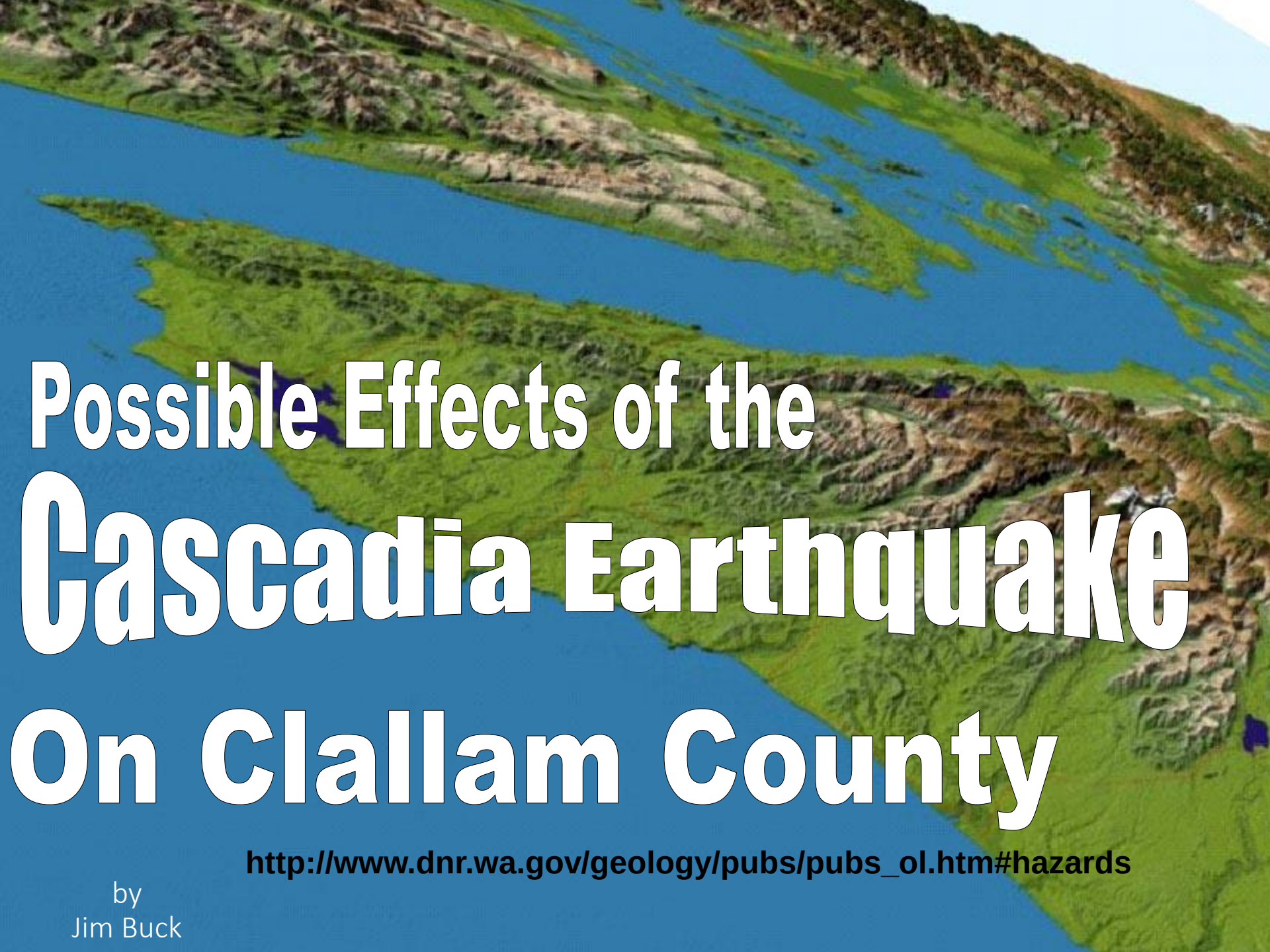


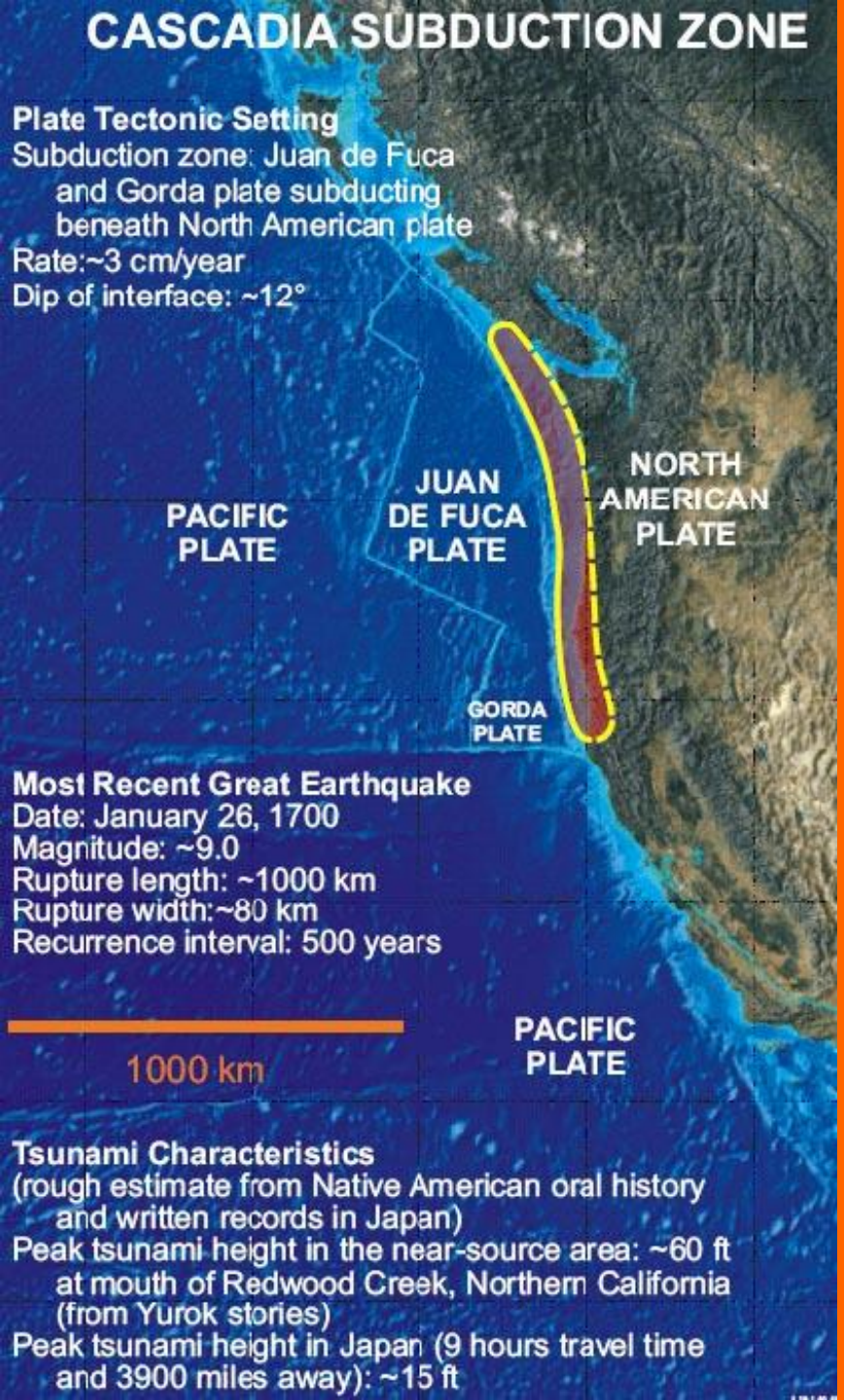
Possible Effects of the Cascadia Earthquake On Clallam County

http://www.dnr.wa.gov/geology/pubs/pubs_ol.htm#hazards

by
Jim Buck

Cascadia Animation

Thanks to Michael Lienau of Global Networks Productions for letting us use this animation. Michael is the producer of several excellent programs about the quake that might be useful for your community. Contact michael@globalnetproductions.com.



THE QUAKE

Location: 130 miles off coast

Length of Rupture: 600 miles

Width of Rupture: 50 miles

Duration: 6.5 minutes

Magnitude at rupture: 9.2

PGA on Oly Pen: 20 to 25% G

PGA near I-5: 15 to 20% G

WORST CASE SCENARIO

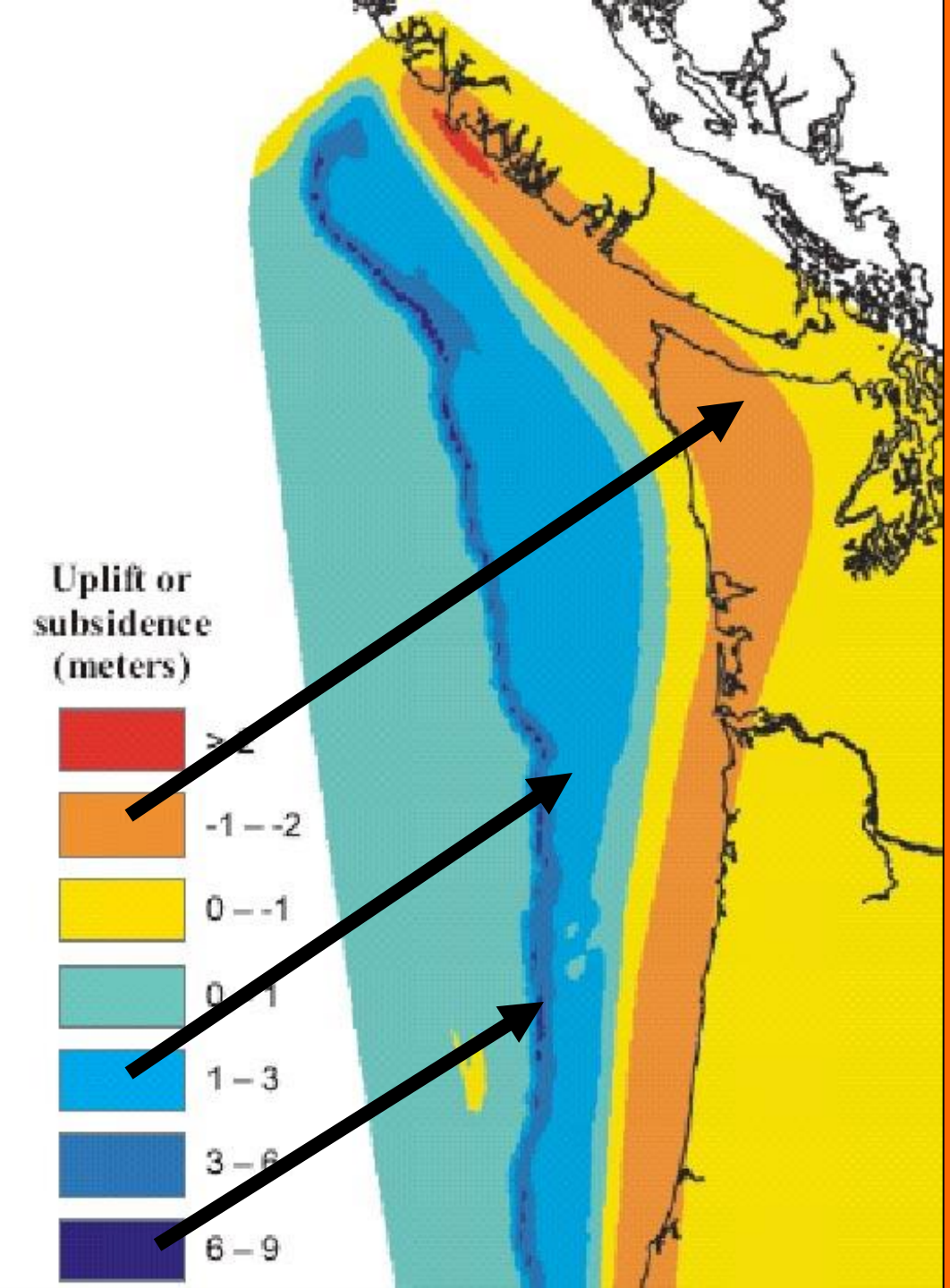
Time: January - Late afternoon

Temperature: 35º

Weather: Rain/Snow Storm

Tide: 2 hours before high tide

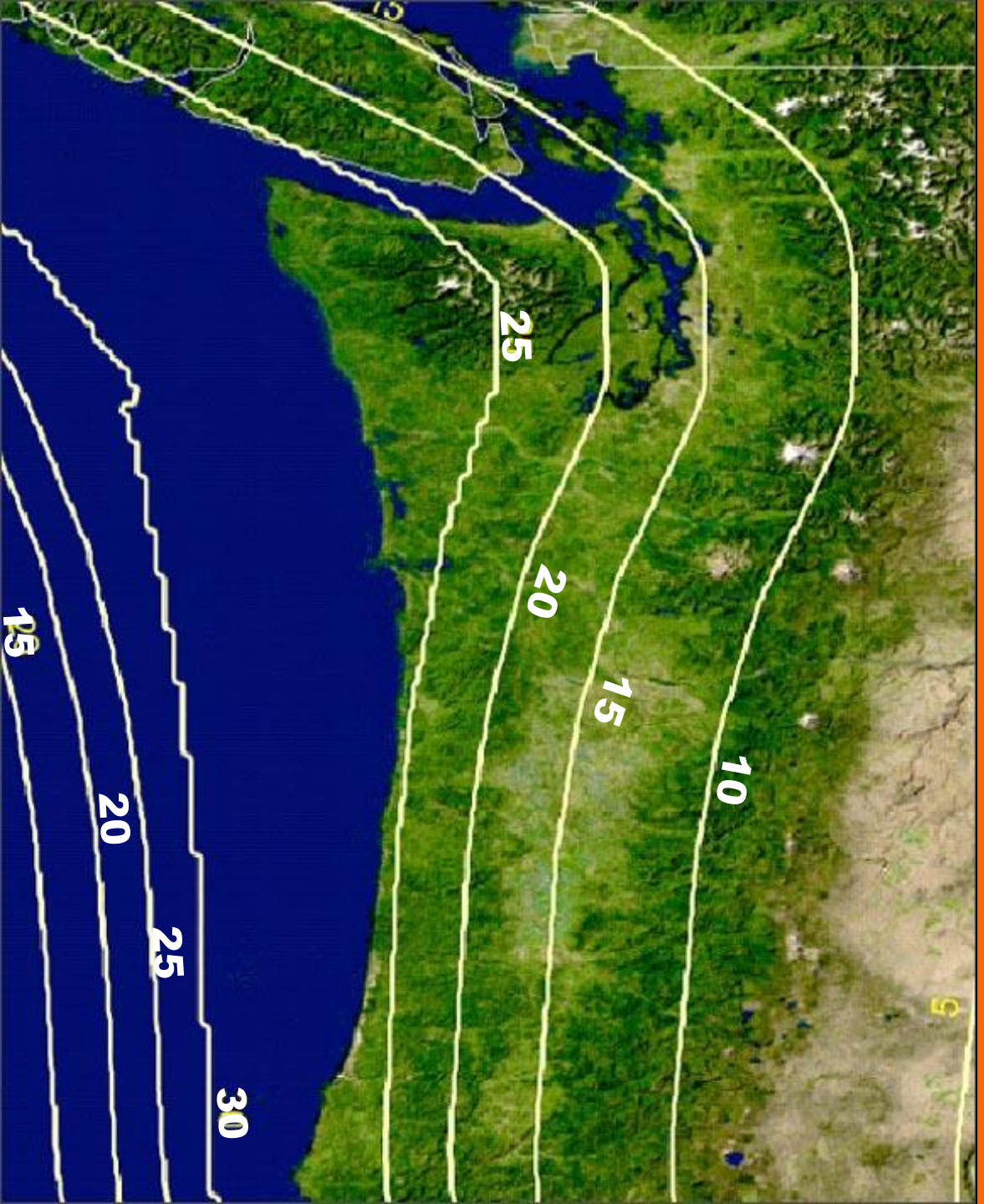
Soil conditions: Saturated



Map of uplift and subsidence along the Cascadia subduction zone for earthquake scenario 1A. Negative numbers indicate subsidence.

Most of the western **Olympic Peninsula is predicted to sink three to six feet** with the rest of western Washington sinking as much as three feet.

A significant portion of the **sea floor off the coast could rise three to ten feet** with a smaller ridge along the subduction zone rising by as much as thirty feet.

