MILLER NASH LLP

William L. Rasmussen
william.rasmussen@millernash.com
503.205.2308 (direct)

August 4, 2026

VIA EMAIL
TYLER.BLANCHETTE@OPRD.OREGON.GOV

Tyler Blanchette
Ocean Shore Permit Coordinator
Oregon Parks and Recreation Department
725 Summer St NE, Ste C
Salem, OR 97301-1271

Subject: Response to Request for Additional Information
Application for Ocean Shore Alteration Permit
Maxine and Martin Siegel (Property at 3915 Ocean Ave)

Dear Tyler:

This letter responds to your request for additional information dated July 10, 2026, related to the above-referenced application. We have updated the application form and materials to address the following:

Section 2 – Applicant Information (*Appears complete except for City R/W written authorization.*).

> A copy of the City's ROW written authorization has been added to the application materials.

Section 7 – Geologic Report (*Please identify what pages of the report the erosion rate standards are located.*).

> The past rate of erosion for the site is included on pages 12 and 13 of the June 11, 2026, Geologic Investigation and Design Report from Certerra. As Certerra notes, that past rate of erosion is not indicative of future erosion at this site.

Section 8 – Additional Permit Requirements (*Affidavit states that a conditional use permit is required. Please revise and include documentation.*).

A copy of the City Council decision dated November 14, 2025, approving a conditional use permit for a new shoreline stabilization structure on the Siegels' property, has been added to the application materials.

Section 10 – Required Drawings (*Plan view does not provide all required elements. Profile view OK.*).

Certerra has submitted updated plan view sheets dated July 22, 2026, to more clearly show the required elements, and those updated drawings have been included in the application materials.

Section 11 – Application Fees and Calculation Worksheet (*Please cite what page of the application the fee calculation evidence is located.*)

An updated fee worksheet (application form at page 8) showing the fee calculation and supporting documentation is provided in the application materials.

For clarity, here is a list of the items that are included with this resubmittal:

1. Application form;
2. Narrative;
3. Certerra Supplemental Plan View drawings dated July 22, 2026;
4. Certerra Geotechnical Report revised June 11, 2026;
5. Simpson Coastal Engineering Report dated May 19, 2025;
6. Simpson Coastal Engineering letter dated September 4, 2025;
7. Nicoterra Report dated July 29, 2025;

8. Construction, Design, and Maintenance Cost documents:

   a. Investigations, surveys, and assessments;

   b. Construction activities;

   c. Site revegetation and rehabilitation; and

   d. Monitoring and maintenance of vegetation and rehabilitation;

9. Cannon Beach CUP approval; and

10. Cannon Beach Right-of-Way permit.

Please let us know if you need any additional information.

Very truly yours,

[redacted]

William L. Rasmussen

cc: Allison Mangini, Coastal Region Administrative Specialist
(by certified mail, return receipt requested)

OREGON PARKS AND RECREATION DEPARTMENT
OCEAN SHORE PERMIT APPLICATION AND INSTRUCTIONS

SHORELINE PROTECTION STRUCTURE

In accordance with ORS 390.640, 390.715, and 390.725, no person shall make an alteration, or construct a pipeline, cable line or conduit or remove any natural product on any property that is within the ocean shore, without first obtaining a permit to do so from the Department.

Permit Instructions

An application is considered complete only when all required materials are received. This includes a completed Ocean Shore Permit Application and all additional required supporting documents, reports, drawings, affidavits, and fees. Incomplete applications will not be processed and will be returned to the applicant.

An Ocean Shore Permit Application and City/County Planning Department Affidavit shall be submitted for each individual tax lot and project.

To assist in submitting a complete application, please follow these step-by-step instructions:

Section 1. Proposed Project

Check appropriate box for the type of project. If the type of alteration project is not listed, provide a brief description on the line next to "Other."

Provide a brief description of the project in the box provided.

Provide estimated start and completion dates.

Section 2. Applicant Information

Owner: Provide the name, mailing address, phone number, fax number, and email address of the person who legally owns the property.

Agent: An agent is a person who is authorized by the owner to represent their interest during the permitting process with Oregon Parks and Recreation Department (OPRD). Examples of an agent may be another property owner, consultant, attorney or contractor. *Agents are optional*.

Primary Contact: If the legal owner has chosen to include an agent, indicate which party will act as the primary contact; owner or agent. This is the person OPRD will contact for any application questions or concerns.

Section 3. Property Location and Information

Provide situs address (physical address) of property. Provide the township, range, section, subsection, and tax lot number. (Do not list multiple tax lots in this section, as each individual tax lot requires a separate Ocean Shore Permit Application.)

Check the appropriate box to indicate the current use of the property.

Provide the zoning designation, the year in which the main structure was built.

Provide all lot dimensions and setbacks from property lines.

Provide the names, situs and mailing addresses of oceanfront landowners with property boundaries common to those of the property described in the application. For projects involving multiple tax lots, the most northern and southern oceanfront landowners of the entire project are all that is required.

If you do not know this information, it may be obtained from the county tax assessor's office and/or local planning office.

Section 4. Project Justification and Impacts

There shall be adequate justification for the proposed project to occur and alter the ocean shore area.

Provide a detailed description of the hazard and the threat it poses to the property to justify your request for alteration of the ocean shore area.

Describe all potential impacts this project may have in the short and long-term to neighboring properties, to recreation, scenic, safety, and natural resources of the ocean shore.

List the measures that will be taken to minimize those potential impacts. All projects will have some impact on the ocean shore; a "no impact" conclusion is not an appropriate answer.

Section 5. Project Details

Provide the total for the entire project, (this will include totals for all properties if the project includes multiple tax lots). Total length, height, width and slope specifics, and the total volume of all material and average rock size.

Your contractor or geologist should assist you with the specifics of all project materials, type, source, size, and amount.

Section 6. Analysis Of Hazard Avoidance

The application shall be accompanied by an analysis of hazard avoidance alternatives, including the relocation of existing buildings or other infrastructure. This analysis shall also describe why potential hazard avoidance alternatives are not feasible, or if tried why they were not successful. Relevant factors may include topographic limitations, the limitations of the area for relocation, or the cost. If the cost of moving a building or infrastructure is listed as a factor, the report shall include a cost estimate(s) from a licensed contractor specializing in building relocation.

Section 7. Geologic Report

Projects greater than 50 feet in length require a geologic report from a registered professional geologist experienced in coastal processes. This report should include:

- The potential impacts from the proposed project on sand source, supply, and movement on the affected beach as well as within the same littoral cell;
- The bank or bluff stability and erosion rates on the subject property and adjacent properties and the potential impacts of the proposed project on bluff stability and erosion rates on the subject and adjacent properties;
- A review of potential non-structural solutions, including, but not limited to, vegetative stabilization, non-structural dynamic revetments, and foredune enhancement. The review shall describe reasons why non-structural solutions were unsuccessful, if tried, or why they were considered unfeasible;
- The known or suspected geologic and seismic hazards in the project area and how the proposed project may affect or be impacted by those geologic and seismic hazards.

Section 8. Additional Permit Requirements

List any additional necessary permits and/or authorizations required by local, state, or federal agencies. Additional agencies may include city/county planning departments, Oregon Department of State Lands and/or U. S. Army Corps of Engineers.

Section 9. Signature Requirement

The owner's signature is required for acknowledgment and completion of the application. If an agent has been included, check the box authorizing the agent to act on your behalf with OPRD.

If an agent has been authorized, the agent's signature is also required for acknowledgment and completion of the application.

Section 10. Required Drawings

The application shall include a plot plan and a cross-section of the project, drawn to scale. Drawings shall be clear and concise and follow the format specifications outlined.

Section 11. Application Fees and Calculation Worksheet

Each application filed under ORS 390.640, for an alteration on the ocean shore shall be accompanied by a processing fee for the purpose of partial recovery to the department of its administrative costs.

The fee shall be determined according to the construction value of the project. Evidence the Department may consider in establishing the construction value of a project shall include: Itemized estimates from licensed, bonded, contractors; construction values accepted by the county or city for purposes of issuing local permits; itemized costs of equipment rental and other such charges if the project is completed by the property owner; estimates that reflect unit costs typically associated with the type, quality and standards of construction proposed in the application.

Complete the calculation worksheet based on construction value.

Additionally, the Department may require a cash bond, or other security acceptable to the Department, to ensure that the permittee complies with the terms of the permit.

City/County Planning Department Affidavit

Applicant and Property Details: The applicant shall complete all information in this section before submitting the affidavit to the appropriate city or county planning department for review and signature.

Planning Department Certification: This section is to be taken to the appropriate city or county Planning Department for completion and signature.

OREGON PARKS AND RECREATION DEPARTMENT
OCEAN SHORE PERMIT APPLICATION

SHORELINE PROTECTION STRUCTURES

FOR OFFICIAL USE ONLY	
OPRD PERMIT #:	3123-26
APPLICATION DATE:	8/21/26
DATE POSTED:	8/28/26
COORDINATOR:	Blanchette
60 DAY DUE DATE:	11/19/2026

Section 1. Proposed Project

Project type:

☒ Riprap Revetment	☐ Vegetative Stabilization
☐ Seawall	☐ Other

Provide a brief description of the project:
Application for ocean shore permit for construction of a vegetated riprap revetment.

Estimated project start date	Estimated project completion date

Section 2. Applicant Information

Owner	Maxine and Martin Siegel	Agent	William Rasmussen
Mailing Address	9515 SE 15th St	Mailing Address	1140 SW Washington St, Ste 700
City Bellevue	State WA Zip 98004	City Portland	State OR Zip 97205
Phone (425) 786-8266	Fax	Phone (503) 224-5858	Fax (503) 224-0155
Email	mimi.siegel@kindering.org	Email	william.rasmussen@millernash.com

Primary Contact	☐ Owner	☒ Agent

Section 3. Property Location and Information

Situs Address		3915 Ocean Ave	
City/Town	Cannon Beach	County	Clatsop

Township T04N	Range R10W	Section 06	Subsection 41006BC	Tax Lot 400

Current Use

☒ Residential	☐ Commercial/Industrial	☐ Public
☐ Vacant (unbuilt)	☐ Other (explain)	

City/County Zoning Designation	R1	Year main structure was built	2006

Lot Dimensions

Lot Size	.13 acre	Oceanfront footage (in feet)	50
Street front footage (in feet)	50	East-West footage (in feet)	120

Setbacks

Distance from eastern (or landward) property line to nearest building (in feet)	15
Distance from seaward dune crest or bluff edge to nearest building (in feet)	33
Approximate height of oceanfront bluff, dune or escarpment (in feet)	6

List the names, situs and mailing addresses of oceanfront landowners with property boundaries common to those of the property or properties described in the application.

Name	Property situs address	Mailing address
Carol Raitt	3887 Ocean Ave Cannon Beach, OR 97145	701 N 64th St Seattle, WA 98103-5633
Lori M. James Rodney C. Dowell	3923 Ocean Ave Cannon Beach, OR 97145	PO Box 216 Tolovana Park, OR 97145

Section 4. Project Justification and Impacts

Provide a detailed explanation of the hazards and threat to property:
Please see the attached Application Narrative.

(Include documented supporting evidence, i.e. photographs, and/or chronology of bank retreat)
Attach additional pages as necessary

Describe all potential impacts:
Please see the attached Application Narrative.

Attach additional pages as necessary

Describe measures that will be taken to minimize the impacts identified above:
Please see the attached Application Narrative.

Attach additional pages as necessary

Section 5. Project Details

Total Length along shoreline (in feet) 50	Height (in feet) 15
Total width of project (in feet) 24	
Slope (ratio-horizontal to vertical) 1.0V to 1.5H	Total volume of all material(s) (cubic yards) 474

Riprap Specifications:

Armor stone type Basalt	Armor stone source Drake pit
Diameter of armor stone (in feet) 3 to 8' g	Amount of armor stone (cubic yards) 444
Type of filter fabric Marafi 700 filterweave	Type of backing fill material 4-inch minus pit run
The amount of backing fill material (cubic yards) 30	Will toe be keyed into bedrock? ☐ Yes ☒ No
Elevation of toe trench Approx. 9 feet above MSL	Depth of toe trench 2 feet

Section 6. Analysis Of Hazard Avoidance

Please verify that the attached hazard avoidance analysis includes:

☒ A list of hazard avoidance alternatives	
☒ A description of why hazard avoidance alternatives are not feasible	☒ If an alternative was tried, explain why it did not succeed
☐ Is the relocation cost estimate included? ***(If the cost of moving the building is listed as an unfeasible factor.)***	

Section 7. Geologic Report

Please provide the following information:

Date of Report	6/11/26	Company	Certerra (formerly Earth Engineers, Inc.)
Geologist Name	Troy Hull, P.E., G.E.	Geologist Certifications	See report
Mailing Address		2411 NE 8th Ave	
City Camas	State WA	Zip 98607	
Phone (360) 567-1806	Fax	Email address	thull@certerra.com

Please verify your geologic report contains all of the following information:

☒ The potential impacts from the proposed project on the sand source, supply, and movement on the affected beach as well as within the same littoral cell.

☒ The known or suspected geologic and seismic hazards in the project area and how the proposed project may affect or be impacted by those geologic and seismic hazards.

☒ A review of potential non-structural solutions, including, but not limited to: vegetative stabilization; non-structural dynamic revetments and foredune enhancement.

☒ The bank or bluff stability and erosion rates on the subject property and adjacent properties.

Section 8. Additional Permit Requirements

List the agency and type of permit required: *Cannon Beach Right of Way Permit*

☐ **No additional agency permit required**

Section 9. Signature Requirement

The application is hereby made for the ocean shore alteration described within this application. I certify that I am familiar with the information contained in this application, and, to the best of my knowledge and belief, this information is true, complete and accurate. I further certify that I possess the authority to undertake the proposed alteration.

I understand that the granting of an OPRD permit does not release me from obtaining any additional permits from any/all local, state, and/or federal agencies that may be required before commencing the project.

I understand that the payment of required OPRD processing fee does not guarantee the issuance of an approved permit.

[redacted] 6-12-26

Owner Signature Date

☒ *I (Owner) authorize the Agent included in this application to act on my behalf during this application process.*

[redacted] 06.08.26

Agent Signature Date

Section 10. Required Drawings

The submitted application shall be accompanied by a plan view and a cross-section of the proposed project. Neatness and accuracy are important in order for those reviewing the application to clearly understand the proposal. Copies of county assessor's maps may not be used as site plan maps.

For consistency and quality please follow these format specifications:

- **All Drawings shall be:**
  - On 8.5 X 11 inch white paper
  - In black ink or clear legible photocopy of plan(s)
  - Printed or typed (no cursive) minimum size 10 point font
  - Drawn with a straight-edge and not freehanded.
  - Drawn accurately to scale
  - Be labeled appropriately

- **Plan view drawing shall include:**
  - Scale of drawing and north arrow
  - All lot lines with dimensions
  - Existing structures
  - Roads, driveways, etc. (existing, proposed, or temporary access roads)
  - Setback distance from nearest structure or infrastructure to upper edge of bluff or dune edge
  - Location of proposed improvements in relation to Statutory Vegetation Line and Actual Vegetation Line
  - Location of proposed project in relation to all property lines
  - Location of the proposed project in relation to the top of the bluff or dune and the existing toe of bluff or dune

- **Cross-section (side view) drawing shall include:**
  - Scale of drawing
  - Location of the existing base of bluff or dune
  - Location of top of bluff or dune
  - Location of proposed project in relation to base and top of bluff or dune
  - Approximate length, in feet, the project will occupy beyond the existing toe of bluff or dune, include buried toe of proposed shoreline protection structure.
  - Depth of toe trench or footing
  - Slope of the project (width/height ratio (i.e. 2:1))
  - Overall height of the project from bottom of buried toe to the top
  - Armor stone layer with rock size accurately depicted
  - Thickness of armor stone
  - Backing fill layer with thickness accurately depicted
  - Type of filter fabric, if applicable

OCEAN SHORE ALTERATION APPLICATION FEE WORKSHEET

Section 11. Application Fees and Calculation Worksheet

Instructions for fees

- OPRD recommends fees be submitted once an application is verified complete. Refund options are outlined in OAR 736-020-0004.
- Once construction value has been verified by staff, applicants will be provided instruction on how to pay the fee (Online if under $10,000).
- Under each heading below include a description of the project related activities or items included in the costs for that heading.
- Add in the total cost for each heading. Similar or associated items may be lumped, so long as the documentation clearly supports the cost.
- Attach documentation behind this form and add to application packet as a separate appendix. Once documentation is attached, check the box for "Documentation included". Acceptable evidence of construction value may be found in OAR 736-020-0004.
- Construction Value "means the costs of labor, equipment, materials, and all contractor fees, where those costs are incurred by the applicant or the applicant's agent(s)" (OAR 736-020-0002).
- If you are a public agency looking for a reduced fee, check the appropriate box(s) on lines 13 and 14 and enter the amount on line 13.

Line #	Describe itemized cost. (Briefly list item, vendor, and describe scope of cost)	Total Cost	Documentation included
1	Investigations, surveys, and assessments	$ 9,950.00	☑
2	Consulting and design	$ 0.00	☐
3	Construction Activities	$ 121,005.20	☑
4	Site revegetation and rehabilitation	$ 2,810.00	☑
5	Monitoring and Maintenance of vegetation and rehabilitation	$ 2,500.00	☑
6	Other:	$ 0.00	☐
7	Total construction value (Auto calculates total of sections 1 through 6 above)	$ 136,265.20	
8	Base construction value	$2,500	
9	Net construction value (Auto calculates. If line 7 is greater than $2,500, subtract line 8 from line 7)	$ 133,765.20	
10	Construction value fee (Auto calculates. If line 9 is greater than $0, multiply line 9 by 0.03)	$ 4,012.96	
11	Base Application Fee	$400	
12	TOTAL APPLICATION FEE (Auto calculates total of lines 10 and 11)	4,412.96	
	STOP, lines 13 and 14 are only for public body or tribal agency undertaking actions to benefit the ocean shore.		
13	A fee reduction may be available if all three of these are met: ☐ You are a public body or Tribal Agency. ☐ One of the scenarios below applies to this project (check appropriate box in line 14) ☐ You have verified with OPRD Ocean Shore staff that a fee reduction will be provided. Enter amount of fee reduction agreed to by OPRD to the right.		
14	Scenarios (select appropriate box) ☐ Restoring, conserving or protecting the natural, resource, scenic, recreational, cultural or economic values of the ocean shore. ☐ Restoring native beach or dune habitat contributing to the recovery of sensitive species, including state and federally listed threatened or endangered species. ☐ Improving native biological values of the ocean shore. ☐ Improving, maintaining, repairing, or replacing public access.		

CITY/COUNTY PLANNING DEPARTMENT AFFIDAVIT

Applicant

Last	Siegel	First	Maxine and Martin	MI	

Property Details

Township	T04N	Range	R10W	Section	06	Subsection	41006BC
Tax Lot	400						

County

☒ Clatsop	☐ Tillamook	☐ Lincoln	☐ Lane
☐ Douglas	☐ Coos	☐ Curry	

Project Type

☒ Shorefront Protection	☐ Access/Other Misc.	☐ Sand Alteration
☐ Pipeline/Cable/Conduit	☐ Natural Product Removal	

Planning Department Certification
(To be completed by local planning official)

Part I

In accordance with Statewide Planning Goal #18, Beaches and Dunes alteration permits for beachfront protective structures may be issued only where development existed on January 1, 1977, or where an exception to this Goal 18 implementation requirement has been approved by the appropriate local jurisdiction. For the purpose of this requirement, the definition of "development" means houses, commercial and industrial buildings, and vacant subdivision lots which are physically improved through the construction of streets and provisions of utilities to the lot.

