Tsunami Evacuation Drill Guidebook

How to Plan a Community-Wide Tsunami Evacuation Drill

Oregon Office of Emergency Management

December 2017

Tsunami Evacuation Drill Guidebook: How to Plan a Community-Wide Tsunami Evacuation Drill

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This tsunami evacuation drill guidebook is dedicated to the memory of Maryanne Bozza of the Hatfield Marine Science Center, Oregon State University. We are pretty sure she is leading evacuation drills in her afterlife. We will miss her passion.

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Introduction

This guidebook is intended to help communities along the coast plan and implement community-wide tsunami evacuation drills. Whether your community is planning its first walk-out drill or preparing for more complex evacuation exercises, the following pages offer guidance and recommendations based on best practices and the experience of coastal communities and emergency management professionals.

Photo: Kyra Nourse

The Proven Effectiveness of Drills

While a tsunami triggered by a distant earthquake will take hours to reach our coastline, a tsunami generated by an earthquake on the Cascadia subduction zone can hit shore in under 20 minutes. With so little time, people on the coast cannot wait for official warning systems or guidance, but must recognize natural warning signs and evacuate immediately. This independent response is more likely to happen and be effective if coastal populations have learned their evacuation routes and practiced walking out of the hazard zone. A community-wide tsunami evacuation drill raises awareness and, through practice, improves overall preparedness, while also reinforcing the positive sense of community and cooperation that will make the community more resilient. Moreover, regular drills are an effective means of widely developing the knowledge, skills, and confidence that people will need to evacuate quickly and efficiently during a real event.

Recent tsunamis in the Indian Ocean, Chile and Japan have revealed the importance of preparedness among coastal populations and demonstrated the effectiveness of evacuation drills. For instance, despite the scale of the magnitude 9.0 Tohoku earthquake and tsunami that struck Japan in 2011, Japan achieved a 96-percent survival rate among those living in the tsunami zone. This is attributed largely to tsunami-preparedness education and evacuation drills.

Lessons from the Tohoku event underscore the need for community involvement and regular exercises. Tsunami education, clear communication, planning, and practice that engages all parts of the community — from schools and families to businesses, local organizations and emergency officials — can save lives and give peace of mind to people on the coast. When

Photo: OSU Hatfield Marine Science Center

everyone knows not only where they will go to reach safety and how they will get there, but also how their loved ones will be evacuating, they are more likely to clear the hazard zone immediately and less likely to endanger themselves and others by searching for family members and friends.

In addition, a regularly practiced walk-out drill reinforces the importance of evacuating on-foot wherever this is feasible. As the experience of communities in Japan during the Tohoku event demonstrated, on-foot evacuation is critical to prevent traffic congestion and blocked escape routes. An evacuation drill is also an opportunity to convey other essential safety information, such as why evacuees should keep out of the inundation zone until the official "all clear" is given, and how the all clear will be announced.

Other Benefits of Community-Wide Evacuation Drills

Evaluating the Community's Plans and Preparedness

An evacuation drill can help your community evaluate its preparedness and emergency response plans, providing concrete information and feedback to assist community officials (as well as public and private organizations and businesses) to improve the effectiveness of their plans, procedures and hazard-mitigation priorities.

Meeting Eligibility Criteria for Grants

In order to apply for a FEMA hazard mitigation grant, state and tribal governments (and local governments as sub-applicants) must have approved hazard mitigation plans. The hazard mitigation planning process includes implementation of the plan and monitoring of progress. In particular, the community's plan must be evaluated and revised periodically to ensure that it

continues to address changing risks and priorities. A community-wide tsunami evacuation drill is an effective way to implement, evaluate and adjust a plan and, from the standpoint of a grant application, to demonstrate that the plan is relevant and active.

If done properly, the drill can count as a "community exercise" as required and defined by certain emergency preparedness grants; for details, refer to the Oregon Office of Emergency Management's State Exercise Program webpage:

- Homeland Security Grant Program (HSGP)
- Emergency Management Performance Grant (EMPG)

Engaging Trained Volunteers

Performing regular drills keeps volunteers engaged, which encourages them to remain active and involved after training. It also gives both official personnel and volunteers an opportunity to learn their roles, practice their skills, and consider their responses to issues that could arise during a real tsunami event. It can reveal the need for more training and for targeted public awareness campaigns.

Building Confidence

Participation in a community-wide drill can be an empowering experience. Some participants have reported that, prior to the drill, they doubted their ability to reach the safe assembly area within the time available; by participating in the drill, they discovered that they could walk the distance and reach safety in time.

Moreover, people who know what they should do and who practice evacuating will be more likely to respond calmly and effectively when the need for a real evacuation arises.

Graphic: The TsunamiZone (tsunamizone.org)

Understanding the Tsunami Hazard

Profile of a Tsunami

Tsunamis are the result of sudden, large-scale displacement of water. They can be caused by landslides under or into water, by large submarine earthquakes, by eruptions of coastal or island volcanoes and by meteor impacts in water. For the coastlines of the Pacific Northwest, the most likely sources of tsunamis are earthquakes and landslides. Tsunamis from earthquakes pose the greatest threat.

The largest tsunamis produced by earthquakes are created by ruptures along subduction zones, where geologic forces drive an oceanic tectonic plate beneath a continental plate. Sudden, large movements along such zones produce great earthquakes on the order of magnitude 8.0 and above, with ground shaking that lasts for several minutes. The abrupt movement of the seafloor as it lifts or drops when the fault zone breaks moves the water above the rupture, and it is this displacement that creates a tsunami.

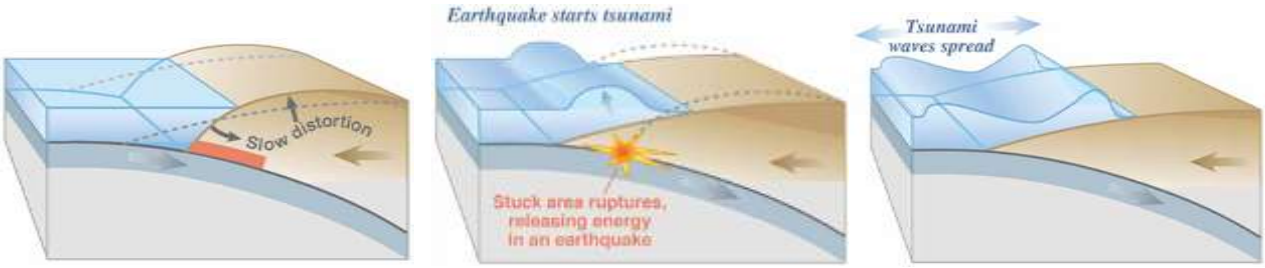

Figure 1. Illustration of a tsunami triggered by a subduction zone. The image on the left shows the subducting plate (grey) sliding under the continental plate (brown); the red area marks the zone where the two plates are stuck, and the dotted lines show how the continental plate would lie if it were not distorted by pressure. In the central image, the locked section breaks: the two plates move abruptly, displacing the water above the rupture. In the righthand image, the tsunami travels away from the rupture zone. (Image: USGS Circular 1187)

Unlike wind-driven waves, which travel through surface layers of water, tsunami waves travel through the entire column of water, from seafloor to surface. Their speed depends on the depth of the water: in the deep water of the open ocean, they travel at high speeds, reaching nearly 500 miles (800 km) per hour. As they enter shallower waters along coastlines, the waves slow down and increase in height. The appearance and behavior of a wave as it approaches shore depends on the bathymetry, or underwater topography, of the shoreline. Generally, a tsunami wave looks less like the cresting ocean waves beloved of surfers and more like a surging wall of water or rapidly rising tide. If the trough of a tsunami wave arrives first, it can even look like a sudden low tide.

A tsunami consists not of a single wave, but of a series of waves reaching shore at intervals over many hours; the first waves may not be the largest in the series. The tsunami's effects include not only rapid flooding of low-lying land, but also dangerously strong currents. As the water travels inland, it scours the ground and picks up large debris, which gives the waves an additional element of destructive force.

Tsunamis in the Pacific

The western coast of North America is part of the Pacific Ring of Fire, a vast chain of geologic activity that includes a number of subduction zones. Coastal communities around the Pacific are vulnerable to tsunamis generated by these zones. From the standpoint of communities living next to a subduction zone, two kinds of threat exist. The first and most destructive is a tsunami triggered by an earthquake on the subduction zone nearest the communities' own coastline (defined as a local source). Waves will be large and arrive quickly. The second is a tsunami generated by a fault zone elsewhere in the Pacific (known as a distant source): the waves, which must cross the ocean, can take many hours to arrive and will decrease in size and force as they travel, but they may still cause damage along shores and harbors (see the appendix).

Local Source: Cascadia Subduction Zone

For the coastline of the Pacific Northwest, the most important local source of tsunamis is the Cascadia subduction zone, which runs under and roughly parallel to the coast, from northern California to southern British Columbia. Great earthquakes and tsunamis occur less frequently on this fault zone than they do along the subduction zones off the coasts of Japan and Chile, but Cascadia is capable of producing an event at least as large as the magnitude 9.0 earthquake and tsunami that struck Japan in 2011. Apart from a relatively small event off Cape Mendocino in 1992, the last major rupture of the Cascadia subduction zone occurred on January 26, 1700. The earthquake, estimated at magnitude 9.0, produced a tsunami large enough to cross the Pacific and be recorded in Japan. Evidence for the local effects is still detectable in the geologic record and in Native American and First Nations oral stories.