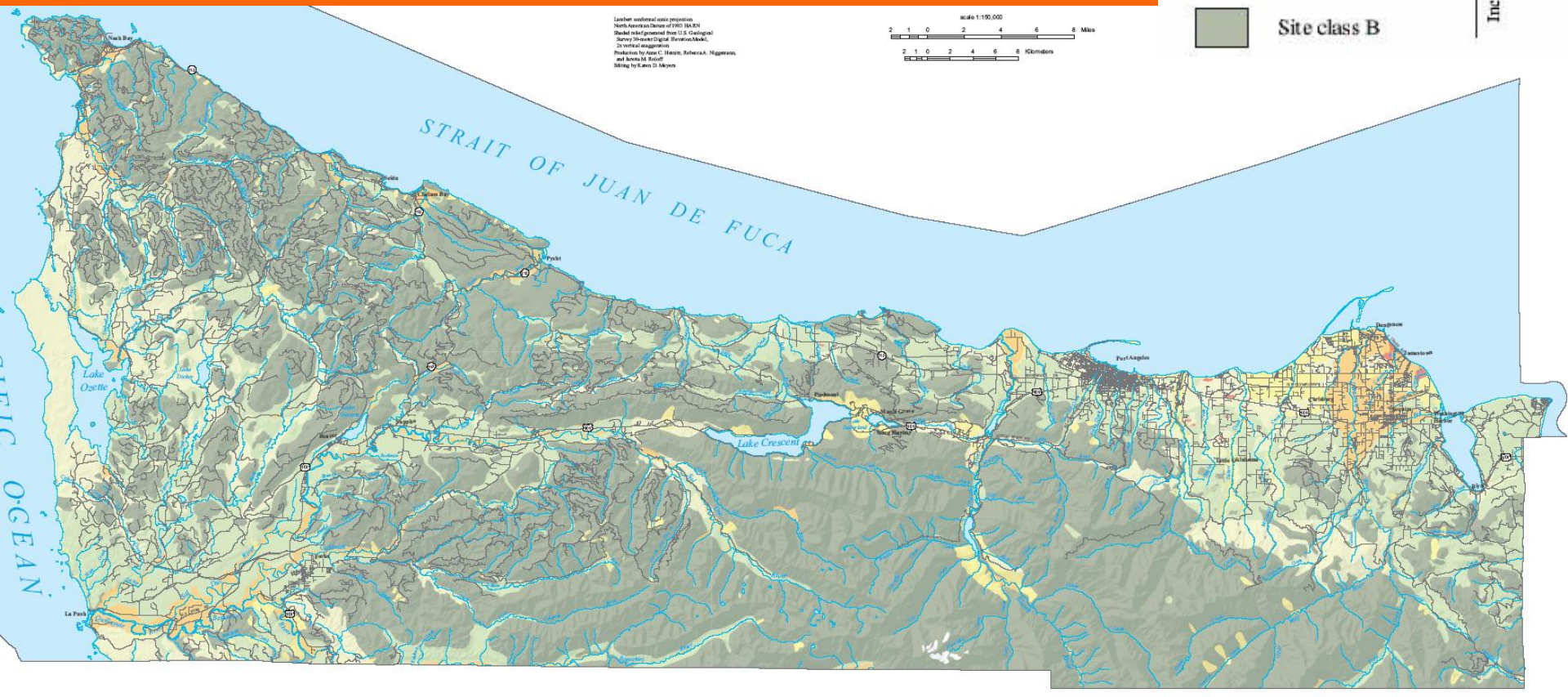


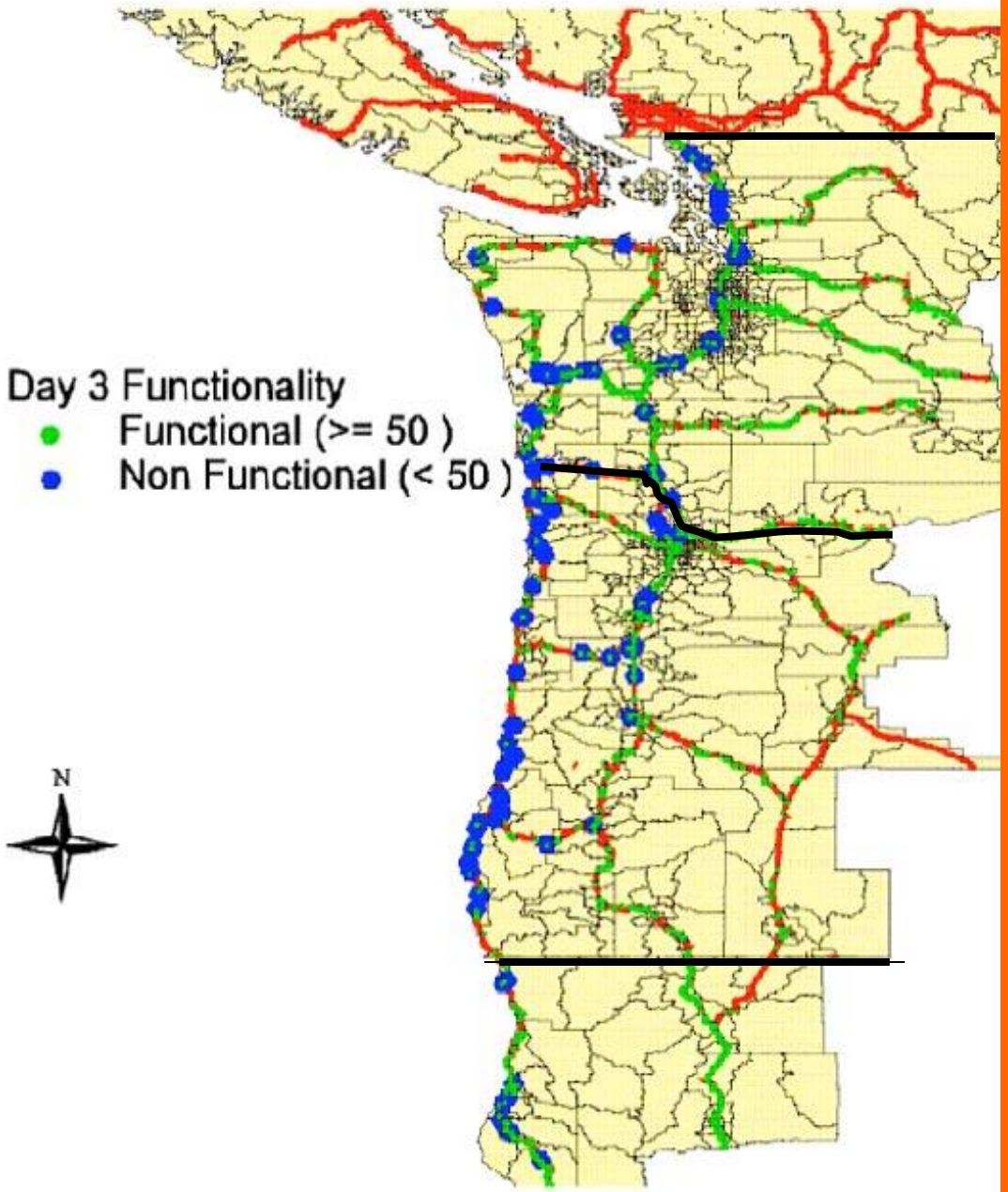
This map shows Peak Ground Accelerations (PGAs). PGA is one measure of the strength of shaking. Higher PGAs generally result in more damage. Because this map shows average expected PGAs in an area, specific locations may have higher or lower PGAs, and significantly more or less damage. Site conditions such as soil and building type will affect the type and amount of damage at any given place.

Kobe footage

The picture shows a six story structural steel office building with a partial failure of the foundation due to liquefaction.

Ground Shaking





Significant damage to roads, bridges and Cascade passes from Northern California to Northern Vancouver Island

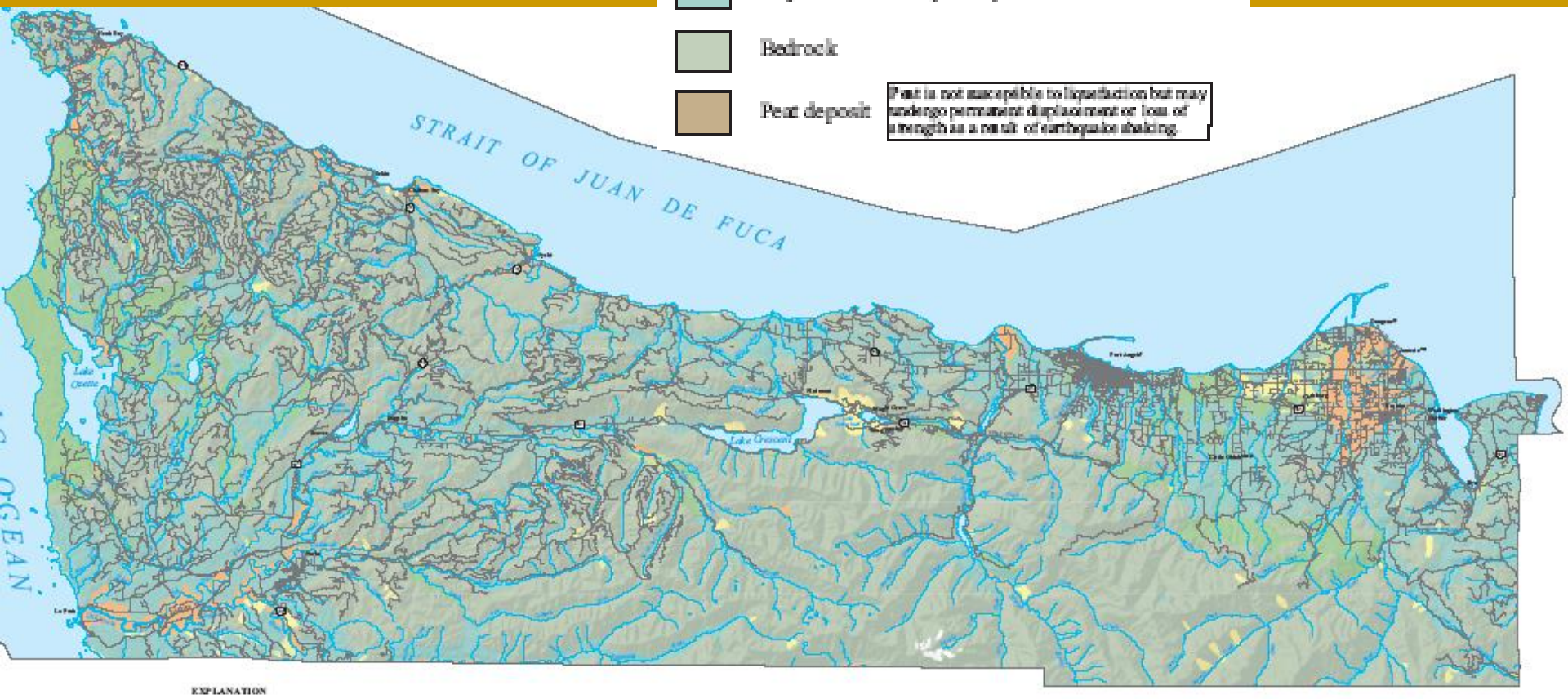
Each blue dot represents a bridge that is out of service three days after the earthquake. This is only one possible outcome, not a listing of all bridges that will be damaged. The effects of liquefaction or tsunamis, either of which could create more damage at a specific site, were not included. Segments shown in green would likely be functional.

The importance of the map is in recognizing the pattern of widespread damage along the major transportation corridors of Hwy 101, I-5, Hwy 99, and across the Coast Range. This pattern can be applied to other types of structures in those areas. Including tall buildings and long power lines and pipelines.


Highway 101 near Olympia`
2001 M6.8 Nisqually Earthquake

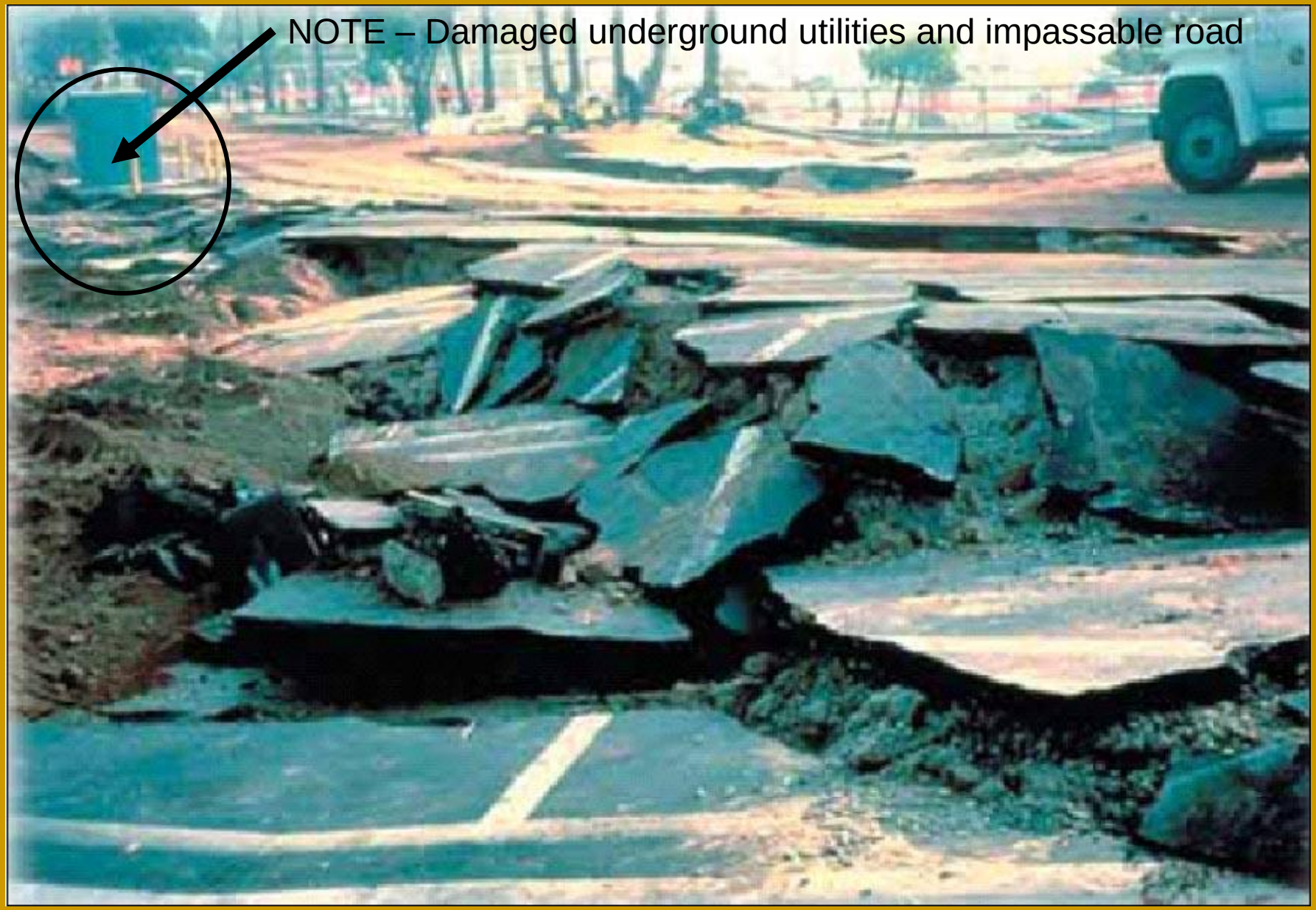
After the 1989 Loma Prieta earthquake, debris trapped people in buildings and blocked roads in Santa Cruz. After a large earthquake in the Pacific Northwest, it could take days, even months, to reopen freeways and surface streets. Rescue and recovery efforts on the Olympic Peninsula will be effected by damaged infrastructure in the I-5 corridor.

