

Oregon Tsunami Evacuation Zones and Tsunami Deposits Database

Proposal submitted to:
Oregon Geographic Information Council
Framework Data Development Program

2009-2011 Biennium

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Background

Members of the Tsunami Hazards Workgroup, a subcommittee of the Framework Implementation Team (FIT) Hazards Committee, met in February 2009 to identify and prioritize various data elements for the Tsunami Hazards Framework Theme. The proposed data elements include: (1) Oregon's tsunami inundation line to implement Senate Bill 379, (2) tsunami evacuations zones for both distant and local Cascadia tsunami hazards and (3) a tsunami deposits geospatial database. A draft Oregon Tsunami Hazards Theme standard has been prepared and was presented to the FIT Hazards Committee on March 13, 2009.

Oregon's local and state agencies and coastal communities rely on tsunami maps to prepare and plan for emergency and to mitigate tsunami risks. Oregon's tsunami inundation line, mapped by the Oregon Department of Geology and Mineral Industries (DOGAMI) to implement Senate Bill 379 (1995 legislative session), delineates areas where state law (Oregon Revised Statutes 455.446 and 455.447) restricts new construction of certain critical facilities (Olmstead, 2003). Metadata and standards for Oregon's tsunami inundation line were established in 2001 (<http://www.oregon.gov/DAS/EISPD/GEO/docs/metadata/tsunami.html>).

DOGAMI has embarked on an ambitious 4-year program to develop the next generation tsunami inundation map for the entire 362-mile length of the Oregon coast. Principally funded by a 4-year, \$2.8 million grant from NOAA's National Tsunami Hazard Mitigation Program (NTHMP), DOGAMI plans to carry out tsunami inundation modeling and mapping across four segments of the Oregon coast over the next four years (Fig. 1). DOGAMI's approach will build on the results of the successful tsunami hazard assessment completed at Cannon Beach (Priest et al., 2009) that demonstrates that Oregon communities should prepare for more severe tsunami inundation than that shown by currently available maps. Among the many mitigation products resulting from this effort will be more accurate tsunami evacuation zones to aid emergency planning and identify safe evacuation routes in the event of a tsunami (Fig.2). We propose to complete two tsunami evacuation zones, including a coast-wide polygon for local Cascadia tsunami inundation and a second coast-wide polygon for distant tsunami inundation.

The proposed tsunami deposits database provides critical geospatial information necessary to validate tsunami inundation modeling. Data compilation will incorporate published and unpublished data on tsunami deposits, including existing databases developed for the Pacific

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coast of the western U.S. (NGDC, 2009; Peters et al., 2003). Limited field mapping and ground truthing will be carried out to provide quality assurance for the database.

The purpose of this proposal is to complete the first phase of a four-year project to build tsunami hazard theme elements for the state's vulnerable coastline. Phase 1 of this program will be implemented in the 2009-2011 biennium and focus on the southern Oregon coast and parts of Tillamook County (Fig. 1). Phase 2 of the project, to be carried out in the 2011-2013 biennium, will complete tsunami hazard elements for Clatsop County and the central Oregon coast. The results of both phases of work over the next two biennia will complete state-wide tsunami evacuation zones and the tsunami deposits geospatial database for the entire Oregon coast.

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Project Narrative

This proposal and cost estimate addresses work planned for phase 1 to be carried out during the 2009-2011 biennium. The first phase of the project will focus on completing tsunami evacuation map themes and a tsunami deposits database for the southern Oregon coast and parts of Tillamook County. areas targeted for NTHMP-funded tsunami modeling and mapping over the next two years (Fig. 1). Therefore, the tsunami hazard elements developed over the 2009-2011 biennium will leverage approximately \$1.4 million in funding from the NTHMP, which amounts to about half of the total federal grant award to DOGAMI for tsunami mitigation over the next four years.

