



2013

**Tsunami Inundation Maps for Depoe Bay,
Lincoln County, Oregon**

Plate 1

The Oregon Department of Geology and Mineral Industries (DOGAMI) has been identifying and mapping the tsunami inundation along the Oregon coast since 1994. In Oregon, DOGAMI manages the National Tsunami Hazard Mitigation Program, which has been assigned the task of creating tsunami inundation maps for the entire United States. The Oregon State Department of Transportation (ODOT) is also working with DOGAMI to develop tsunami inundation maps for the entire Oregon coast. DOGAMI is also working with the Oregon Department of Transportation (ODOT) to develop tsunami inundation maps for the entire Oregon coast. DOGAMI is also working with the Oregon Department of Transportation (ODOT) to develop tsunami inundation maps for the entire Oregon coast.

The CSZ is the tectonic plate boundary between the North American Plate and the Juan de Fuca Plate (Figure 1). These plates are converging at a rate of about 15 km/year per year, but the movement is not smooth and continuous. Rather, the plates lock in place, and unstressed energy accumulates in the locked region. When the locked region is suddenly released in the form of a megathrust earthquake rupture, where the North American Plate suddenly slips westward over the Juan de Fuca Plate. This rupture causes a vertical displacement of the seafloor that creates a tsunami (Figure 2). Similar rupture processes and tsunamis have occurred elsewhere in the world, including the 1992 Great Alaska Earthquake (see Example on Slide 10) and 1990 and 2010 eruptions of Alaska in March 2011.

CSZ Frequency. Comprehensive research of the historical geologic record indicates that at least 10 major eruptions of the full length of the CSZ have occurred since 1800 CE (Fig. 1). The 10 largest eruptions of the CSZ since 1800 CE were likely Magnitude 8.9 to 9.2 earthquakes (Witter and others, 2011). The most recent CSZ event occurred on 26 March 1906, at 3:00 a.m. local time, and caused 250,000 deaths and 23 million dollars of damage (Witter and others, 2011). The 1700 event has been found to be the largest CSZ event since 1800 CE, and is estimated to have caused 100,000 deaths and 23 million dollars of damage (Witter and others, 2011). The 1700 event has been found to be the largest CSZ event since 1800 CE, and is estimated to have caused 100,000 deaths and 23 million dollars of damage (Witter and others, 2011).

C2: Model Parameters: The sizes of the earthquake and its resultant tsunami are primarily driven by the amount and geometry of the slip that takes place when the North American Plate slips westward over the Pacific Plate during the Cretaceous. In our CAGM we modeled a wide range of earthquake sizes and slip geometries that would produce a wide range of slip geometries that could amplify the amount of seawater displacement and increase tsunami inundation. Seismic displacement and tsunami inundation could be a deep sleep slip running nearly parallel to the CAGM but closer to the Oregon coastline (Figure 7). The amount of slip could be as small as 10 cm or as large as 10 m. The amount of slip could increase in the amount of vertical displacement of the Pacific Ocean, resulting in an increase of the tsunami inundation onshore in

A cross-sectional diagram of the Juan de Fuca Plate subducting beneath the North American Plate. The Pacific Plate is shown on the left, with the Juan de Fuca Plate extending from it. The Juan de Fuca Plate is shown subducting under the North American Plate. The subducting plate is labeled 'Juan de Fuca Plate' and the overriding plate is labeled 'NORTH AMERICAN PLATE'. The boundary between them is labeled 'JUAN DE FUCA RIFT ZONE'. The subducting plate is shown dipping into the mantle, with a 'Locked Zone' indicated. The mantle is labeled 'Magma' at the base. The diagram also shows the 'Washington Oregon' coastline and the 'British Columbia' coastline.

Figure 1: This block diagram depicts the tectonic setting of the region. See Figure 2 for the sequence of events that occur during a Cascadia Subduction Zone megathrust earthquake and tsunami.

A The North American Plate rides over the descending Juan de Fuca Plate at a rate of approximately 1.5 inches per year.

B Because the two plates are stuck in place at the "locked zone," strain builds up over time and the North American Plate bulges up.

C Eventually the locked zone ruptures and causes a great earthquake. The sudden slip of the two plates displaces Pacific Ocean water upwards and creates a tsunami.

D Displaced and uplifted Pacific Ocean water rushes in all directions.