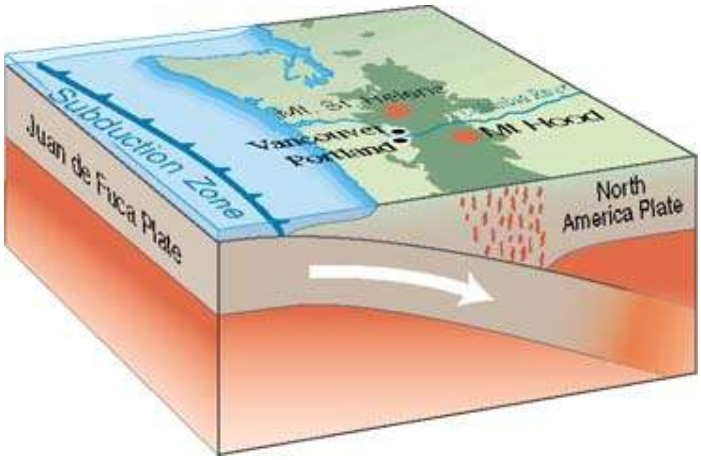

Figure 2. Cross section of the Cascadia subduction zone, an approximately 700-mile (1,130-km) long fault zone where the Juan de Fuca Plate, along with the Explorer Plate to the north and the Gorda Plate to the south, collide with and descend beneath the North America Plate. (Image: USGS)

Pressure has been building along this subduction zone for more than 300 years, and the next great Cascadia earthquake and tsunami could occur at any time. A major rupture essentially means that a section of the oceanic plate, which has become stuck as it tries to slide under the North America plate, will suddenly slip. Not only will this movement displace the water column above it, generating a tsunami, but at the same time, some of the dry land along shore is likely to drop. This occurs because the pressure that previously warped and elevated the edge of the North America plate will suddenly be released. (See Figures 1 and 2 above.)

Heeding Natural Warning Signs

When it comes to tsunami education, few things are as important as learning how to recognize and respond to natural warning signs. This was well illustrated in 2004 by Tilly Smith, a 10-year-old from Great Britain who was celebrating the winter holidays with her family on the coast of southern Thailand.

On December 26, Tilly and her family were on the beach, unaware that a magnitude 9.1earthquake off the coast of northern Sumatra had triggered a tsunami. As Tilly observed the unusual behavior of the sea, she recalled recent school lessons about plate tectonics and undersea earthquakes. Realizing what the odd appearance of the water meant, she raised the alarm, which allowed her family and the other tourists on the beach to reach safety before the tsunami waves engulfed the shore and surged inland.

Low-lying land — including coastline that drops during the earthquake — will shortly afterwards be flooded by powerful tsunami waves emanating from the ruptured fault zone. The topography of the shoreline influences the behavior of the waves: harbors and river mouths, for example, can focus and magnify the waves, so that in some places the waters will flow much farther inland than in others. The impact of the tsunami will be widespread, affecting the entire coastline bordering the subduction zone.

Natural Warning

The nearness of the fault zone to the shore means that a tsunami will arrive within minutes of the earthquake: in some places, as little as fifteen minutes. This brief timeframe means that the local population must learn to rely not on official warnings or instructions, but on their own ability to recognize the earthquake as a natural warning and evacuate immediately to high ground. Wherever possible, evacuation should proceed on foot. Use of automobiles, particularly on routes damaged by the earthquake, is likely to result in gridlock, hindering everyone's ability to reach safety. Fortunately, along much of the Pacific Northwest's coastline, high ground is not far away, and tsunami hazard zones, evacuation routes, and safe assembly areas are marked with signs and defined on evacuation maps.

Tip:

If your community is planning its first evacuation drill, or you just want to practice walking your evacuation route, a very simple walkout exercise may be a good choice. You'll find basic instructions for this type of drill in the Resources section of The TsunamiZone website (see their *Template for a TsunamiWalkout*).

How to Put Together a Community-Wide Drill

The following sections outline the steps to take in order to plan and implement a community-wide tsunami evacuation drill. Incorporated into these steps are recommendations and best practices, as well as suggestions for adapting the drill to suit your community's particular circumstances and needs. Because drills vary in size and complexity, the steps outlined here are intended as guidance: the larger and more complex the drill, the more your team will benefit from following all of the steps; if you're planning a very simple drill, such as a self-directed walkout for a small group, you may be able to simplify or even skip steps.

Build Teams to Plan and Conduct the Drill

Begin by identifying:

- Those who will participate in the drill.
- Those who will plan the drill
- Those who will implement the plan and conduct the drill.

Some of the people on the planning team may also be part of the implementation team, but the membership and organizational structure of the two teams can differ.

Local involvement in the process is critical. Ideally, the planning team should consist of between five and seven people who are representative both of participating groups and the geographic areas included in the drill. Successful drills depend on strong partnerships between local individuals and organizations and emergency management professionals from public agencies.

Photo: Althea Rizzo/Oregon Office of Emergency Management

Tip:

One way to improve interest and participation in the drill is to seek out and engage a local "champion" to serve on the planning team or simply act as an informal liaison between the planning team and particular neighborhoods or groups in the community.

Get the Most out of Meetings

Appoint an experienced facilitator to keep the group on task: Team leaders may facilitate meetings, or delegate this function.

Document every step of the process; designate someone to take minutes at meetings.

Prepare agendas and stick to them. If participants veer off topic, note ideas, but return promptly to the agenda.

Name action items at each meeting and identify those who will enact them and when they must be done.

Provide your team with informational packets in advance of planning sessions. Packets may include planning scenarios, evacuation maps, relevant grant requirements and excerpts from emergency preparedness and response plans, after-action reports, and training and exercise plans.

Before the team picks a planning scenario, ask an expert to present the options and answer questions. It may also help to offer a presentation about grant requirements and other points that will inform the team's choice of objectives and the methods used for evaluating the drill.

Initial Meeting of the Planning Team: Getting Organized

Define the structure of the planning team and assign responsibilities, making sure that roles and responsibilities are clearly articulated and that there is a clear chain of command. The incident command system offers a useful model (see Figures 3 and 4 below), although you may arrange roles and functions to suit your team and needs. Depending on the size of the team, some members may fulfill more than one role or share an area of responsibility with another team member. For example:

- Select a team member to keep track of planning decisions, draft a written framework and timeline for the drill, and maintain checklists to track the status of the various tasks that must be accomplished in preparation for the drill (along with the names of those who are responsible for them).
- Select a team member to take charge of drill-related marketing and communications.
- Select a team member to manage the evaluation process; for example:
    - Take charge of documenting and assessing the drill.
    - Coordinate the evaluators of the drill.
    - Draft the after-action report.
    - Facilitate (or find facilitators for) after-drill debriefings, hot-washes and review sessions.
- Select a team member to plan day-of-drill logistics and recruit volunteers (for example, arranging for barricades and signage, food and water, first-aid stations, traffic control, security and so on).
- Select a team member to serve as general administrator; for example:
    - Manage finances.
    - Arrange for meeting space and venues.
    - Prepare agendas and informational packets.
    - Arrange for supplies needed at meetings or during the drill.
    - Register (or otherwise keep track of) the drill's sponsors and participants; send invitations and thank-you notes.

Discuss whether the current membership of the planning team is sufficient; if needed, identify additional individuals who should be invited to join the planning team in order to ensure adequate expertise and representation. If you're likely to need cooperation or involvement from law enforcement or other public agencies, you may also want to consider inviting agency representatives or an elected official (such as a county commissioner, city council member or county commissioner) to join your planning team.

Before you conclude the first meeting, be sure to set up a schedule for subsequent meetings.

