



Clatsop County

## Tsunami Evacuation Facilities Improvement Plan



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FINAL

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# Clatsop County Tsunami Evacuation Facility Improvement Plan

*Prepared for*

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## EXECUTIVE SUMMARY

### Introduction

The Clatsop County Tsunami Evacuation Facilities Improvement Plan (TEFIP) is rooted in the need to address the danger posed by a major earthquake and resulting tsunami to coastal Oregon communities. A Cascadia Subduction Zone (CSZ) earthquake and tsunami event along the coast of northern California, Oregon and Washington is predicted to be the largest and most destructive natural disaster to strike the United States. With much of its population living and working in the tsunami inundation area, Clatsop County is especially vulnerable to the potential impacts of a CSZ event. Recommendations within this plan aim to maximize life safety in the event of a tsunami, especially for those community members who may be most vulnerable.

While the primary focus of recommended evacuation facility improvements is to promote life safety, this plan also focuses on facilities that provide recreation benefits through the improvement or creation of trails and other recreation amenities. These facilities will provide safe evacuation routes in the event of a tsunami, as well as year-round opportunities for walking, biking, and hiking for residents and visitors of Clatsop County. Integrating recreation opportunities into the evacuation network also increases community familiarity with evacuation routes. In the event of a CSZ earthquake, evacuees will only have minutes to reach safety ahead of a tsunami. A resident or visitor who frequently uses a trail that leads to high ground will be more familiar and comfortable with that evacuation route should they need to use it. This TEFIP also makes recommendations for trail amenities, recommends locations for establishing additional assembly areas, and identifies areas of the County where vertical evacuation structures may be considered.

A video with information on the TEFIP project may be viewed here: <https://youtu.be/3E7EcbjiXgl>

### Project Goals

The goals and objectives below capture the intent of the project and reflect the critical role of evacuation facilities as part of the County's transportation system most immediately able to assist residents and visitors at risk in the event of a tsunami.

- **Safety:** Reduce risk to the community from a tsunami event by increasing convenient and accessible evacuation routes that connect at-risk communities to safe areas.
- **Connections:** Expand the connected network of hardened evacuation facilities that can also provide year-round recreational benefits.
- **Equity:** Reduce transportation-related disparities and barriers for communities at risk.
- **Collaboration:** Continue cooperation and collaboration among partners to implement and maintain a coordinated evacuation trails network and tsunami wayfinding signage for Clatsop County.

### Evacuation and Trail Facility Types

#### Trails

Trails are classified into three types for the purposes of this TEFIP: on street trails, multi-use paths, or recreational trails. This planning effort prioritizes more developed trails for evacuation routes because

they are easier to travel and are accessible to more people. However, less developed trails are recommended in areas where a recreational hiking trail is appropriate or in areas that lack other evacuation options.

Additional amenities can make trails more attractive for everyday use. Benches and seating, for example, provide opportunities for people to rest or stop and enjoy the scenery. Lighting can help make a trail feel safer in low light conditions. Some amenities can also be helpful after a seismic event. Shelters outside the inundation zone can be used for assembly areas. Wayfinding signs can point toward high ground and can include information about earthquake and tsunami resilience.

## Assembly Areas

Assembly areas provide space on high ground outside the inundation area for people to gather temporarily during a tsunami. At minimum, they provide a clear and safe place for people to come together. This requires a plot of land outside the evacuation zone, effective wayfinding signs to get people there, and regular maintenance to keep it in good condition.

Survival equipment can support evacuees at assembly areas after a tsunami event. A covered area will help people stay dry in wet weather and provide shade in hot weather. Assembly areas can also hold stashes of food, water, blankets, first aid supplies, communication devices, and other emergency items. Which survival equipment and how much to provide depends on the evacuation shed that the assembly area serves, how many people are likely to assemble there, and whether those people are likely to need support. What to provide also depends on the context of the assembly area. An area that is geographically isolated will benefit more from survival equipment than an area with nearby resources.

## Vertical Evacuation Structures

In locations where natural high ground is not available or is not practical to reach in the time before the first tsunami wave arrives, vertical evacuation structures can be appropriately designed and constructed to serve as places of refuge where many people can evacuate and remain for up to 24 hours to escape the initial and subsequent tsunami waves.

Types of vertical evacuation structures include soil berms, towers, and buildings. Vertical evacuation structures of all three types can be designed and built to serve recreational or other community functions, in addition to providing refuge in areas too far from natural high ground. Berms can be incorporated into parks and recreational areas; towers can be made for use as an accessible viewpoint to take in the coastal beauty of Clatsop County, and a rooftop evacuation platform could be located atop a variety of multistory civic, commercial, or residential buildings.

## Recommended Tsunami Evacuation Facility Improvements

**Table ES-1. Recommended Trail Alternatives**

ID & Trail Type	General Location	Description	Recommended Amenities or Features	Benefits or Constraints	Recommendation & Justification	Cost Estimate
T-01 On street (shared roadway)	Arch Cape	Continue evacuation route outside of inundation zone from E Shingle Mill Lane, north on Fire Rock Road, and east to high ground. Pave 20-foot wide roadway to improve seismic resilience.	Wayfinding	<p>This is an existing evacuation route to serve the southern area of Arch Cape, but the route does not go far enough to escape the Cascadia “XXL” inundation zone.</p> <p>Trail could connect with a future trail system in nearby forest land that is in the process of being acquired by the Arch Cape Water District.</p> <p>Local residents have recently opposed road construction unless it is associated with new permitted development.</p>	<p><b>Recommended.</b></p> <p>Criteria: Addresses evacuation need; directness of travel</p> <p>Justification: T-01 extends an existing evacuation route out of the XXL inundation zone. It is located at the south end of Arch Cape, which is vulnerable to a tsunami and has a community of residents and has lodging for visitors. The route is relatively short and is along existing roads.</p>	\$250,000
T-02 Multi Use Path (MUP)	Arch Cape	Create a trail along Oceanview Lane right of way that leads to high ground.	Wayfinding Potential assembly area	<p>The County already has the right of way here, but it has not been built out and it is not maintained.</p> <p>The County owns four parcels at the end of Oceanview Lane that are outside the inundation zone.</p> <p>Trail could connect with a future trail system in nearby forest land that is in the process of being acquired by the Arch Cape Water District.</p> <p>Local residents have recently opposed road construction unless it is associated with new permitted development.</p>	<p><b>Recommended.</b></p> <p>Criteria: Addresses evacuation need; directness of travel</p> <p>Justification: T-02 creates an evacuation route along existing County right of way. It is located toward the south end of Arch Cape, which is vulnerable to a tsunami and has a community of residents and has lodging for visitors.</p>	\$400,000

ID & Trail Type	General Location	Description	Recommended Amenities or Features	Benefits or Constraints	Recommendation & Justification	Cost Estimate
T-04 Multi Use Path	Arch Cape	Create a trail at the north end of Carnahan Road that continues north to high ground.	Wayfinding Fencing to delineate trail right of way from private property	Consider wooden steps for steep slope. Potential need for public easement. Requires coordination with owner of one parcel of private property	<b>Recommended.</b> Criteria: Addresses evacuation need; low cost increases feasibility; possible need for public easement. Justification: T-04 creates an evacuation route with a new MUP extending to high ground. It is located at the north end of Arch Cape, which is vulnerable to a tsunami and has a community of residents and has lodging for visitors.	\$100,000
T-06 Recreation	North of Gearhart	Create a trail to connect - Shady Pine Road across Neacoxie Creek to higher ground to the west.	Wayfinding Fencing to delineate trail right-of-way from private property	Potential need for easement. Requires coordination with owners of four parcels of private property. If easement for a trail cannot be obtained, consider vertical evacuation structure(s) for people west of Sunset Lake. Locations would need to be determined through analysis and with community input. Requires bridge over Neacoxie Creek, which is a Goal 5 wetland. Will require an elevated boardwalk to reduce impacts to wetland (300 foot boardwalk included in cost estimate). Likely to require environmental permitting. Will require environmental review; this area might be endangered species habitat (silverspot butterfly).	<b>Recommended.</b> Criteria: Addresses evacuation need; feasibility may be difficult because this route involves coordination with multiple property owner and potential environmental permitting. Justification: T-06 provides an evacuation route for residents in the west portion of the Surf Pines community. This area is currently constrained by Sunset Lake and private property ownership. T-06 would provide a more direct path for this community to reach high ground. Challenges: It would require coordination with owners of four properties, an environmental review, and structures to bridge the creek and wetlands. Even so, this trail connection would likely be more practical and more cost effective than building a vertical evacuation structure.	\$1,250,000

ID & Trail Type	General Location	Description	Recommended Amenities or Features	Benefits or Constraints	Recommendation & Justification	Cost Estimate
T-07 Recreation	North of Gearhart	New trail to high ground from Cullaby Lake County Park parking areas and recreation areas.	Wayfinding Benches Shade structure Associated with potential assembly area A-10	Requires a new trail in wooded hill near the beaches and parking areas. Hill may have steep slopes in some areas.	<b>Recommended.</b> Criteria: Addresses evacuation need; provides multimodal connectivity; high feasibility. Justification: T-07 provides an evacuation route for visitors to Cullaby Lake County Park and creates a new recreational trail for visitors to enjoy.	\$300,000
T-08 Recreation	North of Gearhart	New trail to high ground from Cullaby Lake Lane. Adds a pedestrian bridge over Skipanon River parallel to the existing roadway bridge.	Wayfinding Associated with proposed assembly area A-11	Current evacuation route ends within inundation zone. Short trail segment needed to reach high ground. Hillside appears steep. Trail likely to need switchbacks. Retaining walls are not included in the cost estimate. Trail could be a feature of Carnahan County Park, which is owned by Clatsop County.	<b>Recommended.</b> Criteria: Addresses evacuation need; provides benefit to residents and park visitors; high feasibility because land is publicly owned. Justification: T-08 extends an existing evacuation route out of the XXL inundation zone into Carnahan County Park.	\$300,000
T-10 Multi Use Path	Southeast of Camp Rilea	Connect the neighborhood at Glenwood Village to high ground with trail to the east.	Benches or seating for recreational use Fencing to delineate trail right of way from private property	Requires a bridge over the Skipanon River. Potential need for easement acquisition. Likely to require environmental permitting.	<b>Recommended.</b> Criteria: Addresses evacuation need; direct route to higher ground; need for bridge and environmental permitting makes the project more challenging. Justification: T-10 connects the neighborhood at Glenwood Village to high ground.	\$450,000



ID & Trail Type	General Location	Description	Recommended Amenities or Features	Benefits or Constraints	Recommendation & Justification	Cost Estimate
T-11 On street (shared roadway)	Camp Rilea	Improve Pacific Road to serve as an evacuation route.	Wayfinding Associated with proposed assembly area A-14	Needs to be coordinated with Camp Rilea.	<b>Recommended.</b> Criteria: Safety and security for people in the area; uses existing roadway; high benefit for low cost of signage. Justification: T-11 would provide an evacuation route for visitors at Camp Rilea. At some areas of the camp, the shortest/easiest route to high ground is to the west, which is not intuitive and this trail would help clarify. Existing road is paved and would only require signage/wayfinding.	<\$50,000
T-12 On street (shared roadway)	Camp Rilea	Improve Demo Road to serve as an evacuation route. Paves a 20-foot-wide roadway surface.	Wayfinding Associated with proposed assembly area A-15	Needs to be coordinated with Camp Rilea.	<b>Recommended.</b> Criteria: Safety and security for people in the area; uses existing roadway; high benefit for low cost of signage. Justification: T-12 would provide an evacuation route for visitors at Camp Rilea. At some areas of the camp, the shortest/easiest route to high ground is to the west, which is not intuitive and this trail would help clarify. Existing road is gravel and would require paving.	\$700,000
T-15 Multi Use Path	Fort Stevens	Improve existing trail to serve as evacuation route for people in park or at beach.	Wayfinding	Trail is oriented east-west and provides fairly direct route to high ground.	<b>Recommended.</b> Criteria: Addresses evacuation need; multimodal connection; potential to serve many recreational users. Justification: T-15 would provide an evacuation route for visitors at Fort Stevens State Park and would improve the existing trail for everyday use.	\$450,000

ID & Trail Type	General Location	Description	Recommended Amenities or Features	Benefits or Constraints	Recommendation & Justification	Cost Estimate
T-16 Multi Use Path	Fort Stevens	New connection from existing trail to high ground.	Wayfinding	May be steep terrain.	<b>Recommended.</b> Criteria: Addresses evacuation need; multimodal connection; potential to serve many recreational users. Justification: T-16 would provide an evacuation route for visitors at Fort Stevens State Park and would improve the existing trail for everyday use. Includes seismic upgrades to the Burma Road undercrossing.	\$400,000
T-17 Multi Use Path	Fort Stevens	New connection from existing Jetty Road parking area to high ground.	Wayfinding	May be steep terrain.	<b>Recommended.</b> Criteria: Addresses evacuation need; multimodal connection; potential to serve many recreational users from the Jetty Road parking area. Justification: T-17 would provide an evacuation route for visitors at Fort Stevens State Park and would improve the existing trail for everyday use.	\$100,000

**Table ES-2. Recommended Assembly Area Alternatives**

ID	General Location	Description	Recommended Investment Package	Benefits or Constraints	Recommendation & Justification
A-01	Arch Cape	Establish a formal assembly area at the end of the trail from Option T-01.	High Arch Cape could be quite isolated following an earthquake. This location can take advantage of the fire station nearby by stocking water, food, supplies, and other survival equipment to serve the surrounding neighborhood.	Area is available on undeveloped right of way.	<b>Recommended.</b> Provides a place for nearby residents and visitors to evacuate to. Establishes a safe ending location for the existing evacuation route. This area could become quite isolated following an earthquake.
A-02	Arch Cape	Establish a formal assembly area at the end of the trail from Option T-02.	Medium Shelters, benches, and lighting	Area is available on undeveloped right of way.	<b>Recommended.</b> Provides a place for nearby residents and visitors to evacuate to.
A-03	Arch Cape	Establish a formal assembly area at the end of the evacuation route on Buena Vista Drive from Option T-03.	Minimum	An assembly area would indicate that evacuees have made it to a safe place. Area appears to be privately owned but undeveloped.	<b>Recommended.</b> Provides a place for nearby residents and visitors to evacuate to.
A-04	Arch Cape	Establish a formal assembly area at the end of the trail from Option T-04.	Minimum	An assembly area would indicate that evacuees have made it to a safe place. Area appears to be privately owned but undeveloped.	<b>Recommended.</b> Provides a place for nearby residents and visitors to evacuate to.

ID	General Location	Description	Recommended Investment Package	Benefits or Constraints	Recommendation & Justification
A-07	North of Gearhart	Establish one or multiple formal assembly areas along Polo Ridge Road.	Medium Shelters, benches, and lighting could also serve as everyday amenities for residents of Pole Ridge Road. This area is surrounded by low ground expected to be inundated.	Polo Ridge Road is on a narrow ribbon of high ground above the inundation zone. This is the most accessible high ground for most of the Surf Pines community. Multiple assembly areas spaced along the road to maximize accessibility is preferred. Much of the property along the road is developed with homes, and some of the space is required landscape buffer. Some parcels of undeveloped land may be common spaces for the subdivision, opportune locations for assembly areas pending coordination with the landowner (Clatsop Estates LLC).	<b>Recommended.</b> Provides a place for nearby residents to evacuate to. Amenities could be features for everyday use by nearby residents. This area is surrounded by low ground expected to be inundated.
A-08	North of Gearhart	Establish a formal assembly area at the end of the trail from Option T-06.	Minimum Though this area is surrounded by low ground, it is approximately one half mile from A-07 on the same patch of high ground.	Land appears to be privately owned but undeveloped.	<b>Recommended.</b> This provides a place for nearby residents to evacuate to. Evacuees could walk to A-07 for additional amenities during non-emergency situations.
A-09	North of Gearhart	Establish one or multiple formal assembly areas near West Lake Acres Drive.	High This location can take advantage of the fire station by stocking water, food, supplies, and other amenities to serve the surrounding neighborhood. This area is surrounded by low ground expected to be inundated.	Could co-locate with Gearhart Rural fire station. Multiple assembly areas spaced along the road to maximize accessibility is preferred. Constraints: this area is near wetlands and potential habitat for a federally listed threatened species.	<b>Recommended.</b> Provides a place for nearby residents to evacuate to. The fire station is an ideal opportunity to also provide other amenities. This area is surrounded by low ground expected to be inundated.
A-10	North of Gearhart	Establish an assembly area on the wooded hill in Cullaby Lake County Park that connects with T-07.	Medium Shelters, benches, and lighting would also serve as everyday amenities for Cullaby Lake County Park.	A majority of the park land is owned by the Finlandia Foundation. A portion of the land is owned by Clatsop County.	<b>Recommended.</b> Provides a place to evacuate for visitors to Cullaby Lake. Also provides amenities for park visitors.

ID	General Location	Description	Recommended Investment Package	Benefits or Constraints	Recommendation & Justification
A-11	North of Gearhart	Establish a formal assembly area at the end of the trail from Option T-08.	Medium Shelters, benches, and lighting would also serve as everyday amenities for Carnahan County Park.	Land is Carnahan Park, owned by Clatsop County.	<b>Recommended.</b> Provides a place to evacuate for residents of North Cullaby Lake and visitors of Cullaby Lake Park. Amenities could be integrated into the park's trail system.
A-13	East of Camp Rilea, east of Hwy 101	Establish a formal assembly area at the end of the trail from Option T-10.	Minimum	Well connected with existing roads. Could serve as evacuation point for several neighborhoods.	<b>Recommended.</b> Provides a place to evacuate for nearby neighborhood residents.
A-14	Camp Rilea	Establish a formal assembly area along Pacific Road in Camp Rilea. Connects with Option T-11.	Medium Shelters, benches, and lighting can serve as features of Camp Rilea. This area is surrounded by low ground expected to be inundated.	Well connected with existing roads. Needs to be coordinated with Camp Rilea.	<b>Recommended.</b> Provides a place to evacuate for visitors to Camp Rilea. Amenities could be features for everyday visitors of Camp Rilea. This area is surrounded by low ground expected to be inundated.
A-15	Camp Rilea	Establish a formal assembly area along Demo Road in Camp Rilea. Connects with Option T-12.	Medium Shelters, benches, and lighting can serve as features of Camp Rilea. This area is surrounded by low ground expected to be inundated.	Well connected with existing roads. Needs to be coordinated with Camp Rilea.	<b>Recommended.</b> Provides a place to evacuate for visitors to Camp Rilea. Amenities could be features for everyday visitors of Camp Rilea. This area is surrounded by low ground expected to be inundated.
A-16	Camp Rilea	Establish a formal assembly area along 2nd Causeway Road near the south intersection with Cev Road in Camp Rilea.	Medium Shelters, benches, and lighting can serve as features of Camp Rilea. This area is surrounded by low ground expected to be inundated.	Well connected with existing roads. Needs to be coordinated with Camp Rilea.	<b>Recommended.</b> Provides a place to evacuate for visitors to Camp Rilea. Amenities could be features for everyday visitors of Camp Rilea. This area is surrounded by low ground expected to be inundated.
A-17	Camp Rilea	Establish a formal assembly area for Option T-13 along 2nd Causeway Road near the north intersection with Cev Road in Camp Rilea.	Minimum A-17 is approximately 1,500 feet north of A-16 and on the same patch of high ground.	Well connected with existing roads. Needs to be coordinated with Camp Rilea.	<b>Recommended.</b> Provides a place to evacuate for residents of Spirit Place and Douglas Lane as well as for visitors to Camp Rilea. A-17 is approximately 1,500 feet north of A-16 and on the same patch of high ground.

ID	General Location	Description	Recommended Investment Package	Benefits or Constraints	Recommendation & Justification
A-18	North of Camp Rilea	Establish a formal assembly area at the south end of Smith Lake County Park; provide signage identifying high ground.	Minimum	Can be co-located with Smith Lake County Park. Potential wetlands in the west part of the park. The south end of the neighborhood is roughly one-half mile from the proposed assembly area, consider a vertical evacuation structure to serve this area (V-03)	<b>Recommended, low priority.</b> Provides a place to evacuate for residents of Smith Lake Road.
A-19	North of Camp Rilea	Establish a formal assembly area along Whiskey Road to serve neighbors on the northeast side of Smith Lake.	Minimum	Located on platted, but undeveloped right of way. Adjacent to Warrenton city limits. Coordinate with the City of Warrenton.	<b>Recommended.</b> Provides a place for nearby residents and visitors to evacuate to.
A-20	Fort Stevens	Establish a formal assembly area on this ridge of high ground to serve the trails in Options T-15, T-16, and T-17.	Medium Shelters, benches, and lighting can serve as features of Fort Stevens State Park.	Evacuation shed may be large for this location when the park hosts many visitors.	<b>Recommended.</b> Provides a place to evacuate for visitors to Fort Stevens State Park. Amenities can serve as everyday features of the park.

**Table ES-3. Recommended Vertical Evacuation Structure Areas**

ID	Type	General Location	Description	Recommended Amenities or Features	Benefits or Constraints	Recommendation
V-01	Vertical structure	North of Gearhart	Area north of Gearhart is not well connected and requires traversing long distances to reach high ground.	Wayfinding, solar charging, communications.	Placement should be considered through community outreach.	<b>Recommended.</b>
V-02	Vertical structure	North of Gearhart	Area is separated from high ground by Sunset Lake. Requires traveling long distances to evacuate the inundation zone. Consider vertical evacuation structures.	Wayfinding, solar charging, communications.	Placement should be considered through community outreach.	<b>Recommended.</b>
V-03	Vertical structure	Camp Rilea	Beach area is nearly one-half mile to high ground.	Wayfinding, solar charging, communications.	Placement should be considered through community outreach and coordination with Camp Rilea.	<b>Recommended.</b>
V-04	Vertical structure	South of Warrenton	The community at the southwest end of Smith Lake is roughly one-half mile from high ground.	Wayfinding, solar charging, communications.	Placement should be considered through community outreach. Option A-17 proposes an assembly area at the high ground on the north end of the community.	<b>Recommended.</b>
V-05	Vertical structure	Jeffers Garden	Area is surrounded by water and not well connected to high ground.	Wayfinding, solar charging, communications.	Placement should be considered through community outreach.	<b>Recommended.</b>
V-06	Vertical structure	Miles Crossing	Area is surrounded by water and not well connected to high ground.	Wayfinding, solar charging, communications.	Placement should be considered through community outreach.	<b>Recommended.</b>
V-07	Vertical structure	Clatsop Spit	The Clatsop Spit is long, flat, and vulnerable to a tsunami. It is also popular with visitors of Fort Stevens State Park.	Wayfinding, solar charging, communications.	Placement should be considered through community outreach and coordination with Fort Stevens State Park.	<b>Recommended.</b>

## Implementation

Evacuation route improvements may be implemented through a variety of approaches. An important first step is ensuring that the goals and recommendations within the TEFIP are consistent with county policy and regulations. The county should amend its planning documents to reflect the goals of the TEFIP and support the development of recommended evacuation facility improvements. This should include adding supportive goals and policies in the Clatsop County Comprehensive Plan, incorporating transportation network improvements into the Clatsop County Transportation System Plan (TSP), and making amendments to the Clatsop County Land and Water Development and Use Code to support the goals and recommendations within the TEFIP.

Assembly areas are a critical part of evacuation system infrastructure, as they provide a gathering place and survival equipment for evacuees in the event of a tsunami. A vital first step in implementation is for the County to designate land for each assembly area and negotiate with private property owners to obtain easements, if needed. Dedicating space for an assembly area should be considered a condition of development for new subdivisions or major development occurring in area of high ground that may be used during an evacuation. Signage should be placed at each assembly area location, so evacuees will know when they have reached safety.

Many jurisdictions have had success in encouraging neighborhoods and communities to create and maintain their own local supply caches. The county should consider establishing a program that would assist communities in establishing their own supply caches at the assembly area they will use in the event of a tsunami. Supporting community ownership of supply caches has the added benefit of increasing familiarity with tsunami assembly areas and evacuation procedures.

To implement vertical evacuation structures, we recommend that Clatsop County build upon the success of Washington's Project Safe Haven. The County should leverage the work completed as part of this current TEFIP planning effort to develop a community engagement process and implementation strategy to determine the desired locations for vertical evacuation structures. The plan would develop initial tsunami vertical evacuation options and associated budgetary needs for planning, design, construction, maintenance, and management.



# 1. INTRODUCTION AND BACKGROUND

## 1.1 Introduction

The Clatsop County Tsunami Evacuation Facilities Improvement Plan (TEFIP) is rooted in the need to address the danger posed by a major earthquake and resulting tsunami to coastal Oregon communities. A Cascadia Subduction Zone (CSZ) earthquake and tsunami event along the coast of northern California, Oregon and Washington is predicted to be the largest and most destructive natural disaster to strike the United States. With much of its population living and working in the tsunami inundation area, Clatsop County is especially vulnerable to the potential impacts of a CSZ event. Recommendations within this plan aim to maximize life safety in the event of a tsunami, especially for those community members who may be most vulnerable.


