

City of Rockaway Beach, Oregon



Tsunami Evacuation Facilities Improvement Plan (TEFIP)

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City Council DRAFT

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Rockaway Beach Tsunami Evacuation Facilities Improvement Plan (TEFIP)

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List of Acronyms and Abbreviations

BTW Beat the Wave

CERT Community Emergency Response Team

City City of Rockaway Beach

County Tillamook County

CSZ Cascadia Subduction Zone

DLCD Oregon Department of Land Conservation and Development

DOGAMI Oregon Department of Geology and Mineral Industries

FEMA Federal Emergency Management Agency

fps Feet per Second

HMA Hazard Mitigation Assistance

mph miles per hour

NTHMP National Tsunami Hazard Mitigation Program

RV recreational vehicle

TEFIP Tsunami Evacuation Facilities Improvement Plan

TIM Tsunami Inundation Map

1. Introduction

1.1 General Introduction

The City of Rockaway Beach (the City) is vulnerable to the effects of a Cascadia Subduction Zone (CSZ) earthquake and tsunami event. In addition to the potentially catastrophic damage caused by the earthquake event itself, the resultant tsunami could inundate portions of the community, and a risk-based and community-specific approach to evacuation will be critical to saving lives. This Tsunami Evacuation Facilities Improvement Plan (TEFIP) is a comprehensive look at existing and potential evacuation routes and needed improvements for this community, and includes identified facility and infrastructure improvement projects and potential financing strategies. This TEFIP is essential to the implementation of evacuation route development and improvement in conjunction with the land use review and approval process.

The Oregon Department of Geology and Mineral Industries (DOGAMI) has identified and mapped the tsunami inundation hazard along the Oregon coast since 1994. DOGAMI developed a series of Tsunami Inundation Maps (TIMs) in 2013 to assist residents and visitors along the coast to prepare for the next CSZ earthquake and tsunami. The TIMs display five scenarios, labeled as “T-shirt sizes” (i.e., S, M, L, XL, and XXL), showing the impact of a CSZ tsunami that reflects the full range of possible inundation. The geologic record shows that the amount of time that has passed since the last great CSZ earthquake (January 26, 1700) is not a reliable indicator of the size of the next one, so the size ranges are intended to be inclusive of the range of scenarios that a community might expect during a CSZ event.

1.2 Limitations and Constraints

The purpose of this TEFIP is to provide guidance and recommendations for methods so that all areas within the XXL scenario can be effectively evacuated to protect life safety. This local tsunami is generated by a high magnitude earthquake just off the Oregon Coast and, thus, the inundation area is much larger than for a distant tsunami event. In addition, unlike a distant tsunami that can be predicted several hours prior to its arrival (4 or more hours), this local CSZ tsunami can arrive at coastal beaches within 15 to 20 minutes after the earthquake.

For the purposes of this plan, tsunami evacuation means the immediate movement of people from the tsunami inundation zone to high ground or safety following a local CSZ earthquake. Comprehensive disaster planning for a CSZ earthquake and tsunami event requires a phased and scalable approach to planning and coordination; immediate evacuation for the purposes of life safety is only one phase (albeit a very important one). While this TEFIP does not include planning for earthquake shaking damage mitigation or post-event disaster response and recovery, it is important to note that groundshaking will have an immediate impact on the ability to evacuate due to debris on roadways and sidewalks and damage to critical infrastructure. Other entities at the local, state, and federal level continue to prepare for these additional phases.

1.3 Definitions

Horizontal evacuation is the preferred response for tsunami evacuation, which is the movement of people to high ground and/or inland away from tsunami waters. In some locations, high ground may not exist, or tsunamis triggered by a local event may not allow sufficient time for communities to evacuate low-lying areas. Where horizontal evacuation out of the tsunami inundation zone is neither possible nor

practical, a potential solution is **vertical evacuation**¹ into the upper levels of structures designed to resist the effects of an earthquake as well as a tsunami. A **vertical evacuation structure** is a building or earthen mound that has sufficient height to elevate evacuees above the level of tsunami inundation, and is designed and constructed with the strength and resiliency needed to resist the expected earthquake shaking and the loading due to tsunami waves.

This TEFIP identifies and discusses **tsunami evacuation facilities**, which are defined as places, amenities, infrastructure, or equipment that can be used to assist in tsunami evacuation (horizontally or vertically). Tsunami evacuation facilities generally include (but are not limited to) roads, trails, wayfinding elements (signs, kiosks, trail markers), supply caches, assembly areas, bridges, and vertical evacuation structures. Evacuation improvements for a community may also include education and outreach activities.

1.4 Coordination with the Tsunami Hazard Overlay Zone (Article 3.1.40-42)

Rockaway Beach has adopted land use regulations addressing tsunami risk for certain types of new development and substantial improvements. These regulations are implemented through the Tsunami Hazard Overlay Zone, Article 3.1.40-42 of the Rockaway Beach Zoning Ordinance. Except single family dwellings on existing lots and parcels, all new development, substantial improvements and land divisions in the Tsunami Hazard Overlay Zone (everything within the XXL tsunami scenario) are required to incorporate evacuation measures and improvements which are consistent with and conform to this adopted Tsunami Evacuation Facilities Improvement Plan.

For purposes of compliance with this TEFIP and the THOZ, applicants should review the entire plan, particularly the following sections as they relate to the proposed development and related evacuation improvements:

- **Section 3: Evacuation Facility Assessments and Recommendations** – this section is organized into five discrete geographic areas. Review the subsection applicable to the proposed project location for evacuation routes and identified improvement projects.
- **Section 4: Implementation Resources for Evacuation Projects** – this section describes resources related to different types of evacuation improvements. In particular, the *Oregon Tsunami Evacuation Wayfinding Guidance* (Version 05-13-2019) developed by the Oregon Office of Emergency Management and the Department of Geology and Mineral Industries should be reviewed for compliance with evacuation signage standards.
- **Section 5: Education, Outreach, and Training** – this section describes resources related to education, outreach, and training materials and activities for tsunami evacuation. If an applicant is proposing evacuation improvements related to this topic, this section should be consulted for consistency.
- **Appendices 1-5 as needed.**

¹ Applied Technology Council. 2012. *FEMA Guidelines for Design of Structures for Vertical Evacuation from Tsunamis*, Second Edition. Prepared for the Federal Emergency Management Agency, National Oceanic and Atmospheric Administration. FEMA P-646. April 2012.

1.5 Whole Community

Every person who lives in, works in, or visits the City shares responsibility for minimizing tsunami risks and vulnerability. These individual responsibilities include tsunami awareness, knowledge of appropriate protective actions, and preparations for personal and family safety. Knowledgeable residents and visitors who are prepared to take care of themselves and their families, and to assist neighbors in the early phases of a tsunami flooding event can make a significant contribution towards survival and community resiliency.

The development of this TEFIP involved a range of stakeholders, including the public, scientific community, local government, and community-based organizations.

Summary of Community Involvement

Kickoff Open House

The Tsunami Resilience Land Use Strategies project was introduced at a community open house in March 2018. Attendees were able to learn more information about the project and its timeline and could sign up to receive email updates about the project as it progressed.

Project Advisory Committee

The Rockaway Beach Planning Commission acted as the Project Advisory Committee (PAC) throughout this project. The PAC was used to audit current zoning and comprehensive plan language, review tsunami hazard maps and data, and provide input to shape the overall outcome of the project. The PAC worked with the project team to decide on risk reduction strategies appropriate for Rockaway Beach, read, analyze, and provide input on all draft mapping and land use materials, and participate in community outreach activities. All PAC meetings were held during regular Planning Commission meetings and were open to the public.

Emergency Preparedness Committee Workshop

A workshop was held during the regular meeting of the Rockaway Beach Emergency Management Committee in January 2019 to discuss evacuation facility improvements in Rockaway Beach. After a brief presentation, Committee members and meeting attendees participated in a mapping activity and discussion to identify shortcomings in existing evacuation facilities and recommend potential improvements. See Appendix 7 for notes summarizing the discussion at this meeting.

Online Survey

An online survey was developed to assess current tsunami awareness and preparedness in Rockaway Beach, as well as to hear community members' feedback on evacuation facility needs. 109 people completed the survey. See Appendix 6 for full survey results.

Plan Recommendations Open House

The TEFIP recommendations and proposed Tsunami Hazard Overlay Zone were presented to the community at a public Open House in March 2019. The project team gave a brief presentation, after which attendees were able to view detailed information on the recommendations printed on posters displayed around the room. The project team and PAC members were available to answer questions from the public. The posters were displayed in the Rockaway Beach Civic Facility lobby in the weeks after the meeting for public viewing.



TSUNAMI HAZARD OVERLAY ZONE

These limitations apply primarily to uses which present a high potential for life safety risk, or to uses which provide an essential function during and after a disaster event. OHS-AS, which is implemented through the state building code, currently prohibits certain facilities and structures in the tsunami inundation zone as defined by the Oregon Department of Geology and Mineral Industries (DOGAMI). The overlay incorporates these requirements, and also provides a higher margin of safety for some essential facilities.

CITYWIDE RECOMMENDATIONS

These recommendations are not tied to a specific location. Instead, they should be enacted on a city-wide level. Some recommendations are related to City policies and administration, while others make improvements to evacuation facilities and preparedness for the whole community.

LAKE LYTLE + CRESCENT LAKE

Two bridges in this area, on NE 12th and on Highway 101 crossing Crescent Creek, are expected to fail during a Cascadia Subduction Zone earthquake. The loss of these bridges creates the need for significant evacuation speeds to clear the area safely in the event of a tsunami. There are a number of construction projects that can address this issue, including retrofitting or reconstructing the existing bridges, constructing new pedestrian bridges that are seismically sound, or building a vertical evacuation structure.

There are very few existing evacuation route signs in this area.

WAYFINDING PROJECTS

- ▶ Add signage identifying assembly areas at NE 18th Street.
- ▶ Expand Evacuation Route Signage along Highway 101
- ▶ Expand Evacuation Route Signage in neighborhood east of Highway 101
- ▶ Add additional signage at NE Charlotte and NE Lake Boulevard. Signage is currently behind a stop sign and is only visible from the north, and not visible to evacuees as they head uphill.
- ▶ Add signage to indicate vertical safety at high ground areas.

CONSTRUCTION PROJECTS

These projects have been recommended to address the potential bridge failures in this area and associated evacuation difficulties. However, not all need to be completed to completely address this issue. They may either improve or reconstruct existing bridges, or construct a vertical evacuation structure.

- ▶ New pedestrian bridge at Highway 101 Crescent Creek crossing
 - or
 - ▶ Existing bridge retrofit or replacement at Highway 101 Crescent Creek Crossing
- ▶ New pedestrian bridge at NE 12th Avenue
 - or
 - ▶ Existing bridge retrofit or replacement at NE 12th Avenue
- or
- ▶ Vertical evacuation structure at Highway 101 and NE 11th Avenue

Open House March 20, 2019

Left: Participants at the Emergency Management Committee Workshop. Right: Posters from the Plan Recommendations Open House

2. Tsunami Risk and Vulnerability

2.1 Hazard Identification

The hazard being addressed by this TEFIP is a tsunami event that results in the need for community evacuation. A tsunami affecting the City would be the result of an earthquake from one of two categories:

- Local Tsunami: Generated by an earthquake immediately offshore of the Oregon Coast (e.g., a CSZ earthquake) and would result in a tsunami coming onshore within 15 to 25 minutes following the earthquake.
- Distant Tsunami: Generated by a distant earthquake (e.g., large event occurring off a distant coastline, such as Japan) and would result in a tsunami coming onshore 4 hours or more following an earthquake on another subduction zone.

A local earthquake resulting in a tsunami is likely to generate additional hazards that may further hinder an individual's ability to evacuate and may increase the time needed to evacuate. Such examples include:

- Damage to buildings: Severe shaking, especially in areas of poor soils, will damage buildings, making it difficult to evacuate. Homes built before 1974 may not be tied to foundations and can shift off foundations. Unreinforced masonry buildings and under-reinforced concrete buildings will be severely damaged or collapsed. Furnishings and equipment not securely fastened can cause injuries. Mobile homes may be heavily damaged.²
- Damage to infrastructure: Severe shaking and areas of poor soils will result in infrastructure failures. Infrastructure systems that may cause barriers to evacuation are water, wastewater, and stormwater facilities; liquid fuel and natural gas tanks and lines; electrical systems; bridges; and embankments and roads. Shaking damage may result in fallen electrical lines, damaged gas lines, tank and pipeline failures and leaks, and bridge failures, as well as physical interruptions in the surface transportation system due to slope failures and ground failures.
- Landslides: Landslides and ground movement may present added barriers to evacuation resulting in blocked roads, bridges, and walking trails.
- Fires: Fires from damaged electrical lines or propane may result in injuries that hinder an individual's ability to evacuate.
- Liquefaction: Similar to landslides, liquefied soils may result in damaged and unstable roads, bridges, and walking trails that present added barriers to an individual's ability to evacuate, especially those who experience access and functional needs.
- Vehicular accidents and traffic jams: Individuals may attempt to evacuate in personal vehicles en masse and push their vehicles to cover unusual terrain either due to damaged infrastructure or in an attempt to bypass typical infrastructure to save time. This may result in accidents and

² US Department of Housing and Urban Development, Office of Policy Development and Research. Minimizing damage and repair costs to manufactured homes during an earthquake. 1995.
<https://www.huduser.gov/publications/pdf/pdrbrch.pdf>

traffic jams that prevent individuals from reaching higher ground. Vehicular evacuation is not recommended and likely will not be possible following a local earthquake and tsunami event.

2.2 Mapping

Mapping produced by the DOGAMI is the primary source of information for the identification of areas subject to tsunami inundation. DOGAMI produced a number of products depicting tsunami inundation for the City, including the TIMs, Tsunami Evacuation Brochures, and, more recently, the “Beat the Wave” (BTW) maps. Throughout this plan, these products are referenced, and they identify areas within the City that are subject to potential life safety risk and that need to be evacuated during a local CSZ tsunami event.

Studies completed by DOGAMI show the impact of the earthquake that effect tsunami evacuation, including information on building damage and ground disturbance.

Tsunami Inundation Maps

The TIM series depicts the projected tsunami inundation zone from five different magnitude seismic events. These events are categorized as small, medium, large, extra-large, and extra extra-large (S, M, L, XL, XXL) tsunami inundation events. These different modeled events reflect the full range of earthquake and tsunami events experienced in the past and what will be encountered in the future. The amount of time that has passed since the last great Cascadia earthquake (January 26, 1700) is not a reliable indicator of the size of the next one, so the size ranges are intended to fully bracket what might happen next.

See <http://www.oregongeology.org/tsuclearinghouse/pubs-inumaps.htm> for more information.

Tsunami Evacuation Brochures

The Tsunami Evacuation Brochures are public products designed to direct visitors and residents away from low-lying areas in the event of a tsunami. They depict three color zones: orange for the largest expected distant tsunami, yellow for the largest expected local tsunami, and green for safety (or high ground).

See <http://nvs.nanoos.org/TsunamiEvac> and www.oregontsunami.org for more information.

Beat the Wave Maps

DOGAMI has also recently completed (in 2017) the BTW tsunami evacuation modeling for the City, which provides additional detail on estimated evacuation clearance times and evacuation needs. The results of this mapping have been used in this plan to identify evacuation deficiencies, as well as potential evacuation improvements. These maps will be discussed in greater detail in Section 3.

The focus of this TEFIP is primarily an XXL tsunami event

See Appendix 3 and DOGAMI's [Tsunami Evacuation Analysis of Rockaway Beach, Oregon](#), for more information.

Earthquake Damage Maps

Studies completed by DOGAMI provide detailed risk assessments for natural hazards affecting Tillamook County (the County), including a CSZ earthquake and tsunami. Results include estimates of building damage and loss as well as population impacts (i.e., displacement of permanent residents) due to earthquake shaking, earthquake liquefaction, and tsunami inundation.

See DOGAMI’s Natural Hazard Risk Report for Tillamook County, Oregon, for more information.

2.3 Populations at Risk

The purpose of this section is to determine the overall numbers of people and identify, to the extent possible, access and functional needs populations that are within the tsunami inundation zone areas. The goal is to estimate how many people will need to be evacuated, and to identify the characteristics and locations of populations that may have specific additional needs or requirements for evacuation.

Overall, the City has high vulnerability to tsunami risk. All of the City’s critical facilities are located within the inundation zone. Most areas of the City can be evacuated to high ground at a walk (4-6 feet per second) or slower. However, the likely failure of bridges on Highway 101 at Spring Creek and NE 12th Avenue create evacuation difficulties in areas west of Lake Lyle and Crescent Lake, where evacuees will have to maintain a run (8-10 fps) or sprint (10+ fps) to reach high ground safely³.

Critical/Essential Facilities

Critical Facilities, or facilities that present a high life safety risk or are necessary for response and recovery post-disaster, are considered to be at risk if they are located within the potential inundation zone. All of the critical facilities identified within Rockaway Beach are within the XXL inundation zone.