Liquefaction



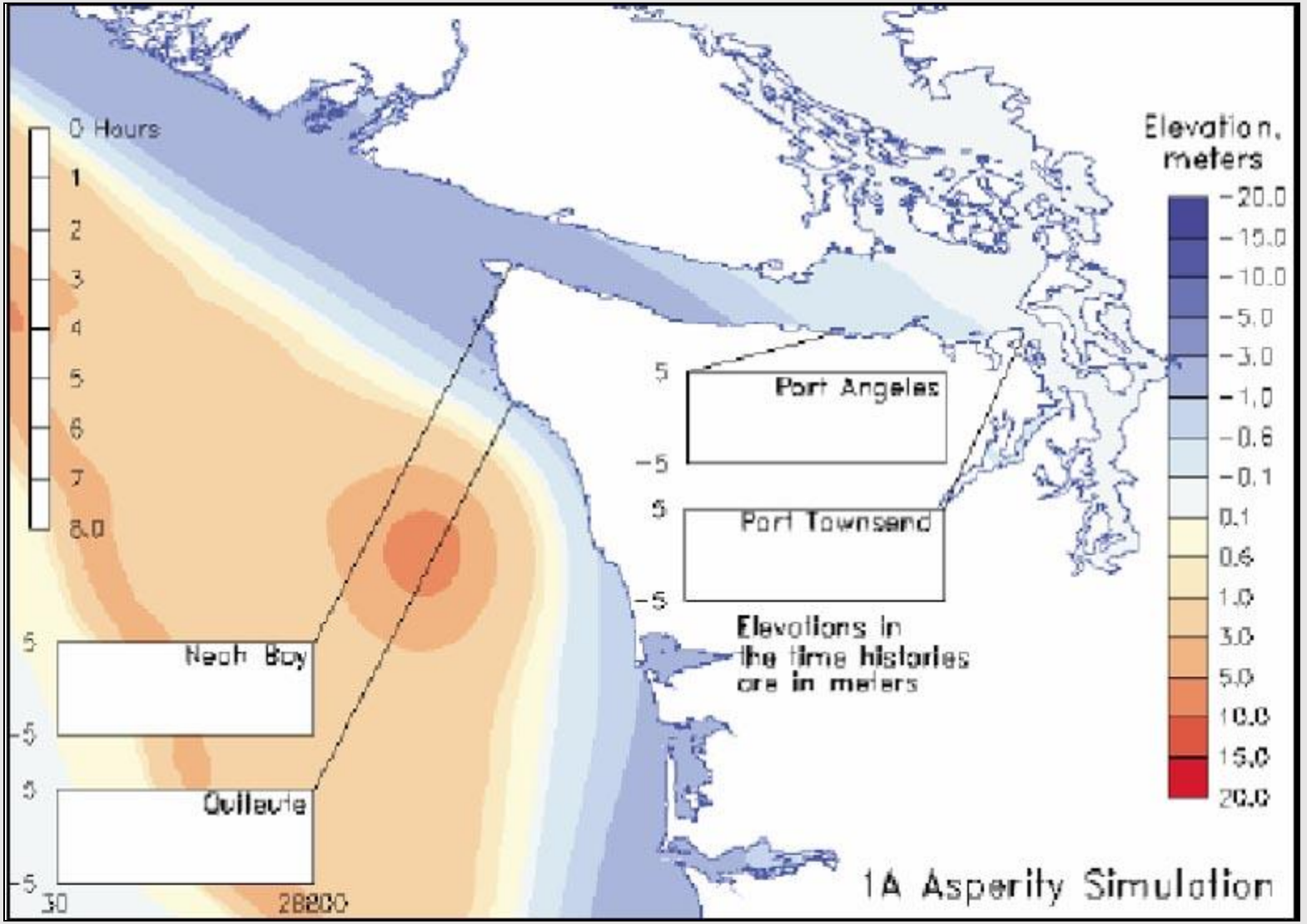
Liquefaction can destroy roads, as the 2001 Nisqually earthquake did to this street outside Olympia. Many stretches of HWY 101 and other coastal roads in Cascadia are vulnerable to this type of destruction.

Photo: T. Walsh, WA Division of Geology and Earth Resources.



This road was destroyed by liquefaction, when soil beneath the asphalt turned to liquid.

Foundation failure caused by liquefaction damaged this apartment building. *Photo: USGS/Ft. Collins, CO*



Initial deformation model for scenario 1A with an asperity or area of additional uplift, located west of the core of the Olympics. Warmer colors are areas of uplift and cooler areas are subsidence.

Ships and boats need to leave harbor as soon as the quake is over to avoid being beached by the tsunami.

Log loaders, fork lifts, fuel trucks and other heavy equipment that survives the earthquake need to be moved to high ground before the tsunami arrives so they can be used to clear debris flows and reopen road and port facilities.

Roads

Area of Operation	None	Low	Medium	High
Coastal	14%	6%	5%	75%
I-5 corridor	65%	5%	8%	22%
East	33%	66%	0%	0%
Summary of damage description	No damage.	1 - 3 inches ground displacement. Slight cracking or movement. No interruption of traffic.	3 - 12 inches ground displacement. Moderate to extensive cracking or movement of pavement surface but not failure of subsurface soils.	Over 12 inches ground displacement. Roadway pavement and subsurface soils fail. Roadway surface requires replacement.

Road Bridges

Area of Operation	None	Low	Medium	High
Coastal	16%	12%	23%	50%
I-5 corridor	53%	7%	27%	13%
East	100%	0%	0%	0%
Summary of damage description	No damage.	Slight damage requiring only minor, cosmetic repairs, but the bridges can support traffic even before these repairs are made.	Moderate damage requiring repairs before use, but not requiring demolition of bridges. Bridges may not support heavy loads and will likely require engineering assessments before deemed safe for traffic.	Bridge collapse or damages so severe as to require demolition and complete replacement of the entire bridge. Bridge likely impassable to traffic.

Airports

Area of Operation	None	Low	Medium	High
Coastal	0%	0%	45%	55%
I-5 corridor	0%	30%	32%	8%
East	27%	73%	0%	0%
Summary of damage description	No structural damage. Possible non-structural damage.	Minor structural damage, with some beams and columns exhibit hairline cracks near joints or within joints. Some nonstructural damage.	Most beams and columns exhibit cracks. Some frame elements have reached yield capacity, which may result in partial collapse. Damage may obstruct air control and monitoring capabilities.	Structure is collapsed or in imminent danger of collapse.

Ports

Area of Operation	None	Low	Medium	High
Coastal	0%	0%	22%	78%
I-5 corridor	0%	18%	73%	9%
East	33%	67%	0%	0%
Summary of damage description	Port facility is fully functional.	Slight ground settlement causing minor cracking of pavement and sliding of piers. Minor repairs may be required.	Broken and damaged piles supporting piers/ seawalls. Considerable crane and warehouse derailment, with some toppled cranes. Rail repair and some repair to structural members required.	Extensive damage is widespread at the port facility. Failure of most piles and extensive sliding of piers. Potential for totally derailed cranes and derailment of warehouses over extended length Replacement of structural members required.

Electricity

Area of Operation	None	Low	Medium	High
Coastal	0%	0%	60%	40%
I-5 corridor	0%	22%	66%	12%
East	31%	69%	0%	0%
Summary of damage description	No damage to distribution systems and substations.	Light damage to generation plants, substation equipment, and buildings. No transformer damage. Repairs completed in a few hours to days. Temporary outage period, if any.	Considerable damage to generation plants, substation equipment, and buildings. Repairs are needed to regain functionality. Restoring power to meet 90% of demand may take weeks to months.	Extensive damage to generation plants, substations, and buildings. Repairs are needed to regain functionality. Restoring power to meet 90% of demand may take months to one year.

Law Enforcement

Area of Operation	None	Low	Medium	High
Coastal	0%	5%	38%	57%
I-5 corridor	8%	49%	6%	37%
East	100%	0%	0%	0%
Summary of damage description	Facility is fully functional.	Facility is structurally sound and able to be occupied, though damage to interior contents may make immediate use more difficult.	Facility is damaged and may need repair before full occupation.	Facility is not accessible.

Hospitals

Area of Operation	None	Low	Medium	High
Coastal	0%	7%	43%	50%
I-5 corridor	7%	42%	28%	24%
East	100%	0%	0%	0%
Summary of damage description	Hospital is fully functional.	Hospital is structurally sound and able to be occupied, though damage to interior contents may make immediate use more difficult.	Hospital is extensively damaged and operating at limited capacity. Partial evacuation may be required.	Hospital is severely damaged. Full evacuation may be required.

Schools

Area of Operation	None	Low	Medium	High
Coastal	0%	3%	22%	75%
I-5 corridor	3%	47%	31%	19%
East	89%	11%	0%	0%
Summary of damage description	School is fully functional.	School building suffers limited damage and can be immediately occupied. However, damage to interior contents, loss of power, damaged utilities, etc. impact usability.	School building suffers damages that make immediate occupancy unlikely. Shoring up of damaged structural elements and other more costly and time-consuming repairs likely needed before the school can be occupied again.	School building suffers extensive damages, which may include partial or full collapse. Immediate occupancy is impossible. Repairs will be extensive. Many buildings need to be demolished and rebuilt.

Water

Area of Operation	None	Low	Medium	High
Wastewater Facilities				
Coastal	0%	0%	44%	56%
I-5 corridor	0%	12%	576%	12%
East	21%	79%	0%	0%
Potable Water Facilities				
Coastal	0%	0%	67%	33%
I-5 corridor	0%	11%	86%	3%
East	0%	100%	0%	0%
Summary of damage description	No structural damage to water and waste-water treatment plant, lift-stations, pumping plants and water storage tanks.	Loss of electric power and backup power, resulting in temporary malfunction for less than three days. Loss of water quality may occur. Minor water storage tank damage without loss of functionality.	Loss of electric power and backup power, resulting in malfunction for about a week. Loss of water quality is likely. Damaged pipes connecting to basins and chemical units, which may result in a shutdown of treatment plant. Damage to pumps and lift-stations may be beyond repair. Considerable to severe damage to water storage tanks, resulting in loss of content.	Complete failure of pipings, or extensive damage to the filter gallery at treatment plant. Pumping plant or lift-station building collapse. Water storage tank collapse and loss all of content.

Communications

Area of Operation	None	Low	Medium	High
Coastal	0%	0%	33%	67%
I-5 corridor	5%	19%	55%	21%
East	95%	5%	0%	0%
Summary of damage description	No damage to facility building or equipment. Antennae misalignment may temporarily disrupt service.	Slight damage to the communication facility building, or loss of the center's ability to provide services for up to a few days due to loss of electric power and backup power. The facility may be functional with minor repairs.	Moderate to severe damage to communication facility buildings, many digital switching boards dislodged, resulting in malfunction. The central office may be without service for a few days due to loss of electric power or loss of backup power, typically due to overload.	Severe to complete damage to the communication facility building, with most switching boards dislodged, resulting in malfunction. The damage to digital switching boards may beyond repair.

WASHINGTON STATE DEPARTMENT OF
Natural Resources

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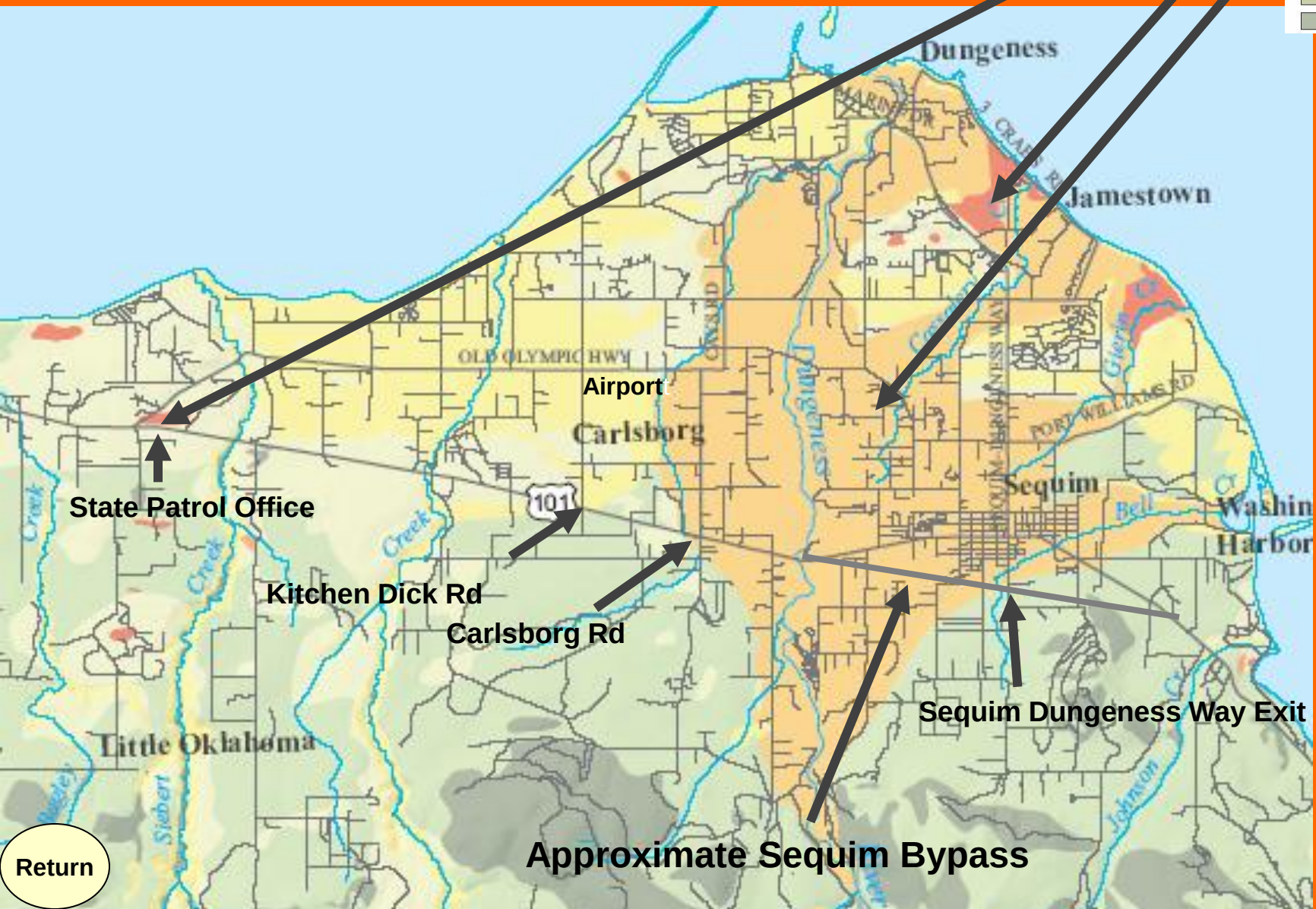
http://www.dnr.wa.gov/geology/pubs/pubs_ol.htm#hazards