While the primary focus of recommended evacuation facility improvements is to promote life safety, this plan also focuses on facilities that provide recreation benefits through the improvement or creation of trails and other recreation amenities. These facilities will provide safe evacuation routes in the event of a tsunami, as well as year-round opportunities for walking, biking, and hiking for residents and visitors of Clatsop County. Integrating recreation opportunities into the evacuation network also increases community familiarity with evacuation routes. In the event of a CSZ earthquake, evacuees will only have minutes to reach safety ahead of a tsunami. A resident or visitor who frequently uses a trail that leads to high ground will be more familiar and comfortable with that evacuation route should they need to use it. This TEFIP also makes recommendations for trail amenities, recommends locations for establishing additional assembly areas and identifies areas of the County where vertical evacuation structures may be considered.

This TEFIP was developed through engagement with county staff, elected and appointed officials, key stakeholders, and Clatsop County community members. This plan assesses the risk and vulnerability of the County's transportation system; analyzes existing evacuation facilities and needs for improvement; identifies, evaluates, and selects highest priority evacuation facility improvements; and prioritizes options that provide dual use and year-round community benefit.

## 1.2 TEFIP Purpose

The primary objective of a TEFIP is to identify tsunami evacuation routes and provide for development of infrastructure needed to facilitate and improve effective evacuation. The County's coastal cities of Astoria, Warrenton, Gearhart, Seaside, Cannon Beach, and numerous unincorporated communities are vulnerable to the risks of earthquake and tsunami. In addition to damage from the earthquake itself, an accompanying tsunami could inundate low-lying coastal areas. The Oregon Department of Geology and Mineral Industries (DOGAMI) has mapped the tsunami inundation hazard areas and has developed a series of maps and evacuation scenarios to assist coastal community planning and preparedness efforts.

Increasing tsunami resilience through local planning is a major priority of Clatsop County. Extensive tsunami resilience efforts have been completed in the project study area. County staff and stakeholders are working to address tsunami hazards through land use planning policies and regulations. The County has initiated an emergency wayfinding signage program and adopted its Multi-Jurisdictional Natural Hazard Mitigation Plan in March 2021. County planning staff have completed work to identify a Tsunami Hazard Overlay Zone, although this has not been adopted by the Board of Commissioners. The County is also in the process of updating its comprehensive plan, including Goal 7, Natural Hazards Mitigation.



The results of the County's on-going resilience work have been incorporated into or referenced by the TEFIP, particularly in identifying evacuation and co-located recreational improvements. The TEFIP identifies and prioritizes dual-use routes that can both serve as emergency evacuation routes and as year-round facilities, such as off-road bike paths, hiking and equestrian trails. The plan focuses on planned and existing routes, including underutilized or underpublicized trails and rights-of-way, as well as strategic recommendations for new trails or routes, where no suitable trails or evacuation routes exist today.

## 1.3 Process Summary

This TEFIP was created with input from county staff, elected and appointed officials, key stakeholders, subject matter experts, and Clatsop County community members. The planning process included the following tasks:

### 1.3.1 Public Outreach and Engagement

Outreach to and engagement with Clatsop County occurred throughout the project, with three online open houses and three webinars occurring at key milestones in the process. The plan was guided by a Project Advisory Committee (PAC) consisting of representatives from local, county, state, and tribal agencies, community groups, and other area stakeholders.

In addition to the major engagement events, project information was provided on the project website ([www.clatsopTEFIP.org](http://www.clatsopTEFIP.org)), a project information video, and a project fact sheet. Information was provided in both English and Spanish. The project team coordinated with Consejo Hispano, an Astoria-based community organization, to engage with the Hispanic community in Clatsop County throughout the planning process.

### 1.3.2 Define Goals and Project Objectives

Goals and objectives for the TEFIP and planning process were developed based on ongoing hazard mitigation planning and through conversations with County staff, leaders, stakeholders, and the community. These goals and objectives guided the creation of the plan and the ultimate TEFIP recommendations.

### 1.3.3 Understanding Existing Conditions

The project team examined the existing tsunami evacuation network, including gaps in the network and potential opportunities for improvements. Community demographics were analyzed to identify potentially vulnerable groups that may need additional resources for effective evacuation in the event of a tsunami. This stage of the planning process included documentation of land uses and natural and cultural resources in the study area, as well as a review of previous and ongoing relevant tsunami resilience planning efforts.

### 1.3.4 Develop Evacuation and Trail Options

Based on existing conditions research and community feedback, the project team identified and mapped potential tsunami evacuation facility improvements, including trails, assembly areas, and vertical evacuation structures. Potential improvements were evaluated using screening criteria developed in coordination with county staff and stakeholders.

### 1.3.5 Identify Preferred Evacuation and Trail Options

Final recommended evacuation facilities were determined through screening criteria assessment and input from county staff, the PAC, the County Board of Commissioners, and public feedback. The project team developed cost estimates for each of the preferred facilities.

## 1.4 Goals, Objectives, and Evaluation Criteria

### 1.4.1 Project Goals and Objectives

The goals and objectives below capture the intent of the project outlined in the project scope, as well as goals identified in the County's recently adopted Hazard Mitigation Plan (2021). The goals and objectives reflect the critical role of evacuation facilities as part of the County's transportation system most immediately able to assist residents and visitors at risk in the event of a tsunami. Core objectives provide a step-wise approach to developing the TEFIP and are based on core objectives outlined in the project scope.

#### 1.4.1.1 Project Goals

- **Safety:** Reduce risk to the community from a tsunami event by increasing convenient and accessible evacuation routes that connect at-risk communities to safe areas.
- **Connections:** Expand the connected network of hardened evacuation facilities that can also provide year-round recreational benefits.
- **Equity:** Reduce transportation-related disparities and barriers for communities at risk.
- **Collaboration:** Continue cooperation and collaboration among partners to implement and maintain a coordinated evacuation trails network and tsunami wayfinding signage for Clatsop County.

### 1.4.2 Core Objectives

- Assessment
  - Assess tsunami risk and vulnerability of the County's transportation infrastructure
  - Determine evacuation needs
  - Evaluate existing evacuation facilities
- Improvements
  - Identify and prioritize needed improvements to evacuation facilities, including evacuation route easement dedications and reservation
  - Prioritize trail options that provide dual use and year-round benefits
  - Identify design considerations, constraints, and recommendations for tsunami evacuation facilities
- Implementation
  - Develop an implementation strategy to prioritize and phase trail improvements
- Engagement
  - Develop and implement a robust community engagement process

### 1.4.3 Evaluation Criteria

Evaluation criteria in Table 1 are based on the project objectives and were used to evaluate and screen trail concepts, design and amenities. Each criterion was evaluated using an evaluation scale as follows:

- Project/alternative meets or fully addresses the criterion
- ◐ Project/alternative partially meets or addresses the criterion
- Project/alternative does not meet or has negative impacts with respect to the criterion

N/A Not applicable

These criteria were applied to screen out those alternatives that should not move forward in the process. Additionally, weighting of the criteria is proposed in the table; weighting indicates how some criteria were emphasized in the screening process.

**Table 1. Screening Criteria**

Subject	Criteria	Measure	Weighting
User experience	Provides the most comfortable and enjoyable user experience	Degree of separation from auto traffic and/or recreational value	
Safety and security	Provides a clear tsunami evacuation benefit	Follows existing evacuation route or facilitates new/enhanced evacuation connection; and/or project increases access to existing assembly areas	3x
Multimodal connectivity	Increases connectivity of the multimodal network	Increases network connectivity	
Planning, land use, and regulatory impacts	Aligns with the existing County land use plans	Project is compatible with the Comprehensive Plan and TSP	
Property ownership impacts	Minimizes impacts to private property owners	Project would rely on existing ROW and/or require minimal or no new easements	
Directness of travel	Supports directness of evacuation routes	Supports directness of evacuation routes or increases connectivity of the evacuation network so as to reduce evacuation clearance times	
Cost and funding availability	Relative cost and likelihood of funding with grants	Project is low-cost relative to benefit provided and/or has a high likelihood of being funded through grants	
Infrastructure hardening	Increases the resiliency of the existing infrastructure system	Project would increase infrastructure resiliency, including hardening of other transportation system features	
Phasing opportunities	Project may be phased so as to facilitate incremental benefit	Project could be phased to implement useable segment/elements incrementally (or not)	
Accessibility	Facilitates connections for people with physical disabilities	Project is ADA accessible (or not)	2x
Populations served	Enhances evacuation routes or connections for unincorporated communities	Project would provide an evacuation/recreation benefit to a relatively large number of people, and/or to vulnerable populations*	2x

Notes:

\*"Vulnerable populations" includes Environmental Justice and Title VI communities, including those that are racial or ethnic minorities, have disabilities, are younger (<18) or older (>65) adults, do not have access to a car, are low income, or have limited English proficiency

#### 1.4.4 Prioritization Criteria

Once trail, amenities, and design alternatives were developed and screened, the project team prioritized investments based on the criteria in Table 2. These criteria are based on the project goals and objectives. Projects are prioritized by timeframe for implementation, with near-term corresponding to higher priority and more easily implemented projects, with long-term corresponding to more costly and difficult to implement projects.

**Table 2. Prioritization Criteria**

Subject	Criteria
Timeframe for implementation	Relative implementation timeframe, based on ability to fund, design, permit, and implement the project: <ul style="list-style-type: none"><li>• Near-term (0-5 years)</li><li>• Medium-term (5-10 years)</li><li>• Long-term (10+ years)</li></ul>
Feasibility	Relative feasibility, based on assessment of: <ul style="list-style-type: none"><li>• Public support</li><li>• Cost</li><li>• Need for easements</li><li>• Environmental/permitting considerations</li><li>• Engineering complexity</li><li>• Ability to phase the project</li></ul>
Relative need	Addresses a documented evacuation and/or multimodal connectivity need, based on assessment of gaps in the existing evacuation and multimodal route network and on public/stakeholder feedback
Relative benefit to communities	Provides a high level of benefit, based on assessment of: <ul style="list-style-type: none"><li>• Degree of need</li><li>• Evacuation and multimodal connectivity benefit relative to cost</li><li>• Degree to which vulnerable populations would benefit</li><li>• Public and stakeholder feedback</li></ul>
Potential for grant funding	Project has a high likelihood of being funded through one or more grant programs

### 1.5 Study Area

The study area for this project extends ¼ mile inland from the edge of the “local” tsunami inundation zone. The local inundation zone that informs the project study area is the “Local Cascadia Earthquake and Tsunami.” This local Cascadia earthquake and tsunami inundation area is based on the worst-case scenario Cascadia subduction earthquake (also identified by DOGAMI as the “XXL tsunami”). This local tsunami generated by an earthquake just off the Oregon Coast is of very large magnitude and thus the inundation area is much larger. Also, unlike a distant tsunami that can be predicted several hours prior to its arrival, this local tsunami can strike the coast within 15 – 20 minutes after the ground stops shaking from the earthquake.

The focus of all evacuation planning is life safety. Because life safety risk is present in all areas potentially subject to inundation during a tsunami event, this project will use the “Local Cascadia Earthquake and Tsunami” (“XXL”) as the design event for evacuation facility planning. This means that evacuation planning and facility development will be based on the worst-case scenario, which is consistent with the purpose of the TEFIP to help ensure that all areas potentially subject to tsunami inundation can be effectively evacuated.

### 1.5.1 Key Characteristics

Clatsop County, Oregon extends more than 30 miles north to south along the Pacific Ocean to the mouth of the Columbia River. The study area includes portions of all five of the County's cities (Astoria, Warrenton, Gearhart, Seaside, and Cannon Beach); unincorporated coastal communities (including Arch Cape); multiple state parks; the Astoria Regional Airport; and the Camp Rilea Military Reservation. The focus of the TEFIP is on unincorporated areas of Clatsop County, but connections to and beyond the limits of incorporated cities were considered.

Future land use reflects the mix of urban and rural areas within coastal Clatsop County and includes designations for future residential and commercial growth areas, conservation areas and resource lands.

#### *Community Assets*

The study area includes portions of multiple water districts (excluding incorporated cities). The study area includes portions of three school districts, including Astoria School District #1, Warrenton-Hammond School District #30 and Seaside School District #10. The Sunset Empire Park & Recreation District covers much of the central Clatsop County coastal areas, extending from just south of Sunset Beach State Recreation Site to just north of Cannon Beach, excluding the communities of Gearhart, Cannon Beach, Tolvana Park and the southern coast (from Tolvana Park to the Tillamook County Line).

Coastal Clatsop County is served primarily by the US 101 highway corridor, which runs north-south along the coast. The highway is located within DOGAMI's local tsunami inundation area for much of its length. US 26 connects to US 101 just east of Ecola State Park, north of Cannon Beach, connecting coastal communities to the Portland region. The County maintains an extensive road network. The Oregon Coast Bike Route follows US 101 for its entire length in Clatsop County.

Clatsop County has an extensive recreational trail network, managed by a variety of entities (cities, Oregon state parks, Oregon Coast Trail), and many of the trails are located near the coast. Private timber companies allow the use of many of their roads for hiking and hunting via a free permit system.

There are more than a dozen schools within the study area, including preschools, elementary, middle and high schools and the Clatsop Community College Seaside campus.

### 1.5.2 Earthquake and Tsunami Event

This plan considers the potential impacts from a local earthquake event (Cascadia Subduction Zone XXL earthquake and tsunami). DOGAMI has recently completed detailed evacuation time and distance modeling, called "Beat the Wave." Mapping produced by DOGAMI is the definitive source of information for the identification of areas subject to tsunami inundation.<sup>1</sup> DOGAMI has produced several map products depicting tsunami inundation for the Oregon coast:

- [Tsunami Inundation Maps](#) (TIM's) depict the projected tsunami inundation zone from five different magnitude seismic events and resulting tsunamis: small, medium, large, extra-large, or extra extra-large (S, M, L, XL, XXL) events. These different modeled events are associated with differing levels of risk in terms of the relative likelihood of tsunami inundation.

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<sup>1</sup> Tsunami Planning, Department of Land Conservation and Development.  
<https://www.oregon.gov/LCD/OCMP/Pages/Tsunami-Planning.aspx>

- [Tsunami Evacuation Maps](#) 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 (from Alaska); yellow for the largest expected local tsunami (corresponding to the DOGAMI “XXL” scenario); and green for safety (or high ground).
- [Beat the Wave](#): DOGAMI has completed detailed tsunami evacuation modeling for several coastal communities to determine the best routes to “beat the wave” to safety for a local tsunami event, also based on the XXL “worst case scenario.” These maps show areas of expected tsunami inundation, the most efficient routes to reach safety, and how fast one must travel to get there.
  - For Clatsop County, Beat the Wave evacuation modeling has been completed for Seaside, Gearhart and Warrenton/Hammond, but is not currently available for the rest of the County.

### 1.5.3 Existing and Planned Evacuation Routes

The County has an established network of evacuation routes. The cities of Warrenton and Seaside have additional designated evacuation routes that have been mapped. Both cities have evacuation route scenarios that show available routes. There may be additional evacuation routes that the project team has not received.

## 2. EXISTING CONDITIONS

The project team assessed existing conditions within the study area to inform analysis of evacuation route options and the development of final plan recommendations. Relevant plans and policies from the federal, state, county, and local levels were reviewed to provide a planning context for the project. This section describes existing evacuation routes and trail networks in the project area, along with a discussion of gaps and potential opportunities. These were considered by looking at existing facilities superimposed with the tsunami inundation zones developed by DOGAMI. Also included are a summary of land uses, natural and cultural resources, and demographics of the project area.

### 2.1 Inventory of Evacuation Routes and Trails

This section provides an inventory of existing evacuation routes and known trails in the project area. These were analyzed to identify gaps in the networks, potential vulnerabilities, and opportunities for improvements. In addition to the maps included in this section, the inventory and analysis are mapped in detail in the companion [web map](#).

#### 2.1.1 Designated Evacuation Routes

Clatsop County has roads designated as evacuation routes. These may be signed, as seen in Photograph 1, and often, but not always, lead out of the XXL inundation zone. Designated evacuation routes are illustrated in Figure 1, Figure 2, and Figure 3.



Designated evacuation routes in unincorporated Clatsop County use roadways. The road network has relatively few east-west connections, which is often the most direct route to higher ground. Additionally, several long bodies of water are oriented parallel to the coast north of Gearhart, inhibiting east-west connections. Existing bridges over these waterways were built before current seismic standards and may be vulnerable to an earthquake and its effects (including liquefaction).

### 2.1.2 Trails

Known existing trails are mapped in Figure 1, Figure 2, and Figure 3. Few trails are positioned to make practical evacuation routes. One such trail is the Fort to Sea Trail that connects Fort Clatsop National Memorial with Sunset Beach State Recreation Area. The Fort to Sea Trail provides a relatively direct route to high ground from Sunset Beach where there are no roads. It could also provide a route for the residents of the community on US 101 near Camp Rilea. The trail uses a bridge over Sunset Lake.

The Oregon Coast Trail that leads into the north portion of Oswald West State Park may provide a way for people in Arch Cape to get out of the inundation zone, though the landslide risk is high at this segment of the Oregon Coast Trail. An alternative route that heads south on the street grid may be more desirable because it is more direct, offers more space to congregate, and has a lower landside risk.

The trail system in Ecola State Park is fully outside the inundation zone and does not connect to where people will be evacuating. Much of the park is also in an area of moderate to high landslide risk. Most of the trails in Fort Stevens State Park are within the boundaries of the City of Warrenton, as are the small areas of high ground where it would be safe to assemble.

Based on input from Advisory Committee members, two additional trail opportunities have been identified for exploration:

- Arch Cape Community Forest – the community of Arch Cape is acquiring many hundreds of acres of forest land for a community forest in 2022. The effort will include formal planning for recreational and ecological resources within the forest. Existing logging roads could be designated and upgraded to trails that serve as evacuation routes, where appropriate.
- Delaura Beach Road provides access to the beach near Camp Rilea and could be improved as an evacuation route. Road improvements have not been planned or made because the route crosses a wetland, but the route exists and provides an existing connection from the beach.


### 2.1.3 Assembly Areas

Tsunami assembly areas are designated along the coastal areas of the County and are shown in Figures 1-6. Many of these are in areas with moderate to high landslide risk or in areas highly susceptible to liquefaction. Assembly areas are concentrated near populated areas and most are within incorporated cities. Those in unincorporated Clatsop County are near Arch Cape (seven locations), near Sunset Lake and Camp Rilea (four locations), and south of Astoria near the Lewis and Clark River and the Youngs River (seven locations). The



**Photograph 1. Tsunami Evacuation Route Sign Outside Seaside** (Source: Google Streetview)





portion of the coast from Gearhart north to Fort Stevens is relatively flat and close to sea level. Assembly areas here are located on narrow ridges or small hills that are projected to be just above the inundation level. Those ridges in the north portion of Gearhart are below the inundation level.

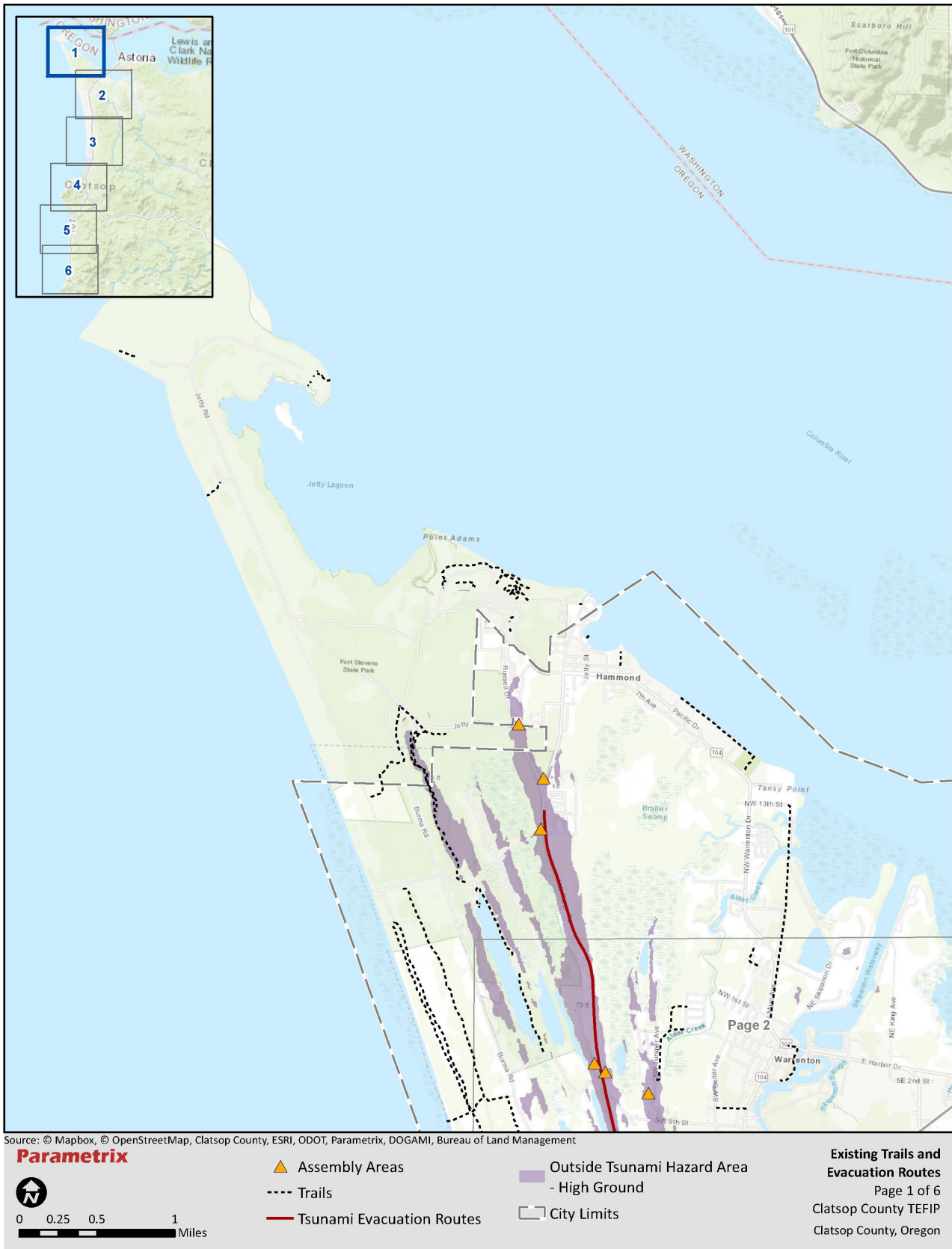
#### 2.1.4 Additional Evacuation Route Resources

DOGAMI has also developed evacuation maps to show locations of high ground and directions for getting there for the entire coastal area of Clatsop County. These show the inundation area, assembly areas, and arrows pointing to the nearest high ground. The maps use existing roads and may or may not use designated evacuation routes. DOGAMI's "Beat the Wave" maps take this a step further by looking at areas in more detail and estimating the speed one must travel to escape the inundation zone. Beat the Wave maps are developed for Seaside, Gearhart, and Warrenton and the Clatsop Spit. Beat the Wave analysis is included in the web map for these four communities.

The City of Cannon Beach created a series of pedestrian evacuation route maps for each of the City's neighborhoods<sup>2</sup>. Routes lead to designated assembly areas. This evacuation network is contained within the incorporated City.