Table 1 – Critical Facilities in the XXL Tsunami Inundation Zone

Category	Locations	Within Inundation Zone?
Public Facilities and Infrastructure	Neah-Kah-Nie School District & Preschool	Yes
	Neah-Kah-Nie Middle School & High School	Yes
	City Hall	Yes
	Public Works	Yes
	Rockaway Beach Fire Department	Yes
	Rockaway Beach Police Department	Yes
	Rockaway Beach Water Treatment Plant	Yes

Demographics

According to the US Census, 1,308 people lived in the City of Rockaway Beach in 2017⁴. There is expected to be a slight increase in the average annual growth rates (.8%) for the City through 2035⁵.

The following demographic characteristics of Rockaway Beach may have implications for tsunami evacuation improvements in the community.⁶

³ Gabel, Laura L.S. and Jonathan C. Allan. *Local Tsunami Evacuation Analysis of Rockaway Beach, Tillamook County, Oregon*. State of Oregon, Oregon Department of Geology and Mineral Industries. Open-File Report O-17-06. https://www.oregongeology.org/pubs/ofr/O-17-06/O-17-06_report.pdf

⁴ US Census Bureau. American Community Survey 2013-2017 (5-year estimates). Rockaway Beach city, Oregon.

⁵ Portland State University, College of Urban & Public Affairs: Population Research Center. 2017. *Coordinated Population Forecast 2017 through 2067, Tillamook County*. https://www.pdx.edu/prc/sites/www.pdx.edu/prc/files/Tillamook_Report_2017_Final.pdf

⁶ US Census Bureau. American Community Survey 2013-2017 (5-year estimates). Rockaway Beach city, Oregon.

Mobility Challenges

Certain members of the community, including young children, older adults, and people with disabilities, may have difficulty reaching or maintaining the speeds required for tsunami evacuation, and may have a harder time navigating steep or unimproved roads and trails.

- Percent 65+: 35% of permanent residents in the XXL inundation area (Statewide: 17.3%)
- Percent 5 and under: 2.6% (Statewide: 5.8%)
- Persons with a self-reported disability: 24.3% (Statewide: 14.4%)

Economic Indicators

Renters, people experiencing poverty, and those who are unemployed may face difficulties in ensuring their preparedness. It may be financially out of reach for people with lower incomes to purchase and maintain the recommended two-week supply of food and water for use post-disaster. Additionally, renters may be left out of outreach and education that is targeted towards homeowners or property owners with regard to preparedness and evacuation plans.

- Poverty rate: 24.2% (State 16.2%)
- Unemployment rate: 6.9% (State 4.2%)
- Rate of homeownership: 61.7% (State 61.7%)

English Proficiency

Evacuation information and signage may not be easy to understand for people who speak a language other than English, or do not speak English very well.

- Percent speaking English less than very well: 0.1% (State 6.1%)

Note – Demographic analysis only includes the population within Rockaway Beach City limits. Census data only includes people who indicate that their primary residence is in Rockaway Beach, therefore this analysis does not reflect second home owners, vacationers, part-time residents, etc.

Population Estimates

Tsunami evacuation is of greatest concern to populations residing or working within the inundation zone. Much of the population of Rockaway Beach lives within the hazard area, with 1,004 permanent residents within the urban growth boundary living within the XXL inundation zone.⁷

Access and Functional Needs Populations

Access and functional needs populations (also referred to as vulnerable populations and special needs populations) are members of the community who experience physical, mental, or medical care needs and who may require assistance before, during, and after an emergency incident after exhausting their usual resources and support network. In the case of evacuations, examples of individuals who have access and functional needs that may make evacuation challenging include, but are not limited to:

- Individuals who experience mobility challenges (e.g., those with physical disabilities, older adults, children)

⁷ DOGAMI

- Individuals who are blind or have low vision
- Individuals with limited-English proficiency
- Individuals who are deaf or hard of hearing
- Individuals who have been injured during the earthquake

Tsunami evacuation requires the ability to move from the inundation zone to high ground (or safety) in a timely matter. Due to this short onset time, individuals who experience access and functional needs may lack the resources to travel such distances. The vast majority of access and functional needs facilities in Rockaway Beach are located within the inundation zone. However, the location of these facilities can only serve as a proxy for the presence of access and functional needs populations. It is highly probable that access and functional needs populations live and work within the inundation zone.

Using Key Locations as a Proxy

Specific information about where or how many access and functional needs individuals would need assistance in an evacuation is not available; however, by identifying key locations that can be used as a proxy for access and functional needs populations, we can extrapolate where those individuals may be in a CSZ event (see Table 2).

Table 2 – Access and Functional Needs Populations Locations within the XXL Tsunami Hazard Zone

Category	Proxy For	No. of Facilities in XXL Zone
Schools, Youth Organizations, and Childcare Facilities	Children	3
Hospitals and Medical Centers	Medically-fragile individuals	0
Senior Facilities	Elderly	0
Impoverished/Homelessness Facilities	Individuals who experience poverty or homelessness	0
Hotels, Second Homes, and Vacation Lodging	Out of area visitors and tourists	4 motels with 134 rooms, 1,312 seasonal households* (vacation rentals or second homes)
Damaged Buildings (projected)	Individuals injured during the earthquake	616

*According to DOGAMI estimates

Housing

According to the US Census Bureau 66.5% of the occupied housing stock in Rockaway Beach was built pre-1990, before seismic standards were put into place.⁸ This could have implications both for difficulty of evacuation in damaged structures within the inundation zone, and for sheltering needs after a CSZ earthquake and tsunami event. More people could be displaced following an event beyond those in the tsunami inundation zone due to extensive earthquake damage in the communities.

The relatively large number of manufactured homes in Rockaway Beach could also present evacuation difficulties, as these homes are more likely to sustain damage in an earthquake. Approximately 28% of Rockaway Beach permanent residents live in manufactured homes.

⁸ US Census Bureau. American Community Survey 2013-2017 (5-year estimates). Rockaway Beach city, Oregon.

Another challenge for successful evacuation in Rockaway Beach is the large number of second homes, vacation homes, and short-term rentals in the community. According to DOGAMI estimates, there are 134 motel rooms, and as many as 1,312 “seasonal” households in the Rockaway Beach urban growth boundary. It is estimated that the total resident and visitor population of the city could be as high as 5,000 people, and possibly as many as 10,000 on weekends, holidays, and during summer months. A large percent of the population of the city at any given time is made up of people who are not residents and may be unfamiliar with tsunami risks and evacuation procedures.

Community Sheltering

There are no facilities appropriate for community sheltering located outside the XXL zone in Rockaway Beach. While Neah-Kah-Nie school has been identified as a community shelter for use in other emergencies, it is not expected to withstand a tsunami and should not be used as shelter in the event of a Cascadia Subduction Zone event.

Permanent and temporary residents who successfully evacuate out of the tsunami zone will very likely require short- to medium-term shelter, given that their residences are presumed destroyed or rendered uninhabitable. Temporary residents will likely not be able to return to their permanent homes for at least several weeks, given the anticipated disruption to the regional transportation network and fuel supply and that their personal vehicles were likely destroyed or damaged in the tsunami. During a summer weekend, the displaced population in Rockaway Beach could be as high as 10,000 people. (This number is limited to those in the XXL tsunami zone and does not include those displaced just from the earthquake damage, or those outside of the UGB who may need sheltering, too.)

2.4 Conclusions

Vulnerability related to loss of life to a tsunami in Rockaway Beach is high. Much of the city is within the hazard area, though most of those that occupy the zone will likely have enough time to reach high ground before the first tsunami wave. Relatively high populations of older adults and people with disabilities could face challenges moving out of the hazard area in time.

Additionally, vulnerability to critical facilities is high, as all of Rockaway Beach’s critical facilities are located within the hazard zone. This puts vulnerable populations, such as students, at higher risk, and creates difficulties for first responders post-disaster.

The City experiences high numbers of visitors and tourists, who are unfamiliar with the landscape and tsunami hazards and may need additional assistance in evacuating effectively. Successful evacuations will be challenging because visitors and tourists need to understand the threat, recognize signs of imminent waves, and take self-protective action. Evacuees will also need to overcome sudden obstacles that arise as a result of the earthquake (e.g., fallen trees or buildings, liquefaction, landslides).

3. Evacuation Facility Assessments and Recommendations

The process of evaluating existing evacuation facilities and identifying prioritized improvement recommendations involved three phases:

1. **Existing facility assessments:** The project team engaged in discussions with the PAC, Emergency Management Committee, and City staff to discuss existing evacuation facilities and potential improvements. In addition, the project team surveyed the area through multiple site visits to assess the condition of existing facilities and identify the locations of existing signage throughout the project area.
2. **Identification of needed improvements:** The site visits also served to assess gaps in existing facilities to determine locations requiring improvements. This task led to an initial list of potential projects that underwent comparison and scrutiny to existing studies, including DOGAMI's BTW modeling, to ensure project need and feasibility. The project team discussed these findings with the PAC and City staff.
3. **Prioritization of needed improvements:** Following the identification of needed improvements, the planning team reviewed the list of proposed projects and prioritized them (high, medium, low) based upon the project's perceived effectiveness and feasibility (measured by capacity, administrative control, and political considerations). This resulted in the prioritized project alternatives identified in the rest of this section.

Considering Co-Benefits

The most cost-effective and successful projects generate benefits outside of their intended purpose. For example, a tsunami evacuation route sign provides lifesaving guidance following an earthquake, but it also increases overall hazard awareness and personal preparedness. Sections 3.1 to 3.6 below highlight recommended evacuation improvement projects throughout the City. In addition, the recommendations also identify co-benefits created through the implementation of each project, which may support the identification of additional partners and funding opportunities. The co-benefits identified in this plan are as follows:

- Hazard Awareness and Education
- Personal Preparedness
- Health and Wellness
- Transportation Effectiveness
- Asset Protection
- Economic Development
- Environmental Protection

More information on potential project partners, potential funding sources, estimated costs, and project beneficiaries for each proposed improvement can be found in the Implementation Matrix, Appendix 1.

For maps of recommended project locations, see Appendix 2.

Figure 1 - Types of Tsunami Evacuation Wayfinding and Signage

The recommendations within the plan reference the following types of signs and wayfinding for use in the Rockaway Beach Tsunami Evacuation Facilities network:

Clockwise from top left: 1. Evacuation Route Arrow, 2. You Are Here map, 3. Assembly Area sign, 4. Blue Line, 5. High Ground Safety Area sign, 6. Entering/Leaving Hazard Zone sign



3.1 Citywide Recommendations

There are a number of steps that the City of Rockaway Beach should take in order to increase tsunami resilience in the community, beyond location-specific recommendations for wayfinding and construction projects. These citywide recommendations fall into two categories: those that deal with City administration and policies, and those that deal with increasing the effectiveness of the entire network of tsunami evacuation facilities in the community.

Administration and Policy Recommendations

- RB1. **Adopt recommended Comprehensive Plan policies.** DLCDC has created a set of model Comprehensive Plan policies that support increasing resilience through goals related to hazard planning, transportation, and urbanization. The project team has customized these model policies to meet the needs of the Rockaway Beach community. These policies should be incorporated into the Comprehensive Plan upon its next update. For the full text of the policies, see Appendix 4. **Priority - High**
- RB2. **Identify staff member to lead implementation.** Implementation of the recommendations within this plan will be a years-long process, requiring coordination between the City and many other stakeholders and organizations. Identifying a staff member who can lead this effort will help the city improve evacuation facilities in an efficient and timely manner. **Priority - High**
- RB3. **Increase interdepartmental coordination.** Maintain and improve communication between the City Manager, Planning Department, Public Works, and Emergency Management leaders to increase efficiency and effectiveness of resilience efforts. **Priority - High**
- RB4. **Integrate evacuation facilities improvements with ongoing planning efforts.** Tsunami resilience and evacuation facilities improvements should be incorporated into other ongoing planning efforts, as appropriate. Such ongoing projects may include the Salmonberry Trail, Safe Routes to School, Local Improvement Districts, etc. **Priority - High**
- RB5. **Explore hiring a City Emergency Manager.** A dedicated Emergency Manager on staff would aid in implementation the TEFIP, as well as lead other emergency preparedness efforts in the community. **Priority - Medium**

Evacuation Facilities and Preparedness

- RB6. **Establish supply caches and emergency shelters in strategic areas outside of the inundation zone.** The availability of supplies and shelter will be absolutely essential to survival post-disaster. Determining the best locations for supply caches and amount and types of supplies and shelter to provide will require further study. However, the following recommendations can be used as a starting point when considering where and how to establish these resources:
- The City should ask the following questions when determining the suitability of a potential site for a supply cache:
 - Who owns the land?
 - Is there good access to the site for establishing and maintaining supplies?
 - Is the site susceptible to other hazards, such as landslides?
 - How will the caches be maintained, monitored and secured?
 - Will the City purchase and maintain supplies, or will residents?
 - Consider a phased approach – create one cache in each sub area to start, then expand to all appropriate sites as resources and funding allow

- Maintain already established supplies at Scenic View, McMillan Creek, and N 3rd Street. *Note – the supply cache on N 3rd is located within the inundation zone, and should be relocated to outside of the hazard area when a suitable location is determined.*
- Coordinate with DLCD and DOGAMI as they continue to research supply cache best practices

Priority - High

RB7. **Continue to pursue acquisition of land for relocation of critical facilities.** All of the critical facilities in Rockaway Beach are currently within the inundation zone. The City has been in discussions with a major landowner outside of the inundation area to purchase land for the relocation of some of these facilities. The City should continue to pursue this effort and should work closely with DLCD to ensure that a UGB expansion is acquired for the development of these new facilities. ***Priority - High***

RB8. **Create trail connectivity between high ground and assembly areas.** Post-disaster movement may be difficult in the inundation zone, due to damage and debris. A series of trails above the inundation zone could help evacuees move more easily from high ground safety areas to assembly areas. ***Priority - Medium***

RB9. **Map logging roads that may be used for evacuation/movement post-disaster.** A network of logging roads already exists in the hills east of the city. Some of these roads lead out of the city and could potentially connect assembly areas for movement of people and supplies post-tsunami. A publicly available map of these roads would help evacuees and first responders know the most efficient route to provide evacuation and assistance. This data may be obtainable through the timber companies or the Oregon Department of Forestry. ***Priority - Medium***

3.2 Nedonna Beach & North Rockaway Beach

Community Overview

This area is defined as the northern boundaries of Rockaway Beach city limits and Urban Growth Boundary (UGB) limits, south to NE Lake Boulevard. Residential uses in this area are primarily located within the Nedonna Beach neighborhood, although there are homes located east of Highway 101. The Manhattan Beach State Recreation Site is located just south of Nedonna Beach. Approximately 90,000 people visit the recreation site every year, according to Oregon State Parks. Neah-Kah-Nie Middle School and High School is also located in this area and is within the XXL inundation zone.

While Nedonna Beach is outside the city limits, it is within the Rockaway Beach UGB, and the city provides water service and administers its zoning ordinance in the neighborhood. Nedonna Beach residents have been active in creating tsunami evacuation facilities for their community, including extensive evacuation route signage, evacuation trails, and supply caches at nearby Assembly Areas.

Existing Evacuation Facilities Analysis

Tsunami Wave Arrival Time

In the XXL scenario, waves will begin to arrive at the beach approximately 16-18 minutes after the earthquake begins. The wave crosses the area fairly uniformly from west to east, arriving somewhat sooner on the banks of the Nehalem River to the north. The area is inundated within 26-28 minutes after the earthquake begins.

Existing Evacuation Routes and Signage

Evacuation routes in the area direct evacuees east out of the Nedonna Beach neighborhood along Beach Street to Highway 101, along Riley Street and a trail to Highway 101, and along Section Line Street and up a trail to Highway 101. Neighborhood residents built and maintain the staircases and trails on Riley Street and Section Line Street. From Highway 101, evacuees are directed east up Scenic View Drive and east to the McMillan Creek Reservoir. There are designated assembly areas at both of these locations. The entrance to the McMillan Creek reservoir area is blocked by a locked gate, though pedestrian access is possible. Neah-Kah-Nie Middle and High School have a trail that leads to high ground and an assembly area from their parking lot.

