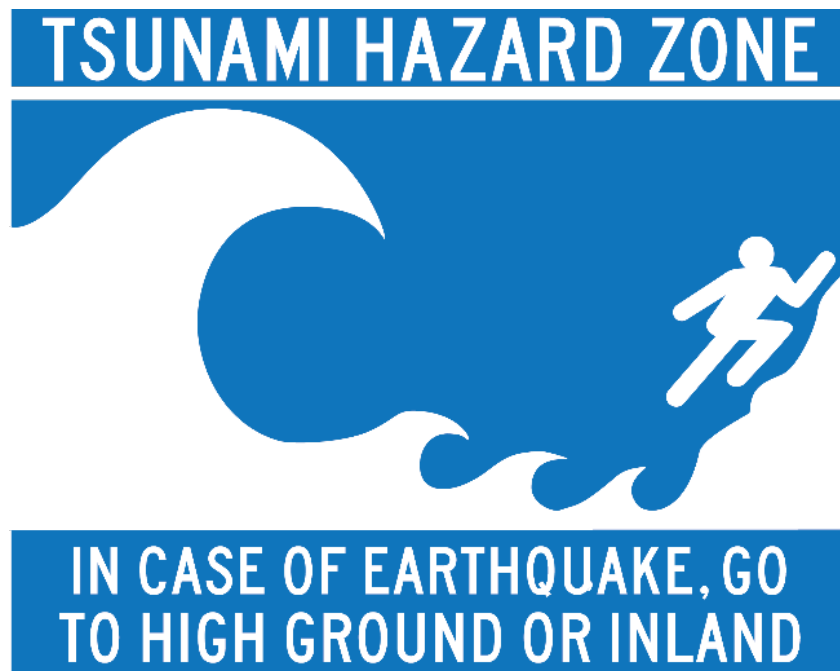


Figure 5: Tsunami Hazard Zone sign

³ <http://www.oregongeology.org/tsuclearinghouse/pubs-regmaps.htm>

You are Here Maps

DOGAMI has been developing “You are Here” tsunami evacuation maps in high traffic sites along the Oregon coast. To date these signs have been established at some 132 sites. In particular, a concerted effort was undertaken in 2017 between DOGAMI, Lincoln County Emergency Management and the Oregon State Parks Recreation Department to establish “You are Here” signage at every beach access point throughout Lincoln County.

These signs are printed on large format 3x4 ft aluminum sheets (4 mm thick). Signs are developed by DOGAMI staff in consultation with the local community, while sign installation is completed by the requesting community. To ensure consistency with the tsunami evacuation brochures, design of the “You are Here” signage is entirely consistent with the evacuation brochures produced by DOGAMI in 2013 (<http://www.oregongeology.org/tsuclearinghouse>). Signs clearly indicate the following:

- “You are Here” location (ideally this could include either a distance or time to safety);
- Evacuation zones (distant and local);
- Green safety zone, along with safety destinations identified on every road or trail;
- Primary evacuation route from the “You are Here” location, along with secondary routes for other locations in the map.
- Where available, critical facilities that define Assembly Areas, Fire, Police, Hospitals, and Schools.