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<sup>2</sup> The City of Cannon Beach, "Tsunami Evacuation: Pedestrian Route Maps" (2012)  
<https://www.ci.cannon-beach.or.us/emergencymanagement/page/tsunami-evacuation-pedestrian-route-maps>



**Figure 1. Existing Trails and Evacuation Routes: Page 1**

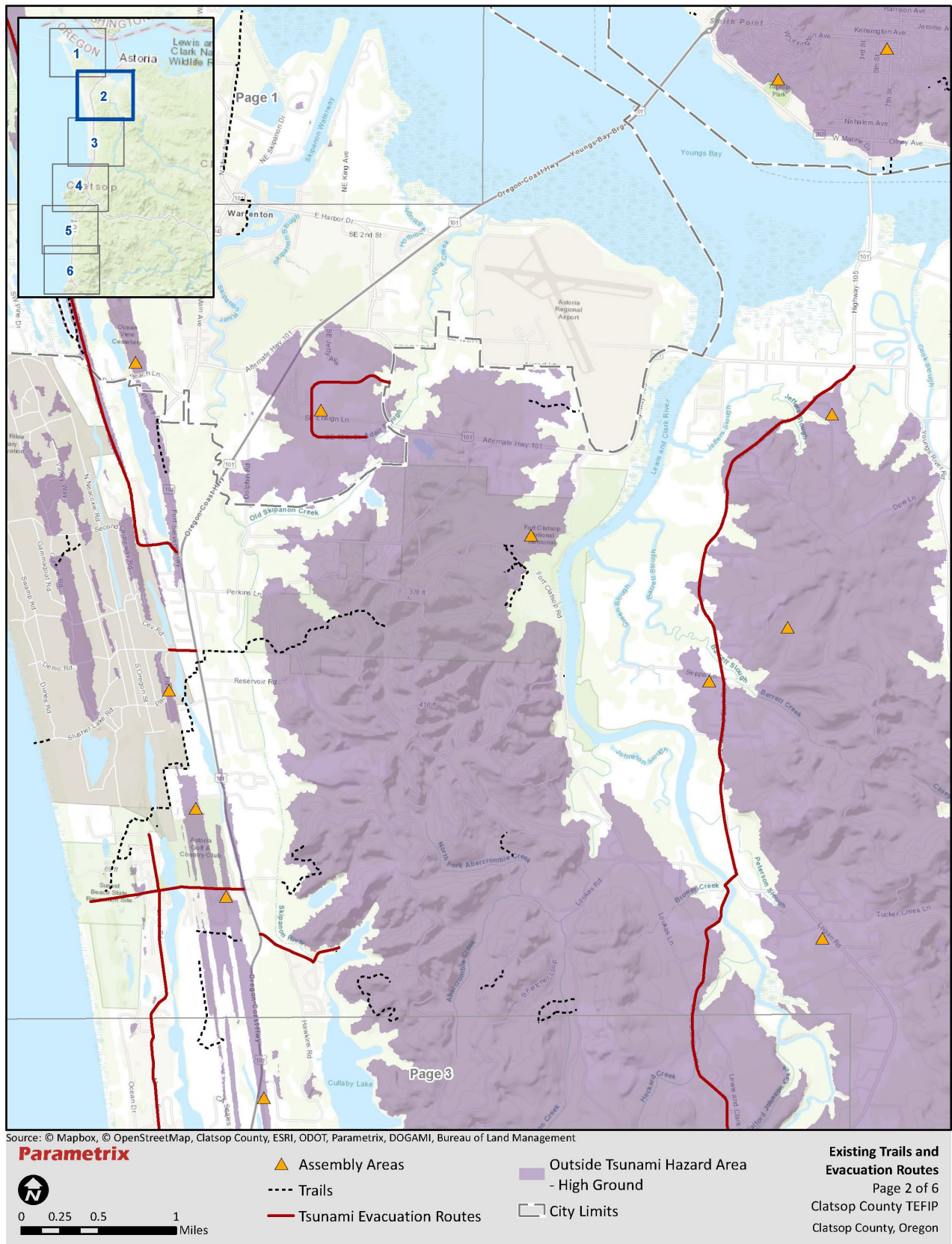


Figure 2. Existing Trails and Evacuation Routes: Page 2



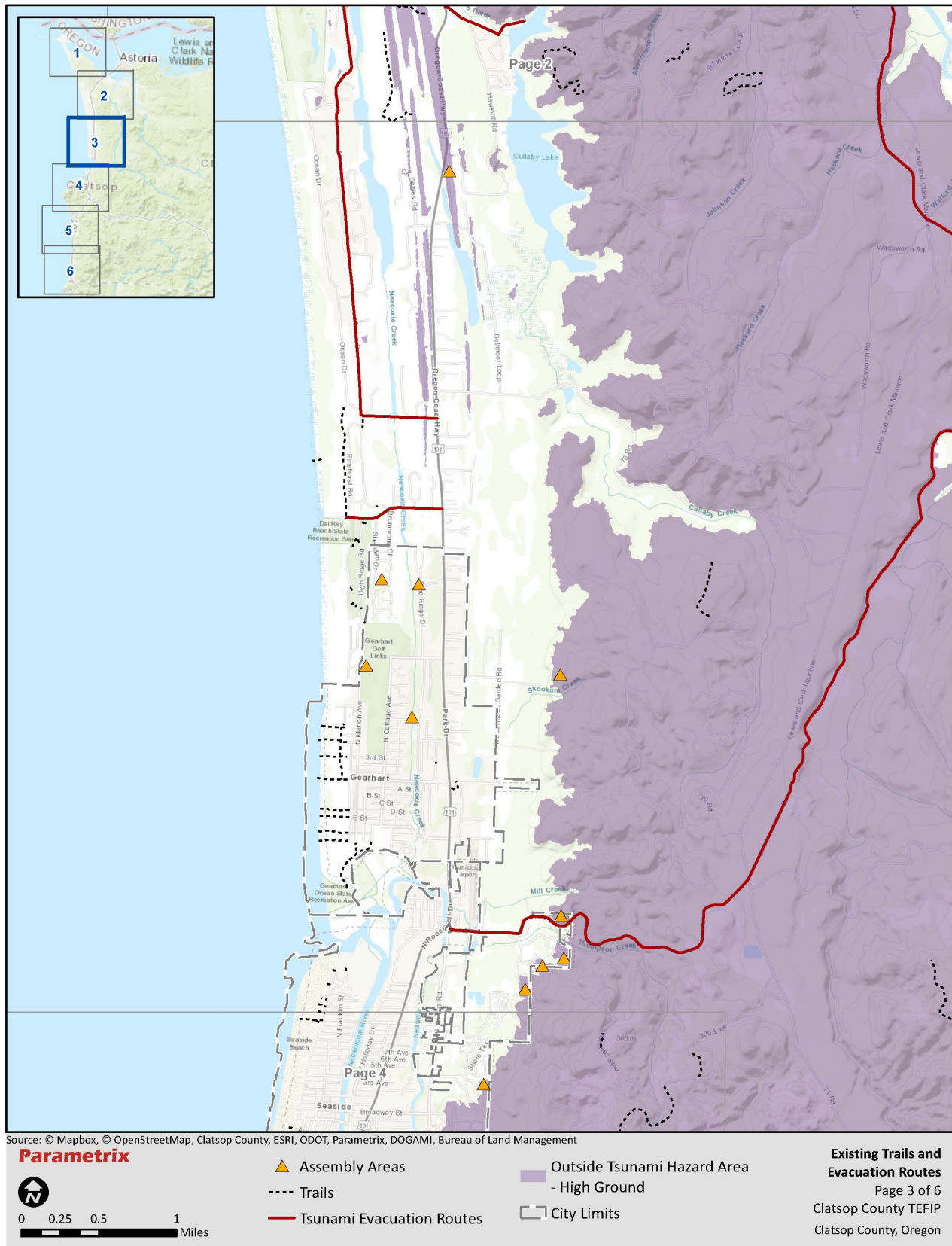


Figure 3. Existing Trails and Evacuation Routes: Page 3

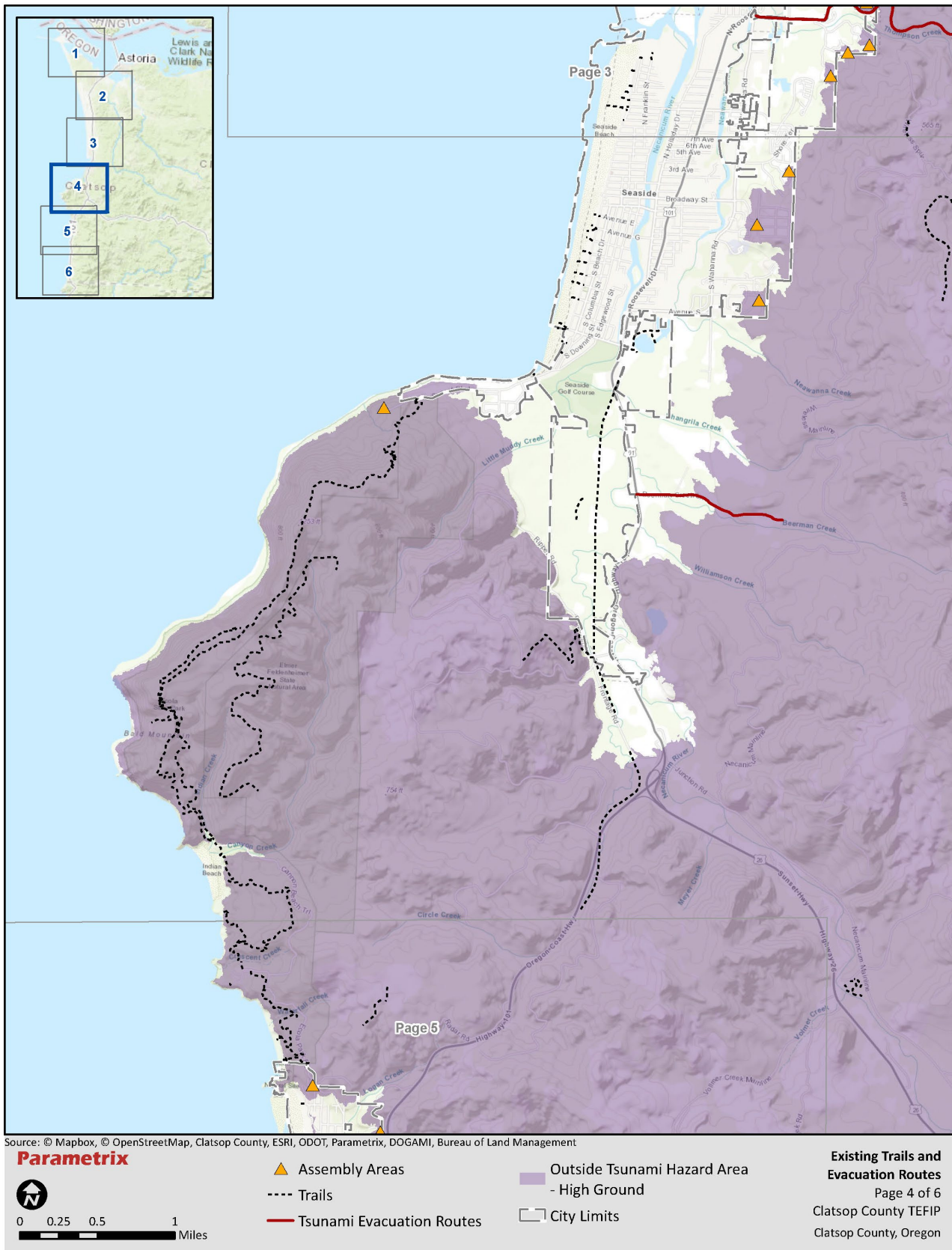


Figure 4. Existing Trails and Evacuation Routes: Page 4



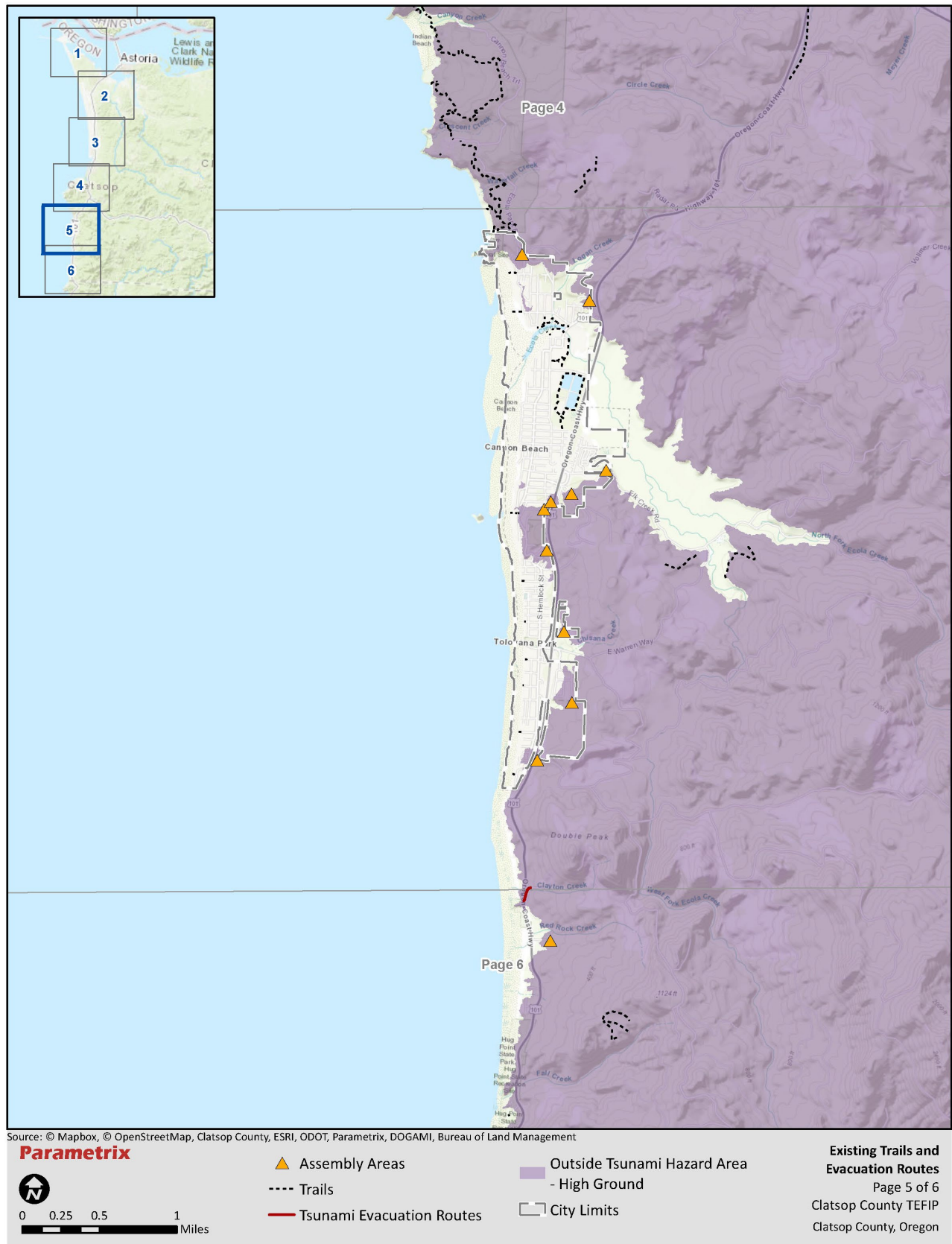


Figure 5. Existing Trails and Evacuation Routes: Page 5

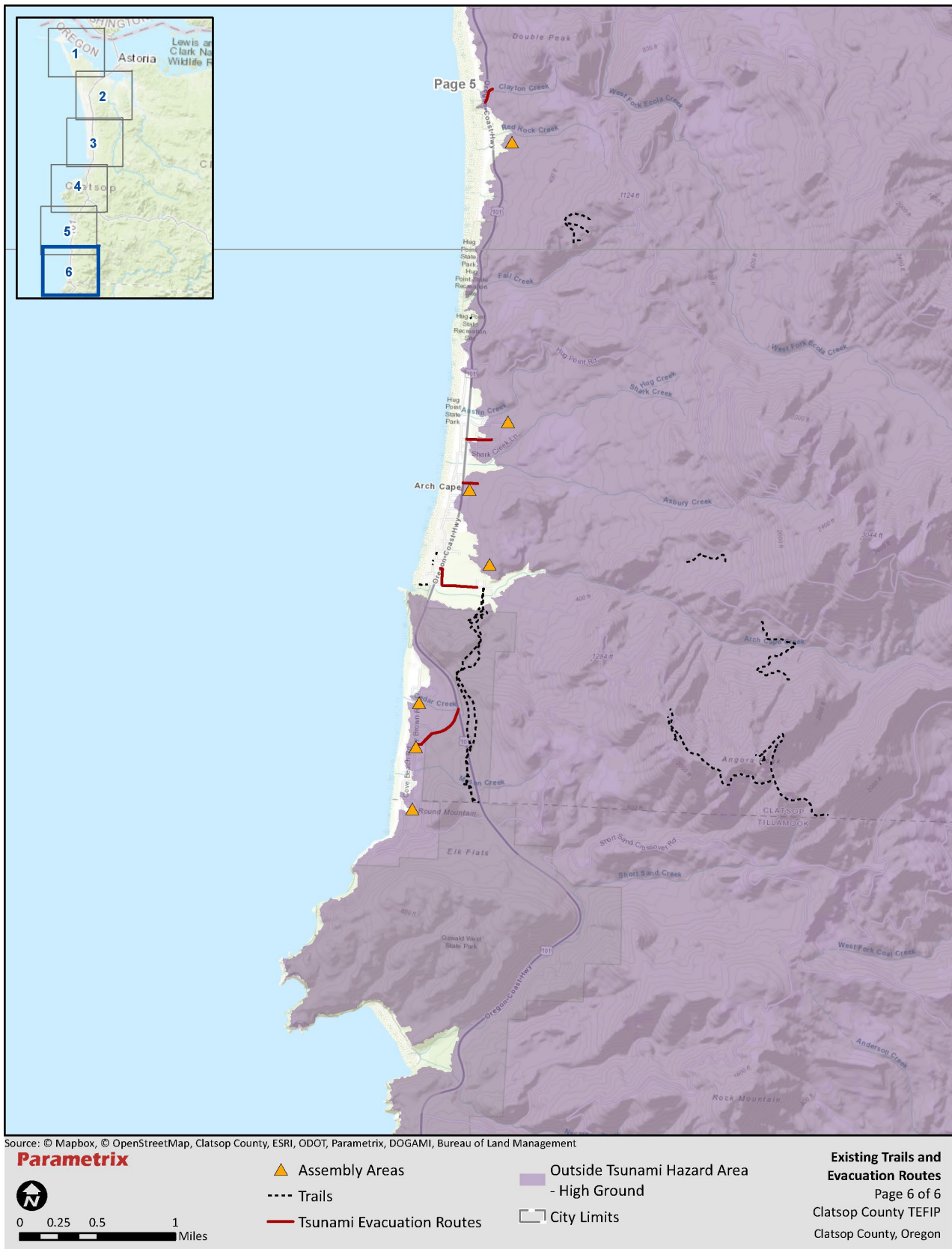


Figure 6. Existing Trails and Evacuation Routes: Page 6

## 2.1.5 Gaps in the Evacuation Route Network

This section catalogs the gaps found in the existing roadway and trail networks for providing effective evacuation. Gaps are organized by three types:

- Areas of Concern
- Network Gaps
- Potentially Vulnerable Bridges and Culverts

These are illustrated in Figures 7-12 on the following pages.

### 2.1.5.1 Areas of Concern

Clatsop County's evacuation routes are based on the existing road network, which does not provide adequate egress from the inundation zone from all coastal areas. Table 3 identifies these "areas of concern," where timely evacuation is unlikely, particularly for vulnerable populations. Areas of concern take into account:

- The distance needed to travel to escape the inundation zone.
- Whether the evacuation route relies on potentially vulnerable bridges.
- The adequacy of assembly areas (those in C-01 are located on small areas that are just above the inundation level).
- Whether these insufficiencies are compounded by liquefaction and/or landslide susceptibility.

Much of the project area, especially elevations above the inundation zone, have moderate to high landslide risk. Each assembly area will need to consider landslide risk and mitigation strategies.

**Table 3. Areas of Concern**

#	Map	Note
C-01	Figure 8	The area north of Gearhart is relatively flat and low-lying. This requires travelling long distances to reach high ground. The land has a high risk of liquefaction. High ground and designated assembly areas are on narrow strips of land that are just above the projected inundation zone. Most streets and trails run north-south, with few east-west routes through this area. Sunset Lake, West Lake, Cullaby Lake, Neacoxie Creek, and other water bodies create barriers for east-west travel. Neighborhoods east of Hwy 101 may need to travel west to reach the nearest high ground.
C-02	Figure 7	The Clatsop Spit is low lying and requires travelling a long distance to reach high ground. The land has a moderate to high risk of liquefaction. This area has few residents but is a popular place to visit.
C-03	Figure 8	This community on the peninsula defined by the Lewis and Clark River and Jeffers Slough is surrounded by water and has a long way to travel to reach high ground. The land has a high risk of liquefaction.
C-04	Figure 8	This community on the peninsula defined by Youngs River and Knowland Slough is surrounded by water and has a long way to travel to reach high ground. The land has a high risk of liquefaction.

### 2.1.5.2 Network Gaps

Trails in the unincorporated County that could also work as evacuation routes do not always lead directly to high ground or may not easily connect to nearby communities. Table 4 lists gaps in the trail network that, if addressed, could serve as evacuation routes, as well as gaps in the evacuation route network that could be served by trails.



**Table 4. Gaps in the Trail System or Evacuation Route Network**

#	Map	Note
G-01	Figure 8	Fort to the Sea Trail could connect to higher ground at ridge.
G-02	Figure 8	Consider new connection to the east from this neighborhood east of US 101 and near the south end of Camp Rilea. Consider using existing forest road. Existing assembly area is on narrow strip of high ground to the west across 101 and wetlands.
G-03	Figure 8, Figure 9	Evacuation route ends in inundation zone. Needs to extend to high ground. Serves Glenwood Community. Consider new facility connecting north to nearby high ground and avoids crossing US 101.
G-04	Figure 8, Figure 9	Evacuation route in this area west of Sunset Lake is much too long before it connects to higher ground. Consider a route east or vertical evacuation structures.
G-05	Figure 9	Existing evacuation route on Highlands Lane ends within inundation zone.
G-06	Figure 12	Carnahan Road ends within inundation zone. A short extension to the north would get people to high ground. Existing route requires walking much further to the south.
G-07	Figure 12	Evacuation route at the south end of Arch Cape ends within inundation zone. Connection needed. Evacuation route ends within inundation area - need connection to higher ground
G-08	Figure 10	A trail would provide a fast connection to higher ground. This area has a high risk of landslide.

### 2.1.5.3 Potentially Vulnerable Bridges

The bridges and culverts along evacuation routes are vital for providing movement. However, most of these structures were built before current seismic standards and are likely vulnerable to a tsunami-causing earthquake. Table 5 lists the bridges and culverts on existing or potential routes. These structures were not inspected for this planning effort. Bridge sufficiency is a federally defined term rated on a scale from 0 (poor) to 100 (very good), considers structural adequacy, whether the bridge is functionally obsolete, and level of service provided to the public.

**Table 5. Potentially Vulnerable Bridges**

#	Map	Bridge Name	Road/ Trail	Crosses	Year Built	Condition	Sufficiency Rating (2019)	Owner	Notes
B-01	Figure 8	Fort-to-Sea-Trail-Pedestrian Culvert	Fort to Sea Trail	US 101	2005	Good	N/A	ODOT	Fort to Sea Trail could make a good evacuation route. Culvert provides a crossing under US 101. Culvert is potentially seismically vulnerable. A detour is possible if culvert fails.
B-02	Figure 8	Arch Bridge at Sunset Lake	Fort to Sea Trail	Sunset Lake	2006	Good	N/A	Corps of Engineers (Military)	Fort to Sea Trail could make a good evacuation route. Bridge is potentially seismically vulnerable. Bridge not in database.
B-03	Figure 8	Sunset Lake Bridge	Sunset Beach Ln	Sunset Lake	1963	Fair	39.3	Clatsop County	Vital link for evacuating community west of Sunset Lake
B-04	Figure 8	Cullaby Creek Bridge	Carnahan Park Rd	Cullaby Creek	1964	Fair	71.0	Clatsop County	On east edge of inundation zone, east of Highway 101. Could be an evacuation connection for the Cullaby Lake neighborhood.
B-05	Figure 9	Maki Bridge	Lounsberry Ln	Cullaby Creek	1976	Fair	70	Clatsop County	East of Surf Pines Could be a link to high ground to the east.
B-06	Figure 9	Neacoxie Cr Bridge	Highlands Ln	Neacoxie Creek	1975	Fair	86.7	Clatsop County	Just north of Gearhart. Important for evacuating community west of Neacoxie Creek.
B-07	Figure 9	Neawanna Creek, Hwy 9	US 101	Neawanna Creek	1930	Fair	49	ODOT	Important route for evacuating the north end of Seaside (high ground is outside city limits)
B-08	Figure 9	Stanley Creek, Lewis and Clark Rd	Lewis and Clark Rd	Stanley Creek	2005	Good	96.7	Clatsop County	East edge of Seaside, leads to higher ground.

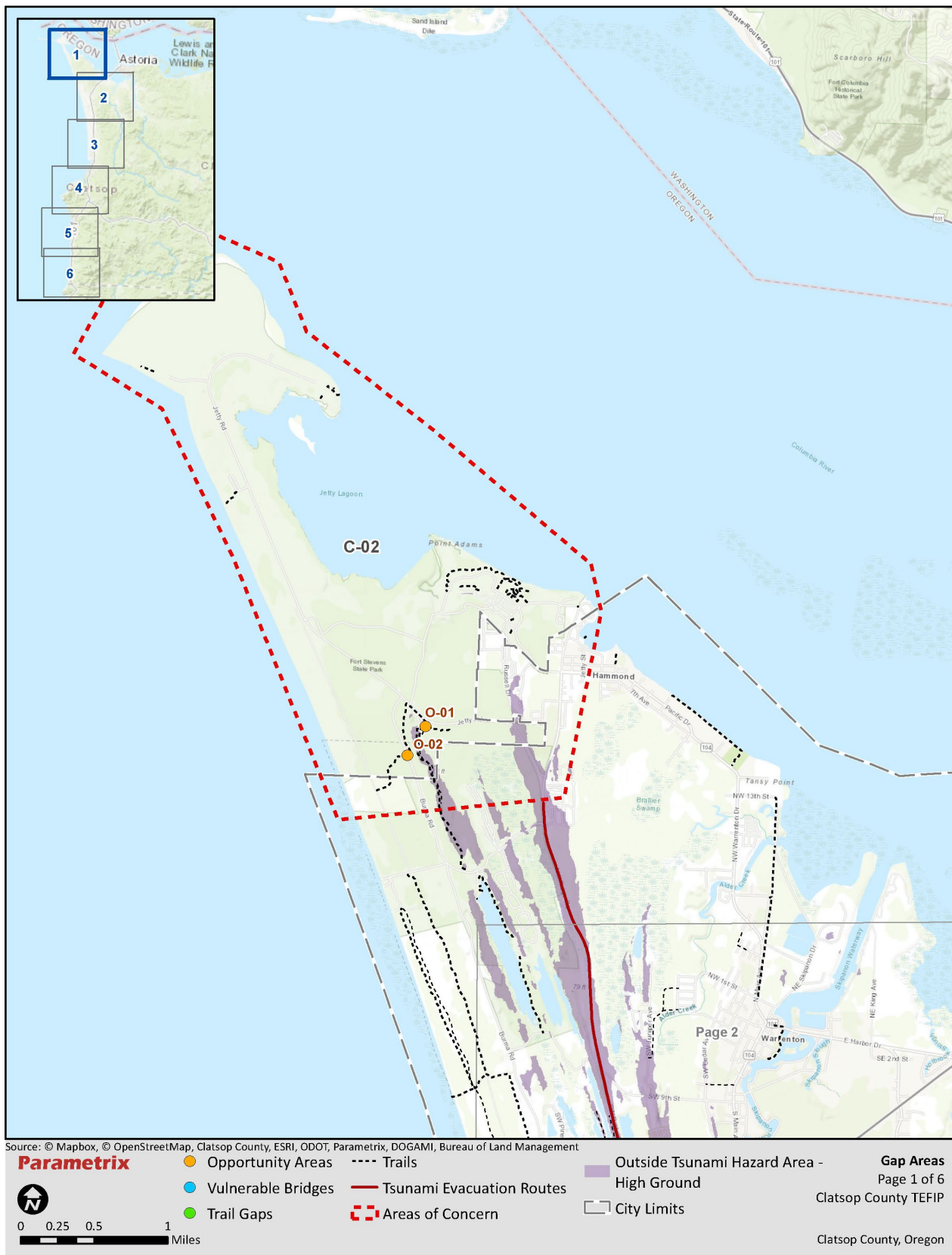
#	Map	Bridge Name	Road/ Trail	Crosses	Year Built	Condition	Sufficiency Rating (2019)	Owner	Notes
B-09	Figure 10	Rippet Rd Bridge	Rippet Ln	Circle Creek		[Unknown, not in available data]	76.1	Clatsop County	South edge of Seaside. Allows quick evacuation of one or two homes
B-10	Figure 8	Unknown Culvert (likely County-owned)	Lewis and Clark Rd (just south of Astoria)			[Unknown, not in available data]			Potential culvert location. This culvert is not in ODOT's database but was inferred from LIDAR data. This is a critical location for evacuating a large area.