Above property meets Goal 18 Eligibility? ☒ Yes ☐ No ☐ Not Applicable

Part II

I have reviewed the proposed project application and have determined that:

☐ This project is not regulated by the local comprehensive plan and zoning ordinances.

☒ This project has been reviewed and **is consistent** with the local comprehensive plan and zoning ordinance.

☐ This project has been reviewed and **is not consistent** with the local comprehensive plan and zoning ordinance.

☐ The consistency of this project with the local planning ordinance cannot be determined until the following local approvals are obtained:

☐ Conditional Use Approval	☐ Zone Change	☐ Plan Amendment
☐ Development Permit	☐ Other (Specify)	

Comments:

See APP#25-03 and CU#25-06 for local land use approval.

Local Planning Official Name (Please Print)	Title
Robert St. Clair	Planner
Signature [redacted]	Date June 5, 2026

The completed/signed form shall be submitted with the completed Ocean Shore Permit Application

Application Narrative

Ocean Shore Permit Application for a Shoreline Protection Structure
3915 Ocean Avenue, Cannon Beach, OR 97145

This narrative is submitted in support of the application by Maxine and Martin Siegel ("Applicants") to the Oregon Parks and Recreation Department ("OPRD") for an ocean shore permit authorizing construction of a vegetated riprap revetment along the failing oceanfront bluff of their property at 3915 Ocean Avenue, Cannon Beach, Oregon 97145 (the "Property"). The proposed revetment is necessary to protect Applicants' home from the accelerating erosion of the bluff and the increasing threat of ocean flooding as wave runup and overtopping advance landward.

This narrative is supported by the exhibits cited throughout, including site-specific expert analysis in the following four geotechnical, coastal engineering, and ecological restoration reports:

1. Geotechnical Investigation and Design Report ("Geotechnical Report") by Certerra Northwest, LLC ("Certerra");

2. Coastal engineering opinion letter by coastal engineer David Simpson (the "Coastal Engineering Opinion");

3. Coastal engineering letter opinion responding to public comments during the conditional use application review ("Coastal Engineering Response Letter"); and

4. Site evaluation letter by ecological restoration and arboriculture firm, Nicoterra ("Nicoterra Site Evaluation").[1]

This expert analysis and the other materials submitted with the Application demonstrate that the Property is uniquely vulnerable to worsening ocean flooding because of its unusually low elevation, short and actively eroding bluff, and direct exposure to high-energy wave action. The evidence further demonstrates that the proposed revetment is necessary to protect the home

[1] Attached as Exhibits 1-4, respectively.

from the imminent risk of flood-related structural damage as the bluff continues to erode and retreat, and that the carefully designed and limited nature of the project will avoid any meaningful adverse impacts to the adjacent beach, neighboring properties, public access, recreation, scenic resources, or natural resources.

For these and all the other reasons set out below, the Application satisfies all approval criteria.

I. PROPERTY OVERVIEW

The Property is located in south Cannon Beach on Ocean Avenue, between West Orford Street and Braillier Street. It is adjacent to the undeveloped Midway Street right-of-way, which provides unmarked public beach access. The Property is zoned R1, Residential Moderate Density, and lies within the City's Oceanfront Management Overlay. The Property has approximately 50 feet of ocean frontage.

Satellite Imagery from Google Earth[2] and Clatsop County Webmaps[3]

The lot is eligible for a beachfront protective structure under Statewide Planning Goal 18 because it was created in 1927[4] and first developed around 1940.[5] On November 14, 2025, the City of Cannon Beach approved a conditional use permit for the proposed riprap revetment.[6]

The Property's 50-foot shoreline is fronted by a short bluff that ranges from only five to seven feet in height.[7] The bluff is composed primarily of sand, silt, and other uncompacted materials that are particularly vulnerable to the intense wave energy impacting the Property. Further, the bluff toe is subject to undercutting, resulting in steep slopes that range from 45 degrees to near

---

[2] https://earth.google.com/web/search/3915+Ocean+Avenue,+Cannon+Beach,+OR/@45.87691993,-123.968915,-3.97658446a,20996.2394106d,35y,0h,0t,0r/data=Co4BGmQSXgolMHg1NDk0YmFjYjgwYWI3OWE1OjB4ZmMxNml4NWUzZGIzOWE5YbkKTtjZ6-5GQCHcYKjDiv1ewCojMzkxNSBPY2VhbiBBdmVudWUsIENhbm5vbiBCZWFjaCwgT1IYAiABIiYKJAlsCssmG-9GQBHDlVdwvO5GQBkB-34CeP1ewCEHkMYqmf1ewA.

[3] https://delta.co.clatsop.or.us/apps/ClatsopCounty/.

[4] The lot was created as part of the Wave Crest subdivision https://delta.co.clatsop.or.us/surveys/Subdivisions_by_Name_All/Wave%20Crest%20on%20Cannon%20Beach%20B9%20P2.pdf. In 2006, the previous house was replaced by the current two-story home

[5] Geotechnical Report at 6. The earliest satellite photos available online show a house on the Property in 1967. https://www.coastalatlas.net/oceanshores/map/#on=parcels/parcels;historicphotos/ODOT_1967;OSIP_2022/0:cartolight/light&loc=0.5138;-13799065.43;5759038.82.

[6] Findings of Fact, Conclusions, and Order, Appeal No. APP# 25-03 (CU#25-06).

[7] Geotechnical Report at 2.

vertical.[8] As explained in the Geotechnical Report, this type of oversteepened bluff is prone to sloughing and increased erosion. *Id.*

Property's Shoreline Bluff (April 2024)

At the time of Certerra's site visit in February 2025, the distance from the bluff edge to the attached deck on the Property was approximately 19 feet, and the distance to the house itself was approximately 33 feet.[9] Certerra also observed that over the last three years, the bluff has become increasingly undercut, steeper, and has developed a more pronounced vertical face compared to earlier conditions, with notably reduced vegetation cover.[10]

II. APPLICATION SECTION 4—PROJECT JUSTIFICATION AND IMPACTS

A. Detailed explanation of the hazards and threat to property.

Section 4 of OPRD's Shoreline Protection Structure application requires applicants to provide a detailed description of the hazard at issue and the related threat to property that justifies the proposed alteration of the ocean shore.

---

[8] Geotechnical Report at 7.

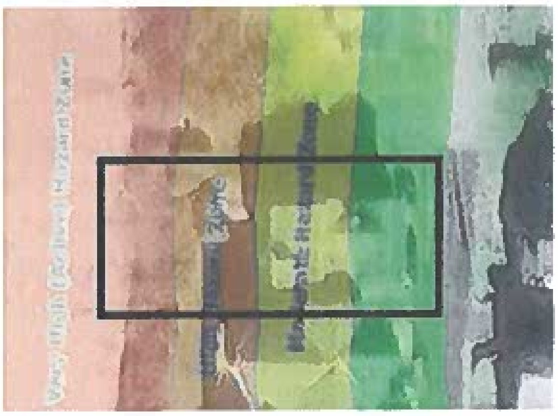
[9] Geotechnical Report at 2.

[10] Geotechnical Report at 7-9.

Here, the hazards threatening the Property arise from the combined and reinforcing effects of bluff erosion, wave overtopping, ocean flooding, and the Property's unusually low elevation and exposed shoreline position. As explained below, the bluff is actively retreating, becoming increasingly undercut and unstable, and losing the limited natural protection that separates the home from direct ocean forces. At the same time, as the bluff recedes, storm-driven wave runup and flooding are advancing landward, increasing the risk that future storm events will damage the residence, its supporting foundations, and the surrounding improvements.

1. The Property bluff is eroding at a rapid and accelerating rate.

According to the Oregon Department of Geology and Mineral Resources (DOGAMI) GIS hazard-mapping tool (HazVu), the Property's shoreline bluff is in the highest erosion-hazard category, "Very High (Active) Hazard Zone," while the ocean yard up to the western edge of the house is mapped as part of the "High Hazard Zone."



Oregon HazVu: Statewide Geohazards Viewer[11]

Consistent with this hazard designation, the Property's bluff has retreated approximately five feet over the past ten years.[12] This past rate of erosion, however, does not accurately capture the risk to the structures on the Property due to the retreating shoreline for two primary reasons.

[11] https://gis.dogami.oregon.gov/maps/hazvu/.

[12] Geotechnical Report at 1, 25.

First, data indicates that the rate of erosion at the Property is significantly increasing.[13] Certerra predicts that erosion will more than triple over the next ten years compared to the last ten years—even without taking into account the likely increasing consequences of climate change.[14]

Second, coastal erosion is episodic and unpredictable, subject to acute events of significant bluff recession. As explained in the Geotechnical Report, "[t]hese high-energy events can cause sudden bluff undercutting, rapid collapse of vertical bluff faces, and flooding from wave overtopping[,]" resulting in bluff retreat that "poses a significant hazard to properties located along the bluff[.]"[15] The Coastal Engineering Opinion explains further that:

> "Because of the random occurrence of storms and their intensity, the Siegel property faces a certain percent chance every year of experiencing an extremely damaging storm (often back-to-back storms) that would remove much of the bluff and expose the residence to direct attack. For this reason averaging a bluff retreat rate over a long time and assuming that is the rate that will happen next year is unwise."[16]

The susceptibility of this section of shoreline to erosion is evidenced by the extensive riprap to the north and south of the Property. To the immediate south there is 300 feet of riprap fronting five houses, ending at Braillier Street.[17] Continuing south from Braillier Street, approximately 1,300 out of the next 1,500 feet of shoreline is protected with riprap.[18]

---

[13] Geotechnical Report at 12.

[14] Geotechnical Report at 13.

[15] Geotechnical Report at 12.

[16] Coastal Engineering Opinion at 10.

[17] These approximate measurements were derived using the OCMP Ocean Shores Viewer, https://www.coastalatlas.net/oceanshores/map/.

[18] These approximate measurements were derived using the OCMP Ocean Shores Viewer, https://www.coastalatlas.net/oceanshores/map/.

Riprap South of the Property[19]

Likewise, approximately 130 feet north of the Property, there is a continuous line of 550 feet of revetment. Overall, approximately 3,500 feet of the 4,000 feet of shoreline to the north of the Property is protected by shoreline-protection revetments.

Riprap North of the Property[20]

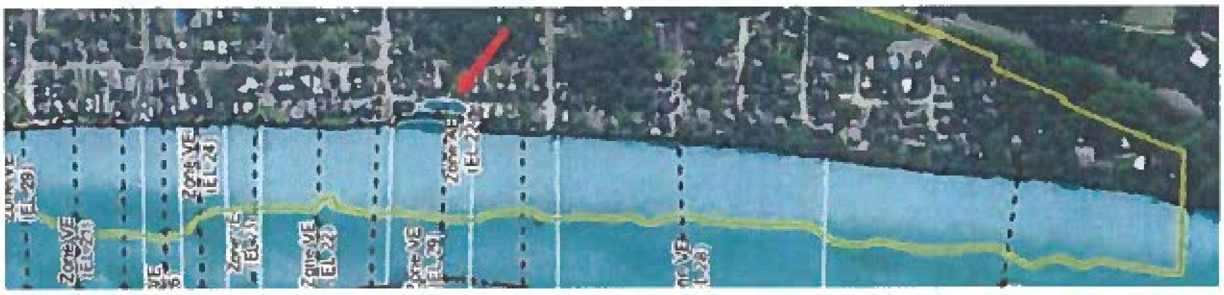
2. The house is subject to ocean flooding, which is increasing as the bluff erodes and retreats towards the house.

The Property is designated as being within a high flood hazard zone. As shown below, it is one of only a handful of properties in Cannon Beach within FEMA's most severe coastal flood hazard designation, Zone VE, also known

[19] Satellite image from OCMP Ocean Shores Viewer, https://www.coastalatlas.net/oceanshores/map/. Illustrations based on designations in Ocean Shores Viewer.

[20] *Id.*

as a "Coastal High Hazard Area."[21] While Zone VE and Zone AE both identify areas subject to the 1-percent-annual-chance flood, properties within Zone VE are also exposed to large waves and fast-moving water capable of causing extensive structural damage.[22]



Images from FEMA National Flood Hazard Layer Viewer[23]

Applicants' home appears to be the only residence within a mile-long stretch of shoreline that is within the Limit of Moderate Wave Action (LiMWA) boundary, which designates shoreline areas that are likely to experience

[21] *See* Flood Insurance Rate Map 41007C0652F (Ex. 6).

[22] FEMA website, *Features of Flood Insurance Rate Maps in Coastal Areas, available at* https://www.fema.gov/flood-maps/coastal/insurance-rate-maps, accessed April 22, 2024.

[23] https://www.arcgis.com/apps/webappviewer/index.html?id=8b0adb51996444d4879338b5529aa9cd.

waves greater than 1.5 feet in height—a height that has historically caused significant property damage.[24]

Conistent with these designations, the Property has regularly experienced ocean flooding during winter storms as waves overtop the small bluff fronting the Property and adjacent right-of-way.

Flooding on Property During a Storm[25]

The ongoing erosion of the bluff therefore does more than threaten shoreline stability. It also increases the ocean-flooding hazard that poses an immediate risk to Applicants' home. As the bluff retreats, the flood threat increases in several related ways:

- ***Shorter Distance from Shoreline to Home:*** First, the bluff erosion directly moves the flooding risk closer to the residence, thus progressively shortening the distance between the house and wave run-up/flooding.[26]

- ***Reduction in Bluff Height due to site topography:*** Ongoing erosion also lowers the effective height of the bluff as the crest retreats inland

[24] FEMA Fact Sheet, *Using the Limit of Moderate Wave Action* (May 2021), *available at* https://www.fema.gov/sites/default/files/documents/fema_using-limit-oderate-wave-action_fact-sheet_5-24-2021.pdf.

[25] Geotechnical Report at 4, photo 1.

[26] Geotechnical Report at 1; Coastal Engineering Opinion at 9-10.

to lower ground, the bluff face collapses, and the bluff top is directly eroded. As observed by Certerra,

> *"the natural ground surface at the subject property slopes downward from the top of the existing bluff face toward the residence. As erosion continues and the bluff face retreats, the elevation of the bluff will decrease, further exposing the property to wave overtopping and increasing its susceptibility to flooding."*[27]

This reduces the vertical buffer that previously limited wave overtopping and increases the likelihood that storm waves will reach the upland portion of the Property.[28] In short, a small amount of bluff loss can result in materially increased overtopping and flooding.

- ***Increased Wave Run-Up, Overtopping, and Splash Overtopping:*** Erosion also steepens and undercuts the bluff face, creating a more vertical and abrupt profile. That condition increases the force with which waves strike the bluff and causes greater upward deflection of wave energy, resulting in higher wave runup, overtopping, and splash overtopping. This increases both the frequency and severity of flooding at the Property.[29]

The increasing threat of flood damage to the home is imminent because floodwater during large storms already pools near the home, and floodwater does not need to enter the home to cause significant damage. Rather, flooding near the residence at this site can saturate and weaken the underlying soils, significantly reducing their bearing capacity and stability and ultimately threatening the home's foundation through settlement or structural failure.[30] Moreover, flood flows and wave uprush can carry drift logs and other debris into the home's supports, damage utilities located below the floor and near

[27] Geotechnical Report at 13.

[28] Geotechnical Report at 12-13; Coastal Engineering Opinion at 9-10.

[29] Coastal Engineering Opinion at 7, 14.

[30] Geotechnical Report at 27; Coastal Engineering Opinion at 7, 9.

ground level, and scour soil from in front of the house and around foundation posts, further reducing support for the structure.[31]

3. The bluff erosion and concomitant ocean flooding will increase at an accelerating rate because of climate change impacts.

As discussed in the Geotechnical Report,[32] the bluff erosion and flooding occurring on the Property will only increase as climate change results in greater storm activity, substantial growth of wave intensity/size, ocean acidification, more frequent El Niño systems, and rising sea levels.

The existence of these changes and their significant impact on coastal erosion and ocean flooding has been widely documented in numerous scientific studies and governmental reports. For example, in the 2010 report titled "Impacts of Climate Change on Oregon's Coasts and Estuaries," found that there is a "long-term trend [of] increasing storm intensities and the heights of the waves they generate[,]" and that these storms and extreme waves are the "dominant factor responsible for episodes of erosion and flooding along this coast."[33] Similarly, in a 2008 study,[34] Dr. Peter Ruggiero of Oregon State University concluded that the "decadal-scale increases in storm intensity (wave height)" combined with more frequent El Niño events and future sea-level rise could increase erosion and flood frequency by as much as a factor of ten on the Oregon coast.

These types of findings and forecasts have been consistently echoed by subsequent research and adopted in state planning documents, including

---

[31] Coastal Engineering Response Letter at 2-4.

[32] Geotechnical Report at 26.

[33] Peter Ruggiero et al., *Impacts of Climate Change on Oregon's Coasts and Estuaries* (2010), at 209, 223, published as a chapter in the *Oregon Climate Assessment Report*, Washington, DC, EPA/600/R-10/184 (2011), funded by the U.S. Environmental Protection Agency.

[34] Peter Ruggiero, *Impacts of Climate Change on Coastal Erosion and Flood Probability in the US Pacific Northwest* (2008).

2020 Oregon Natural Hazards Mitigation Plan,[35] updated in 2025,[36] and Oregon's *2021 State Agency Climate Change Adaptation Framework*.[37]

4. Past mitigation efforts have not slowed the erosion of the Property's shoreline or reduced wave overtopping and flooding during storm events.

Three separate attempts have been made to slow down the erosion of the Property's bluff and mitigate the flooding of the Property during storm events—each of which have proved ineffective.[38] The first effort was in 2007, when the current house was constructed. In addition to the home construction, a vegetated berm was built along the shoreline. The berm quickly eroded, however, and the bluff continued to recede at a significant rate.[39]

Next, in the spring of 2022, Applicants obtained a conditional use permit to place 50 cubic yards of cobbles along the bluff. The intervention, however, did not last through one winter. By the following spring, the cobbles had been carried away and scattered across the beach.[40]

---

[35] Some of the most in-depth analysis by the state is set forth in the 2020 Oregon Natural Hazards Mitigation Plan, which that [r]ecent research indicates that sea levels along Oregon's coast are rising and that significant wave heights off the Oregon coast are increasing[,]" which are both expected to increase coastal erosion and coastal flooding. (2020 Oregon Mitigation Plan at 14.) The report explained further that "[p]revious analyses of extreme waves for the Oregon coast estimated the '100-year' (1%) storm wave to be around 33 feet[, but i]n response to a series of large wave events that occurred during the latter half of the 1990s, the wave climate was subsequently re-examined and an updated projection of the 1% storm wave height * * * is now estimated to reach approximately 47 to 52 feet * * *." (2020 Oregon Mitigation Plan at 474.)

[36] https://www.oregon.gov/oem/Documents/2025-2030_Oregon_Natural_Hazards_Mitigation_All-Chapters.pdf

[37] This report was collectively prepared by more than two-dozen state agencies, which found that the "[i]ncidence of stormy weather is likely to increase along the coast, causing flooding from storm surge, coastal erosion, landslides, and severe wind events[,]" and that this damage will be exacerbated by the rising sea levels. ***2021 State Agency Climate Change Adaptation Framework** at* 1. Available at https://www.oregon.gov/lcd/CL/Documents/2021_CLIMATE_CHANGE_ADAPTATION_FRAMEWORKandBlueprint.pdf

[38] Geotechnical Report at 2, 7, 25

[39] *Id.*

[40] *Id.*

Photo Taken on February 1, 2023 [41]

Accordingly, in the spring of 2023, Applicants obtained a permit from the OPRD to gather the stones with an excavator and place them back along the bluff toe.[42] Again, within one winter, the stones were carried away.[43]

5. Riprap revetment is necessary to protect the Property from the immediate threat from ocean flooding and ongoing erosion of the ocean bluff.

