Maritime Guidance for Distant Source Tsunami Events

Ports of Newport and Toledo
Lincoln County, Oregon

Oregon Maritime Tsunami Response Guidance (MTRG) No. 2015-OR-01

Maritime response guidance in this document is based on anticipated effects of a **maximum-considered distant tsunami event**, scenario **AKmax** of the Oregon Department of Geology and Mineral Industries (see www.oregontsunami.org for more information on this scenario). Smaller distant source tsunamis will occur more commonly and are likely to cause significantly less damage than this maximum considered scenario. Check with local authorities for more specific guidance that may be appropriate for smaller distant tsunami events.

Oregon Department of Geology and Mineral Industries

Oregon Office of Emergency Management

Virginia Institute of Marine Sciences

National Oceanic and Atmospheric Administration

Members of the Oregon Marine Advisory Council

Funded by the National Tsunami Hazard Mitigation Program (Document adapted from the Humboldt Bay Tsunami Maritime Actions website and the California Maritime Tsunami Response Playbook No. 2014-Humb-01)

INTRODUCTION

DISTANT TSUNAMIS are caused by great earthquakes far away from the Oregon coast and will strike *approximately* 4 hours or more after the earthquake and cause water level and current changes for many hours after first arrival. This document provides response guidance in the event of a **DISTANT TSUNAMI** for **SMALL CRAFT** (vessels under 300 gross tons) such as recreational sailing and motor vessels, and commercial fishing vessels. For **LOCAL TSUNAMIS** caused by great earthquakes on the Oregon coast, see maritime response guidance at http://www.oregongeology.org/tsuclearinghouse/maritime.htm.

TSUNAMI HAZARDS that can directly affect boats include:

- Sudden water-level fluctuations
- Grounding of vessels as water level suddenly drops
- Capsizing from incoming surges (bores), complex coastal waves, and surges hitting grounded boats
- Strong and unpredictable currents that can change direction quickly
- Eddies/whirlpools
- Drag on large-keeled boats
- Collision with other boats, docks, and debris

BACKGROUND ON TSUNAMIS

Very large underwater earthquakes are the most likely cause of tsunami waves, which can produce significant damage at very distant shores. Earthquake-caused tsunami waves occur when the seafloor abruptly deforms and vertically displaces the overlying water column. The displaced water travels outward in a series of waves that grow in intensity as they encounter shallower water along coastlines. Tsunami wave impacts are greatest in and around ocean beaches, low-lying coastal areas, and bounded water bodies such as harbors and estuaries. These areas should always be avoided during tsunami events. Any tsunami event can threaten harbors, facilities, and vessels. A distant source tsunami event does allow some time for local agencies and citizens to take steps to help mitigate the expected impacts of tsunami surges. However, there may not be enough time to accomplish all needed mitigation actions before the first wave arrives. Therefore, the actions to be taken must be prioritized and based on life-safety preservation. Only those actions assured to be successful should be attempted.

The source of the distant tsunami greatly impacts the ability of local governments to respond and the public to mitigate expected impacts. A tsunami originating in Chile (14-15 hours away) or Japan (9-10 hours away) will allow much more local mitigation activity than will a tsunami originating in the closest distant sources in the Gulf of Alaska or the Aleutian Islands (4-5 hours away). Response entities and the public should allow enough time to complete the mitigation activity and to depart the ***Distant Tsunami Evacuation Zone*** (see maps on last two pages) prior to the projected arrival time of the first tsunami surge. Local mitigation activities will be extensive and involve large numbers of people resulting in congestion and delayed actions—it may not be possible to complete normally simple mitigation actions in the time frame available.

NOTABLE HISTORICAL TSUNAMIS IN NEWPORT AREA

The table provides basic information about historical tsunami events; very minor tsunamis are not shown. The largest, most damaging distant-source tsunamis in Newport area have come from large earthquakes in the Alaska-Aleutian Islands region. The peak amplitude and damage information may help provide port authorities background for comparing future Advisory and Warning level tsunamis in the area. For example, the 2011 Japan tsunami may provide a threshold for no damage occurring below a forecast amplitude (wave height) of 0.43 m (1.4 ft).

Location	Event	Peak Amplitude Observed (m)	Peak Amplitude Observed (ft)	NTWC Tsunami Alert Level Assigned	Tides During First 5 Hours	Damage Summary
Newport area	1964 M9.2 Alaska	3.5	11.5	Warning	High*	light damage to ships and docks**
South Beach	2009 M8.0 Samoa	0.08	0.3	Advisory***	High	no damage reported
South Beach	2010 M8.8 Chile	0.16	0.5	Advisory***	Low	no damage reported
South Beach	2006 M8.3 Kuril	0.17	0.6	—	Low	no damage reported
South Beach	2011 M9.0 Japan	0.43	1.4	Warning***	Low	no damage reported

*Alaska 1964 arrival on PNW coast was at mean high water flood tide.