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In phase 1, tsunami evacuation zones will be digitized from the results of detailed numerical tsunami inundation models conducted by Dr. Yinglong Zhang of Oregon Health Sciences University (OHSU). In addition, we will compile existing data on tsunami deposits in Oregon and carry out limited reconnaissance field work to verify the accuracy of the data. This work will be accomplished in four specific tasks summarized below:

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Task 1a – In 2009-2010 DOGAMI will derive tsunami evacuation zones from numerical tsunami inundation modeling by OHSU for the southern Oregon coast from Brookings to North Bend (Fig. 1). This task involves digitization of numerical inundation lines for a worst-case local Cascadia tsunami and a worst-case distant tsunami from Alaska. The evacuation zones will be examined closely to check for errors and for consistency with LiDAR topography acquired in 2008. We also plan to involve officials from local government and emergency response teams to review the evacuation zones for accuracy and practical application. Both evacuation zones will be available to the public on DOGAMI's new Arc-GIS map server and maintained online as an interactive tsunami evacuation map.

Task 1b – in 2010-2011 DOGAMI will derive tsunami evacuation zones for part of Tillamook County, including the coastline between Neskowin and Rockaway Beach. Approach and procedures will mirror those followed in task 1a for the southern Oregon coast.

Task 1c – DOGAMI staff will compile all available data documenting tsunami deposits archived in Oregon's estuaries, coastal lakes and lowlands, and other geologic environments. Data compiled will include published databases (e.g., NGDC, 2009; Peters et al., 2003) as well as

unpublished data sources from graduate student theses and available geological and geotechnical reports. The geospatial database will include information on site coordinates (xyz location/elevation), inundation distance, method of investigation, age of deposit, sedimentary characteristics of deposits (thickness, grain size, grading, layering), information on the geologic context in which the deposit is found, and other pertinent geophysical data. An example of ongoing tsunami deposits mapping at the Nestucca Estuary is shown in Fig. 3.

Task 1d – Limited field reconnaissance at selected sites will validate the accuracy of the database by ground truth checking deposits of questionable origin. Because of the limited scope of this task, we will not have the resources to check each and every deposit documented in the database. Instead, field work will focus on verifying the presence of tsunami deposits that have been incompletely documented, estimating the ages of undated deposits by radiocarbon dating, or evaluating the origin of particular layers through microfossil and mineralogical analyses. Fig. 4 shows an example of a sandy deposit along Upton Slough near the Little Nestucca River that is being evaluated for a tsunami origin. Work in 2009-2010 will focus on coastal sites between North Bend and the Oregon-California state line. Field verification in 2010-2011 will concentrate on sites in central and southern Tillamook County.

Assuming funding is available for the 2011-2013 biennium, phase 2 of the project will release seamless evacuation zone maps for the entire Oregon coastline and include a complimentary statewide tsunami deposits database. Work during the second phase of the project will complete tsunami hazard elements for Clatsop County, parts of Tillamook County and the central Oregon coast. If funded for two consecutive biennia, the entire four-year project will be completed by the end of the 2011-2013 biennium.

Project Deliverables

The key deliverables of phase 1 (2009-2011 biennium) will include two tsunami evacuation zones covering the southern Oregon coastline and parts of Tillamook County coastline and an accompanying tsunami deposits database. These products will adhere to strict standards approved by the FIT Hazards Committee and make available the following geospatial information:

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- (1) Spatial data – (ESRI shape files, including evacuation polygons and tsunami deposit point data) Geospatial data will include two seamless polygons that represent evacuation zones for a worst case local Cascadia tsunami and a worst-case distant tsunami from Alaska. Point data will map the locations of tsunami deposits and be attributed with complete descriptions of the deposit, location and other appropriate information. All files will include metadata that meet FIT standards for the Tsunami Hazards Theme, and released in the Oregon Lambert Statewide projection. Vertical datums will be tied to the North American Vertical Datum of 1988. All datasets will be freely available via the web.
- (2) Tabular data – (Ascii delimited text files) Data describing the location of tsunami deposits (xyz location/elevation) and geologic descriptions of the deposit (grain size distributions,

sorting characteristics, mineralogy, microfossil analyses, etc.) will be linked to spatial data.

- (3) Imagery – (JPEG files) Where available, photographs of tsunami deposits and study sites will be linked to the database to enhance the description of the deposit and provide additional evidence for tsunami inundation.