Tsunami Evacuation Route Arrow

- Highway 101 and Scenic View Drive
- Highway 101 across from trail to McMillan Creek Reservoir
- Beach Street and Morgan Street
- Beach Drive and Park Street
- Nedonna Avenue and Park Street
- Geneva Avenue and Park Street
- David Avenue and Park Street

Other Evacuation Route Signs (these signs provide direction to evacuation routes, but are not consistent with design standards recommended by the State Office of Emergency Management)

- Section Line Street and Beach Drive
- Section Line Street and Nedonna Avenue

- Section Line Street and Geneva Avenue
- Section Line Street and Kittiwake Drive
- Nedonna Avenue and Riley Street
- Nedonna Avenue and Western Street
- Nedonna Avenue and Sunset Street
- Geneva Avenue and Riley Street
- David Avenue and Riley Street
- David Avenue and Western Street
- Chieftain Drive and Riley Street

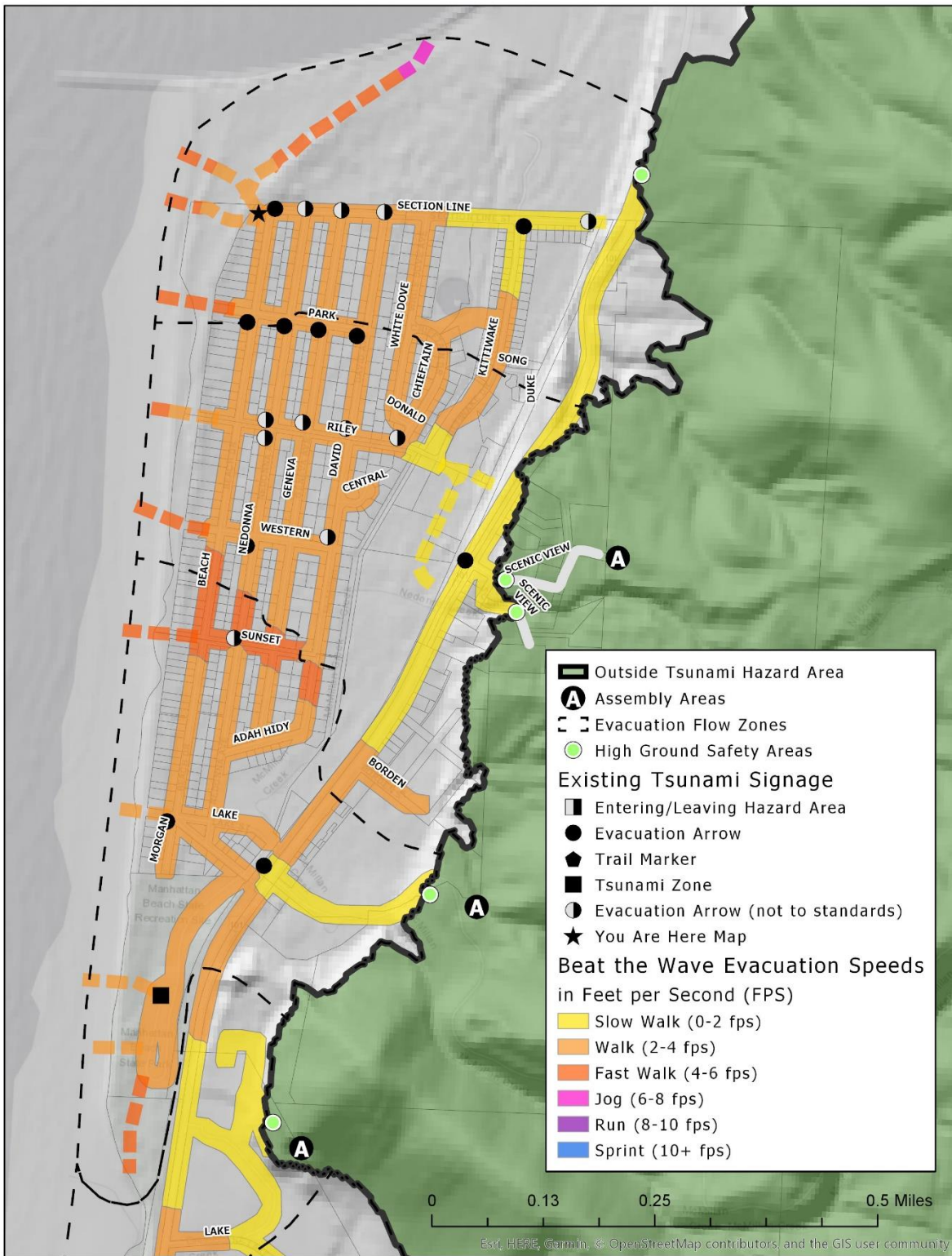
Tsunami Hazard Zone Sign

- Manhattan Beach State Park beach access trailhead

“You Are Here” Tsunami Evacuation Route Map and Information

- Nedonna Beach beach access trailhead at Section Line Street (Note – the evacuation route indicated on this map leads to the Scenic View Reservoir Assembly Area, which is *not* the nearest high ground location. The nearest high ground is located east of Section Line Street.)

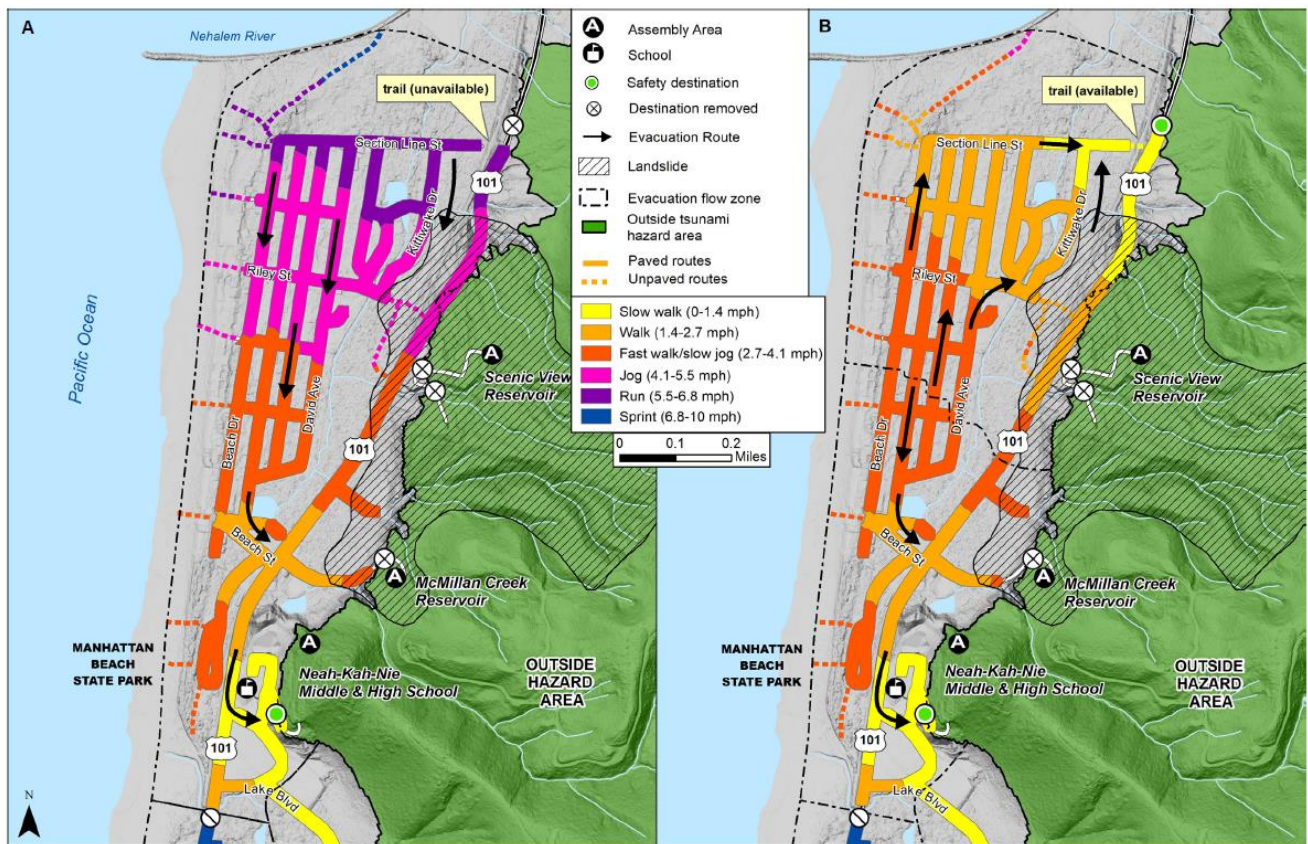
Figure 2 – Required Evacuation Speeds and Existing Tsunami Evacuation Facilities in Nedonna Beach & North Rockaway Beach



Evacuation Speeds

Walking speeds required to reach safety in the area range from a slow walk (0-2 FPS) to a jog (6-8 FPS) from the beach area near the jetty, assuming no loss of evacuation facilities during the earthquake. However, the areas east of Highway 101 have been identified to be at risk of landslides, potentially removing the evacuation areas at Scenic View Reservoir and McMillan Creek Reservoir. The loss of these areas increases required evacuation speed from a walk (2-4 FPS) to a fast walk (4-6 FPS) for much of the area. Failure of the staircase and trail at the east end of Section Line Street in addition to landslides increases required speeds even more, with the northernmost areas of Nedonna Beach required to maintain a jog or run (8-10 FPS) to evacuate safely. Figure 3 identifies required clearance times for both of these scenarios.

Figure 3 – Beat the Wave landslide scenarios in Nedonna Beach with A. Failure of the Section Line trail and B. Section Line trail intact



Source: DOGAMI Beat the Wave Report

Critical Facilities

This area has one critical facility within the XXL inundation area, Neah-Kah-Nie Middle School and High School.

Conclusions

While the Nedonna Beach neighborhood is completely within the inundation area and faces a high tsunami risk, the efforts of residents has created a comprehensive system of evacuation facilities in the neighborhood. These efforts can be expanded on and improved by installing signage that is consistent

with recommended design standards and hardening of evacuation trails on the east side of the neighborhood. Outside of the neighborhood, there are few evacuation signs.

The risk of landslides in the hills east of Highway 101 is troublesome for the area, as the loss of these high ground and assembly areas could lead to significantly increased minimum evacuation speeds for area residents. At-risk populations in this area include large numbers of visitors to the beach access points at Nedonna Beach and Manhattan Beach, as well as students at Neah-Kah-Nie Middle School & High School.

Evacuation Improvement Projects

Wayfinding

NB1. Add signage identifying assembly areas at Scenic View Reservoir, McMillan Creek Reservoir, and the Neah-Kah-Nie Middle & High School Assembly Areas. These areas do not currently have any signage indicating when you have arrived, which may cause confusion among evacuees. **Priority – High**

NB2. Add evacuation arrow signage directing evacuees up trail towards McMillan Creek Reservoir. There is currently no signage at the trail entrance directing towards high ground or the assembly area, potentially causing confusion for evacuees. Adding signage here would ensure that evacuees would know to head past the gate and up the trail to safety. **Priority – High**

NB3. Add evacuation arrow signage at Neah-Kah-Nie School directing towards evacuation trail in parking lot and at Highway 101 entrance. There is no signage currently directing towards the high ground and assembly area located east of the school parking lot. While students are familiar with the evacuation trail, visitors to the area who may be closest to this evacuation point need direction towards safety during an evacuation, both from the highway as well as when they reach school grounds. **Priority – High**

NB4. Add entering/leaving tsunami hazard area sign on Highway 101 at edge of hazard area when entering town from the north. There is currently no indication that you are entering or leaving a tsunami hazard area when traveling on Highway 101 north of Rockaway Beach. Adding this signage would help increase awareness of the hazard for residents and visitors in the city. **Priority – High**

NB5. Expand Evacuation Route Signage in Nedonna Beach neighborhood. While the neighborhood is already fairly well-signed, the addition of signage at key intersections will help create a more comprehensive wayfinding network in the area. Due to the number of signs required, this work may need to be accomplished in several phases. Some areas, such as Manhattan Beach State Recreation Site and the east Nedonna Beach evacuation trails, are lacking signage altogether. These areas should be given a higher priority during implementation. Add signs at the following intersections:

High priority:

- Add signage directing towards Riley Street evacuation trail
- Add signage at ends of trails on Section Line Street and Riley Street directing towards nearest high ground

- Add signage to Manhattan Beach State Park access road directing out of park towards Highway 101

Medium priority:

- Riley Street and Kittiwake Drive
- Riley Street and Beach Drive
- Nedonna Avenue and Adah Hidey Street
- Nedonna Avenue and Beach Street
- Sunset Street and Geneva Avenue
- Sunset Street and David Avenue
- Sunset Street and Beach Drive
- Beach Street and Railroad Street

NB6. Add “You Are Here” sign at Manhattan Beach State Recreation Site and replace “You Are Here” sign at Nedonna Beach access lot. New Nedonna Beach map should illustrate route for fastest evacuation to high ground east of Section Line Street, rather than Scenic View Assembly Area.

Priority – Medium

NB7. Install new signs in Nedonna Beach neighborhood that are consistent with state design standards. Much of the existing signage in the Nedonna Beach neighborhood is not consistent with state recommended design standards, or signage found in the rest of the community.⁹ These design standards are intended to maximize readability and visibility of signage in all light and weather conditions. Creating a network of consistent signage will also help increase recognition of evacuation routes for people throughout the community. However, because Nedonna already has a good network of signage, updating these signs should be prioritized after new signs can be installed in areas that do not currently have adequate signage. Due to the number of signs required, this work may need to be accomplished in several phases. New signs should be installed at the following locations:

- Section Line Street and Beach Drive
- Section Line Street and Nedonna Avenue
- Section Line Street and Geneva Avenue
- Section Line Street and Kittiwake Drive
- Nedonna Avenue and Riley Street (Sign at Riley Street and Nedonna should point east towards evacuation trail at top of Riley, rather than south)
- Nedonna Avenue and Western Street
- Nedonna Avenue and Sunset Street
- Geneva Avenue and Riley Street
- David Avenue and Riley Street
- David Avenue and Western Street

⁹ Oregon Office of Emergency Management, Department of Geology and Mineral Industries. *Oregon Tsunami Evacuation Wayfinding Guidance*. May 13, 2019. https://www.oregon.gov/oem/Documents/Tsunami_Evacuation_Signage_and_Wayfinding_Guidance.pdf

- Chieftain Drive and Riley Street

Priority – Medium-Low

Construction

NB8. Landslide mitigation measures East of Highway 101 and Nedonna Beach. DOGAMI has determined that there is a risk of landslides in the hills east of Highway 101 in the event of a CSZ earthquake. Landslides in this area could potentially block access to high ground safety areas and assembly areas that area evacuees rely on, increasing the minimum evacuation speeds required to reach safety ahead of a tsunami. Reinforcing vulnerable slopes could help ensure that evacuees in this area are able to reach safety in a timely manner. **Priority – High**

NB9. Improvements to trails on Section Line Street and Riley Street to increase seismic resilience. Neighborhood residents built and maintain the evacuation trails and staircases at the top of Section Line Street and Riley Street. While the seismic resilience of these facilities is unknown, it is likely that they would not be passable after the shaking of a CSZ earthquake. Hardening these trails to survive the earthquake would help preserve important evacuation routes for the community. **Priority – Medium**

3.3 Lake Lytle and Crescent Lake

Community Overview

This area consists of the communities surrounding Lake Lytle and Crescent Lake, between NE Lake Boulevard and North 6th Avenue. There is a residential subdivision east of the lakes, with new housing currently under construction and more expected to be built in the future. The areas west of the lake are primarily residential, with some commercial uses along Highway 101. Surfside Resort, the largest motel in the city, is located within this area.

Existing Evacuation Facilities Analysis

Tsunami Wave Arrival Time

In the XXL scenario, waves will begin to arrive at the beach approximately 16-18 minutes after the earthquake begins. The wave crosses the area fairly uniformly from west to east, arriving somewhat sooner in the Crescent Creek area. The area is inundated within 28-30 minutes after the earthquake begins.

Existing Evacuation Routes and Signage

The two lakes create a geographic barrier for those who may be seeking high ground from the west, as the only bridge crossing the water at NE 12th Avenue, is expected to fail during a CSZ earthquake. Evacuation to the north will also likely be impeded by the failure of the Highway 101 bridge over Crescent Creek. For this reason, evacuees will need to travel south to N 6th Avenue to be able to move to high ground.