**1964 observation by ship captain Terry Thompson communicated February 19, 2015 to George Priest.

***Alert assigned by forecast OUTSIDE of bay.

Lessons learned in northern California from the March 11, 2011 Japanese tsunami

During the March 11, 2011 event, Crescent City boats headed to sea. Once the tsunami hit and they realized they were unable to return to Crescent City harbor, decisions had to be made as to where to go because of a huge storm approaching the coast. Some vessels had enough fuel to make it to Brookings Harbor in Oregon or to Humboldt Bay, California. Some smaller vessels did not have enough fuel and made the choice to re-enter Crescent City harbor to anchor. Some Crescent City captains had never been to Humboldt Bay and some were running single handed as they did not have enough time to round up crewmen. As with the captains who chose to go to Brookings, all of the captains heading to Humboldt Bay kept in close contact with each other for safety and for moral support. Even though the tsunami initially impacted the west coast on the morning of March 11, 2011, the largest surges in Crescent City did not arrive until later in the evening.

ACTIONABLE TSUNAMI ALERT LEVELS

Tsunami Advisories and Warnings are the two actionable alert levels for maritime communities. For both Advisory and Warning level events, it is important that clear and consistent directions are provided to the entire boating community and to waterfront businesses.

Sign up to receive notifications from the National Tsunami Warning Center in Palmer, Alaska at the following website: http://wcatwc.arh.noaa.gov. The Center issues two types of bulletins that require action by Oregon boaters:

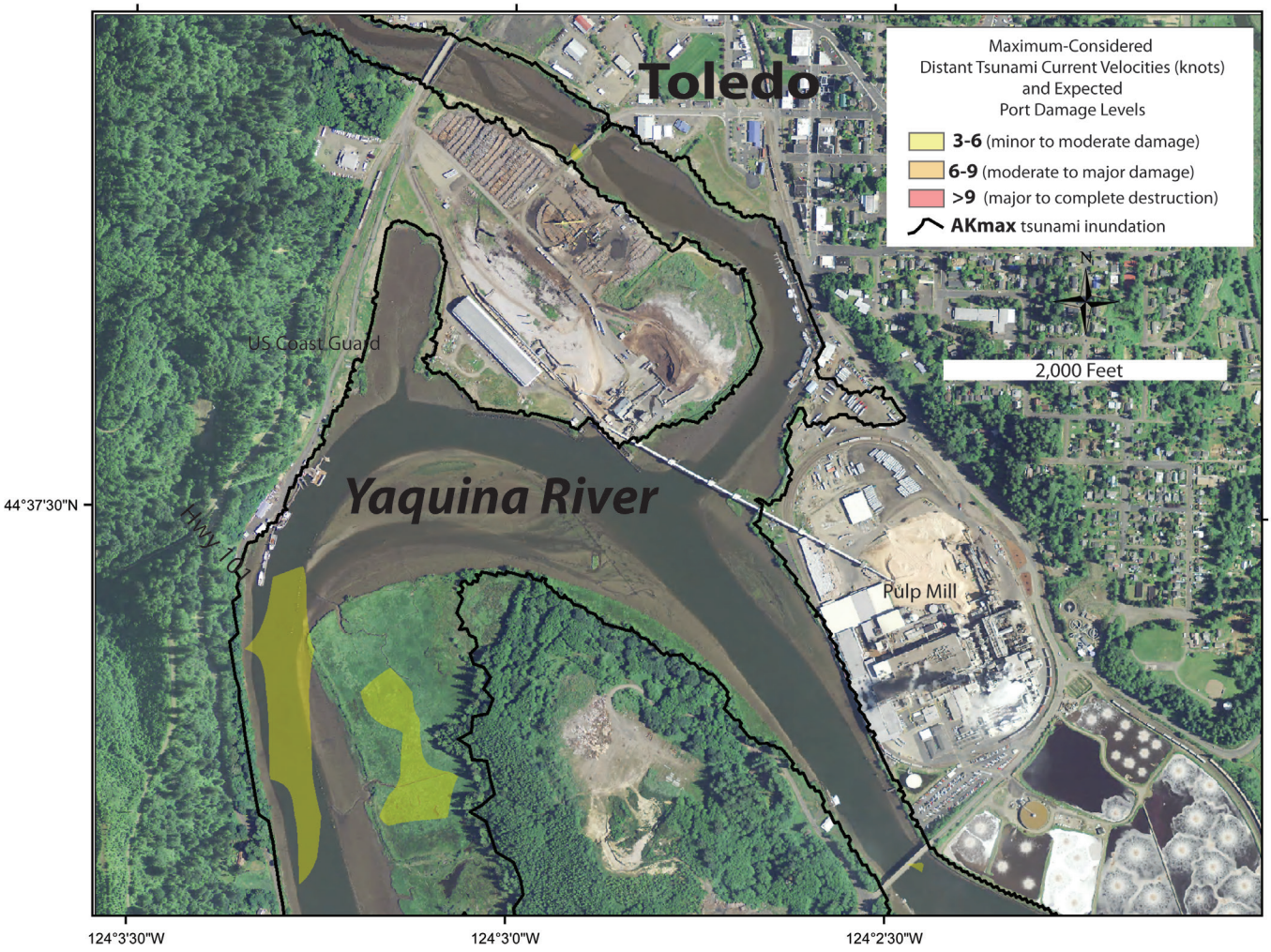
 **Tsunami Advisories**	 **Tsunami Warnings**
Peak tsunami wave heights of 1 to 3 feet are expected, indicating strong and dangerous currents can be produced in harbors near the open coast. • **NO** significant tsunami currents or damage are expected **at Toledo**. • **SIGNIFICANT** tsunami currents or damage are possible **at Newport** near harbor entrances or narrow constrictions.	Tsunami wave heights could exceed 3 feet in harbors near the open coast, indicating very strong, dangerous currents and inundation of dry land is anticipated. • **SIGNIFICANT** tsunami currents or damage are possible **at Toledo and Newport**. • Depending on the tidal conditions, **docks may overtop the pilings in the Ports of Toledo and Newport.**