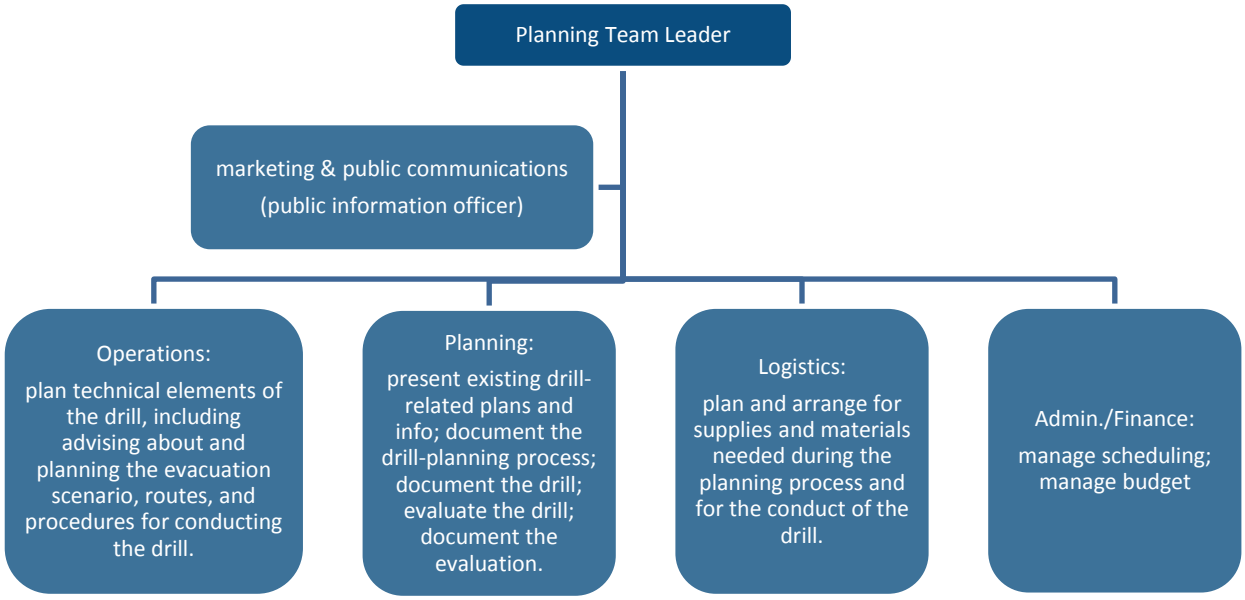

Figure 3: Example of possible structure of the planning team based on the structure of the incident command system. Depending on the size of the team and complexity of the drill, some functions may be combined and overseen by one individual, such as logistics and administration/finance.

Tip:

Prior to planning a community-wide drill, the planning team may want to conduct a discussion-based "tabletop" exercise with relevant emergency response personnel in order to explore the chosen planning scenario and anticipate issues likely to affect either the evacuation of the tsunami inundation zone, or the procedures of the evacuation drill.

Checklist: Build Your Team

- ☐ Identify the drill's participants:
    - Identify the agencies and individuals who are officially involved in emergency planning, mitigation and response.
    - Identify groups who will be invited and encouraged to participate in the drill (for example, schools, businesses, organizations and the general public).
- ☐ Choose people to serve on the planning and implementation teams:
    - Coordinate with federal, state, tribal, and local emergency services and emergency management offices: recruit representatives from these offices as team members or consultants to bring in relevant expertise and knowledge of the hazard and of community-wide emergency response and planning.
    - Coordinate with schools, public agencies, medical facilities, and public works and utilities; recruit representatives as team members or consultants to ensure that the planning and implementation teams are aware of issues related to these particular facilities or services, including organizations that serve the needs of vulnerable populations.
- ☐ Appoint someone to lead the planning team and someone to direct the drill (these roles may already be filled by individuals from the organization that initiated or sponsored the drill).
- ☐ Define the structure of the planning team, including the chain of command, and assign roles and responsibilities. (This may be done at the planning team's first meeting.)
- ☐ Identify those whom the planning team should involve in the planning process (such as by seeking their advice, permission or assistance).
- ☐ Identify those whom the planning team should simply inform about the drill.
- ☐ Obtain buy-in and participation from relevant elected and appointed officials (in particular, those whose responsibilities encompass aspects of the drill, including providing resources and logistical support).
- ☐ Solicit buy-in and participation from local businesses (including the hospitality industry: hotels, motels, bed-and-breakfasts, campgrounds, RV parks and so on).
- ☐ Recruit previously trained volunteers, if available.
- ☐ Solicit new volunteers from neighborhood associations and other organizations (such as clubs, sports teams and faith-based organizations), if needed.

Outline of the Planning Team's Tasks

Over the course of its planning meetings, the team should:

- Review existing tools and resources.
- Decide how to gather input from and share information with officials, consultants and other stakeholders who are not members of the planning team.
- Define objectives.
- Choose and define a planning scenario for the drill.
- Discuss evacuation-related issues and any local concerns or sensitivities in light of the chosen planning scenario.
- Choose the date and type of drill.
- Discuss logistics of the drill and finalize a plan that includes:
    - Clear assignments and well-defined milestones for preparing for the drill.
    - A description of how the drill will proceed, noting the timeline and the required steps, tasks, personnel and resources at each stage.
    - A procedure for termination (in the event that a real emergency occurs during or immediately before the drill).
- Decide on a scheme for evaluation of the drill, including documentation and debriefings after the drill. (Make sure evaluation methods and documentation will meet any grant requirements.)
- Periodically review the status of preparations and solve any problems.
- Review and revise drafts of plans and other drill-related documents as they evolve.
- Conduct a final review of the procedures for the drill; make sure all pre-drill preparations are complete and address any last-minute issues (i.e., at the final meeting before the drill).

Coordinating the Drill with Related Exercises

A community-wide evacuation drill may be used by various organizations as an opportunity to conduct related exercises in order to evaluate their own plans and capabilities. It might even be an occasion for multiple organizations and jurisdictions to engage together in an exercise to examine various aspects of emergency response and coordination.

If the drill is to be part of a larger full-scale exercise, the drill-planning team should include representatives from participating organizations and jurisdictions. Alternatively, if the full-scale exercise will have its own planning team, the team in charge of the evacuation drill may need a liaison officer to ensure that the drill is effectively aligned with other aspects of the exercise.

Overview of the Incident Command System

When creating a framework for conducting the tsunami evacuation drill, it helps to have a general understanding of the incident command system (ICS), which is used by local, state and federal agencies to manage emergency response. ICS consists of a hierarchical management framework and procedures that establish the chain of command and facilitate clear communication and coordination of resources during the response.

The following diagram illustrates the basic components and organization of the incident command framework. The framework is designed to expand or contract to suit the demands of the situation: for a smaller or more focused incident, fewer organizational elements and positions may be sufficient; a more complex incident may require additional positions, support staff and organizational elements. For example, if the operations section involves both air and ground activities, the operations section can be divided into two branches, each overseen by a branch director who reports to the operations section chief.

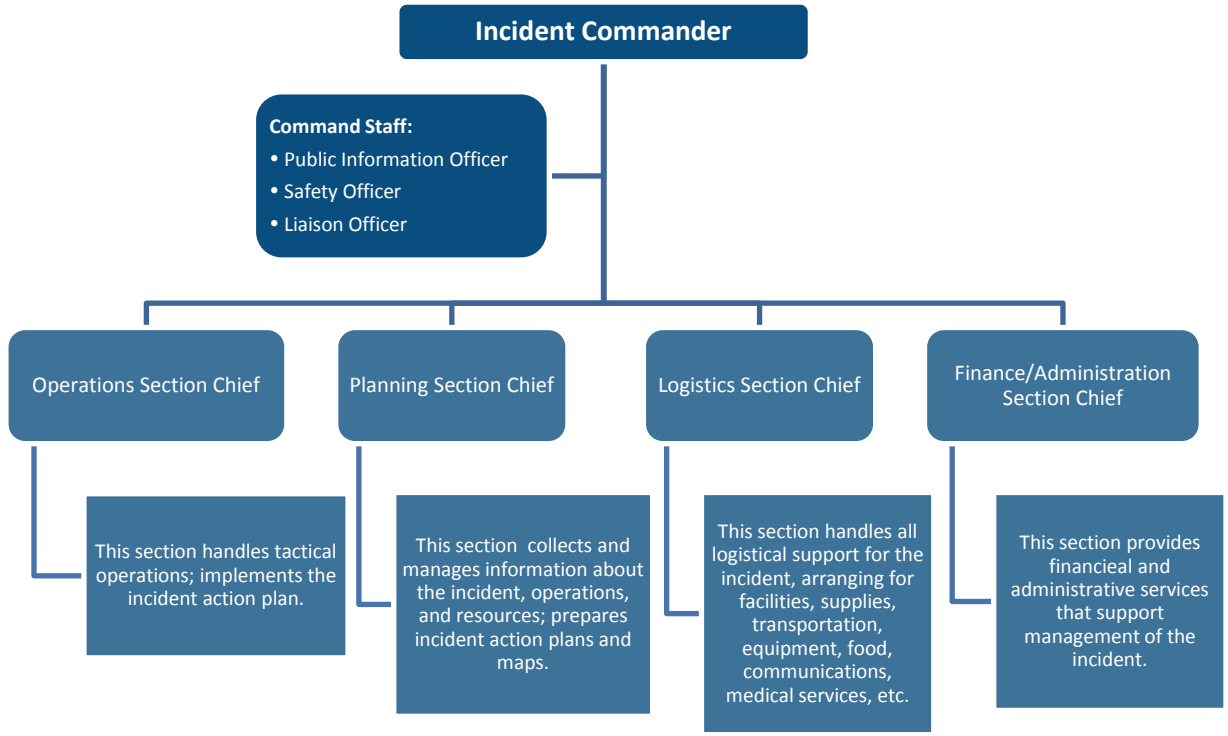

Figure 4: Basic framework of the incident command system.

At the top of the command hierarchy is the incident commander. The three officers at the head of the command staff report directly to the commander. The public information officer manages communications between incident command and the public, including the press. The safety officer develops the incident safety plan and advises incident command about all safety issues. The liaison officer is the contact person between incident command and representatives from other agencies and organizations.

