CRESCENT Partnerships & Applications Workshop,
Portland, OR - June 27, 2024
Q+A

The following questions were collected via QR code during the workshop and were subsequently answered by the relevant presenters. Please also reference the meeting recordings for Q+A addressed in person during the meeting (Video 1 - 1:07:47, Video 2 - 41:25).

Mike Britch, Tualatin Valley Water District

- Did you have any cases where considered crustal earthquakes required higher design levels due to frequency content than the MCE CSZ event?

For the Willamette Water Supply Program (WWSP, Program), we relied on the work that went into the development of the PSHA for the Program (Shannon & Wilson, 2017). In that work, the relevant nearby crustal earthquake sources were included, the Portland Hills Fault being one of them. Depending on the fault structure and how that fault ruptures, near source accelerations from the Portland Hills Fault could be higher than those used for the WWSP based on work done by Wong et al. (2001).

- Curious if you've looked at the M9 Project simulations (3D simulations of CSZ earthquakes) for estimates of spectral acceleration at various periods. These simulations are being used in various ways by the NSHM, WA EMD, etc.

No, I am not familiar with that work. Perhaps related though, in the development of the PHSA, I believe Shannon & Wilson's work included incorporating the latest available ground motion models. If a link could be provided, I'd be curious to spot check accelerations at a few key locations to compare the results.

- Comment, please check out the seismic hazard tools from the USGS (link below). For any location you can compute seismic hazard intensities and dominant sources. Different site classes and spectral frequencies were recently added https://earthquake.usgs.gov/nshmp/

Thank you. Are there documents or some other training available that helps guide someone through the proper use of this tool? [USGS response: NSHMP tool does include a help tab, can also contact USGS for support]

Albert Kottke, PG+E

- Can you say something about interconnectivity of the grids? Do earthquake impacts to the OR grid affect CA and viceversa?

The power in CA, OR, and WA is part of the Western Interconnection which spans west of the Rocky Mountains from some parts of Baja up through British Columbia. Within this network load is balanced. A major earthquake could affect both the production and transmission of electricity. However, I am not familiar with the details of grid management and how impactful that could be.

- How will you work with local indigenous tribes to address hydroelectric dam impacts on local wildlife, and how are you collaborating with them on possible seismic impacts?

This is outside of my area of expertise.

- Large crustal EQ will also occur near and on shore in the Cascadia region. These events will produce significant shaking of different dominant frequencies than the CSZ. How do you model this complexity?

Most of our structures have natural periods less than 1 s so the greatest difference between subduction and crustal sources is mostly in the duration of shaking. We consider both crustal and subduction sources in our seismic hazard evaluations. Depending on the hazard and the structure, the seismic analysis varies. For structures that are sensitive to duration, we will consider time series from subduction earthquakes or empirical models calibrated to subduction earthquakes.

Martin Lawrence, BC Hydro

- Martin, what pre-disaster mitigation investments do you make to minimize liquefaction damage? E.g. tower foundation improvements at river crossings?

At BC Hydro, we have several examples where we have taken steps to mitigate the risk of liquefaction in the event of a significant earthquake. These have included deep piling and soil densification at transmission towers at major river crossings, and mitigation at earthfill dams by combinations of removal of liquefiable toe foundation soils soil improvement by densification/compaction, and downstream buttressing.

Vasily Titov, NOAA PMEL

- Do your tsunami maps (current or future) consider ground elevation settlement from the earthquake rupture?

Yes. The inundation modeling, which is performed to forecast tsunami inundation (either for the real-time forecast or for the tsunami evacuation maps) takes into account potential change of topography due to earthquake-induced crustal deformation. It is, of course, as accurate as the earthquake deformation model.

- Is the goal to be able to issue warnings earlier than is currently done based on DART measurements?

The goal is to issue data-driven warning and forecast of tsunami inundation before the waves reach coastlines. The most important data for narrowing down the uncertainty of the inundation forecast is the DART data. With current DART locations along the Cascadia, its data may not be coming in time for the forecast for the coasts closest to the earthquake source. However other data (seismic, real-time GNSS and other) are available earlier to constrain models, so it will be used for the forecast event before the DART data is available, however, it may have larger uncertainties.

- How can realtime geodetic data be used to constrain rapid tsunami modeling?