GENERAL GUIDANCE ON RESPONSE TO NOAA ADVISORIES AND WARNINGS

In and near the PORT OF TOLEDO…

Tsunami Advisories	**NO** significant tsunami currents or damage is expected at Toledo. Therefore, no actions are necessary.
Tsunami Warnings	• **Before and during the tsunami,** ○ Remain in port; do not try to reach deep water. Projected currents from distant-source tsunamis should be less than approximately 3 knots, so no significant damage to port facilities is expected.[1] ○ Secure and strengthen all mooring lines, specifically areas near harbor entrances or narrow constrictions. ○ Get out of the ***Distant Tsunami Evacuation Zone*** (orange zone on map at http://www.oregongeology.org/tsuclearinghouse/pubs-evacbro.htm (PDF) or http://nvs.nanoos.org/TsunamiEvac (interactive map). ○ Monitor VHF FM Channel 16 and the marine WX channels for periodic updates of tsunami and general weather conditions; additional information will be available from NOAA Weather Radio. • **After the tsunami,** ○ Check with local authorities to assess safety of navigation in and out of the port. ○ "CAUTIONARY RE-ENTRY" DOES NOT MEAN THAT YOU CAN SAFELY NAVIGATE ALL THE WAY TO OPEN SEA. ○ The "CAUTIONARY RE-ENTRY" is for land entry only. ○ If in an onshore assembly or evacuation area, check with local authorities for guidance before returning to the inundation zone.

[1] Based on scientific studies (e.g., Lynett et al., 2013).



TOLEDO. Map of maximum tsunami current velocities and expected port damage resulting from a maximum-considered DISTANT tsunami. Rise of water above prevailing tide should be no more than 3-4 ft. Floating dock pilings should be constructed to handle this change in water level plus an appropriate tide such as mean higher high water (MHHW). MHHW is 7.6 ft above geodetic mean sea level (NAVD88) in this area. Be aware that tsunamis are many surges of water over at least several hours. Withdrawing tsunami waves will rapidly drain the estuary and can ground your vessel, making it vulnerable to being sunk by the next incoming tsunami wave.

GENERAL GUIDANCE ON RESPONSE TO NOAA ADVISORIES AND WARNINGS

In and near the PORT OF NEWPORT…

Tsunami Advisories

- **During the event** (before the tsunami arrives):
  - Evacuate from all structures and vessels in the water.
  - Access of public along waterfront areas will be limited by local authorities.
  - All personnel working on or near the water should wear personal flotation devices.
  - Port authorities will shut off fuel to fuel docks, and all electrical and water services to all docks.
  - Secure and strengthen all mooring lines throughout harbor, specifically areas near the entrance or narrow constrictions.
- **After the event**: Port authorities will not allow public to re-enter structures and vessels in the water until Advisory is cancelled.