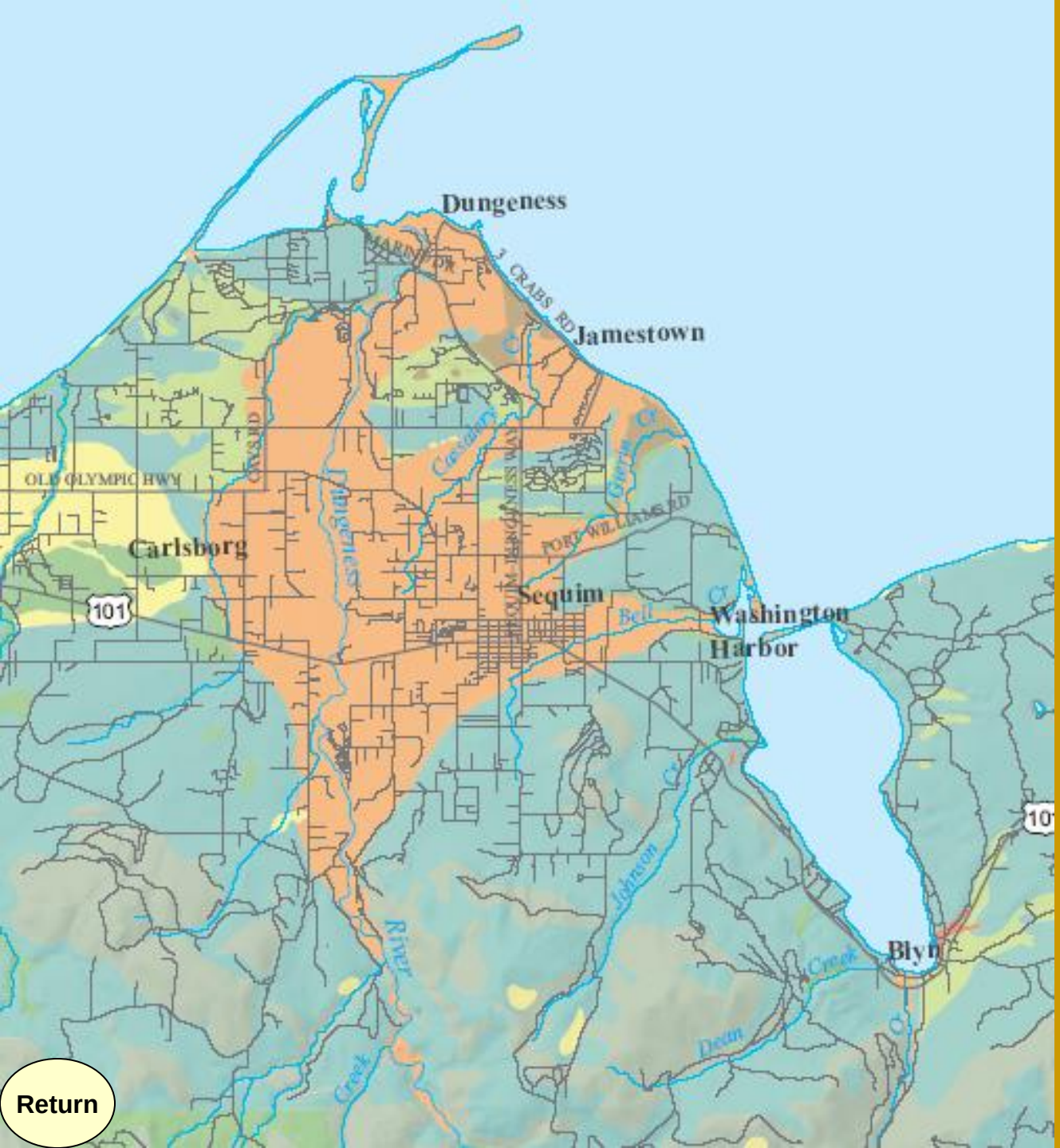
CLALLAM COUNTY

Return

Ground shaking – East Clallam



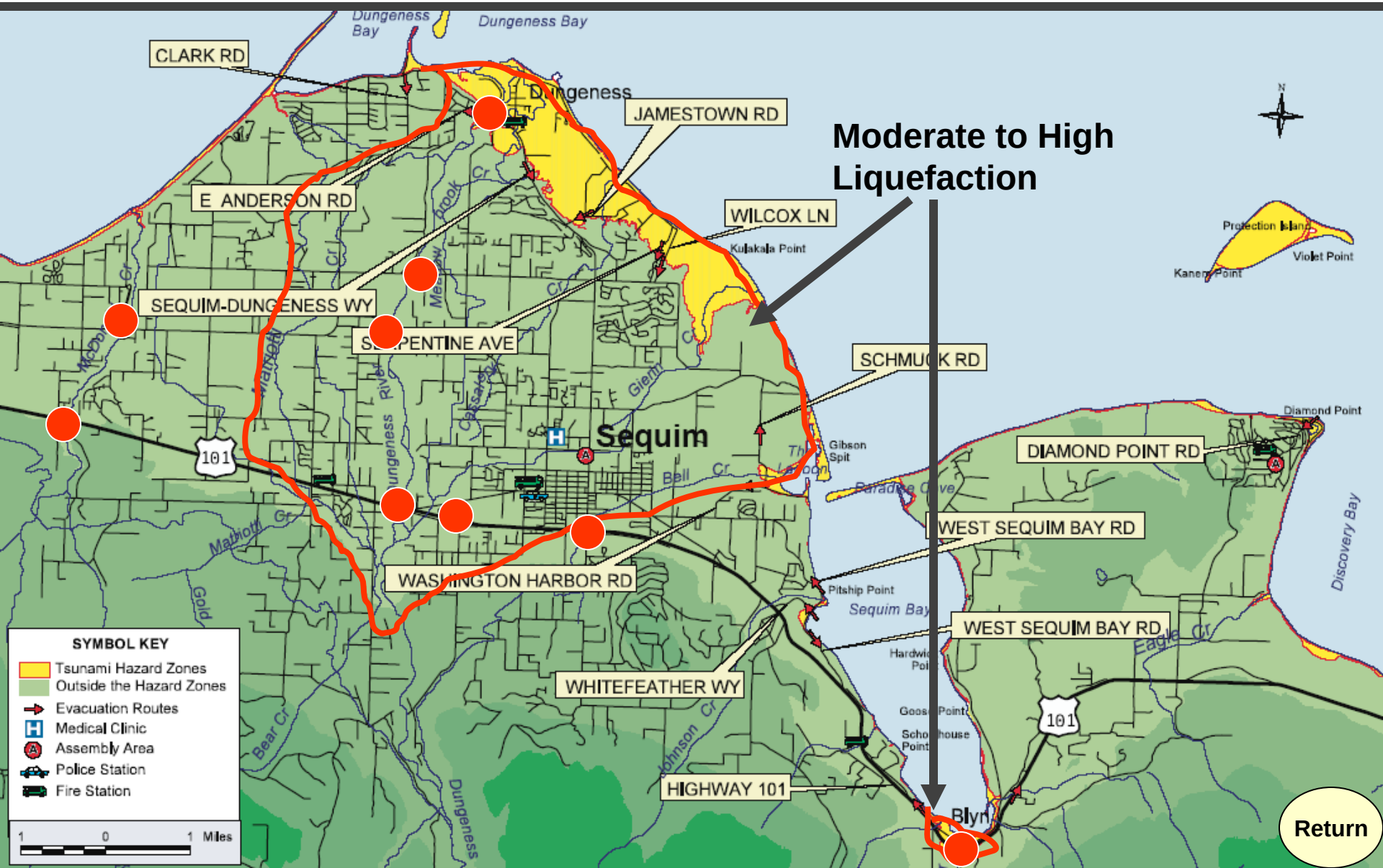
Liquefaction – East Clallam



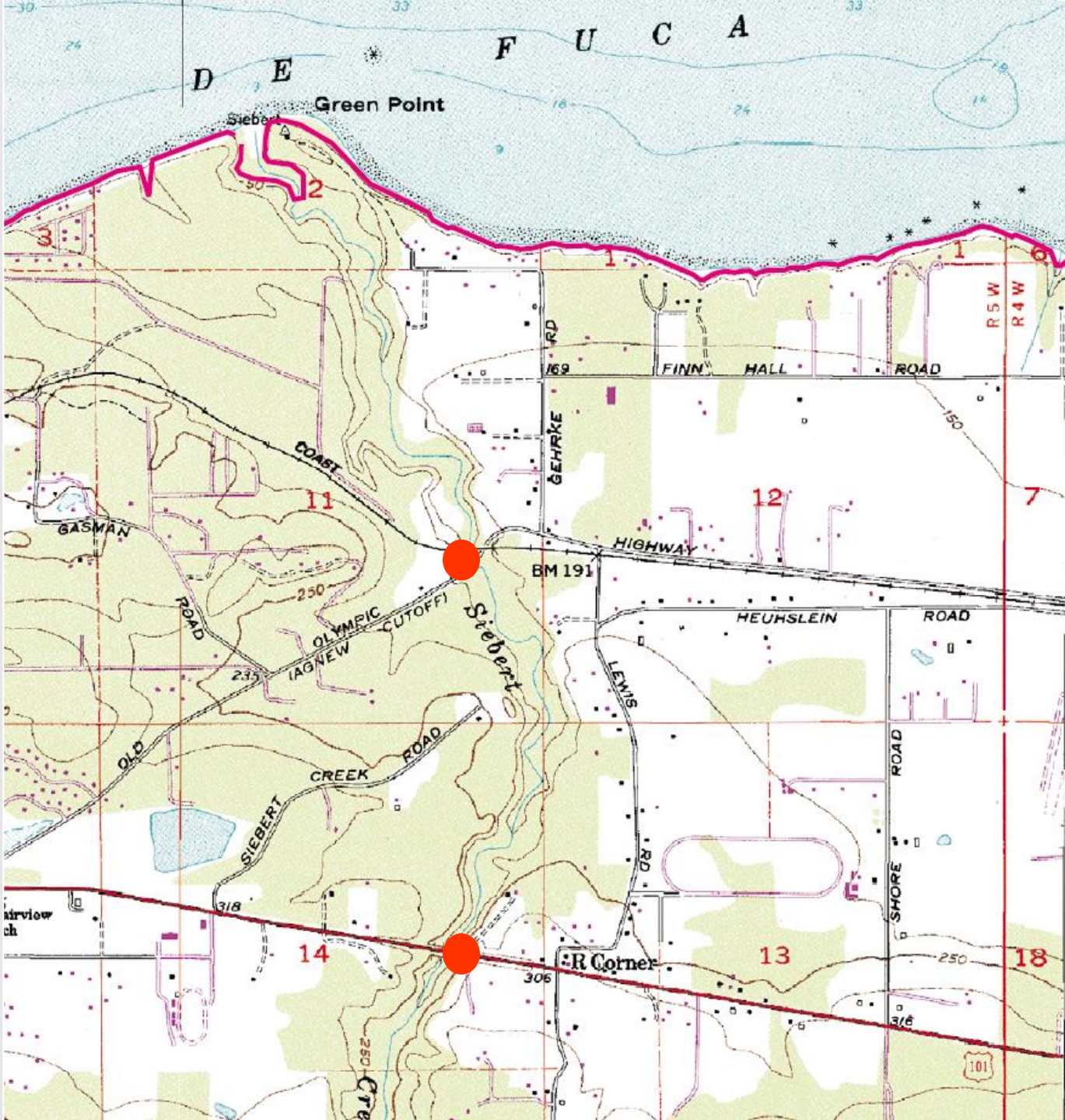
EXPLANATION

- Liquefaction susceptibility: HIGH
- Liquefaction susceptibility: MODERATE to HIGH
- Liquefaction susceptibility: MODERATE
- Liquefaction susceptibility: LOW to MODERATE
- Liquefaction susceptibility: LOW
- Liquefaction susceptibility: VERY LOW to LOW
- Liquefaction susceptibility: VERY LOW
- Bedrock
- Peat deposit — Peat is not susceptible to liquefaction but may undergo permanent displacement or loss of strength as a result of earthquake shaking

Damage Summary – East Clallam



Tsunami Hazard – Green Point



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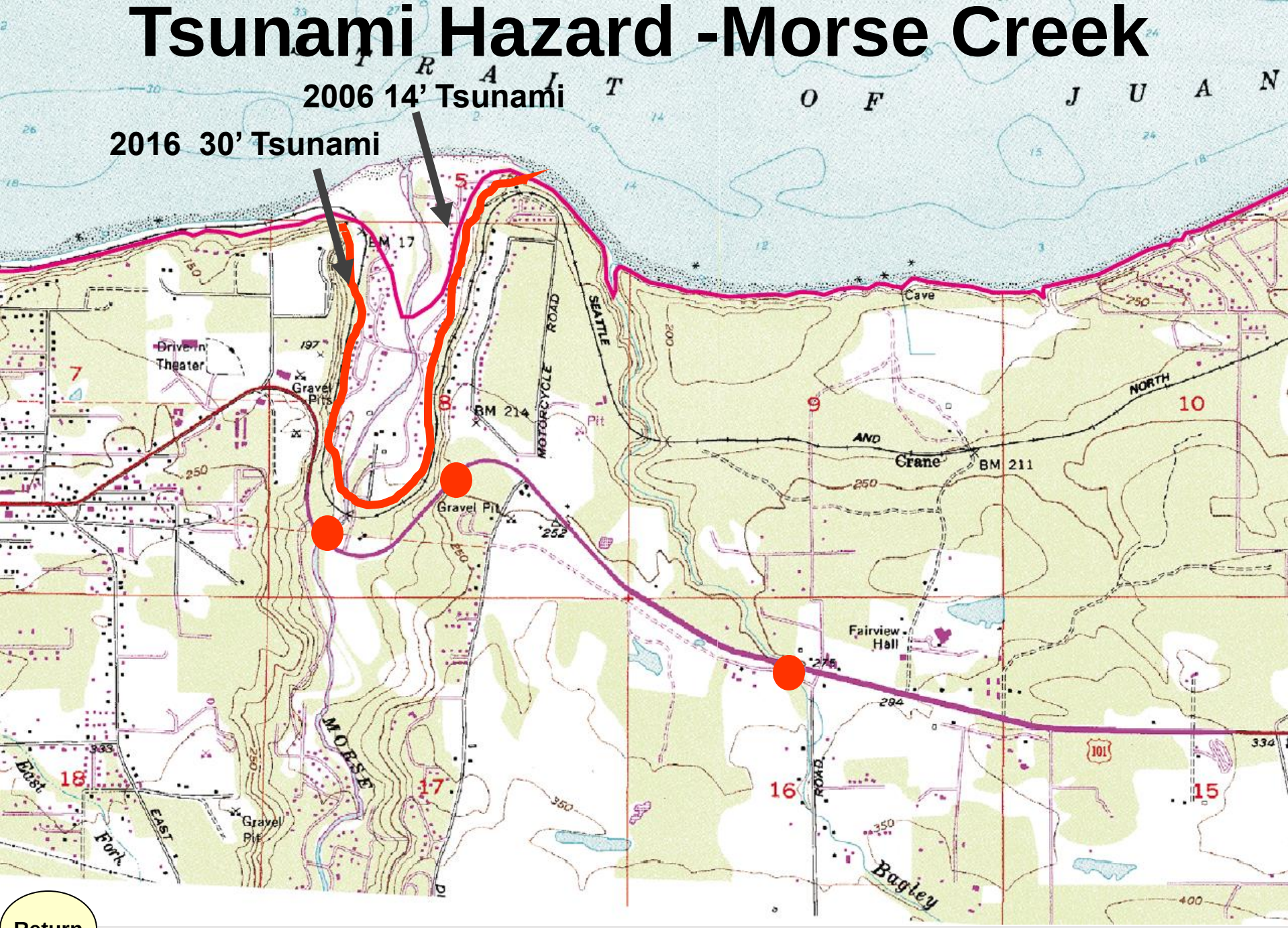
Tsunami Hazard -Morse Creek



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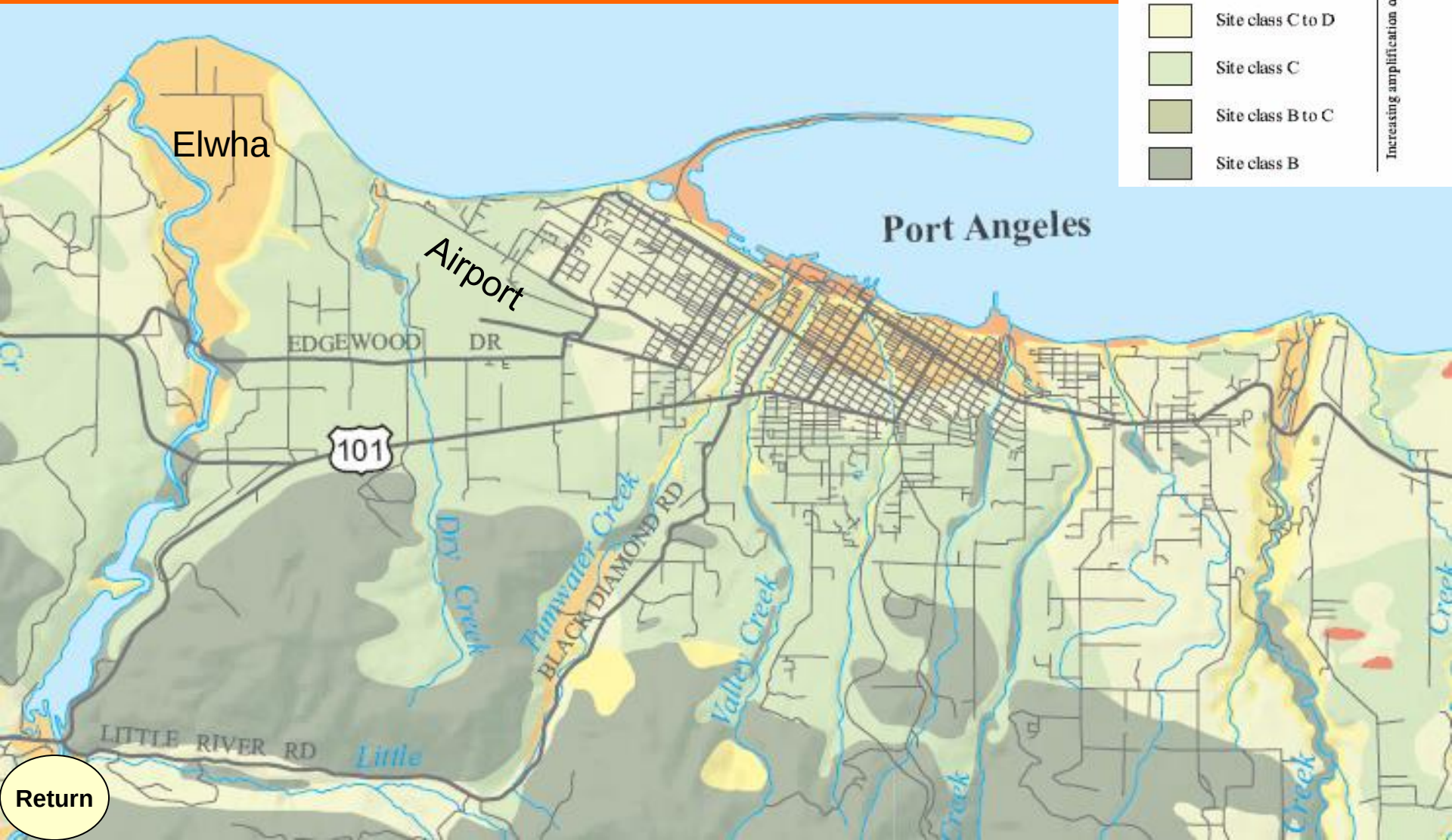
Ground Shaking – PA Vicinity

