Earthquake Hazard Inventory & Mitigation Planning Activity

Objectives

In this two-part activity, students/participants first:

- Complete a Hazard Inventory for their city or area of interest in the event of a magnitude 9 Cascadia subduction zone earthquake and tsunami
- Identify what critical structures and infrastructure will be affected

Then:

- Write a summary statement assessing strengths and vulnerabilities of essential services or infrastructure.
- Propose actions for mitigating vulnerabilities.
- Create an Action Plan to address identified needs.

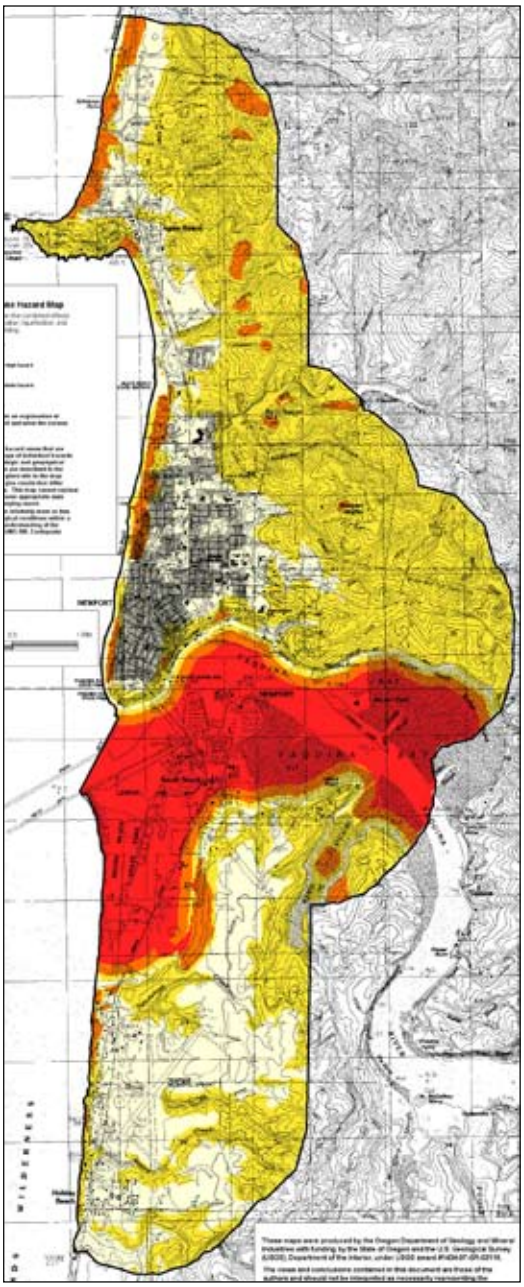
Part 1: Hazard Inventory

Students/Participants investigate the vulnerability of essential public services (police, fire, hospitals, schools, etc.) and essential infrastructure (major roads, bridges, utilities, etc.) from the effects of a great earthquake that can cause liquefaction, ground amplification, and landslides. Tsunami inundation is assessed as well as mobilization of dangerous debris (logs, boats, building materials, etc.). Students/Participants evaluate how the age and construction style of buildings and infrastructure affect their vulnerability. A comprehensive document called Rapid Visual Screening provides additional assessment of critical structures. The investigation also considers access to high ground and to basic survival supplies.

Part 2: increase Community Resilience by Mitigating Hazard Vulnerability

After completing the Hazard Inventory in Part 1, students/participants analyze their findings and consider the implications to their community for selected essential services and infrastructure in the event of a magnitude 9 Cascadia Subduction Zone Earthquake and Tsunami. Students/participants should address both strengths and weaknesses (areas that need improving) to better survive this significant natural disaster in a written summary statement. Students/Participants next determine positive, achievable steps that will mitigate vulnerabilities and improve the resilience of selected essential services and infrastructures such as relocating a school to a safer area, or seismically retrofitting a roadway, bridge, or water reservoir. Finally, an Action Plan is proposed to meet the need for improvements.

Materials and NGSS Standards on next page



Sample of a DOGAMI Relative Earthquake Hazard map for Newport, Oregon shows the possible occurance of earthquake hazards compiled from amplification-, liquefaction-, and landslide-hazard studiess.

This activity was prepared by Bonnie Magura, retired teacher Portland Public Schools, education consultant.

