Thunderbird and Whale 2022
Exercise Scenario

Tribal History

Elders in coastal tribal nations throughout the Pacific Northwest recount oral histories about the struggle between Thunderbird and Whale[1] which generally describe the effects of an earthquake and/or a tsunami. These seismic events have taken place along the coast for thousands of years, and it is imperative that tribal nations be prepared for the next "struggle" between Thunderbird and Whale.

The Incident

On June 9, 2022, an abrupt shifting of the Earth's crust along the Cascadia Subduction Zone resulted in a full-length "megathrust" rupture[2] of that fault between Cape Mendocino in Northern California and Nootka Island in British Columbia, producing a magnitude 9.0 earthquake.[3]

Ground Motion

Severe shaking (Modified Mercalli Intensity scale[4] VIII) to Very Strong shaking (MMI VII), up to six minutes in duration, took place along all coastal areas of Washington, Oregon, Northern California, and Vancouver Island, and in Puget Sound. Strong shaking (MMI VI) occurred in all other areas west of the Cascade Mountains, and this tapered off from Moderate shaking (MMI V) to Light shaking (MMI IV) further east. Numerous aftershocks, some exceeding magnitude 7.0, continue for weeks.

Subsidence

Movement of the Earth's crust caused coastal shoreline areas of each state, and along the Strait of Juan de Fuca, to immediately drop, ranging from four feet at La Push, Washington, to 13 feet at Neah Bay, Washington.[5] When this happened, water rushed in to compensate for the sudden imbalance compared to the global sea level. That coseismic subsidence increased the effective height of the tsunami in affected low-lying areas.

Tsunami

The crest of the first wave of a massive tsunami exceeded 30 feet in height and reached the coast in 10 to 30 minutes of the start of the earthquake shaking (depending on distance from the fault).[6] Subsequent tsunami wave action was hazardous to maritime operations for more than 24 hours.[7]

Inundation

Flooding depths on land reached or exceeded 60 feet along most Pacific coastline beaches. The greatest amount of inundation occurred near the mouth of the Hoh River and Yellow Banks Beach where flooding depths reached 100 feet.[8]

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1 https://rctwg.humboldt.edu/sites/default/files/ludwin_native_stories_cascadia_0.pdf
2 https://www.pnsn.org/outreach/earthquakehazards/ground-motion
3 https://pubs.usgs.gov/gip/earthq4/severitygip.html
4 https://www.usgs.gov/programs/earthquake-hazards/modified-mercalli-intensity-scale
5 https://fortress.wa.gov/dnr/geologydata/tsunami_hazard_maps/ger_ms2022-01_tsunami_hazard_olympic_peninsula.zip [ger_ms2022-01_tsunami_hazard_olympic_peninsula_pamphlet.pdf (Pages 8,10,12)]
6 https://mil.wa.gov/asset/5d8ba2a03a1b7 (Page 18)
7 https://fortress.wa.gov/dnr/geologydata/tsunami_hazard_maps/ger_ms2022-01_tsunami_hazard_olympic_peninsula.zip [ger_ms2022-01_tsunami_hazard_olympic_peninsula_pamphlet.pdf (Page 1)]

Liquefaction

Soils in tidal flats, river estuaries, and in areas with artificial fills have liquefied.[9] This caused buildings and infrastructure (roadways, docks, railways, airports) to tilt and/or sink.

Landslides

Landslides[10] have occurred along steeper slopes and some older deep-seated landslides were reactivated in areas west of the Cascade Mountains. Catastrophic debris flows occurred in many areas.

Hazardous Materials

Widespread containment failure occurred in above-ground and below-ground fuel and chemical storage tanks in Puget Sound and the lower Columbia River.[11] Ground and surface water was contaminated, and the number of toxic chemical spills and fires remains significant.

Fires and Toxic Emissions

The combination of leaking fuels and combustion sources make fires a major hazard following an earthquake. Extinguishing fires rapidly has been hampered by debris on roadways, damaged firefighting apparatus, and water distribution systems failures.[12] Fuel tanks have given off toxic plumes.[13]

Response Challenges

Numerous aftershocks, some exceeding magnitude 7.0, continue to disrupt response efforts. Bridges have collapsed and paved surfaces buckled.[14] Low-lying areas which were subjected to subsidence will be flooded twice daily at mean high water to a depth of three to 10 feet for decades.[15] West of the Cascade Mountains, power, water, and communications are severed. Medical facilities, food and water distribution points, temporary shelters, and other emergency locations are overwhelmed with people seeking assistance. Tens of thousands of survivors need medical care. Over ten thousand buildings have been completely destroyed. Hundreds of thousands of people are either homeless or living in structures with major damage. In severely affected areas of the Pacific coast, a full accounting of all lives lost may never be known.

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8 https://fortress.wa.gov/dnr/geologydata/tsunami_hazard_maps/ger_ms2022-01_tsunami_hazard_olympic_peninsula.zip [ger_ms2022-01_tsunami_hazard_olympic_peninsula_pamphlet.pdf (Page 7)]

9 https://www.pnsn.org/outreach/earthquakehazards/liquifaction

10 https://www.pnsn.org/outreach/earthquakehazards/landslides

11 https://multco-web7-psh-files-usw2.s3-us-west-2.amazonaws.com/s3fs-public/Impacts_of_CSZ_Earthquake_on_CEI_Hub_Pub_DRAFT_063021.pdf (Page 16)

12 https://www.pnsn.org/outreach/earthquakehazards/fire

13 https://multco-web7-psh-files-usw2.s3-us-west-2.amazonaws.com/s3fs-public/Impacts_of_CSZ_Earthquake_on_CEI_Hub_Pub_DRAFT_063021.pdf (Page 46)

14 https://wsdot.maps.arcgis.com/apps/webappviewer/index.html?id=030c578820454709938ac966957069dc

15 https://digital.lib.washington.edu/researchworks/bitstream/handle/1773/45287/ShoalwaterFinalReport.pdf