The general staff is organized into sections, each headed by a section chief who reports to the incident commander. Section chiefs may create specialized units to manage the various functions of the section, or divide the section first into separate branches, each of which can in turn be divided into units, divisions (based on geography), or groups (based on function).

Identify and Review Existing Resources

Before the planning team starts making decisions and shaping the plan for the drill, examine any materials that have a bearing on tsunami evacuation in your community:

- Collect relevant tsunami evacuation maps and brochures, along with planning scenarios for a Cascadia earthquake and tsunami.
- Review your community's tsunami evacuation plan.
- Coordinate with the local emergency management office and content experts to review the tsunami hazard and assess the impacts of any mitigation that has already been done.
- Review relevant sections of the evacuation plans of major facilities (such as schools and medical clinics) with a view to identifying potential issues and coordinating the community-wide evacuation drill with personnel at these facilities.
- Review after-action reports and improvement plans from previous tsunami evacuation drills.
- If the community has an overall training and exercise plan, review it, and discuss how a community-wide evacuation drill will fit into it (that is, how the evacuation drill will meet priorities and objectives described in the training and exercise plan).
- Identify any grant requirements that the drill must be designed to meet.
- Identify available resources for conducting the drill, including the budget.

Define the Objectives of the Drill

Specify what you will use the drill to accomplish or evaluate. Describe the objectives of this drill in relation to:

- The multi-year training and exercise plan (if there is one).
- The results of previous drills.
- The community's tsunami evacuation plan.
- Any grant requirements.

Does Your Community Have a Tsunami Evacuation Facilities Improvement Plan?

Communities can improve their resilience and the effectiveness of evacuations by creating and implementing a Tsunami Evacuation Facilities Improvement Plan (TEFIP), which guides the development of the local evacuation system, including such strategies as hardening evacuation routes and applying wayfinding technologies.

To learn more, check out:

***Preparing for a Cascadia Subduction Zone Tsunami: A Land Use Guide for Oregon Coastal Communities* (by the Oregon Coastal Management Program).**

Get SMART

The Homeland Security Exercise and Evaluation Program (HSEEP) recommends that objectives be "SMART." The acronym stands for five criteria that define a useful objective as:

SPECIFIC

MEASURABLE

ACHIEVABLE

RELEVANT (to the mission of the planners and the purpose of the exercise)

TIME-BOUND (able to be done within a reasonable and defined period of time)

Sources for Planning Scenarios and Related Information:

Tsunami evacuation brochures and maps developed by the Oregon Department of Geology and Mineral Industries (DOGAMI). These and related resources are available at the Oregon Tsunami Clearinghouse webpage. You may also find links on the website of your local emergency planning agency.

Past tsunami warning system exercises: Pacifex series (on the website of NOAA/National Weather Service: West Coast/ Alaska Tsunami Warning Center). The handbooks created for annual Pacifex exercises (beginning with Pacifex 10 in 2010) contain scenarios that may be adopted or adapted for use in a community's evacuation drill.

Cascadia Subduction Zone Earthquakes: A Magnitude 9.0 Earthquake Scenario (2013) by the Cascadia Region Earthquake Workgroup (CREW). This publication examines categories of impacts anticipated for a large-magnitude Cascadia earthquake and tsunami and so may be useful for envisioning potential issues affecting evacuation, emergency response, plans for tsunami refugees, and short- and long-term recovery.

Limit the number of objectives: As a general rule, focus on no more than three objectives; avoid having more than five. If your team identifies a longer list of objectives, choose three for the current drill and table the rest for consideration later when you plan subsequent drills.

Examples of objectives include:

- Participants walk their evacuation routes in order to become familiar with them.
- Participants practice evacuating within the estimated time available before the arrival of the first tsunami wave.
- The community and local emergency planners evaluate particular aspects of the community's evacuation plan. (When writing the objective, identify the particular aspects to be evaluated.)
- The community and local emergency planners evaluate the impact of particular variables on the evacuation, such as how seasonal population changes may affect evacuation procedures, or how the time of day or night affects procedures and outcomes. (Be sure to specify the variables to be evaluated.)

Once you decide on a short list of objectives, consider prioritizing them so that it will be easier to adjust the scope of the drill to fit the available budget and resources. When choosing the scenario and planning the drill, consider the objectives, available resources, budget limitations and projected costs.

Identify and Describe the Tsunami Planning Scenario

A planning scenario describes the circumstances of the hypothetical tsunami event and evacuation. It includes basic information, such as the date and time of day, the source of the tsunami, and the amount of time between the triggering event (earthquake) and arrival of the waves. It may also include other hypothetical factors and events, such as power and communication outages, traffic jams on particular evacuation routes, the failure of an essential bridge during the earthquake, or heavy rain during the evacuation. How complex and detailed the scenario is will

depend on the type of exercise you are planning and, in particular, on the planning team's objectives for the exercise.

After reviewing information about your community's tsunami hazard and considering existing scenarios, choose and define your planning scenario. When selecting or formulating a planning scenario, discuss how it will align with the objectives that you have chosen for the drill.

- Choose and describe details of the Cascadia scenario that will be used for the drill: for example, the time, season, duration of the earthquake, wave arrival times and inundation area. Shape the scenario to ensure that it will allow you to meet your objectives, but make sure the end result is realistic.
- Produce a written narrative or descriptive timeline of the scenario, including specific events.
- Identify and review official tsunami evacuation routes and emergency assembly areas in the community (also, vertical refuges) in relation to the scenario.

Discuss the Scenario in Relation to Evacuation

An actual evacuation will be impacted and often complicated both by the circumstances that exist just before a Cascadia earthquake strikes, and by the damage and distress that the earthquake itself will cause. A community-wide evacuation drill is an opportunity to examine the factors that can influence the success of a real evacuation. With the particular objectives of the drill in mind, consider how the various factors described in the drill's planning scenario would be likely to impact evacuation.

Seasonal Considerations

If the real event occurs during the summer months, the number of people evacuating will be swelled by summer visitors. How easy is it for visitors to learn what to do in the event of an earthquake? How intuitive is the system of evacuation routes?

Consider also that if the drill is held during the summer months, the presence of large numbers of summer visitors will affect the logistics of running the drill.

Alternatively, consider the possible impacts of wet-season weather on evacuation routes, emergency assembly areas, and so on. For instance, rainfall during the winter and spring may increase the likelihood of earthquake-induced ground failure, such as landslides. It will also increase the urgency of the need for shelter once evacuees reach the assembly areas.

Time-of-Day Considerations

Evaluate the distribution of the population at different times of day: How might this affect the volume of people using different evacuation routes and emergency assembly areas or evacuation refuges?

Evacuation Routes & Refuges

Consider having the planning team and volunteers walk the evacuation routes prior to the drill to perform a general evaluation:

Photo: Kyra Nourse

- Basic Understanding: Is the route wide enough for the expected volume of people? Is it the shortest possible distance? Are the evacuation signs that mark the route visible, sufficient in number, and appropriately spaced? Do they clearly convey the direction that people must go to reach the assembly area? Is there redundancy in the way that routes are marked to ensure that people won't lose their way even if sign posts fall down during the earthquake? Is there emergency lighting for nighttime evacuation? Will it illuminate regardless of power outages? (Note that reflective signs will only be visible at night to people carrying flashlights.)
- Hazards: Identify existing hazards or obstacles along evacuation routes (such as gates, bottle-necks, rough terrain and stairs; also note heavy traffic that may pose a risk during the drill). Identify potential post-earthquake hazards (such as damaged bridges, roads and overpasses, landslides and other ground failures, downed powerlines, leaking natural gas lines and other fire hazards, and hazardous material spills). Is there a need to mitigate hazards or alter the routes?
- Time: Estimate the average time required to walk designated evacuation routes and compare it to anticipated tsunami arrival times. (Consider having volunteers conduct a pre-drill test; compare their time to the results of the community-wide evacuation drill.)
- Vertical Evacuation: Identify possible existing vertical evacuation refuges for any areas that may require such an option.
- Emergency Assembly Areas: Is the assembly area clearly marked? Is it large enough to accommodate the number people, pets and service animals likely to gather there? Are there instructions posted to tell evacuees what to do next? Will it be affected by potential weather-related issues or post-earthquake hazards?

Photo: Kyra Nourse

Discuss what your messaging will be regarding problematic evacuation zones (in particular, places where the distance to high ground or an adequate vertical refuge may not be walkable in the time available). Make sure that decisions about such messaging align with the messaging developed by your community's emergency management officials. Incorporate the results of these decisions into your team's communications plan.

Vulnerable Populations

While anyone who lives, works or plays in a tsunami inundation zone is at risk if a tsunami occurs, some populations are potentially more vulnerable than others in the context of evacuation. When planning an evacuation drill, it is important to identify groups that are likely to have difficulty evacuating without some form of assistance, such as visitors, young children, people with disabilities that reduce mobility, those with limited English proficiency, and seniors. When planning, include consideration of where such groups are likely to cluster at different times of the day: for example, pay particular attention to facilities such as hospitals and urgent-care clinics, schools and daycare centers for children, tourist attractions, retirement communities, elder-care facilities and senior-oriented community centers. Neighborhood associations and aid organizations may also be able to help identify families and individuals in residential areas who are likely to need assistance during an evacuation.