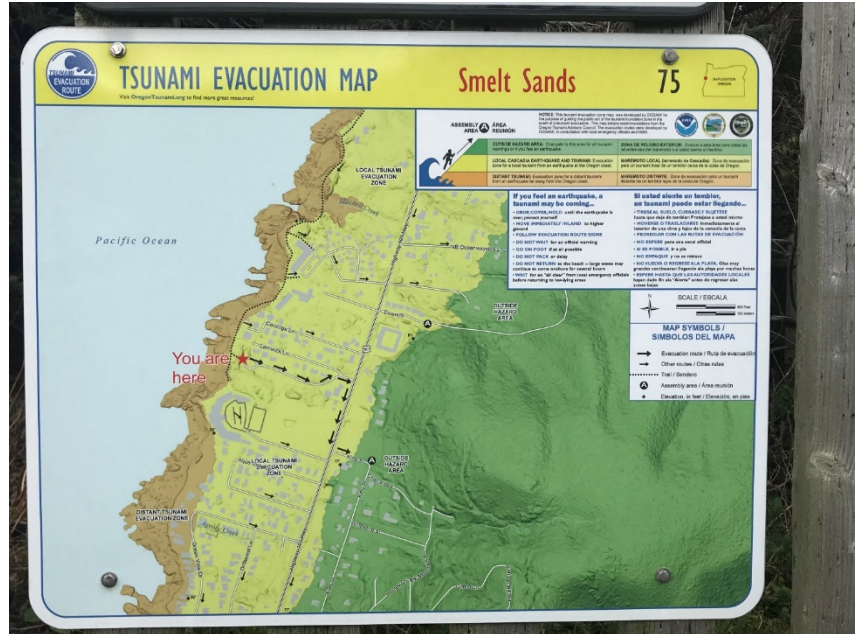


Figure 6: Example “You are Here” sign developed for Smelt Sands in Yachats.