Tsunami Warnings

- **During the event:**
  - Access of public along waterfront areas will be limited by local authorities.
  - Port authorities will shut off fuel to fuel docks, and all electrical and water services to all docks.
  - If you are on the water,
    - Prepare for heavy seas and currents. Maintain extra vigilance and monitor VHF Channel 16 for possible Urgent Marine Information Broadcast from the US Coast Guard.
    - Monitor VHF FM Channel 16 and the marine WX channels for periodic updates of tsunami and general weather conditions; additional information will be available from NOAA Weather Radio.
    - If advised that offshore evacuation is an option and this option looks practical for your vessel, proceed to a staging area **greater than 30 fathoms (180 ft)**; at Yaquina Bay go to greater than 5 nautical miles offshore.
    - If conditions do not permit, dock your boat and get out of the ***DISTANT Tsunami Evacuation Zone*** (ORANGE zone on map at http://www.oregongeology.org/tsuclearinghouse/pubs-evacbro.htm (PDF) or http://nvs.nanoos.org/TsunamiEvac (interactive map).

(continued on next page)

General guidance on response to NOAA advisories and warnings in and near the PORT OF NEWPORT

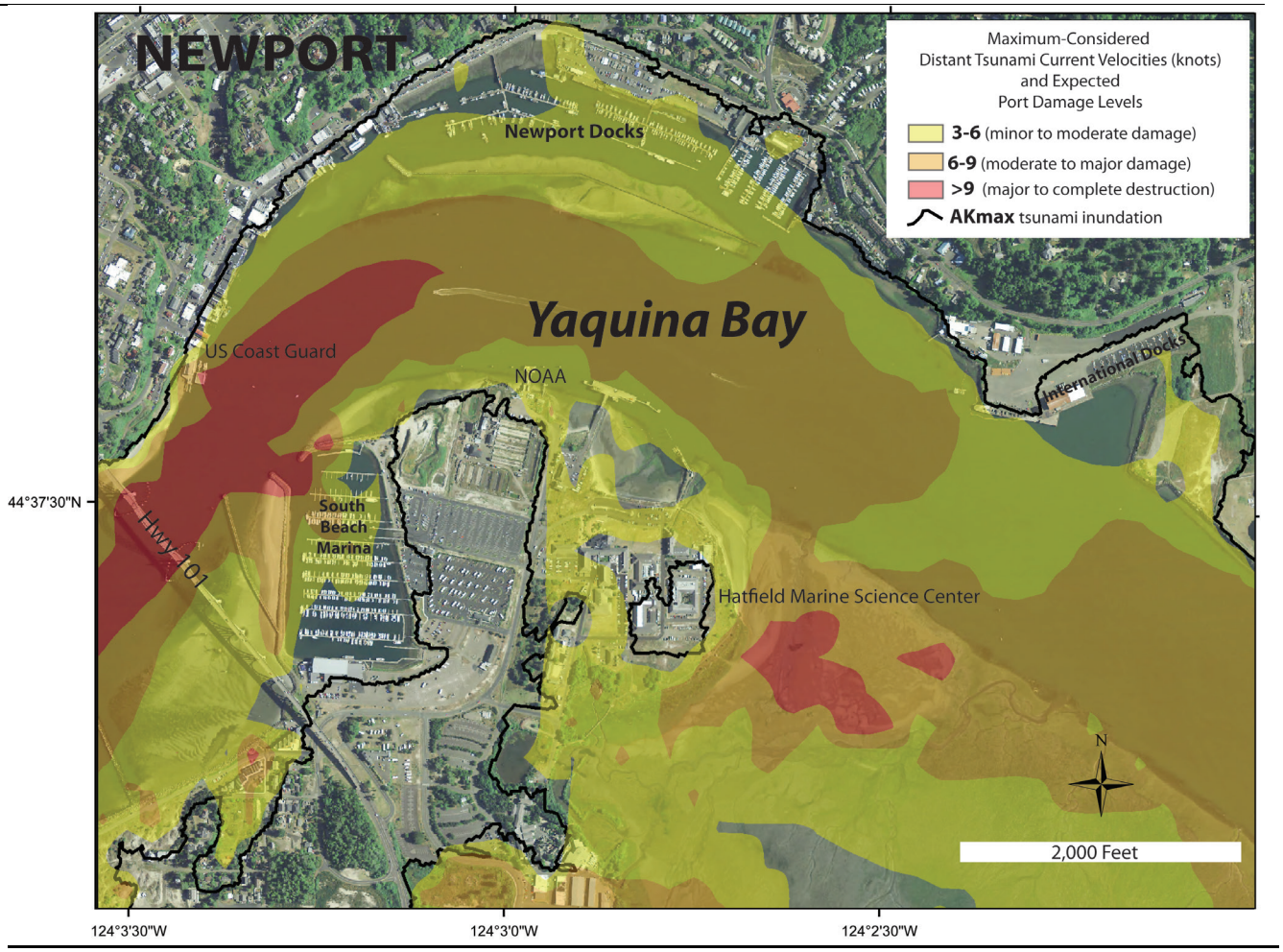
Tsunami Warnings

During the event *(continued from previous page)*:

- VESSELS considering leaving the harbor and heading to sea, please consider the following:
  - Make sure your family is safe first.
  - Check tide, bar, and ocean conditions.
  - Check the weather forecast for the next couple of days.
  - Ensure you have enough fuel, food and water to last a couple of days.
  - Have someone drive you to the marina so your vehicle is not in the DISTANT Tsunami Evacuation Zone (ORANGE zone on map at http://www.oregongeology.org/tsuclearinghouse/pubs-evacbro.htm (PDF) or http://nvs.nanoos.org/TsunamiEvac (interactive map).
  - PLEASE REMEMBER: There may be road congestion. There may also be vessel congestion in the harbor as ships, barges and other vessels attempt to depart at the same time. All vessels should monitor VHF Channel 16 and use extreme caution. NEVER impede another vessel.
  - If you do not have time to accomplish your goal, you should not make the attempt.
- **VESSELS that stay In port** should check with local port authorities for guidance on what is practical or necessary with respect to vessel removal or mooring options, given the latest information on the distant tsunami event; then go outside the DISTANT Tsunami Evacuation Zone (ORANGE zone on map links listed above).

- **After the tsunami:**
  - The "CAUTIONARY RE-ENTRY" DOES NOT MEAN THAT THE HARBOR IS OPEN. The “CAUTIONARY RE-ENTRY” message is for land entry only.
  - Mariners at sea should monitor VHF Channel 16 for possible US Coast Guard Safety Marine Information Broadcasts regarding the conditions and/or potential restrictions placed on navigation channels and the entrances to harbors.
  - Check with your docking facility to determine its ability to receive vessels. Adverse tsunami surge impacts may preclude safe use of the harbor. Vessels may be forced to anchor offshore or to travel great distances to seek safe harbor. An extended stay at sea is a possibility if the Harbor is impacted by debris or shoaling. Make sure your vessel is prepared to stay at sea. Where possible, mariners should congregate for mutual support while at sea, anchor or during transit elsewhere.
  - If in an onshore assembly or evacuation area, check with local authorities

for guidance before returning to the inundation zone.



NEWPORT. Map of maximum tsunami current velocities and expected port damage resulting from a maximum-considered DISTANT tsunami. Dangerous eddies and whirlpools can be expected in narrow channel constrictions like in and near the entrance to the South Beach Marina. Maximum rise of water above prevailing tide should be 7-8 ft at the US Coast Guard docks, 8-9 ft at the South Beach Marina and Newport docks, and 6-7 ft at the International Docks on the east side of Yaquina Bay. Floating dock pilings should be constructed to handle these changes in water level plus an appropriate tide such as mean higher high water (MHHW). MHHW is 7.6 ft above geodetic mean sea level (NAVD88) in this area. Be aware that tsunamis are many surges of water over at least several hours. Withdrawing tsunami waves will rapidly drain the estuary and can ground your vessel, making it vulnerable to being sunk by the next tsunami surge.