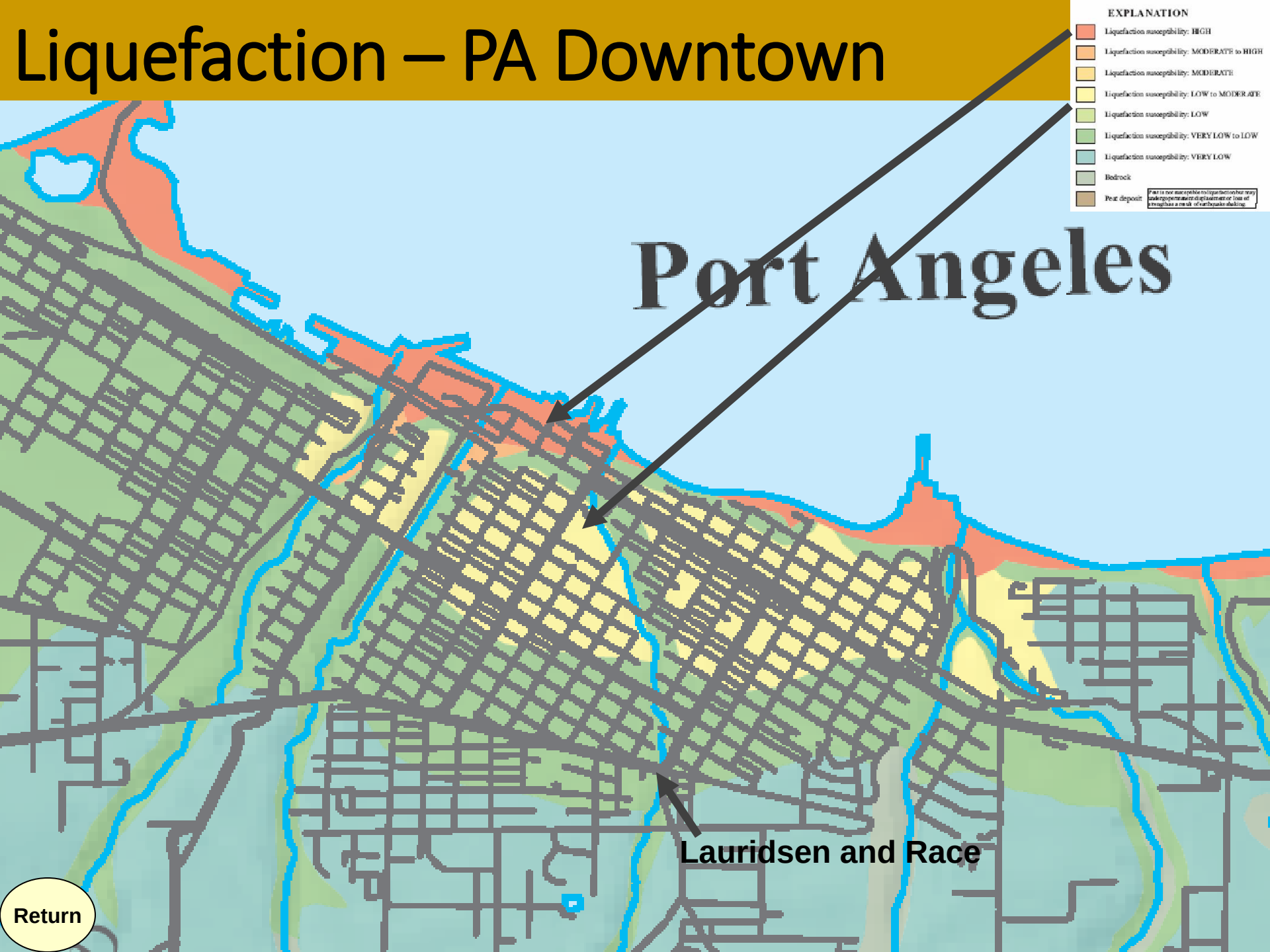


Ground Shaking - PA Downtown

Liquefaction – PA Vicinity

Return

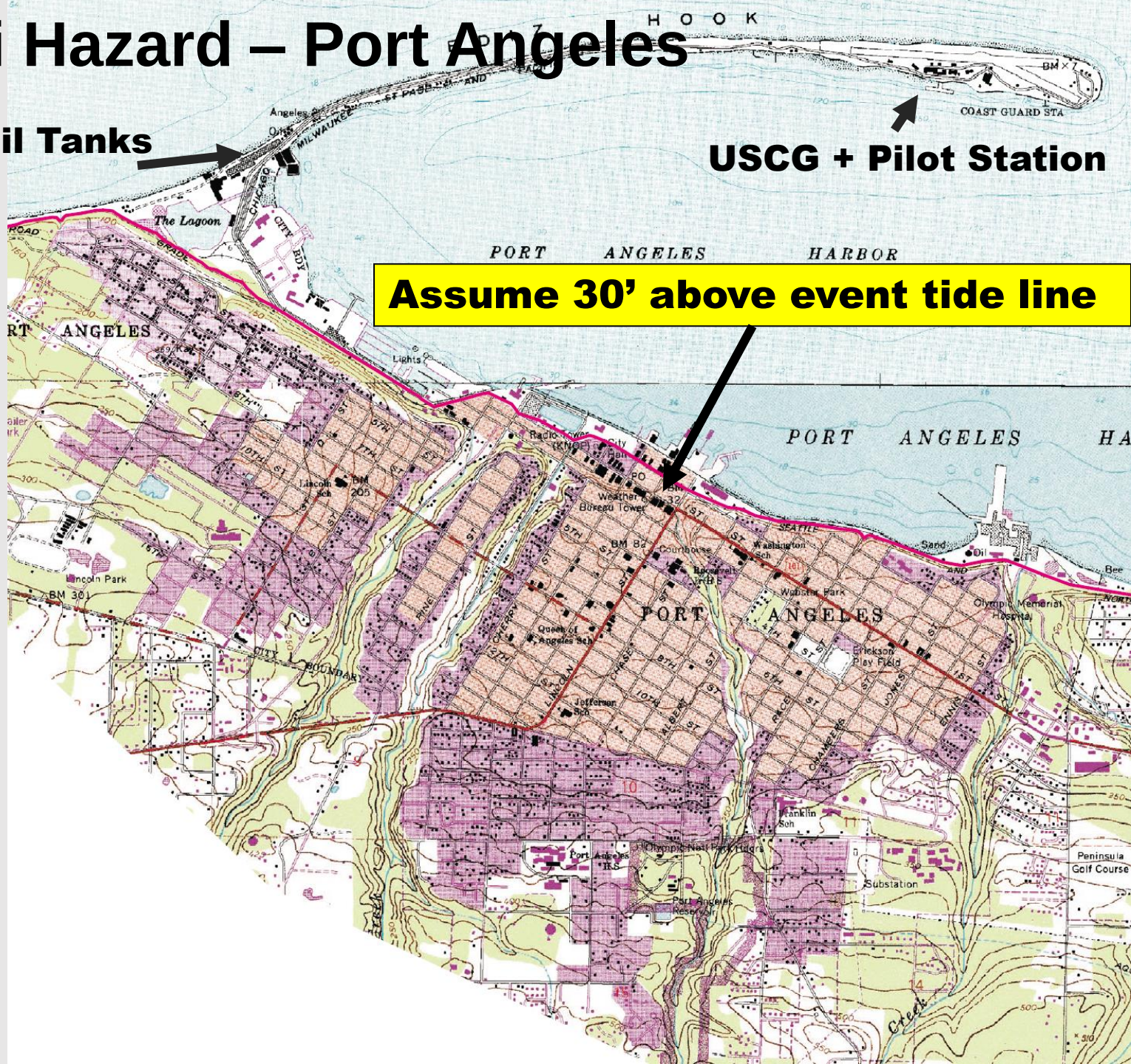
Liquefaction – PA Downtown



Return

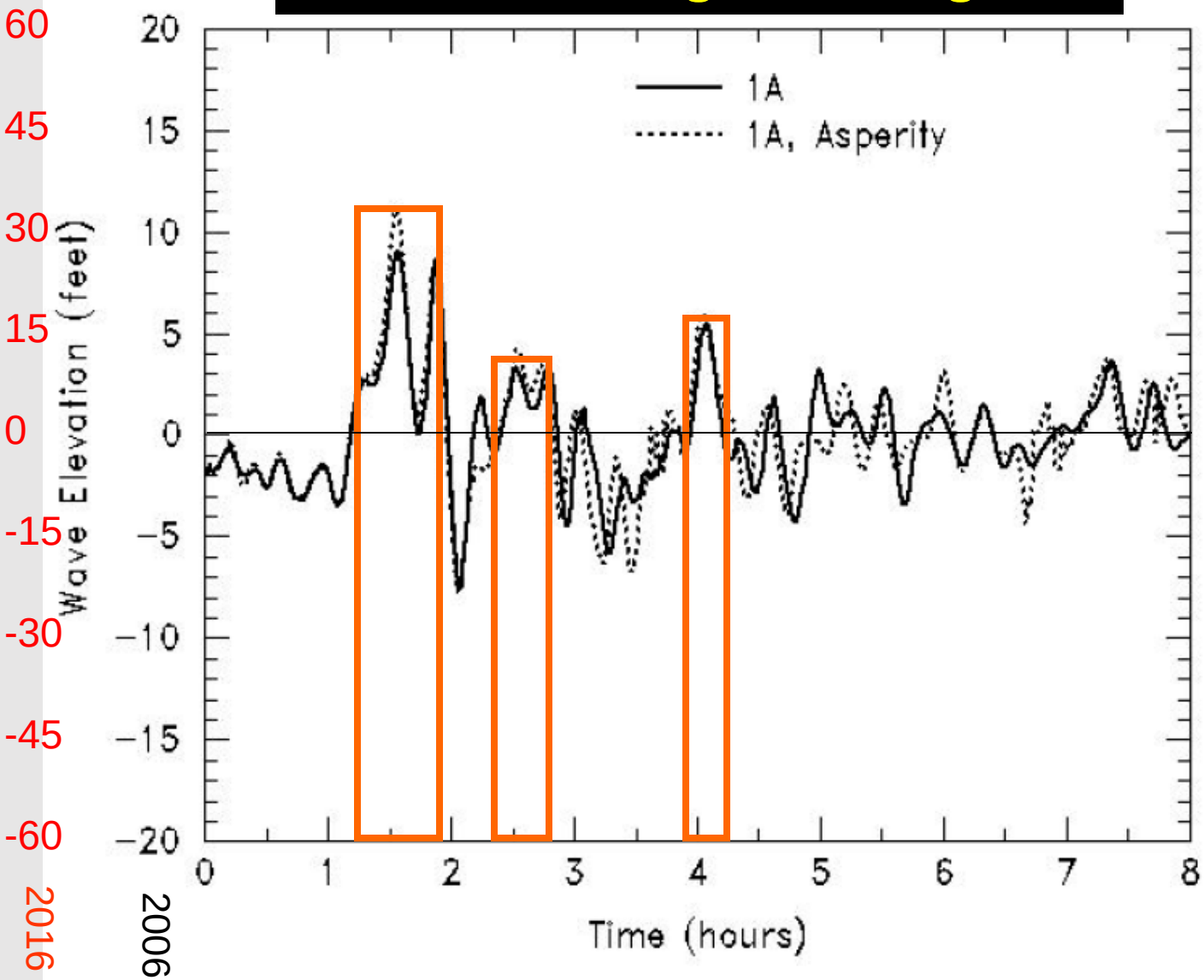
Tsunami Hazard – Port Angeles

Diashowa + Oil Tanks



Return

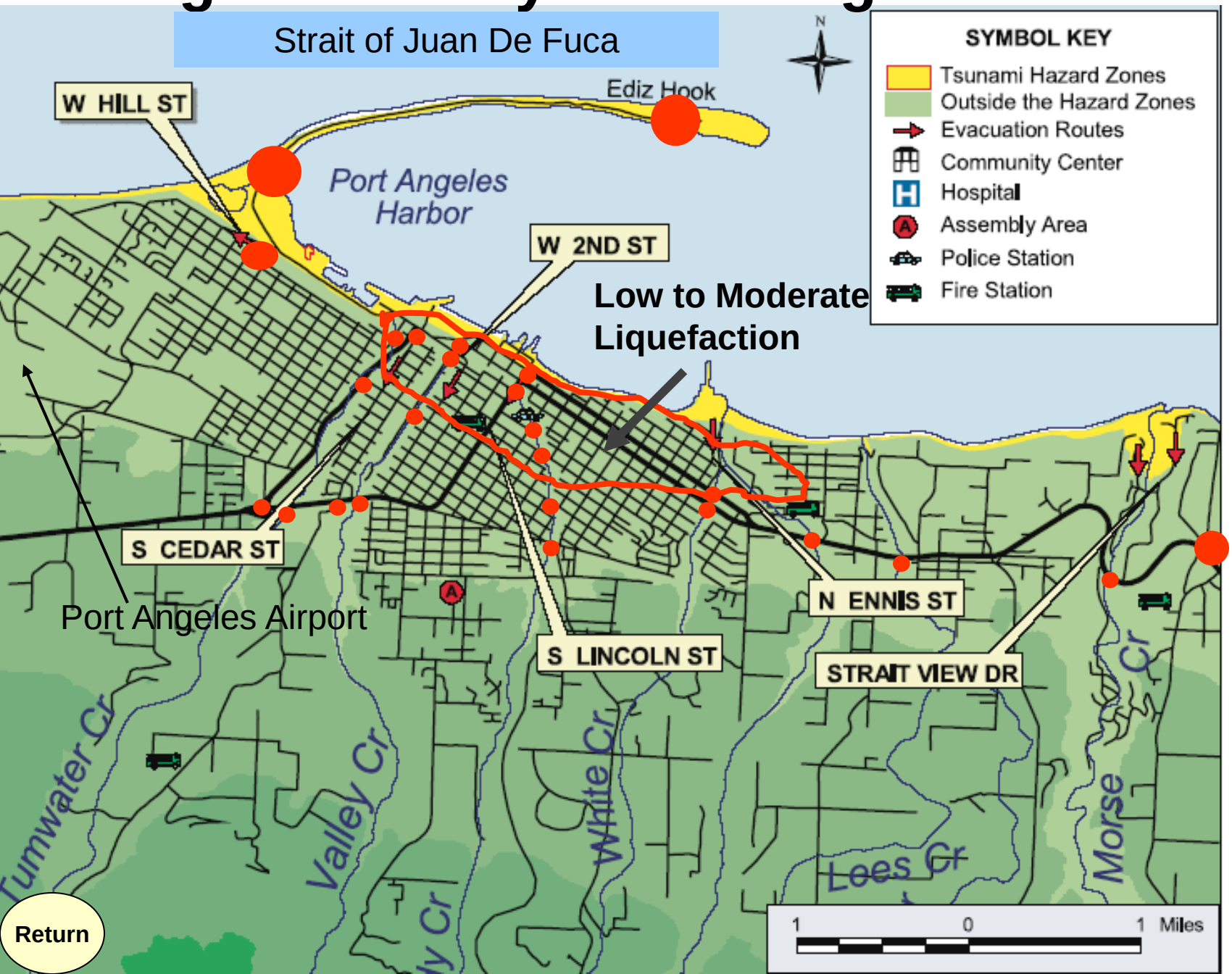
Tsunami Timing - Port Angeles



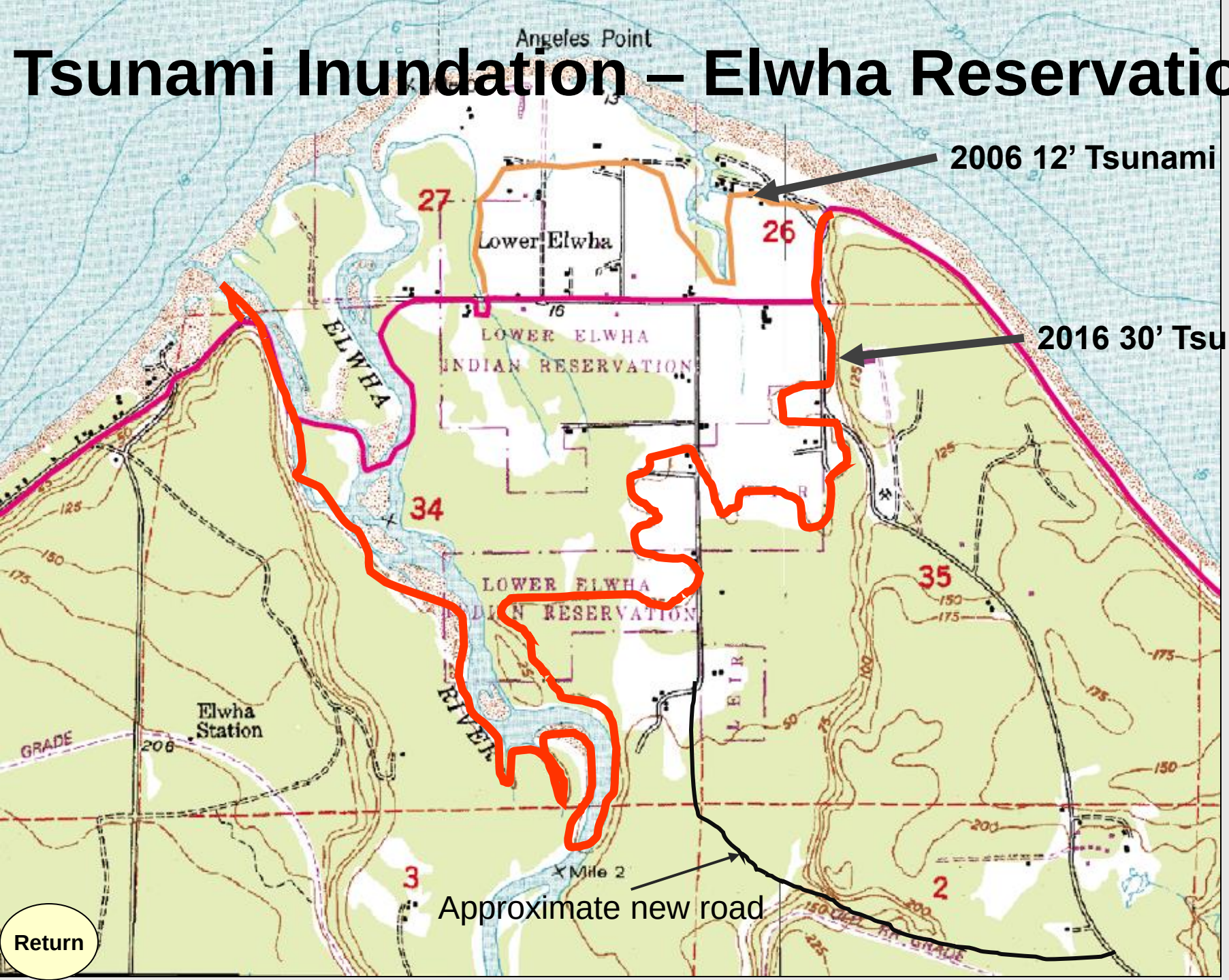
gure 3. Elevation time history of tsunami waves in open water near Ediz Hook.
gative numbers indicate water moving out and positive numbers are water moving in

Return

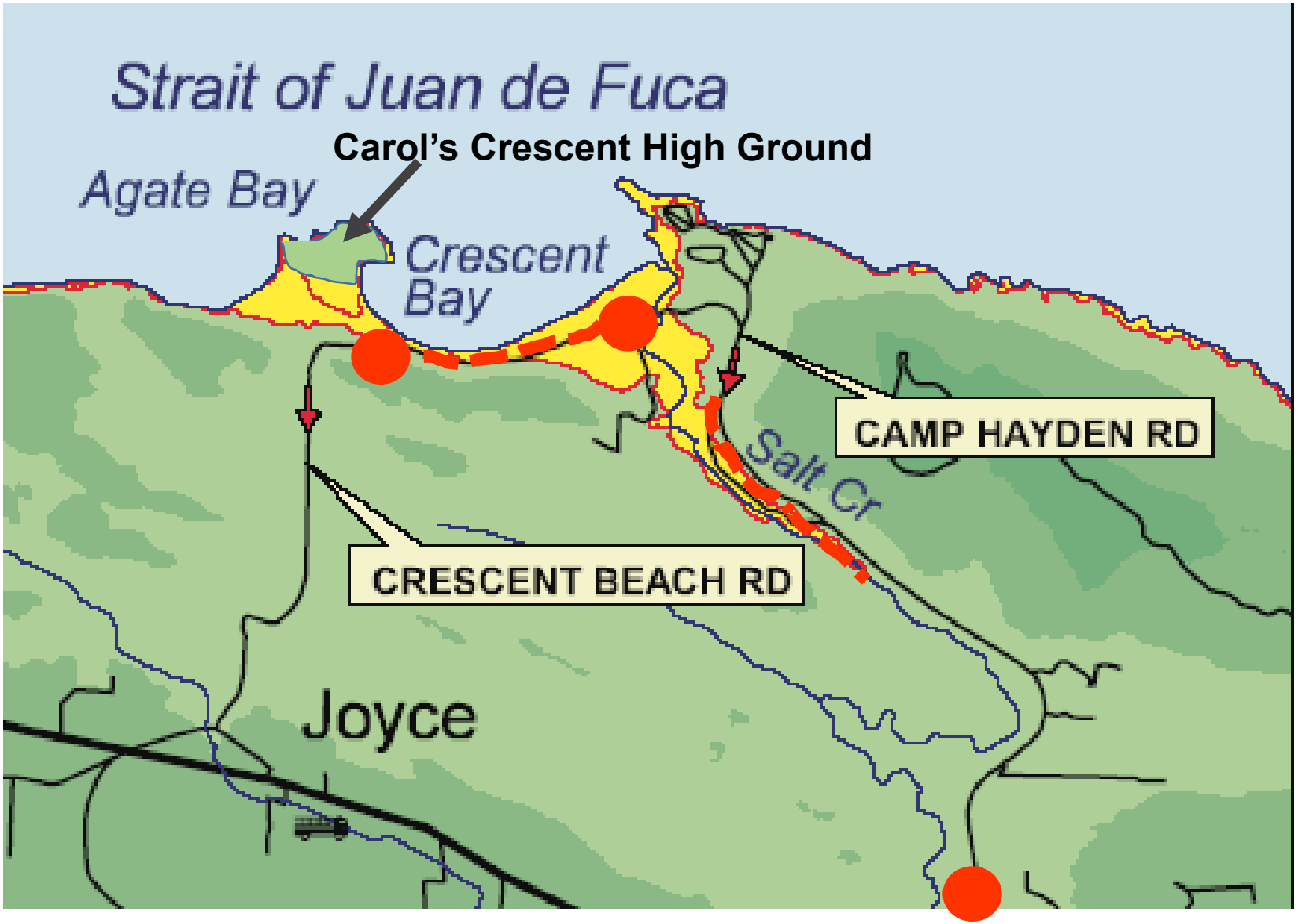
Damage Summary – Port Angeles



Tsunami Inundation – Elwha Reservation



Damage Summary – Salt Creek

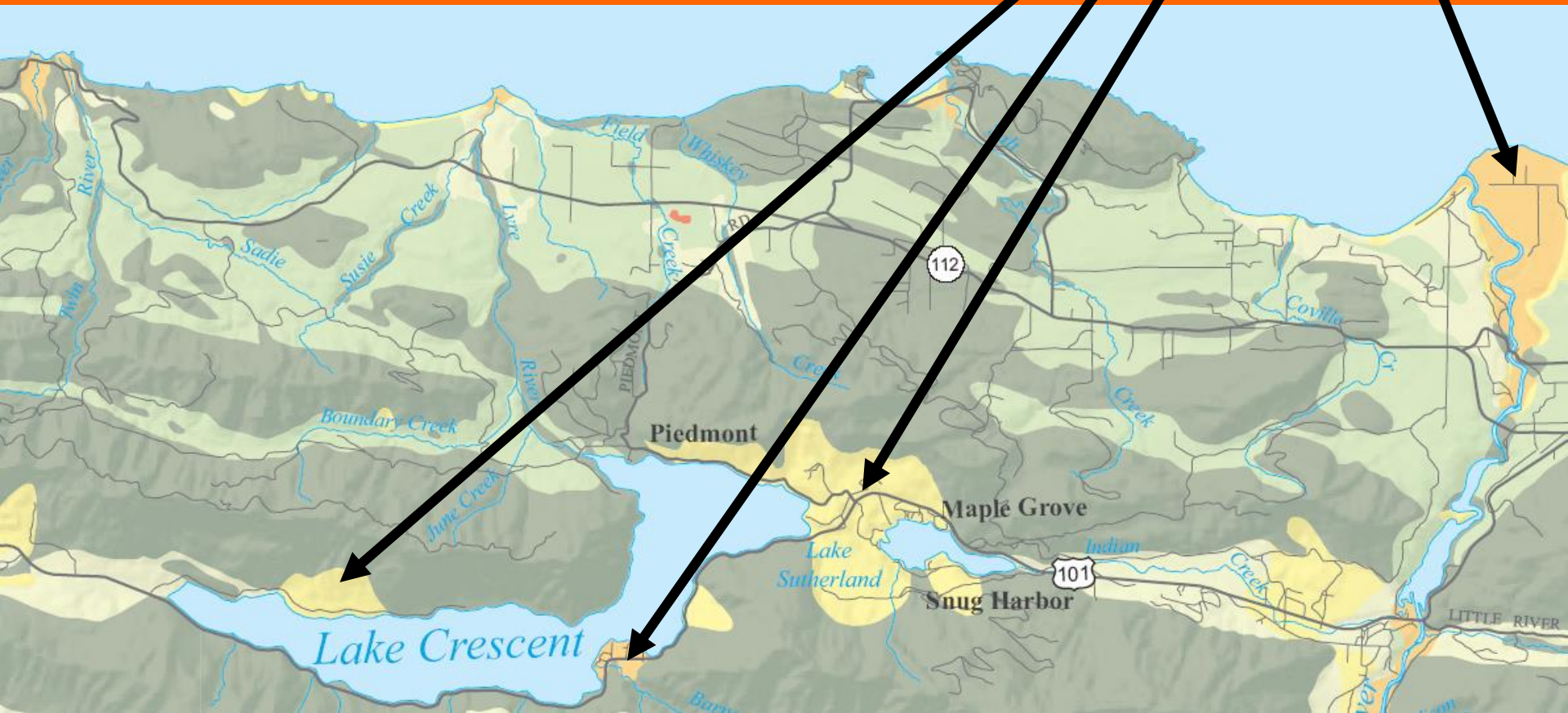


Return

Ground Shaking – Elwha to Twin