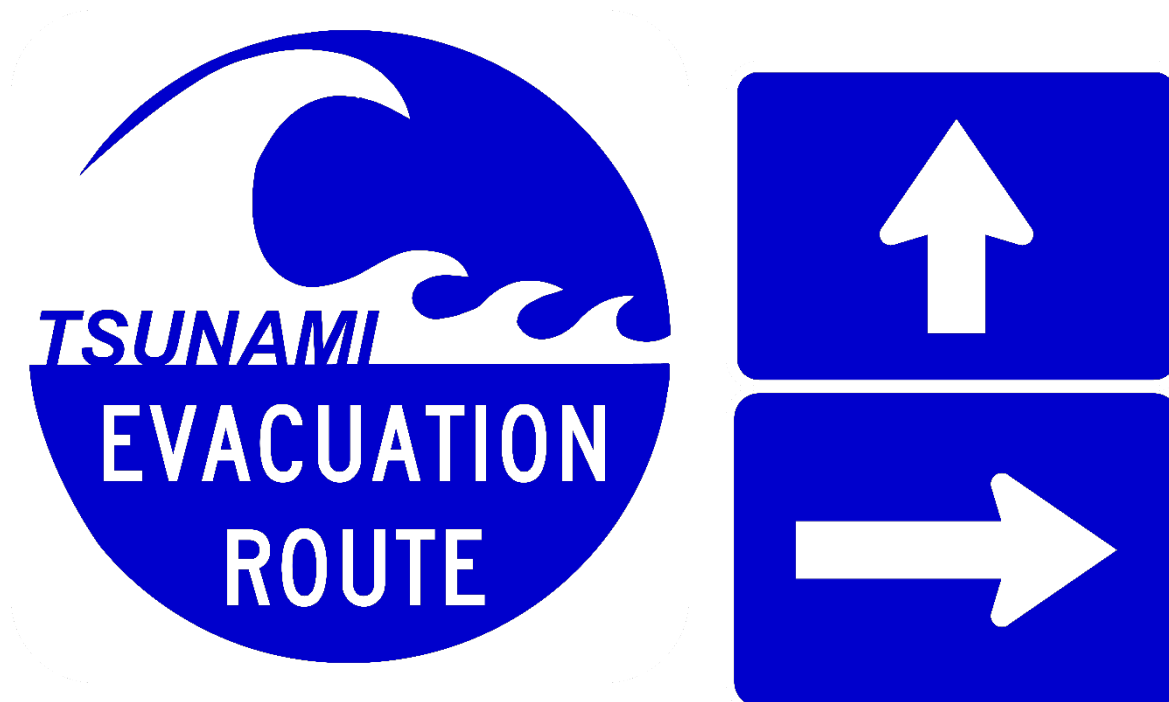
Tsunami evacuation route

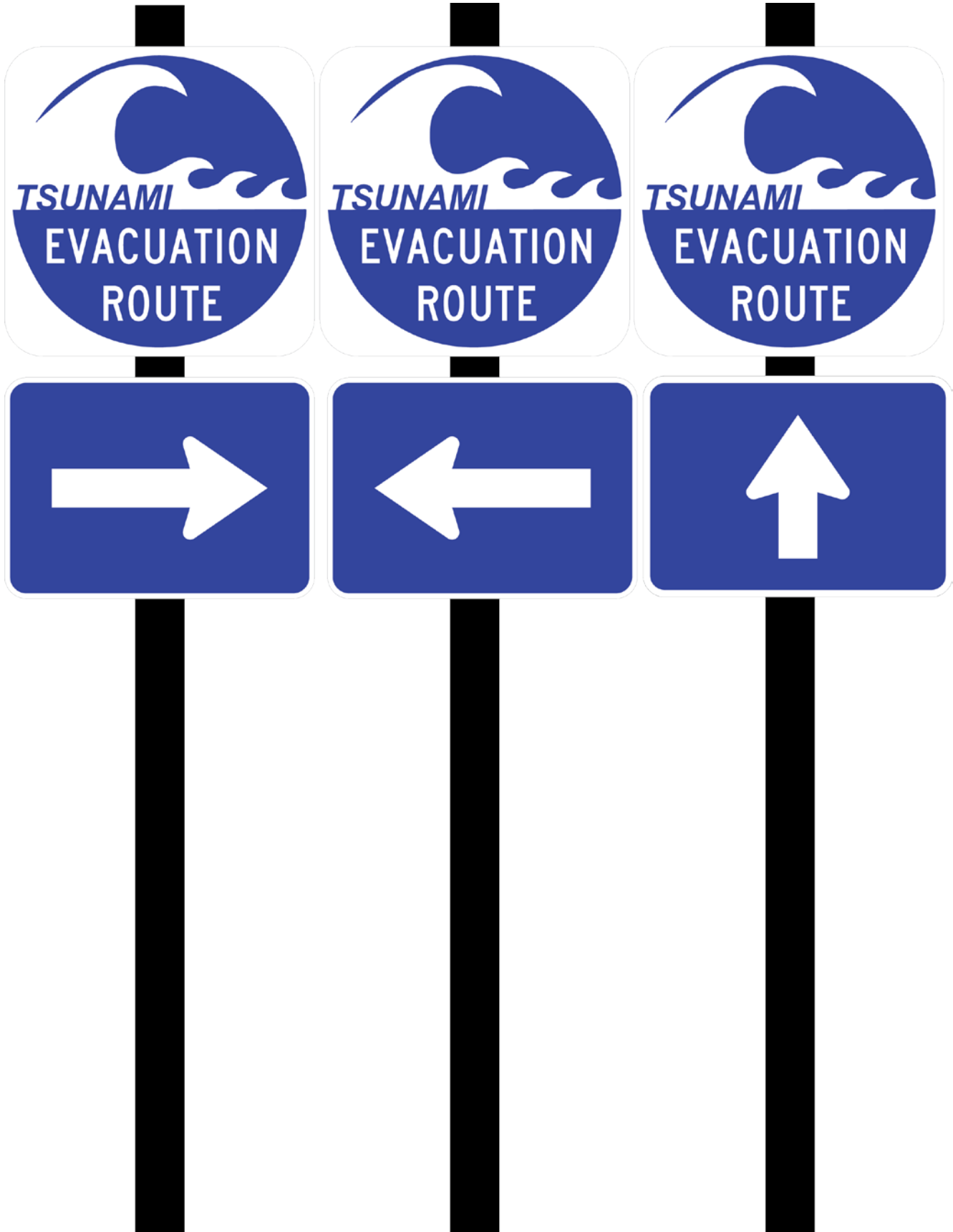
This sign should be placed along roads designated as tsunami evacuation routes that take people out of the tsunami hazard zone. Evacuation routes are identified by local governments.

At present the sign comes in two sizes: standard size is 24" in width and a minimum of 18" in width. Due to Federal Standards, ODOT will no longer make the round signs. It is important that the sign be visible; thus the larger sign may be warranted in some situations.

It is recommended that an arrow sign be used in conjunction with the evacuation route sign to insure that people go in the right direction. The orientation of the arrow sign with respect to the evacuation route sign may vary.