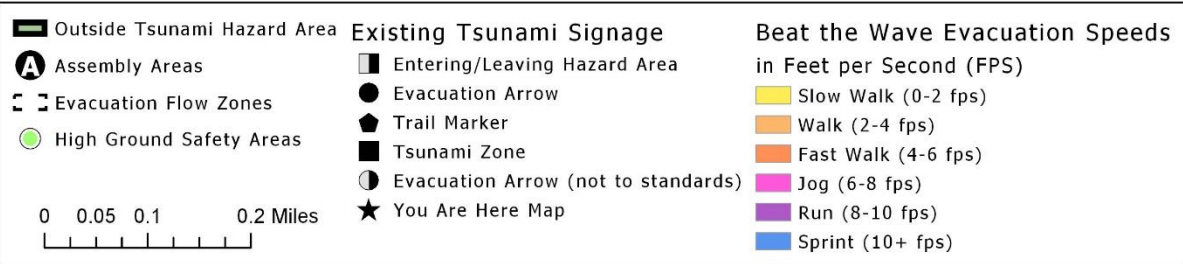
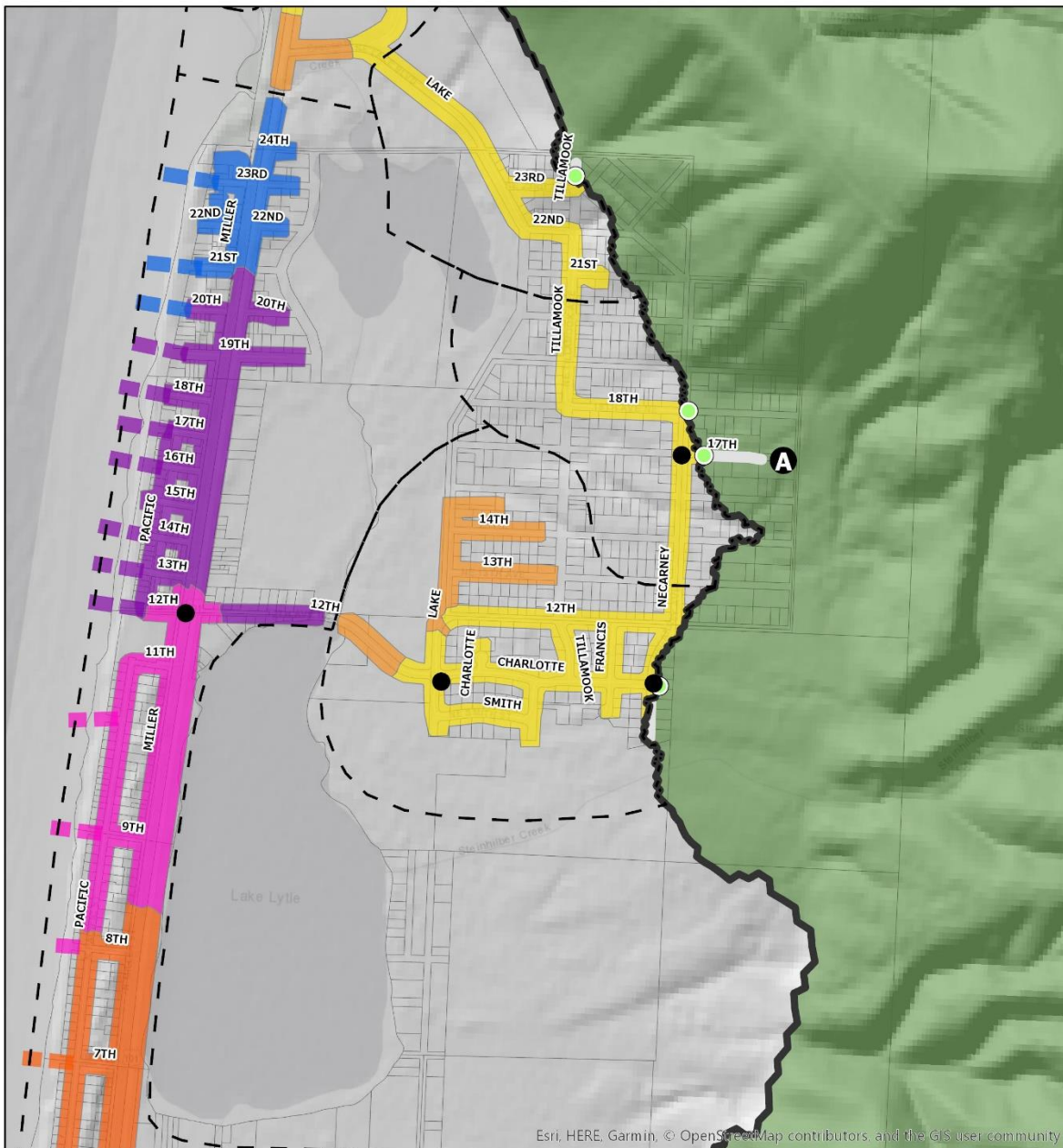
Existing evacuation facilities direct evacuees east on NE 12th Avenue, up Charlotte Street, and west on Nectarney Avenue towards an assembly area on NE 15th Street. There are high ground safety destinations at the following approximate locations:

- Top of NE Charlotte Street
- Top of NE 23rd Avenue
- Top of NE 17th Avenue
- Top of NE 15th Street

Tsunami Evacuation Route Arrow

- NE 12th Avenue and Highway 101
- NE Lake Boulevard and NE Charlotte Street
- NE Charlotte Street and Nectarney Avenue
- NE 15th Street and Nectarney Avenue

Figure 4 – Required Evacuation Speeds and Existing Tsunami Evacuation Facilities in Lake Lytle and Crescent Lake



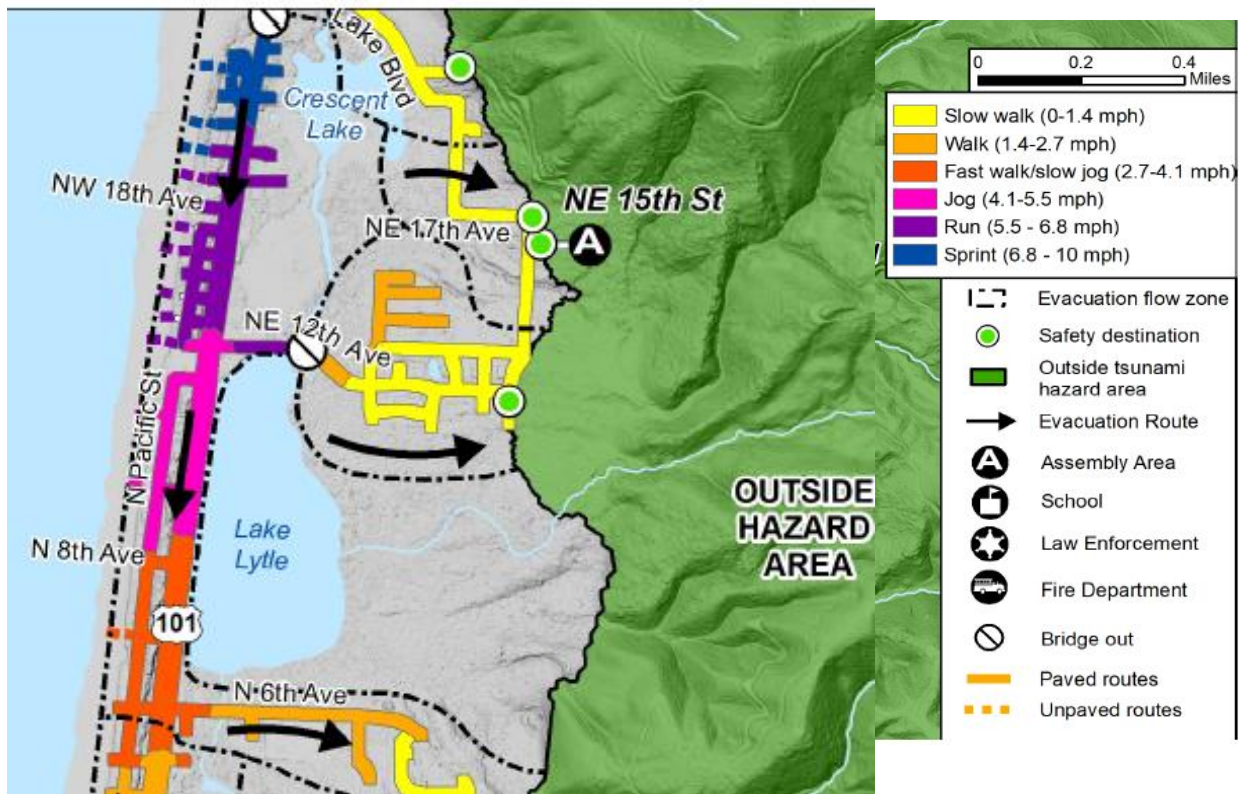
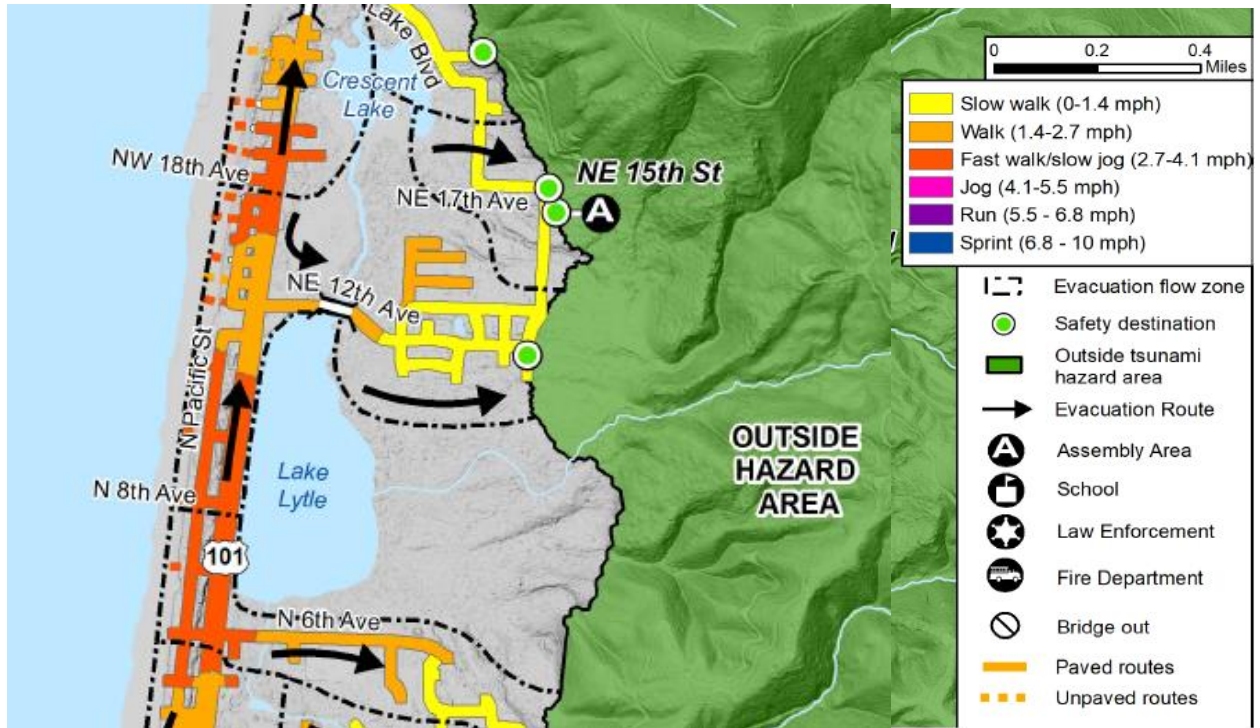
Evacuation Speeds

Required evacuation speeds vary across the area and are highly dependent on the structural integrity of the bridges on NE 12th and Highway 101 at Crescent Creek post-earthquake. For this reason, evacuation clearance speeds have been presented for two separate scenarios below. Figure 5 identifies required clearance times for both of these scenarios.

Scenario 1 – Existing Road Network is Operational – Areas east of Highway 101 can mostly be evacuated at a slow walk speed, with some areas requiring a walk speed to evacuate. West of Highway 101, some areas require a fast walking speed (4-6 FPS), while the areas closest to NE 12th Avenue and Lake Boulevard need to maintain a walking speed (2-4 FPS) or less to evacuate successfully.

Scenario 2 – Failure of 12th Avenue and Highway 101 Bridges – Figure 6 illustrates the estimated evacuation clearance times under a situation in which the NE 12th Avenue and Highway 101 bridges fail. This increases necessary evacuation speeds for all areas south and west of the bridges, as evacuees are required to travel south to N 6th Avenue for the nearest evacuation route. Evacuees nearest the route will have to maintain a fast walk, while those further north will have to jog (6-8 FPS), run (8-10 FPS), or sprint (10+ FPS) to reach safety.

Figure 5 – Evacuation Speed Scenarios for 1. Bridges intact, and 2. Bridges out in Lake Lytle/Crescent Lake subarea



Source: DOGAMI Beat the Wave Report

Critical Facilities

There are no critical facilities within the inundation zone in this area.

Conclusions

This area of Rockaway Beach faces the highest vulnerability to a tsunami, due to the likely failure of both bridges on Highway 101 and NE 12th Avenue. Failure of these bridges and loss of these evacuation routes creates the need for a minimum evacuation speed that is difficult for most of the population to achieve. Completing a project or projects in this area to overcome this gap in the City's evacuation facilities should be one of the highest priorities as this plan is implemented. Additionally, this area has very little existing evacuation signage or wayfinding, which may cause confusion for evacuees who need to determine the best way across the lakes and to higher ground.

Evacuation Improvement Projects

Wayfinding

LL1. Add signage identifying assembly area at NE 15th Street. This area does not currently have any signage indicating when you have arrived, which may cause confusion among evacuees.

LL2. Expand Evacuation Route Signage along Highway 101. There is currently very little signage to aid evacuees traveling east from the beach and along Highway 101. Due to the number of signs required, this work may need to be accomplished in several phases. Signs should be added where every east/west route crosses the highway, at the following intersections:

- Highway 101 and Lake Boulevard
- Highway 101 and NW 23rd Avenue
- Highway 101 and NW 21st Avenue
- Highway 101 and NW 19th Avenue
- Highway 101 and NW 13th Avenue
- Highway 101 and NW 11th Avenue
- Highway 101 and NW 9th Avenue
- Highway 101 and N 8th Avenue
- Highway 101 and N 7th Avenue

Priority – High

LL3. Expand Evacuation Route Signage east of Highway 101. There is a need for additional signage in the subdivision east of the lakes. Signs should be added at the following intersections:

- NE 12th Avenue and NE Lake Boulevard
- Lake Boulevard and NE 23rd
- NE Tillamook Avenue and NE 18th Avenue
- NE Charlotte and NE Lake Boulevard. Existing signage is currently behind a stop sign and is only from the north, and not visible to evacuees as they head uphill.

Priority – High

LL4. Add signage to indicate arrival at safety at high ground areas. There is currently no signage that indicates when evacuees have reached a high ground safety area outside of the inundation zone. Signage should be added to the following areas:

- Top of NE Charlotte Street

- Top of NE 23rd Avenue
- Top of NE 17th Avenue
- Top of NE 15th Street

Priority – High

LL5. Add "You Are Here" map signs to major beach access points. "You Are Here" map signs in high-traffic locations can help raise awareness and inform beachgoers of the nearest evacuation routes. These signs should be installed at the following locations:

- Beach access trail at NW 16th Avenue
- Beach access trail at NW 13th Avenue
- Beach access trail at NW 8th Avenue

Priority – Medium

Construction

There are a number of approaches to address the likely failure of the Highway 101 and NE 12th Avenue bridges. Not all of these projects will need to be completed to improve the evacuation difficulties in this area. Rather, they should be considered as alternatives.

LL6. Bridge retrofit or replacement on NE 12th Ave. The DOGAMI Beat the Wave study found that, at a minimum, hardening or replacing the NE 12th Avenue bridge would be the most beneficial to the evacuation network in this area, potentially having a significant impact on reducing the minimum required travel speeds required to evacuate safely.¹⁰ **Priority – High**

LL7. Pedestrian bridge on NE 12th Ave. Constructing a seismically sound pedestrian bridge across the lake at NE 12th is a potential alternative to a retrofit or replacement of the existing bridge. A pedestrian bridge could be more cost effective than a replacement or retrofit and would provide a safe walking path for residents and visitors. **Priority – High**

LL8. Bridge retrofit at Highway 101 Crescent Creek Crossing. While creating a safe crossing point at the NE 12th Avenue bridge would make some improvements to the evacuation route network, it would be most effective if both bridges were to be retrofitted or replaced. Improving Highway 101 over Crescent Creek would create an additional route to safety in the northern section of the area.

Priority – High

LL9. Pedestrian bridge at Highway 101 Crescent Creek crossing. Similar to NE 12th Avenue, a pedestrian bridge may be an alternative to a full bridge retrofit or replacement. This project could potentially tie into the ongoing Salmonberry Trail project, who's Coastal Segment Plan has identified the need for a new crossing at this location.¹¹ This would provide a large benefit not only to evacuation facilities, but also to recreation and tourism in Rockaway Beach. **Priority – High**

¹⁰ Gabel, Laura L.S. and Jonathan C. Allan. *Local Tsunami Evacuation Analysis of Rockaway Beach, Tillamook County, Oregon*. State of Oregon, Oregon Department of Geology and Mineral Industries. Open-File Report O-17-06. https://www.oregongeology.org/pubs/ofr/O-17-06/O-17-06_report.pdf

¹¹ Parametrix. *Salmonberry Trail Coast Segment Planning Study*. Prepared for Oregon Parks and Recreation Department. February 2017.