If additional funding is available for phase 2 (2011-2013 biennium), the final products will include a seamless tsunami evacuation zone layer for the entire coast and a state-wide tsunami deposits database.

Amount Requested

DOGAMI requests a total of \$89,676 to complete the phase 1 of tsunami evacuation zone maps and a tsunami deposits database covering the southern Oregon coast and parts of Tillamook County (Fig. 1).

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Preliminary Budget Breakdown

A summary of the proposed budget is included below:

Category	Proposed Cost
Personnel (salaries/wages)	\$52,145
Equipment	\$0
Supplies	\$0
Lab Analyses (e.g., radiocarbon, diatom)	\$19,000
Travel (in state)	\$3,898
Indirect Costs (19.5%)	\$14,633
Total Project Cost	\$89,676

Additional Information

To date, DOGAMI has not received funding from OGIC to complete the tsunami hazards geospatial database. However, the agency has been supported by OGIC to complete and publish the Oregon Geologic Data Compilation (OGDC). In the 2005-2007 biennium, DOGAMI received \$50,000 for support of the first two parts of a six part statewide digital geologic map compilation. The NE and SE compilation areas were both completed on time, and published as OGDC-1 and OGDC-2, respectively. In the 2007-2009 biennium, DOGAMI received \$50,000 for support of the next two parts of a six part statewide digital geologic map compilation. The Central and SW compilation areas were both completed on time, and published as OGDC-3 and OGDC-4, respectively. In the 2009-2011 biennium, DOGAMI received \$150,000 for support of the final two parts of the six part statewide digital geologic map compilation. The W and NW compilation areas are essentially complete, and will be published by the end of the biennium as OGDC-5.

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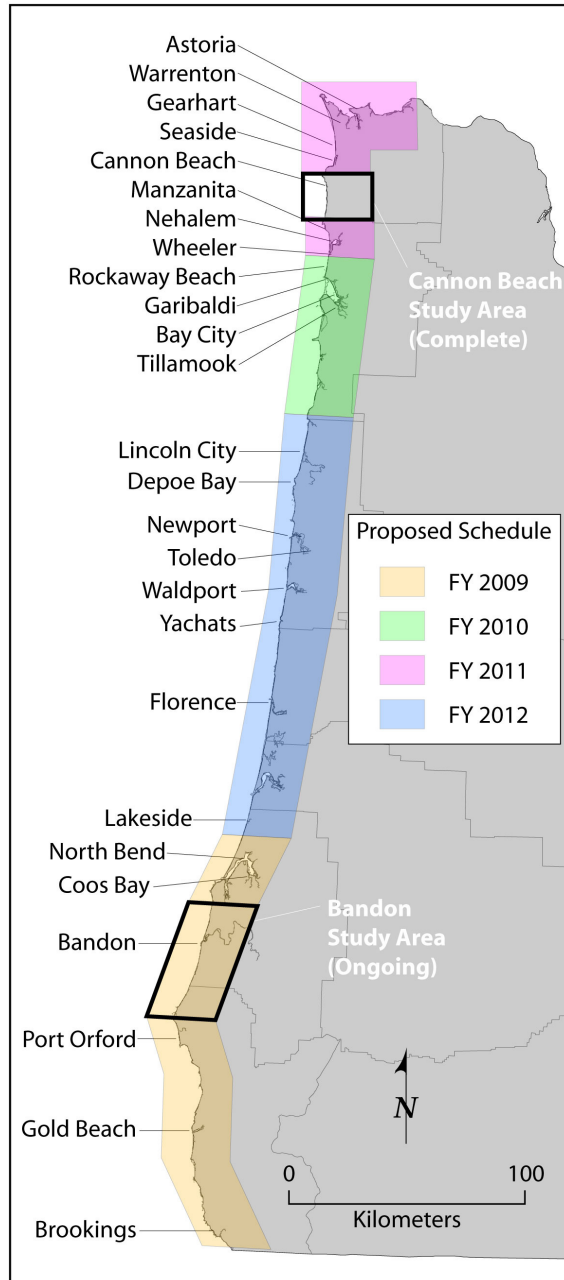


Figure 1. Proposed study areas for accelerating tsunami inundation mapping in Oregon. List on the left identifies 26 of 40 coastal communities that face tsunami hazards. Black boxes define areas of detailed hazard assessment.