Background for Teacher or Presenter

Hazard Inventory & Mitigation Planning Activity

In this two-part activity, participants will complete a Geophysical Hazard Inventory for their city or area of interest in the event of a magnitude 9 Cascadia Subduction Zone Earthquake and Tsunami and identify what critical structures and infrastructure will be affected. Participants will also propose a process for responding to the potential hazards to create a more earthquake and tsunami resilient community.

Part 1: Complete a Vulnerability Assessment of Essential Services and Infrastructures

Teacher/Presenter Notes:

This activity requires several maps and resources that the teacher/presenter will need to assemble prior to doing the activity. Some of the maps are very detailed and will require introduction, orientation and explanation. The Rapid Visual Screening document covers the entire state of Oregon by county. You may want to print only your county/city as a resource or plan to help students/participants navigate the website and document on-line.

Students will complete the Hazard Inventory worksheet on the following page using maps and resources provided.

The Relative Earthquake Hazard Map and Tsunami Inundation Map use color to indicate "Possibility of Occurrence" which can be used as the Vulnerability rating.

Part 2: Propose ways to mitigate hazard vulnerability and increase community resilience.

Teacher/Presenter Notes

Encourage students/participants to select the services or infrastructures they are most interested in (from the Hazard Inventory in part 1) to use in this section.

Creating an Action Plan to address identified needs involves students/participants in positive; action oriented planning steps following the Vulnerability Assessment. The Teacher/Presenter will want to become familiar with possible answers for the "Who Is Involved and What Happens" portion for the Action Plan section. This is designed to be a brainstorming activity which may require help from the teacher/presenter. The focus is on the process more than specific correct answers.

Materials

Student worksheets on Pages 3-5

Maps (see References on last page):

- DOGAMI's Relative Earthquake Hazard* maps showing liquefaction, ground-shaking amplification, earthquake-induced landslides.
- Washington State Department of Natural Resources Hazard maps
- Tsunami Inundation Maps
- Local or city maps (visitor's maps or information materials, real estate maps, park maps)

Additional Resources:

- Rapid Visual Screening (select: Final Screening Results click on the "Search by County for individual site results" tab) http://www.oregongeology.com/sub/projects/rvs/
- Office of emergency services
- City hall
- Phone directories

Science Standards (NGSS; pg. 287)

- Ecosystems—Interactions, Energy, and Dynamics: MS-LS2-1, HS-LS2-1, MS-LS2-4, HS-LS2-7, HS-LS2-8
- Energy: MS-PS3-1, HS-PS3-2, MS-PS3-5
- Waves and Their Applications in Technologies for Information Transfer: MS-PS4-1, HS-PS4-1, MS-PS4-2, HS-PS4-2, HS-PS4-5
- Earth's Systems: HS-ESS2-2
- Earth and Human Activity: HS-ESS3-1, MS-ESS3-2
- Engineering Design: MS-ETS1-1, HS-ETS1-1, HS-ETS1-3

** Maden and Wang, 1999*

Name _____

Part 1: Hazard Inventory

Complete this worksheet using the maps and resources provided.
The Relative Earthquake Hazard Map uses color to indicate the probability (possibility or likelihood) that a specific hazard will occur. The Tsunami Inundation Map uses color to indicate earthquake magnitude.

	Location Describe an approximate location using street names. or landmarks	**Vulnerability** (high, moderate, low or none)								
		Landslide	**Ground Amplification**	**Liquefaction**	**Tsunami Inundation**	**Dangerous Debris**	**Rapid Visual Screening**	**Construction (age, masonry, multi-levels, etc.)**	**Access to High Ground**	**Access to Basic Survival Supplies**
Current Location										
Your Home										
Essential Services										
Police										
Fire										
Hospital/Clinic										
City/County Government										
Emergency Ops Center										
Jail										
School										
School										
Banks/$ Institutions										
Essential Infrastructure										
Communications Networks										
Water/Waste-Water Supply Systems										
Utility Plants										
Bridges										
Harbors/Ports										
Airports										
Main Roads										
Haz Mat Structures										
Large Gathering Areas or Vulnerable Populations										
Hotel/Resort										
Parks										
Beach Access										
Bank										
Nursing Homes, Asst. Living, etc.										
Casino										
Event Center										
Shopping Areas										
Other:										
Other:										

Part 2: Mitigating Hazard Vulnerability to increase Community Resilience

1. **Write a Summary Statement** assessing strengths and vulnerabilities of essential services or infrastructure.
2. **Propose Actions** for mitigating vulnerabilities.
3. **Create an Action Plan** to address identified needs.