An arrow plaque should be used to show the recommended evacuation direction, whether left, right, or straight ahead."





Tsunami assembly area

This sign can be placed outside of the tsunami evacuation zone indicating that people do not need to go further inland or uphill. It could also be placed at a pre-designated destination or assembly area. An assembly area does not necessarily mean that there will be shelter or supplies available. It is a pre-designated meeting place to aid in response efforts.

This sign also comes in two sizes: 18" x 22" and 24" x 30". Once again the sign should be visible so choose the right sized sign for the location.



Entering and leaving the tsunami hazards zone

DOGAMI, in partnership with ODOT, is working to ensure Entering and Leaving tsunami hazard zone signs are installed along the length of the Highway 101 system, as well as certain critical secondary highways that intersect with Highway 101. To date, ~175 signs have been installed on the central to northern Oregon coast (Lincoln, Tillamook, and Clatsop counties). The final phase of sign installation planned for the south coast is expected to be completed in late 2019.

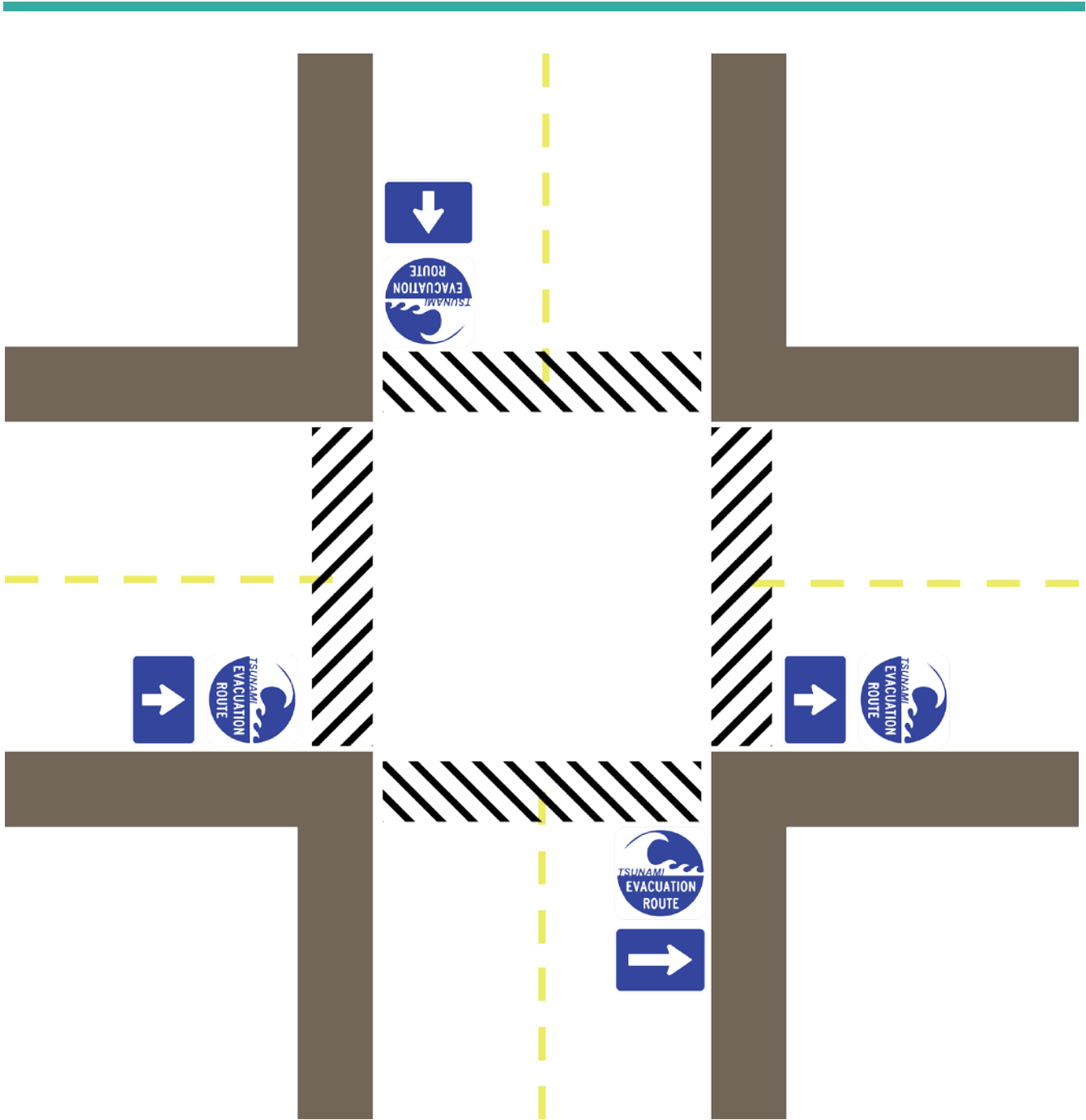
These signs should be placed on major state or county roads where the road enters and leaves the tsunami hazard zone. They should be placed on both sides of the road and at both ends of the specific stretch of road within the tsunami hazard zone. However, if the road dead ends, then signs need only be placed at one end where people are entering and leaving, such as a State Park.