ADDITIONAL GUIDANCE

Do Your Homework

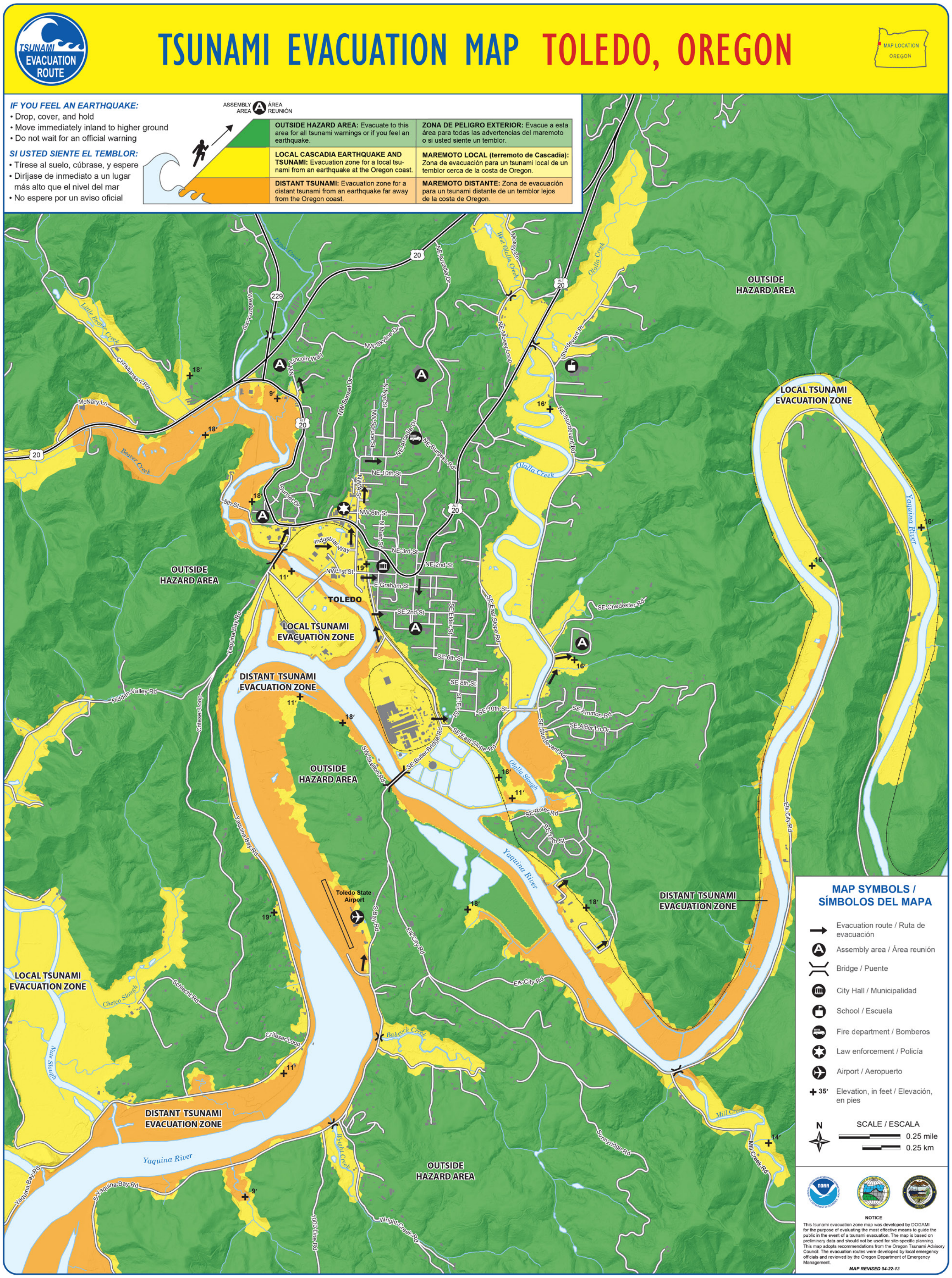
Check the Oregon Department of Geology and Mineral Industries Tsunami Clearinghouse at www.oregontsunami.org for detailed information on tsunami hazards in your area and tips on preparedness. Preparedness information is also available from Oregon Emergency Management at www.oregon.gov/OMD/OEM/. Download and review the statewide tsunami maritime guidance brochure at http://www.oregongeology.org/tsuclearinghouse/maritime.htm. For general information on tsunami maritime hazards consult www.tsunami.noaa.gov and the information below.