## 2.1.6 Opportunities to Improve Evacuation Routes

Opportunities exist to improve the evacuation network by enhancing existing trails to better serve evacuees, by creating short trail connections, or by locating new assembly areas. Opportunities are listed Table 6 and mapped in Figures 7-12.

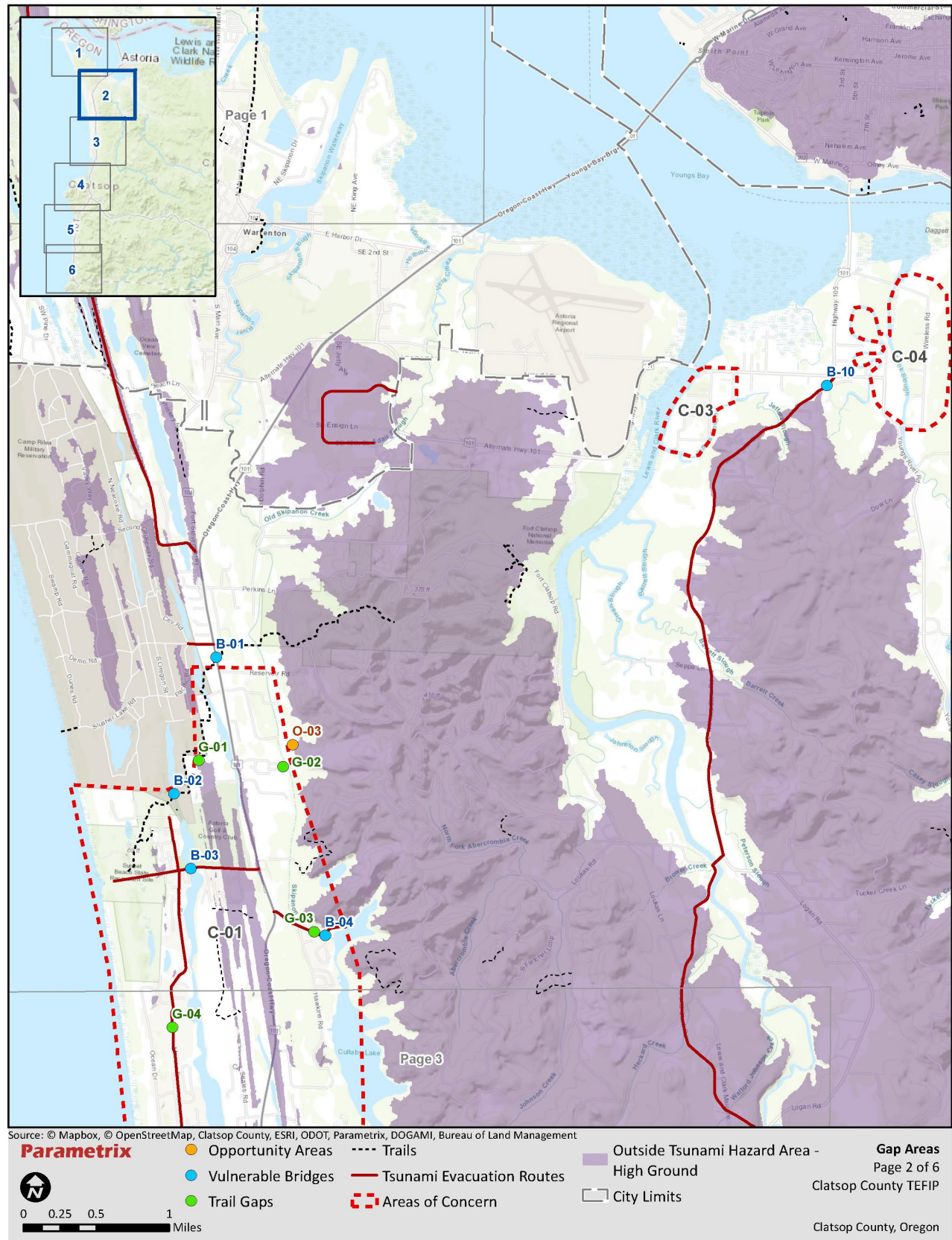
**Table 6. Opportunities to Improve Evacuation Routes**

#	Map	Note
O-01	Figure 7	Trail provides opportunity for evacuation route in Fort Stevens State Park. Connects road (in inundation area) to higher ground. Consider improving trail as evacuation route.
O-02	Figure 7	Existing trail is an opportunity for an evacuation route in Fort Stevens State Park. Unpaved trail intersects with road leading to higher ground.
O-03	Figure 8	Opportunity for new assembly area east of US 101 at the south end of Camp Rilea. Already connected by road/path visible in aerial. Privately owned.
O-04	Figure 9	Structure over the creek just south of Sunset Lake appears to be a foot bridge. Could provide an east-west trail connection. Privately owned.
O-05	Figure 9	Potential for an assembly area at Polo Ridge Road.
O-07	Figure 10	Potential for assembly area at the south end of Seaside.
O-08	Figure 11	Parcels owned by ODOT are platted but undeveloped and unlikely to develop. Opportunity to plan evacuation routes should development become likely.
O-09	Figure 12	Potential connection to high ground for the Arch Cape community with platted but undeveloped Oceanview Ln.

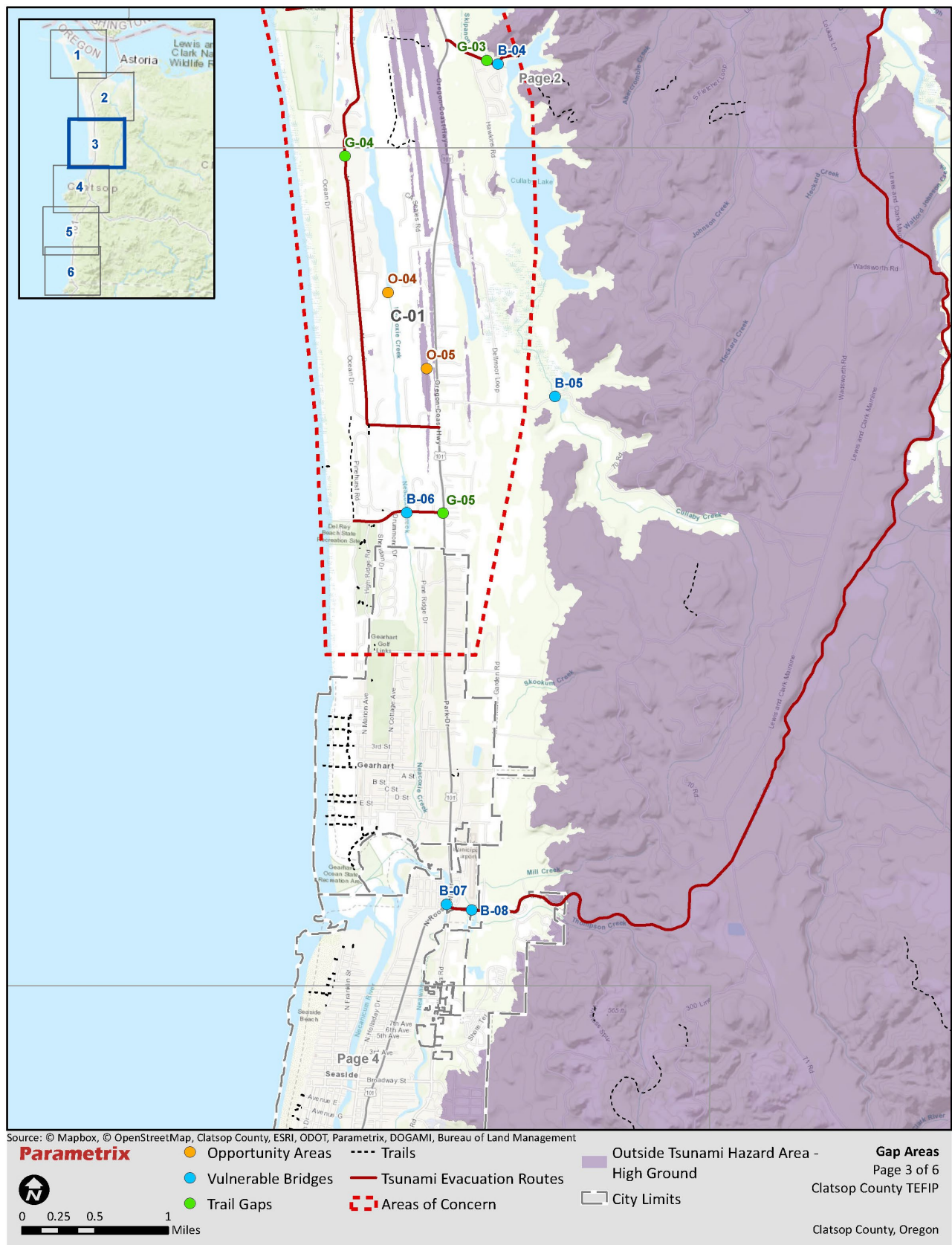


**Figure 7. Gaps and Opportunities: Page 1**



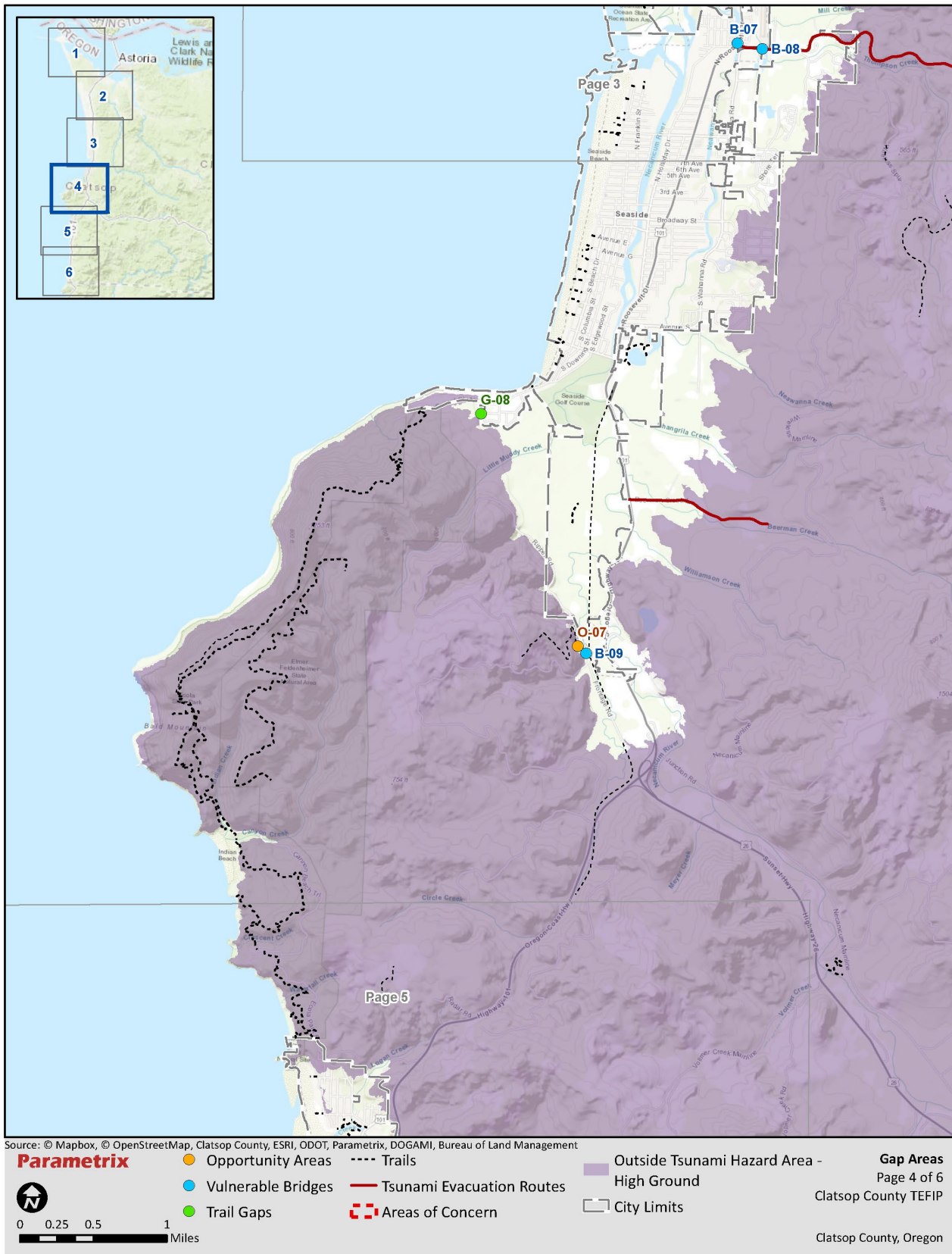


**Figure 8. Gaps and Opportunities: Page 2**

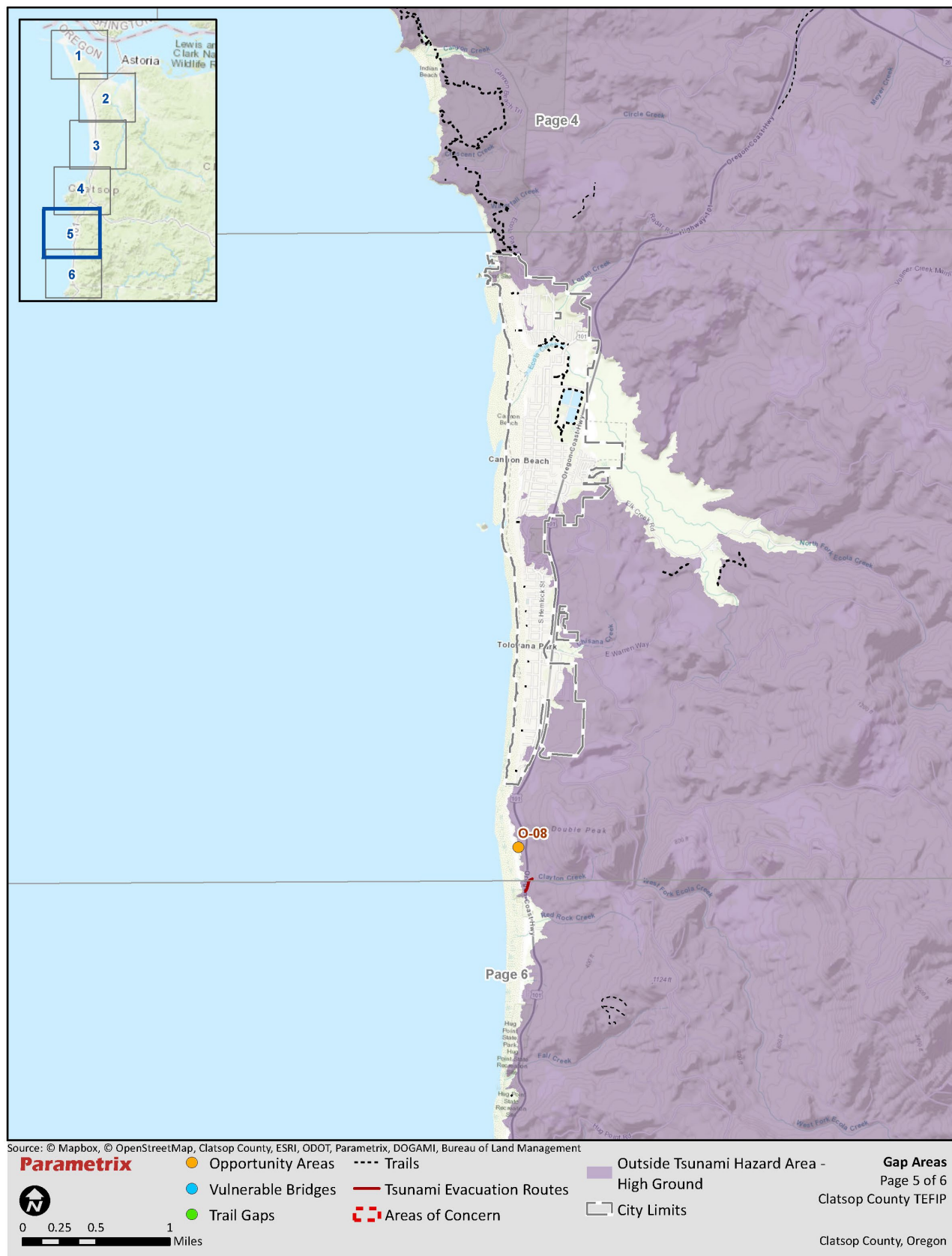


**Figure 9. Gaps and Opportunities: Page 3**



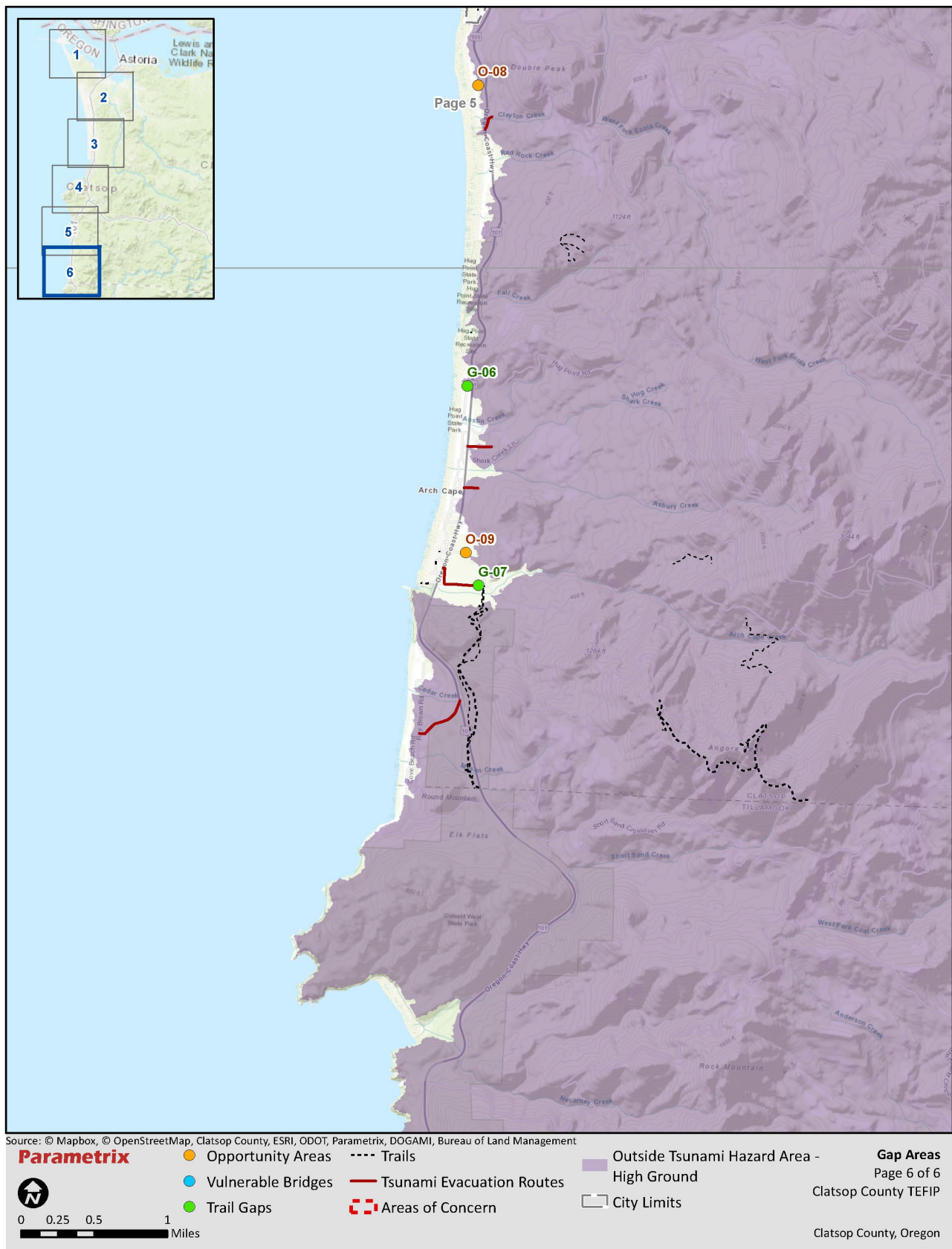


**Figure 10. Gaps and Opportunities: Page 4**



**Figure 11. Gaps and Opportunities: Page 5**





**Figure 12. Gaps and Opportunities: Page 6**

## 2.2 Natural and Cultural Resources

The project study area overlaps with many natural and cultural resources. These are reviewed at a high level here. Future project development will require further study.

**Table 7. Natural and Cultural Resources**

Resource	Notes
Land Use Goal 5 Resources	Many resources protected by Goal 5 are inconsistent with evacuation route siting, particularly if the trail requires a structure. However, some resources, such as Recreation Trails, Natural Areas, and Open Space, could support a trail.
Regulatory floodplains	Floodplains tend to follow waterways inland, such as the Necanicum River, the Skipanon River, the Lewis and Clark River, the Youngs River and several sloughs in the Miles Crossing/Jeffers Garden area. The lower elevation areas of Seaside, Gearhart, and Warrenton are also within floodplains. The tsunami inundation zone largely overlaps with floodplain areas.
Levees, including locations and geometries	Levees have been constructed adjacent to waterways throughout the project area. These are potentially vulnerable to both earthquake and tsunami.
Wetlands and non-wetland waters	A large portion of the project area is covered by wetlands and non-wetland waters. These areas are environmentally sensitive and are almost fully within the tsunami inundation zone.
Endangered Species Act and Oregon-listed sensitive species	Preliminary research reveals 11 endangered species, 3 critical habitats, and 40 migratory bird species that intersect the project area. <sup>3</sup>
Hazardous materials sites	Preliminary research reveals 87 environmental cleanup sites <sup>4</sup> in Clatsop County, including several that are closed or require no further action. There are 392 leaking underground storage tanks <sup>4</sup> with active investigations. Further investigation is needed in a future phase of project development to understand specific impacts related to each project.

<sup>3</sup> "Information for Planning and Consultation," U.S. Fish & Wildlife Service, accessed March 29, 2021. <https://ecos.fws.gov/ipac/location/G2GHOLCLBBC23JJXBGNPTMF7HE/resources>

<sup>4</sup> "Environmental Cleanup Site Information Database," Oregon Department of Environmental Quality, accessed March 29, 2021. <https://www.deq.state.or.us/lq/ECSI/ecsiquery.asp>

<sup>4</sup> "Leaking Underground Storage Tanks (LUST) Database," Oregon Department of Environmental Quality, accessed March 29, 2021. <https://www.deq.state.or.us/lq/tanks/lust/LustPublicLookup.asp>

Resource	Notes
Historic, cultural, and archaeological resources and sites	The areas of Clatsop County along the coast and Columbia River have been inhabited for centuries and are home to historic landmarks and parks. These areas are historical territories of the Clatsop, Nehalem, and Chinook tribes, <sup>6</sup> and, are expected to have archaeologically, historically, or culturally significant resources located throughout. Future projects must consider these resources as the projects are developed.
Topographical information, including steep and unstable slopes	Steep or unstable slopes are common near coastal areas. These pose substantial challenges for evacuation routes. Steep slopes may be insurmountable to people walking or biking. Unstable slopes are prone to develop landslides in a seismic event.
Public lands	Publicly owned lands present an opportunity for evacuation routes or assembly areas that will not require new easements. Routes through public lands may require the jurisdictions to develop memoranda of understanding.
Tsunami inundation data	Tsunami inundation data was developed by DOGAMI. This planning effort considers the tsunami zone from the most severe event: a “local” earthquake, also called the Cascadia “XXL” scenario.