Geodetic data using real-time GNSS can be used to directly measure deformation by an earthquake at the GNSS station's locations and infer the deformation at the source. This type of data may be a more direct estimate of the earthquake tsunami potential than just the seismic data from seismometers and accelerometers. These data have potential to constrain tsunami models faster than sea-level data. This real-time GNSS data stream and earthquake source analysis capability has been already implemented into tsunami warning procedures and it is now in test operations (to be tested during real events)

- Vasily, NTHMP reauthorization has expired. How does this affect your tsunami work?

NTHMP is an important component of the NOAA tsunami program. Agencies, states and local experts of NTHMP are our partners in implementation of any tsunami mitigation measures and products, including forecast, emergency planning and education activities. We will continue to collaborate with our partners, as described in the Tsunami Warning, Education, and Research Act of 2017.

- Is NOAA thinking long term about using submarine cables (telecom + custom) to support observations for rapid tsunami modeling?

Tsunami warning operations already use submarine cable data for tsunami forecast, including NEPTUNE Canada and OOI data. If more cable data becomes available, especially the bottom pressure recording, it can be seamlessly included into the forecast data stream. We are closely monitoring activities that explore possibilities of telecommunication cables for tsunami data, we are partners in several working groups that consider these developments.

Althea Rizzo, Oregon Department of Emergency Management

- While there is a need for improvement, there is already a lot of data and tools to help people evaluate earthquake risks. What strategies do you use to help communities make sense of all the info to make decisions to mitigate their risks?

I would recommend 3 strategies.

1. Start with your people, households and neighborhoods.
    - Preparedness and mitigation of hazards starts in the home.
    - Programs like "Be 2 Weeks Ready" and CERT can help with resources to educate the public and encourage protective actions.
2. Talk to the relevant state agencies, they have done a lot of this work for you
    - DOGAMI is a resource for hazard maps and data.
    - OEM can provide technical guidance on mitigation strategies
    - DLCD can provide land use and hazard mitigation assessments
    - There are many more agencies that can help guide
3. Look to your neighboring communities to learn from them. They will likely have similar risks to yours.
    - What is in their Natural Hazard Mitigation Program?
    - Have they successfully applied for BRIC, or other federal grants?
    - Can you pool resources and collaborate?

Carolina Gomez, Home Forward

- What is a good way to find/reach out to low-income or vulnerable collaborators in our communities?

You can reach out to local housing authorities, community development organizations and non-profit organizations. In Oregon you can reach out to:

- **Oregon Housing and Community Services (OHCS)**: This is the state's housing finance agency, offering a variety of programs for affordable rental housing, home ownership assistance, and homelessness prevention. OHCS website.
- **Housing Authorities**:
  - **Portland Housing Bureau (PHB)**: Focuses on affordable housing development and services in Portland. PHB Website
  - **Home Forward (Multnomah County)**: Provides affordable housing and supportive services. Home Forward Website
  - **Housing Authority of Clackamas County**: Offers rental assistance and affordable housing. HACC Website
  - **Housing Authority of Jackson County**: Provides housing resources and services in Jackson County. HAJC Website
- **Community Action Agencies**:
  - **Community Action Partnership of Oregon (CAPO)**: Represents various local Community Action Agencies across Oregon, providing housing assistance, energy assistance, and other services. CAPO Website
  - Local agencies like **Community Action Agency of Washington County** and **Community Action Organization of Columbia County** offer direct assistance and housing services.
- **Non-Profit Organizations**:
  - **Habitat for Humanity Oregon**: Works to build affordable housing through community partnerships. Habitat for Humanity Oregon Website
  - **NEDCO (Neighborhood Economic Development Corporation)**: Offers affordable housing programs and financial education. NEDCO Website
  - **REACH Community Development**: Develops and manages affordable housing in the Portland metro area. REACH Website
  - **Hacienda CDC website**
  - **Central City Concern website**