E Along the Oregon coast, tsunami waves run up onto the land for several hours.

Figure 2: The North American Plate rides over the descending Juan de Fuca Plate at a rate of approximately 1.5 inches per year. Because the two plates are stuck in place at the "locked zone," strain builds up over time and the North American Plate bulges up. Eventually the locked zone ruptures and causes a great earthquake. The sudden slip of the two plates displaces Pacific Ocean water upward and creates a tsunami.

Figure 3: This chart depicts the last timing, frequency, and magnitude of the last 19 great Cascadia Subduction Zone events over the past 10,000 years. The most recent event occurred on January 26, 1700. The 1700 event is considered to be a "medium sized" event. The data used to create this chart came from research that examined the many submarine landslides, known as "turbidites," that are triggered only by these great earthquakes (Witter and others, 2011). The loose correlation is "the bigger the turbidite, the bigger the earthquake."

	Entire Map		Unincorporated
	Area	Depose Bay	Areas
Total Buildings	1,218	1,143	75
Buildings within Tsunami Zones*			
Small	11	9	2
Medium	16	14	2
Large	32	30	2
Extra Large	254	245	9
Extra Extra Large	307	298	9

Small	0.9%	0.8%	2.7%
Medium	1.3%	1.2%	2.7%
Large	2.6%	2.6%	2.7%
Extra Large	20.9%	21.4%	12.0%
Extra Extra Large	25.2%	26.1%	12.0%

*Building counts shown are based on polygon centroids and are cumulative within the map area

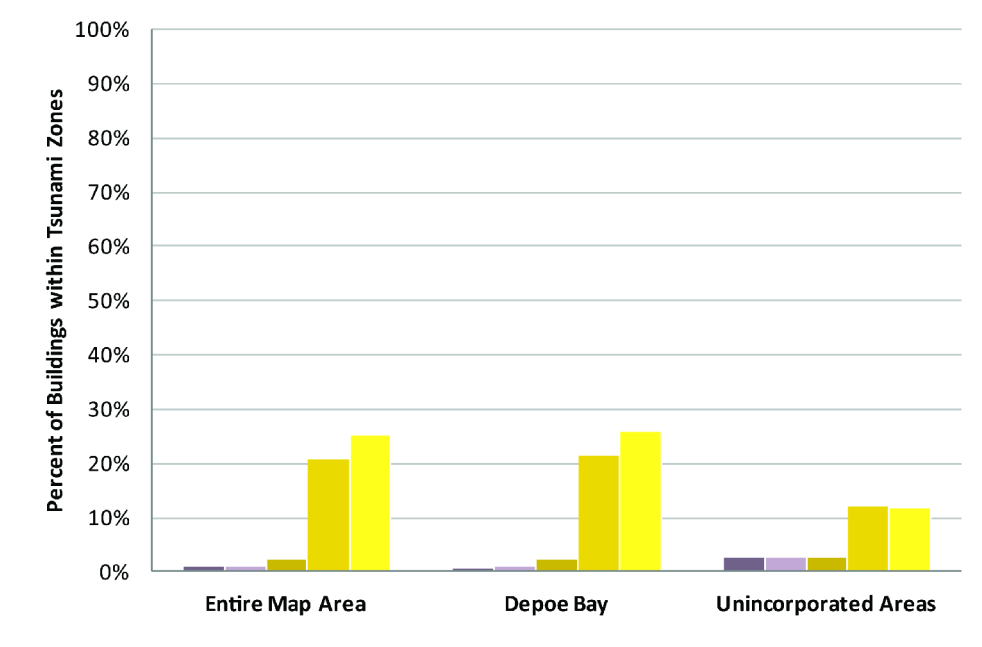


Figure 4: The table and chart show the number of buildings inundated for each "tsunami T-shirt scenario" for cities and incorporated portions of the map.

