

TSUNAMI EXPOSURE SNAPSHOT

Lincoln City, OR

The Department of Geology and Mineral Industries (DOGAMI) has completed a tsunami damage assessment for a local Cascadia Subduction Zone earthquake and tsunami event in Lincoln City, OR. The major results are presented below along with suggested action items to increase resilience in the community. This study was designed so that public decisions might be made with the best science available.

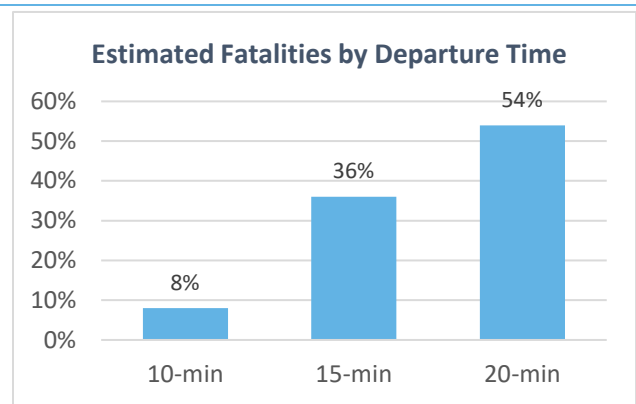


Casualty Estimates (Injuries + Fatalities)

The first tsunami wave arrives in Lincoln City **24 minutes** from the start of earthquake shaking. The wave arrival time is important for assessing a community's ability to quickly evacuate, which directly affects the potential for fatalities.

The results presented here are for the Lincoln City Urban Growth Boundary and characterize a summer weekend at 2 AM, which represents a peak number (all possible beds occupied). The summer population in the city can increase by ~6 times in the XXL tsunami zone.

Assuming a 10-minute departure time and average walking speed of 3 miles per hour, 92% of the Lincoln City summer population located within the XXL tsunami zone (temporary + permanent) is expected to survive. Departure time is the length of earthquake shaking (3-5 min.) plus milling time before someone starts evacuating. Evacuation delays could increase the number of fatalities significantly, as shown in the graph.



Longer evacuation delays can significantly increase the percent of the population that could be killed by a tsunami.

Population & Assets in the Tsunami Zone

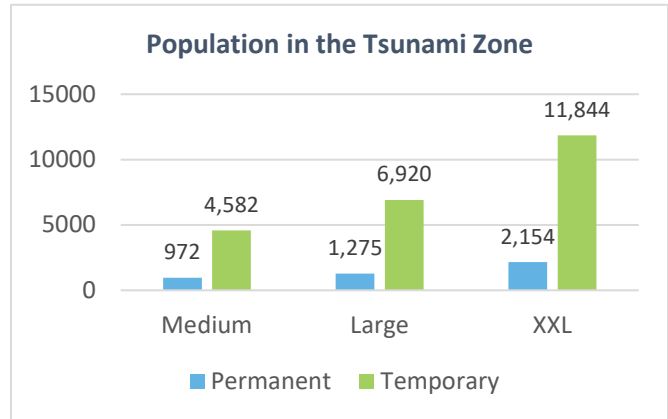
Most of Lincoln City is outside of the XXL tsunami zone due to the topography of the city on marine terraces. However, specific areas are highly impacted by the tsunami: Cutler City, southwest of Devil's Lake near the mouth of D River, and a few discrete areas in the Taft neighborhood.

People located within the tsunami zone will have to quickly evacuate to safety following an earthquake. Effective evacuation, and hence survivability, can become more difficult when additional risk factors are involved, such as visitors, older or younger individuals, or those with mobility challenges.

- About 25% of Lincoln City's permanent residents live in the tsunami zone; 30% are aged 65 years or older.
- Temporary residents could increase the local population within the tsunami zone by ~6 times in the summer.
- Most of the permanent population within the tsunami zone occupies single-family (64%) or manufactured homes (10%). Foundations of manufactured homes may fail in an earthquake, hindering timely evacuation.
- Similarly, about 65% of the temporary population stays in single-family vacation and second homes, while 23% of visitors stay in hotels/motels. A major challenge of such a dispersed temporary population is ensuring every vacation home contains site-specific earthquake and tsunami information.

- About 30% of the jobs in Lincoln City UGB are within the XXL tsunami zone.
- About 8% of the local population speaks a language other than English.
- The population affected roughly doubles from the Medium to XXL tsunami scenario (see graph).

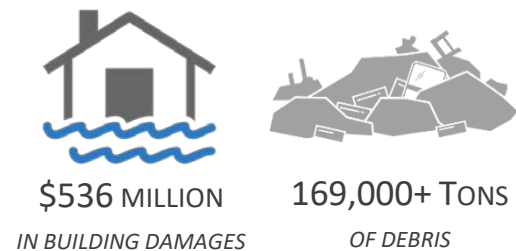
Most buildings in Lincoln City are relatively close to safety. This does not preclude the need for preparation and effective messaging. The areas of Lincoln City where successful tsunami evacuation may be challenging include Cutler City, Southeast 2nd Court just south of Devils Lake, the Taft Trailer Park at Southeast 52nd St, and residences along Southeast 51st Avenue and Southeast Lee Avenue. Landslide failure of the bluffs along Lincoln City may present another factor affecting casualties, although that was not analyzed in this study.