1. **Summary Statement**: Using the Hazard Assessment chart developed in Part 1, select at least 5 essential services or infrastructure in your city or area of interest and write a summary statement assessing their strengths and vulnerabilities. Include specific examples.

2. **Mitigation Actions**: Propose potential mitigation actions that could be taken to reduce risk at the 5 essential services or infrastructure you selected. Additional sites may be included.

Site/Facility	Possible Mitigation Actions

3. **Create an Action Plan to address identified needs.** Consider things such as: community information, education, and/or focus groups; forming an Ad Hoc committee; presenting findings to a responsible jurisdiction such as city council, county commission, parks department, school board; feasibility studies; professional consultants, identifying funding mechanisms, implementation & construction, etc.

	Action Plan Steps	Who is Involved and What Happens
1.		
2.		
3.		
4.		
5.		
6.		
7.		

References and Resources

Oregon State Resources:

Ian P. Madin and Zhenming Wang, Relative Earthquake Hazard Maps for Selected Coastal Communities in Oregon, Interpretive Map Series IMS-10, State of Oregon Department of Geology and Mineral Industries, 1999.
http://www.oregongeology.org/sub/publications/IMS/ims-010/Text/ims-10.pdf
Maps available on CD ROM at http://www.naturenw.org/qs3/products.php?sku=001196

TIM-Linc-07, Tsunami Inundation Maps for Newport South, Lincoln County, Oregon
http://www.oregongeology.org/pubs/tim/p-TIM-Linc-07.htm

Statewide Seismic Needs Assessment Using Rapid Visual Screening (RVS), Oregon Department of Geology and Mineral Industries, http://www.oregongeology.com/sub/projects/rvs/
Excel worksheet available at: www.oregongeology.com/sub/projects/rvs/SSNA-all-data.xls Emergency Operations Plan - City of Newport, Oregon, August 2009
http://www.thecityofnewport.net/pdfs/newport_eop_final_draft_march_2010.pdf
See particularly: Incident Annex IA 6. Earthquake/Tsunami

The Oregon Resilience Plan Reducing Risk and Improving Recovery for the Next Cascadia Earthquake and Tsunami, Oregon Seismic Safety Policy Advisory Commission, Salem, Oregon, February 2013.
http://www.oregon.gov/OMD/OEM/osspac/docs/Oregon_Resilience_Plan_draft.pdf

State of Oregon Emergency Operations Plan, Oregon Office of Emergency Management, Salem, Oregon, 2010.
http://www.oregon.gov/OMD/OEM/plans_train/docs/eop/or_eop_basic_plan.pdf

EARTHQUAKE & TSUNAMI AWARENESS—PREPAREDNESS GAINING MOMENTUM News Release from: Oregon Office of Emergency Management, March 14, 2013.
http://www.oregon.gov/OMD/OEM/public_information/press_releases/EQ_Tsu_awareness_3_14_13.pdf

Washington State Resources:

S. P. Palmer, S. L. Magsino, E. L. Bilderback, J. L. Poelstra, D. S. Folger, and R. A. Niggemann, Liquefaction Susceptibility and Site Class Maps of Washington State, by County, Open File Report 2004-20, 2004
http://www.dnr.wa.gov/ResearchScience/Topics/GeologyPublicationsLibrary/Pages/pub_ofr04-20.aspx

Tsunami Inundation Maps, Washington State Department of Natural Resources
http://www.dnr.wa.gov/Publications/ger_tsunami_inundation_maps.pdf
http://www.dnr.wa.gov/Publications/ger_ri36_aberdeen_liquefaction.zip
There are actually two map files; both are called liquefaction but the "pl1" actually has landslides for both wet and dry conditions. You have to zoom in a bit to see the landslide coloring behind the topographic lines.

Washington State Susceptibility to Liquefaction by county ftp://ww4.dnr.wa.gov/geology/pubs/ofr04-20/

Interactive tsunami inundation and evacuation map for Washington State
https://fortress.wa.gov/dnr/geology/?Theme=tsunami_evac

Washington State Emergency Management Council Seismic Safety Committee, Resilient Washington State, A Framework for Minimizing Loss and Improving Statewide Recovery after an Earthquake, Final Report and Recommendations, 2012. http://www.dnr.wa.gov/Publications/ger_ic114_resilient_washington_state.pdf