The signs come in one size: 42" x 48" so it can be visible by motorists traveling at highways speeds.



Examples of proper placement of hazard zone sign and evacuation route signs



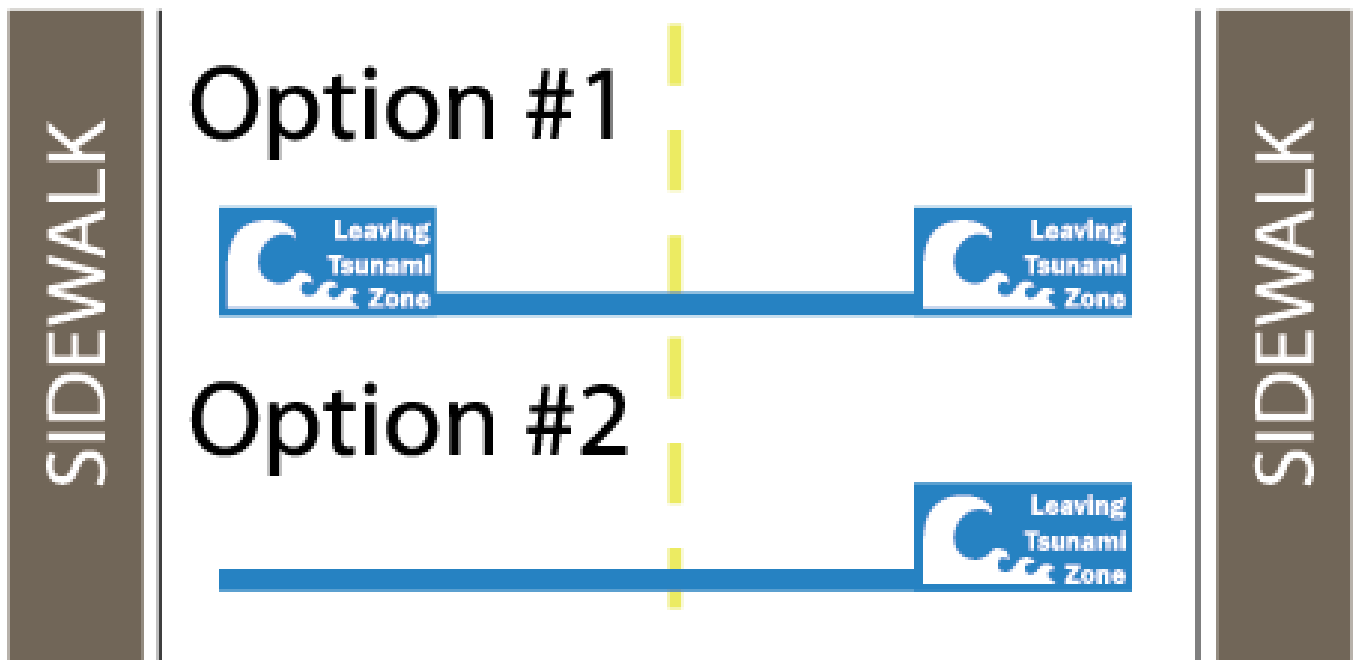


Blue Line

The tsunami blue line was first developed by the city of Wellington in New Zealand. It has been adopted by Oregon and added to our suite of tsunami evacuation wayfinding signage. This marking shows the demarcation point between the “In the zone” and the “out of the zone”. It is very useful in showing the public when they have reached a safe distance from the approaching tsunami.