Change in water level for five tsunami scenarios at the simulated gauge station shown on the map

Depoe Bay (Station A5)

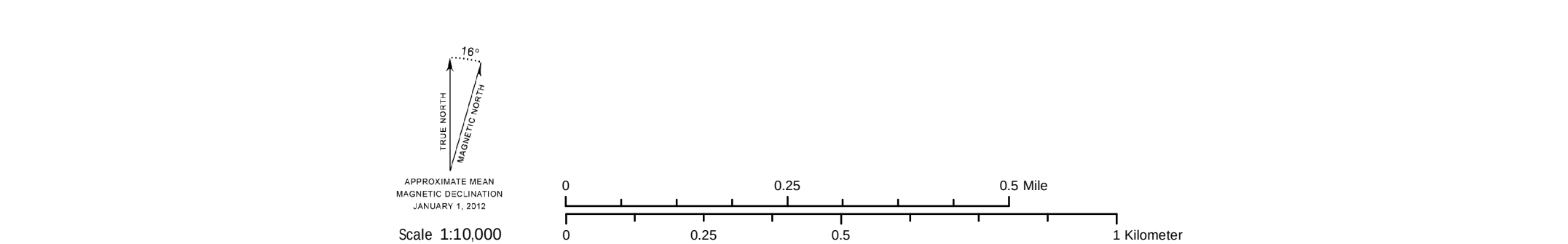
Elevation, feet (NAVD83)

Time since Earthquake (hours)

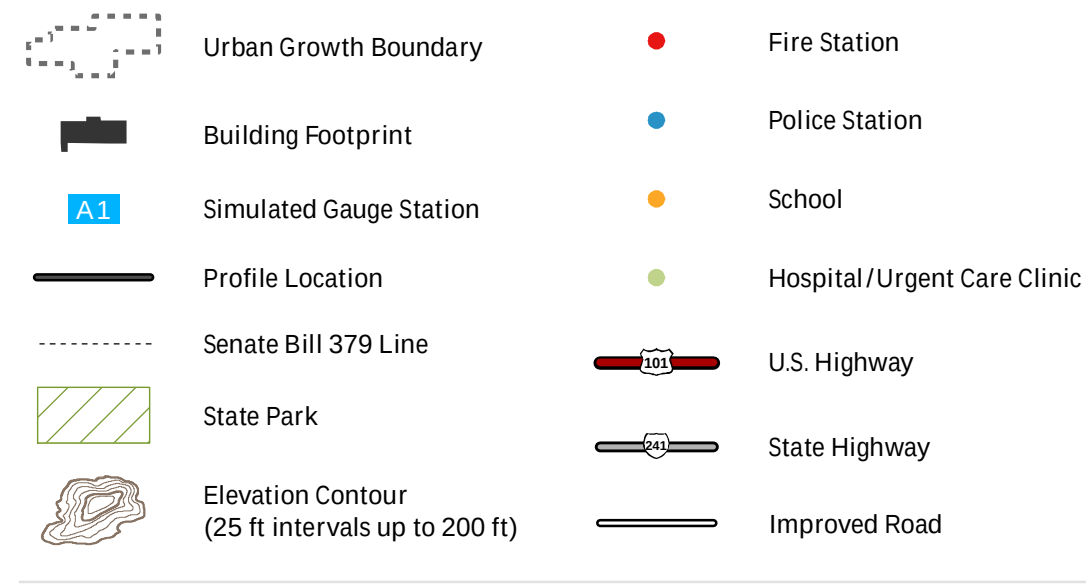
XXL
XL
L
M
S

Figure 5: This chart depicts the tsunami waves as they arrive at the selected reference point (simulated gauge station). It shows the change in wave heights for all five tsunami scenarios over an 8-hour period. The starting water elevation (0.0 hour) takes into account the local land subsidence or uplift caused by the earthquake. Wave heights vary through time, and the first wave will not necessarily be the largest as waves interfere and reflect off local topography and bathymetry. Any absence of data indicates periods for which tsunami inundation has not yet reached or has receded from the station location and dry land is exposed.

Figure 6: These profiles depict the expected maximum tsunami wave elevation for the five "tsunami T-shirt scenarios" along lines A-A' and B-B'. The tsunami scenarios are modeled to occur at high tide and to account for local subsidence or uplift of the ground surface.



Earthquake Size	Average Slip Range (ft)	Maximum Slip Range (ft)	Time to Accumulate Slip (yrs)	Earthquake Magnitude
XXL	59 to 72	118 to 144	1,200	~9.1
XL	56 to 72	115 to 144	1,050 to 1,200	~9.1
L	36 to 49	72 to 98	650 to 800	~9.0
M	23 to 30	46 to 62	425 to 525	~8.9
S	13 to 16	30 to 36	300	~8.7
XXL Mega-Tsuo				

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