Note the Seiche Potential on Lakes Crescent and Sutherland

Return



Damage Summary – Elwha to Twin

Return

Ground Shaking – Pysht Valley

Return

Ground Shaking – Sekiu/Clallam Bay

Return

Summary of Damage
Pysht/Clallam Bay/Sekiu

Ground Shaking – Neah Bay

Return

Liquefaction – Neah Bay

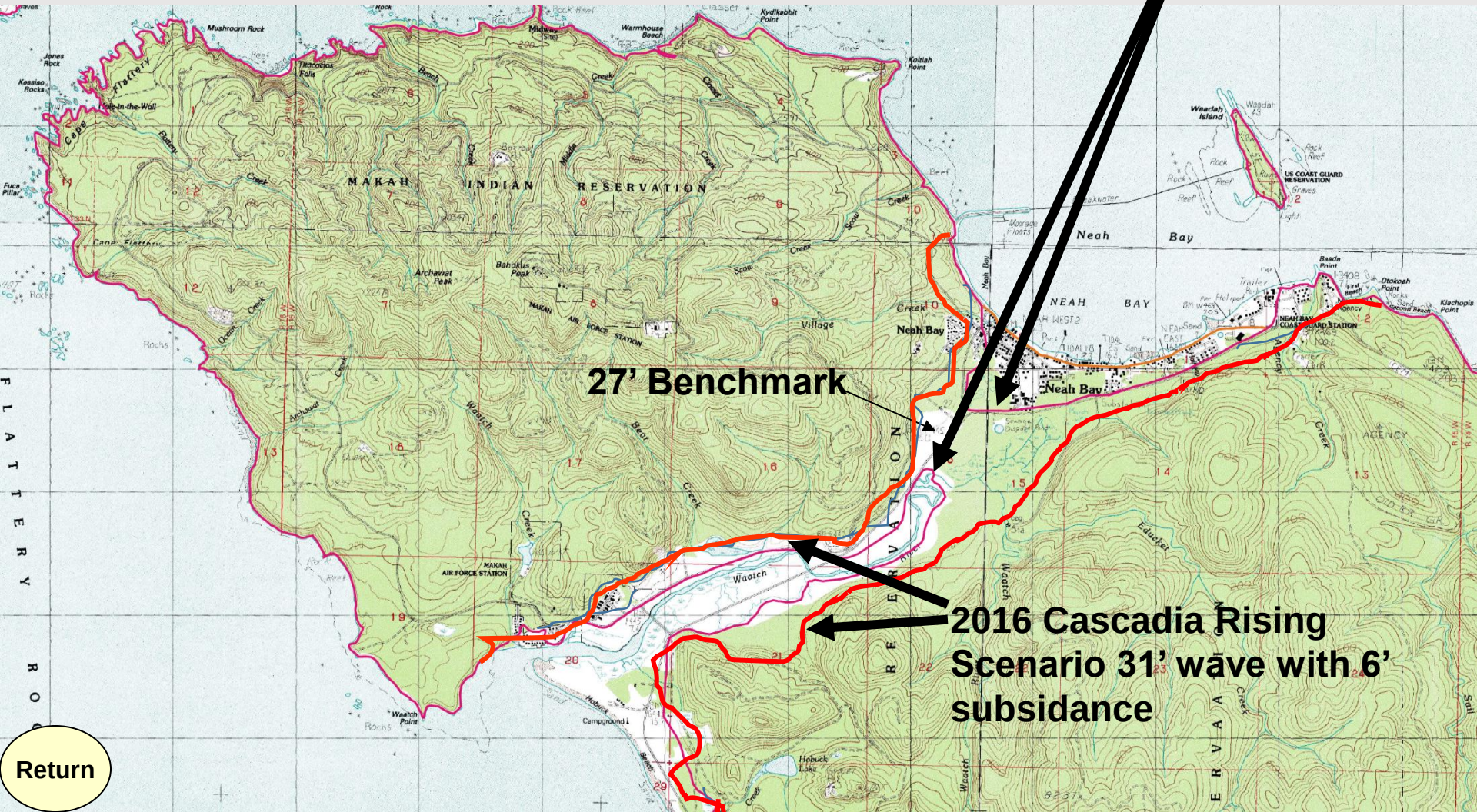
EXPLANATION

- Liquefaction susceptibility: HIGH
- Liquefaction susceptibility: MODERATE to HIGH
- Liquefaction susceptibility: MODERATE
- Liquefaction susceptibility: LOW to MODERATE
- Liquefaction susceptibility: LOW
- Liquefaction susceptibility: VERY LOW to LOW
- Liquefaction susceptibility: VERY LOW
- Bedrock
- Peat deposit — Peat is not susceptible to liquefaction but may undergo permanent displacement or loss of strength as a result of earthquake shaking