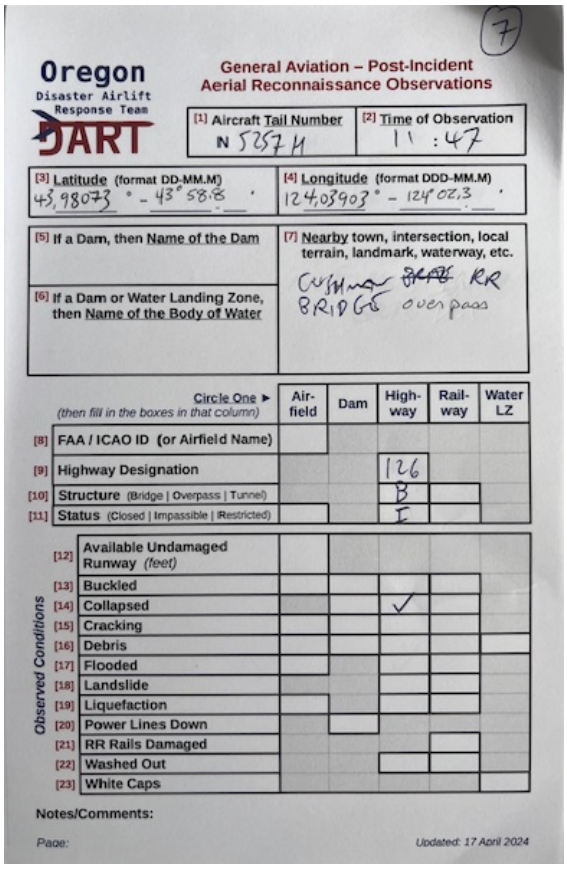
Jim Origliosso, ODART

- Do you actively recruit new pilots to ensure the continuity of your volunteer team/fleet?

YES. Adding pilots and aircraft to our resource base is a continuous and ongoing activity. To volunteer go to **odart.org** click on "**VOLUNTEER WITH US**" and sign up.

- Has ODART considered training pilots to provide real time or near real time situational awareness (damaged buildings and infrastructure) to emergency managers.

YES. ODART has a mission type called a RED FLIGHT which is a reconnaissance of ground transportation routes and airfields to triage response efforts and determine safe landing areas. Results are recorded on a standardized form and referred to Civil Air Patrol for further investigation and for forwarding to Oregon Department of Transportation. RED FLIGHTS routes are practiced at least annually in ODART exercises. For further information on ODART mission types go to **odart.org** click on "**Documents**" and then click on "**Whale Run 2024 Exercise Plan**"



Oregon Disaster Airlift Response Team — ODART

General Aviation – Post-Incident Aerial Reconnaissance Observations

7

[1] Aircraft Tail Number	[2] Time of Observation
N 5257H	11 : 47

[3] Latitude (format DD-MM.M)	[4] Longitude (format DD-MM.M)
43,98073 ° - 43° 58.8 '	124,03903 ° - 124° 02.3 '

[5] If a Dam, then Name of the Dam

[6] If a Dam or Water Landing Zone, then Name of the Body of Water

[7] Nearby town, intersection, local terrain, landmark, waterway, etc.
Crushman ~~SKAT~~ RR
BRIDGE overpass

Circle One ► (then fill in the boxes in that column)		Air-field	Dam	High-way	Rail-way	Water LZ
[8]	FAA / ICAO ID (or Airfield Name)					
[9]	Highway Designation			126		
[10]	Structure (Bridge | Overpass | Tunnel)			B		
[11]	Status (Closed | Impassible | Restricted)			I		
[12]	Available Undamaged Runway (feet)					
[13]	Buckled					
[14]	Collapsed			✓		
[15]	Cracking					
[16]	Debris					
[17]	Flooded					
[18]	Landslide					
[19]	Liquefaction					
[20]	Power Lines Down					
[21]	RR Rails Damaged					
[22]	Washed Out					
[23]	White Caps					

Observed Conditions

Notes/Comments:

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Updated: 17 April 2024

- Would it be possible to fit your planes with aerial cameras to obtain video of ground failure and damaged infrastructure during airlifts following earthquakes to transmit/share with emergency responders and infrastructure owners/managers.

YES. It is possible to fit ODART aircraft with cameras, however each pilot/owner makes their own decision about whether to mount cameras on their aircraft. It is more often the case that pilots will use their phones and tablets to take such photos. ODART refers to recon missions as RED FLIGHTS (see above). Pilots on RED FLIGHTS record their observations on a standardized form (see attached). Currently our process is to use the forms for our own dispatching decisions and we also forward them to Civil Air Patrol for follow up with specialized equipment and pilots with advanced training in recon work.

ODART considers RED FLIGHT observations to be in the public domain and can certainly be shared with emergency managers and property owners. Before doing so, however we would like to collaborate with the interested parties about the process to be used and then have the opportunity to practice and refine that process through periodic exercises.

- Are there similar groups to ODART in other states?

YES In California CalDART is an established volunteer pilot organization that has been active in disaster response for many years. For more information go to caldart.org. In Washington the DART group is called West Coast General Aviation Response Plan (WCGARP). For more information go to EVAC.org and click on NORTHWEST EVAC

- What level of runway damage will prevent your planes from landing? Can your small planes land with only minor or moderate runway damage? Will you be authorized to land on highways to increase your landing options?