Because a tsunami from the Cascadia subduction zone requires evacuation within such a short timeframe, keep in mind that strategies for assisting those who need help should not endanger their helpers.

Be sure to plan strategies for communicating with and including vulnerable populations in the drill.

You may also want to discuss:

- Issues related to evacuation of those with medical needs/medications.
- Issues related to evacuation of those with service animals and pets.

"Assisted evacuation of immobile people or groups requires careful planning within realistic timeframes for tsunami arrival, and should be regularly exercised...."

—Tsunami Evacuation: Lessons from the Great East Japan Earthquake and Tsunami of March 11th 2011.

A drill is a chance to practice walking out of the hazard zone and fixes in peoples' minds the importance of evacuating on foot. It is also an opportunity to discuss options for those who are unable to walk out on their own. For instance, the residents of an elder-care facility located inside the hazard zone must be evacuated in the event of a real tsunami. During the drill, residents who are physically able to walk out should be encouraged to do so. Emergency planners and facility administrators should discuss evacuation options for residents who are less mobile: For example, is limited use of vehicles likely to be feasible after an earthquake? If so, which vehicles? What evacuation route will they take? If vehicles can't be used, what are the alternatives? A simulation or table-top discussion based on the scenario of the all-community drill can be substituted for actual practice in the case of people who cannot be moved without risk of bodily harm.

Tourists

Visitors and seasonal residents are considered a vulnerable population because they tend to be unfamiliar with the area and are less likely to recognize natural warning signs or know what to do and where to go in the event of an earthquake and tsunami. They are also unlikely to be equipped with emergency kits or even basic tools, such as flashlights.

Photo: Kyra Nourse

- Discuss how tsunami information, messaging and signage can be developed to better reach this population.
- Consult with business owners and representatives from the hospitality industry to develop strategies for informing visitors about what to do.
- Encourage businesses and hotels to train employees so that they are prepared to guide visitors out of the hazard zone in the event that evacuation is necessary; invite businesses to practice this strategy during the community-wide evacuation drill.
- Work with business owners to develop an approach to communications that is positive and constructive, allaying any fears that informing visitors about the tsunami hazard may negatively impact tourism.

Evacuation of the Injured

Consider issues and policies related to assisting and evacuating those who are injured in the earthquake preceding the tsunami. During a real tsunami event, even those with serious injuries must be moved out of the inundation zone immediately, and there will be no time to wait for paramedics or other emergency response personnel. Use the drill as an opportunity to discuss policies or practice procedures to aid the injured without endangering helpers.

Emergency Communications

Use the drill as an opportunity to discuss and evaluate emergency communications strategies for tsunami evacuation—in particular, consider how to manage communications at evacuation assembly areas to keep evacuees informed and away from unsafe areas, to help reunite people with loved ones, and to advise people about next steps.

Choose the Date and Define the Drill

Schedule

Choose a date for the drill and determine whether it will be part of a regular schedule; for example, is it:

A fixed annual event? Options include:

- Coordinating the drill with other drills, such as ShakeOut or local school drills.* This approach offers a number of advantages: If the drill coincides with ShakeOut (a fixed day and time in October), planners can take advantage of existing public awareness and marketing; also, schools and businesses may already have scheduled their own drills to coincide with ShakeOut, so they may find participation in the community-wide evacuation drill more convenient.
- Coordinating the drill to coincide with other relevant dates (such as the anniversary of a memorable earthquake and tsunami) or with public-awareness campaigns, such as Tsunami Preparedness Month, to facilitate awareness and marketing.

A regular event, practiced on fixed dates several times within the same year; or an annual drill, but held at different dates and times each year to evaluate seasonal variations and different objectives and types of drill?

Before setting the date for the drill, ask if any neighboring communities are already planning to conduct evacuation drills on the same day. If they are, you may want to choose a different day, because there may not be enough public resources available to support more than one drill at a time. (For instance, neighboring communities may need to draw on the same source for official traffic signs.)

*Note Oregon statute 336.071(3): "In schools in a coastal zone, at least three drills on earthquakes and tsunamis shall be conducted each year." Because schools regularly conduct earthquake drills (and tsunami drills, if the school is within the tsunami hazard zone), timing the community-wide evacuation drill with the school district's schedule may help encourage participation.

How Often Should Communities Practice Tsunami Evacuation?

Frequent community-wide evacuation drills (such as one per month) may be excellent practice in theory, but experience suggests that the number of participants will be disappointingly low, especially after the first couple of drills.

For a community-wide evacuation drill, once per year may be a more reasonable goal, particularly if your community is just beginning to plan and practice evacuation.

Ultimately, two to three drills per year (such as one full drill plus a couple of simple Tsunami WalkOut exercises) may be feasible, especially in communities that have schools located inside the hazard zone. (Oregon requires schools in tsunami inundation zones to practice earthquake and tsunami drills at least three times per year.)

For some organizations, tsunami evacuation drills can be combined with fire drills as part of a regular schedule. To ensure that everyone participates, those in leadership positions should stress the importance of the drills and set an example by always taking part.

Defining the Scope

Objectives, along with any practical limitations, determine the drill's scope and help planners choose the type of drill. For instance, if the main objective is to help people learn their evacuation routes, a simple Tsunami WalkOut may suffice. If the aim is to evaluate parts of the emergency response plan or systems, the planning team may decide to conduct a formal community-wide evacuation drill, or even combine such a drill with other exercises. Other factors that affect the scope include:

- **Number of individuals and groups participating.**
- **Timing and duration of the drill.**
- **Number of locations involved.**
- **Tsunami-education activities and related events held in conjunction with the drill.**

If you're planning your first tsunami evacuation drill, a simple Tsunami WalkOut is a good choice: it's relatively easy to plan and manage, and gives participants a fun, low-key way to learn routes, find assembly areas, and think about making grab-and-go emergency supply packs. Next, try a tabletop exercise to grapple with more complex planning scenarios and objectives. Your team will then be well primed to develop a formal, full-scale drill.

Type of Drill

An all-at-once, formal drill: The drill has a fixed date and time, and everyone evacuates buildings and walks out of the hazard zone along official evacuation routes at the same time. Participants attempt to reach the nearest assembly area within the timeframe fixed by the planning scenario (that is, before the first tsunami wave reaches shore). This constitutes a community-wide exercise: it requires careful planning and coordination, but is strongly recommended because it can achieve a wide range of objectives. The drill has distinct start- and end-times, and vehicular traffic is diverted or controlled to allow pedestrians to follow evacuation routes across normally busy roads. If conducted properly, this type of drill can fulfill grant requirements. It can be concluded or coordinated with an educational event, such as a safety fair, which means the drill not only raises awareness, but is an opportunity to promote tsunami education and public preparedness.

A simple Tsunami WalkOut: This exercise has a fixed date and time. Participation may be community-wide, or limited to a single organization or part of the community. Participants walk their evacuation routes from their starting points to the assembly areas, but vehicular traffic is not generally controlled or diverted, so participants will use crosswalks and wait for traffic signals. They may even detour off the actual evacuation route in order to cross busy roads at safer points. A simple Tsunami WalkOut is relatively easy to organize, raises awareness, and allows participants to learn their routes. Because traffic carries on as usual, participants may not be able to practice evacuating within the timeframe required by the tsunami scenario. The exercise may be less relevant for meeting grant requirements. It supports a more limited range of objectives than a full-scale, formal evacuation drill.

A staggered Tsunami WalkOut: The exercise occurs within a fixed timeframe (such as a particular week), but the timing of walkouts is flexible or staggered—in other words, the various participants evacuate their buildings and walk their evacuation routes at different times during the exercise period. This may be easier for businesses and organizations to fit into their schedules, which may encourage participation. In other respects, the exercise

follows the same design as a simple Tsunami WalkOut, with similar advantages and limitations. Because different groups participate at different times, it may be more difficult to evaluate the exercise, and some factors, such as the volume of evacuees trying to exit via particular routes, may be hard to gauge.

Plan

Once decisions about the objectives, the date and the type of drill have been made, draft a plan. Such a plan may include:

- The date of the drill (and the time, if all participants will evacuate at the same moment).
- A description of the planning scenario.
- A description of the objectives, with an explanation of how the drill has been designed to meet them. (Articulate the scope of the drill).
- The planning team's timeline for planning, preparing for, and conducting the drill.
- The steps required to prepare for the drill, with well-defined milestones and clear assignments of tasks and responsibilities; for instance:
    - Recruiting, briefing and training volunteers.
    - Identifying and evaluating official evacuation routes.
    - Organizing and launching a marketing and public-information campaign.
    - Securing sponsors to provide resources or fund various aspects of the drill (such as supplying water at assembly areas or t-shirts for volunteers).
    - Coordinating with and providing information to participating organizations and businesses.
    - Coordinating with transportation and police officials to manage traffic.
    - Establishing an operations center for the drill, from which the implementation team will manage the event, including communications with participating organizations, volunteers, the public and the press.
    - Coordinating with various organizations to set up an informational safety faire at the conclusion of the drill.
    - Developing an evaluation scheme and materials for gathering feedback.
    - Recruiting and briefing evaluators.
- A description of how the drill itself will proceed, noting the timeline, the starting signal (if any), and the required steps, tasks, personnel and resources at each stage.
- A procedure for cancelling the drill, in the event that a real emergency occurs during or immediately before the drill.
- The schedule for conducting follow-up meetings to debrief members of the planning team, evaluators and volunteers; and to permit officials to assess the drill and discuss the results.