The frequent ocean flooding of the Property creates an imminent risk to the Applicants' home, which will only increase as the bluff continues to retreat landward at an accelerating rate.

Based on their site investigations and expert analysis, Certerra, coastal engineer, Mr. Simpson, and the ecological restoration firm, Nicoterra, all independently determined that the construction of a riprap revetment along the Property's bluff is necessary to protect Applicants' residence. The Geotechnical Report extensively sets out how only a riprap revetment is the only effective, durable, and feasible method to permanently stabilize the bluff

[41] From the City's Findings of Fact, Conclusions, and Order DP No. 23-08 (February 3, 2023).

[42] *Id*; Geotechnical Report at 7, 35.

[43] *Id.*

and protect the residence from further erosion and flooding impacts.[44] Likewise, both the Coastal Engineering Opinion[45] and Nicoterra Site Evaluation[46] state that only a riprap revetment will be effective in this high-wave environment.

The Coastal Engineering Opinion explains that the proposed revetment will not only arrest the increase in flooding risk but will immediately reduce the frequency and severity of flooding at the Property in several ways. First, the porous riprap structure dissipates wave energy, reducing wave runup and overtopping compared to the existing steep, undercut bluff face.[47] Second, the revetment allows for installation of drainage improvements behind the structure to intercept and remove overtopping water before it can pond near the residence.[48] These conclusions are supported by coastal engineering literature and governmental guidance materials cited in the Coastal Engineering Opinion.[49]

Based on the extensive expert analysis and supporting evidence submitted with the Application, the Cannon Beach City Council likewise determined that there was a demonstrated need for the proposed shoreline protection

---

[44] Geotechnical Report at 34-45.

[45] Coastal Engineering Opinion at 11-13, 15.

[46] Nicoterra Site Evaluation at 1.

[47] Coastal Engineering Opinion at 14.

[48] Coastal Engineering Opinion at 14.

[49] *See also FEMA Guidance for Flood Risk Analysis and Mapping: Coastal Wave Runup and Overtopping* (Nov. 2023) at 3 ("Runup heights are dependent on incoming wave characteristics, specifically, wave height, period, and direction, as well as the physical properties of the surf zone and the shore barrier upon which these waves act. If the shore barrier is an engineered structure, runup is influenced by bathymetry seaward of the structure, structure geometry, porosity/roughness, toe elevations, and core permeability.") (Ex. 7); *Manual on wave overtopping of sea defences and related structures | An overtopping manual largely based on European research, but for worldwide application* (EurOtop, 2d ed 2018) at 167 ("In contrast to dikes and embankment seawalls the permeability of the structure and armour layer plays a role in wave run-up and overtopping."), *available at* https://www.overtopping-manual.com/assets/downloads/EurOtop_II_2018_Final_version.pdf; *A State-of-the-Art Review on Storm Events, Overtopping and Morphological Changes in Front of Coastal Structures*, Journal of Marine Science and Engineering (JMSE) (Dec. 2024), *available at* https://www.researchgate.net/publication/387596936_A_State-of-the-Art_Review_on_Storm_Events_Overtopping_and_Morphological_Changes_in_Front_of_Coastal_Structures.

structure. In approving the related conditional use permit, the City Council found that the Property faces a significant erosion and flooding hazard, that the bluff is actively retreating and increasingly unstable, and that the proposed riprap revetment is necessary to protect the residence from continued erosion and ocean flooding.[50]

After multiple contested hearings with substantial expert testimony, Cannon Beach determined that lesser alternatives for beachfront protective measures such as cobble berms, soil burritos, and vegetation-only options "will not work" at this site. [51]

B. Potential impacts and measures to minimize.

The second and third parts of Section 4 of the application form require the applicant to "[d]escribe all potential impacts" and "[d]escribe measures that will be taken to minimize the impacts identified above[.]" The potential impacts and mitigation measures for the revetment and construction activities are addressed separately below.

1. Potential impacts from the proposed revetment and measures to minimize.

The Geotechnical Report states that the primary impact of the proposed revetment will be to prevent further erosion of the Property's bluff, which will mean a reduction of sand supply to the adjacent littoral cell that would have otherwise resulted from the destruction of the bluff. [52] The report states, however, that the quantity of sand that would have been provided from the unabated erosion of the bluff is minimal.[53] The Coastal Engineering Opinion echoes this opinion, stating that "preventing bluff erosion at the Siegel property will have no measurable effect on the sediment budget[,]" and that the "cumulative effect of existing bluff protection structures is unlikely to be

---

[50] Cannon Beach City Council, Findings of Fact, Conclusions, and Order, Appeal No. APP# 25-03 (CU#25-06) at 4-5, 7-8.

[51] City of Cannon Beach FINDINGS OF FACT, CONCLUSIONS AND ORDER NUMBER – APP# 25-03 (CU#25-06) at 7-8.

[52] Geotechnical Report at 34.

[53] *Id.*

measurable, either."[54] This makes particular sense at this site with such a short bluff.

The Geotechnical Report also explains that beachfront revetments have the potential to impact unprotected shoreline immediately adjacent to the end of the new riprap structure.[55] The likelihood and severity of end-effects depend on both the design of the revetment and existing geologic conditions. Here, the proposed revetment will tie into (and protect the integrity of) the existing protection structure to the south of the Property and be graded to match the current embankment slope of right-of-way to the south so that the revetment is unlikely to have any detectable negative effect on the neighboring shoreline.[56]

In addition to potential geologic impacts, the placement of a revetment along a shoreline can potentially impact public use of the beach, as well as the shoreline's aesthetic value and natural resources. As discussed in the application criteria sections below, however, the proposed revetment will have no negative impacts on the use, appearance, and environmental resources on the Property's shoreline and adjacent beach.

Rather, the proposed structure is designed to avoid negatively affecting other properties, the surrounding environment, and shoreline appearance. The key design features include using high-quality and clean riprap materials, limiting the size of the revetment to the minimum footprint necessary, tying the southern end of the revetment into existing revetment, and wrapping/tapering the north end of the revetment into the base bluff.[57] The revetment will also be covered in sand and planted with native vegetation.[58]

2. Potential impacts during construction of the revetment and measures to minimize.

[54] Coastal Engineering Opinion at 5.

[55] Geotechnical Report at 47-48.

[56] Geotechnical Report at 47-48.

[57] Geotechnical Report at 29.

[58] *Id.*

The construction of a shoreline revetment can have temporary detrimental impacts on the surrounding beach. Unless properly mitigated, these impacts can include temporary disruption of public access, interference with public recreation opportunities, creation of hazards to public safety, and harm to surrounding ecosystems.

Here, the potential construction impacts are minimal because construction access to the beach will be from the Property and adjacent right-of-way, and all staging, material storage, and equipment parking will occur upland, off the beach.

Although the undeveloped adjacent right-of-way provides beach access, it is less developed than the many nearby, surrounding access sites (i.e., it lacks signage and formal improvements aside from an old stairway) and is not widely used by the general public.[59] Thus, temporary use of this access during limited construction hours, which will be during times of relatively low beach use, will not meaningfully impact public access to this stretch of shoreline.

The construction of the proposed riprap will also not adversely affect sensitive habitat, wildlife, or other natural resources because this shoreline is entirely developed, lined with extensive riprap, and devoid of unique wildlife habitat or other sensitive natural resources.

These limited potential impacts are addressed in greater detail in Applicants' comprehensive Ocean Shores Construction Impacts, Staging, and Public Safety Plan (the "Construction Plan"), which is submitted together with a Construction Staging and Access Site Plan. These materials demonstrate that the temporary impacts associated with the proposed construction and staging activities have been carefully evaluated and minimized through appropriate construction methods, staging limitations, access controls, and public-safety measures.

III. APPLICATION SECTION 6—ANALYSIS OF HAZARD AVOIDANCE ALTERNATIVES

[59] There are multiple established public beach accessways in close proximity to the Property. The surrounding access points are each located at the beachfront end of developed streets and are more conspicuous in their public nature (e.g., signs and larger accessway). In fact, there are two access points within a few homes to the north and south of the Property at Orford Street and Brailer Road.

Section 6 of the application form requires analysis of alternative mitigation measures and explanation of why they are not feasible for addressing the hazard at issue.

Here, both the site-specific engineering analysis prepared for this Application and the relevant coastal engineering and geologic literature demonstrate that no softer or nonstructural hazard-avoidance measure is feasible to adequately protect the Property from the ongoing erosion and flooding hazards.

A. The robust Property-specific analysis developed by engineers and habitat professionals demonstrate that all lesser alternative measures would quickly fail.

As described in their written analyses, the engineers at Certerra, Mr. Simpson, P.E., L.G., and Nicoterra evaluated a range of alternative mitigation measures to protect Applicants' home from the accelerating bluff erosion and increasing ocean-flooding hazard. Those experts concluded that, given the Property's unique physical conditions, including but not limited to very low elevation and exposure to high-energy coastal processes, softer or nonstructural measures would not provide effective or reliable protection.

Certerra summarizes its evaluation process at the outset of the Geotechnical Report:

> "Prior to determining any geotechnical coastal erosion mitigation conclusions for the project, we conducted an initial assessment of the property's shoreline and mitigation alternatives. This assessment was performed without having a specific predetermined coastal erosion mitigation alternative. Our evaluation began with consideration of non-structural approaches, followed by structural options, progressing from the "softest" solutions (e.g., vegetated slopes, cobble berms, and sand alteration) to the more robust solutions (e.g., sand tubes, revetments, and seawalls). Our objective was to identify the least intrusive method capable of providing effective, long-term protection given the site-specific conditions. We subsequently performed a site-specific subsurface

investigation and technical analysis to assess the suitability of each option."[60]

Based on this comprehensive analysis, Certerra concluded that only a riprap revetment is capable of withstanding the high-energy wave conditions at the site and providing reliable long-term protection for Applicants' low-lying home from the ongoing bluff erosion, wave overtopping, and resulting ocean flooding.[61]

This conclusion was echoed in the Coastal Engineering Opinion[62] and Nicoterra Site Evaluation.[63] Collectively, these expert opinions set out in detail why alternatives such as beach nourishment, vegetation restoration, clay burritos, and dynamic revetments will not work due to the Property's high-wave-energy environment, small bluff, and low elevation.[64]

B. Academic literature and governmental publications also demonstrate why alternative measures are infeasible.

The Property-specific expert reports are consistent with the general academic literature and governmental guidance on selection of erosion mitigation measures.

1. Dynamic Revetment.

Dynamic revetments are engineered beaches made of cobblestones between 2.5 and 10 inches in diameter. They are called "dynamic" because the cobblestones move in response to waves, which can potentially dissipate wave energy.[65] As explained in the DLCD's *Guidebook on Erosion Control Practices*

---

[60] Geotechnical Report at 2.

[61] Geotechnical Report at 45 ("Based on our evaluation of non-structural shoreline protection alternatives outlined in the DLCD Guidebook, including vegetative stabilization, dynamic cobble berms, and sand alteration, it is our professional opinion that none of these approaches are a viable or effective solution for the subject property at 3915 Ocean Avenue.").

[62] Coastal Engineering Opinion at 11-13, 15.

[63] Nicoterra Site Evaluation at 1.

[64] Geotechnical Report at 34-45; Coastal Engineering Opinion at 2, 6-7, 10-11; Nicoterra Opinion at 1-2.

[65] *See* Guidebook, Ex. 3, at 39.

of the Oregon Coast (the "Guidebook")[66], research on this intervention measure is limited, and there are only two successful dynamic revetments on the Oregon coast.[67]

A dynamic revetment is not a viable alternative for the Property. First, such a revetment is not appropriate or effective for the protection of an individual property. A dynamic revetment is an engineered *beach* composed of loose cobblestones that do not stay in place but are in fact intended to be moved by waves along the shoreline.[68] The effectiveness of a dynamic revetment is directly tied to its size. The most comprehensive study on the potential use of dynamic revetments on the Oregon coast was prepared by professional geologists/coastal geomorphologists at DOGAMI for the Oregon Department of Transportation.[69] Based on their comprehensive analysis of natural and engineered cobblestone beaches, the authors concluded that dynamic revetments should have a minimum crest elevation of at least 23 feet[70] and width of 66 feet.[71]

Thus, the only two dynamic revetments on Oregon beaches are expansive: the engineered cobblestone beach at Cape Lookout State Park is approximately 1,000 feet in length,[72] while the dynamic revetment next to the Columbia River south jetty is approximately 1,100 feet.[73] (Pictures below taken from the Guidebook, pages 41-42.)

---

[66] Hailey Bond, *Guidebook on Erosion Control Practices of the Oregon Coast*, Oregon Department of Land Conservation & Development (2021) (Ex. 3).

[67] *Id.*

[68] *See* Guidebook, Ex. 3, at 39-40.

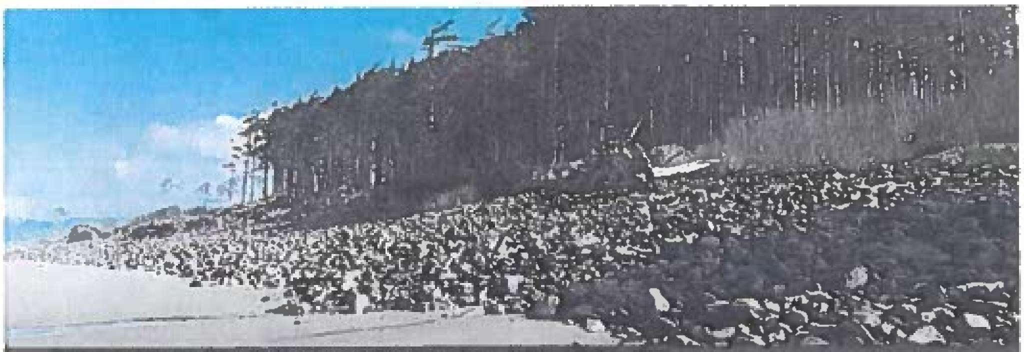
[69] Jonathan C. Allan, Ron Geitgey, & Roger Hart, *Dynamic Revetments for Coastal Erosion in Oregon* (Aug. 2005) (Ex. 5); *available at* https://www.oregon.gov/odot/Programs/Research Documents/DynamicRevetments.pdf).

[70] *Id.* at 64.

[71] *Id.* at 69, 71.

[72] *Id.* at 25.

[73] Jonathan C. Allan & Laura L. Gabel, Monitoring the response and efficacy of a dynamic revetment constructed adjacent to the Columbia River South Jetty, Clatsop County, Oregon (2016), *available at* https://pubs.oregon.gov/dogami/ofr/O-16-07.pdf.



DYNAMIC REVETMENT AT CAPE LOOKOUT. PHOTO BY HAILEY BOND, 2021

DYNAMIC REVETMENT AT THE COLUMBIA RIVER. PHOTO BY JONATHAN ALLAN, 2013

The Property's shoreline is only 50 feet, and thus not appropriate for a dynamic revetment. Even the recommended height and width requirements would not work on this site: the recommended minimum crest for a dynamic revetment is 23 feet, which would be taller than the first floor of Applicants' home. Likewise, a dynamic revetment built with the recommended width of 66 feet would extend five or six times farther onto the beach as the proposed riprap.

Further, as recognized in the DOGAMI study and state Guidebook, dynamic revetments are not recommended in developed areas because the cobblestones become projectiles during severe storms.[74] A dynamic revetment would be particularly dangerous here, where the bluff is mere yards from Applicants' deck, sliding glass door, and windows:

---

[74] *See* Guidebook, Ex. 3, at 40.

Finally, although too small to be considered a true dynamic revetment, Applicants have actually attempted to use cobblestones to protect the Property twice in the past—both times immediately failing.[75]

2. Vegetative stabilization structures (i.e., clay/sand burrito).

Vegetative stabilization structures (also referred to as soil or sand burrito structures, or burrito terraces) consists of building up a berm along the bluff, sometimes using "biodegradable jute or coir fabric" (i.e., sand tubes) and then planting native vegetation thereon in order to stabilize the eroding slope.

While vegetative stabilization structures may be effective in low-energy environments or areas with limited erosion potential, it is not well-suited to high-energy coastal sites like this one, where wave action directly impacts the bluff and ongoing bluff retreat are too severe to allow for the successful establishment of vegetation or to prevent erosion of the underlying terraced soil structure. In such conditions, these measures are unlikely to provide adequate protection against continued erosion impacts.

As explained in the state's Guidebook, vegetative stabilization structures are only suited for areas with mild to moderate erosion.[76] In high-energy wave environments, such as the Property, vegetated berms or "sand tubes" are easily removed by large waves and storm events, which limits the ability of

[75] See discussion in Section II(A)(4) above.

[76] *See* Guidebook, Ex. 3, at 36.

the planted vegetation to take root and results in slope steepening, thus exacerbating the erosion.[77]

In short, vegetative stabilization can be an effective alternative to riprap revetments and other structural solutions in low-erosion areas, but they are ineffective in areas subject to chronic erosion, high-energy waves, and significant storm events, such as the Property.

3. Beach scraping and nourishment.

"Beach scraping is the process of stimulating natural recovery from short-term erosion by moving sand from the intertidal zone to the beach or upper beach through mechanical means[,]"[78] i.e., using heavy machinery to move sand from the area of beach located between high and low tide to the upper beach area being eroded. A similar alternative to beach scraping is beach nourishment, which entails periodically adding sand to existing dunes, existing coastline (to widen the beach), or beyond the intertidal zone to create a sandbar.[79]

This area of the shoreline is subject to intense wave force, extreme high tides, storm events, and coastal erosion,[80] which means the placement of sand would provide no meaningful protection for the Property's undersized, unstable bluff. As explained in the Guidebook, beach nourishment is only intended to be a "temporary solution" meant to address "short-term erosion,[81] and beach scraping has not been successful when attempted on the Oregon coast.[82]

4. Vegetated riprap is the only viable solution suitable for the Property's severe bluff erosion and extremely high wave-energy location.

---

[77] *See* Guidebook, Ex. 3, at 36-37.

[78] Guidebook, Ex. 3, at 47.

[79] *See* Guidebook, Ex. 3, at 44-45.

[80] *Id.*

[81] *Id.*

[82] *See* Guidebook, Ex. 3, at 48.

Consistent with the robust expert analysis submitted in support of the Application, the state's own guidance confirms that a riprap revetment is the only viable solution for the Property due to the site's extremely high-energy wave environment and severe bluff erosion. The manual explains:

> "Riprap is the most common erosion control measure in Oregon for a few reasons. Over time, it's been proven extremely successful. Trial and error have helped to develop designs that are best suited for the highly energetic wave climate in Oregon."[83]

Each of the other mitigation measures set out in the Guidebook are expressly limited to areas with lower wave energy and/or bluffs with only mild to moderate erosion.[84]

C. Relocation of the home is not possible.

Section 6 of the Application directs the Applicant to address the potential relocation of threatened buildings. Here, relocation of Applicants' home is not feasible because there is no space for the home to be moved east. As shown below, the home already abuts the required 15-foot front-yard setback.[85]

---

[83] Guidebook at 53.

[84] *E.g.*, Guidebook at 36 ("While vegetative stabilization is a valuable alternative to the more common kinds of structural erosion control in Oregon, it is not suitable for every location. This design is not as sturdy as riprap, and therefore cannot protect against erosion in the same way. It is therefore only suited to areas with mild to moderate erosion.").