LL10. Vertical evacuation structure at Highway 101 and NW 11th Avenue. While the Beat the Wave report identified that a vertical evacuation structure at this location would be the most impactful at reducing required evacuation speeds, constructing such a structure is not likely to be feasible. The engineering and design required would come at a very high expense, and its height would likely cause planning issues with regards to viewsheds and community impacts. The City should prioritize bridge improvements over a vertical evacuation structure but may wish to explore this option at some point in the future. **Priority – Low**

3.4 Central Rockaway Beach

Community Overview

Central Rockaway Beach is the area between N 6th Avenue and the Nature Preserve. The city's downtown commercial core is in this area, with a number of restaurants and shops along Highway 101. There are many hotels, motels, and condominiums here, as well as popular attractions and community gathering places such as the Wayside and Phyllis Baker City Park. This area is also home to the City's government center at City Hall, Police and Fire Stations, and the Neah-Kah-Nie School District administrative building and Preschool.

There is a large amount of residential uses in the area east of Highway 101, much of which is within the XXL inundation zone. These are primarily single-family homes, with some multifamily developments, and the Rockaway Beach RV park on SE 4th Avenue and S Beacon Street.

Existing Evacuation Facilities Analysis

Tsunami Wave Arrival Time

In the XXL scenario, waves will begin to arrive at the beach approximately 16-18 minutes after the earthquake begins. The wave crosses the area fairly uniformly from west to east. The area just west and downhill of the Pacific View neighborhood is inundated within 22-26 minutes, and the entire area is inundated within 28-30 minutes after the earthquake begins.

Existing Evacuation Routes and Signage

Existing evacuation facilities direct evacuees east on N 3rd Avenue and S 2nd Avenue. There are assembly areas established at the N 3rd Reservoir, S Rock Creek Road, and S 3rd Avenue. The entrance to the N 3rd reservoir area is blocked by a locked gate, though pedestrian access is possible. There is a risk of potential landslides on the north and west side of the Pacific View neighborhood hill, which could make several high ground areas inaccessible. There are high ground safety destinations at the following approximate locations:

- N Palisades Street south of N 4th Avenue
- N 3rd Avenue and N Ocean Loop
- S Nehalem Avenue and N Ocean Street
- S 2nd Avenue and S Palisades Street
- The southern end of S Grayling Street
- The south end of S Juniper Street
- The south end of S Marine Street
- The south end of S Rock Creek Road
- The south end of S Neptune Street
- The South End of S Quadrant
- South 6th Avenue and S Falcon Street

Tsunami Evacuation Route Arrow

- Highway 101 and N 3rd Avenue
- N 3rd Avenue and N Juniper Street
- Highway 101 and S 2nd Avenue
- S 2nd Avenue and S Marine Street

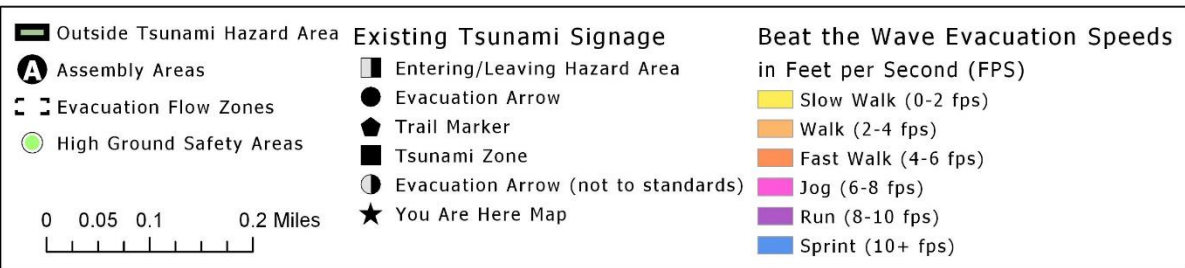
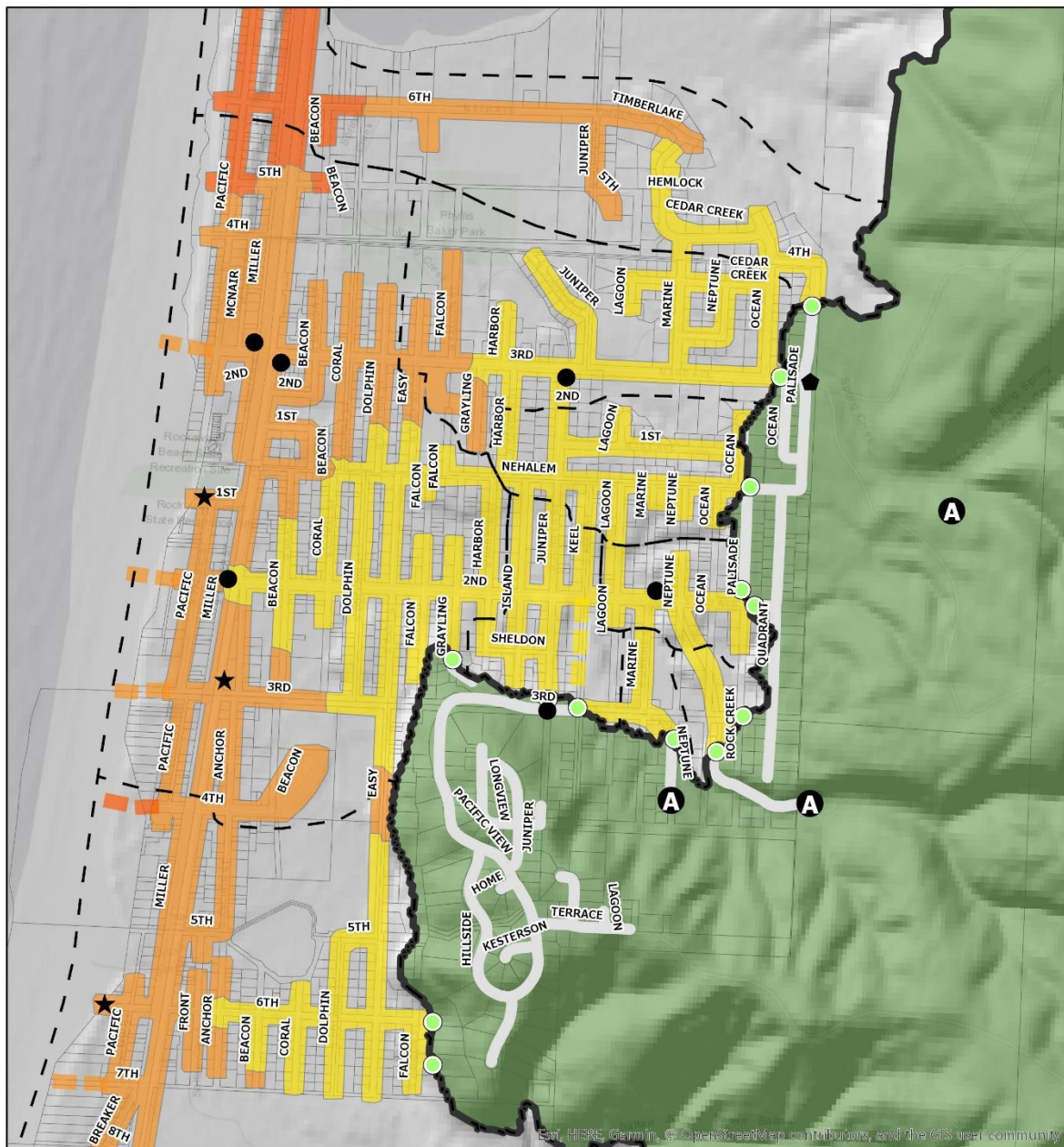
“You Are Here” Tsunami Evacuation Route Map and Information

- Rockaway Beach Wayside (Note – the evacuation route indicated on this map leads to the N 3rd Street Reservoir Assembly Area, which is *not* the nearest high ground location. The nearest high ground is located on S Grayling Street.)
- Rockaway Beach City Hall (Note – the evacuation route indicated on this map leads to the N 3rd Street Reservoir Assembly Area, which is *not* the nearest high ground location. The nearest high ground is located on S Grayling Street.)
- S 6th Avenue beach access (Note – the evacuation route indicated on this map leads to the S 3rd Street Assembly Area, which is *not* the nearest high ground location. The nearest high ground is located on S 6th Avenue.)

Other Signs

- Trail for Emergency Tsunami Evacuation sign at top of North 3rd at entrance to evacuation trail to reservoir

Figure 6 – Required Evacuation Speeds and Existing Tsunami Evacuation Facilities in Central Rockaway Beach

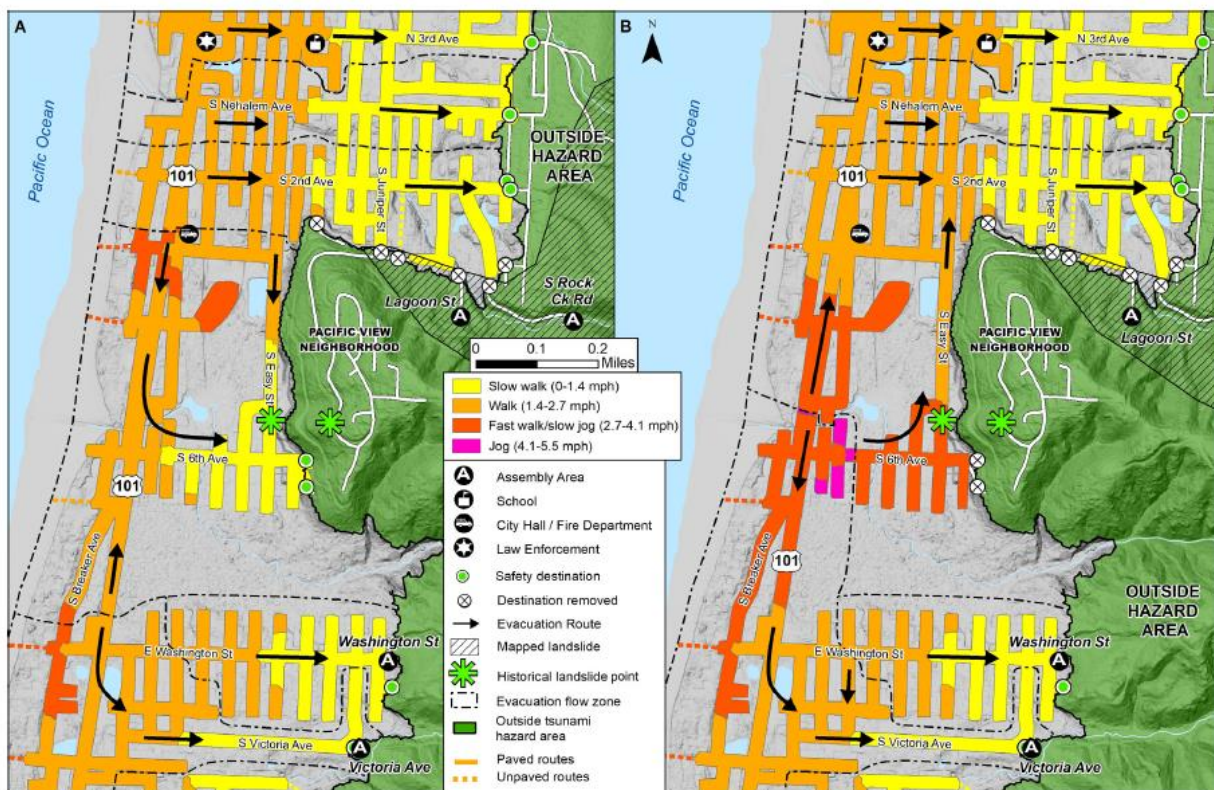


Evacuation Speeds

Walking speeds required to reach safety in the area range from a slow walk (0-2 FPS) in much of the neighborhood east of Highway 101, a walk (2-4 FPS) in the areas surrounding Downtown and Highway 101, to a jog (6-8 FPS) from some parts of the beach and the N 6th Avenue and Highway 101 area. Landslides on the Pacific View neighborhood hill could increase evacuation speeds, particularly on the west side of the hill.

As illustrated in Figure 7, there are two different scenarios for potential landslides in this area. The first, with landslides only occurring in previously mapped landslide areas on the north side of the hill, increase required speeds somewhat, requiring a fast walk from the Rockaway Beach RV Park and the area around City Hall. The second illustrates required speeds if landslides occur in previously mapped areas, as well as historic landslide areas on the west side of the hill. This scenario increases required evacuation speeds in a much larger area, requiring a fast walk or jog in the areas roughly between S 3rd Avenue and Washington Street.

Figure 7 – Evacuation Speed Scenarios for A. Mapped landslides, and B. Mapped and historic landslides Central Rockaway Beach subarea



Source: *DOGAMI Beat the Wave Report*

Critical Facilities

Nearly all of Rockaway Beach’s critical facilities are located within this area – City Hall, Rockaway Beach Public Works, Rockaway Beach Police Department, Rockaway Beach Fire Department, and the Rockaway Beach water treatment facility. All of them are within the XXL inundation zone.

Conclusions

Central Rockaway Beach can be considered a high-risk area in the event of a CSZ tsunami. While minimum evacuation speeds are relatively low for most of the area, the number of critical facilities, residential uses, and tourist lodging and destinations means that there is likely a high concentration of vulnerable populations in this area at any given time. Landslide risks in the area also pose a threat, as they may eliminate access to safety destinations. Strategies for this area include increased signage and wayfinding and landslide mitigation, which should be used in conjunction with increased education and outreach to vulnerable populations.

Evacuation Improvement Projects

Wayfinding

CRB1. Add signage identifying assembly areas at N 3rd Street Reservoir, S Rock Creek Road, and S 3rd Avenue. These areas do not currently have any signage indicating when you have arrived, which may cause confusion among evacuees. **Priority – High**

CRB2. Expand Evacuation Route Signage on Highway 101. There is currently very little signage to aid evacuees traveling east from the beach and along Highway 101. Due to the number of signs required, this work may need to be accomplished in several phases. Signs should be added where every east/west route crosses the highway, at the following intersections

- Highway 101 and N 6th Avenue
- Highway 101 and N 5th Avenue
- Highway 101 and Nehalem Avenue
- Highway 101 and S 3rd Avenue
- Highway 101 and S 4th Avenue
- Highway 101 and S 6th Avenue
- Highway 101 and S 7th Avenue

Priority – High

CRB3. Expand Evacuation Route Signage east of Highway 101 – There is a need for additional signage in the neighborhood east of Highway 101. There are a number of high ground safety areas in locations that may not be immediately apparent to evacuees without clear directional signage. For example, the high ground safety area closest to downtown is located at S Grayling Street, much closer than the assembly areas farther east that most residents are aware of. Due to the number of signs required, this work may need to be accomplished in several phases. Signs should be added at the following intersections:

- N Marine Street and N Cedar Creek Circle
- N 4th Ave and N Palisade Street
- N Ocean Street and N 3rd Avenue
- N 3rd Avenue and N Easy Street
- S Nehalem Avenue and S Easy Street
- S Nehalem and S Juniper
- S 2nd Avenue and S Easy Street
- S 2nd Avenue and S Grayling Street

- S 2nd Avenue and S Juniper Street
- S 2nd Avenue and Marine Street
- S 2nd Avenue and S Rock Creek Road
- S 3rd Avenue and S Easy Street

Priority – High

CRB4. **Add signage or blue lines on roads to indicate arrival at high ground safety areas.** There is currently no signage that indicates when evacuees have reached a high ground safety area outside of the inundation zone. A painted “blue line” on the roadway is an option for safety areas on currently paved roads, or for roads that will be paved in the future. Due to the number of signs required, this work may need to be accomplished in several phases. Signage or blue lines should be added to the following areas:

- N Palisades Street south of N 4th Avenue
- N 3rd Avenue and N Ocean Loop
- S Nehalem Avenue and N Ocean Street
- S 2nd Avenue and S Palisades Street
- The southern end of S Grayling Street
- The south end of S Juniper Street
- The south end of S Marine Street
- The south end of S Rock Creek Road
- South 6th Avenue and S Falcon Street

Priority – High

CRB5. **Add “You Are Here” map sign at Phyllis Baker City Park and major beach access points.** “You Are Here” map signs in high-traffic locations can help raise awareness and inform visitors of the nearest evacuation routes. Due to the number of signs required, this work may need to be accomplished in several phases. Signs should be installed at the following locations:

- Phyllis Baker City Park entrance at S Coral Street.
- Beach access at NW 6th Avenue
- Beach access at N 5th Avenue
- Beach access at N 4th Avenue
- Beach access at N 3rd Avenue
- Beach access at S 2nd Avenue
- Beach access at S 3rd Avenue

Priority – Medium

CRB6. **Replace “You Are Here” signs at Wayside, City Hall, and S 6th Avenue beach access.** Maps should illustrate routes for fastest evacuation to high ground area, rather than closest Assembly Area. **Priority – Medium**

Construction

CRB7. **Landslide mitigation on north and west sides of Pacific View neighborhood.** DOGAMI has determined that there is a risk of landslides around the Pacific View neighborhood hill 101 in the event of a CSZ earthquake. Landslides in this area could potentially block access to some high

ground safety areas and assembly areas that area evacuees rely on, increasing the minimum evacuation speeds required to reach safety ahead of a tsunami. Evacuees on the north side of the hill could reach another area fairly easily, but speeds increase significantly in the area west of the hill with the loss of the S 6th Avenue high ground area. Reinforcing vulnerable slopes could help ensure that evacuees in this area are able to reach safety in a timely manner. **Priority – Medium-High**

3.5 South Rockaway Beach

Community Overview

South Rockaway Beach consists of the area between the northern edge of the Nature Preserve, south to the UGB limits at Spring Lake. This area is primarily residential, with some commercial uses along Highway 101. Land west of the highway consists of mostly single-family homes, many of which are used as vacation rentals. Many of the homes east of the highway are manufactured homes.

