T169: PEDESTRIAN WALK TIME MAPS FOR TSUNAMI EVACUATION IN THE ABERDEEN AREA, WASHINGTON Daniel Eungard, Washington Geological Survey

What are Tsunami Pedestrian Walk Time Maps?

Tsunami evacuation walk time maps show a detailed view of the time it would take to evacuate on foot from a tsunami inundation zone. The maps also show how long it would take for the first tsunami wave to arrive. Emergency managers, planners, and local decision makers use these maps to plan evacuation routes, organize critical resources, and coordinate response. The public should review these maps before the before the tsunami occurs to familiarize themselves with evacuation routes for their home, work, school, and other commonly frequented areas within the tsunami inundation zone.

How are Pedestrian Walk Time Maps Created?

The evacuation walk time maps are created from models that use the Pedestrian Evacuation Analyst Toolkit (PEAT; Jones and Wood, 2014). This toolkit was developed by the U.S. Geological Survey to aid in evacuation planning for natural hazards. The tool uses elevation changes and type of land cover to calculate walking speed along the evacuation route. Areas with steeper terrain or heavy vegetation will take longer to cross. The colors on the map to the right show readers how long it takes to walk to high ground. The Washington Geological Survey works closely with each community's emergency management and government representatives to determine the evacuation routes, shelters, and points of reference shown on each map.





Land cover classification (darker colors are more restrictive to travel)



Lidar derived slope model (yellow-orange is steep)

What Walk Time Maps Can't Tell Us Walk time maps cannot predict the impacts of earthquakes, such as damage to buildings or infrastructure. During an earthquake, power lines may topple, underground utilities may rupture, and the ground may settle or shift. These unpredictable effects may slow evacuation time.



Ground deformation of a roadway, Tohoku Earthquake 2011 (Yamaguchi et al., 2012)



Sand blows and settlement, Tohoku Earthquake 2011 (Yamaguchi et al., 2012)

The maps also assume a slow walk pace (2.5 mph). Not everyone travels at this pace, especially during an emergency. Determine how the times shown on the map compare to your own walking pace. You can and should try to walk the paths to learn your pace, or timing yourself on casual walks. This will give you a better estimate of how long it would take you to get to high ground in an









I...Cannot Evacuate

You may be cut off by damage to infrastructure, or you might not be physically fit to travel. You might also be too far from high ground to evacuate before the wave's arrival. The walk time maps can help identify locations where evacuation is not feasible, providing local officials the opportunity to plan and enact mitigation strategies to safeguard the public. One of the most successful strategies for doing so is the construction of vertical evacuation structures (VES), elevated structures specifically designed to survive a tsunami event. These structures saved lives in Japan (Tohoku earthquake and tsunami, 2011) and are integral to protecting people here in the United States as well.



Area where evacuation is not possible



VES structure in Japan (photo: ASCE)

References Cited

Jones, J.M., Ng, P., Wood, N.J., 2014, The pedestrian evacuation analyst—Geographic information systems software for modeling hazard evacuation potential: U.S. Geological Survey Techniques and Methods, book 11, chap. C9, 25 p., http://dx.doi.org/10.3133/tm11C9

Yamaguchi, A., Mori, T., Kazama, M., & Yoshida, N. (2012). Liquefaction in Tohoku district during the 2011 off the Pacific Coast of Tohoku Earthquake. Soils and Foundations, 52(5), 811–829. https://doi.org/10.1016/j.sandf.2012.11.005

overlay is hazard area)



Ocosta Elementry School VES (photo: WA EMD)

Aberdeen, Hoquiam, and Cosmopolis **Tsunami Evacuation Walk Times**





CITY OF HOQUIAM CITY OF ABERDEEN CITY OF COSMOPOLIS

Bowerman Basin ESTIMATED WAVE ARRIVAL TIM (60+) nd safe slow-walk time-50 MIN nust walk fast (~18 minute/mi to exit inundation zone before tsunami arrival

This map is a planning and preparation tool. Learn the evacuation routes for you and your family where you live, work, and play—evacuation maps may not be on hand during an actual emergency.

his evacuation walk time map for the cities of Aberdeen, Hoquiam, and Cosmopolis, provides an estimate of the amount of time it would take to evacuate from within the modeled inundation zone of a Cascadia-sourced subduction zone earthquake. This map provides inundation extent for the L1 scenario, defined as the 2,500-year event from which seismic and tsunami codes are locally derived. Time estimates on this map are modeled assuming a slow walking pace of 2.46 mph (~24 minute/mile), equivalent to the pace used for the timing of cross walks. Estimated wave arrival times shown on the map indicate the time between the beginning of the earthquake and modeled wave arrival at that location.

- Evacuation should begin as soon as earthquake shaking stops and it is safe to move from your drop, cover, and hold position or as directed by a tsunami warning siren, NOAA weather radio, or other official announcements. You should make your way uphill and follow the designated evacuation routes shown on this map. These routes were selected for pedestrian evacuation, but may be affected by post-earthquake hazards, such as collapsed bridges, landslides, and downed power
- lines. Use situational awareness when evacuating and be prepared to take alternate paths if necessary. Assembly areas are places of high ground for displaced people. These rally points are typically in open outdoor spaces or in large structures just beyond the tsunami inundation zones and likely will not have immediate services or shelter. Do not re-enter or cross back into the inundation zone until instructed to do so by local officials. Tsunamis are multi-wave events. The
- first wave may not be the highest, and danger of tsunami inundation may persist for many hours after the initial wave has subsided.









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