[85] CBMC 17.30.040(B)(3).

IV. SATISFACTION OF APPROVAL CRITERIA

In addition to satisfying the requirements in OPRD's shoreline protection structure application form, Applicants' proposal satisfies all applicable standards in OAR Chapter 736, Division 20.

A. General Standards (OAR 736-020-0010).

1. Project Need—There shall be adequate justification for a project to occur on and alter the ocean shore area.

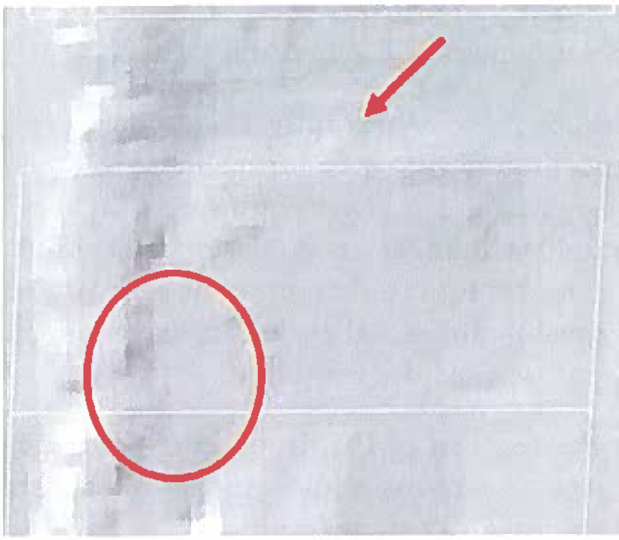
The justification for the project need is set out in detail in Section II(A) above. In short, the evidence demonstrates that:

- The Property's short oceanfront bluff is actively eroding, increasingly undercut, and retreating toward the residence;
- The Property is uniquely vulnerable because of its unusually low elevation within FEMA's most severe coastal flood hazard designation (Zone VE) and exposure to high-energy wave attack and overtopping;
- The home is subject to recurring ocean flooding during winter storms, which is increasing as the bluff erodes and loses elevation, resulting in oceanwater run up towards the Siegel home's foundation;

- Ongoing bluff retreat increases the risk of structural damage to the residence from flooding, debris impact, scour, soil saturation, and foundation settling/instability; and
- Prior softer shoreline-protection efforts failed to stop the erosion or flooding hazards.

Although the adjacent undeveloped right-of-way will remain subject to some ocean flooding unless and until it is also addressed, following construction of the revetment, the proposed structure will nevertheless provide critical protection for the residence in several important ways.

First, as shown in the satellite and LiDAR imagery below, there is a natural rise in bare-ground elevation along the southern edge of the right-of-way approximately 13 feet north of the home's foundation, which should provide some protection from flooding approaching from that direction. By contrast, a low-lying depression exists behind the southern half of the Property's bluff immediately adjacent to the residence. As the bluff continues to erode and lower in elevation, this depressed area will become increasingly vulnerable to wave overtopping and floodwater ponding.



Images from Cannon Beach GIS Mapping Tool[86]

As explained above in the engineering reports[87] and Section II(A)(2) above, ponding floodwater in this area need not enter the home to cause significant damage. Saturation of the underlying soils can weaken and destabilize the

[86] https://gis.cartomation.com/cannonbeach/planning/#on=sketch/default;city/city;ugb/ugb;roads/roads;parcels/parcels;olc_bareEarth/DIGITAL_TERRAIN_MODEL_MOSAIC_HS;OSIP_2024/OSIP_2024&loc=0.1374;-13799347.41;5758988.53

[87] Geotechnical Report at 14; Coastal Engineering Opinion at 7, 9.

foundation soils, reducing their bearing capacity and threatening the residence through settlement and structural failure.

Moreover, and perhaps most importantly, the proposed revetment will protect the residence from direct wave uprush during storm events. Without the revetment, storm waves and flood flows would scour soil from in front of the home and around the foundation supports while simultaneously driving drift logs and other debris into the structure at high velocity.[88] The revetment is specifically designed to prevent those direct wave impacts and dissipate wave energy before it reaches the residence.

2. Protection of Public Rights—Public ownership of or use-easement rights on the ocean shore shall be adequately protected.

The proposed revetment will not meaningfully interfere with the public's use of the adjacent beach, which, during ordinary weather and tidal conditions, is typically hundreds of feet wide. The direct wave impacts to the bluff have thus far occurred only during climatic events and mostly during winter months.

As described in the Geotechnical Report,[89] the revetment has been designed to minimize its footprint on the beach. The design calls for excavation into the existing bluff and placement of the above-grade portion of the revetment largely within the current bluff profile, thereby avoiding extension of the structure onto the active beach area. The proposed structure has also been designed to tie into and align with the existing revetment immediately south of the Property, avoiding any abrupt shoreline projection or isolated encroachment onto the beach.

Given the extensive shoreline armoring already present in this area, the addition of this 50-foot section of vegetated revetment will not meaningfully alter the public's ability to walk along, recreate on, or visually enjoy the beach.

---

[88] Coastal Engineering Response Letter at 2-4.

[89] Geotechnical Report at 28-29.

As discussed above and in the Construction Plan, construction activities will also not meaningfully impact public recreation for several reasons, including:

- Equipment access to the beach will occur from the Property and adjacent undeveloped right-of-way;
- All staging of equipment and construction materials will occur upland;
- Construction will occur over only a few weeks, outside the peak visitor season, and primarily on weekdays during periods of relatively low beach use;
- There are multiple public beach access points along this stretch of shoreline, including access points located only a few houses north and south of the Property; and
- Signage, fencing, and other safety measures will be implemented to protect the public during construction activities.

3. Public Laws—The applicant shall comply with federal, state, and local laws and regulations affecting the project.

As described above, the Cannon Beach City Council approved a conditional use permit for the construction of the proposed revetment on November 14, 2025. Accordingly, the Cannon Beach Community Development Department has executed the enclosed zoning affidavit stating that the Property is eligible for a shoreline protective structure and that the proposed revetment is consistent with the local comprehensive plan and zoning code.

The proposed project is also in compliance with federal and state law. The proposed structure does not require a permit from the U.S. Army Corps of Engineers or the Oregon Department of State Lands.

4. Alterations and Project Modifications—There are no reasonable alternatives to the proposed activity or project modifications that would better protect the public rights, reduce or eliminate the detrimental

affects on the ocean shore, or avoid long-term cost to the public.

As set out in Section III(A) above, the expert analysis submitted in support of the Application evaluated all feasible alternatives to the proposed revetment. Each of those alternatives was determined to be infeasible and/or ineffective for protection of the Property bluff and residence. These conclusions are further supported by the governmental reports and academic literature discussed in Section II(B) above. Moreover, as explained above, relocation of the home is not feasible because of the Property's physical constraints and applicable development standards.

The proposed revetment was also specifically designed to minimize impacts to the public beach. As described in the Geotechnical Report, the structure will be constructed by excavating into the existing bluff and placing the revetment as far landward as feasible so that the above-grade portion of the structure remains largely within the current bluff profile rather than extending onto the active beach. The revetment has also been designed to tie into the existing shoreline armoring immediately south of the Property, thereby avoiding any unnecessary seaward projection or isolated encroachment onto the beach.

5. **Public Costs—There are no reasonable special measures which might reduce or eliminate significant public costs. Prior to submission of the application, the applicant shall consider alternatives such as nonstructural solutions, provision for ultimate removal responsibility for structures when no longer needed, reclamation of excavation pits, mitigation of project damages to public interests, or a time limit on project life to allow for changes in public interest.**

There will be no public cost associated with the revetment because it will be built entirely on the Applicants' private property and maintained solely by Applicants and their successors. Further, there will also be no cost to the public from the construction of the revetment as the staging areas and equipment beach access will be exclusively located on the Property and adjacent undeveloped right-of-way. The beach and City right-of-way will be restored to their original condition upon completion of the project.

> 6. **Compliance with LCDC Goals—The proposed project shall be evaluated against the applicable criteria included within Statewide Planning Goals administered by the Department of Land Conservation and Development.**

The lot is eligible for a beachfront protective structure[90] under Statewide Planning Goal 18 because it was created in 1927[91] and first developed around 1940. Accordingly, the City approved a conditional use permit for the project and certified in the affidavit that the project complies with the City's comprehensive plan and zoning code, which are acknowledged by the Land Conservation Development Commission as satisfying the Statewide Planning Goal requirements.

B. Scenic Standards (OAR 736-020-0015): Projects on the ocean shore shall be designed to minimize damage to the scenic attraction of the ocean shore area.

> 1. **Natural Features—The project shall retain the scenic attraction of key natural features, for example, beaches, headlands cliffs, sea stacks, streams, tide pools, bedrock formations, fossil beds and ancient forest remains.**

The proposed riprap revetment will not impact the scenic attraction of any key natural resources because no such resources are located on or adjacent to the Property.

---

[90] https://www.coastalatlas.net/oceanshores/map/#on=parcels/parcels:oca/goal18_eligibility_inventory;oca/sps_lines:OSIP_2022/0:cartolight/light&loc=0.1603;-13799331.40;5758965.85.

[91] The lot was created as part of the Wave Crest subdivision https://delta.co.clatsop.or.us/surveys/Subdivisions_by_Name_All/Wave%20Crest%20on%20Cannon%20Beach%20B9%20P2.pdf. In 2006, the previous house was replaced by the current two-story home

Moreover, even if such features were present, the proposed project would not meaningfully affect the scenic value of the surrounding shoreline for several reasons. First, as discussed above and shown below, this stretch of shoreline is already extensively armored with riprap revetments both north and south of the Property.

Riprap South of the Property[92]

Riprap North of the Property[93]

Second, the proposed revetment has been specifically designed to minimize its visual presence. The structure will be constructed within the same approximate footprint as the existing bluff, aligned with the adjacent revetments, and graded to transition into the existing upland yard elevation east of the bluff.

[92] Satellite image from OCMP Ocean Shores Viewer, https://www.coastalatlas.net/oceanshores/map/. Illustrations based on designations in Ocean Shores Viewer.

[93] *Id.*

Third, unlike the more exposed riprap structures adjacent to the Property, the proposed revetment will be covered with sand and planted with native vegetation, creating a more natural and visually compatible shoreline condition.

Any scenic impacts associated with construction activities will likewise be minimal and temporary. As described in the Construction Plan, beach disturbance will be limited to a small area around the Property, staging and most construction activities will occur upland, and the duration of construction will be short.

Accordingly, the proposed project will not meaningfully diminish the scenic attraction or visual character of the surrounding shoreline and complies with this standard.

2. Shoreline Vegetation—The project shall retain or restore existing vegetation on the ocean shore when vital to scenic values.

Existing shoreline vegetation on the Property is limited. The short bluff is actively eroding, oversteepened, and subject to frequent wave overtopping, leaving only sparse vegetation primarily along the upper edge of the bluff. Much of the bluff face itself is unvegetated because ongoing erosion and wave action prevent establishment of stable vegetation.

The proposed project will substantially improve this condition. Following construction, the revetment will be covered with sand and planted with native shoreline vegetation designed to stabilize the bluff face and provide a more natural vegetated appearance. Accordingly, the project will restore and increase vegetative cover along the shoreline rather than reduce it.

Thus, the proposed project will increase, not decrease, shoreline vegetation on the bluff, as noted by Arborist Daniel Collins. [94]

---

[94] Nicoterra Site Evaluation at 1-2.

3. **View Obstruction—The project shall avoid or minimize obstruction of existing views of the ocean and beaches from adjacent properties.**

The proposed revetment will not obstruct ocean views because the top of the structure will be the same height as the existing bluff. Because of natural site elevations, the revetment to the south rises higher than that proposed on the Property. There will also be no impacts on views during the short window of construction because the equipment and materials will be staged upland.

4. **Compatibility with Surroundings—The project shall blend in with the existing shoreline scenery (type of construction, color, etc.).**

The proposed revetment will not obstruct existing ocean or beach views from adjacent properties because the top of the structure will generally match the height and alignment of the existing bluff and surrounding yard grade. The project therefore will not create any new vertical obstruction or materially alter existing sightlines toward the ocean. The type of revetment construction will be similar to that on abutting properties, but with additional visual mitigation measures such as sand and plantings.

Any temporary visual impacts during construction likewise will be minimal because construction activities will occur over a short duration and equipment and materials will be staged upland rather than on the beach. This will have a similar impact to any other upland construction in the area.

C. **Recreation Use Standards (OAR 736-020-0020): The following recreation use standards shall be applied, where applicable, to each application for an ocean shore permit.**

1. **Recreation Use—The project shall not be a detriment to public recreation use opportunities within the ocean shore area except in those cases where it is determined necessary to protect sensitive biological resources such as state or federally listed species.**

The proposed revetment will not interfere with recreational use of the beach because the structure has been designed to be constructed largely within the footprint of the existing bluff. As a result, the above-grade portion of the revetment will not extend materially farther west than the current bluff face.

Moreover, even if portions of the structure were to extend slightly west of the existing bluff, the project still would not meaningfully affect public recreation because the adjacent beach is typically hundreds of feet wide throughout the year, leaving ample area for walking, beach access, and other recreational activities.

As set out in detail in the Construction Plan, construction activities likewise have been specifically timed and designed to minimize temporary impacts on beach use. Construction will occur over a short duration, outside the peak visitor season, with staging and most work activities occurring upland rather than on the beach.

2. **Recreation Access—The project shall avoid blocking off or obstructing public access routes within the ocean shore area except in those cases where it is determined necessary to protect sensitive biological resources such as state or federally listed species.**

Because the above-grade portion of the revetment will be constructed largely within the footprint of the existing bluff and in alignment with the abutting revetment to the south, the completed structure will not block or obstruct public access onto or along the ocean shore.

In addition, as discussed in detail in the Construction Plan, the proposed construction methods and logistics have been specifically designed to minimize temporary impacts on beach access during construction. Equipment access will occur directly from the Property and adjacent undeveloped right-of-way, staging and material storage will occur upland, and multiple nearby public access points will remain available throughout construction activities. Any temporary restrictions near the immediate work area will be limited in duration and necessary only to ensure public safety during active construction operations.

D. **Safety Standards (OAR 736-020-0030): "The project shall be designed to avoid or minimize safety hazards to the public and shoreline properties. The following safety standards shall be applied, where applicable, to each application for an ocean shore permit."**

1. **Structural Safety—The project shall not be a safety hazard to the public due to inadequate structural foundations, lack of bank stability, or the use of weak materials subject to rapid ocean damage.**

The proposed riprap revetment was designed by licensed geotechnical engineers with substantial experience evaluating coastal bluff conditions and designing shoreline protection structures. As detailed in the Geotechnical Report and accompanying plans, the revetment design is based on current geotechnical and coastal engineering standards and incorporates appropriately sized and durable armor stone, subsurface preparation, filter materials, and toe stabilization measures necessary to withstand the high-energy ocean conditions present at the site, including severe winter storm events.

The proposed structure therefore will not create a safety hazard to the public from inadequate foundations, unstable conditions, or the use of weak or rapidly deteriorating materials.

2. **Obstructional Hazards—The project shall minimize obstructions to pedestrians or vehicles going onto or along the ocean shore area.**

The proposed revetment will not create an obstruction to pedestrians or vehicles traveling onto or along the ocean shore because the structure has been designed to remain within the footprint of the existing bluff and will not materially extend westward onto the active beach.

In addition, as set out in detail in the Construction Plan, construction activities have been specifically timed and designed to minimize temporary impacts on public use of the beach during the short construction period. Construction will occur over a limited duration, primarily outside the peak visitor season, with upland staging and controlled access measures that will maintain safe public passage along the shoreline.

3. **Neighboring Properties—The project shall be designed to avoid or minimize ocean erosion or safety problems for neighboring properties.**

The proposed revetment was designed by a licensed geotechnical engineer with substantial experience designing coastal riprap structures. The revetment has been specifically engineered to wrap and taper into the adjacent bluff areas in order to avoid significant "end effects" or localized erosion at the structure transitions. As explained in the Geotechnical Report and supporting coastal engineering analysis, the proposed structure will not meaningfully alter shoreline processes or increase erosion on neighboring properties.

As demonstrated in Cannon Beach's conditional use approval[95] land use record for this project, the proposed revetment on the Property is supported by the Siegels' immediate neighbors to the north and south.

Construction of the revetment likewise will result in only minor and temporary impacts to neighboring properties, primarily limited to short-term construction noise and limited use of small portions of the beach during active work periods. As described in the Construction Plan, these temporary impacts will be minimized through the use of upland staging areas, controlled construction access, limited construction duration, and other mitigation and public-safety measures.

4. **Property Protection—Beachfront property protection projects shall be designed to accomplish a reasonable degree of increased safety for the on-shore property to be protected.**

The expert engineering analysis submitted with the Application demonstrates that the proposed revetment will provide a substantial and immediate increase in safety for the Property and residence. As explained in the Geotechnical Report, the revetment is specifically designed to prevent

---

[95] Cannon Beach Appeal No. APP# 25-03 (CU#25-06).

continued erosion and undercutting of the bluff by protecting the bluff toe from direct wave attack during high tides and storm events.[96] Certerra concludes that the proposed structure will stabilize the bluff and protect the residence from the ongoing coastal erosion hazards threatening the Property.[97]

Similarly, coastal engineer David Simpson explains that the proposed revetment will not only prevent continued bluff retreat, but also reduce the frequency and severity of ocean flooding at the site by dissipating wave energy and reducing wave runup and overtopping compared to the existing steep and eroding bluff condition.[98] Mr. Simpson further explains that the revetment design allows for installation of drainage improvements behind the structure to intercept and safely discharge overtopping water before it can pond near the residence and undermine foundation soils.[99]

Together, these expert opinions demonstrate that the proposed revetment will provide a reasonable and effective degree of increased safety for the Property by stabilizing the bluff, preventing further erosion, reducing direct wave impacts, and materially decreasing the risk of flood-related structural damage to the residence.

E. Natural and Cultural Resource Standards (OAR 736-020-0030): "Projects on the ocean shore shall avoid or minimize damage to the following natural resources, habitat, or ocean shore conditions, and where applicable, shall not violate state standards:"

1. Fish and wildlife resources including rare, threatened or endangered species and fish and wildlife habitats.

The proposed project will not adversely affect fish or wildlife resources because the site consists of a previously developed residential shoreline with

[96] Geotechnical Report at 28, 30–32.

[97] *Id.*

[98] Coastal Engineering Report at pp. 10, 14–16.

[99] Coastal Engineering Report at 14–15

minimal existing vegetation and no identified sensitive habitat areas. The surrounding shoreline is heavily developed and armored, and the Property does not contain wetlands, forage fish habitat, or other significant habitat features associated with rare, threatened, or endangered species.

The proposed revetment likewise will not adversely affect marine resources. The structure will be constructed using clean armor stone and other approved materials free of debris or contaminants, and the design incorporates standard erosion-control measures, including filter fabric and drainage elements, to prevent migration of fine sediments and shoreline instability.

As part of the review process, the Oregon Department of Fish and Wildlife will receive notice of the Application and will have the opportunity to confirm the absence of impacts to rare, threatened, or endangered species and associated habitat resources at the project site.

2. Estuarine values and navigation interests.

The project is not adjacent to an estuary and does not affect navigable water on the ocean.