## 2.3 Demographics

### 2.3.1 Population Estimates

Population estimates were developed for the project area, Clatsop County, and the State of Oregon (Table 8).

The project area population includes Census block groups that are within or intersect the project area boundary and exclude the populations within the incorporated cities of Cannon Beach, Seaside, Gearhart, Warrenton, and Astoria. Some block groups on the east edge of the project area are large and extend outside the project area. These block groups are included because it is assumed that most people within them live closer to the coast, and therefore inside or near the project area.

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<sup>6</sup> “Our home on native land,” Native Lands Digital. Accessed March 29, 2021. <https://native-land.ca/>

**Table 8. Population Estimates**

	Project Area	Clatsop County	State of Oregon
<b>Total Population</b>	<b>6,481 *</b>	<b>39,102</b>	<b>4,129,803</b>
Age 17 and Under	17.7% *	19.1%	21.0%
Age 65 and Over	23.2% *	21.4%	17.2%
At or Below 200% of the Federal Poverty Level	19.8%	32.7%	30.8%
Limited English Proficiency	0.7%	1.2%	2.5%
People with Disabilities	18.4%	18.5%	14.0%
<b>Race and Ethnicity</b>			
Hispanic (All Races)	5.8% *	8.5%	13.0%
American Indian/Alaska Native	0.9% *	0.4%	0.9%
Black/African American	1.0% *	0.8%	1.8%
Asian	1.6% *	1.0%	4.3%
Pacific Islander	0.2% *	0.3%	0.4%
White	87.7% *	85.5%	75.7%
Other Race	0.2% *	0.0%	0.1%
Multiple Races	2.7% *	3.5%	3.7%

Sources:

\* 2020 ESRI Estimates

All others: American Community Survey 5-Year Estimate 2015-2019

### 2.3.2 Environmental Justice Populations

For the purposes of the Clatsop County TEFIP, members of Title VI and Environmental Justice communities include:

- Black, Indigenous, and people of color (includes non-white Hispanic and Latino)
- Youth (age 17 and younger) and seniors (age 65 and older)
- Low-income (defined as percentage of households earning less than 200% of the poverty line income)
- Limited English proficiency households

Population estimates indicate the portion of residents who identify as Black, Indigenous, or as persons of color is generally lower than the state as a whole. One exception is the population of American Indian/Alaska Native, which is 0.9 percent for both the project area and for Oregon. The youth population is relatively low for the project area, less than 18 percent. However, nearly one quarter of the population is over age 65, with higher concentrations along the coast north of Gearhart through the Clatsop Spit. The portion of low-income residents is below 19 percent, which is less than Clatsop County or Oregon. Less than one percent of project area residents have limited English proficiency.

### 2.3.3 Vulnerable Populations

Vulnerable and special needs populations are members of the community who experience access, functional or medical care needs and who may require assistance before, during, and after an emergency incident. In the case

of evacuations, examples of individuals who have access and functional needs that may make evacuation challenging include:

- Individuals who experience mobility challenges (e.g., those with physical disabilities, the elderly, children).
- Individuals who are blind or have low vision.
- Individuals who are deaf or hard of hearing.
- Individuals with limited English proficiency.

As indicated in Table 8, over 40 percent of the population is either under age 18 or over age 64. Additionally, 18.4 percent of individuals live with at least one disability. To better understand how many community members may have access or functional needs, **Error! Reference source not found.** lists the portion of the project area population that experience disabilities related to mobility, vision, or hearing. This is not a comprehensive list of disabilities (it does not include cognitive disabilities, for example), and some individuals may experience more than one.

**Table 9. Individuals in the Project Area with Ambulatory, Hearing, or Vision Disability**

Disability Status	
People with Ambulatory Difficulty	4.3%
People with Vision Difficulty (Age 5 and Over)	5.2%
People with Hearing Difficulty	4.6%

Source: American Community Survey 5-Year Estimate 2015-2019

## 2.3.4 Visitors

The Oregon Coast is a popular tourist destination and can host many visitors in addition to the residents. According to a recent study for Travel Oregon, over 1.7 million visitors spent at least one night in Clatsop County in 2019.<sup>7</sup> This number is not specific to coastal areas and does not include day use visitors. Also, the number of visitors in the project area fluctuates with the seasons.

Visitors are likely less familiar with the risk of tsunamis, evacuation procedures, and the geography of the area. Visitors may also not speak English. These are important considerations for the provision of evacuation facility capacity, as well as evacuation information and wayfinding.

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<sup>7</sup> Dean Runyan Associates, *Oregon Travel Impacts, 1992-2019* (2020). <https://industry.traveloregon.com/wp-content/uploads/2020/04/ORImp19.pdf>



### 3. TSUNAMI EVACUATION FACILITIES IMPROVEMENT PLAN

This TEFIP identifies and evaluates potential tsunami evacuation facility improvements in Clatsop County, with a specific focus on improving existing trails to serve evacuation needs. The plan proposes three types of improvements – trails, assembly areas, and vertical evacuation structures – and describes potential amenities for each. In addition to focusing on evacuation needs and prioritizing life safety in the event of a tsunami, recommendations prioritize improvements which also benefit the community by providing year-round recreation benefits.

#### 3.1 Evacuation and Trail Facility Types

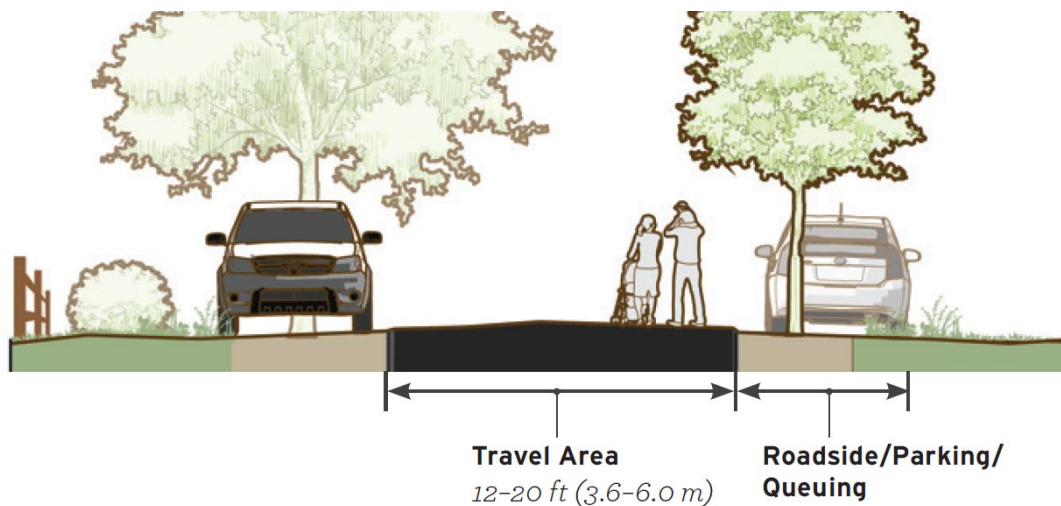
##### 3.1.1 Trail Typology

Trails are classified into three types for the purposes of this plan: on street trails, multi-use paths, and recreational trails.

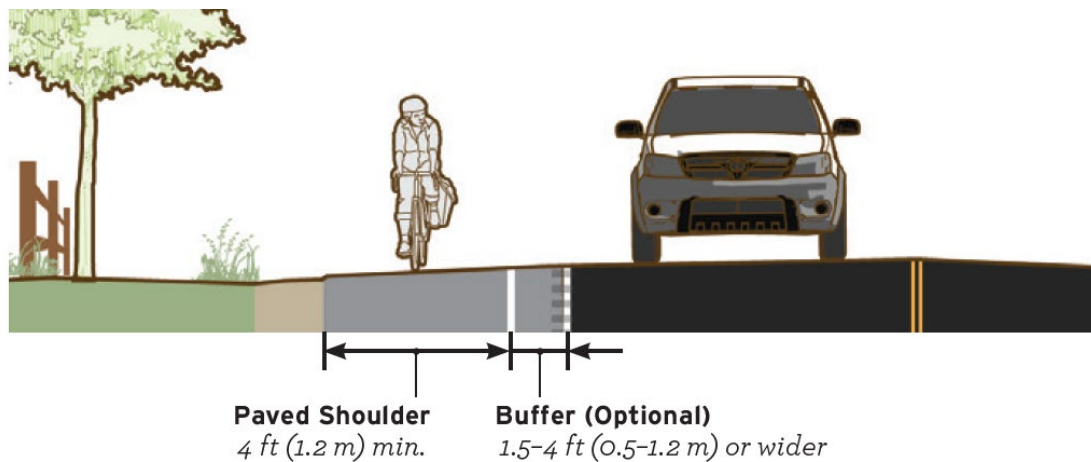
###### On Street Trail

A sidewalk or roadway can provide pedestrian travel in case of an evacuation. On street trails that are recommended are all on the roadway surface, not on sidewalks. Because they are at grade on the roadway, they generally can comply with Americans with Disabilities Act (ADA) accessibility guidelines.

- **Shared roadway.** On quieter roads, an on-street trail can share the travel lane, as shown in Figure 13. This facility is appropriate for volumes of less than 2,000 average trips per day and speeds under 30 miles per hour. Shared roadways may encourage drivers to travel slower, though these roads are already low speed, low volume, and likely being used by pedestrians already.
- **Paved shoulder.** On roads with moderate to high volumes and speeds, the trail can follow a paved shoulder, as seen in Figure 14. A paved shoulder is appropriate for volumes of less than 12,000 average trips per day and speeds under 55 miles per hour. Paved shoulders will have minimal effect on the roadway through traffic.



**Figure 13. On Street Trail: Shared Roadway**  
Source: FHWA Small Town and Rural Multimodal Networks

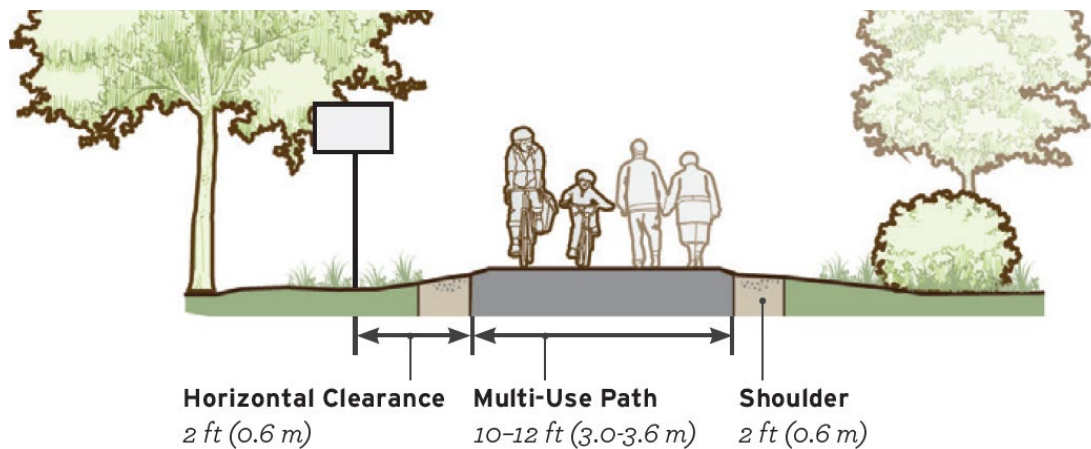


**Figure 14. On Street Trail: Paved Shoulder**

Source: FHWA Small Town and Rural Multimodal Networks

## Multi-Use Path

Multi-use paths (MUPs) are off-street trails that are highly developed and paved, as shown in Figure 15. MUPs would be built to comply with ADA guidelines. MUPs are paved with concrete or asphalt, making them practical for biking, walking, and mobility devices, such as wheelchairs and canes. MUPs tend to be popular because they feel safe and comfortable for a wide range of people. MUPs are practical for evacuation – as long as the facility remains passable after the earthquake – because they are ADA accessible and their narrow cross section allows them to be built in areas where a road will not fit.



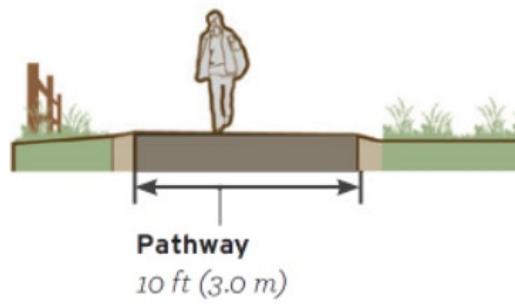
**Figure 15. Multi-Use Path (MUP)**

Source: FHWA Small Town and Rural Multimodal Networks

# Recreational Trail

Recreational trails are less developed and unpaved, as shown in Figure 16. Recreational trails are not built to comply with ADA guidelines. Recreational trails tend to be steeper and more challenging to traverse.

Recreational trails have an unpaved surface of soil, grass, wood chips, or other material. They cost less to construct than a paved MUP and can more easily fit in a natural or undeveloped context. Recreational trails are enjoyable for hiking but may be more difficult to travel along than an MUP. These are appropriate for remote areas that are expected to serve small numbers of people during an evacuation.



**Figure 16. Recreational Trail**

*Source: Adapted from FHWA Small Town and Rural Multimodal Networks*


This plan prioritizes more developed trails for evacuation routes because they are easier to travel and are accessible to more people. However, less developed trails will still be considered in areas that lack other evacuation options.




## 3.1.2 Trail Amenities

Additional amenities can make trails more attractive for everyday use. Benches and seating, for example, provide opportunities for people to rest or stop and enjoy the scenery. Lighting can help make a trail feel safer in low light conditions. Some amenities can also be helpful after a seismic event. Shelters outside the inundation zone can be used for assembly areas. Wayfinding signs can point toward high ground and can include information about earthquake and tsunami resilience. Garbage and recycling bins may be installed in locations where County staff will be able to adequately manage ongoing maintenance.

Potential trail amenities are listed in Table 10 along with considerations relevant to implementation and tsunami evacuation.



**Table 10. Trail Amenities and Considerations**

Amenity	Benefits or Constraints	Example
Benches and seating	Generally appropriate for heavily used trails. Provides opportunities for resting, especially helpful for people with mobility impairments.	 <i>Seating options on the Seaside Promenade (source: Google Streetview)</i>

Amenity	Benefits or Constraints	Example
Fencing	<p>Useful for separating public right of way from private property.</p> <p>Can impact accessibility of the evacuation route from adjacent areas.</p>	 <p><i>Fence along the Fort to Sea Trail (source: Google Streetview)</i></p>
Wayfinding and information signs	<p>Helpful for indicating evacuation route and direction and assembly areas or high ground.</p> <p>Can increase tsunami awareness.</p> <p>Can also include recreational wayfinding and information about the trail system.</p> <p>Signs need to be inventoried on a regular basis to ensure they are still in place and legible.</p>	 <p><i>Tsunami info sign on the Astoria Riverwalk (source: project team)</i></p>
Shelters or pavilions	<p>Shelters can be practical amenities to protect trail users from rain or sun.</p> <p>Shelters outside of the inundation zone may also be used for assembly areas.</p> <p>Shelters within the assembly areas should include clear signage indicating the evacuation route.</p>	 <p><i>Astoria Riverwalk Trolley Stop (source: Astoria Recreational Trail Master Plan 2013)</i></p>

Amenity	Benefits or Constraints	Example
Lighting	<p>Useful for trailheads and trails used at night.</p> <p>Solar-powered lighting can be more seismically resilient than hard-wired, and it avoids the risk of fallen power lines in a seismic event.</p> <p>Balance lighting provision with wildlife and light pollution impacts and employ “dark sky” strategies.</p>	 <p><i>Pedestrian-scale lighting along the Seaside Promenade (source: Google Streetview)</i></p>
Bicycle racks and fix-it stations	<p>Appropriate for trails with expected frequent use by people biking.</p> <p>Consider overlap with or proximity to the Oregon Coast Bike Route.</p>	 <p><i>Bike parking, fix it station, and solar charging at Hagg Lake (source: Washington County Parks)</i></p>
Motor vehicle parking	<p>Requires space.</p> <p>May be used as an assembly area if out of the inundation zone.</p>	 <p><i>Trailhead parking lot for Tillamook Head, Seaside (source: Google Streetview)</i></p>



Amenity	Benefits or Constraints	Example
Restrooms and water fountains	<p>Toilets and water are practical for popular trails, trailheads, and assembly areas.</p> <p>Providing toilets can help protect sensitive ecosystems.</p> <p>Plumbing is vulnerable to a seismic event.</p> <p>More substantial ongoing maintenance needs and costs.</p>	 <p><i>Vault toilets at the Fort to Sea Trail trailhead (source: Google Streetview)</i></p>
Viewpoints	<p>Unique viewpoints can draw people to a trail, which can increase awareness of it as a potential evacuation option.</p> <p>Viewpoints can also be used to survey the area below after a seismic event.</p>	 <p><i>View from the Neah-Kah-Nie Mountain Trail, Oswald West State Park (source: Google Streetview)</i></p>


### 3.1.3 Assembly Areas

Assembly areas provide space on high ground outside the inundation area for people to gather temporarily during a tsunami. At minimum, they provide a clear and safe place for people to come together. This requires a plot of land outside the evacuation zone, effective wayfinding signs to get people there, and regular maintenance to keep it in good condition.

The Oregon Department of Geology and Mineral Industries (DOGAMI) has identified locations for assembly areas in coastal communities as part of their evacuation route mapping. This includes the populated communities of Clatsop County. But these assembly area locations primarily exist on maps and may not be clearly marked or signed for people trying to get to them. Assembly areas also may not be sized to accommodate their evacuation shed. Additional assembly areas will be needed as this TEFIP develops more evacuation route options. DOGAMI's identification of assembly area locations is a good starting point for further development. A thorough review of existing assembly areas is outside the scope of this project.

#### 3.1.3.1 Location

Assembly areas should be located such that everyone in the inundation zone can reach an area within the time between an earthquake and subsequent tsunami. This amount of time varies greatly, depending on the



epicenter of the earthquake and inland location. Generally, locations that are further inland have more time to evacuate. DOGAMI has modeled this to create their *Beat the Wave* evacuation maps. To simplify the planning effort, this TEFIP follows *Guidelines for Design of Structures for Vertical Evacuation from Tsunamis* developed by the Federal Emergency Management Agency (FEMA) and use evacuation time estimate of 15 minutes.<sup>5</sup> This estimate is for people that are close to the water and for a tsunami caused by a local earthquake, the more conservative case with the shorter evacuation time. The distance that can be traveled depends on when a person leaves after the earthquake begins—a long-lasting earthquake will take several minutes, and then people will typically take time to gather themselves before evacuating—and the person’s walking speed.

This TEFIP uses the following assumptions for tsunami evacuation:

- Time to evacuate: 15 minutes (the time between when the shaking stops and when a local tsunami hits)
- Moderate walking speed: 4 miles per hour
- Mobility-impaired walking speed: 2 miles per hour
- Maximum travel distance: one-half mile

With a maximum travel distance of one-half mile, the maximum distance between assembly areas is 1 mile. This distance may be less in areas with terrain that is steep or difficult to traverse.

Siting an assembly area should consider other seismic risks. Is the land susceptible to liquefaction or landslide? Are there structures, trees, or utilities nearby that could pose a hazard after an earthquake? In the study area, there are a limited number of easily accessible areas outside of the inundation zone, so it is likely that assembly areas will need to be located in places with at least one potential hazard. These sites may require mitigation to minimize the risk.

In some locations, the nearest assembly areas are to the west — toward the incoming tsunami. This may be unintuitive for people and risks confusing evacuees. When possible, assembly areas and vertical structures should be located to the east of a community to take advantage of the instinct to run away from the threat. Where this is not possible, the evacuation route must be made very clear.

Some existing and proposed assembly areas are on relatively small strips of ground that are expected to be surrounded by water in the XXL event. Additional survival equipment may be needed at these locations in case it takes emergency response longer to reach them.

Consider whether each assembly area should have motor vehicle access, and for those that will have access, consider how to manage it. Motor vehicle access can help with facility construction, survival equipment inventory, and upkeep. It can also help by allowing emergency responders easy access to evacuees, if roads are still navigable.

Once located, the assembly area location must have clear indication for evacuees to recognize that they have reached a safe place. Signs and wayfinding ideally would include standard graphical icons that are used consistently in the county, state, and beyond. Additional information should be provided in common languages read by residents and visitors.

### 3.1.3.2 Size

Assembly areas need to be sized appropriately for the number of people they are likely to serve. Each assembly area should be analyzed to understand the number of residents and potential workers, students, and visitors

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<sup>5</sup> August 2019. FEMA P-646: Guidelines for Design of Structures for Vertical Evacuation from Tsunamis, Third Edition.



who may use it. The assembly area—and survival equipment—need to be scaled to accommodate this total number of potential evacuees.

### 3.1.3.3 Survival Equipment

Survival equipment can support evacuees at assembly areas after a tsunami event. A covered area will help people stay dry in wet weather and provide shade in hot weather. Assembly areas can also hold stashes of food, water, blankets, first aid supplies, communication devices, and other emergency items as listed in Table 11. Which survival equipment and how much to provide depends on the evacuation shed that the assembly area serves, how many people are likely to assemble there, and whether those people are likely to need support. What to provide also depends on the context of the assembly area. An area that is geographically isolated will benefit more from survival equipment than an area with nearby resources.

Some survival equipment, like supplies and gear, will need storage space at the assembly area that is safe from the weather, pests, earthquake damage, and vandalism or theft, while also being easy to access during a seismic event. Perishable items (food, first aid supplies, water bottles, and batteries, for example) should be regularly maintained or refreshed. This could be provided and managed by the County, or in coordination with a volunteer group. The City of Portland, for example, uses a network of trained volunteers to maintain and — in the case of an emergency — operate their Basic Earthquake Emergency Communications Nodes (BEECNs)

Another method to manage supplies could be similar to the emergency cache programs used by Cannon Beach and Gearhart. For an annual fee, the City will store a personal storage container in a secure building at an assembly area. Individual residents are responsible for acquiring and maintaining the container and the contents of supplies. The City requires the container to meet certain specifications and gives recommendations of the supplies to pack. Cache owners are allowed to access their containers twice a year to maintain their inventory. For more information, see:

[https://www.ci.cannon-beach.or.us/sites/default/files/fileattachments/emergency\\_management/meeting/36218/cache\\_container\\_poster\\_2020\\_11x17.pdf](https://www.ci.cannon-beach.or.us/sites/default/files/fileattachments/emergency_management/meeting/36218/cache_container_poster_2020_11x17.pdf)

And:

[https://www.cityofgearhart.com/sites/default/files/fileattachments/general/page/1771/gearhart\\_cache\\_program\\_brochure.pdf](https://www.cityofgearhart.com/sites/default/files/fileattachments/general/page/1771/gearhart_cache_program_brochure.pdf)

DOGAMI has developed the *Earthquake and Tsunami Disaster Cache Planning Guide* to inform communities wishing to establish supply caches to be used in the event of a tsunami. The guide details a four-step planning process, including design, implementation, maintenance, and deployment. It includes recommended supply lists and case studies of successful supply cache programs. The guide can be viewed at:

<https://www.oregongeology.org/tsuclearinghouse/resources/pdfs/TsunamiDisasterCachePlanningGuide.pdf>

**Table 11. Assembly Area Survival Equipment**

Amenity	Considerations
Shelter	<ul style="list-style-type: none"><li>• Evacuation shed (number of people expected to evacuate to this location)</li><li>• Seismic stability</li></ul>
Food	<ul style="list-style-type: none"><li>• Storage space for longevity and to keep free of animals or pests</li><li>• Evacuation shed</li></ul>
Drinking water	<ul style="list-style-type: none"><li>• System to maintain potability</li><li>• Evacuation shed</li></ul>
First aid supplies	<ul style="list-style-type: none"><li>• Evacuation shed</li><li>• Potential nearby hazards that may cause injuries to evacuees</li></ul>
Radio	<ul style="list-style-type: none"><li>• Power options</li></ul>

Amenity	Considerations
Communication devices	<ul style="list-style-type: none"> <li>• Could include radio transmitters, walkie-talkies, and cell phones (though cell towers may not be operable after a seismic event)</li> </ul>
Lighting	<ul style="list-style-type: none"> <li>• Power options, solar chargeable batteries are a resilient option</li> </ul>
Emergency power	<ul style="list-style-type: none"> <li>• Could be used to charge communication devices</li> <li>• Options include solar power, batteries, and generators</li> </ul>
Blankets	<ul style="list-style-type: none"> <li>• Evacuation shed</li> </ul>
Ponchos	<ul style="list-style-type: none"> <li>• Evacuation shed</li> </ul>




### 3.1.4 Vertical Evacuation Structures

In locations where natural high ground is not available or is not practical to reach in the time before the first tsunami wave arrives, vertical evacuation structures can be appropriately designed and constructed to serve as places of refuge where many people can evacuate and remain for up to 24 hours to escape the initial and subsequent tsunami waves.

Types of vertical evacuation structures include soil berms, towers, and buildings. Vertical evacuation structures of all three types can be designed and built to serve recreational or other community functions, in addition to providing refuge in areas too far from natural high ground. Berms can be incorporated into parks and recreational areas; towers can be made for use as an accessible viewpoint to take in the coastal beauty of Clatsop County, and a rooftop evacuation platform could be located atop of a variety of multistory civic, commercial or residential buildings.