The Nature Preserve, home to one of the largest cedar trees on the Oregon Coast, is a popular destination for visitors and residents. The area has a newly constructed boardwalk trail, with the second phase of the project to be completed in the next few years.

Existing Evacuation Facilities Analysis

Tsunami Wave Arrival Time

In the XXL scenario, waves will begin to arrive at the beach approximately 16-18 minutes after the earthquake begins. The wave crosses the area fairly uniformly from west to east. The wave will arrive at the eastern most area of the inundation zone 26-28 minutes after the earthquake begins.

Existing Evacuation Routes and Signage

Existing evacuation facilities direct evacuees east on S Washington Street and S Victoria Street. There are assembly areas established at eastern end of S Washington Street and the eastern end of S Victoria Street, both of which are located at the top of fairly steep trails. There are high ground safety destinations at the following approximate locations:

- S Juniper Street south of S Washington Street
- East of the eastern end of Hollyhock Street, accessed via trail

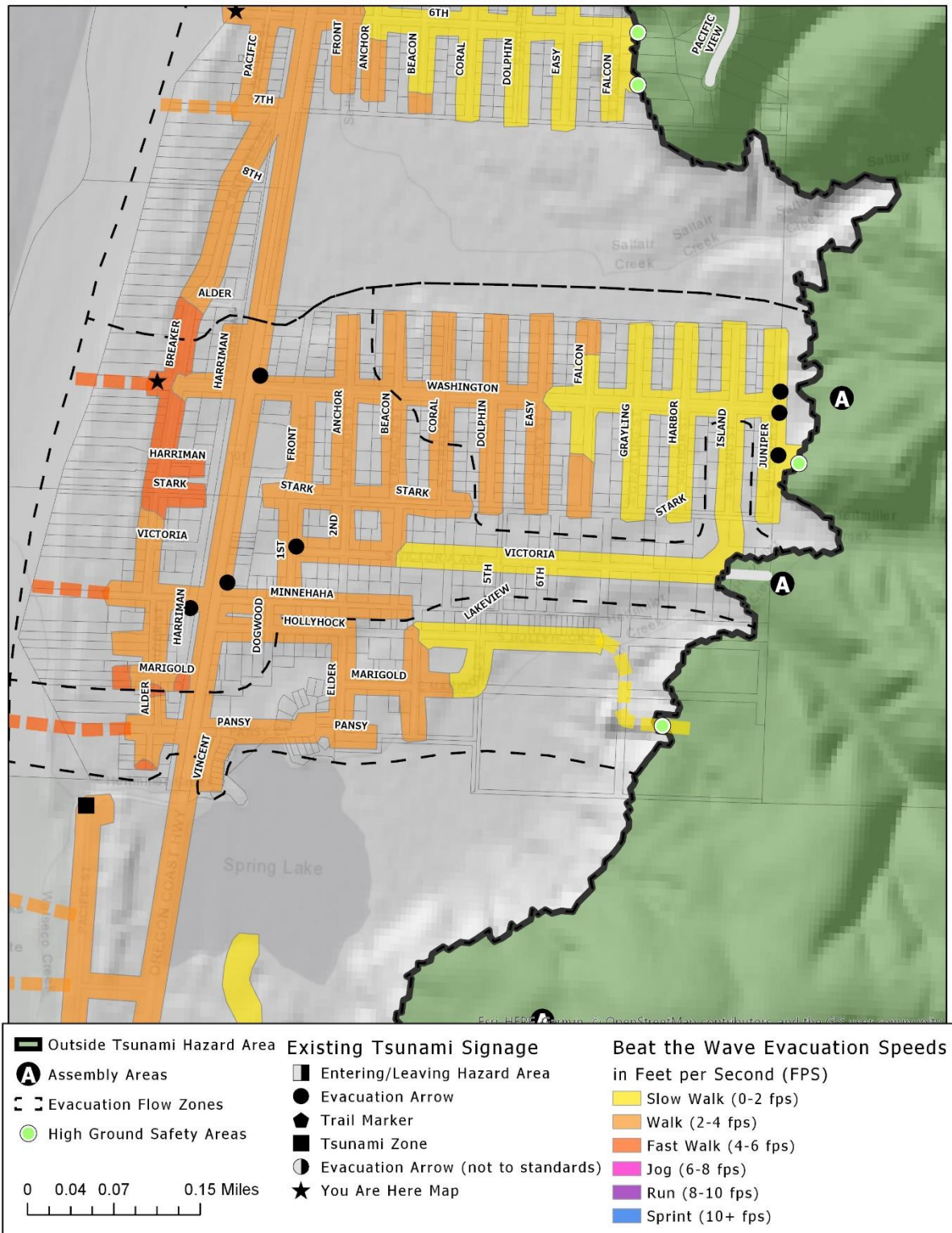
Tsunami Evacuation Route Arrow

- Highway 101 and S Washington Street (only visible to those traveling north)
- Highway 101 and S Minnehaha Street
- S 1st Avenue and S Victoria Avenue
- S Juniper Street and S Washington Avenue
- S Juniper Street and the entrance to the Washington Street assembly area trail

“You Are Here” Tsunami Evacuation Route Map and Information

- Washington Street beach access

Figure 8 – Required Evacuation Speeds and Existing Tsunami Evacuation Facilities in South Rockaway Beach



Evacuation Speeds

Evacuation speeds required to reach safety in the area range from a slow walk and walk in much of the neighborhood east of Highway 101, to a jog from the beach and some areas west of Highway 101.

Critical Facilities

There are no critical facilities located within this area.

Conclusions

While most of this area is within the XXL inundation zone, it is at somewhat lower of a risk than other areas of the city as all existing evacuation routes are likely to be available after the earthquake. Improvements in this area focus on increasing wayfinding signage, including raising awareness at popular destinations such as the Nature Preserve and beach access points, as well as improving evacuation trails to increase accessibility.

Evacuation Improvement Projects

Wayfinding

SRB1. Add signage identifying assembly areas at S Washington Avenue and S Victoria Avenue. These areas do not currently have any signage indicating when you have arrived, which may cause confusion among evacuees. **Priority – High**

SRB2. Expand Evacuation Route Signage. There is currently very little signage to aid evacuees traveling along Highway 101 and east toward high ground. Due to the number of signs required, this work may need to be accomplished in several phases. Signs should be installed at the following intersections:

- Highway 101 and S Washington Street
- S Washington Street and S Front Street
- S Washington Street and S Easy Street
- S Minnehaha Street and 1st Avenue
- S Victoria Street and 6th Avenue
- Highway 101 and Pansy Street
- Pansy Street and Elder Street
- Elder Street and Hollyhock Avenue
- Eastern end of Hollyhock Street

Priority – High

SRB3. Add signage or to indicate arrival at safety at high ground areas. There is currently no signage that indicates when evacuees have reached a high ground safety area outside of the inundation zone. Signage should be added to the following areas:

- S Juniper Street south of S Washington Street
- East of the eastern end of Hollyhock Street, accessed via trail

Priority – High

SRB4. Add “You Are Here” map sign at Nature Preserve Trailhead and major beach access points.

“You Are Here” map signs in high-traffic locations can help raise awareness and inform visitors of the nearest evacuation routes. Signs should be installed at the following locations:

- Nature Preserve parking lot trailhead
- Minnehaha Street beach access

Priority – Medium

Construction

SRB5. **Assembly area trail improvements for increased accessibility at Washington Street and Victoria Street.** The existing trails are fairly steep, and sometimes overgrown with vegetation. This could create evacuation difficulties for people with mobility challenges. Increasing accessibility to these sites would also make it easier to bring in supply caches and emergency shelters, as those projects are implemented. **Priority – Medium**

3.6 Twin Rocks & Barview

Community Overview

The Twin Rocks and Barview area extends from south of the Rockaway Beach UGB boundary to the Three Graces. There are only a handful of commercial uses along Highway 101, and some clusters of residential uses in the Twin Rocks area west of the highway, and in Barview near the highway and to the east on the hill. This area is home to popular destinations such as Barview Jetty Park and the Three Graces. Twin Rocks Friends Camp, Camp Magruder, the Barview Jetty campground, and Shorewood RV Park are areas likely to be hosting a high concentration of visitors to the area.

Note – although the City of Rockaway Beach does not have jurisdiction in these areas, this plan recommends coordination with these communities and Tillamook County in their tsunami evacuation facilities improvement efforts, as these communities are closely linked to Rockaway Beach.

Existing Evacuation Facilities Analysis

Tsunami Wave Arrival Time

In the XXL scenario, waves will begin to arrive at the beach approximately 16-18 minutes after the earthquake begins. The wave crosses the area fairly uniformly from west to east, though it arrives more quickly on the Tillamook Bay side of Barview. The wave will arrive at the eastern most area of the inundation zone 24-26 minutes after the earthquake begins.

Existing Evacuation Routes and Signage

Existing evacuation facilities direct evacuees east to the Twin Rocks Reservoir, and to high ground areas east of Highway 101 in the Barview area. There are assembly areas established at the Twin Rocks Reservoir, the Gravel Pit, the Barview hill, and at Terwiliger Heights. There are high ground safety destinations at the following approximate locations:

- The eastern edge of the Twin Rocks Friends Camp property
- The north and south points of the Barview hill
- East of Highway 101 just north of the Cedar Street intersection
- East of Highway 101 near Lifesaving Creek

Tsunami Evacuation Route Arrow

- On Twin Rocks Friends Camp property (2)
- Highway 101 just north of Cedar Street intersection
- Highway 101 and Harborview Drive intersection

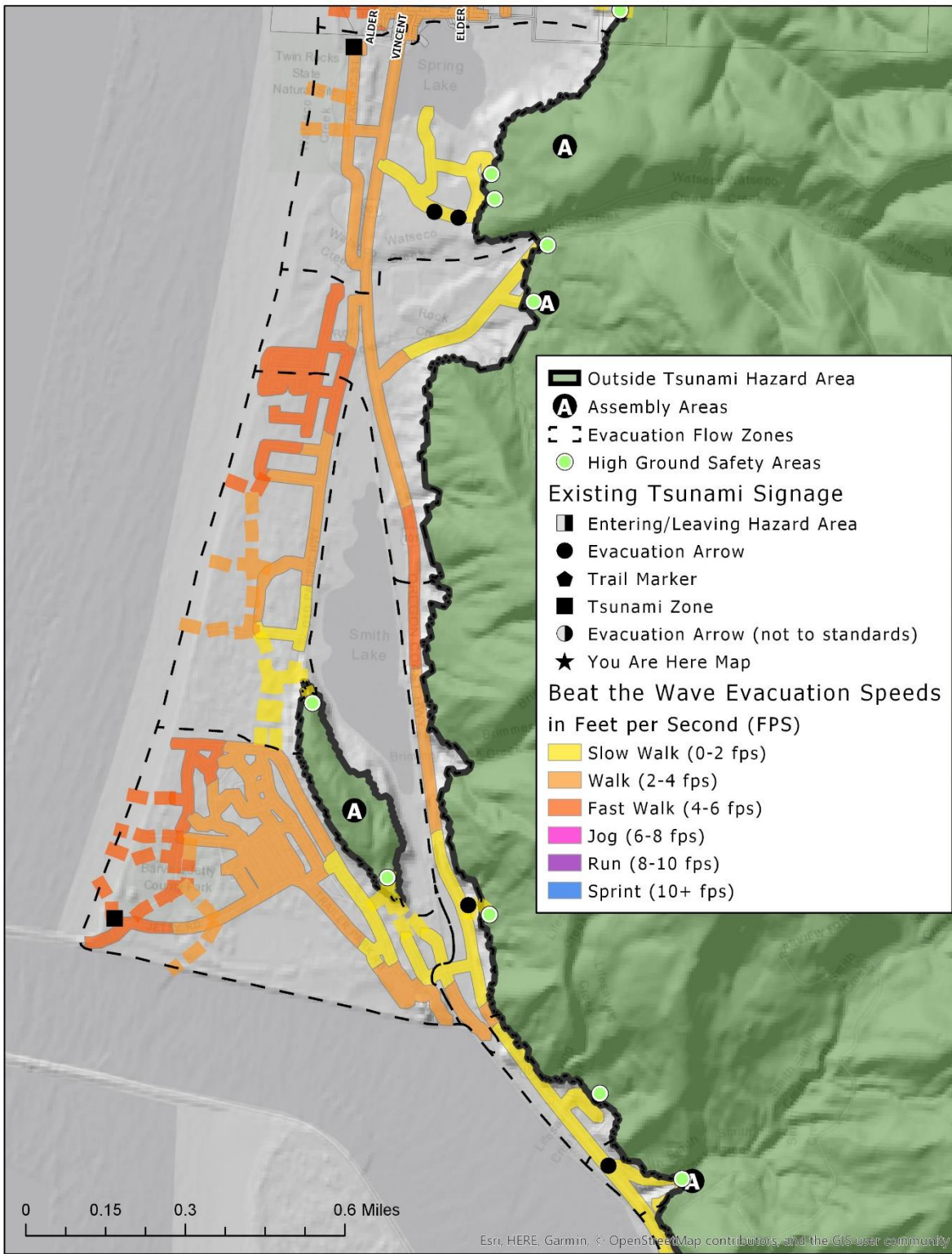
Entering/Leaving Tsunami Hazard Area Signs

- Highway 101 south of Three Graces

Tsunami Hazard Zone Sign

- Twin Rocks State Natural Site beach access trailhead

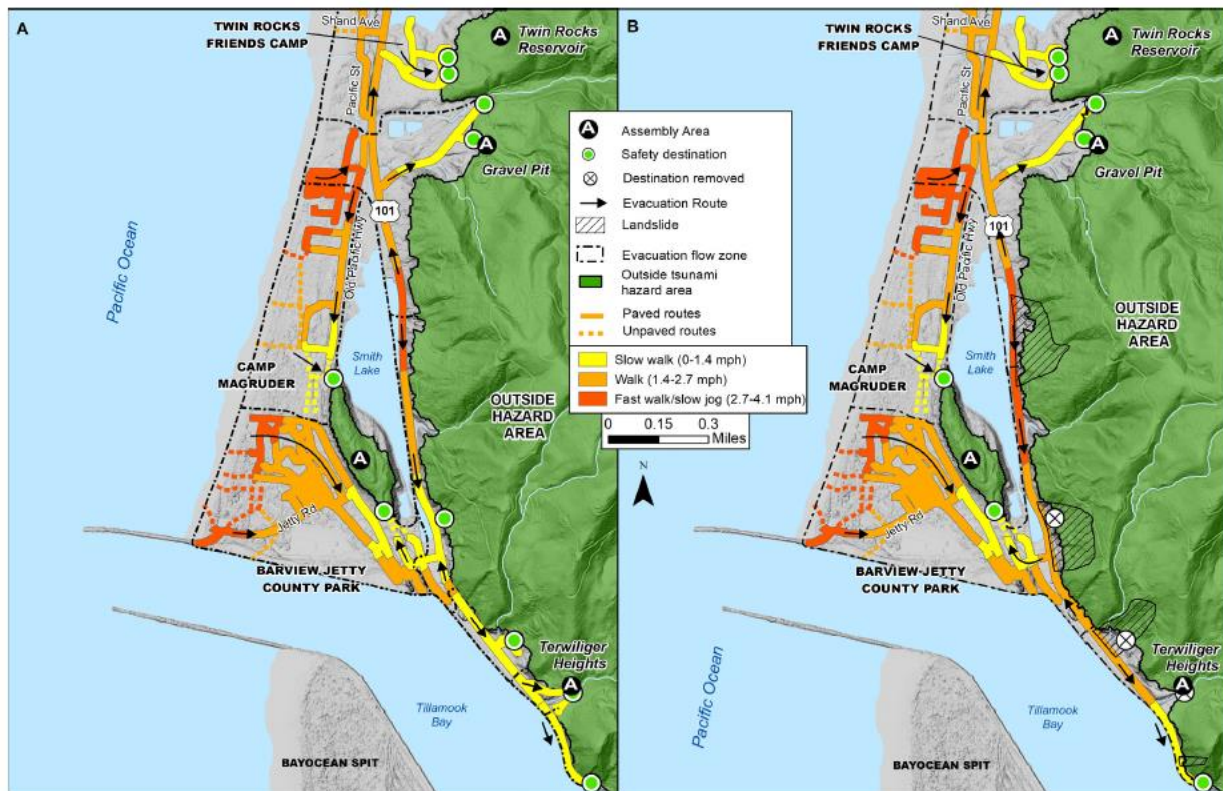
Figure 9 – Required Evacuation Speeds and Existing Tsunami Evacuation Facilities in Twin Rocks & Barview



Evacuation Speeds

Evacuation speeds required to reach safety range from a slow walk and walk in much of the area, though a fast walk is required in areas closer to the beach. There is a landslide risk in the slopes above Highway 101, though evacuees will be able to reach alternate high ground areas nearby if landslides do occur.