3. Historic, cultural and archeological sites.

There are no historic properties or cultural/archeological resources near the project site. Nevertheless, Applicants understand that the requested ocean shore alteration permit will be subject to a condition that this standard is met throughout the project, in case archeological resources are discovered during construction. During the application review, notice and opportunity for comment will be provided to the Oregon State Historic Preservation Office, the Confederated Tribes of Siletz Indians, and the Confederated Tribes of Grand Ronde. Applicants will respond to any cultural issues that may be raised throughout this process.

4. Natural areas (vegetation or aquatic features).

The proposed project will not adversely affect natural areas because the site consists of a previously developed residential bluff and shoreline that lacks significant natural vegetation communities, wetlands, dunes, streams, or other aquatic features. Existing vegetation on the bluff is sparse and limited because the bluff is actively eroding and regularly exposed to wave overtopping and storm impacts.

The revetment itself will stabilize the bluff and restore vegetative cover through installation of native shoreline plantings over the completed structure. As a result, the project will improve the long-term stability and vegetative condition of the shoreline rather than degrade it.[100]

Construction activities likewise will not meaningfully impact natural areas. Construction and staging activities will occur primarily upland, disturbance will be confined to the immediate project area, and the duration of construction will be short.

5. Air and water quality of the ocean shore area.

The riprap structure will incorporate materials free of debris and include design features to prevent erosion thereof. It will not impact air or water quality. The construction of the revetment will also not impact the air and water quality of the ocean shore because all staging and equipment parking/maintenance will occur off the beach on the upland Property and City right-of-way.

6. Areas of geologic interest, fossil beds, ancient forest remnants.

There are no areas of geologic interest, fossil beds, or ancient forest remnants on the project site or in the nearby area.

7. When necessary to protect native plant communities or fish and wildlife habitat on the subject or adjacent properties, only native, non-invasive, plant species shall be used for revegetation.

The revetment will be replanted with only native, noninvasive plant species.

100 Nicoterra Site Evaluation at 1-2.

V. CONCLUSION

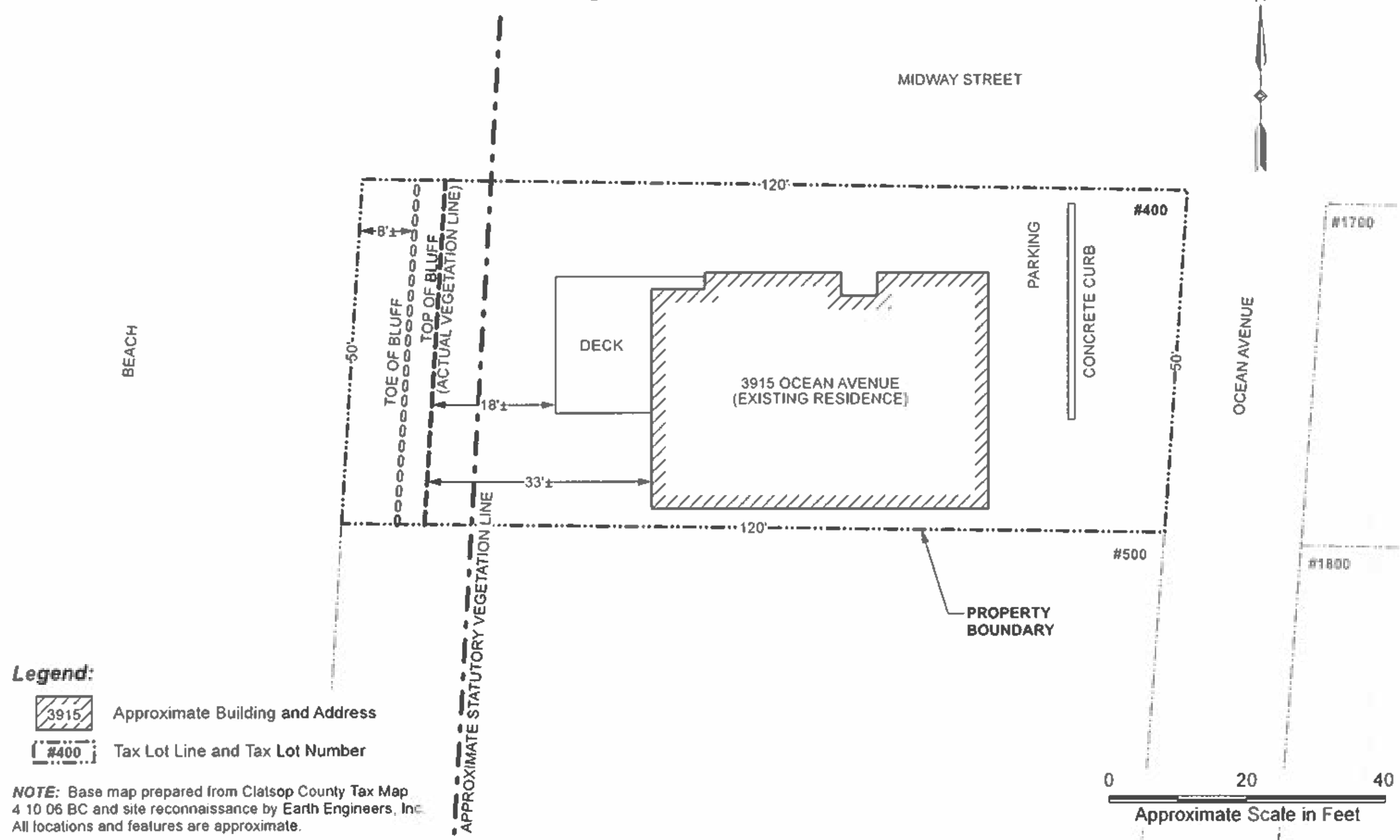
The Application and supporting expert analysis demonstrate that the proposed vegetated riprap revetment is needed to protect the Siegel home and satisfies all applicable approval criteria for issuance of an ocean shore permit.

The evidence establishes that the Property faces an immediate and worsening hazard from ongoing bluff erosion, wave overtopping, and ocean flooding. The Property's unusually low elevation, short and actively eroding bluff, and direct exposure to high-energy wave conditions make the residence uniquely vulnerable to structural damage from flooding, scour, debris impact, and foundation instability. The expert analyses submitted with the Application further demonstrate that softer or nonstructural alternatives would not provide effective or reliable protection at this site.

At the same time, the proposed revetment has been specifically designed to minimize impacts on the ocean shore and surrounding area. The structure will be constructed largely within the footprint of the existing bluff, aligned with adjacent shoreline armoring, covered with sand and native vegetation, and constructed using methods that minimize temporary impacts to public access, recreation, scenic resources, neighboring properties, and natural resources. The extensive supporting materials submitted with the Application—including the Geotechnical Report, Coastal Engineering Opinion, ecological analysis, and Construction Plan—demonstrate that the project has been carefully engineered and planned to provide the necessary protection while avoiding meaningful adverse impacts.

Accordingly, because the proposed project is necessary to protect the residence from imminent coastal hazards and satisfies all applicable approval standards, Applicants respectfully request that OPRD approve the requested ocean shore permit.

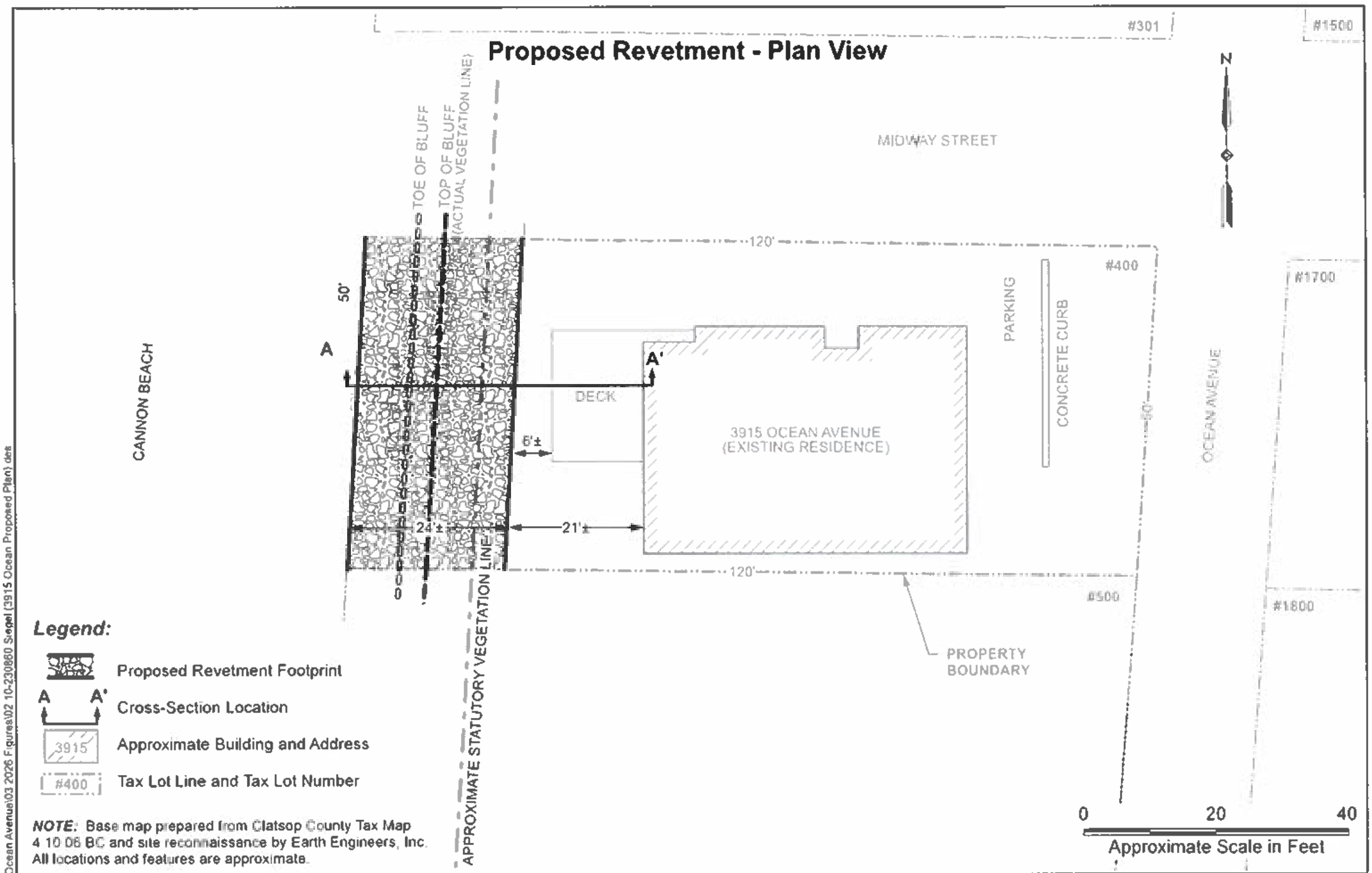
Existing Conditions - Plan View



CERTERRA EARTH ENGINEERS	**Proposed Shoreline Protection Structure** **3915 Ocean Avenue** **Cannon Beach, Clatsop County, Oregon**	**Project No.** **10-230860**	**July 22, 2026**

I:\Client\Earth Engineers\3915 Ocean Avenue\03 2026 Figures\01 10-230860 Siegel (3915 Ocean Existing Plan).dwg

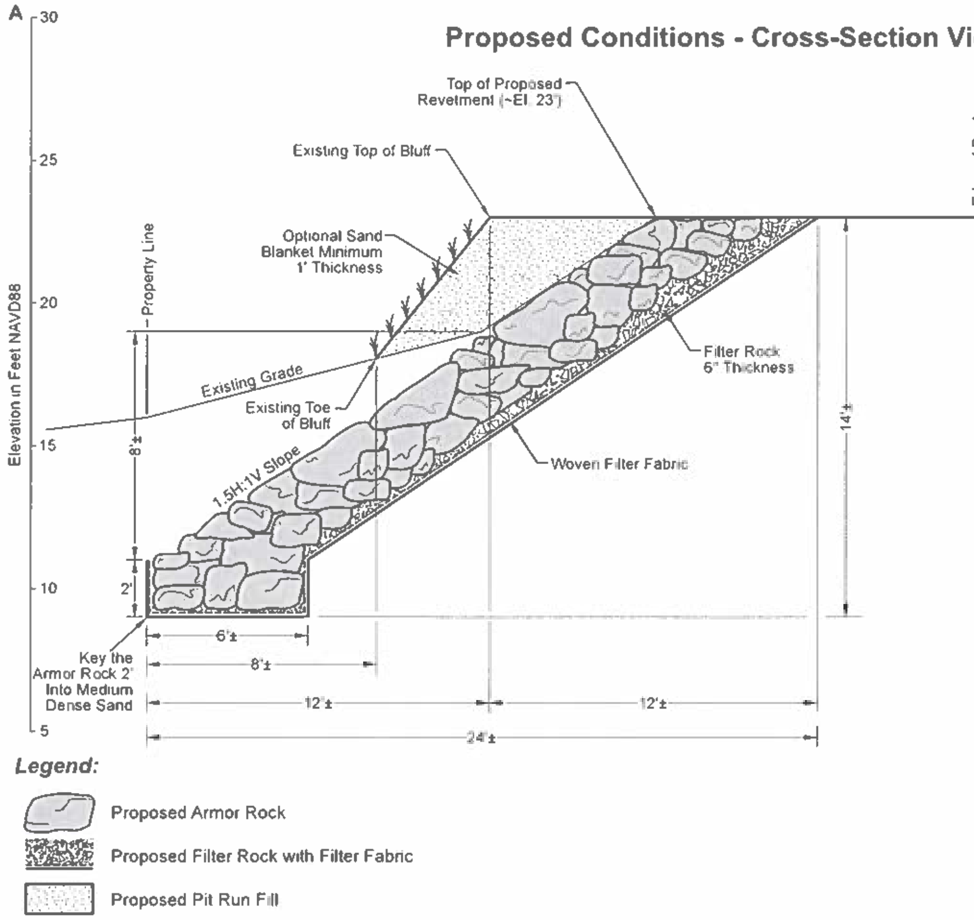
Proposed Revetment - Plan View



CERTERRA EARTH ENGINEERS	**Proposed Shoreline Protection Structure** **3915 Ocean Avenue** **Cannon Beach, Clatsop County, Oregon**	**Project No.** **10-230860**	**July 22, 2026**

I:\Client\Earth Engineers\3915 Ocean Avenue\03 2026 Figures\02 10-230860 Siegel (3915 Ocean Proposed Plan).dwg

Proposed Conditions - Cross-Section View



NOTES:

- The base of the riprap should be embedded at least 2 feet into dense sand (i.e., at an elevation of approx. 8 to 9 feet NAVD88). The final toe elevation should be verified and approved by Certerra during construction, as field conditions may warrant adjustment. If embedment depths cannot be achieved due to heaving or flowing sands, dewatering will be necessary.
- A woven geotextile filter fabric (Mirafi Filterweave 700, or approved equivalent) shall be installed continuously between the native subgrade soils and the overlying filter rock, with seams overlapped sufficiently to prevent migration of fines.
- Overlying the filter fabric, a 6-inch-thick layer of pit run (approximately 4-inch minus) shall be placed at a slope angle of 1.5H:1V.
- An armor rock layer composed of durable, non-weathered, angular basalt ranging from 3 to 8 feet in diameter shall be installed over the filter rock to a minimum thickness of 7 feet, with individual rocks interlocked at a minimum of three points of contact.
- The revetment slope exposed to wave action shall be constructed at approximately 1.5H:1V, and the crest of the revetment shall be built to a minimum elevation of 23 feet (NAVD88).
- Following construction, the revetment should be covered with a 1 to 2-foot thick blanket of sand and planted with native vegetation.

0 5 10
Approximate Scale in Feet

CERTERRA EARTH ENGINEERS	Proposed Shoreline Protection Structure 3915 Ocean Avenue Cannon Beach, Clatsop County, Oregon	Project No. 10-230860	July 22, 2026

I:\Client\Earth Engineers\3915 Ocean Avenue\03 2026 Figures\03 10-230860 Siegel (3915 Ocean Proposed Profile).dwg

CERTERRA EARTH ENGINEERS

Materially Better™

Maxine M. Siegel
9515 Southeast 15th Street
Bellevue, Washington 98004
E-mail: mimi.siegel@kindering.org

January 19, 2024
Revised June 11, 2026
Report No. 10-230860-01-R5

Subject: **Geotechnical Investigation and Design Report**
Proposed Shoreline Protection Structure
3915 Ocean Avenue
Cannon Beach, Clatsop County, Oregon

Dear Maxine:

Certerra Northwest, LLC ("Certerra"), formerly known as Earth Engineers, is pleased to transmit our revised report for the above referenced project. The attached report includes the results of the field investigation and laboratory testing, an evaluation of geotechnical and geologic factors that may influence the proposed construction, recommendations for shoreline protection structure design, and recommendations for revetment construction.

We appreciate the opportunity to perform this geotechnical study and look forward to continued participation during the permitting and construction phases of this project. If you have any questions pertaining to this report, or if we may be of further service, please contact our office.

Sincerely,
Certerra Northwest, LLC

[redacted]

Jacqui Boyer	Troy Hull, P.E., G.E.	Kenneth Andrieu, R.G., C.E.G.
Geotechnical Project Manager	Senior Principal Geotechnical Engineer	Senior Engineering Geologist

Attachment: Geotechnical Investigation and Design Report

Distribution (electronic copy): Addressee
William Rasmussen, Miller Nash LLP (william.rasmussen@millernash.com)

CERTERRA
EARTH ENGINEERS

GEOTECHNICAL INVESTIGATION AND DESIGN REPORT

for the

Proposed Shoreline Protection Structure
3915 Ocean Avenue
Cannon Beach, Clatsop County, Oregon

Prepared for

Maxine M. Siegel
9515 Southeast 15th Street
Bellevue, Washington 98004

Prepared by

Certerra Northwest, LLC
2411 Southeast 8th Avenue
Camas, Washington 98607
Telephone (360) 567-1806

Certerra Report No. 10-230860-01-R5

January 19, 2024
Revised June 11, 2026

[redacted]

Troy Hull, P.E., G.E.
Senior Principal Geotechnical Engineer

[redacted]

Kenneth Andrieu, R.G., C.E.G.
Senior Engineering Geologist

[redacted]

Jacqui Boyer
Geotechnical Project Manager

CERTERRA
EARTH ENGINEERS

Table of Contents

1.0 PROJECT INFORMATION

1.1 Project Authorization

Certerra Northwest, LLC (Certerra), formerly Earth Engineers (EE), has completed a revised Geotechnical Investigation and Design Report for the proposed shoreline protection structure construction located at 3915 Ocean Avenue, in Cannon Beach, Clatsop County, Oregon. Our services were authorized by Maxine M. Siegel on April 28, 2023 by signing EEI Proposal No. 23-P149 issued the same date.

1.2 Project Description

Our initial understanding of the project was based on the information provided via e-mail to former EE Principal Engineering Geologist Adam Reese, as well as a subsequent site visit on October 12, 2023, with Mike Morgan (project advisor) and Tyler Blanchette of the Oregon Parks and Recreation Department (OPRD).

Our current understanding of the project has since been informed by our role as the Geotechnical Engineer of Record and Certified Engineering Geologist of Record for the proposed project. As part of our involvement, we have attended several Planning Commission and City Council meetings during the City of Cannon Beach's review process.

In addition to this report, we have prepared the following supplemental documentation to support the project:

- Alternatives analysis (EE Report No. 10-230860-02)
- Review of sand burrito structures (EE Report No. 10-230860-03)
- Letter of support prepared by a licensed geotechnical engineer (EE Report No. 10-230860-04)

These supplemental reports remain valid and continue to support the overall geotechnical framework for the project.