Evacuees with limited physical ability may require assistance from more able-bodied people to climb stairs or ramps. Providing an elevator may seem like an attractive option to provide access for everybody, however elevators are not practical for evacuation uses. First, they require electricity, which will likely be severed by a seismic event. Second, the cost of a seismically resilient elevator would make a project prohibitively expensive. Third, and most important, elevators are slow and only move a few people at a time. They would create a bottleneck that is dangerous during an evacuation. Instead, ramps can be provided where feasible, like on a soil berm. Where only stairs are feasible, signs can be included to encourage evacuees to help one another reach the assembly area.

**Table 12. Vertical Evacuation Structure Types**

Structure Type	Cost Range	Considerations	Example
Soil berms	<p>\$1,000,000 – \$5,500,000</p> <p>(As berm height and the number of refugees to accommodate are among main cost factors, the construction cost range is based on a refugee capacity of 250 to 850, with berm height less than 35 feet.)</p>	<p>Engineered earth mound created with soil or recycled construction materials.</p> <p>Can be integrated into parks and serve a recreational use.</p> <p>More cost effective than other types of vertical evacuation structures.</p>	 <p><i>A soil berm constructed in Tahara, Japan, in 2018 (Source: Disaster Prevention Bureau of Tahara, Japan)</i></p>
Evacuation towers	<p>\$1,500,000 – \$11,000,000</p> <p>(As the number of refugees to accommodate is a main cost factor, the construction cost range is based on a refugee capacity of 200 to 900.)</p>	<p>Elevated platform, stairs, or ramps.</p> <p>Smaller physical footprint than berms.</p> <p>Space below platforms can serve multiple community uses, including parking.</p> <p>Consider equipping with survival equipment for communications and evacuees' immediate needs.</p> <p>Could be designed to serve recreational purposes, including a viewing platform; space below could be programmed for community events.</p> <p>Should be constructed at a height substantially above expected tsunami wave height; height determined by structural engineers.</p>	 <p><i>Rendering of Tsunami Evacuation Tower in Tokeland, Washington (Source: Degenkolb Engineers)</i></p>
Buildings with rooftop refuge areas	<p>10% to 20% increase in total construction costs</p> <p>(This estimate is based on limited data, including the Ocosta Elementary School, Westport, WA)</p>	<p>Multi-story building, typically with rooftop evacuation area.</p> <p>Can be integrated into buildings serving commercial or community uses.</p> <p>Lower levels typically designed with special features such as break-away walls.</p>	 <p><i>Ocosta Elementary School in Westport, Washington (Source: Degenkolb Engineers)</i></p>

FEMA has developed FEMA P-646 which contains guidelines to assist communities on the west coast to plan and develop tsunami vertical evacuation structures (FEMA 2019).

#### 3.1.4.1 Soil Berms

Soil berms create high ground using soil and/or recycled construction materials such as concrete or masonry. They have a large footprint on the landscape and can be integrated with school playgrounds, parks, and other recreational facilities. In addition to stairs, access ramps can be installed on the berm to provide easy access for mobility impaired individuals to move from the ground to the elevated surface. Evacuating to berms allows people to follow their instinct to go to high ground and eliminates fear of entering a structure that they perceive may not be safe. Berms are immune to damage from large debris such as shipping containers, barges, and ships, making them suitable for locations near port facilities.

#### 3.1.4.2 Evacuation Towers

A tsunami evacuation tower consists of elevated platforms and stairs and/or ramps to lead people to an elevation that is sufficiently above the projected inundation elevation. When not in use as a refuge, space below the platform can potentially serve other community functions to enhance the quality of life. Towers have a small footprint compared to soil berms and buildings, and therefore, can be more easily distributed throughout potentially affected areas to increase accessibility and availability. The Shoalwater Bay Indian Tribe tsunami evacuation tower in Tokeland, Washington, is an example of a recently designed tsunami evacuation tower that has two refuge levels with an occupancy capacity of approximately 400 evacuees. Two sets of stairs are provided for redundancy and are specially detailed to ensure their functionality immediately after an earthquake. The tower will be fed by commercial power for routine maintenance and by emergency power for radio communication and USB charging. Survival equipment (such as food, water, first aid kits, emergency radios, light sticks, tarps, and blankets) can be stored in benches installed at the refuge levels.

#### 3.1.4.3 Buildings with Rooftop Refuge Area

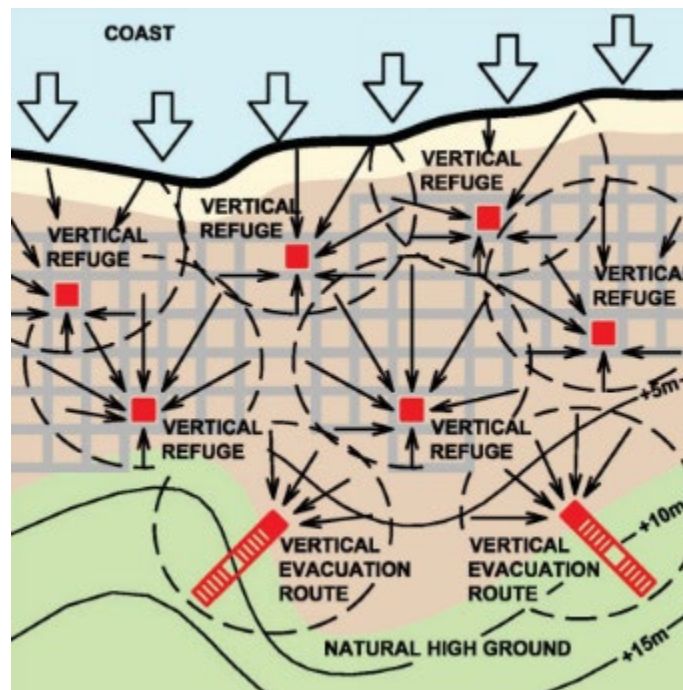
In a building that is specifically designed as a tsunami evacuation structure, the roof level is often designated as the tsunami refuge area while the lower levels are designed with special features (such as break-away walls) that will allow the tsunami waves to flow through lower levels. Instead of being developed as a single-purpose tsunami evacuation structure, the tsunami refuge area is often integrated into buildings that already serve everyday commercial or community-based functions, including public office buildings, school facilities, multi-story parking garages, and multi-story residential facilities. As an example, the Ocosta Elementary School in Westport, Washington, was constructed in 2016 and included the first tsunami vertical evacuation structure in the continental United States. The rooftop of the gymnasium was designed to be 30 feet above grade to serve as a tsunami refuge for up to 1,000 students, staff, and nearby community members. This approach of leveraging ongoing community development (e.g., construction of schools) is a very cost-effective way to enhance tsunami evacuation capacity to protect local residents and tourists.

#### **Spacing, Location, and Size Considerations**

Vertical evacuation structures need to be strategically located to ensure that all persons designated to take refuge at a particular structure can reach it within the time available between the tsunami warning and tsunami inundation. In Oregon and Washington, coastal communities may rely on ground-shaking from an offshore Cascadia Subduction Zone earthquake as tsunami warning. After re-orienting from the physical and emotional turmoil experienced during an earthquake, residents and tourists in Clatsop County may only have as little as 15 minutes for evacuation on foot. Although an average healthy person can walk at approximately 4 mph, people with mobility challenges due to age, health, and disability may only be able to evacuate at 2 mph. This means that the maximum spacing for vertical evacuation structures or natural high ground is about one mile.

In addition to spacing, it is important to consider natural and learned behaviors of human beings when locating tsunami evacuation structures in a community. The natural tendency for evacuees will be moving away from the shore and seeking high ground. Figure 17 illustrates an example for possible arrangement of vertical evacuation structures based on travel distance and evacuation behavior (arrows show anticipated vertical evacuation routes). Once the location of a tsunami evacuation structure is selected, refuge capacity can be estimated based

on the population density within its evacuation radius, and its size can be determined based on the recommendation of 10 square feet per occupant for a short-term vertical evacuation structure.



**Figure 17. Spacing Diagram for Vertical Evacuation Structures**

*Example of Vertical Evacuation Refuge Locations and Anticipated Evacuation Routes (FEMA 2019)*

### Design Considerations


Vertical evacuation structures must be tall enough to ensure safety of those seeking refuge even if the tsunami exceeds the design tsunami event. Determination of elevation for tsunami refuge must consider the uncertainty inherent in the estimation of the tsunami runup elevation, possible splash-up during impact of tsunami waves, and the anxiety level of evacuees seeking refuge in the structure. The minimum refuge elevation recommended by the American Society of Civil Engineers in *Minimum Design Loads and Associated Criteria for Buildings and Other Structures*, ASCE 7-16 (ASCE 2017) is equal to the maximum anticipated tsunami inundation elevation, plus 30 percent, plus 10 feet or one story, whichever is greater.

In the Pacific Northwest, in addition to tsunami load effects, vertical evacuation structures must be designed to resist seismic loads from a Cascadia Subduction Zone earthquake, consider access issues including post-earthquake functionality of vertical circulation systems, and the availability of emergency power. Deep foundation systems are typically required to resist liquefaction and permanent ground deformation during a seismic event and significant scouring during a tsunami.

#### 3.1.4.4 Cost Considerations

The type, height, and size (i.e., refugee capacity) of a vertical tsunami evacuation structure are the main factors that impact the design and construction cost of a vertical evacuation structure. In many cases, tsunami evacuation structures may need to be constructed on a site with poor soil condition, where site-specific hazards such as liquefaction and lateral spreading can create special design challenges, and often require significant cost to improve ground conditions and/or construct robust deep foundation systems. Unlike Japan, designing and constructing a tsunami evacuation structure is relatively new in the Pacific Northwest. In order to develop a planning-level construction cost range (in 2021 dollars) for a tsunami refuge as indicated in Table 12, we have taken a three-pronged approach, including (a) surveying recent tsunami evacuation feasibility studies, (2) compiling overall construction cost of a limited number of tsunami evacuation structures constructed in Oregon and Washington, and (3) leveraging our engineering experience and judgement.





If the county wants to develop a construction cost for budgetary planning or grant application for an individual tsunami evacuation structure, we recommend the county retain a qualified consultant to perform a project-specific engineering study to develop such information. It requires resources and expertise to plan, design, and construct tsunami evacuation structures. Local governments can obtain funding through grants from different departments and agencies of the federal and state governments as well as from local funding sources discussed in section 4.1, Funding and Financing Options.

#### 3.1.4.5 Planning and Implementation in Washington

After the 2011 Tohoku Japan Earthquake and Tsunami, the Emergency Management Division of the State of Washington created Project Safe Haven to increase tsunami preparedness for coastal communities in three counties: Pacific, Grays Harbor, and Clallam. As the outcome of this project, over 43 structures located within a 15-minute walk of population centers have been proposed to provide safe haven for more than 18,450 people with high priority given to children, elderly, and people with disabilities. Project Safe Haven has resulted in planning, design, and construction of a number of tsunami evacuation structures including the completed Ocosta Elementary School, the Shoalwater Bay Indian Tribe tsunami evacuation tower that is under construction, and design of a tsunami evacuation tower in the City of Westport, Washington.

#### 3.1.5 Emergency Operations Center

In the process of researching facility improvements for this plan, it was discovered that the County's Emergency Operations Center (EOC) is located within the inundation zone at Camp Rilea. Though outside of the scope of this planning process, the project team recommends moving the EOC to a more resilient location safely above the inundation zone.

### 3.2 Preferred Evacuation Facilities

The preferred improvements reflect input from the Project Advisory Committee (PAC), County staff, public feedback, and from the County Board of Commissioners. Alternatives considered, but rejected, are also noted.

Cost estimates are "order of magnitude" estimates based on engineer's judgement, improvement assumptions, and unit prices from recent bid tabs in Oregon. Cost estimating details are contained in Appendix A.

#### 3.2.1 Trails

A primary focus of the TEFIP is to establish tsunami evacuation routes along trails in Clatsop County. This section discusses trail alternatives and their characteristics: the trail type, recommended amenities, crossing improvements (if any), structure improvements (if any), and cost estimates. Trail alternatives and recommendations are listed at the end of this section in Table 13.

##### 3.2.1.1 Trail Types

Trails are classified into three types for the purposes of this TEFIP: on street trails, multi-use paths, or recreational trails. This planning effort prioritizes more developed trails for evacuation routes because they are easier to travel and are accessible to more people. However, less developed trails are recommended in areas where a recreational hiking trail is appropriate or in areas that lack other evacuation options.

##### 3.2.1.2 Trail Amenities

Preferred trail amenities are listed in Table 10 along with considerations relevant to implementation and tsunami evacuation. Amenities should be provided as appropriate for each trail; not all amenities are recommended for every trail. See Table 13 for amenity recommendations for each of the preferred trail projects. Some existing trails may already have amenities.

### 3.2.1.3 Structures

Some of the proposed trail projects include improvements to structures, such as bridges, boardwalks, and retaining walls. Projects with a possibility of needing structure improvements are described here by structure type. Structure improvements are also listed in Table 13. This assessment is preliminary. More investigation and engineering are required as projects are developed after the completion of this TEFIP.

#### Bridges

- T-06: Would need a new bridge over the creek (Figure 20).
- T-08: Adds a new pedestrian bridge over the Skipanon River parallel to the existing roadway bridge. A new pedestrian bridge would be more cost effective than seismically retrofitting the existing bridge (Figure 19).
- T-10: Would need a new bridge over the Skipanon River (Figure 19).
- T-15 meets T-16 at an undercrossing of Burma Road in Fort Stevens State Park. The undercrossing is an easier route to high ground than climbing up the steep road embankment and back down to trail level again (Figure 18).

#### Retaining Walls

- T-01: Steep terrain could require switchbacks and retaining walls (Figure 23).

#### Boardwalks

- T-06: Proposed trail appears to traverse wetlands. An elevated boardwalk is included to reduce potential wetland impacts from a new trail (Figure 20).

### 3.2.1.4 Trail Cost Estimates

Costs reported in this memo are conceptual, planning-level estimates and rounded up to the nearest 50,000 dollars. See Appendix A for cost estimating details. Cost estimates are to construct the trail, crossing treatments, anticipated structures, required fencing, and signage. Amenities are not included.

Estimates use unit costs from 2021. They include construction costs based on quantities derived from aerial imagery and unit costs from recent, similar projects. Surveying, mobilization, erosion control, and traffic control services are estimated as an additional percentage of unit costs. A 40 percent contingency was applied to account for unknowns at this high level of conceptual analysis. Engineering and design fees are included as an additional 20 percent of the project subtotal. Projects with a high likelihood of needing environmental permitting have additional costs to cover the permitting.

Costs do not include:

- Recommended amenities or features.
- Escalation or inflation for a future project year. Alternatives do not yet have a build date.

#### Cost Estimates for Each Trail Type


Each type of trail would be constructed differently and would therefore include different line items.

##### ***Cost Estimates for On Street Trails***

Cost estimates for on street trails assume one of three options:

- Marking an existing paved roadway with signs and pavement markings to indicate that it is a shared roadway and an evacuation route.



- 
- Paving an unpaved roadway with a 20-foot-wide asphalt surface. This cost includes clearing and grubbing, excavation, subgrade stabilization, aggregate base, and asphalt pavement that is 4 inches thick.
  - Extending the roadway on one side by paving an additional 8-foot-wide shoulder. This cost includes clearing and grubbing, excavation, subgrade stabilization, aggregate base, and asphalt pavement that is 4 inches thick.

#### ***Cost Estimates for MUPs***

Cost estimates for MUPs assume paving a 12-foot-wide trail. The cost includes clearing and grubbing, excavation, subgrade stabilization, aggregate base, and asphalt pavement that is 4 inches thick.

#### ***Cost Estimates for Recreational Trails***

Cost estimates for recreational trails assume a 10-foot-wide gravel path. The cost includes clearing and grubbing, excavation, subgrade stabilization, and aggregate base (gravel).

**Table 13. Proposed Trail Alternatives**

ID & Trail Type	General Location	Description	Recommended Amenities or Features	Benefits or Constraints	Recommendation & Justification	Cost Estimate
T-01 On street (shared roadway)	Arch Cape	Continue evacuation route outside of inundation zone from E Shingle Mill Lane, north on Fire Rock Road, and east to high ground. Pave 20-foot wide roadway to improve seismic resilience.	Wayfinding	<p>This is an existing evacuation route to serve the southern area of Arch Cape, but the route does not go far enough to escape the Cascadia “XXL” inundation zone.</p> <p>Trail could connect with a future trail system in nearby forest land that is in the process of being acquired by the Arch Cape Water District.</p> <p>Local residents have recently opposed road construction unless it is associated with new permitted development.</p>	<p><b>Recommended.</b></p> <p>Criteria: Addresses evacuation need; directness of travel</p> <p>Justification: T-01 extends an existing evacuation route out of the XXL inundation zone. It is located at the south end of Arch Cape, which is vulnerable to a tsunami and has a community of residents and has lodging for visitors. The route is relatively short and is along existing roads.</p>	\$250,000
T-02 MUP	Arch Cape	Create a trail along Oceanview Lane right of way that leads to high ground.	Wayfinding Potential assembly area	<p>The County already has the right of way here, but it has not been built out and it is not maintained.</p> <p>The County owns four parcels at the end of Oceanview Lane that are outside the inundation zone.</p> <p>Trail could connect with a future trail system in nearby forest land that is in the process of being acquired by the Arch Cape Water District.</p> <p>Local residents have recently opposed road construction unless it is associated with new permitted development.</p>	<p><b>Recommended.</b></p> <p>Criteria: Addresses evacuation need; directness of travel</p> <p>Justification: T-02 creates an evacuation route along existing County right of way. It is located toward the south end of Arch Cape, which is vulnerable to a tsunami and has a community of residents and has lodging for visitors.</p>	\$400,000
T-03	Arch Cape	Create a trail at the south end of Carnahan Road that continues east past US 101 along Buena Vista Drive to high ground. Improves the existing pedestrian underpass. Roadway is already paved, no additional paving included.			<p><b>Not recommended.</b></p> <p>Justification: T-03 creates an evacuation route along existing roads, but these roads are privately owned. The evacuation route would cross US 101 at grade and not through the pedestrian underpass, which may not be passable following an earthquake.</p>	

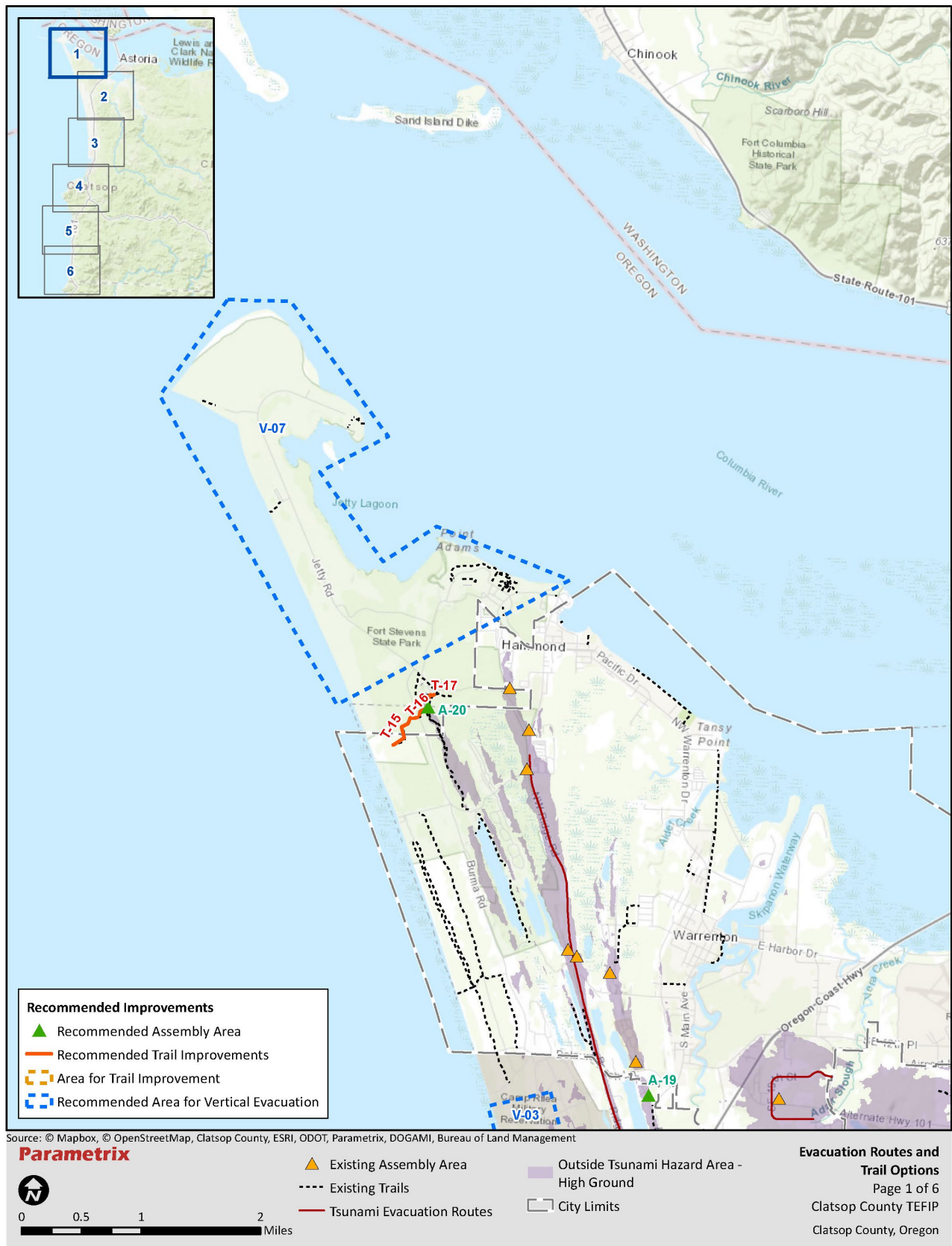
ID & Trail Type	General Location	Description	Recommended Amenities or Features	Benefits or Constraints	Recommendation & Justification	Cost Estimate
T-04 MUP	Arch Cape	Create a trail at the north end of Carnahan Road that continues north to high ground.	Wayfinding Fencing to delineate trail right of way from private property	Consider wooden steps for steep slope. Potential need for public easement. Requires coordination with owner of one parcel of private property	<b>Recommended.</b> Criteria: Addresses evacuation need; low-cost increases feasibility; possible need for public easement. Justification: T-04 creates an evacuation route with a new MUP extending to high ground. It is located at the north end of Arch Cape, which is vulnerable to a tsunami and has a community of residents and has lodging for visitors.	\$100,000
T-05	South of Cannon Beach	Area has platted properties but is not yet developed. Consider placing trail(s) as conditions of development.			<b>Not recommended.</b> Justification: Reconsider if the area becomes more likely for housing development.	
T-06 Recreation	North of Gearhart	Create a trail to connect - Shady Pine Road across Neacoxie Creek to higher ground to the west.	Wayfinding Fencing to delineate trail right-of-way from private property	Potential need for easement. Requires coordination with owners of four parcels of private property. If easement for a trail cannot be obtained, consider vertical evacuation structure(s) for people west of Sunset Lake. Locations would need to be determined through analysis and with community input. Requires bridge over Neacoxie Creek, which is a Goal 5 wetland. Will require an elevated boardwalk to reduce impacts to wetland (300-foot boardwalk included in cost estimate). Likely to require environmental permitting. Will require environmental review; this area might be endangered species habitat (silverspot butterfly).	<b>Recommended.</b> Criteria: Addresses evacuation need; feasibility may be difficult because this route involves coordination with multiple property owner and potential environmental permitting. Justification: T-06 provides an evacuation route for residents in the west portion of the Surf Pines community. This area is currently constrained by Sunset Lake and private property ownership. T-06 would provide a more direct path for this community to reach high ground. Challenges: It would require coordination with owners of four properties, an environmental review, and structures to bridge the creek and wetlands. Even so, this trail connection would likely be more practical and more cost effective than building a vertical evacuation structure.	\$1,250,000

ID & Trail Type	General Location	Description	Recommended Amenities or Features	Benefits or Constraints	Recommendation & Justification	Cost Estimate
T-07 Recreation	North of Gearhart	New trail to high ground from Cullaby Lake County Park parking areas and recreation areas.	Wayfinding Benches Shade structure Associated with potential assembly area A-10	Requires a new trail in wooded hill near the beaches and parking areas. Hill may have steep slopes in some areas.	<b>Recommended.</b> Criteria: Addresses evacuation need; provides multimodal connectivity; high feasibility. Justification: T-07 provides an evacuation route for visitors to Cullaby Lake County Park and creates a new recreational trail for visitors to enjoy.	\$300,000
T-08 Recreation	North of Gearhart	New trail to high ground from Cullaby Lake Lane. Adds a pedestrian bridge over Skipanon River parallel to the existing roadway bridge.	Wayfinding Associated with proposed assembly area A-11	Current evacuation route ends within inundation zone. Short trail segment needed to reach high ground. Hillside appears steep. Trail likely to need switchbacks. Retaining walls are not included in the cost estimate. Trail could be a feature of Carnahan County Park, which is owned by Clatsop County.	<b>Recommended.</b> Criteria: Addresses evacuation need; provides benefit to residents and park visitors; high feasibility because land is publicly owned. Justification: T-08 extends an existing evacuation route out of the XXL inundation zone into Carnahan County Park.	\$300,000
T-09	South of Camp Rilea	Connect Fort to the Sea Trail to high ground with a trail spur at ridge.			<b>Not recommended.</b> Justification: Fort to the Sea trail is located very near to higher ground; formal trail spur is not needed.	
T-10 MUP	Southeast of Camp Rilea	Connect the neighborhood at Glenwood Village to high ground with trail to the east.	Benches or seating for recreational use Fencing to delineate trail right of way from private property	Requires a bridge over the Skipanon River. Potential need for easement acquisition. Likely to require environmental permitting.	<b>Recommended.</b> Criteria: Addresses evacuation need; direct route to higher ground; need for bridge and environmental permitting makes the project more challenging. Justification: T-10 connects the neighborhood at Glenwood Village to high ground.	\$450,000