Training

As you develop the plan, identify roles for volunteers. If the community has already held evacuation drills, experienced volunteers will likely be available (they may require briefing, but less training). If this is the community's first drill, training for new volunteers will be needed.

Volunteers (and evaluators) should understand:

- The plan and procedures for a tsunami evacuation.
- The scenario and plan for the drill.
- Official messaging related to tsunami preparedness and evacuation.
- The structure of the implementation team (personnel and chain of command).
- Their own particular roles in running, documenting and communicating about the drill and related events.
- What to do if a real emergency occurs.

When recruiting new volunteers, seek out people who have training and experience that is easy to translate into the various roles and actions required to plan, promote or conduct the drill.

You may also want to present an informational meeting or training workshop to help inform and prepare the people in the community who will be in charge of evacuating their own buildings or guiding particular groups during the drill. Be sure to involve representatives from organizations that support or advocate for vulnerable population groups.

Develop a Procedure for Evaluating the Drill

Create a plan for evaluating and documenting the drill, taking into consideration what the drill is intended to evaluate and the various ways that the information may be used; for example:

- To prioritize mitigation strategies.
- To update emergency preparedness and response plans.
- To plan subsequent drills and other exercises.
- To improve evacuation systems and wayfinding strategies.
- To promote public education and preparedness (including identifying audiences to be targeted when developing communication policies and tools).
- To meet grant requirements.

Identify the personnel or volunteers who will serve as evaluators under the direction of the lead evaluator; train and brief evaluators regarding:

- The purpose, objectives, scope and schedule for the drill.
- The plan for evaluating the drill, including the documents or other tools that will be used.

- What and how to evaluate (for instance, what to focus on and how to use an evaluation guide or checklist to record observations).
- Individual assignments, if evaluators will be posted in different places and asked to examine different aspects of the drill.

Identify documents that the lead evaluator or evaluation team will use or produce (for example, evaluation guides, feedback forms and the draft of the after-action report); develop, reproduce and distribute these documents as needed. For instance, create feedback forms for individual participants and organizations, and evaluation guides or forms for use by official evaluators during the drill; include specific questions to solicit feedback related to the drill's objectives.

Decide on a procedure for:

- Collecting public feedback (for example, have volunteers on hand to distribute and collect pencils and feedback forms at the assembly areas after the drill, or provide a link to an online public survey).
- Collecting feedback from participating organizations regarding both the conduct of the drill and their concerns or suggestions for improving evacuation.

Draft a plan (based on decisions by the planning team) for debriefings and evaluative meetings after the drill; work with the planning team's general administrator to arrange venues and facilitators for such meetings.

How to Prepare an After-Action Report

Essentially, an after-action report should describe the drill, including basic features such as the type of drill, date, timeframe, scenario, participants and organizers (including the initiator or sponsor and the planning and implementation teams). It should assess how the performance of the drill and the actions of the participants fulfilled the purpose and met the objectives specified by the planning team; and it should draw attention both to strengths (what went well), and to issues that must be addressed to make an evacuation more successful.

The source material for the report will include evaluators' notes and other feedback.

Typically, the sponsor of the drill distributes the after-action report to participating organizations.

FEMA offers detailed guidelines for producing after-action reports. See the Supplemental Materials section of this guide for sources of templates.

Checklist: Overview of the Planning Team's Tasks

- ☐ Review existing tools and resources.
- ☐ Decide how to gather input from and share information with officials, consultants and other stakeholders who are not members of the planning team.
- ☐ Define objectives.
- ☐ Define the planning scenario for the drill.
- ☐ Discuss evacuation-related issues and any local concerns or sensitivities in light of the chosen planning scenario.
- ☐ Set the date of the community-wide evacuation drill.
- ☐ Define the type and scope of drill you will conduct.
- ☐ Discuss logistics of the drill and finalize a plan:
    - Define tasks and milestones for planning and preparing for the drill.
    - Designate assignments.
    - Describe the procedures for conducting the drill (the timeline and required steps, tasks, personnel and resources needed at each stage).
    - Define the procedure for cancelling the drill (in the event that a real emergency occurs during or immediately before the drill).
- ☐ Decide on a scheme for evaluating the drill, including documentation and debriefings after the drill. (Make sure evaluation methods and documentation will meet any grant requirements.)
- ☐ Periodically review the status of preparations and solve any problems.
- ☐ Review and revise drafts of plans and other drill-related documents as they evolve.
- ☐ Conduct a final review of the procedures for the drill; make sure all pre-drill preparations are complete and address any last-minute issues (i.e., at the final meeting before the drill).

Manage Communications and Marketing

Getting Started

Identify your target audiences (for instance, students and families, visitors, staff of hospitality facilities, boaters and local business owners). Identify the best advertising messages and methods for sharing information with these audiences.

Consult with local and state emergency management officials to ensure that drill-related messaging is consistent with official messaging about the tsunami hazard and emergency response and preparedness.

Present information about the hazard clearly and accurately, keeping the overall focus on positive action and preparedness. As you develop your communications strategy, be aware that some members of the community may have reason to doubt their ability to reach a safe assembly area within the time available. Take such concerns into account when developing your strategy and messages. In some situations, the most effective message or advice you may be able to give someone is, "Get as high as you can, as fast as you can, however you can."

Prepare a Communications Plan

Develop a communications plan and materials for informing people about the drill and promoting participation. Make sure the plan covers the drill at all stages: before, during and after. For example, consider:

- Producing a press release that provides general information about the drill; distribute it to all media outlets.
- Advertising and informing community members about the drill via social media resources; choose options strategically to reach and attract a variety of age groups and audiences.
- Using local media to make public announcements about the drill.
- Using pamphlets and mass mailings to announce the drill and inform the public (or particular audiences) about the drill.

What to Include in a Press Release

A press release about the community-wide tsunami evacuation drill may include the names of the drill's sponsors or organizers and a brief overview of the scope, the purpose or objectives, and the tsunami planning scenario. It conveys the date and time of the drill, and may also identify some participating organizations. It should include a call for public participation, as well as information about where people can look for more details and updates.

Send your press release to local media outlets. Develop a list of these outlets, including the names and contact information of the editors or reporters who usually handle this topic or type of information.

Incentives for Participation

As part of your marketing strategy, you may want to develop creative incentives to encourage participation.

Incentives can be especially helpful after the first few evacuation drills, as participants become increasingly familiar with routes and procedures and consequently may be more complacent about the need to practice.

For example, participating organizations might motivate their personnel with simple treats or rewards (such as ice cream for those who participate). A strategy to motivate the wider community could include offering raffle tickets to participants as they arrive at assembly areas, and then concluding the drill with a drawing for a grab-and-go emergency kit or other prizes donated by local businesses.

- Recruiting businesses and other organizations to participate in the drill. Promote the drill as an opportunity both to evaluate and practice an organization's own emergency plan and procedures, and to see how they mesh with those of the rest of the community.
- Encouraging schools to use the drill as an opportunity for earthquake education and for related interdisciplinary projects (for instance, combining earth sciences, media arts, English and history).
- Promoting participation in the drill among families and individuals. (Coordinate with the school district to promote preparedness and participation of families through the schools' drill and students' related projects.)
- Maintaining a website or webpage for the drill.
- Providing checklists and a resource list for participating organizations and businesses; for instance, include information about how to develop an evacuation plan that takes into account factors such as one's location, proximity to evacuation routes, building type and potential hazards or obstacles.
- Encouraging organizations and businesses outside of the inundation zone to participate in the drill by planning to assist refugees or by offering their facilities as assembly areas for evacuees. (When considering the use of buildings for such purposes, be aware that structures must withstand both the main earthquake and aftershocks. Unless specifically designed to exceed life-safety seismic standards, structures may need to be inspected for damage after an earthquake and designated safe for use.)
- Posting and distributing a synopsis of the drill and the drill's planning scenario. Describe the event and anticipated impacts (including the day, time and duration of the earthquake) to help participants plan for the drill. You may want to include a short list of questions for participants to consider during the drill to help them evaluate their own response and preparedness.

- Taking advantage of existing marketing. For instance, if the drill is coordinated with ShakeOut, take advantage of the resources already available for this annual event. Existing marketing and informational tools from other sources can be adapted for the drill as well (such as resources on The TsunamiZone website).
- Inviting elected officials and local celebrities to lead the walk-out from particular public venues.
- Inviting representatives from the media to observe or participate in the drill. Arrange press briefings and interviews with key officials or spokespeople. Consider assigning a specific person to the role of media relations guide.
- Discussing how to clearly and consistently identify and advertise the event as a *drill* in order to avoid confusion, false information and false alarms on the day of the drill.
- Identifying volunteers who will interact with the public during the drill, training them to answer frequently asked questions, and briefing them regarding procedures for handling and communicating problems or emergencies during the drill.
- Taking photos and making film clips of the drill to post online along with descriptions.