Return

Tsunami Hazard – Neah Bay

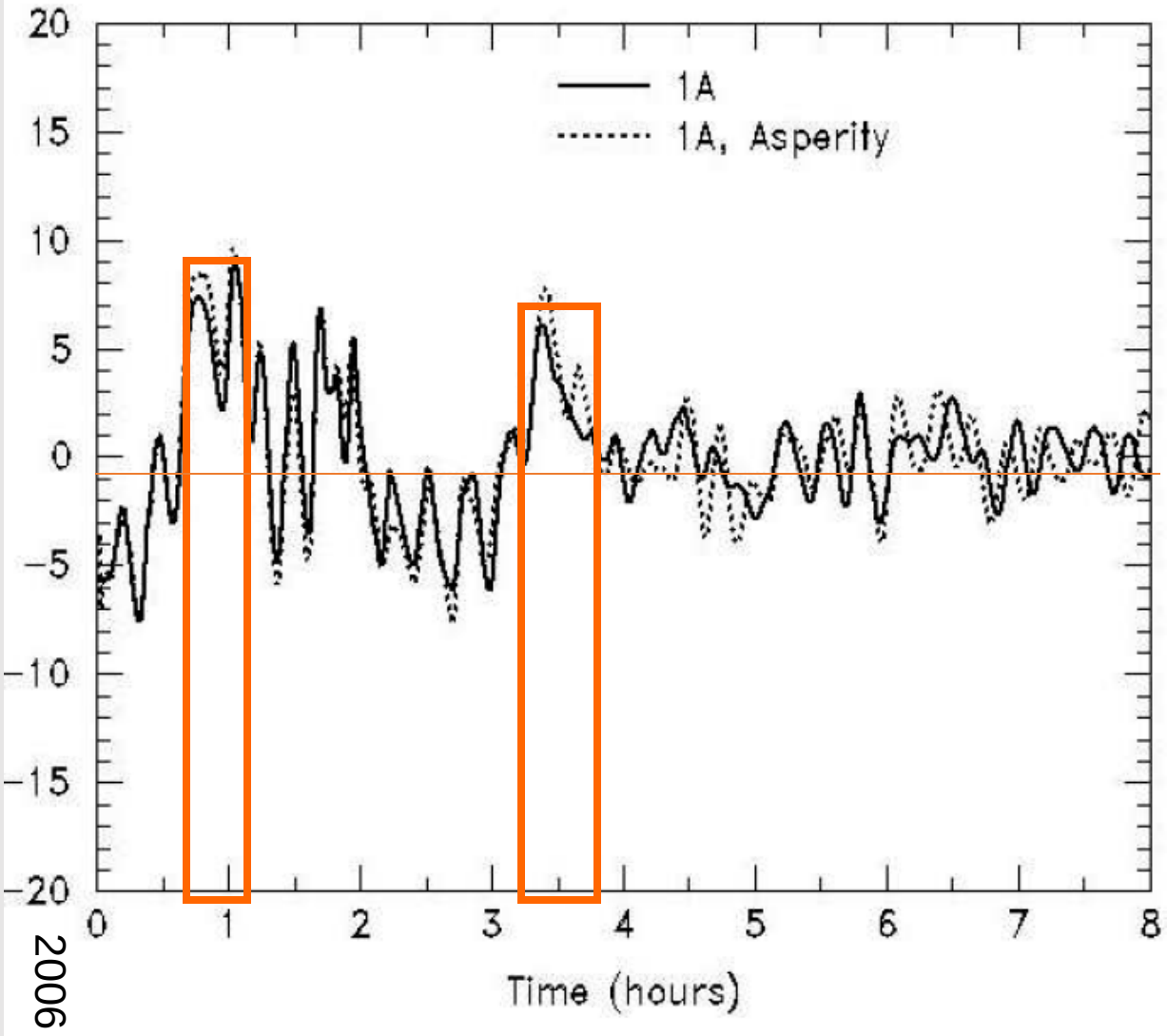
2006 Animation of Predicted 10’ tsunami and wave runup



Return

Tsunami Timing - Neah Bay

80
60
40
20
0
-20
-40
-60
-80

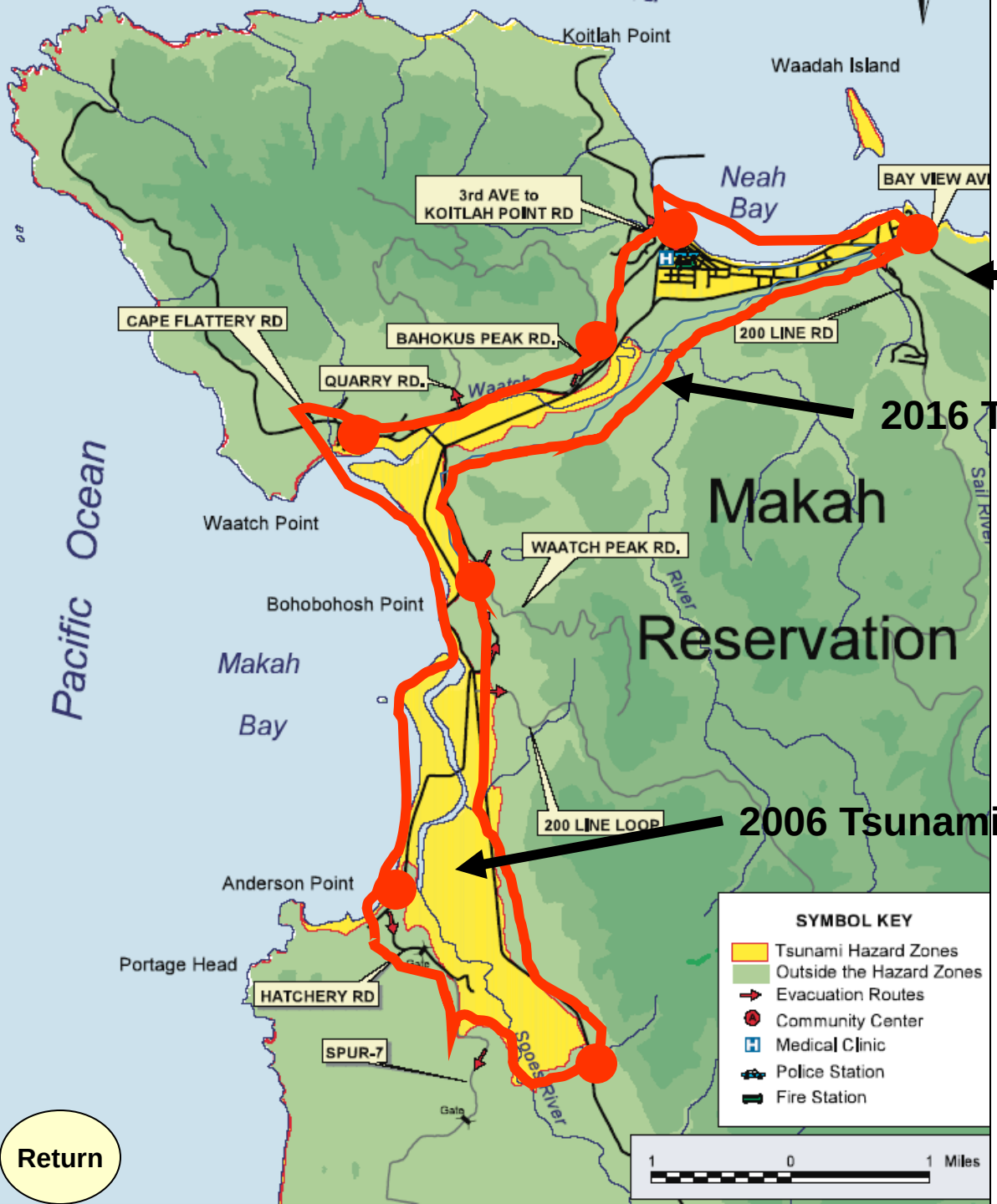


2006
2016

ıre 3. Elevation time history of tsunami waves in open water near Neah
Negative numbers indicate water moving out and positive numbers
ıcate water moving in.

Return

Summary of Damage Neah Bay



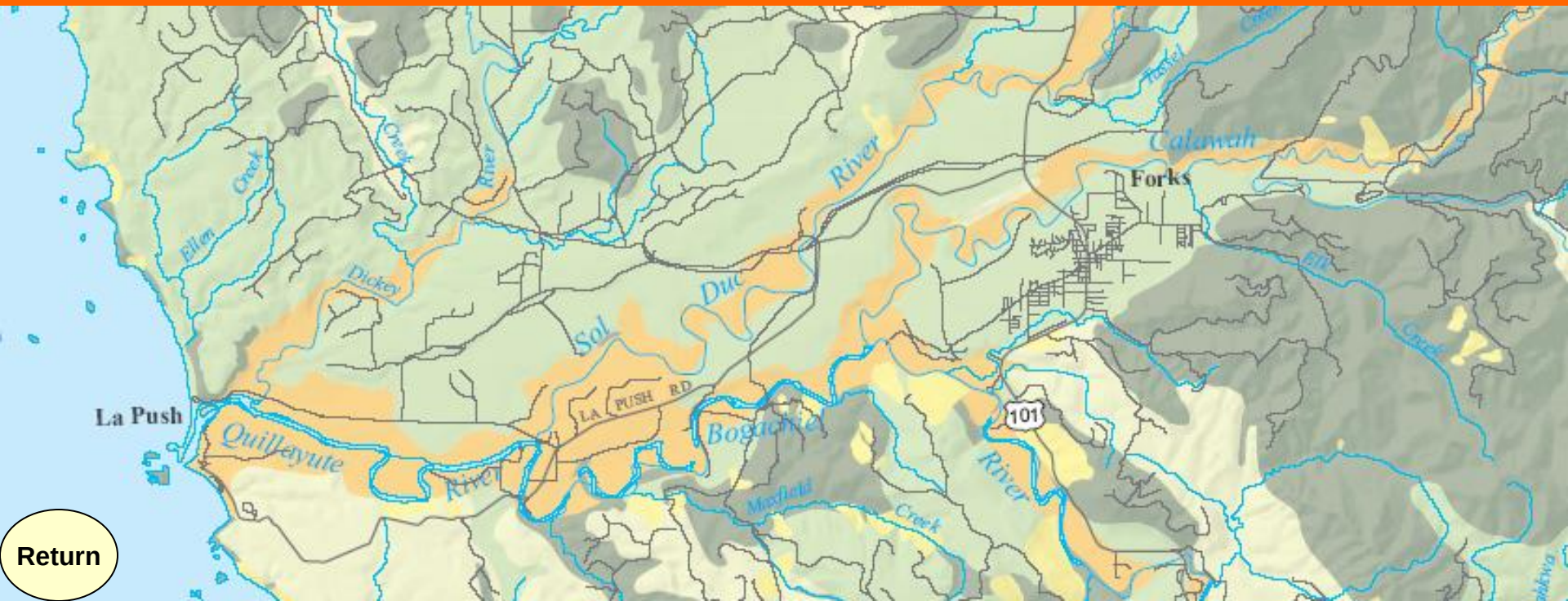
Highway 112 Impassible to Sekiu River due to slide and tsunami Debris