Communities have flexibility in the material used to create the signage. They can choose thermoplastic or paint, depending on their own needs. The weather on the coast can be a factor in how well the signage endures traffic abrasion.

Color: It is recommended to use a lighter blue for this signage than might be used for the vertical signage. When the pavement is wet, the darker blue can be difficult to see. Reflective material can be added to thermoplastic and to paint to make the markings more visible in low light.

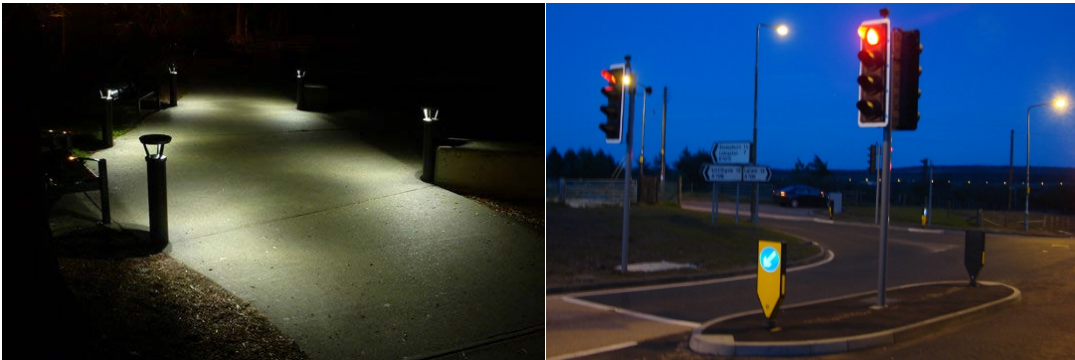


An alternative approach adopted by the City of Newport includes the incorporation of Spanish translation in the sign, with the text and graphic placed in the middle of the lane.



Accessories

Any accessories used in the wayfinding system, should not impede existing traffic control cues. This wayfinding marking allows more flexibility to keep your evacuation route marking in line with your community aesthetics. Using visual cues that the public are already familiar with will help you enculturate your new evacuation routes.



Flexible delineator post



Raised pavement reflector



Additional Resources:

- **Tsunami Sign Placement Guidelines**
 - <http://www.oregongeology.org/sub/earthquakes/Coastal/OFR0306Signs.pdf>
- **Technical Standard [TS01/08] National Tsunami Signage – New Zealand**
 - <https://www.civildefence.govt.nz/assets/Uploads/publications/ts-01-08-national-tsunami-signage.pdf>
- **Signs & Symbols - International Tsunami Information Center**
 - http://itic.ioc-unesco.org/index.php?option=com_content&view=category&layout=blog&id=1406&Itemid=1406
- **Up and Out Phase1**
 - http://www.oregon.gov/oem/Documents/Up_And_Out_Phase1.pdf
- **Up and Out Phase 2**
 - http://www.oregon.gov/oem/Documents/Up_And_Out_Phase2.pdf
- **Tsunami Evacuation Signs**
 - <https://nws.weather.gov/nthmp/signs/signs.html>
- **Tsunami Signs - Caltrans - State of California**
 - <http://www.dot.ca.gov/trafficops/tcd/tsunami.html>
- **Manual on Uniform Traffic Control Devices, Chapter 2N, Emergency Management Signing**
 - <https://mutcd.fhwa.dot.gov/pdfs/2009/mutcd2009edition.pdf>
- **Oregon sign Policy and Guidelines, chapter 5, Guide Signs**
 - https://www.oregon.gov/ODOT/Engineering/Documents_TrafficStandards/Sign-Policy-05-Guide.pdf