Briefly, we understand that the subject lot has beach frontage of approximately 50 feet. We understand that efforts to protect the shoreline had been implemented previously. Based on the information provided by Mike Morgan, a vegetated berm had been constructed along the bluff when the residence was constructed, and more recently two attempts were made to protect the bluff by placing 50 cubic yards of loose cobbles as shoreline protection following consultation with the City of Cannon Beach and OPRD. We have been informed that all previous attempts at armoring the property shoreline were ineffective (i.e. they were eroded away by the ocean). In addition, it is our understanding that, even with the "softer" solutions described above, the bluff has seen 4 to 5 feet of erosional bluff regression over approximately 10 years. Finally, we understand the subject property, situated at a relatively low elevation compared to neighboring properties, is susceptible to flooding during events where repetitive waves breach the property's relatively low bluff. See Photos 1 and 2 below. As the bluff continues to recede and the wave runup moves eastward, there is increased risk that the flooding will cause structural damage.

Given (1) the previous attempts to protect the shoreline were not effective, (2) with substantial erosion occurring within a 10 year time period despite attempts at shoreline protection, and (3) the flooding experienced on the subject property, we conclude that there is a heightened risk of imminent damage to the residential structure on the subject property.

Prior to determining any geotechnical coastal erosion mitigation conclusions for the project, we conducted an initial assessment of the property's shoreline and mitigation alternatives. This assessment was performed without having a specific predetermined coastal erosion mitigation alternative. Our evaluation began with consideration of non-structural approaches, followed by structural options, progressing from the "softest" solutions (e.g., vegetated slopes, cobble berms, and sand alteration) to the more robust solutions (e.g., sand tubes, revetments, and seawalls). Our objective was to identify the least intrusive method capable of providing effective, long-term protection given the site-specific conditions.

We subsequently performed a site-specific subsurface investigation and technical analysis to assess the suitability of each option. Based on this analysis, coupled with the observed erosion history, repeated failure of prior softer stabilization efforts, active wave undercutting, episodic bluff retreat, flooding conditions, and the site's exposure to high-energy wave action, we concluded that non-structural and hybrid measures alone would not provide reliable long-term protection at this location. However, vegetation may still serve a supplemental ecological and surface stabilization role when integrated with a properly engineered shoreline protection structure.

In our professional opinion, without the implementation of a permanent shoreline protection solution, bluff regression will continue. Unless the base of the bluff is adequately stabilized and protected from wave attack, the property will remain vulnerable to continued erosion and associated flooding impacts.

This report addresses the engineering geology and geotechnical conditions at the site, and provides recommendations for an oceanfront shoreline protection structure (SPS). For the purposes of this report, the terms "rip rap", "revetment", and "SPS" are interchangeable. In addition to its purpose of presenting the geotechnical investigation and design information for the SPS, this report is also presented as supporting information for a future OPRD Ocean Shore Alteration Permit Application, and the local permit applications for the City of Cannon Beach.

The subject property (i.e. 3915 Ocean Avenue) has a beach frontage that is approximately 50 feet wide and has no current bluff protection, with the exception of some remaining loose cobbles from prior limited erosion protection attempts. See Figure 1 below. The height of the bluff slope at this property location is approximately 5 to 7 feet, as measured in elevation from the beach to the backyard of the upland property. The distance from the top of the bluff to the residence is approximately 33 feet, and the deck attached to the residential structure is located approximately 19 feet horizontally from the top of the bluff. The existing top of the bluff currently is approximately 7 feet west of the statutory vegetation line established by the Oregon Beach Bill. See Figure 2 below.

Figure 1: Project vicinity (subject property outlined in blue), showing the extent of the roughly 50-foot shoreline frontage (dashed yellow line). Base map source: Clatsop County Webmaps.

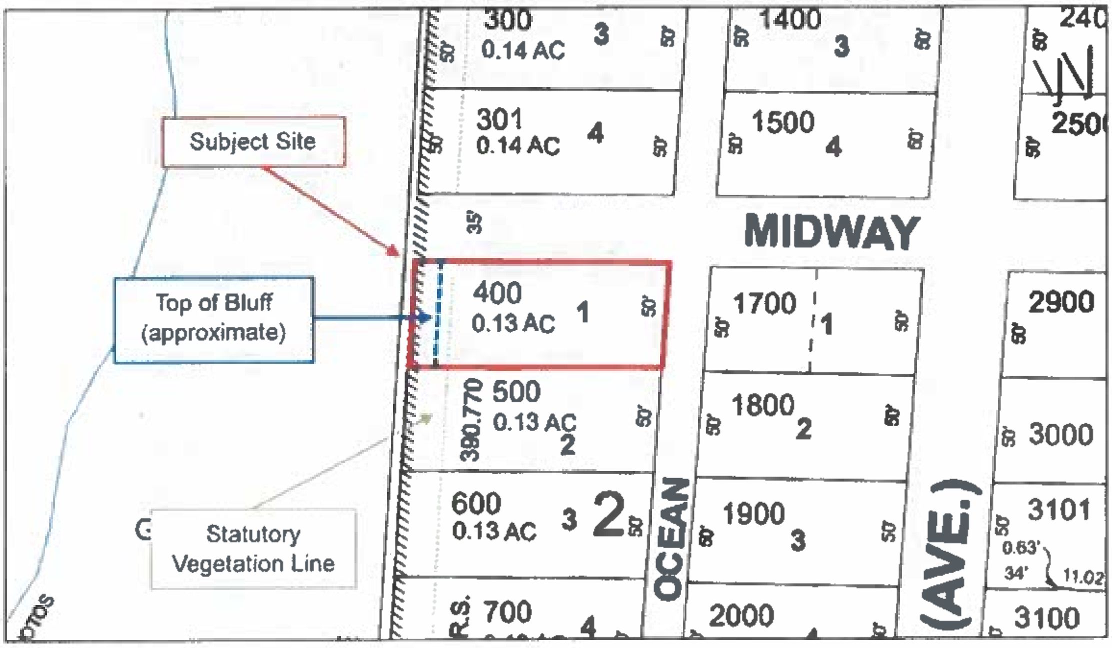


Figure 2: Tax lot survey of the project area (subject property outlined in red). Base map source: Clatsop County Tax Map.

Photo 1: Snapshot captured from a video showing water pooling on the subject property during an event with repetitive waves breaking over the bluff. The deck of the subject residence can be seen in the foreground.

Photo 2: Drift line showing extent that water pooled on the subject property after an event with repetitive waves breaking over the bluff. The subject residence can be seen in the background.

1.3 Purpose and Scope of Services

The purpose of our services was to review prior shoreline protection efforts, perform a site-specific subsurface investigation, and evaluate a range of shoreline protection alternatives in order to provide geotechnical related recommendations for the protection of the property's shoreline.

As stated above, we performed a site-specific investigation in order to explore the subsurface conditions at the site and better define the existing soil, rock, and groundwater properties. Our site investigation consisted of advancing 2 test pits (TP-1 and TP-2) supplemented with drive probe testing. The test pits were advanced on the beach, located adjacent to the subject bluff.

Grab samples were obtained from each stratum encountered in the test pits for laboratory testing. Laboratory testing was accomplished in general accordance with ASTM procedures.

This report briefly outlines the testing procedures, presents available project information, describes the site and subsurface conditions, and presents recommendations regarding the following:

- A discussion of subsurface conditions encountered including pertinent soil and rock properties.
- Qualitative (visual) assessment of bluff slope stability.
- 2022 Oregon Structural Specialty Code seismic design criteria.
- Geotechnical related recommendations and design for the proposed riprap revetment.
- Drafted cross-section and site plan showing the proposed SPS conditions at the subject property.
- Recommendations for riprap revetment foundation subgrade preparation.
- Discussions on geotechnical issues that may impact the project
- A detailed alternatives assessment evaluating each of the non-structural and structural shoreline protection described in the "Guidebook on Erosion Control Practices on the Oregon Coast".
- A discussion of other considerations related to the project such as project need, erosion factors, and public considerations for the use in the OPRD permit application.

Although not a part of our original scope of services outlined in our proposal, we performed a site visit with Tyler Blanchette of OPRD and Mike Morgan (referenced above) to get feedback regarding the anticipated permitting hurdles and concerns that OPRD has with the project. In addition, although not a part of our original scope of services, we subcontracted the preparation of a scaled site plan and cross-section of the proposed SPS, as these detailed drawings are required for permitting.

2.0 SITE AND SUBSURFACE CONDITIONS

2.1 Site Location and Description

The site for the proposed shoreline protection structure is located at 3915 Ocean Avenue, Cannon Beach, Oregon. The subject property is zoned Residential Moderate Density ("R1"). The property is bordered by single-family residences to the north and south, Ocean Avenue to the east, and the beach and the Pacific Ocean to the west. The site is located approximately 0.4 miles south of the Tolovana Beach State Recreation parking lot. Figure 1 above shows the project vicinity.

The property is currently occupied by an existing single family residential structure. The original residence on the subject property was demolished, and a new residence was constructed in its place in 2006. The subject property, however, was originally developed in 1940. As a result, the subject property is eligible for shoreline stabilization consistent with Goal 18 and the "Oregon Beach Bill," which require properties to be developed prior to January 1, 1977 to be eligible for shoreline stabilization, up to and including hard structural protection such as rip-rap revetments. The locations of existing Beachfront Protective Structures (also known as SPS) and eligibility for constructing future SPS are depicted on Figure 3 below. As shown in Figure 3 below, the length of properties immediately to the south of the subject property are currently armored with SPS.

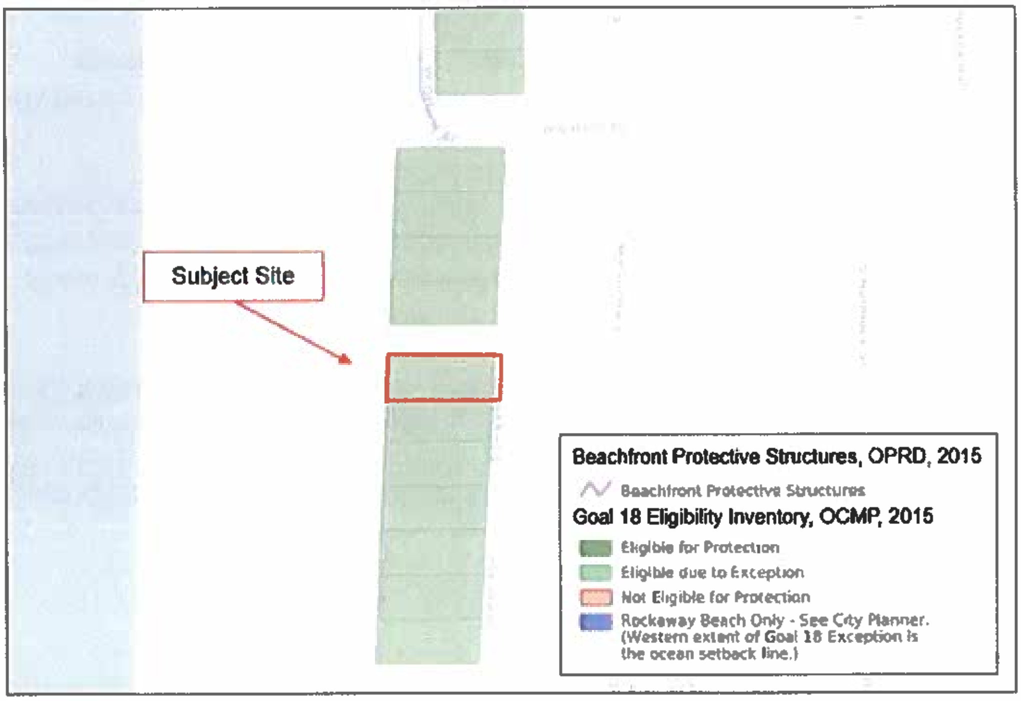


Figure 3: Existing Shoreline Armoring and Goal 18 Eligibility (base map source: Ocean Shores Viewer, Oregon Coastal Atlas; https://www.coastalatlas.net/oceanshores/).

As stated above, the subject bluff is located approximately 33 feet west of the existing residence, and 19 feet west of the existing porch. The natural ground elevation of the subject property decreases from the current top of bluff towards the residence. The oversteepened bluff slope stands at approximately 1H:1V (Horizontal:Vertical) to near-vertical. It should be noted, we consider soil slopes steeper than 2H:1V to be oversteepened and therefore prone to sloughing and erosion. This risk of erosion is further exacerbated as the sea level rises.

In addition, as stated above, the subject property is at low elevation point with respect to its vicinity. The subject property ranges in elevation from 19 to 25 feet above mean sea level (msl), with an elevation of 19 feet above msl along the western property line (i.e. the coastline). The elevation along the coastline generally increases to the north and to the south of the subject property. For reference, the elevation gradually increases to an elevation of 28 feet above msl approximately 375 feet north of the subject property and 30 feet above msl approximately 350 feet south of the subject property.

The condition of the property's coastline at the time of our initial site visit on April 20, 2023 is shown in Photo 3 below. During this site visit, we observed active erosion at the toe of the 5- to 7-foot-tall bluff. We also observed the bluff face was composed of light brown sand with silt and had become over-steepened due to continuous wave attack from the ocean. At the bluff toe, we also noted the presence of trace cobbles and angular rock, which we understand were previously placed as a limited, simplified dynamic revetment. According to available information, the volume of cobble placed was below permit-triggering thresholds (i.e., less than 50 cubic yards), with material placed on two separate occasions. This cobble placement followed a prior, unsuccessful attempt to stabilize the bluff using a vegetated berm, as described earlier.

We performed subsequent site visits on December 16, 2024 and February 11, 2025. The conditions of the property's coastline during those visits are shown in Photos 4 and 5 below. As illustrated in Photos 4 and 5, the bluff appears more undercut and steepened, with a more pronounced vertical face compared to the conditions observed in Photo 3 (April 2023), which showed greater vegetation cover and a relatively more stable slope profile. Additionally, the grasses and willows along the bluff crest appear to continue to retreat inland in Photos 4 and 5 relative to their positions in Photo 3, indicating active bluff edge retreat. Finally, the beach elevation in front of the bluff also appears lower and more scoured in Photos 4 and 5, which may contribute to increased exposure of the bluff toe to wave action and further erosion.

Photo 3: Site conditions observed during our initial visit on April 20, 2023, showing active erosion along the approximately 4- to 7-foot-tall bluff. Trace amounts of cobbles and angular rock placed at the toe of the bluff are also visible.

Photo 4: Site conditions at the time of a subsequent site visit on December 16, 2024, showing the continued erosion of the subject property's coastal bluff.

Photo 5: Site conditions at the time of a subsequent site visit on February 11, 2025, showing the continued erosion of the subject property's coastal bluff.

2.2 Mapped Soils and Geology

The project site is located on the lower west foothills of the Oregon Coast Range, specifically south of Cannon Beach (in between Tolovana State Park and Silver Park). The Oregon coast range is defined by a 30- to 40-mile-wide swath of moderately high mountains that span approximately 200 miles along the Pacific Coast. In general, the region has been uplifted as a result of plate convergence from the Cascadia subduction zone located about 150 to 200 km west of the coast range[1]. The region is underlain by a framework of Miocene aged (23 to 5 million years ago) volcanic rocks and Oligocene (33 to 23 million years ago) to Miocene aged marine sedimentary deposits that have been deposited over a basement rock of Eocene-aged (60 to 33 million years ago) volcanic arc deposits. Overlying this framework are Quaternary-aged (1.8 million years ago to present) marine terrace deposits, beach and dune deposits and landslide deposits.

[1] Kelsey, H.M., and J.G. Bockheim, Coastal landscape evolution as a function of eustasy and surface uplift rate, Cascadia margin, southern Oregon, Geol. Soc. Am. Bull., 106, 840-854, 1994.

The project area was mapped by Alan R. Niem and Wendy A. Niem, of the U.S. Geological Survey from 1972 to 1984. Within the project vicinity the underlying geologic unit is mapped as Quaternary (i.e. the past 2.58 million years) aged surficial deposits made up of mixed grained sediments. This unit consists of deposits of unconsolidated sediments including alluvium, colluvium, river and coastal terrace, landslide, glacial, eolian, beach, lacustrine, play and pluvial lake deposits, and outburst flood deposits. Beach sand from the Holocene (the past 11,000 years) has also been mapped within the vicinity of the project site[2].

The United States Department of Agriculture (USDA) Soil Survey provides geographical information of the soils in Clatsop County as well as summarizing various properties of the soils. The USDA shows the native soils on the site mostly mapped as Unit 28 – Humitropepts-Tropaquepts complex, 0 to 20 percent slopes.[3] This unit is formed on stream terraces from a parent material of alluvium derived from igneous and sedimentary rocks. A typical profile consists of silt to silty clay loam overlying fine sandy loam. The western portion of the property (from approximately the top of the bluff to the western property limit) is mapped as Unit 4 – Beaches. A typical profile consists entirely of stratified sand to gravel.

2.3 Geologic Hazards

The Oregon Department of Geology and Mineral Resources (DOGAMI) maps various geologic hazards such as 100-year flooding, earthquake ground shaking, coastal erosion, tsunamis, and landslides. DOGAMI presents hazard levels derived from this mapping in an interactive geographic information system (GIS), generally referred to as Oregon HazVu.[4] Hazvu presents the primary geologic hazard levels associated with the subject property as follows:

- Low to very high (active) coastal erosion hazard zones.
- Flood hazard area (FEMA 100-year floodplain).
- Tsunami inundation hazard area.
- Low to moderate landslide hazard area.
- Severe Cascadia earthquake expected shaking.
- Severe crustal earthquake expected shaking.
- High liquefaction (soft soil) hazard area.

Pertinent to this study, we describe the coastal erosion hazard in more detail below, as well as discussion of earthquake and landslide hazard risk levels for this property.

[2] Niem, A.R., and Niem, W., 1985, Geologic map of the Astoria Basin, Clatsop and northernmost Tillamook Counties, northwest Oregon: Portland, Oreg., Oregon Dept. of Geology and Mineral Industries Oil and Gas Investigation Map OGI-14, Plate 1, scale 1:100,000.

[3] Soil Survey Staff, Natural Resources Conservation Service, United States Department of Agriculture. Web Soil Survey. Available online at http://websoilsurvey.nrcs.usda.gov/ accessed 8/24/23.

[4] Oregon HazVu: Statewide Geohazards Viewer, available online at: http://www.oregongeology.org/sub/hazvu/ accessed 8/24/23.

2.3.1 Coastal Erosion Hazard

The primary purpose of this study is to address coastal erosion. We assessed the site location relative to the Oregon Department of Land Conservation and Development (DLCD) Coastal Erosion Hazard Zones. From east to west, the Oregon HazVu mapping shows that portions of the site fall within the low, moderate, high, and very high (active) coastal erosion hazard zones (see Figure 4). These hazard zones are based on estimated bluff recession distances and timeframes derived from historical erosion rates and projected future shoreline retreat. The Very High (Active) Hazard Zone represents areas of active beach erosion, while the High, Moderate, and Low Hazard Zones generally correspond to areas where the bluff could recede over progressively longer periods.

Figure 4: Coastal Erosion Hazard Zone provided by DOGAMI HazVU.

As shown on Figure 4, the subject property's bluff is mapped entirely within the Very High (Active) coastal erosion hazard zone. Mapping within this hazard zone indicates that the bluff is currently experiencing active erosion or is highly susceptible to continued erosion during future storm events. This designation reflects both documented shoreline change and anticipated future coastal processes affecting the site. As a result, the property faces a high risk of continued bluff retreat and erosion-related impacts if protective measures are not implemented.