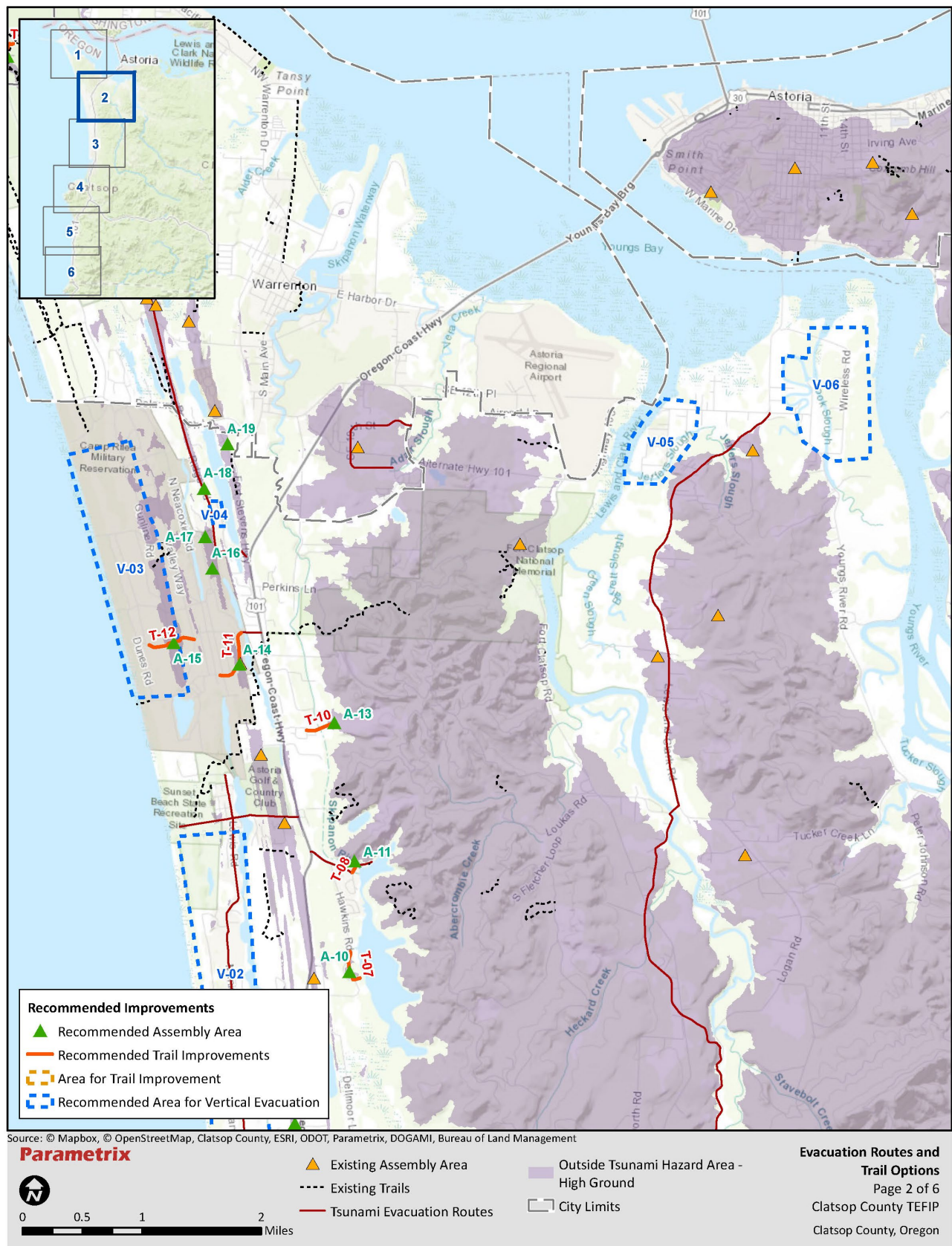
ID & Trail Type	General Location	Description	Recommended Amenities or Features	Benefits or Constraints	Recommendation & Justification	Cost Estimate
T-11 On street (shared roadway)	Camp Rilea	Improve Pacific Road to serve as an evacuation route.	Wayfinding Associated with proposed assembly area A-14	Needs to be coordinated with Camp Rilea.	<b>Recommended.</b> Criteria: Safety and security for people in the area; uses existing roadway; high benefit for low cost of signage. Justification: T-11 would provide an evacuation route for visitors at Camp Rilea. At some areas of the camp, the shortest/easiest route to high ground is to the west, which is not intuitive, and this trail would help clarify. Existing road is paved and would only require signage/wayfinding.	<\$50,000
T-12 On street (shared roadway)	Camp Rilea	Improve Demo Road to serve as an evacuation route. Paves a 20-foot-wide roadway surface.	Wayfinding Associated with proposed assembly area A-15	Needs to be coordinated with Camp Rilea.	<b>Recommended.</b> Criteria: Safety and security for people in the area; uses existing roadway; high benefit for low cost of signage. Justification: T-12 would provide an evacuation route for visitors at Camp Rilea. At some areas of the camp, the shortest/easiest route to high ground is to the west, which is not intuitive, and this trail would help clarify. Existing road is gravel and would require paving.	\$700,000
T-13	Camp Rilea	Connect the residential area along Douglas Lane to high ground at Camp Rilea with a short trail to 2nd Causeway Road.			<b>Not recommended.</b> Justification: Trail segment connects to assembly area; Douglas Lane leads to higher ground, so trail is not needed for evacuation.	
T-14	South of Warrenton	Delaura Beach Lane is an important connection from the beach to higher ground. Improve to be an effective evacuation route. Pave an 8-foot-wide shoulder.			<b>Not recommended.</b> Justification: T-14 would improve Delaura Beach Lane, which provides an evacuation route for nearby residents. There are few alternative routes near here because the road has water on both sides: Cemetery Lake to the north and Smith Lake to the south.	

ID & Trail Type	General Location	Description	Recommended Amenities or Features	Benefits or Constraints	Recommendation & Justification	Cost Estimate
T-15 MUP	Fort Stevens	Improve existing trail to serve as evacuation route for people in park or at beach.	Wayfinding	Trail is oriented east-west and provides fairly direct route to high ground.	<b>Recommended.</b> Criteria: Addresses evacuation need; multimodal connection; potential to serve many recreational users. Justification: T-15 would provide an evacuation route for visitors at Fort Stevens State Park and would improve the existing trail for everyday use.	\$450,000
T-16 MUP	Fort Stevens	New connection from existing trail to high ground.	Wayfinding	May be steep terrain.	<b>Recommended.</b> Criteria: Addresses evacuation need; multimodal connection; potential to serve many recreational users. Justification: T-16 would provide an evacuation route for visitors at Fort Stevens State Park and would improve the existing trail for everyday use. Includes seismic upgrades to the Burma Road undercrossing.	\$400,000
T-17 MUP	Fort Stevens	New connection from existing Jetty Road parking area to high ground.	Wayfinding	May be steep terrain.	<b>Recommended.</b> Criteria: Addresses evacuation need; multimodal connection; potential to serve many recreational users from the Jetty Road parking area. Justification: T-17 would provide an evacuation route for visitors at Fort Stevens State Park and would improve the existing trail for everyday use.	\$100,000





**Figure 18. Evacuation Routes and Trail Options – Page 1**



**Figure 19. Evacuation Routes and Trail Options – Page 2**



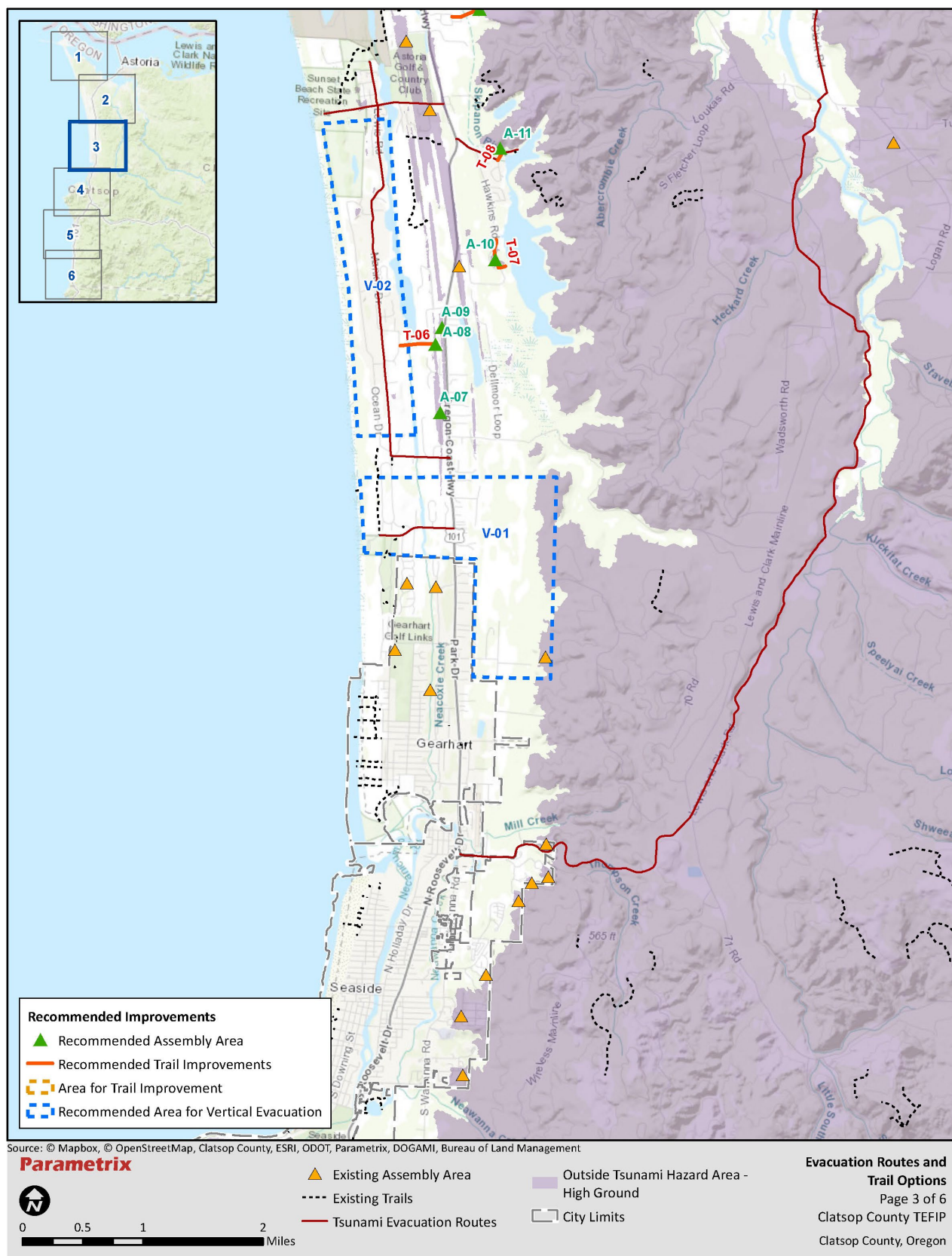
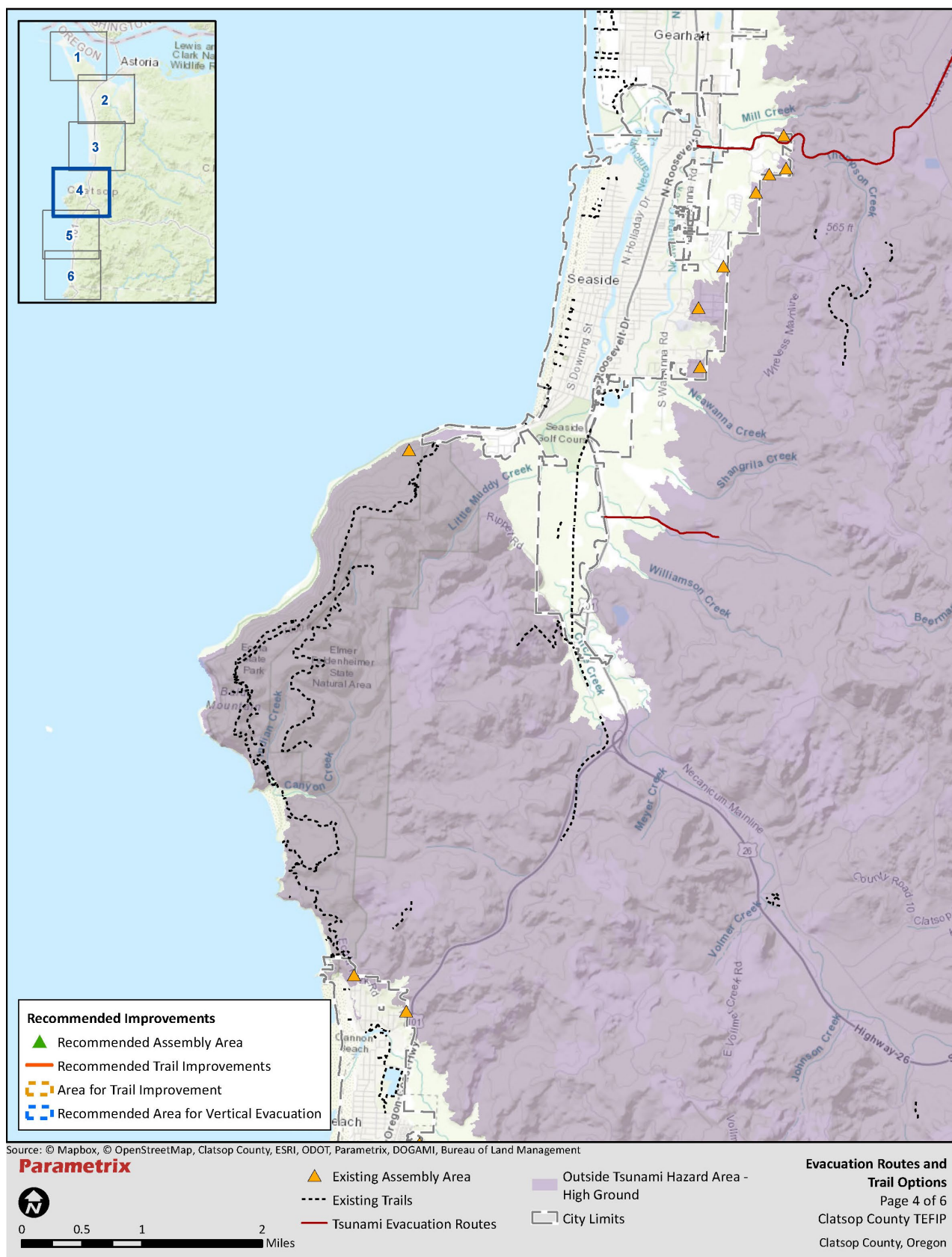


Figure 20. Evacuation Routes and Trail Options – Page 3



**Figure 21. Evacuation Routes and Trail Options – Page 4**



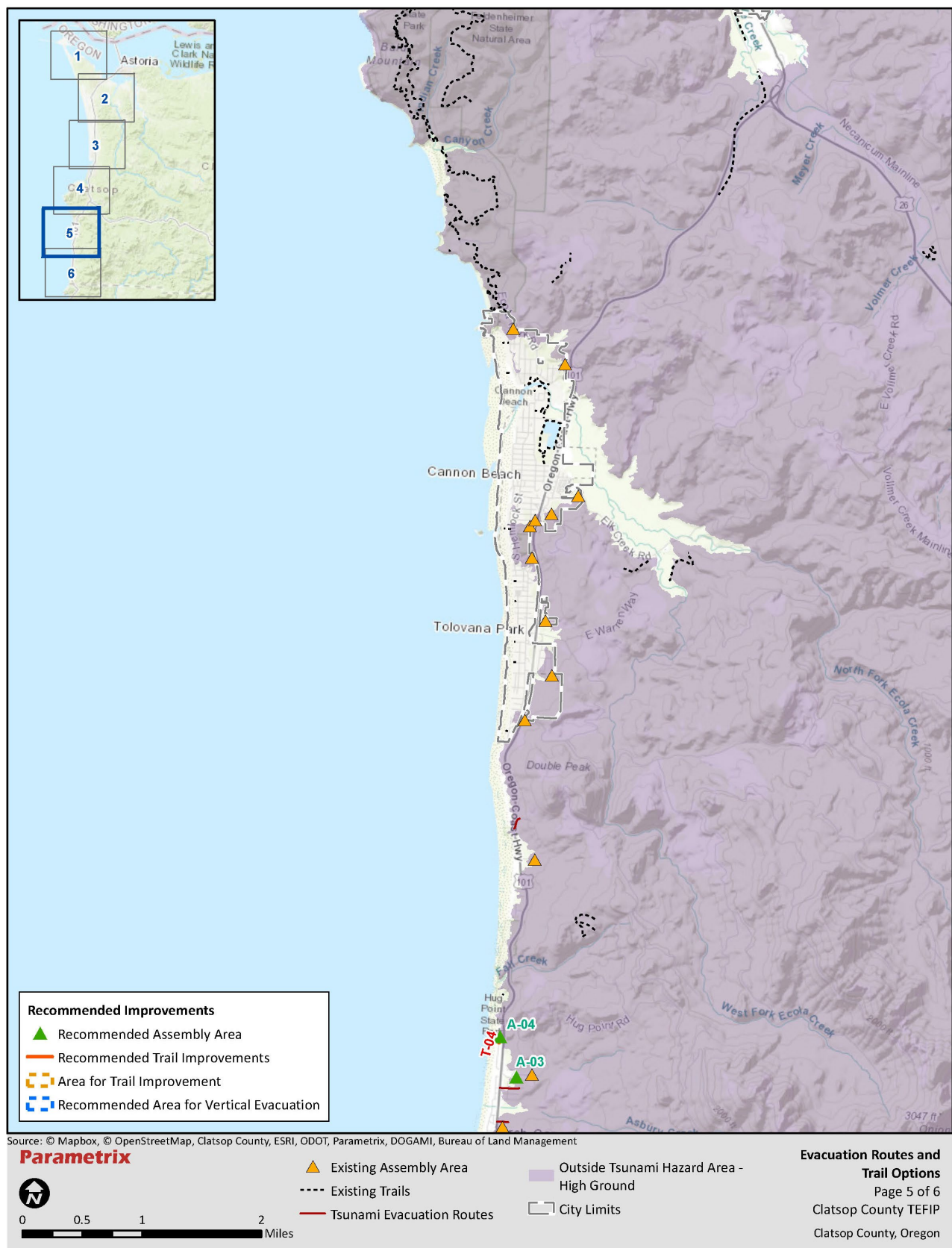


Figure 22. Evacuation Routes and Trail Options – Page 5

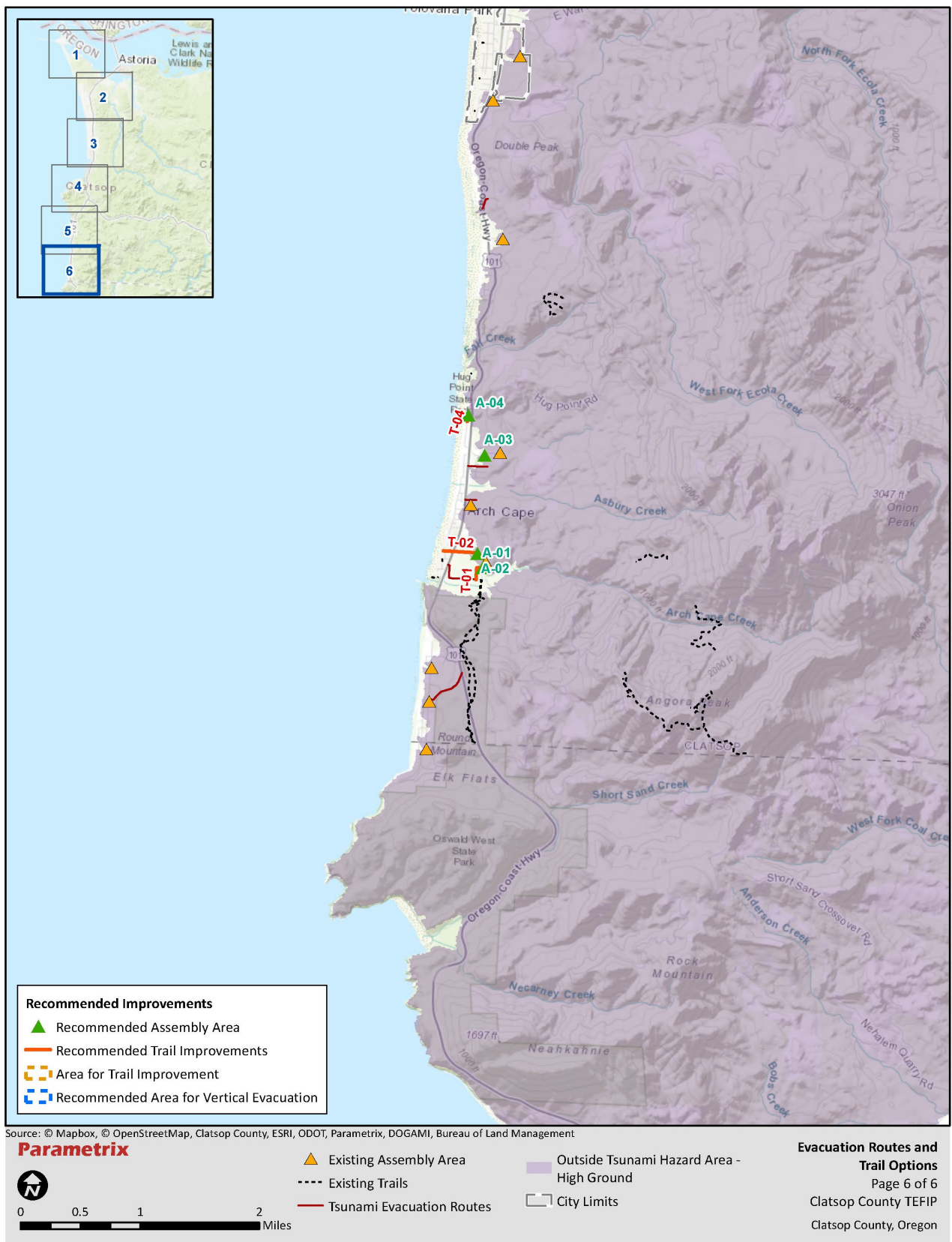


Figure 23. Evacuation Routes and Trail Options – Page 6



### 3.2.2 Assembly Areas

Assembly areas provide space on high ground outside the inundation zone for people to gather temporarily during a tsunami. At minimum, they provide a clear and safe place for people to come together until the high water recedes. This requires a plot of land outside the evacuation zone, effective wayfinding signs to get people there, and regular maintenance to keep it in good condition.

It is worth noting that it is not necessary for people to evacuate to assembly areas specifically. It is most important that people get to high ground, which does not need to be an assembly area. But assembly areas help by indicating to people that they are in a safe place on high ground and by bringing people together for collective support.

#### 3.2.2.1 Assembly Area Investment Packages

The appropriate amount of investment in each assembly area depends on its evacuation shed and how accessible it is for emergency responders. Locations expected to serve many residents or visitors will require more space and survival equipment than locations expected to serve a small number. Assembly areas in more remote or isolated locations would benefit from more survival equipment because it will take more time for emergency responders to reach them. Assembly areas that would be disconnected from resources during a tsunami could have survival equipment to keep people safe and comfortable, and to treat injuries incurred during the evacuation.

Assembly areas that are in neighborhoods or are connected by roads that lead to high ground outside the inundation zone would require less investment. Evacuees at assembly areas in neighborhoods on high ground would have access to resources from their neighbors. Assembly areas that are connected to other areas outside the inundation zone would be relatively easy to reach (assuming the area is still passable following the earthquake), and evacuees there could safely travel beyond their assembly area. Assembly areas that are connected to other areas require less survival equipment.

To ensure the correct level of investment for each assembly area, three investment packages are defined (Table 14). One package is proposed for each assembly area.