Due to the wide diversity in aircraft and pilot experience, there is not a straightforward answer to the question of how much ground damage is too much. Some pilots are highly skilled in Short Take Off and Landing (STOL) operations and have aircraft that are specially designed for that environment. Others require a long hard surface runway to safely land and take off. In making flight assignments, we attempt to match the aircraft, pilot, and cargo capacity with the known landing area conditions as closely as possible.

We have circulated an idea internally that would allow for the use of specific roadways for disaster response operations and to permit use in exercises. This would require considerable research and most likely authorizing legislation.

- Is there an organization similar to yours in Washington? If so, what is their name and who is their contact?

YES. The Washington DART organization is called the West Coast General Aviation Response Plan (WCGARP) and is headed by Sky Terry satnolimits@comcast.net 425.737.3923

- Is ODART working with Washington DART teams at all on planning and exercising?

YES. ODART and WCGARP work closely in organizing a regional response. Although separate organizations, we collaborate on annual Cascadia airlift exercises and sharing resources

- Have you worked with airport owners to understand the impact to runways and hangers in Willamette Valley Hubs to CSZ ground motions?

Thus far we would like to think we have made educated guesses as to what the impacts will be to the aviation infrastructure in ODART staging areas. Some airports have been quite active in hardening facilities and installing emergency equipment and systems and others not as much. There is a recent report issued by the Oregon Department of Aviation that attempts to describe the current state of airport resiliency, (ODAV Airport Resiliency Report Reduced.pdf (oregon.gov) however it does not seem to rely much on the underlying science. At ODART we look forward to working with the scientific community to refine our survivability and useability assumptions.

Gabriel Lotto (PNSN) & Robert deGroot (USGS Shake Alert)

- Question: 6x per day my phone gives the location and a number associated with a shake event… are there any identifiable patterns that indicate a larger event may be coming?

Scientists have long sought to find patterns in the data that can be used to determine when a larger earthquake is about to happen, but nothing so far has shown definitive predictive power. That's why, for now, earthquake early warning (i.e., rapid earthquake detection) is the best short-term tool at our disposal.

- Question: What kind of preparation for shaking is happening in hospitals? Many patients will be unable to drop, cover, and hold on.

Hospital emergency managers work very hard to prepare for shaking in hospitals, where hundreds or thousands of patients, staff, and visitors who may be on campus at a given time have different needs and abilities. Some hospitals are already using ShakeAlert-powered alerts to warn staff, who then protect themselves and patients accordingly. As you mentioned, "Drop, Cover, Hold On" is not possible for everyone; we promote modified protective actions for people who have access and functional needs.

Harold Tobin, University of Washington

- What kind of administrative investment ($ and time/hours) is needed to effectively run something like the Cascadia Community Engaged Research Clearinghouse?

Managing the requests that come in, connecting people, attending meetings, managing emails etc. averages about 8 hours a month of

administrator's time, plus about the same amount of specialist's time to respond, depending on which direction the request is going.

Yumei Wang, PSU

- Does the fatality number include tourist and people who work within the tsunami zone?

Answer: yes it includes tourists. No it does not include people who work in the tsunami zone. Here's the report I cited, which is based on DOGAMI and USGS work. _Oregon_Tsunami_Casualties_Report_SLSLLC.pdf

- Does a plan exist to limit the impact of a large oil spill at the old storage facilities? For example, to stop oil from making it to the pacific.

Answer: The EPA and US Coast Guard have jurisdiction on the Spill Prevention, Control and Countermeasure (SPCC) and they regulate facilities for potential oil spills. More here: Oil Spills Prevention and Preparedness Regulations | US EPA I don't think EPA and USCG do an adequate job at preparing for what could spill at the CEI Hub (and am working with our Congressional delegates to change that). The State's new program requires the fuel terminals to mitigate their risks by 2035. More here: Department of Environmental Quality : Overview of Fuel Tank Seismic Stability : Seismic Stability : State of Oregon

- What would you say are the equivalent facilit(ies) to the OR CEI in Washington?

Answer: There aren't any "single points of failure" like the CEI hub (with a concentration of fuel facilities and very little redundancy) that can prevent the State of WA from responding and recovering from a Cascadia disaster that I'm aware of. Although there are 5 refineries that could experience damage including pollute the Puget Sound waters (listed below), the "cascading" impacts would not be as severe to the state's population.

- BP Cherry Point in Blaine
- Phillips 66 in Ferndale
- Shell Oil in Anacortes
- Tesoro in Anacortes
- U.S. Oil in Tacoma