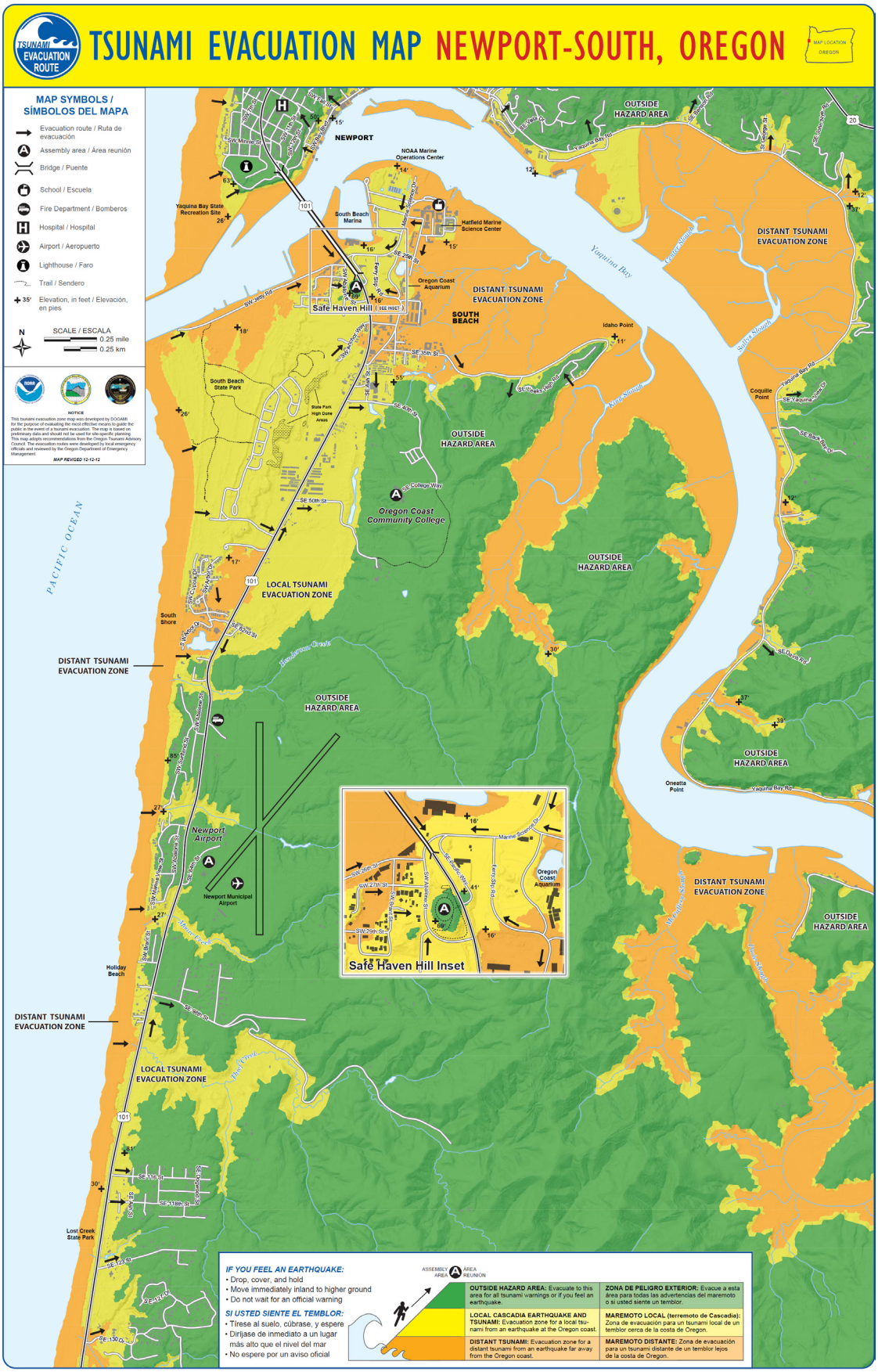
Know real-time and permanent mitigation measures appropriate for your area

Real-time response mitigation measures may include:	Permanent mitigation measures may include:
Moving boats and ships out of harbors	Fortify and armor breakwaters
Repositioning ships within harbor	Increase size and stability of dock piles
Move large, deep keeled ships from harbor entrances	Strengthen cleats and single-point moorings
Remove small boats/assets from water	Improve floatation portions of docks
Shut down infrastructure before tsunami arrives	Increase flexibility of interconnected docks
Evacuate public/vehicles from water-front areas	Improve movement along dock/pile connections
Restrict boats from moving during tsunami	Increase height of piles to prevent overtopping
Prevent boats from entering harbor during event	Deepen/dredge channels near high hazard zones
Secure boat/ship moorings	Move docks/assets away from high hazard zones
Personal flotation devices/vests for harbor staff	Widen size of harbor entrance to prevent jetting
Remove hazardous materials away from water	Reduce exposure of petroleum/chemical facilities
Remove buoyant assets away from water	Strengthen boat/ship moorings
Stage emergency equipment outside affected area	Construct floodgates
Activate Mutual Aid System as necessary	Prevent uplift of wharfs by stabilizing platform
Activate Incident Command at evacuation sites	Debris deflection booms to protect docks
Alert key first responders at local level	Make harbor control structures tsunami resistant
Restrict traffic entering harbor; aid traffic evacuating	Construct breakwaters farther away from harbor
Personnel to assist rescue, survey and salvage	Install Tsunami Warning Signs
Identify boat owners/live-aboards; establish phone tree, or other notification process	Equipment/assets (patrol/tug/fireboats, cranes, etc.) to assist response activities

Consult local tsunami evacuation maps

Use the maps on the following pages to determine where the DISTANT tsunami evacuation zone (orange zone) is, and how to reach high ground.