Figure 10 – Evacuation Speed Scenarios for A. No landslides, and B. Potential landslides in Twin Rocks/Barview subarea



Source: DOGAMI Beat the Wave Report

Critical Facilities

There are no critical facilities located within this area.

Conclusions

Twin Rocks and Barview are at a somewhat high risk during a CSZ tsunami event, due to the high concentration of visitors likely to be in the area at any given time. These risks are amplified during weekends and summer months, when the two camps may be fully occupied, along with the Barview Jetty campground and Shorewood RV Park. Recommendations in this area aim to increase awareness among residents and visitors, and improve the wayfinding and signage network.

Evacuation Improvement Projects

Wayfinding

TRB1. **Add signage identifying assembly areas at the Twin Rocks Reservoir, the Gravel Pit, the hill south of Smith Lake, and at Terwiliger Heights.** These areas do not currently have any signage indicating when you have arrived, which may cause confusion among evacuees. **Priority – High**

TRB2. **Expand Evacuation Route Signage along Highway 101.** There is currently very little signage to aid evacuees traveling east from the beach and along Highway 101. Due to the number of signs required, this work may need to be accomplished in several phases. Signs should be added where every east/west route crosses the highway, at the following intersections:

- Highway 101 and Shand Avenue
- Highway 101 at the Twin Rocks Friends Camp entrance
- Highway 101 at the Gravel Pit access road
- Highway 101 at the Old Pacific Highway
- Highway 101 at Cedar Street

Priority – High

TRB3. **Expand Evacuation Route Signage in Barview** – There is a need for additional signage in the Barview area. The road network in the area is somewhat confusing, and the direction of travel to the nearest high ground area may not be immediately apparent to evacuees. Signs should be added at the following intersections:

- Cedar Street and Oceanview Avenue
- Barview Jetty Park Road at hill access trail
- Jetty Road and Trailer Park Road
- Barview Jetty Park Road and Trailer Park Road

Priority – High

TRB4. **Add signage to indicate arrival at safety at high ground areas.** There is currently no signage that indicates when evacuees have reached a high ground safety area outside of the inundation zone. Signage should be added to the following areas:

- The eastern edge of the Twin Rocks Friends Camp property
- The north and south points of the hill south of Smith Lake
- East of Highway 101 just north of the Cedar Street intersection
- East of Highway 101 near Lifesaving Creek

Priority – High

TRB5. **Add “You Are Here” map sign at Barview Jetty Park and Twin Rocks Beach Access.** “You Are Here” map signs in high-traffic locations can help raise awareness and inform visitors of the nearest evacuation routes. **Priority – Medium**

Construction

TRB6. **Landslide mitigation east of Highway 101.** DOGAMI has determined that there is a risk of landslides in the Barview area east of Highway 101 in the event of a CSZ earthquake. Landslides in this area could potentially block access to some high ground safety areas and assembly areas that

area evacuees rely on, increasing the minimum evacuation speeds required to reach safety ahead of a tsunami. However, the majority of evacuees would be able to reach an alternate area fairly easily. Reinforcing vulnerable slopes could help ensure that evacuees in this area are able to reach safety in a timely manner. **Priority – Low**

4. Implementation Resources for Evacuation Projects

4.1 Design and Construction Standards

Below is a list of resources related to Evacuation Facility Design and Construction Standards, applicable for a variety of projects suggested in the sections above:

- Bicycle and pedestrian design:
 - Oregon Department of Transportation. 2011. Oregon Bicycle and Pedestrian Design Guide, 3rd Edition. Oregon Highway Design Manual Appendix L.
- Design requirements and ideas for wayfinding signage:
 - Portland Urban Architecture Research Lab. 2014. "Up and Out" Oregon Tsunami Wayfinding Research Project: Final Project Report and Guidance Document.
 - Portland Urban Architecture Research Lab. 2015. "Up and Out 2" Oregon Tsunami Wayfinding Research Project: A Study in Seaside and Warrenton.
 - DOGAMI. 2003. OFR-03-06 Tsunami Sign Placement Guidelines.
 - Office of Emergency Management and DOGAMI. 2019. Oregon Tsunami Evacuation Wayfinding Guidance.
- Vertical evacuation structures:
 - Applied Technology Council. 2012. FEMA Guidelines for Design of Structures for Vertical Evacuation from Tsunamis, Second Edition. Prepared for the Federal Emergency Management Agency and National Oceanic and Atmospheric Administration. FEMA P-646. April 2012.
 - Chock, G. 2016. Design for Tsunami Loads and Effects in the ASCE 7-16 Standard. Journal of Structural Engineering: 142 (11). (International Building Code standards)
 - Applied Technology Council. 2009. Vertical Evacuation from Tsunamis: A Guide for Community Officials. Prepared for the Federal Emergency Management Agency, National Oceanic and Atmospheric Administration. June 2009.

4.2 Tsunami Evacuation and Wayfinding Signage

A tsunami escape wayfinding system informs people what to do and when to do it. The system is designed to make the process clear and efficient before, during, and after a tsunami. Prime elements to include in wayfinding improvements are:

- Awareness kiosks
- Tsunami hazard zone signs
- Tsunami evacuation route signs
- Zone thresholds (entering/leaving)
- Assembly areas

For different populations, such as people with disabilities and the many unprepared tourists during the spring and summer seasons, special escape sequences and patterns provide innovative wayfinding solutions for tsunami evacuation. These populations include elderly, disabled, children, visitors in hotels, RV park visitors, etc.

For implementation of any wayfinding improvements, it is important to consider:

- Cost

- Ease of construction/implementation
- Aesthetic style
- Complexity of technological requirements
- Media
- Purpose

Tsunami Escape Wayfinding is Human Wayfinding in high stress situations that requires additional instruments, means, and techniques to find safe ground in a limited period of time, potentially at night or during difficult weather conditions.

Sign Type Selection

Signage can be two-dimensional, but also can include technological/sensory signals (e.g., sound, light)—an important concept when considering access and functional needs populations. When selecting a sign as a part of a signage system, the following elements should be considered:

- Basic function and visibility of signage
- Signage technology applied
- Position in space, method of fixing
- Size in relation to reading distance
- Illumination
- Requirements for impaired users
- Level of vandal resistance

4.3 Financing Strategies

Cost estimates for the tsunami evacuation improvement projects identified in this plan are general and may not reflect precise costs. Resources to develop facility improvement cost estimates can be found at the following links:

- American Association of Cost Engineers – requires membership or payment (<https://web.aacei.org/resources>)
- Whole Building Design Guide – Cost Estimating (http://www.wbdg.org/design/dd_costest.php)
- American Association of State Highway and Transportation Officials - Practical Guide to Cost Estimating, requires membership or payment (https://bookstore.transportation.org/collection_detail.aspx?ID=122)
- FEMA Cost Estimating Format (<https://www.fema.gov/public-assistance-cost-estimating-format-standard-operating-procedure>)
- Disaster Recovery Reform Act (<https://www.fema.gov/news-release/2018/10/05/disaster-recovery-reform-act-2018-transforms-field-emergency-management>)

Questions to Ask

- In identifying projects to move forward with, it is important to bear in mind the following questions:
- Do citizens consider this to be an important public issue that requires a public remedy?
- Who directly benefits from the design, construction, and operation of these assets?
- Who indirectly benefits from the presence of these assets when not needed for an emergency?

- Do citizens have a preference among the various options available to finance the infrastructure investment?
- Is the scale of the need within the means of the community to finance or is outside assistance necessary?
- Should different strategies be used to elicit funding from seasonal vs. year-round residents?
- Is needed infrastructure within the jurisdiction/control of the community, or is there a need to engage other units or levels of government?
- Is there a way to fit improvements into existing programs or needs?

The following tools are most likely to succeed for enhancing a community's evacuation route system¹²:

- Using existing rights-of-way,
- Negotiating/purchasing easements, and
- Purchasing new rights-of-way.

In addition, the construction of evacuation facilities should consider the following:

- Determining the most effective location,
- Determining co-benefits to access additional funding streams, and
- Determining design and construction standards applicable to specific project.

More information on potential financing sources can be found in Appendix 1.

¹² Oregon Department of Land Conservation and Development. 2018. *Tsunami Land Use Guide, Chapter 5, Tip*. https://www.oregon.gov/LCD/OCMP/docs/Publications/TsunamiLandUseGuide_FINAL_062718.pdf

5. Education, Outreach, and Training

In tsunami areas, it is crucial to support an ongoing sustained tsunami public education program in order to ensure effective evacuation and save lives. This section presents guidance for creating pre-disaster education and outreach activities to educate the public about appropriate actions to take when natural signs (i.e., ground shaking) indicate a tsunami is imminent or when a tsunami warning message has been issued.

Residents, homeowners, business owners, and tourists alike benefit from educational activities that increase their awareness of local hazards. These educational activities can and should be combined with other, existing hazard education programs, such as earthquake preparedness, when possible.

The Rockaway Beach Emergency Preparedness Leadership team is conducting outreach, education, and training in the City, for preparedness related to tsunamis and other hazards. Their work currently includes preparedness events, training opportunities, a radio emergency communications network, and dissemination preparedness information to the community. City staff should work alongside the Preparedness Leadership Team in education, outreach, and training efforts, helping to build upon the work that is already being done.

5.1 News and Social Media

Traditional local media outlets (TV, radio, newspaper, etc.), public social media accounts, and other local websites (e.g., the Chamber of Commerce) should be utilized as appropriate to announce community training events and provide public service announcements (PSAs) regarding tsunami evacuation.

News Organizations

Many community members rely on local news sources for information about their community. Developing a working relationship with local newspapers and radio is an effective mode of communicating with the public.

Recommended Action

- Work with local newspapers and radio stations to announce tsunami awareness events and provide community education information and resources. Local service providers include the Tillamook Headlight Herald, the Tillamook County Shopper, and local radio stations.

Resources

Tsunami Emergency Guidebook for Oregon Mass Media, Oregon Emergency Management, September 2007:

http://www.oregongeology.org/tsuclearinghouse/resources/pdfs/OregonTsunamiMediaBinder_final_6_20_07.pdf

Social Media

Social media's role in emergency communication has grown over the past several years, not only as a major channel for broadcasting emergency information but also as a means of engaging and conversing with the public during all emergency mission phases (i.e., protection, preparedness, mitigate, response, and recovery).

The City of Rockaway Beach maintains an official Facebook page, and the Emergency Preparedness Leadership team runs a Facebook page where they share community preparedness information. In addition, there are many active community pages run by Rockaway Beach residents and businesses where local news and information is shared with a wide audience.

Recommended Action

- Consistently incorporate tsunami education information into social media accounts, including the graphics used on tsunami evacuation signs. Social media accounts should be monitored to manage misinformation and rumor control.
- Develop working relationships with local bloggers and businesses to utilize their social media presence to retweet or copy posts so they reach a larger audience.
- Link social media accounts to OEM, FEMA, other County and City sites so that there is continued information and feeds that help with keeping posts new and relevant.

Resources

FEMA Social Media and Emergency Preparedness Press Release: <https://www.fema.gov/news-release/2018/04/16/social-media-and-emergency-preparedness>

FEMA Social Media in Emergency Management Training:
<https://training.fema.gov/is/courseoverview.aspx?code=IS-42>

The Department of Homeland Security's Innovative Uses of Social Media in Emergency Management:
https://www.dhs.gov/sites/default/files/publications/Social-Media-EM_0913-508_0.pdf

Sample Social Media Posts

The following sample social media posts have been developed by the National Weather Service and edited for use by the City.

Facebook

- A tsunami can strike our coast at any time throughout the year. While they don't happen very often, they pose a major threat to coastal communities like Rockaway Beach. Check out this video for things you can do to prepare: https://youtu.be/x0GX_kc7JZo #TsunamiPrep
- A tsunami can be very dangerous to life and property on the coast. It can produce strong and dangerous currents, rapidly flood the land and cause great destruction. Even small tsunamis can be dangerous. Strong currents can injure and drown swimmers and damage and destroy boats in harbors. Visit <http://www.nws.noaa.gov/om/Tsunami/about.shtml> #TsunamiPrep
- Because tsunamis are a threat in our community, you should include tsunami-specific preparations in your emergency plan. Learn the evacuation routes, identify safe places and practice evacuating. Visit <http://www.nws.noaa.gov/om/Tsunami/before.shtml> #TsunamiPrep
- Do you live, work or play on the coast? Do you know our community's tsunami risk? Our community has identified and mapped tsunami hazard and evacuation zones. Check out links to tsunami maps on this page <http://nws.weather.gov/nthmp/maps.html> or ask your local/state emergency management office or your local NWS forecast office for more info. #TsunamiPrep
- Official tsunami warnings are broadcast through local radio and TV, marine radio, wireless emergency alerts, NOAA Weather Radio, and National Oceanic and Atmospheric Administration (NOAA) websites. They may also come through outdoor sirens, local officials, text message

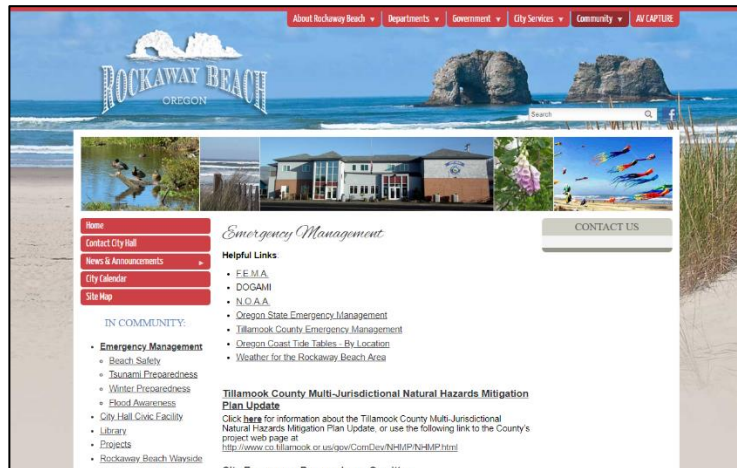
alerts and telephone notifications. Learn about the four levels of tsunami alerts for the U.S. at: <http://www.nws.noaa.gov/om/Tsunami/alerts.shtml>. #TsunamiPrep

Twitter

- If you live, work or play on the coast, you should prepare for a #tsunami https://youtu.be/x0GX_kc7JZo #TsunamiPrep
- A #tsunami, which may resemble a fast-rising flood, can be very dangerous to life & property <http://www.nws.noaa.gov/om/Tsunami/about.shtml> #TsunamiPrep
- At risk from #tsunamis? Plan for and practice evacuation. <http://www.nws.noaa.gov/om/Tsunami/before.shtml> #TsunamiPrep
- Live, work or play on the coast? Know your #tsunami risk & evacuation zones <https://nws.weather.gov/nthmp/maps.html> #TsunamiPrep
- Tsunami alerts come from many sources like @NOAA websites & @NOAA Weather Radio <http://www.nws.noaa.gov/om/Tsunami/alerts.shtml> #TsunamiPrep

Websites

Websites continue to play a large role in providing information and outreach activities to residents and tourists. The City of Rockaway Beach website shares information on official City events, shares information on emergency preparedness. The Emergency Preparedness Leadership maintains and updates the City’s emergency management information page.



The City of Rockaway Beach Emergency Management Website

Recommended Actions

- Include tsunami awareness information on the City’s website in a prominent location and use the website to announce tsunami-related community activities. Consider linking to relevant webpages from Tillamook County Emergency Management, DOGAMI, Oregon Department of Land Conservation and Development (DLCD), NOAA, etc., rather than recreating the information.
- Develop working relationships with local businesses and organizations to include a link back to the City’s tsunami information to increase the website’s reach.

5.2 Community Activities

Community activities are a vital part of public education and outreach. These activities and events not only build awareness and familiarity with tsunami preparedness and evacuation facilities, but also allow the opportunity for neighbors to build important community connections that will be vital in the event of a disaster.