Address Day-of-Drill Circumstances and Needs

While the implementation team and volunteers will perform the tasks required to conduct the tsunami evacuation drill, the planning team should lay the groundwork by including these tasks in the plan for the drill and taking whatever steps are required to prepare for implementation.

In Advance of the Drill

If the drill is designed so that everyone evacuates at once, designate an official signal or other means of announcing the start and end of ground shaking (the drop-cover-and-hold-on phase of the drill).

Determine a method of communication between groups (such as between the center of operations and volunteers) to help manage logistics and any unexpected issues that may arise during the drill (for instance, controlling traffic, coordinating evaluators, managing minor emergencies and cancelling the event should a significant, real emergency arise).

Identify and prepare for likely traffic issues (including pedestrian safety) during the drill:

- Set up procedures for traffic control or detours/rerouting (identify and attend to any local procedures or permits required for traffic management during such events).
- Work with the Oregon Department of Transportation (ODOT) and the Oregon State Police to manage evacuation routes that will require pedestrians to cross Highway 101. ODOT may also be able to provide caution signs for the drill.

Anticipate likely pedestrian traffic issues: For example, if the drill is designed so that everyone evacuates at once, those who walk quickly or have a shorter distance to travel will likely reach the assembly areas before others. Will those who are the first to reach the assembly areas wait

Final Planning Meeting

Shortly before the drill, the planning team should hold a final meeting to review the procedure for the drill and make sure that all preparations are complete or on schedule. Discussion may include:

- **The schedule.**
- **Procedures for setting up and taking down temporary signs and facilities.**
- **Measures for traffic control and other safety-related procedures.**
- **The signal or plan for officially starting the drill.**
- **Roles and positions of volunteers and evaluators.**
- **ID for volunteers (hats, badges, nametags, vests or shirts bearing official insignia).**
- **Location and role of the center of operations.**
- **Method and procedures for communication among organizers, participating organizations and volunteers.**
- **Evaluation procedures and materials.**
- **Times, dates and locations of post-drill debriefings and evaluative meetings.**
- **The procedure for cancelling the drill if a real emergency intervenes.**

The meeting is a chance to address any last-minute issues or concerns; the team should avoid making big changes at this stage.

there for the end of the drill, or will they walk back immediately? If they're likely to return straight away, will they become an obstacle for those still walking out? If the plan is to have them wait at the assembly areas, consider setting up an information booth. You may also want to provide refreshments at the site. (See *End-of-Drill Public Information and Events*)

If needed, make arrangements for:

- A center of operations from which to coordinate the drill and any associated exercises as well as manage communications among volunteers and other personnel and participants.
- Teams who will prepare the center of operations and set up communications, temporary signage, information booths, and whatever else is required for the running of the drill.
- First-aid stations.
- Information booths at assembly areas.
- Drinking water (and possibly other refreshments) at assembly areas.
- Access to restrooms near the site of the after-drill event (if any).
- Strategically placed trash and recycling bins.
- Clean-up teams to clear up after the drill (for example, removing temporary signs, striking the operations center, and patrolling for litter).

Brief the volunteers, evaluators and other personnel who have a role in running or assessing the drill. Distribute:

- Copies of required documents and tools (for example, instructions, evaluation guides, feedback forms and pencils).
- Identification badges, vests or other clothing to be worn by volunteers during the drill.

Send volunteers to check all evacuation routes to ensure that they are well marked with official evacuation-route signs.

Implementation: Just Prior to the Start of the Drill

- Set up the center of operations and test communications.
- Verify that volunteers who will be interacting with the public are wearing identification or distinctive clothing (such as hats, reflective vests or t-shirts bearing the logo and colors of the drill).
- Send volunteers to put up temporary signage (such as signs announcing the drill, marking traffic detours, and directing evacuees to assembly areas, drinking water, restrooms or the end-of-drill safety fair).
- Verify that volunteers and evaluators are in position and have whatever materials they require (such as evaluation guidance documents and forms, instruction sheets and communication devices).

Implementation: During the Drill

- Volunteers and evaluators monitor the drill as it proceeds and note aspects that appear to be working well and issues that may need to be addressed to make evacuation safer and more effective in future. (For example: Are evacuees using the official evacuation routes? If there's a tendency to deviate from the official route, is this due to lack of clear signage or because pedestrians gravitate intuitively to some other route or shortcut that might be better than the official route?)
- Evaluators observe and assess the drill within the context of the objectives outlined in the plan so that the particular features that the drill is meant to evaluate are noted.
- Volunteers visually document the drill (photos, visual recording).
- Volunteers at assembly areas gather participants' feedback (for example, by distributing and collecting pencils and feedback forms).

Photo: OSU Hatfield Marine Science Center

Tip:

Recruit volunteers from outside of the hazard zone to help with the drill or provide water or other refreshments at assembly areas. This is one way to involve the wider community in the drill and thus raise awareness more broadly.

End-of-Drill Public Information and Events

The drill can be used as an opportunity for tsunami education and outreach:

- At the assembly areas, station volunteers who are well-trained to answer questions about the drill and the hazard. Provide additional information to those who walked out of the inundation zone: Explain what the next steps would be if the evacuation were real. Stress the importance of staying out of the inundation zone and explain or demonstrate how the official "all clear" will be announced after a real evacuation.
- Provide information about the various sources of tsunami warning and explain the differences between distant-source tsunami events and local-source events.
- Draw attention to the absence of emergency supplies at assembly areas and the need for each person to create a grab-and-go emergency pack for use during a real evacuation. (For example, distribute flyers that list the items that such a pack should contain.)
- Document community response; options include:
    - Providing participants with printed feedback forms and pencils.
    - Setting up an online feedback form or public survey (provide the link on informational brochures and on the drill's website).
    - Hold a post-drill public meeting to invite feedback and answer questions.

Safety Fair

Coordinating a safety fair in conjunction with a community-wide evacuation drill is a good way to raise awareness and promote positive attitudes and actions that will improve preparedness. Most assembly areas at the end of tsunami evacuation routes are not suitable locations for such an event, but you can set up the fair elsewhere, such as at a community center or public park, and promote it at the assembly areas as participants complete the evacuation drill.

Invite local emergency planners and specialist groups — such as the Cascadia Region Earthquake Workgroup (CREW) — to provide resources and information or to set up public information booths that explain the earthquake and tsunami hazard and show how to create personal and business preparedness plans and portable emergency-supply kits (grab-and-go packs) for home, car and business. Booths might also display physical examples of such kits and plans.

Consider inviting local school classes or clubs to display relevant school projects or artwork. Think of the fair not just as a way to inform the community, but also as a way to involve various community members in the project of improving preparedness.

Post-Drill Actions

Hot Wash

After the drill — preferably on the same day — members of the planning team should meet with evaluators and volunteers in order to assess the drill. With the guidance of an experienced facilitator, discuss the following questions and issues:

- What aspects were realistic? What seemed unrealistic?
- What happened versus what could have happened
- What worked well versus problems or potential problems
- How long it actually took for everyone to reach high ground
- The condition and suitability of official evacuation routes (in light of volume, hazards, obstructions, signage, etc.); any physical features that had changed since previous drills
- Feedback from participants and observations of evaluators
- Potential effects of aftershocks on evacuation
- Training that might improve the efficiency and safety of evacuation
- Mitigation that might improve the efficiency and safety of evacuation
- Other suggestions for improving either the drill (as an exercise) or an evacuation
- How well the drill met the objectives specified in the plan
- Suggestions for what a future drill should evaluate

After-Action Report

To develop the after-action report, the planning team should assess the evaluations and feedback that they receive, including input from participants and the results of the "hot wash." Follow FEMA guidance to prepare a draft of the report. Identify in advance who will take up the draft and make final recommendations for follow-up actions and mitigation. (For further guidance, see *Sources for Templates* in the Supplemental Materials section of this guide.)

Evaluation and Planning Meeting

Conduct a review and discussion for emergency response officials, city managers and others who are responsible for deciding how to apply lessons learned from the drill. Participants will:

- Review the draft after-action report (if available) and assessment of feedback of evaluators, participants and organizers.
- Reach agreement concerning both the strengths revealed by the drill, and the areas that require attention and improvement.

Deciding on Recommendations

The assessment of the drill should lead to recommendations for actions or mitigation that will improve the success of evacuation and make the community better prepared and more resilient.

For example, final recommendations may include changing parts of preparedness plans, altering evacuation routes or procedures, making physical changes to enhance the safety and efficiency of evacuation routes, or suggesting additional training or exercises.

The planning team should identify in advance which officials and organizations have the authority and responsibility to adopt and implement recommendations for follow-up actions and mitigation.