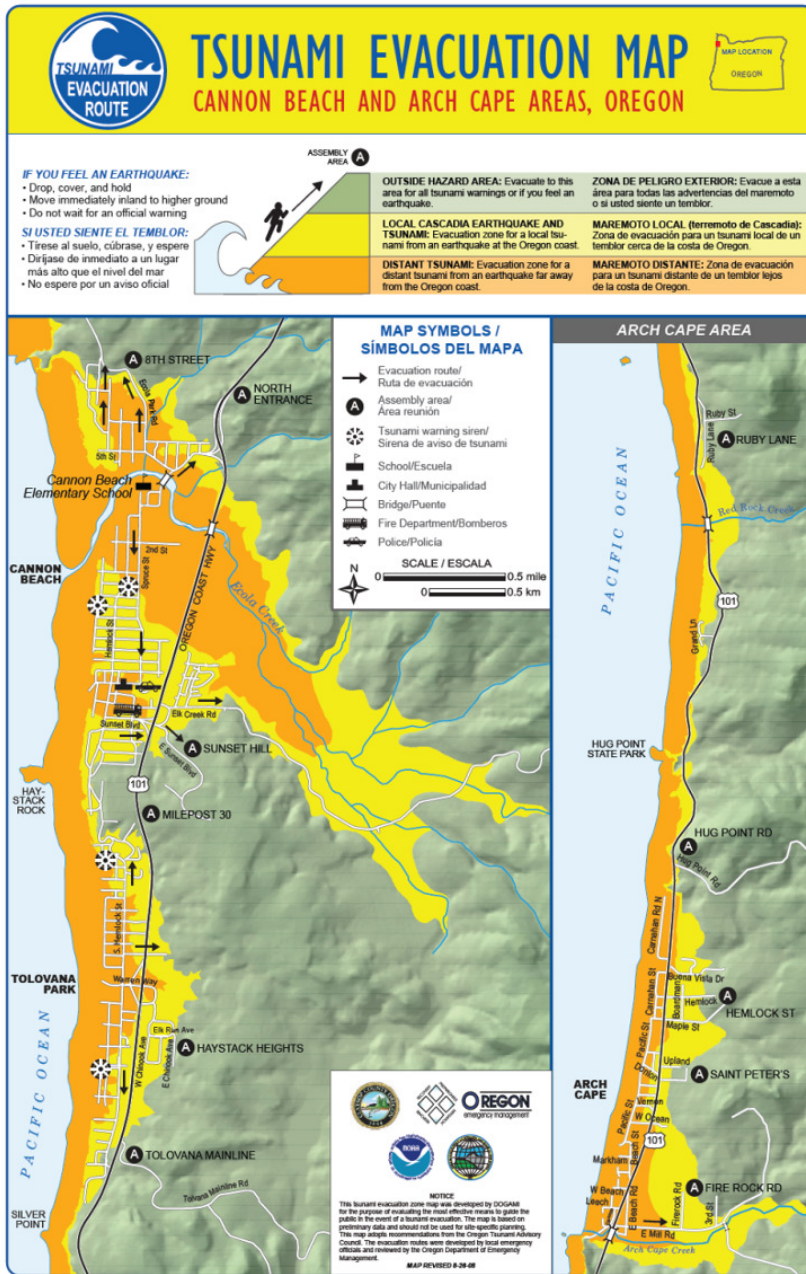


Figure 2. Tsunami evacuation map for Cannon Beach, Oregon. Orange indicates the evacuation area for a distant tsunami; yellow indicates the evacuation area for a local Cascadia tsunami.



Figure 3. Example of tsunami deposits map being developed for Nestucca Bay.



Figure 4. Example of a candidate tsunami deposit from core 5 at Upton Slough, a tributary of the Little Nestucca River. The gray deposit contains fine-grained sandy mud with similar mineralogy to river channel sediment. Ongoing microfossil analyses will provide additional data with which to evaluate whether this sandy layer was deposited by a tsunami or a river flood. Scale on right in centimeters.