Recommended Actions

- Hold at least one community-wide outreach or education activity annually.
- Provide educational and evacuation information at every State, County, and City park.
- Develop community outreach materials, such as the following, to be distributed at community events:
 - Brochures containing zone and route information
 - Refrigerator magnets with preparedness information
 - Maps to be printed in phonebooks
 - Permanent posted material for hotels, rentals, restaurants, and other businesses

Door-to-Door Education and Community-wide Evacuation Drills

The National Tsunami Hazard Mitigation Program studied which educational strategies work best for tsunami awareness in Seaside, Oregon (Connor 2005). Door-to-door outreach and evacuation drills were the most effective techniques according to polls for this study. This has been confirmed during recent events in Japan and Mexico where earthquake and evacuation drills are routinely used as a training technique.

Recommended Action

- Develop Volunteer Educators who can go door-to-door to discuss tsunami awareness and safety with residents. These volunteers would be trained by the City and given brochures to hand out to residents.
- Conduct a community-wide tsunami evacuation drill using the Oregon Office for Emergency Management Tsunami Evacuation Drill Guidebook as a reference.

Resources

- The Oregon Office for Emergency Management’s Tsunami Evacuation Drill Guidebook: https://www.oregon.gov/oem/Documents/Tsunami_Evacuation_Drill_Guidebook.pdf

Run/Walk Event

Events like the Cannon Beach “Race the Wave” provided an opportunity to build awareness of tsunami routes. Participants in the 5K and 10K Race the Wave fun run/walk/roll started on the beach, followed a scenic tsunami evacuation route through the city, and reached the finish line out of the tsunami inundation zone. A preparedness fair was held near the finish line for all participants and included food, games, and giveaways.

Recommended Action

- Host a run/walk event that has participants race a tsunami evacuation route as a fun awareness event.
- Hold a preparedness fair at the end of the race. See below for additional information on preparedness fairs.



Participants in the Cannon Beach “Race the Wave” event in 2015. Source: Race the Wave Facebook page.

Resources

- <https://www.fema.gov/news-release/2015/09/08/know-your-tsunami-evacuation-routes-race-wave-cannon-beach-or-sept-13>
- Up and Out Oregon Tsunami Wayfinding Research Project Final Project Report & Guidance Document: https://www.oregon.gov/oem/Documents/Up_And_Out_Phase1.pdf

Preparedness Fairs/Booth

An emergency preparedness fair or a tsunami preparedness-focused booth at a community event can help educate community members and visitors about tsunami evacuation. A preparedness fair can feature many booths and activities. It can be held separately or combined with another event, such as a 5K run/walk, farmers market, or festival.

The Rockaway Beach Preparedness Leadership Team conducts Preparedness Fairs in the community and staffs a booth at city functions such as the 4th of July, Kite Festival and Carnival at the Park.

Preparedness literature is available at these events.

Recommended Action

- Work with the Emergency Preparedness Leadership to ensure that they have the information and resources they need to communicate tsunami preparedness information with the public
- Identify additional community events where a preparedness booth may be appropriate, or community groups and organizations willing to host a preparedness fair.

Resources

- The American Red Cross and California Emergency Management Agency's Disaster Preparedness Event Toolkit: https://www.redcross.org/content/dam/redcross/atg/Chapters/Division_2_-_Media/Bay_Area/Bay_Area_-_PDFs/Preparedness_Event_Toolkit.pdf

Tsunami Quests

A Tsunami Quest is an educational activity for families and children to learn about tsunamis and tsunami evacuation routes in a clue-directed hunt format. The Oregon Sea Grant is already using Tsunami Quests in Clatsop, Lincoln, and Coos Counties to help residents and visitors prepare for a major earthquake and tsunami. The “hunt” culminates in discovery of a box that holds a guest book so participants can record their achievement at completing the Quest. The goal is to encourage people to explore these routes for fun, so that they will be familiar with them in the event of a tsunami.



Tsunami Quest participants. Source: OSU Oregon Sea Grant.

Recommended Action

- Invite the Oregon Sea Grants Quest Coordinator to hold a workshop like the one highlighted in this video: <https://youtu.be/TQvgSMiby7k>.
- Develop a map and a series of educational clues that, when followed, lead the walkers to higher ground.

- Engage elementary or middle school students to develop the clues as a class exercise.
- Consider incorporating geocaches with preparedness information.

Resources

- The 2017-18 Oregon Coast Quests Book: <https://seagrant.oregonstate.edu/sgpubs/2017-18-oregon-coast-quests-book>
- A video that describes the quest concept and how quests are used to teach coastal visitors and locals what to do in the event of a tsunami: <https://youtu.be/TQvgSMiby7k>.

5.3 Schools and Childcare Facilities

Empowering children with knowledge about tsunami hazards and evacuation routes can be an excellent motivator for families to become more aware and prepared. Tsunami education efforts can be incorporated into existing emergency exercises and trainings.

Child Appropriate Trainings

Many materials are available online for teachers to use in educating children about tsunamis. The Tommy Tsunami Coloring Book from the National Tsunami Warning Center is one example.



Students from Seaside High School participate in a tsunami evacuation drill. Source: <https://www.knkx.org/post/coastal-schools-drill-tsunami-would-rather-relocate>

Recommended Action

- Work with teachers to develop tsunami curriculum that is age appropriate.
- Coordinate with Neah-Kah-Nie High School and Middle School to ensure they have the information and educational resources they need to ensure that their students and staff are prepared
- Coordinate with Camp Magruder and Twin Rocks Friends Camp to ensure they have the information and educational resources they need to ensure that their campers and staff are prepared

Resources

- The Washington Military Department, Emergency Management Division's booklet "How the Smart Family Survived a Tsunami" for elementary children (K-6): <https://www.mil.wa.gov/uploads/pdf/Publications/HowtheSmartFamilySurvivedaTsunami.pdf>
- The Tommy Tsunami Coloring Book from the National Tsunami Warning Center: https://www.tsunami.noaa.gov/pdfs/tommy_tsunami_coloring_book.pdf

- San Diego County used an animated short film to educate kids about tsunamis:
<https://www.youtube.com/watch?v=UzR0Rt3i4kc>
- NOAA's Tsunami Education website: <https://www.tsunami.noaa.gov/education.html#kids>
- OEM's Without Warning:
<https://www.oregon.gov/newsroom/pages/NewsDetail.aspx?newsid=1396>

Parent/Guardian Trainings and Workshops

Children are not the only audience that can be reached through school activities—parents and guardians attend many events at schools, providing ample opportunities to reach them with the tsunami preparedness message.

Recommended Action

- Encourage schools to incorporate tsunami information into their back-to-school nights or other gatherings where parents/guardians are present.

5.4 Seniors

Empowering seniors and their caregivers with knowledge about tsunami hazards and evacuation routes is important to ensure those who may have a tougher time evacuating due to physical limitations understand the importance of evacuating without delay and connecting with their neighbors for support.

Senior Workshops

Seniors and their caregivers need tsunami evacuation education and training to ensure everyone knows when and how to evacuate in the event of a local earthquake and tsunami.

Recommended Action

- Work with existing senior groups to host regular training sessions on tsunami preparedness and evacuation measures.

Resources

- Natural Disaster Awareness for Caregivers of Senior Citizens: Building Senior Resilience:
<http://centennialadultcare.com/wp-content/uploads/2015/03/Natural-Disaster-Awareness-for-Caregivers-of-Senior-Citizens.pdf>
- Disaster Preparedness Guide for Seniors and Caregivers:
<https://www.seniorliving.org/research/disaster-preparedness/>

5.5 Businesses

Businesses in the hazard zones may be owned, staffed, or frequented by customers who, like visitors, live outside the city limits and may not have been reached by the local outreach activities. Therefore, employers and their employees need tsunami evacuation education and training to ensure everyone knows when and how to evacuate in the event of a local earthquake and tsunami.

Recommended Action

- Work with the Chamber of Commerce to host regular training sessions for business owners, sharing information with them, so they, in turn, could return to their businesses and host in-house training.
- Develop Volunteer Educators to conduct in-house trainings at local businesses for staff.

- Encourage businesses to perform seismic upgrades.

Resources

How to Prepare Your Business for the Next Tsunami (Hawaii specific, but useful information):
http://tsunami.org/1about/pdfs/how_to_prepare_your_business_for_the_next_tsunami.pdf

Tsunami Quests for Businesses

Tsunami Quest activities are not just for families and children, they can be used by businesses to educate their employees about tsunami preparedness.

Recommended Action

- Encourage local businesses to utilize the Tsunami Quest activity (described above) as a “wellness event” for their employees. The activity may need to be adapted to be more appropriate for businesses.

Resources

- The 2017-18 Oregon Coast Quests Book: <https://seagrant.oregonstate.edu/sgpsubs/2017-18-oregon-coast-quests-book>
- A video that describes the quest concept and how quests are used to teach coastal visitors and locals what to do in the event of a tsunami: <https://youtu.be/TQvgSMiby7k>.
- Effective Emergency Preparedness Planning: Addressing the Needs of Employees with Disabilities: <https://www.dol.gov/odep/pubs/fact/effective.htm>

5.6 Visitors/Recreationists

Visitors and recreationists may spend a limited amount of time in tsunami prone communities, but they are still at risk. There are many ways to provide these temporary residents with some education about the possibility of a tsunami and what to do if one happens. The significant amount of short-term rental, second homes, and vacation lodging in Rockaway Beach suggests that there is a relatively large number of temporary residents in the city at any given time. Being able to educate this population on the tsunami threat, preparedness, and evacuation measures will be critical to life safety in the event of a tsunami.

Education Materials

The brochures and other handouts developed for community activities can be used to educate visitors about what to do and why.

Recommended Action

- Place materials at the following locations:
 - Visitor centers
 - Information kiosks
 - Trail markers
 - Signs on beaches (particularly areas that are hard to evacuate from or in which the direction



Tsunami Evacuation brochures included alongside information for visitors.

you need to evacuate to is not obvious)

If printing materials on this scale is prohibitive, consider developing a catchy phrase and website link that individuals can go to in order to download the files.

Resources

- The Disaster Response Guidebook for Hotels and Motels on Washington's Coast, published by the Washington Military Department Emergency Management Division, includes information about a variety of disasters, including tsunamis:
https://www.mil.wa.gov/uploads/pdf/emergency-management/haz_hotelmotel_guidebook.pdf
- FEMA Website tsunami page with information about recognizing the signs:
<https://www.ready.gov/tsunamis>

Hotels, Motels, Bed and Breakfasts, and Short-Term Rentals

Visitors staying overnight for the weekend or on an extended vacation may be unfamiliar with tsunamis. The handouts used for preparedness fairs and other events hold valuable information about tsunami evacuation that can be shared with temporary residents.

Recommended Action

- Provide tsunami evacuation literature to local hospitality businesses. Request that they be permanently displayed in the lobby and hotel rooms, informing tourists of evacuation routes and general earthquake/tsunami awareness.
- Provide training and education opportunities to hotel, motel, B&B, and short-term rental owners who wish to provide preparedness supplies (such as go-bags) for their employees or guests.
- Adopt City ordinance that requires posting tsunami info in hotels/motels/STRs. Tillamook County has proposed a Short Term Rental Ordinance that would require that tsunami evacuation information be posted in all short term rentals within the evacuation zone. The ordinance reads as follows:

A copy of an Oregon Department of Geology and Mineral Industries (DOGAMI) Tsunami Evacuation Brochure furnished by the Tillamook County Department of Community Development at the time of Short-Term Rental Permit issuance and renewal shall be posted in a visible location of a short term rental located within a DOGAMI mapped area susceptible to tsunami hazards.

Resources

- A glossy brochure is available in many languages from UNESCO, at: http://itic.ioc-unesco.org/index.php?option=com_content&view=article&id=1169&Itemid=2017
- Disaster Response Guidebook for Hotels and Motels on Washington's Coast:
https://www.mil.wa.gov/uploads/pdf/emergency-management/haz_hotelmotel_guidebook.pdf
- Manzanita Hotel owner stocked guest room with go-bags:
https://www.dailyastorian.com/news/local/manzanita-hotel-stocks-every-room-with-go-bags/article_19c85034-315f-11e9-bc95-031bca675e7e.html

5.7 Access and Functional Needs Populations

Access and Functional Needs populations (also referred to as vulnerable populations and special needs populations) are members of the community who experience physical, mental, or medical care needs and who may require assistance before, during, and after an emergency incident. Targeted education, outreach, and training can help inform and prepare these populations to evacuate successfully in the event of a CSZ tsunami.

Mobility Challenges

Within mobility disabilities, there are several subcategories that should be considered when planning for tsunami evacuations, including: wheelchair users, ambulatory mobility disabilities, respiratory issues, and young children.

Recommended Action

- Encourage residents to get to know their neighbors and whether they will need assistance evacuating.
- Encourage hospitals, doctors, and clinics to provide tsunami evacuation materials to their patients.
- Incorporate evacuation planning into CERT training.

Resources

- To Define, Locate, and Reach Special, Vulnerable, and At-risk Populations in an Emergency: This CDC workbook is intended to provide public health and emergency preparedness planners with better ways to communicate health and emergency information to at-risk individuals with access and functional needs for all-hazards events through step-by-step instructions, resources guides and templates. https://emergency.cdc.gov/workbook/pdf/ph_workbookfinal.pdf
- This guidance from the U.S. Department of Health & Human Services Office of the Assistant Secretary for Preparedness and Response will introduce and connect you to available resources and inclusive strategies for integrating the access and functional needs of at-risk individuals into emergency preparedness, response, and recovery planning at all jurisdictional levels. <https://www.phe.gov/Preparedness/planning/abc/Pages/afn-guidance.aspx>
- Preparing for Disaster for People with Disabilities and other Special Needs <https://www.fema.gov/media-library/assets/documents/897>

Vision Impairment

Individuals who experience partial or total vision loss, including night vision challenges, rely on their sense of touch and hearing to perceive their environment. After a CSZ event, when physical obstructions such as debris, road or sidewalk damage, and liquefaction changes the lay of the land, those who experience vision impairment may find it difficult to navigate to a location outside the tsunami zone without assistance.

Recommended Action

- Incorporate lighting and reflective material on evacuation signs.
- Produce community information in larger text options.

Resources

- American Council for the Blind: <http://www.acb.org/large-print-guidelines>

- American Foundation for the Blind: <http://www.afb.org/info/reading-and-writing/making-print-more-readable/35>

Limited-English Proficiency

Key to an individual's ability to evacuate is access to information. Individuals with limited English proficiency may require additional guidance in their native language.

Recommended Action

- Incorporate communication education materials, in appropriate native languages, into community events and websites.

Resources

- The U.S. Department of Justice's 2016 Tips and Tools for Reaching Limited English Proficient Communities in Emergency Preparedness, Response, and Recovery: <https://www.justice.gov/crt/file/885391/download>
- The U.S. Department of Health & Human Services' Emergency Preparedness Resources for Persons with Limited English Proficiency (LEP): <https://www.hhs.gov/civil-rights/for-individuals/special-topics/emergency-preparedness/limited-english-proficiency/index.html>

Deaf or Hard of Hearing

Individuals who are deaf or hard of hearing may not respond to verbal direction or hear warning sirens.

Recommended Action

- Work with organizations who provide services to those who are deaf or hard of hearing to recognize the signs of a possible tsunami (i.e., ground shaking) and the necessity of evacuating immediately after the ground stops shaking.
- Encourage residents to get to know their neighbors and whether they will need non-verbal communication assistance.

Resources

- Emergency Preparedness for Individuals with Hearing Loss: A Family Guide, from the Vanderbilt Kennedy Center for Excellence in Developmental Disabilities: <https://vkc.mc.vanderbilt.edu/assets/files/tipsheets/emprephearinglosstips.pdf>
- The American Red Cross and NTID's Disaster Preparedness and the Deaf Community — For the Deaf, Hard of Hearing and Latened Deaf: http://www.cidrap.umn.edu/sites/default/files/public/php/332/332_brochure.pdf

5.8 Training and Exercises

Trainings and exercises are an excellent tool to help solidify provided educational materials into action.

Recommended Action

- Conduct yearly exercises with City staff to encourage awareness around their responsibilities during and after a tsunami event.
- Conduct community exercises.
- Offer frequent trainings to local businesses and community organizations.

5.9 Measuring Success

Learning what the community's awareness is about tsunamis through community surveys is an informative way to help guide education efforts.

Recommended Action

- Distribute questionnaires bi-annually to measure the baseline of public awareness and preparedness and subsequent changes to determine program effectiveness and to revise efforts. Consider encouraging participation by utilizing a raffle prize related to emergency preparedness.

Resources

- A sample Community Tsunami Awareness Survey is available here:
<http://kejian1.cmatc.cn/vod/comet/emgmt/community/media/documents/survey.pdf>

Appendices

1. Implementation Matrix and Financing Strategies
2. Evacuation Improvements Project Identification Maps
3. Beat the Wave Maps and Wave Arrival Times
4. Comprehensive Plan Policies
5. Tsunami Risk and Vulnerability Assessment
6. Online Survey Results
7. Notes from Emergency Management Committee Meeting