2016 Tsunami Scenario

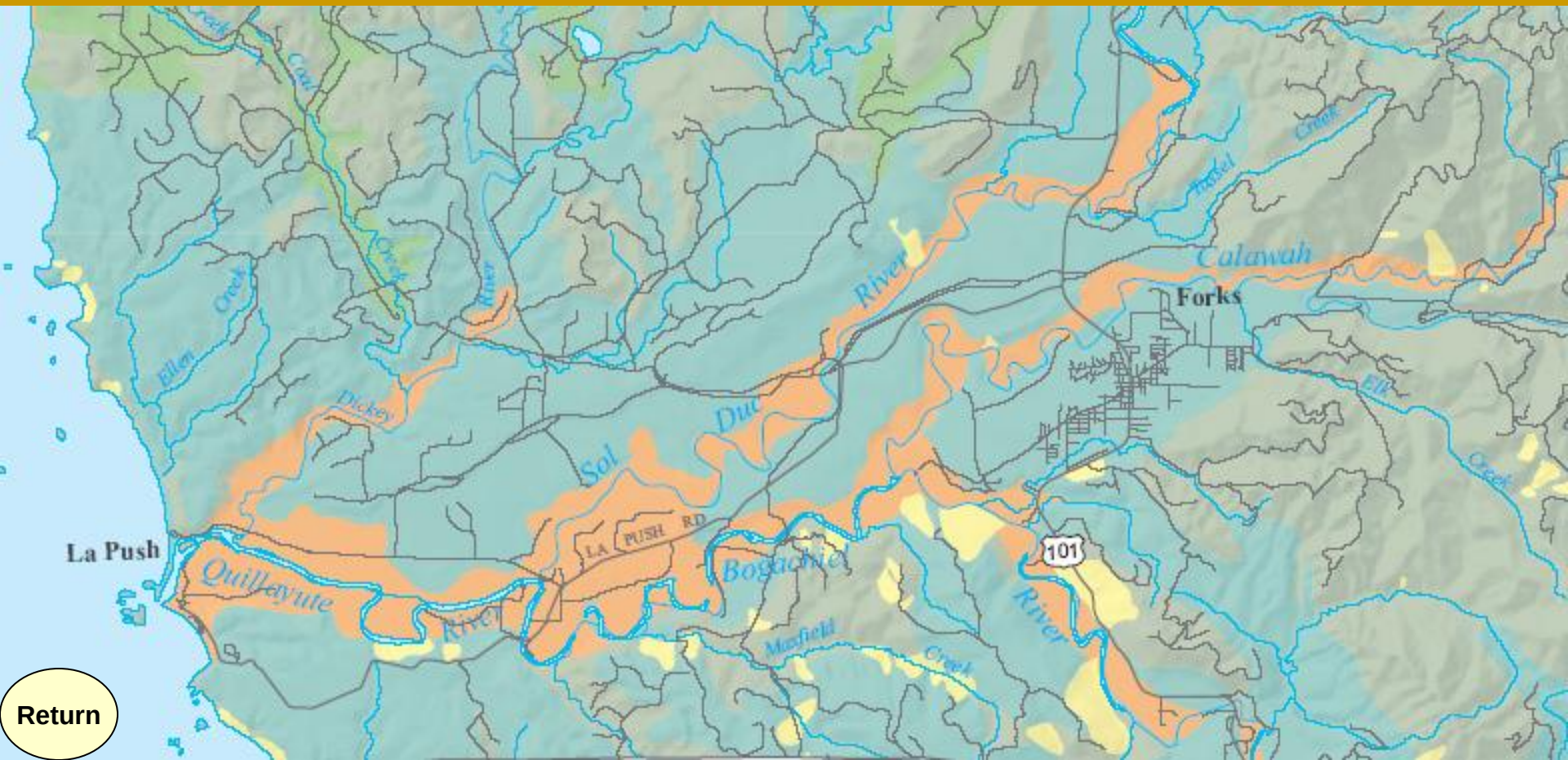
2006 Tsunami Scenario

Return

Ground Shaking – Forks/La Push



Liquefaction – Forks/La Push



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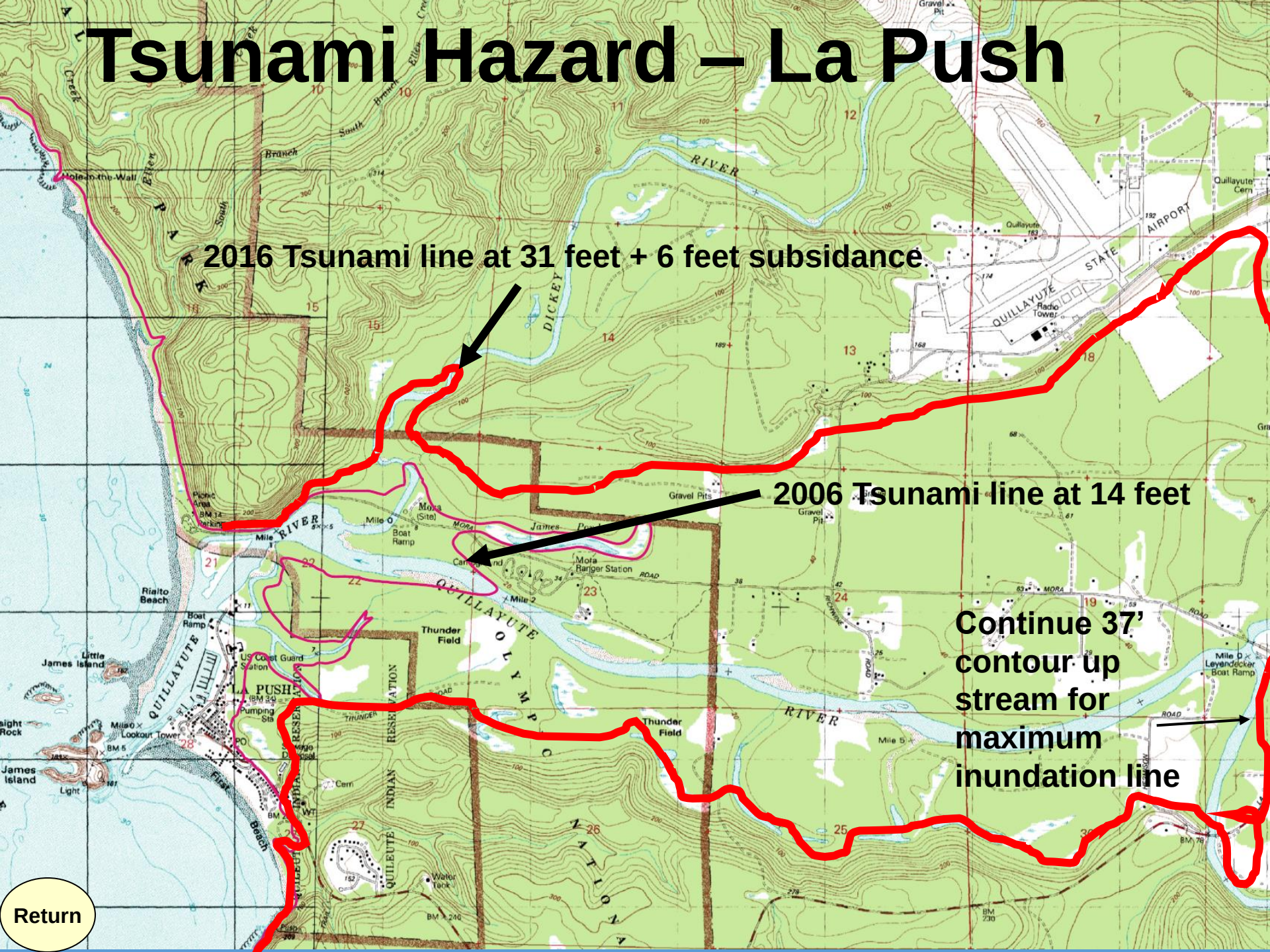
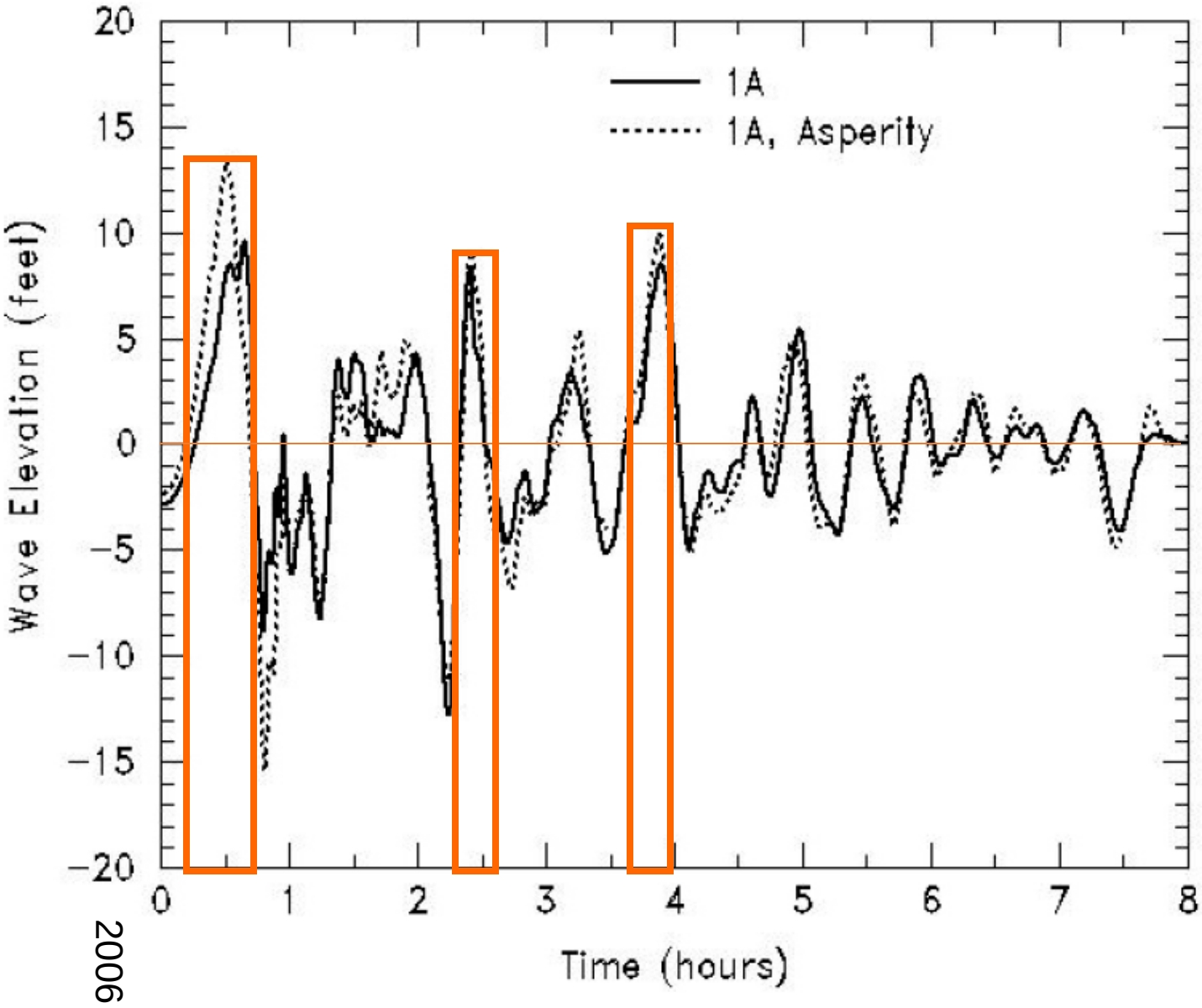
Tsunami Hazard – La Push



Tsunami Timing - La Push

60
45
30
15
0
-15
-30
-45
-60

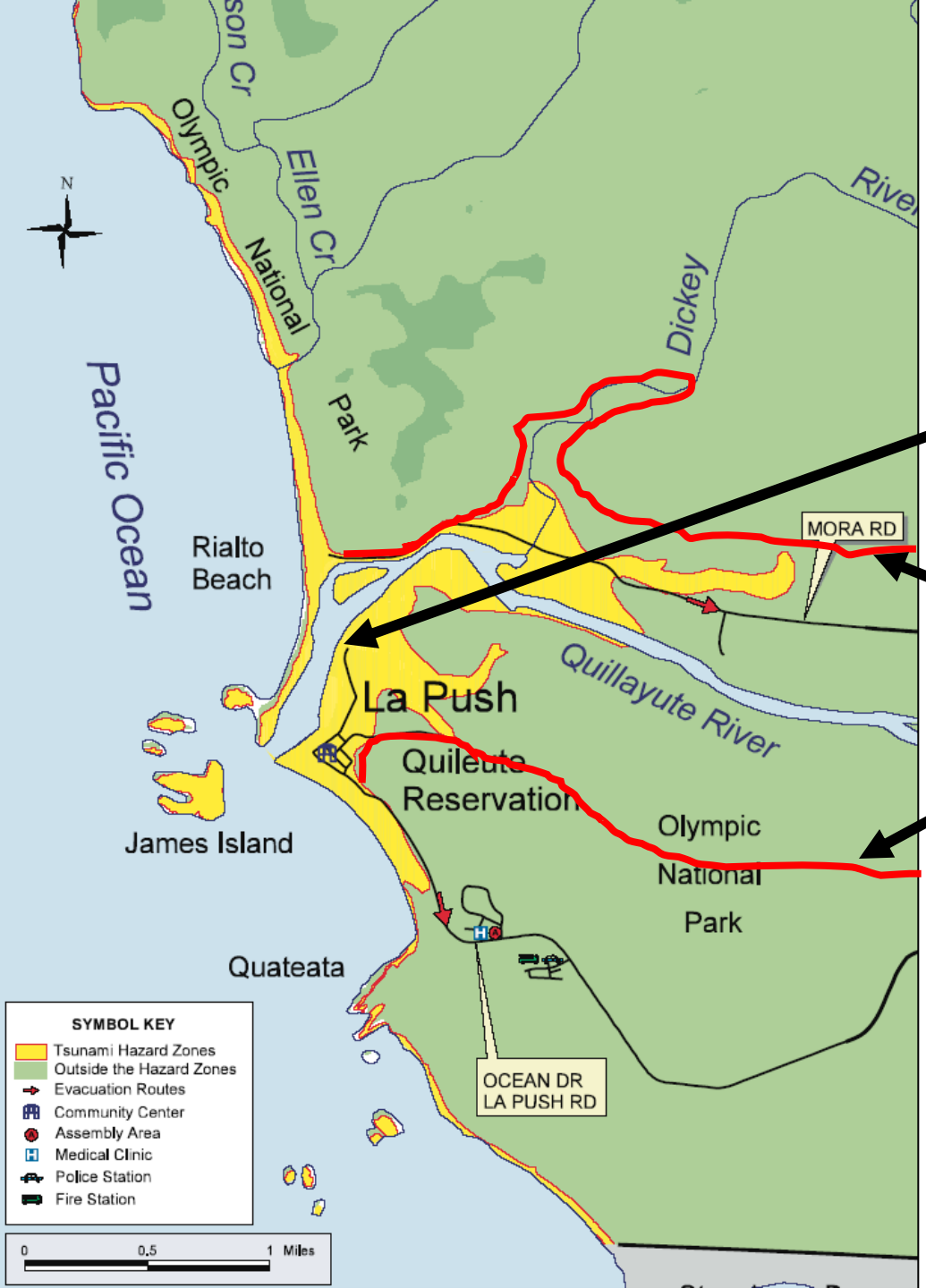


2016

Figure 3. Elevation time history of tsunami waves in open water off the Quileute Reservation. Negative numbers indicate water moving out and positive numbers

Return

Evacuation routes for La Push



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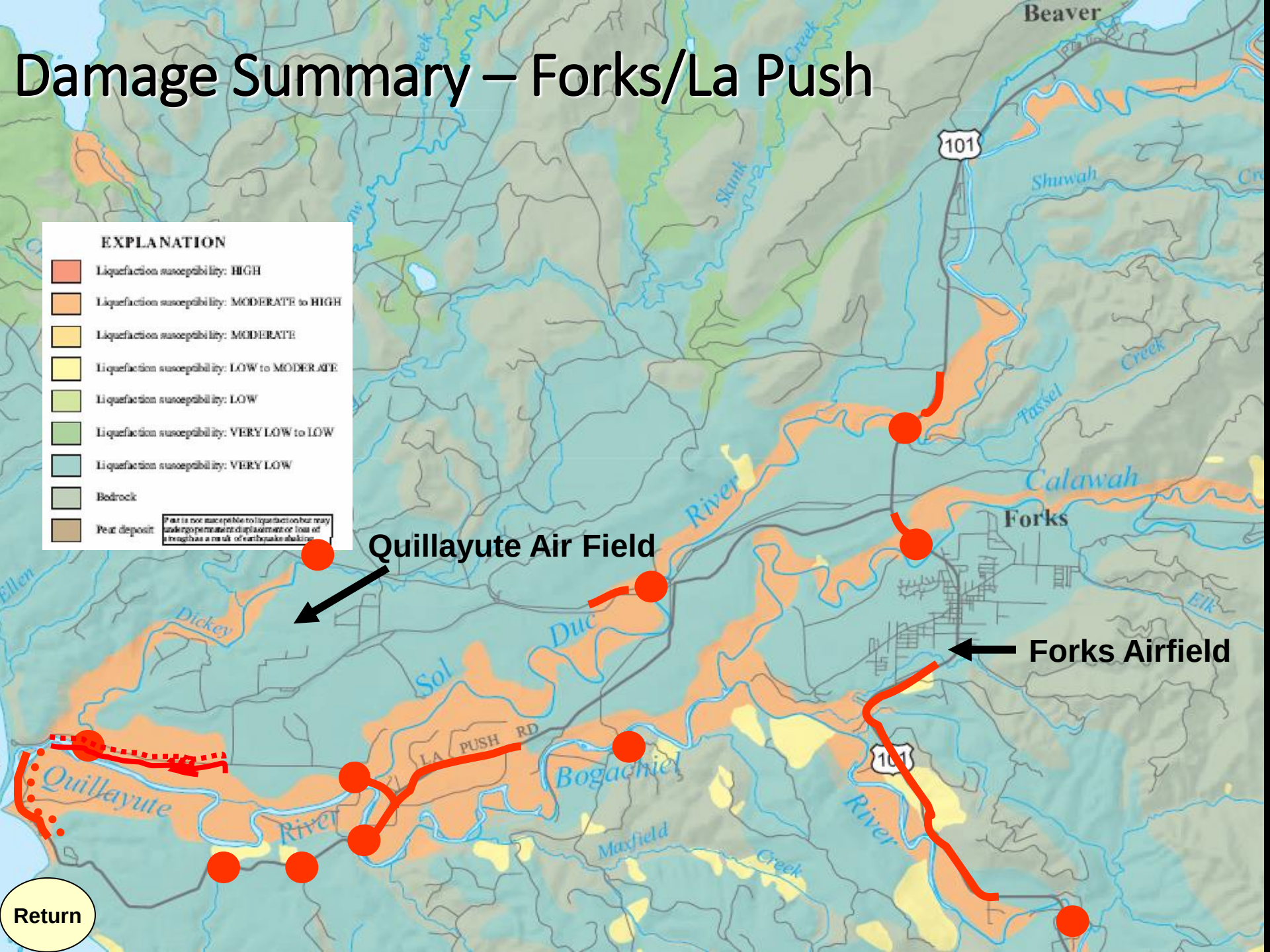
Damage Summary – Forks/La Push



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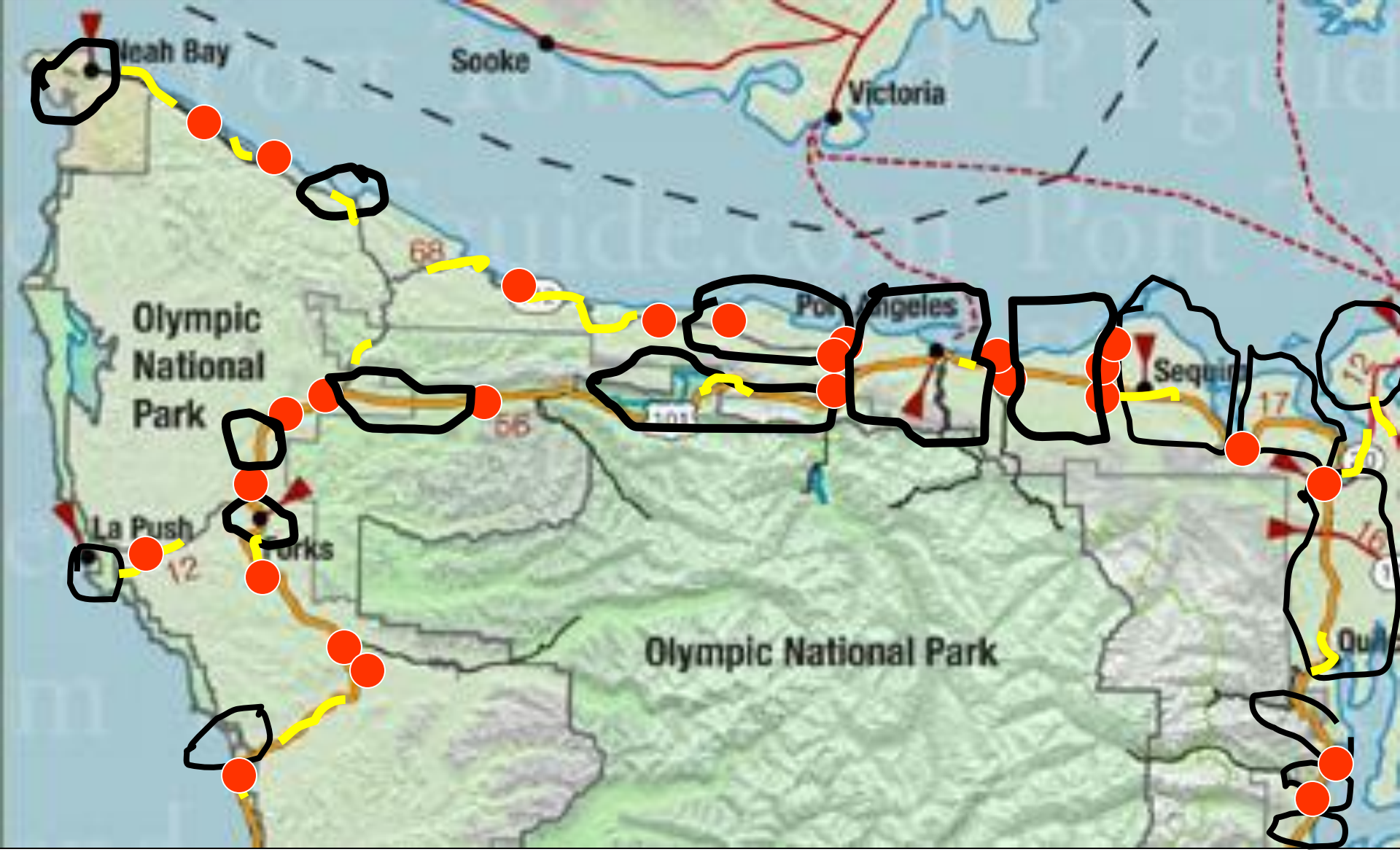

Isolation of communities on the north Olympic Peninsula