During the past quarter century, there has been a general increase in ocean wave erosion observed along much of the Oregon coast, including Cannon Beach. This trend has been attributed to an increased frequency of relatively severe global climatic episodes, such as El Niño and La Niña periods, which result in stronger storms, elevated wave heights and more substantial beachfront erosion than what has been seen in prior recorded history. The severity and frequency of these episodes is expected to increase in the future, and there is near certainty that the rate of sea-level rise will also increase as a result of global warming.

Offsetting recent historical sea level rise, the regional tectonic processes on the northern Oregon coast result in emergence (gradual uplift). This negates the short-term effects of sea-level rise in areas like Cannon Beach. However, according to a national scale report prepared by the National Oceanic and Atmospheric Administration (NOAA), the sea level rise is outpacing the tectonic lift.[5] As a result, there will be more substantial impacts caused by the rising trend in future years compared to the past (along with the overall trending rate of sea level rise increases), exacerbating the coastal erosion impacts compared to what has been seen historically.

In addition to the climate changes, local factors also contribute to erosion intensity. The configuration of offshore reefs and currents can direct ocean waves to particular stretches of the beach in the form of rip embayments. Rip embayments can be particularly destructive in that they create deep troughs in the near-shore sand deposits, allowing waves to reach the bluffs and dunes backing the beaches with full energy. Rip embayments can set up at random locations and cause extensive destruction in short periods of time.

We reviewed a recent study by the U.S. Geological Survey as a part of a national shoreline change assessment (Ruggerio, et al., 2012), which evaluated historical shoreline change along the Pacific Northwest coast. The study analyzed long-term (i.e., approximately 100-year period) and short-term (i.e., approximately 30-year period) erosion and accretion trends across Oregon's 18 littoral cells. Most regions exhibited either stable or accreting shorelines, with only a few areas showing statistically significant long-term erosion (i.e. rates between 1.3 and 1.6 feet per year).[6] In the Cannon Beach littoral cell, the long-term average shoreline change rate was recorded as +0.65 feet per year (net accretion), with a maximum historical erosion rate of 1.6 feet per year. However, more recent data indicate that erosion rates have increased significantly in many locations, including the Cannon Beach littoral cell. In this region, short-term erosion rates average approximately 1.6 feet per year, with maximum observed short-term erosion rates up to 7.8 feet per year.[7] This increase in rates of erosion in the Cannon Beach area are likely related to the effects of sea-level rise and storm patterns, underscoring the growing vulnerability of the Cannon Beach shoreline.

Importantly, erosion in Cannon Beach does not always occur gradually. Instead, it often manifests in episodic events during severe coastal storms – particularly those associated with El Niño or La Niña climatic cycles. These high-energy events can cause sudden bluff undercutting, rapid collapse of vertical bluff faces, and flooding from wave overtopping. Such episodic retreat poses a significant hazard to properties located along the bluff and underscores the need for durable shoreline protection measures. Bluff retreat at the site is expected to occur episodically during high-energy storm events, where rapid undercutting and localized collapse may occur over short durations rather than through uniform gradual erosion.

[5] Sweet, W.V., et al. 2022. Global and Regional Sea Level Rise Scenarios for the United States: Updated Mean Projections and Extreme Water Level Probabilities Along U.S. Coastlines. NOAA Technical Report. National Oceanic and Atmospheric Administration, National Ocean Service, Silver Spring, MD.

[6] Ruggiero, P., M.G. Kratzmann, E.A. Himmelstoss, D. Reid, J. Allan, and G. Kaminsky. 2013. National assessment of shoreline change—historical shoreline change along the Pacific Northwest coast. U.S. Geological Survey Open-File Report 2012–1007: 29.

[7] Ibid, 30.

The subject property (i.e. Clatsop County Tax Lot No. 400) has been exposed to the erosion cycles noted above. At the subject project vicinity (i.e. south of Tolovana Beach State Park and north of Silver Point), short-term erosion-rates recorded by the U.S. Geological Survey shoreline assessment referenced above range between 1.6 feet and 6 feet per year.[8] We understand that the subject property has experienced approximately 5 feet of erosion in 10 years. despite repeated by the property owners attempts to protect the shoreline during that time (i.e. erosion occurred while concurrent mitigation was conducted, and therefore the erosion rate of an unmitigated shoreline at this location would have been inherently greater than the observed erosion rate).

Based on observed site conditions, documented historical retreat, nearby shoreline behavior, and published regional shoreline change data, continued bluff recession on the order of approximately 15 feet or greater over a 10-year period is predicted in the absence of effective shoreline protection. It should be noted, this estimate does not take into account the continued anticipated increasing impacts from climate change.

In the absence of adequate shoreline protection at the subject property, the erosion has occurred in the form of episodic bluff undercutting. As shown in Figure 3 above, several adjacent properties are protected by an SPS. Our experience with bluff erosion in the Cannon Beach area, as well as our field observations on this site, indicate that erosion at the site is not gradual, but instead occurs during high-energy wave events, resulting in rapid undercutting of the bluff and formation of a near-vertical bluff face. The fine-grained soils will temporarily stand in this configuration; however, without protection, the bluff soils will soon collapse at their natural angle of repose (approximately 2H:1V), triggering immediate and more substantial recession of the disturbed soil back to the new bluff crest.

Additionally, the natural ground surface at the subject property slopes downward from the top of the existing bluff face toward the residence. As erosion continues and the bluff face retreats, the elevation of the bluff will decrease, further exposing the property to wave overtopping and increasing its susceptibility to flooding. This flood risk is detailed in Section 2.3.2 below.

It is our opinion that unless the bluff base is stabilized and shielded from wave attack, slope regression and flooding will continue on the subject property. As the bluff continues to recede and water continues to break over the top of the low bluff (as shown in Photo 1 above), the flooding issue on the subject property will be exacerbated. Ultimately, in the absence of effective, permanent shoreline protection, there is an increased risk that the flooding will cause structural damage (i.e. settlement caused by saturated subgrade).

2.3.2 Flood Hazard

As stated above, the subject property is located at a low elevation point relative to surrounding properties along the shoreline. This topographic positioning makes it especially vulnerable to wave overtopping and flooding during winter storms and other high tide events.

[8] Ibid, 45.

According to the FEMA Flood Insurance Rate Map (FIRM)[9], the subject property is located within Flood Zone VE (also referred to as a "Coastal High Hazard Area"). See Figure 5 below. Zone VE is designated for areas subject not only to inundation by the 1% annual chance flood (also known as the 100-year floodplain, as mapped by HazVu), but also to additional hazards associated with high-velocity wave action and hydrodynamic loading. Unlike standard floodplain mapping, the VE designation reflects both inundation and the destructive forces associated with moving water and breaking waves.

The Base Flood Elevation (BFE) mapped for this site is approximately 26 feet NAVD88. This designation underscores the risk of extreme flooding and wave damage at this location. In addition to inundation hazards, FEMA Zone VE conditions also imply increased exposure to wave velocity forces, debris transport, localized scour, and hydrodynamic impacts during coastal storm events.

Figure 5: FEMA mapping showing the flood hazard layer in the project vicinity.

Furthermore, FEMA's Limit of Moderate Wave Action (LiMWA) boundary intersects the property, identifying it as one of the few in the vicinity exposed to waves greater than 1.5 feet in height during flood events. This wave height threshold is significant, as it has historically been associated with increased damage to structures.

[9] FEMA, 2018, Flood Insurance Rate Map (FIRM) Panel 41007C0652F, Clatsop County, Oregon and Incorporated Areas. Federal Emergency Management Agency. Effective June 20, 2018. Available online at: https://msc.fema.gov/portal/home, accessed 5/1/2025.

Accordingly, the flooding hazard at the property is not static. As the bluff continues to erode, retreat, steepen, and lower in elevation, the limited natural barrier between the ocean and the residence is progressively reduced, increasing the frequency and severity of wave runup, overtopping, and flooding at the property during storm events.

These conditions make the property exceptionally vulnerable to damage during storm events, particularly as the bluff continues to erode. As detailed in Section 1.2 above, wave overtopping and flooding have already been observed at the site, resulting in ponding of seawater near the residential structure foundations. With continued bluff recession, lowering of the bluff elevation, sea level rise, and progressive inland migration of wave runup, the potential for floodwaters to reach and damage the residence foundations increases significantly. Unlike many shoreline stabilization projects that are intended primarily to address anticipated future conditions, wave overtopping and flooding have already been documented at the subject property. In our opinion, the proposed SPS is intended to prevent the progressive worsening of these existing conditions as bluff erosion continues.

Floodwaters do not need to enter the residence itself to cause substantial damage. Saturation of the underlying foundation soils may reduce vertical bearing capacity, contribute to localized scour and loss of soil support, and decrease overall subgrade strength beneath the structural footings. Repeated exposure to seawater and coastal flooding may also accelerate deterioration of foundation materials and reduce the long-term durability of the foundation materials. These coastal flood hazards are particularly significant at the property because the residence is supported on soils that may become destabilized by repeated flooding, saturation, scour, and wave impacts. The impacts of flooding on the residential foundations from a geotechnical perspective are discussed in more detail in Section 3.1 below.

It should also be noted, the natural ground elevation of the subject property decreases from the current top of bluff towards the residence. With the continued retreat of the bluff, reduced resultant elevation of the bluff face, and the eastward movement of wave runup, the risk of structural damage to the existing residence is significantly increased.

Given the proximity to the shoreline and low elevation of the site, the potential for flooding remains a significant hazard, particularly during storm surge events, king tides, and long-term sea level rise. While there are existing flooding concerns, the primary goal of the proposed SPS is to prevent conditions from worsening. By halting ongoing bluff erosion, the project aims to maintain the current flood risk conditions, rather than allowing erosion to progress and increase the potential, frequency, and severity of flooding over time.

The riprap revetment recommended in this report will play a critical role in stabilizing the bluff, reducing wave run-up, and minimizing further landward retreat of the shoreline. This will help mitigate the risk of damage to the residence and surrounding infrastructure. By preserving the current site conditions, the SPS will help safeguard the long-term safety and viability of the property.

certerra.com 2411 NE 8th Avenue, Camas, WA 98607 T: 360.567.1806

2.3.3 Earthquake and Tsunami Hazard

Oregon's position at the western margin of the North American Plate and its location relative to the Pacific and Juan de Fuca plates have had a major impact on the geologic development of the state. The interaction of the three plates has created a complex set of stress regimes that influence the tectonic activity of the state. The western part of Oregon is heavily impacted by the influence of the active subduction zone formed by the Juan de Fuca Oceanic Plate converging upon and subducting beneath the North American Continental Plate off the Oregon coastline.

The Cascadia Subduction Zone, located approximately 100 kilometers off of the Oregon and Washington coasts, is a potential source of earthquakes large enough to cause significant ground shaking at the subject site. Research over the last several years has shown that this offshore fault zone has repeatedly produced large earthquakes, on average, every 300 to 700 years. It is generally understood that the last great Cascadia Subduction Zone earthquake occurred about 300 years ago, in 1700 AD. Although researchers do not necessarily agree on the likely magnitude, it is widely believed that an earthquake moment magnitude (M_w) of 8.5 to 9.5 is possible. The duration of strong ground shaking is estimated to be greater than 1 minute, with minor shaking lasting on the order of several minutes.

Additionally, earthquakes resulting from movement in upper plate local faults are considered a possibility. Crustal earthquakes are relatively shallow, occurring within 10 to 20 kilometers of the surface. Oregon has experienced at least two significant crustal earthquakes in the past decade—the Scotts Mills (Mt. Angel) earthquake (M_w 5.6) on March 25, 1993 and the Klamath Falls earthquake (M_w 5.9) on September 20, 1993. Based on limited data available in Oregon, it would be reasonable to assume a M_w 6.0 to 6.5 crustal earthquake may occur in Oregon every 500 years (recurrence rate of 10 percent in 50 years). There are no mapped crustal faults in the immediate vicinity of the property, but there is a marine crustal fault approximately 3.7 miles northwest of the property[10]. It is possible that there are faults present that are not currently mapped.

A Cascadia Subduction Zone earthquake or other strong seismic event could result in severe seismic ground shaking on the subject property lasting for several minutes. Based on geologic deposits from past CSZ earthquake it is possible that broad areas of the coastline, including the low lying town of Seaside, could experience rapid co-seismic subsidence or down dropping as accumulated tectonic stress is released during the earthquake. Many low-lying coastal areas may subside below sea level or into flood ways of estuaries and tsunamis, which could change erosional patterns of the area. A subduction zone earthquake would also likely result in soil liquefaction and lateral spreading in loose, saturated sand deposits along the coast and bays.

[10] USGS U.S. Quaternary Faults Interactive Map, https://usgs.maps.arcgis.com/apps/webappviewer/index.html?id=5a6038b3a1684561a9b0aadf88412fcf.

We reviewed the Tsunami Inundation Map for Cannon Beach, Oregon[11] for information on the tsunami hazard in the project vicinity. The map shows that this property, along with nearly all of the other beachfront properties in this part of Cannon Beach, is mapped within the tsunami inundation zone (represented by dark purple, light purple, and yellow shaded areas in Figure 6 below). Notably, this site is located at a low-lying elevation relative to the surrounding properties, making it more vulnerable to tsunami impacts (as shown in the mapping), exemplifying the heightened flooding risk conditions present at this location compared to other areas in Cannon Beach.

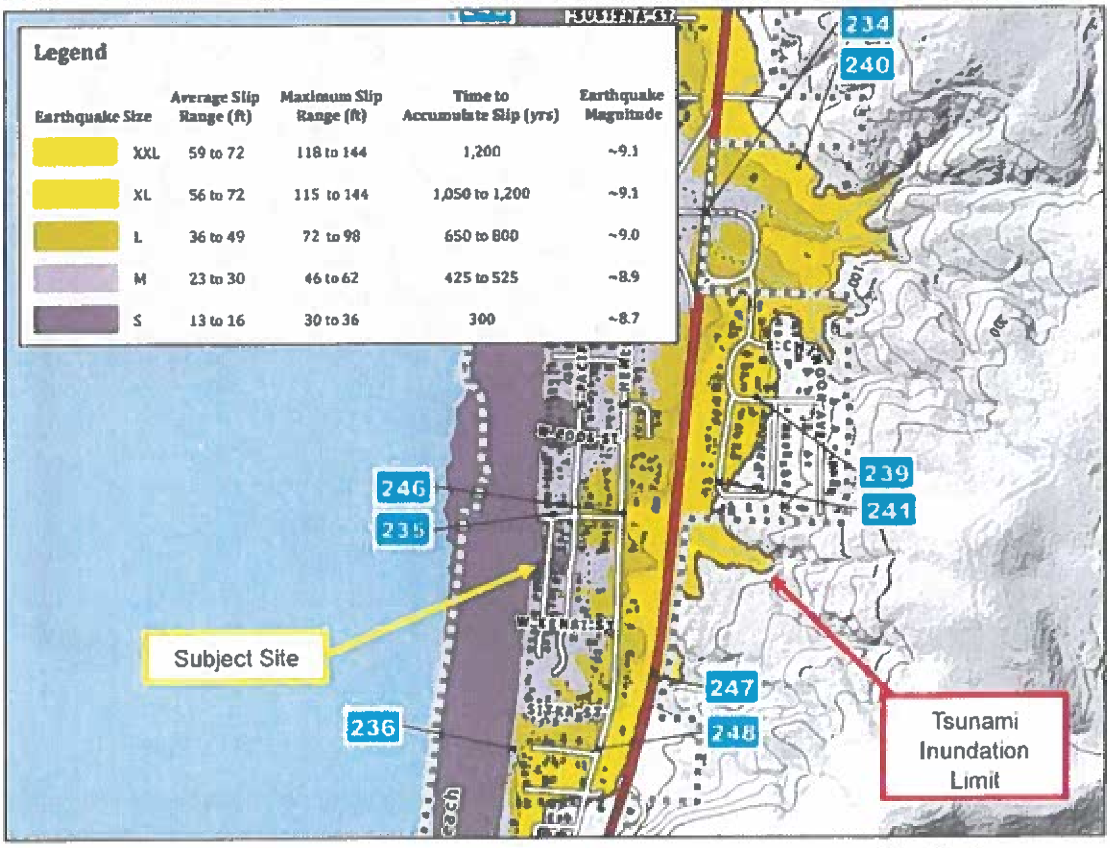


Figure 6: Tsunami hazard map for Cannon Beach provided by DOGAMI. The dark purple shading indicates the area expected to be generated by a "small-sized" Cascadia Subduction Zone Earthquake (earthquake magnitude ~8.7).

[11] Zhang, J., 2013, Local Source (Cascadia Subduction Zone) Tsunami Inundation Map, Cannon Beach, Oregon. Oregon Dept. of Geology and Mineral Industries Tsunami Inundation Map TIM-Clat-09, Plate 1, scale 1:12,000. Available online at: https://pubs.oregon.gov/dogami/tim/p-TIM-Clat-09.htm accessed 8/25/23.

As stated above, Oregon HazVu mapping indicates the subject property is mapped in a high liquefaction susceptibility area, shown in Figure 7 below. Based on our investigation, we anticipate the sandy soils in the project area to be liquefiable due to the presence of shallow groundwater. The subsurface conditions encountered in our investigation are discussed in further detail below.

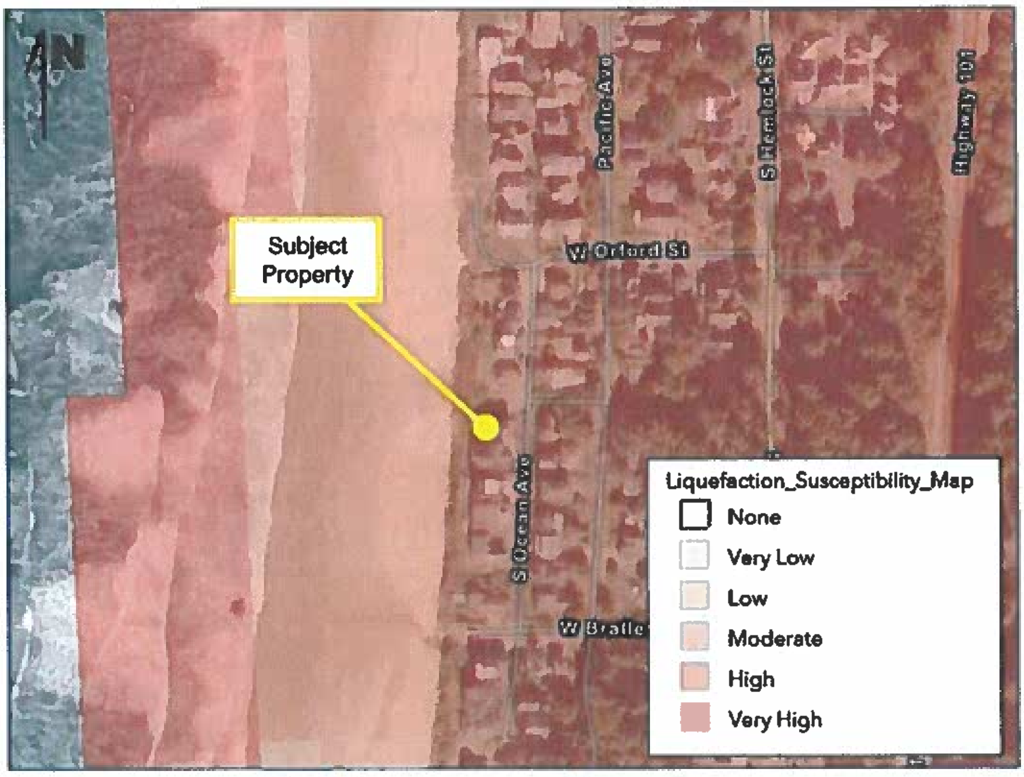


Figure 7: Liquefaction Hazard Zone provided by DOGAMI HazVu.