**Table 14. Assembly Area Investment Packages**

Minimum Investment Package	Medium Investment Package	High Investment Package
<i>The minimum investment package is the lowest cost and is just enough infrastructure to establish and declare the assembly area.</i>	<i>The medium investment package includes investments to make people more comfortable without requiring much maintenance or management of the assembly area.</i>	<i>The high investment package is the highest cost and includes survival equipment to keep people safe and comfortable for some time after the tsunami. The high investment package requires the most ongoing maintenance and management.</i> <i>Supplies could be provided by the county or other organization. Supplies could also be brought by residents and stored on site in a locked facility.</i>
<ul style="list-style-type: none"><li>• Signs indicate that people are above the inundation zone and that they have reached the assembly area (with language such as “this is an official assembly area”).</li><li>• Assembly area is the appropriate size for the expected evacuation shed.</li></ul>	<ul style="list-style-type: none"><li>• Signs indicate that people are above the inundation zone and that they have reached the assembly area (with language such as “this is an official assembly area”).</li><li>• Assembly area is the appropriate size for the expected evacuation shed.</li></ul>	<ul style="list-style-type: none"><li>• Signs indicate that people are above the inundation zone and that they have reached the assembly area (with language such as “this is an official assembly area”).</li><li>• Assembly area is the appropriate size for the expected evacuation shed.</li></ul>

Minimum Investment Package	Medium Investment Package	High Investment Package
<i>The minimum investment package is the lowest cost and is just enough infrastructure to establish and declare the assembly area.</i>	<i>The medium investment package includes investments to make people more comfortable without requiring much maintenance or management of the assembly area.</i>	<i>The high investment package is the highest cost and includes survival equipment to keep people safe and comfortable for some time after the tsunami. The high investment package requires the most ongoing maintenance and management.  Supplies could be provided by the county or other organization. Supplies could also be brought by residents and stored on site in a locked facility.</i>
<ul style="list-style-type: none"> <li>• Assembly area is maintained to be accessible and clear for evacuees.</li> </ul>	<ul style="list-style-type: none"> <li>• Assembly area is maintained to be accessible and clear for evacuees.</li> <li>• Shelter.</li> <li>• Furniture, such as benches and seats.</li> <li>• Solar lighting.</li> </ul>	<ul style="list-style-type: none"> <li>• Assembly area is maintained to be accessible and clear for evacuees.</li> <li>• Shelter.</li> <li>• Furniture, such as benches and seats.</li> <li>• Solar lighting.</li> <li>• Communication devices (radio transmitters or walkie talkies).</li> <li>• First aid supplies.</li> <li>• Blankets.</li> <li>• Drinking water.</li> <li>• Food.</li> </ul>

### 3.2.2.2 Assembly Area Alternatives

Proposed assembly area alternatives are listed in Table 15 and shown in Figures 18-23.

**Table 15. Proposed Assembly Area Alternatives**

ID	General Location	Description	Recommended Investment Package	Benefits or Constraints	Recommendation & Justification
A-01	Arch Cape	Establish a formal assembly area at the end of the trail from Option T-01.	High Arch Cape could be quite isolated following an earthquake. This location can take advantage of the fire station nearby by stocking water, food, supplies, and other survival equipment to serve the surrounding neighborhood.	Area is available on undeveloped right of way.	<b>Recommended.</b> Provides a place for nearby residents and visitors to evacuate to. Establishes a safe ending location for the existing evacuation route. This area could become quite isolated following an earthquake.
A-02	Arch Cape	Establish a formal assembly area at the end of the trail from Option T-02.	Medium Shelters, benches, and lighting	Area is available on undeveloped right of way.	<b>Recommended.</b> Provides a place for nearby residents and visitors to evacuate to.
A-03	Arch Cape	Establish a formal assembly area at the end of the evacuation route on Buena Vista Drive from Option T-03.	Minimum	An assembly area would indicate that evacuees have made it to a safe place. Area appears to be privately owned but undeveloped.	<b>Recommended.</b> Provides a place for nearby residents and visitors to evacuate to.
A-04	Arch Cape	Establish a formal assembly area at the end of the trail from Option T-04.	Minimum	An assembly area would indicate that evacuees have made it to a safe place. Area appears to be privately owned but undeveloped.	<b>Recommended.</b> Provides a place for nearby residents and visitors to evacuate to.

ID	General Location	Description	Recommended Investment Package	Benefits or Constraints	Recommendation & Justification
A-07	North of Gearhart	Establish one or multiple formal assembly areas along Polo Ridge Road.	Medium Shelters, benches, and lighting could also serve as everyday amenities for residents of Pole Ridge Road. This area is surrounded by low ground expected to be inundated.	Polo Ridge Road is on a narrow ribbon of high ground above the inundation zone. This is the most accessible high ground for most of the Surf Pines community. Multiple assembly areas spaced along the road to maximize accessibility is preferred. Much of the property along the road is developed with homes, and some of the space is required landscape buffer. Some parcels of undeveloped land may be common spaces for the subdivision, opportune locations for assembly areas pending coordination with the landowner (Clatsop Estates LLC).	<b>Recommended.</b> Provides a place for nearby residents to evacuate to. Amenities could be features for everyday use by nearby residents. This area is surrounded by low ground expected to be inundated.
A-08	North of Gearhart	Establish a formal assembly area at the end of the trail from Option T-06.	Minimum Though this area is surrounded by low ground, it is approximately one half mile from A-07 on the same patch of high ground.	Land appears to be privately owned but undeveloped.	<b>Recommended.</b> This provides a place for nearby residents to evacuate to. Evacuees could walk to A-07 for additional survival equipment during non-emergency situations.
A-09	North of Gearhart	Establish one or multiple formal assembly areas near West Lake Acres Drive.	High This location can take advantage of the fire station by stocking water, food, supplies, and other survival equipment to serve the surrounding neighborhood. This area is surrounded by low ground expected to be inundated.	Could co-locate with Gearhart Rural fire station. Multiple assembly areas spaced along the road to maximize accessibility is preferred. Constraints: this area is near wetlands and potential habitat for a federally listed threatened species.	<b>Recommended.</b> Provides a place for nearby residents to evacuate to. The fire station is an ideal opportunity to also provide other survival equipment. This area is surrounded by low ground expected to be inundated.
A-10	North of Gearhart	Establish an assembly area on the wooded hill in Cullaby Lake County Park that connects with T-07.	Medium Shelters, benches, and lighting would also serve as everyday amenities for Cullaby Lake County Park.	A majority of the park land is owned by the Finlandia Foundation. A portion of the land is owned by Clatsop County.	<b>Recommended.</b> Provides a place to evacuate for visitors to Cullaby Lake. Also provides amenities for park visitors.

ID	General Location	Description	Recommended Investment Package	Benefits or Constraints	Recommendation & Justification
A-11	North of Gearhart	Establish a formal assembly area at the end of the trail from Option T-08.	Medium Shelters, benches, and lighting would also serve as everyday amenities for Carnahan County Park.	Land is Carnahan Park, owned by Clatsop County.	<b>Recommended.</b> Provides a place to evacuate for residents of North Cullaby Lake and visitors of Cullaby Lake Park. Amenities could be integrated into the park's trail system.
A-13	East of Camp Rilea, east of Hwy 101	Establish a formal assembly area at the end of the trail from Option T-10.	Minimum	Well connected with existing roads. Could serve as evacuation point for several neighborhoods.	<b>Recommended.</b> Provides a place to evacuate for nearby neighborhood residents.
A-14	Camp Rilea	Establish a formal assembly area along Pacific Road in Camp Rilea. Connects with Option T-11.	Medium Shelters, benches, and lighting can serve as features of Camp Rilea. This area is surrounded by low ground expected to be inundated.	Well connected with existing roads. Needs to be coordinated with Camp Rilea.	<b>Recommended.</b> Provides a place to evacuate for visitors to Camp Rilea. Amenities could be features for everyday visitors of Camp Rilea. This area is surrounded by low ground expected to be inundated.
A-15	Camp Rilea	Establish a formal assembly area along Demo Road in Camp Rilea. Connects with Option T-12.	Medium Shelters, benches, and lighting can serve as features of Camp Rilea. This area is surrounded by low ground expected to be inundated.	Well connected with existing roads. Needs to be coordinated with Camp Rilea.	<b>Recommended.</b> Provides a place to evacuate for visitors to Camp Rilea. Amenities could be features for everyday visitors of Camp Rilea. This area is surrounded by low ground expected to be inundated.
A-16	Camp Rilea	Establish a formal assembly area along 2nd Causeway Road near the south intersection with Cev Road in Camp Rilea.	Medium Shelters, benches, and lighting can serve as features of Camp Rilea. This area is surrounded by low ground expected to be inundated.	Well connected with existing roads. Needs to be coordinated with Camp Rilea.	<b>Recommended.</b> Provides a place to evacuate for visitors to Camp Rilea. Amenities could be features for everyday visitors of Camp Rilea. This area is surrounded by low ground expected to be inundated.
A-17	Camp Rilea	Establish a formal assembly area for Option T-13 along 2nd Causeway Road near the north intersection with Cev Road in Camp Rilea.	Minimum A-17 is approximately 1,500 feet north of A-16 and on the same patch of high ground.	Well connected with existing roads. Needs to be coordinated with Camp Rilea.	<b>Recommended.</b> Provides a place to evacuate for residents of Spirit Place and Douglas Lane as well as for visitors to Camp Rilea. A-17 is approximately 1,500 feet north of A-16 and on the same patch of high ground.

ID	General Location	Description	Recommended Investment Package	Benefits or Constraints	Recommendation & Justification
A-18	North of Camp Rilea	Establish a formal assembly area at the south end of Smith Lake County Park; provide signage identifying high ground.	Minimum	Can be co-located with Smith Lake County Park. Potential wetlands in the west part of the park. The south end of the neighborhood is roughly one-half mile from the proposed assembly area, consider a vertical evacuation structure to serve this area (V-03)	<b>Recommended; low priority.</b> Provides a place to evacuate for residents of Smith Lake Road.
A-19	North of Camp Rilea	Establish a formal assembly area along Whiskey Road to serve neighbors on the northeast side of Smith Lake.	Minimum	Located on platted, but undeveloped right of way. Adjacent to Warrenton city limits. Coordinate with the City of Warrenton.	<b>Recommended.</b> Provides a place for nearby residents and visitors to evacuate to.
A-20	Fort Stevens	Establish a formal assembly area on this ridge of high ground to serve the trails in Options T-15, T-16, and T-17.	Medium Shelters, benches, and lighting can serve as features of Fort Stevens State Park.	Evacuation shed may be large for this location when the park hosts many visitors.	<b>Recommended.</b> Provides a place to evacuate for visitors to Fort Stevens State Park. Amenities can serve as everyday features of the park.
A-21	Cove Beach	Establish a formal assembly area for people in Cove Beach to gather following a tsunami.	High Cove Beach could be quite isolated following an earthquake. This location can take advantage of the fire station nearby by stocking water, food, supplies, and other survival equipment to serve the surrounding neighborhood.	Located in a neighborhood above the inundation zone. The Cove Beach area may be difficult to access after a seismic event. Located on Falcon Cove Water District land.	<b>Not recommended.</b> Falcon Cove Water District is not in favor of an assembly area at this location. Provides a place to evacuate for residents and visitors of Cove Beach. Amenities could be features for everyday use by nearby residents. This area is surrounded by low ground expected to be inundated.





### 3.2.3 Vertical Evacuation Structures

In locations where natural high ground is not available or is not practical to reach in time before the first tsunami wave arrives, vertical evacuation structures can be appropriately designed and constructed to serve as places of refuge where many people can evacuate and remain for up to 24 hours to escape the initial and subsequent tsunami waves.

#### 3.2.3.1 Structure Locations

Vertical evacuation structures would provide needed refuge in low-lying coastal areas of Clatsop County. General areas that would benefit from vertical evacuation structures are identified in Table 16 and shown in Figures 18-23. Further study is recommended to determine the number of structures in each area, their sizes and types, and their exact location. The study should include robust community involvement. This level of planning for vertical evacuation structures is outside the scope of this TEFIP.

**Table 16. Proposed Vertical Evacuation Structure Alternatives**

<b>ID</b>	<b>Type</b>	<b>General Location</b>	<b>Description</b>	<b>Recommended Amenities or Features</b>	<b>Benefits or Constraints</b>	<b>Recommendation</b>
V-01	Vertical structure	North of Gearhart	Area north of Gearhart is not well connected and requires traversing long distances to reach high ground.	Wayfinding, solar charging, communications.	Placement should be considered through community outreach.	<b>Recommended.</b>
V-02	Vertical structure	North of Gearhart	Area is separated from high ground by Sunset Lake. Requires traveling long distances to evacuate the inundation zone. Consider vertical evacuation structures.	Wayfinding, solar charging, communications.	Placement should be considered through community outreach.	<b>Recommended.</b>
V-03	Vertical structure	Camp Rilea	Beach area is nearly one-half mile to high ground.	Wayfinding, solar charging, communications.	Placement should be considered through community outreach and coordination with Camp Rilea.	<b>Recommended.</b>
V-04	Vertical structure	South of Warrenton	The community at the southwest end of Smith Lake is roughly one-half mile from high ground.	Wayfinding, solar charging, communications.	Placement should be considered through community outreach. Option A-17 proposes an assembly area at the high ground on the north end of the community.	<b>Recommended.</b>
V-05	Vertical structure	Jeffers Garden	Area is surrounded by water and not well connected to high ground.	Wayfinding, solar charging, communications.	Placement should be considered through community outreach.	<b>Recommended.</b>
V-06	Vertical structure	Miles Crossing	Area is surrounded by water and not well connected to high ground.	Wayfinding, solar charging, communications.	Placement should be considered through community outreach.	<b>Recommended.</b>
V-07	Vertical structure	Clatsop Spit	The Clatsop Spit is long, flat, and vulnerable to a tsunami. It is also popular with visitors of Fort Stevens State Park.	Wayfinding, solar charging, communications.	Placement should be considered through community outreach and coordination with Fort Stevens State Park.	<b>Recommended.</b>

## 4. IMPLEMENTATION AND NEXT STEPS

### 4.1 Funding and Financing Options

The following funding sources should be considered for implementing evacuation trail improvements to provide a supplement to existing local funding. Tsunami evacuation planning completed for Washington's three southern-most counties has received substantial interest and support from FEMA, and there is a good opportunity for Oregon and Clatsop County to work with FEMA and others to identify and fund innovative tsunami evacuation facilities including trails, assembly areas, and vertical evacuation structures.

#### 4.1.1 Federal Emergency Management Agency (FEMA)

One of the grant programs is FEMA's Building Resilient Infrastructure and Communities (BRIC). It is a relatively new FEMA pre-disaster hazard mitigation program that replaced the former Pre-Disaster Mitigation Grant Program to support states, local communities, tribes, and territories through capability- and capacity-building to reduce the risks they face from disasters and natural hazards. Eligible projects should: be cost effective, reduce or eliminate risk from future natural hazards, meet published codes/standards, align with community hazard mitigation plan, and meet environmental and historic preservation requirements. The Oregon point of contact is the State Hazard Mitigation Officer, Amie Bashant. Contact information: 503-378-4660; [amie.bashant@state.or.us](mailto:amie.bashant@state.or.us).

More information: <https://www.fema.gov/grants/mitigation/building-resilient-infrastructure-communities>

In 2016, the City of Newport, Oregon, partnered with FEMA and ODOT to develop Safe Haven Hill as a tsunami evacuation assembly area. In Washington, FEMA has funded the construction of the Shoalwater Bay Indian Tribe tsunami evacuation tower and provided grant assistance to develop the design of a tsunami evacuation platform in the City of Westport.

#### Oregon Community Paths Program

The Community Paths Program is a new funding program that ties together several pre-existing as well as new funding sources for trails and multimodal pathway improvements. The program is funded through both state and federal sources including funding from the new state bicycle excise tax as well as federal funding from the Transportation Alternatives pot of federal transportation monies. There are two main funding tracks with the Community Paths Program:

- Project refinement – Furthers planning, environmental or permitting work, and design on projects, but does not fund construction explicitly.
- Construction – Funding for final design and construction of trails projects. These can be state or federal funds.

In 2021, the Oregon Transportation Commission approved approximately \$15 million in funding for projects across the state. To be competitive, projects need to be well defined, ideally link communities together, fill a critical missing link in a corridor, or serve as an element of the larger regional trail network. Clatsop County would be eligible to apply for both project refinement and construction funds.



More information: <https://www.oregon.gov/odot/Programs/Pages/OCP.aspx>

#### 4.1.2 Rivers, Trails, and Conservation Assistance Grants from the National Park Service

The National Park Service (NPS) offers the Rivers, Trails and Conservation Assistance grant program for community-led natural resource conservation and outdoor recreation projects. Selection criteria favor projects with a near-term implementation schedule (within 5 years), clearly defined roles for project sponsors, evidence of broad community support, and project attributes that fit with the program's five focus areas, which are listed below. NPS will consider projects outside these focus areas as well.

- Build healthy communities.
- Conserve natural lands, rivers, and watersheds.
- Engage youth in outdoor recreation and stewardship.
- Strengthen organizational capacity of partners.
- Support NPS and community networks.

More information: <https://www.nps.gov/orgs/rtca/apply.htm>

#### 4.1.3 Oregon Recreational Trails Program


The Recreational Trails Program (RTP) is a federally funded grant program administered by the Oregon Parks and Recreation Department. Since 1993, Oregon has funded over 500 projects with RTP funds to develop, improve, or expand motorized and non-motorized trails and their facilities. This annual grant program allocates approximately \$1.5 million each year and prioritizes projects that are accessible for users of all ages and abilities. The RTP grants can be used for a variety of trails projects, including the following:

- New trail construction
- Heavy trail restoration
- Trail head facilities
- Purchase or lease of trail construction and maintenance equipment
- Land or easement acquisition for trail purposes
- Safety and education programs or materials
- Assessment of trail conditions for accessibility or maintenance
- Water trails

More information: <http://www.oregon.gov/oprd/grants/Pages/trails.aspx>

#### 4.1.4 Land and Water Conservation Fund

The Land and Water Conservation Fund State Grants program provides 50/50 matching grants to state and tribal governments for the acquisition and development of public parks and other outdoor recreation sites. Grants have funded projects in every county in the country—over 40,000 projects since 1965. Land and Water Conservation Fund monies are distributed to states based on population, and



project selection for these funds is conducted at the state level. Selection criteria for the grants are aligned with Oregon’s statewide recreation plan goals and priorities.

More information: <https://www.oregon.gov/oprd/GRA/Pages/GRA-lwcf.aspx>

## 4.2 Next Steps

### 4.2.1 Vertical Evacuation Structures

To implement vertical evacuation structures, we recommend that Clatsop County build upon the success of Washington’s Project Safe Haven. The County should leverage the work completed as part of this current TEFIP planning effort to develop a community engagement process and implementation strategy to determine the desired locations for vertical evacuation structures. The plan would develop initial tsunami vertical evacuation options and associated budgetary needs for planning, design, construction, maintenance, and management.

The general areas recommended for vertical evacuation structures in the this TEFIP will need to be refined to determine specific locations, based on land availability, development feasibility, impacts to the surrounding community, and overall benefit to the evacuation network. This refinement should be conducted alongside a robust community engagement process to allow for public input on vertical evacuation structure location, type, and design.


This analysis may determine that locating a vertical evacuation structure in each of the recommended locations may not be feasible, due to funding constraints, lack of available land, or undesirable impacts to the surrounding community. The county will likely need to make difficult decisions about where to prioritize the construction of vertical evacuation structures. This prioritization should be based on a thorough examination of tradeoffs, establishing an acceptable level of risk, and determining which communities may be most at-risk, based on geographic location, vulnerable populations, or other factors. The county should work closely with subject matter experts, stakeholders, and community members throughout this planning process.

Several funding sources are available to assist with the construction of vertical evacuation structures. The county should coordinate with FEMA and the Oregon Office of Emergency Management to explore grant opportunities for specific projects. The county may also wish to explore alternative funding sources, such as public-private partnerships.

With help from potential grants and funding from federal, state, and local partners, Clatsop County can take the important step of beginning to build the first vertical evacuation structure in the county and steadily increase the capability of its local governments and community champions to plan and implement additional future tsunami vertical evacuation structures. These vertical evacuation structures will save lives following a Cascadia Subduction Zone earthquake, enhance the tsunami resilience of the community, and by leveraging potential synergies between vertical evacuation structures and other community enhancements (e.g., parks, community centers, etc.), improve the everyday quality of life for Clatsop County residents and tourists.

### 4.2.2 Evacuation Route Improvements

Evacuation route improvements may be implemented through a variety of approaches. An important first step is ensuring that the goals and recommendations within the TEFIP are consistent with county policy and regulations. The county should amend its planning documents to reflect the goals of the TEFIP and support the development of recommended evacuation facility improvements. This should



include supportive goals and policies in the Clatsop County Comprehensive Plan for Statewide Planning Goal 7 (Natural Hazards), Goal 8 (Recreational Needs), Goal 11 (Public Facilities and Services), Goal 12 (Transportation), and Goal 14 (Urbanization), and any other relevant chapters. Incorporating TEFIP goals into the Comprehensive Plan will support the county in making land use and development decisions that implement recommended evacuation facility improvements.

Improvements to the transportation network should be incorporated into the Clatsop County Transportation System Plan (TSP). Identifying recommended improvements will allow the county to prioritize, plan for, and obtain funding for projects identified within the TEFIP.

Amendments to the Clatsop County Land and Water Development and Use Code should be made to support the goals and recommendations within the TEFIP. Code changes may include amendments to zone regulations to allow for the construction of evacuation facilities, such as modification of height limits to allow for vertical evacuation structures, or permitting emergency evacuation facility uses in farm, forest, and residential zones.

Development standards may be amended to require either on- or off-site evacuation facility improvements as a condition of development, in proportion to the impact that the development will have on the evacuation system. Requirements may include trail development or providing amenities such as wayfinding signage or lighting. Additional code amendments may incentivize developers to contribute to evacuation facility improvements, through incentives such as providing flexibility in setbacks, height, or lot coverage.

### 4.2.3 Assembly Areas

Assembly areas are a critical part of evacuation system infrastructure, as they provide a gathering place and survival equipment for evacuees in the event of a tsunami. This TEFIP makes recommendations for the establishment or improvement of assembly areas throughout the county. An important first step is for the County to designate land for each assembly area and negotiate with private property owners to obtain easements if needed. Dedicating space for an assembly area should be considered a condition of development for new subdivisions or major development occurring in area of high ground that may be used during an evacuation. Signage should be placed at each assembly area location, so evacuees will know when they have reached safety. Design of assembly areas and survival equipment should consider the needs of people with disabilities.

The need for survival equipment will vary for each assembly area, based on location, nearby amenities, and the number of people the area is expected to serve. Because the need is so dependent on local conditions, many jurisdictions have had success in encouraging neighborhoods and communities to create and maintain their own local supply caches. The county should consider establishing a program that would assist communities in establishing their own supply caches at the assembly area they will use in the event of a tsunami. This program should rely on guidance from DOGAMI's *Earthquake and Tsunami Community Disaster Planning Guide* in supporting communities as they design, implement, and maintain their supply caches. Supporting community ownership of supply caches has the added benefit of increasing familiarity with tsunami assembly areas and evacuation procedures.

Funding for supply caches may come from a variety of sources. Some communities may have the ability to purchase and maintain their own supplies, while others, especially vulnerable communities, may lack the resources to establish a supply cache. The county may wish to establish a grant program to distribute funding to communities who need financial assistance to obtain emergency supplies. Supplies or funding may also be obtained through non-profits, community groups, or donations from local businesses.



#### 4.2.4 Coordination

Ongoing coordination between the County and stakeholders will be essential to realizing implementation of the TEFIP. These stakeholders should include all relevant state and federal agencies, local community organizations and institutions, and landowners.

Lewis and Clark Timberlands has expressed interest in partnering with Clatsop County to permit the development of evacuation facilities on their land, which is primarily located outside of the inundation zone. County staff should work with Lewis and Clark to explore opportunities for evacuation pathways and assembly areas. Evacuation routes could be co-located with existing logging roads but would need to have appropriate signage and maintenance to remain accessible. Gated logging roads may present barriers to vehicular access, and the County should work with Lewis and Clark to coordinate gate access in the event of an evacuation. Assembly areas on timberlands could contain amenities such as informational kiosks with information about forest policies, fire awareness, wildlife, and wayfinding.

While this plan focuses on evacuation facilities outside of incorporated cities, the County should coordinate with City staff members and institutions such as hospitals and schools outside of the inundation zone to establish locations that could act as regional gathering places for evacuees in the days after a tsunami event.

##### **Junction at 101 and 26**

The US 101/US 26 interchange has been identified as a strategic location for an assembly area and/or evacuation point, due to its high level of traffic and location on natural high ground. A parking structure at this location could be used year-round as overflow parking for the cities of Seaside and Cannon Beach and may be used to store emergency supplies and act as a helipad in the event of a tsunami and subsequent evacuation.

Project selection for the TEFIP prioritized projects located on public lands. However, some recommendations are identified on private property. Any easements for trails located on private property will be voluntary. For areas not yet developed, trail rights-of-way or easements could be incorporated into future site design. County staff should communicate with property owners where improvements have been proposed to discuss potential easements, trail access, maintenance, and any other concerns.

#### 4.2.5 Education

By incorporating evacuation routes into the recreational trail network, residents and visitors will become more familiar with the location of trails that lead to assembly areas and high ground. Naming these trails to reflect their purpose (for example, “Warrenton *High Ground Trail*”) will help residents and visitors identify them as evacuation routes in the event of a tsunami.

Educating the community about evacuation procedures and evacuation routes is an essential component of tsunami preparedness. Maps of evacuation routes and instructions on what to do in the event of an earthquake and tsunami should be made available to both residents and visitors. This material should include information on what to expect during the hours and days after a tsunami event, how to establish a supply cache, and where the nearest assembly areas with emergency supplies and shelter are located. In addition to the information already provided on the Clatsop County website, tsunami information may be shared via mail or posting in spaces such as parks, community centers, hotels, and vacation rentals.

Tsunami preparedness educational resources:



<https://nctr.pmel.noaa.gov/education/>

<https://www.oregongeology.org/tsuclearinghouse/>

<https://community.fema.gov/ProtectiveActions/s/article/Tsunami>