TSUNAMI EVACUATION MAP TOLEDO, OREGON
TSUNAMI EVACUATION ROUTE
IF YOU FEEL AN EARTHQUAKE:
• Drop, cover, and hold
• Move immediately inland to higher ground
• Do not wait for an official warning
SI USTED SIENTE EL TEMBLOR:
• Tírese al suelo, cúbrase, y espere
• Diríjase de inmediato a un lugar más alto que el nivel del mar
• No espere por un aviso oficial
ASSEMBLY AREA / ÁREA REUNIÓN
OUTSIDE HAZARD AREA: Evacuate to this area for all tsunami warnings or if you feel an earthquake.
ZONA DE PELIGRO EXTERIOR: Evacue a esta área para todas las advertencias del maremoto o si usted siente un temblor.
LOCAL CASCADIA EARTHQUAKE AND TSUNAMI: Evacuation zone for a local tsunami from an earthquake at the Oregon coast.
MAREMOTO LOCAL (terremoto de Cascadia): Zona de evacuación para un tsunami local de un temblor cerca de la costa de Oregon.
DISTANT TSUNAMI: Evacuation zone for a distant tsunami from an earthquake far away from the Oregon coast.
MAREMOTO DISTANTE: Zona de evacuación para un tsunami distante de un temblor lejos de la costa de Oregon.
OUTSIDE HAZARD AREA
LOCAL TSUNAMI EVACUATION ZONE
DISTANT TSUNAMI EVACUATION ZONE
TOLEDO
Yaquina River
Toledo State Airport
MAP SYMBOLS / SÍMBOLOS DEL MAPA
Evacuation route / Ruta de evacuación
Assembly area / Área reunión
Bridge / Puente
City Hall / Municipalidad
School / Escuela
Fire department / Bomberos
Law enforcement / Policía
Airport / Aeropuerto
Elevation, in feet / Elevación, en pies
SCALE / ESCALA
0.25 mile
0.25 km
NOTICE
MAP REVISED 04-22-13


TSUNAMI EVACUATION MAP NEWPORT-SOUTH, OREGON
TSUNAMI EVACUATION ROUTE
MAP SYMBOLS / SÍMBOLOS DEL MAPA
Evacuation route / Ruta de evacuación
Assembly area / Área reunión
Bridge / Puente
School / Escuela
Fire Department / Bomberos
Hospital / Hospital
Airport / Aeropuerto
Lighthouse / Faro
Trail / Sendero
Elevation, in feet / Elevación, en pies
SCALE / ESCALA
0.25 mile
0.25 km
NOTICE
MAP REVISED 12-12-12
NEWPORT
OUTSIDE HAZARD AREA
DISTANT TSUNAMI EVACUATION ZONE
LOCAL TSUNAMI EVACUATION ZONE
SOUTH BEACH
Safe Haven Hill
Safe Haven Hill Inset
Oregon Coast Community College
Newport Airport
Newport Municipal Airport
PACIFIC OCEAN
Yaquina Bay
NOAA Marine Operations Center
Hatfield Marine Science Center
Oregon Coast Aquarium
South Beach Marina
South Beach State Park
Yaquina Bay State Recreation Site
Idaho Point
Coquille Point
Oneatta Point
South Shore
Holiday Beach
Lost Creek State Park
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• Move immediately inland to higher ground
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MAREMOTO DISTANTE: Zona de evacuación para un tsunami distante de un temblor lejos de la costa de Oregon.

REFERENCES CITED

California Maritime Tsunami Response Playbook for Humboldt Bay, 2015 in press, California Geological Survey, California Office of Emergency Services, and University of Southern California, No. 2015-Humb-01, p. 22.

Humboldt Bay Tsunami Maritime Actions website: http://humboldtharborsafety.org/sites/humboldtharborsafety.org/files/BMP%20Tsunami%20Maritime%20Actions%20Small%20Craft%20Final.pdf.

Lynett, P., Borrero, J., Son, S., Wilson, R., and Miller, K., 2013, Assessment of the tsunami-induced current hazards: Geophysical Research Letters, v. 41, no. 6, 2048-2055.

Tsunami evacuation maps for Oregon:

http://www.oregongeology.org/tsuclearinghouse/pubs-evacbro.htm (PDFs)

and http://nvs.nanoos.org/TsunamiEvac (interactive map)

Smartphone apps:

Android: https://play.google.com/store/apps/details?id=org.nanoos.tsunami&hl=en
iPhone: https://itunes.apple.com/us/app/tsunamievac-nw/id478984841?mt=8

Warning: After an earthquake and tsunami, cell phone towers might be damaged. Know and practice your evacuation plan beforehand.