Temporary population = those occupying vacation rentals & second homes. Temporary population estimates are based on a peak summer weekend scenario.

Building Damage & Debris Estimates

Within the XXL tsunami zone, combined earthquake and tsunami building repair costs are estimated to be ~\$536 million (which includes ~2,300 buildings), with the bulk of the cost attributed to the destruction caused by the tsunami. The costs to repair buildings and infrastructure located outside the tsunami zone that are also damaged by the earthquake are **not** included in this estimate.



The weight of debris generated by the destruction of the buildings in the tsunami zone is estimated to be ~169,000 tons, which is a minimum estimate (excludes content in the buildings, vehicles, and other forms of debris).

Sheltering Needs

Permanent and temporary residents who successfully evacuate out of the tsunami zone will require short- to medium-term shelter. For an XXL tsunami event, the displaced population in Lincoln City could range from ~1,800 (mid-winter) to ~13,000 people (peak summer, every rental facility at max. capacity).

These numbers reflect only those displaced from the tsunami zone; there may be additional sheltering needs for those whose homes have been damaged or destroyed by the earthquake event outside of the tsunami zone and for any day visitors to Lincoln City that may be stranded. In addition, development exists south of the Lincoln City UGB (i.e., Gleneden Beach, Salishan Spit). Displaced people in those locations will also temporarily need food and shelter.



1,800 – 13,000 PEOPLE
IN NEED OF SHELTER

Data Source:

Open File Report O-20-03, *Analysis of earthquake and tsunami impacts for people and structures inside the tsunami zone for five Oregon coastal communities: Gearhart, Rockaway Beach, Lincoln City, Newport, and Port Orford*, DOGAMI: www.oregongeology.org/pubs/ofr/p-O-20-03.htm. More resources at: www.oregontsunami.org.

Instill a Culture of Preparedness.

Through adaptation planning, communities can be better prepared to face natural disasters.

Action Items:

- **CONDUCT COMMUNITY EVACUATION DRILLS** – All neighborhoods in Lincoln City should review evacuation maps, walk evacuation routes, and conduct tsunami evacuation drills.
- **EDUCATE** – Loss of life can be minimized if individuals evacuate as soon as possible after the earthquake and travel on foot as fast as possible to safety. Tsunami evacuation map distribution, signage, and roadway paint are education tools that are highly effective if used widely.
 - Focus education and outreach to second homeowners and vacation home renters and those who speak a language other than English. Locally specific evacuation maps can now be generated for any location via the online tsunami evacuation portal: <http://nvs.nanoos.org/TsunamiEvac>. Or the smartphone application: NVS Tsunami Evacuation.
- **PREPARE COMMUNITY RESOURCES**, such as disaster supply caches and mass sheltering plans. OEM and DOGAMI have a newly released community disaster cache [planning guide](#) with resources to get groups started.
- **ENCOURAGE THE PURCHASE OF FLOOD INSURANCE TO COVER TSUNAMI LOSSES** – Over 2,000 buildings in Lincoln City are in the XXL tsunami zone but **not** in a designated FEMA flood zone. The voluntary purchase of flood insurance is available to all building owners through the National Flood Insurance Program, which covers building loss due to a tsunami. Standard homeowner’s insurance does not cover flood, tsunami, or earthquake damage. Find out more: www.fema.gov/flood-insurance.
- **IMPLEMENT EVACUATION IMPROVEMENTS**, focused to the challenges of the community, such as:
 - Increase the density of tsunami evacuation signage so that signs can be easily viewed and read.
 - Evaluate major engineering projects to improve resilience, such as a vertical evacuation structure in Cutler City. A vertical evacuation structure could save hundreds of lives if strategically placed in this area.
 - Encourage residents of manufactured homes to store crowbars and sledgehammers near doors or windows to address compromised egress. Such homes may slip off their foundations during an earthquake, hindering timely evacuation out of the tsunami zone.
- **ADVANCE LOCAL PLANNING**
 - Develop a plan for how to manage earthquake and tsunami debris after a disaster event. Look to OEM and FEMA for resources to get started.
 - Relocate critical and essential buildings if they are within the tsunami zone.
 - Adopt zoning restrictions or building standards for certain types of new development in the most hazardous areas in alignment with the community’s risk tolerance.
- **DEVELOP MUTUAL AID AGREEMENTS** with other jurisdictions or organizations to provide additional resources for the community during disaster events.
 - Coastal hospitals will need to prepare for a surge in injuries that could exceed existing capacity.
- **KNOW WHAT RESOURCES ARE AVAILABLE** – Federal and state agencies have grant funds available for risk reduction activities (e.g., FEMA’s Hazard Mitigation Grant Program, NOAA’s Coastal Management Program).