- Reach agreement concerning a set of recommendations; identify the entities who have the authority to be responsible for implementing them.
- Discuss next steps, including further development of an improvement plan and finalization of the after-action report.

Post-Evacuation Tabletop Exercise

An evacuation drill can be used as an opportunity to conduct an additional tabletop exercise to explore what happens after an evacuation. That is, once a tsunami evacuation occurs and the evacuees are at the assembly areas, what will happen next? What is the plan?

Applying the planning scenario that you developed for the drill, examine the issues that are likely to arise once the evacuation has occurred and develop (or evaluate) post-evacuation plans.

Communications Follow-up

Share highlights, lessons and images of the drill with the community.

Encourage organizations and businesses to evaluate their own performance and update their own disaster preparedness plans after the drill; when relevant, provide recommendations based on the planning team's official evaluation of the drill.

Supplemental Materials

In addition to the following agencies, organizations, publications and online resources, check out the websites of your local emergency management and response offices. (Because links to webpages may change, titles and search terms are listed below instead.)

Tsunami Info Online

Oregon Tsunami Clearinghouse resource library

National Weather Service: Tsunami Safety

National Oceanic and Atmospheric Administration: Tsunami

Oregon Office of Emergency Management: Hazards and Preparedness: Tsunami

U.S. Department of Homeland Security's *Tsunami Ready* webpage

Tsunami WalkOut at The TsunamiZone

The Great Oregon ShakeOut

International Tsunami Information Center

Tsunami-Related Publications

Tsunami evacuation brochures and maps for the Oregon coast (Oregon Department of Geology and Mineral Industries)

Tsunami inundation map (TIM) series for the Oregon coast (Oregon Department of Geology and Mineral Industries)

Oregon Coast Hospitality Disaster Planning Guidebook (Oregon Office of Emergency Management)

Preparing for a Cascadia Subduction Zone Tsunami: A Land Use Guide for Oregon Coastal Communities (Oregon Coastal Management Program, Oregon Department of Land Conservation and Development)

The Oregon Resilience Plan: Reducing Risk and Improving Recovery for the Next Cascadia Earthquake and Tsunami (Oregon Seismic Safety Policy Advisory Commission (OSSPAC))

State of Oregon Cascadia Rising 2016 Exercise: Catastrophic Earthquake & Tsunami Scenario, Statewide After-Action Final Report (Oregon Office of Emergency Management)

Cascadia Subduction Zone Earthquakes: A Magnitude 9.0 Earthquake Scenario, Update, 2013 (Cascadia Region Earthquake Workgroup (CREW))

Earthquake and General Hazard-Related Info

Oregon Office of Emergency Management

Oregon Department of Geology and Mineral Industries (DOGAMI)

Oregon Office of Emergency Management: Emergency Management Resources: State Exercise Program

FEMA's hazard mitigation assistance grants

FEMA Community Emergency Response Team Drills and Exercises

NOAA Weather Radio All Hazards

Earthquake Country Alliance

Sources for Brochures, Flyers and Other Public Education Materials

For *Drop, Cover, and Hold On* instruction flyers, preparedness checklists, posters and other materials that you can use or adapt as part of the public education component of your drill, check out the following online resources:

- The Great Oregon ShakeOut: ShakeOut Resources
- The Tsunami Zone (tsunamizone.org): Tsunamizone Resources
- State of Oregon Department of Geology and Mineral Industries (DOGAMI): Oregon Tsunami Clearinghouse

Sources for Templates (Drill Planning and Evaluation)

Exercise-related templates are available through a number of preparedness websites and include designs for both the planning stages of the drill and the after-action report. You can use these templates, or simply refer to them for general guidance. Online sources include:

- FEMA Preparedness Toolkit (HSEEP Policy and Guidance: HSEEP Resources)
- Oregon Emergency Management Resources: State Exercise Program (Forms and Templates)
- New Mexico Department of Homeland Security & Emergency Management: Preparedness: Exercise: New HSEEP

Sample Preparedness Questionnaire

Materials such as this questionnaire can be adapted to suit your needs and distributed as part of your public information campaign. This example is based on a questionnaire that was developed for the hospitality industry (see the *Oregon Coast Hospitality Disaster Planning Guidebook*).

Tsunami Preparedness Questionnaire

1. Is my home/business/facility in the inundation zone for a local tsunami? Yes No
2. Is it in the inundation zone for a tsunami from a distant earthquake? Yes No
3. How long does it take to walk from my home/business/facility to an area outside of the tsunami inundation zone?
4. Where is the closest posted assembly area for tsunami evacuations?
5. If there is no assembly area near me, where is the nearest safe-area?
6. What is the most direct walking evacuation route to the nearest assembly area?
7. Does this route cross any bridges that might not withstand the earthquake? Yes No
8. What is an alternative evacuation route, if the most direct route is blocked or otherwise unusable?
9. Does my home/business/facility have a NOAA weather radio? Yes No
   a. If yes, where is it located and how will it be monitored for announcements?
   b. If no, do I/we have a battery-powered radio? (Where is it located?) Yes No
10. Do I/we have an out-of-area contact in case of emergencies? Yes No
    a. If yes, do I/we have the necessary contact information? Yes No
11. Do I/we have a disaster kit or grab-and-go emergency supply pack? Yes No
    a. If yes, what does it contain?
    b. If yes, where is it located?
    c. If yes, is it easily accessible if my home/business/facility is in the inundation zone? Yes No
    d. If yes, will it be accessible after a major local earthquake? Yes No
12. What agency is responsible for emergency management in my area?
13. What is the contact information for that agency?
14. How do I find out if the "all clear" has been given and the danger of more tsunami waves has ended?

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Appendix: Tsunamis from Distant Sources

The focus of this guidebook is evacuation in the event of a tsunami from a local source (Cascadia); however, carrying out community-wide evacuation drills is also useful preparation for a tsunami from a distant source.

Figure 5. Example of a tsunami evacuation map for a section of the Oregon coast (in this case, the community of Yachats). Orange marks the evacuation zone for a distant tsunami, yellow the evacuation zone for a local Cascadia tsunami, and green the area outside of the hazard zone. (Image: DOGAMI)

Earthquakes around the Pacific

Ocean-crossing tsunami waves from earthquakes along other subduction zones can damage distant coastlines, as a number of historic events have shown. The tsunami from Japan's magnitude 9.0 earthquake in 2011, for instance, seriously damaged the harbor at Crescent City, California. A major quake off the coast of Alaska in 1964 triggered a tsunami that reached the Pacific Northwest coast within a few hours and caused 16 deaths as well as severe damage.

The inundation area for a distant event is less than for a local one, but people may still need to clear beaches and other hazard zones. Oregon's tsunami evacuation maps use color coding to distinguish evacuation zones for distant tsunami events (orange) from local events (yellow).

While coastal residents should be aware of the natural warning signs that indicate the approach of a distant-source tsunami, an evacuation for such an event is more likely to be announced by emergency management officials. Tsunamis from distant sources take hours to reach the Pacific Northwest, and they are carefully measured and monitored to provide advance warning to people living in vulnerable areas.

Tsunami Warning System

For the Pacific, tsunamis are monitored and warnings issued by the NOAA/National Weather Service's West Coast/Alaska Tsunami Warning Center. After a large submarine earthquake, the center will issue and update levels of alert that reflect the potential danger to coastlines. There are four such levels: an information statement, a watch, an advisory, and a warning.

- A warning means that an earthquake has occurred that likely created a tsunami with dangerous coastal flooding and powerful currents. The tsunami is expected to be greater than three feet. A warning signifies the need to prepare for flooding and possibly evacuate inundation zones.
- An advisory means that an earthquake has occurred that likely created a tsunami with strong currents and waves dangerous to those in or very near the water. The tsunami is expected to be between one and three feet. The response may include closing beaches and evacuating marinas, harbors and coastal waterways.

All four alert levels and the actions associated with them are defined and explained on the NOAA/National Weather Service's website (see the webpage headed *Tsunami Message Definitions*). The Oregon Emergency Response System in Salem receives these alerts and disseminates them to county emergency officials via the National Warning System (NAWAS).

Local emergency officials may decide to alert the public using coastal warning sirens and Emergency Alert System (EAS) broadcasts. (Because sirens cannot be heard by all coastal residents at all times, however, they should not be relied upon as the only means of communicating a warning.)

In the event of a tsunami warning, NOAA/National Weather Service will also issue an emergency message to peoples' cell phones using the Wireless Emergency Alerts (WEA) system. Those in the tsunami warning area who have WEA-enabled cell phones will receive a short message telling them of the tsunami danger and advising them to move to high ground or inland. (For more information, see NOAA/National Weather Service's website and the fact sheet *Tsunami Warnings via Wireless Emergency Alerts (WEA)*).

When the danger of the tsunami has passed, local officials will issue an official "all clear" notice. People should continue to monitor their local news sources and stay out of the hazard zone until this notice is given.

To learn more about how to prepare for and respond to tsunamis from distant sources, refer to *Local Planning Guidance on Distant Tsunami Response* (2012) by the Oregon Tsunami Working Group, published by the Oregon Department of Geology and Mineral Industries (DOGAMI).


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