2.3.4 Landslide Hazard

As stated above, we reviewed DOGAMI's HazVu database which indicated that the property is mapped within a low to moderate landslide hazard area. In addition, the database maps the subject property adjacent to a mapped landslide fan. See Figure 8 below.

We also reviewed the DOGAMI Statewide Landslide Information Layer for Oregon (SLIDO) for more information on landslides in the project vicinity. Unlike HazVu, SLIDO does not map the subject property within an existing landslide fan. See Figure 9 below. The nearest mapped landslide is located approximately 0.2 miles south of the subject property.

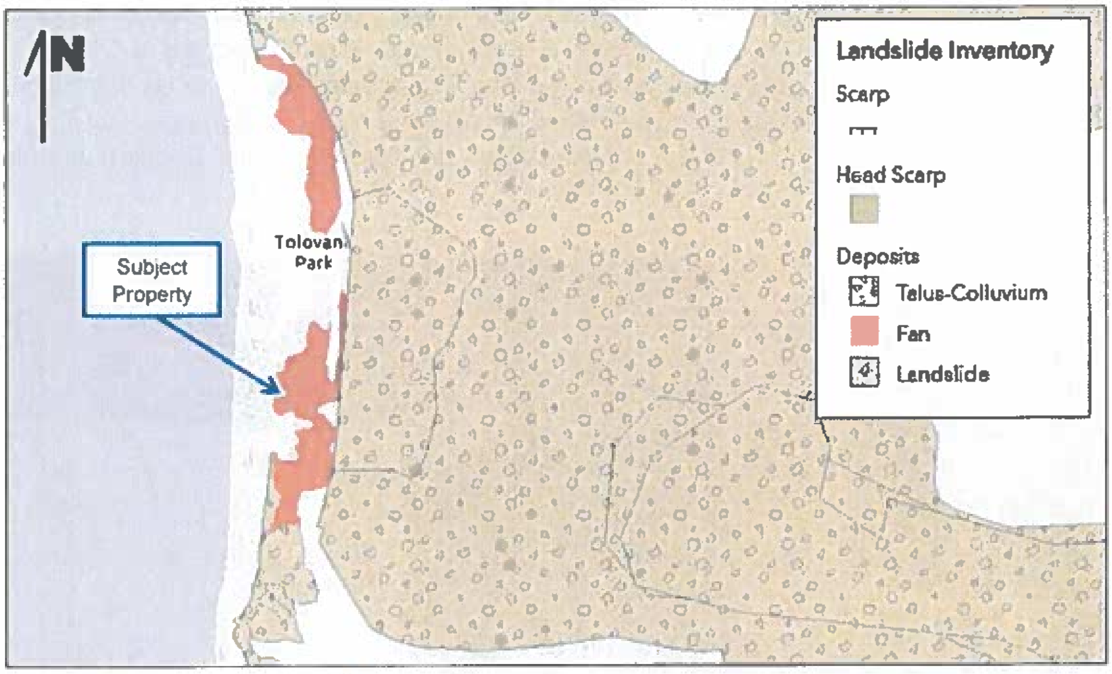


Figure 8: DOGAMI HaZvu database mapped landslides in the project vicinity.

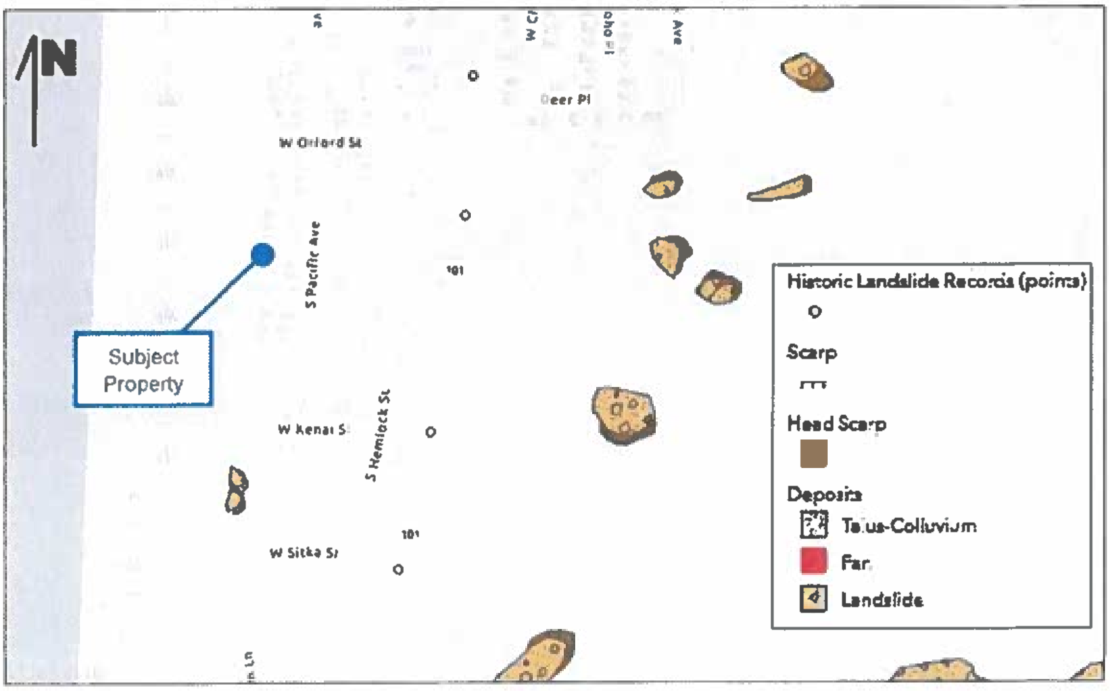


Figure 9: DOGAMI SLIDO database mapped landslides in the project vicinity.

We also reviewed publicly available reports that reference the project vicinity and the mapped landslide hazard risk. A report prepared by the Oregon Department of Geology and Mineral Industries (DOGAMI) provides mapping of the geology in Southern Clatsop County. The mapping indicates that alluvial fan deposits (Unit Qpf) and coastal terrace deposits (Unit Qpt) are present along the marine terrace of this property and in its vicinity.[12] The property is mapped partially on Unit Qpf and partially on Unit Qpt. See Figure 10 below and the legend describing each geologic unit.

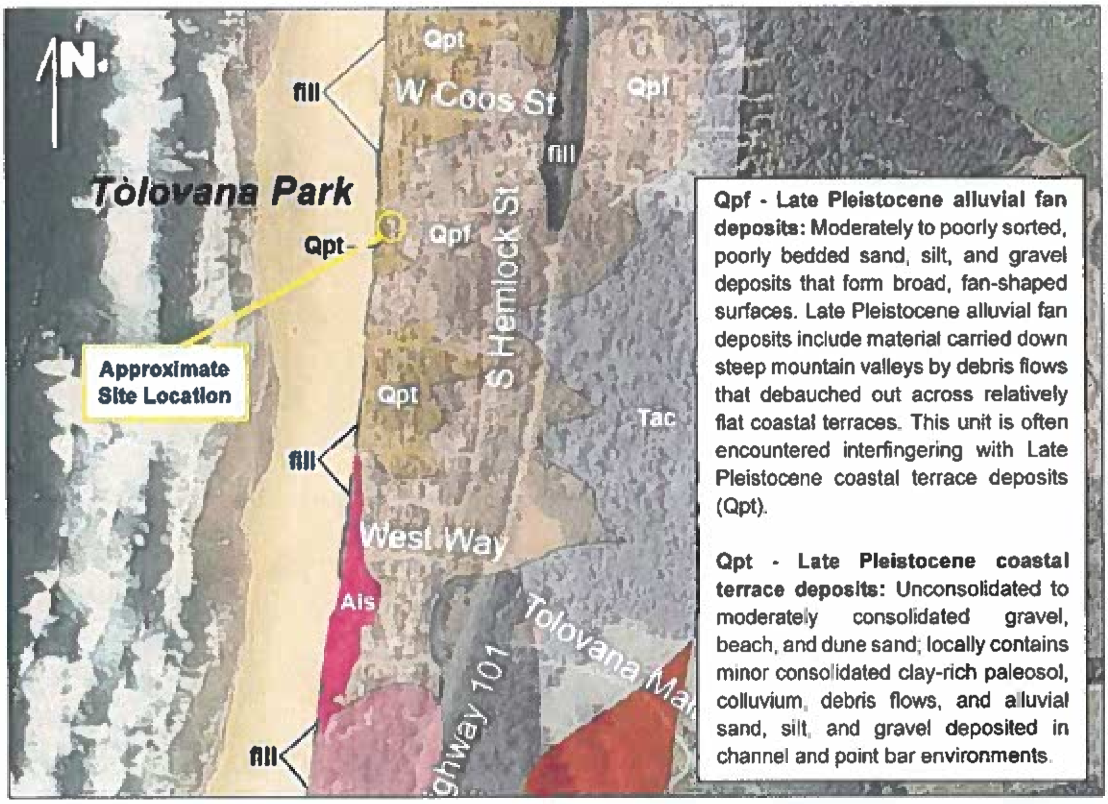


Figure 10: Local geology in the project vicinity (reference: DOGAMI Open-File Report 0-09-06).

Given the observed soil and rock units on the property and our visual observations of site conditions, we recommend that landslide risk for this property is relatively low (with the exception of the localized slumping of the bluff due to wave attack and coastal erosion).

[12] Allan, J.C., Horning, T., and Witter, R.C., 2009, "Coastal Erosion Hazard Zones in Southern Clatsop County, Oregon: Seaside to Cape Falcon", State of Oregon Department of Geology and Mineral Industries, Open-File Report 0-2009-06.

2.4 Subsurface Materials

The site was explored with two test pit explorations (TP-1 and TP-2) located immediately west of the bluff on the subject property. The test pits were excavated to depths ranging from 10 to 12 feet below ground surface (bgs). For approximate exploration locations see the Exploration Location Plan in Appendix B. The test pits were advanced by Bob McEwan Construction using an excavator with a 2-foot wide toothed bucket. Soil samples were collected at the discretion of the Geotechnical Engineer's representative and transported to our laboratory for testing.

We supplemented TP-1 with drive probe testing. The drive probe testing extended to a depth of 12 feet bgs. The drive probe test is based on a "relative density" exploration device used to determine the distribution and to estimate strength of the subsurface soil units. The resistance to penetration is measured in blows-per-½-foot of an 11-pound hammer which free falls roughly 39 inches driving a 3/4-inch outside diameter pipe with a 1-inch diameter endcap into the ground. This measure of resistance to penetration can be used to estimate relative density of soils. For a more detailed description of this geotechnical exploration method, please refer to the Slope Stability Reference Guide for National Forests in the United States, Volume I, USDA, EM-7170-13, August 1994, P 317-321. Results of the drive probe tests are reported in Appendix C.

Select soil samples were tested in the laboratory to determine material properties for our evaluation. Laboratory testing was accomplished in general accordance with ASTM procedures. The testing performed included moisture content testing (ASTM D2216), fines content determination (ASTM D1140), particle size distribution (ASTM D 6913), and Atterberg limits testing (ASTM D4318). The test results have been included on the Exploration Logs in Appendix C, the Particle Size Distribution Report in Appendix E, and the Report of Atterberg Limits Testing in Appendix F.

In general, we encountered a surficial layer of beach sand overlying clayey silt overlying sand which extended to the terminal depths of the explorations. Each of the strata we encountered in our explorations are described below:

SURFICIAL LAYER

In both of our explorations, we encountered beach sand as the surficial layer. This stratum was generally a brown to gray beach sand with trace fines. Laboratory moisture content testing on samples obtained within this stratum ranged from 3 to 4 percent indicating a dry condition. Fines content laboratory testing for a sample obtained within this stratum yielded a result of 0.3 percent passing the #200 sieve. Based on drive probe testing and excavator digging effort, this stratum was generally loose. This stratum extended to a depth of 1.5 feet bgs in both our explorations.

FINE-GRAINED SOILS

Underlying the surficial layer described above, we encountered layers of fine-grained soils in both explorations. This stratum was generally a brown to gray clayey silt with orange mottling. Laboratory moisture content testing on samples obtained within this stratum ranged from 44 to 60 percent indicating a moist to wet condition. Fines content laboratory testing for a sample obtained within this stratum yielded a result of 90 percent passing the #200 sieve. We also conducted Atterberg limits testing on a sample obtained within this stratum which indicated that the material is a low plasticity silt (ML). Based on drive probe testing and excavator digging effort, this stratum was generally soft to very stiff. This stratum extended to depths ranging from 3 to 6 feet bgs.

COARSE-GRAINED SOILS

Underlying the layers described above, we encountered layers of coarse-grained soils in our explorations. In TP-1, we encountered a silty sand underlying the clayey silt described above. This stratum was generally a brown-gray silty sand with organics (wood chips). The presence of organics indicates that this is possibly old landslide debris. Laboratory moisture content testing on samples obtained within this stratum ranged from 35 to 43 percent indicating a moist to wet condition. Fines content laboratory testing for a sample obtained within this stratum yielded a result of 48 percent passing the #200 sieve. Based on drive probe testing and excavator digging effort, this stratum was generally medium dense to dense. This stratum extended to a depth of 10 feet bgs in TP-1. We did not encounter this stratum in TP-2.

Both of our explorations terminated in a poorly graded sand stratum. In TP-1, this stratum was underlying the silty sand described above. In TP-2, this stratum was underlying the clayey silt described above. This stratum was generally a blue-gray to brown to gray sand with trace silt. Laboratory moisture content testing on samples obtained within this stratum ranged from 30 to 36 percent indicating a wet to saturated condition. Fines content laboratory testing for samples obtained within this stratum ranged from 4 to 5 percent passing the #200 sieve. Based on drive probe testing and excavator digging effort, this stratum was generally medium dense to dense. This stratum extended to a depth of 12 feet bgs in TP-1 and 10 feet bgs in TP-2.

The classifications noted above were made in accordance with the Unified Soil Classification System (USCS) as shown in Appendix D. The above subsurface description is of a generalized nature to highlight the major subsurface stratification features and material characteristics. The exploration logs included in Appendix C should be reviewed for specific information at specific locations. These records include soil descriptions, stratifications, and locations of the samples. The stratifications shown on the logs represent the conditions only at the actual exploration locations. The stratifications represent the approximate boundary between subsurface materials and the actual transition may be gradual. Water level information obtained during field operations is also shown on these logs.

2.5 Groundwater Information

We encountered groundwater at depth of approximately 10 feet bgs in TP-1 at the time of our explorations. We did not encounter groundwater in TP-2.

We reviewed publicly available well logs from the Oregon Water Resources Department website (http://apps.wrd.state.or.us/apps/gw/well_log/) for historic information. We found historical logs advanced on July 25, 2001 for a property located approximately 0.6 miles north of the subject property at approximately the same elevation. The logs indicates that a static groundwater level was measured to be at a depth of 8.5 and 9 feet bgs. See Appendix G for a copy of the well logs.

It should be noted that groundwater conditions can fluctuate based on changes in land use, seasonally changing climatic conditions, and/or ocean tidal conditions.

2.6 Seismicity

In accordance with ASCE 7-16 we recommend a Site Class D (stiff soil profile with an average standard penetration resistance of 15 to 50 blows per foot) when considering the average of the upper 100 feet of bearing material beneath the surface. This recommendation is based on the drive probe blow counts, excavator digging difficulty, and our knowledge of the local subsurface and geologic conditions.

Inputting our recommended Site Class as well as the site latitude and longitude into the Structural Engineers Association of California (SEAOC) – OSHPD Seismic Design Maps website (http://seismicmaps.org) which is based on the United States Geological Survey, we obtained the seismic design parameters shown in Table 1 below. Note that the values for F_a and F_v in Table 1 were obtained from ASCE's Supplement 3 dated November 5, 2021 and issued for ASCE 7-16 to correct some seismic design issues in the original publication.

Table 1: Seismic Design Parameter Recommendations (ASCE 7-16, including Supplement 3 dated November 5, 2021)

PARAMETER	RECOMMENDATION
Site Class	D
S_s	1.314g
S_1	0.690g
F_a	1.000
F_v	1.700
S_{MS} (=S_s x F_a)	1.314g
S_{M1} (=S_1 x F_v)	1.173g
S_{DS} (=2/3 x S_s x F_a)	0.876g
S_{D1} (=2/3 x S_1 x F_v)	0.782g
Design PGA (=S_{DS} / 2.5)	0.350g
MCE_G PGA	0.662g
F_{PGA}	1.100
PGA_M (=MCE_G PGA x F_{PGA})	0.728g

Note: Site latitude = 45.866530, longitude = - 123.961892

The return interval for the ground motions reported in the table above is 2 percent probability of exceedance in 50 years.

Per Section 11.4.8 of ASCE 7-16, a site-specific ground motion hazard analysis shall be performed in accordance with Section 21.2 for the following conditions:

1. Structures on Site Class D sites with S_1 greater than or equal to 0.2g.

   Exception: ASCE 7-16 does not require a site-specific ground motion hazard analysis when the value of S_{M1} is elected to be increased by 50% for all applications of S_{M1} by the Structural Engineer. If S_{M1} is increased by 50% to avoid having to perform the seismic response analysis, then the resulting value of S_{D1} shall be equal to 2/3 * [1.5*S_{M1}]).

2. Structures on Site Class E sites with values of S_s greater than or equal to 1.0, or values of S_1 greater than or equal to 0.2.

   Exception: ASCE 7-16 does not require a site-specific ground motion hazard analysis when:
   1. The Structural Engineer uses the equivalent lateral force design procedure and the value of Cs is determined by Eq. 12.8-2 for all values of T, or
   2. Where (i) the value of S_{ai} is determined by Eq. 15.7-7 for all values of T_i, and (ii) the value of the parameter S_{D1} is replaced with 1.5*S_{D1} in Eq. 15.7-10 and 15.7-11.

We classified this site as Site Class D. Because the S_1 value is greater than 0.2g as shown in Table 1 above, a ground motion hazard analysis is required unless the design engineer elects to increase the S_{M1} value by 50 percent (which results in also increasing the S_{D1} value by 50 percent). If the design engineer elects not to utilize the 50 percent increase on S_{M1} and S_{D1}, then Certerra should be retained to perform a site-specific ground motion hazard analysis in accordance with Section 21.2 of ASCE 7-16. We do not anticipate that a site-specific ground motion hazard analysis will be required for this project.

3.0 GEOTECHNICAL EVALUATION AND RECOMMENDATIONS

3.1 Geotechnical Discussion

Based on the information provided to us, as well as our subsurface investigation and literature review, it is our professional opinion that the primary factors influencing the stability of the bluff slope, as well as future impacts to the property and existing structures, include the following:

1. **Erosional Retreat** – Coastal erosion is the primary hazard to this property, including erosion from tidal and wave impacts during seasonal extremes. Past efforts, such as implementing a vegetated berm and the placement of cobbles, have been insufficient in preventing erosion along the property's shoreline. Despite these measures to actively stop the erosion, we understand that the subject bluff has receded approximately 5 feet in the past decade. Without adequate shoreline protection, a conservative estimate indicates a site-specific rate of bluff retreat of approximately 16 feet per decade (based on the short-term erosion rates for the project area referenced in Section 2.3.1 above).

   The subject property, situated at a relatively low elevation compared to neighboring properties, is susceptible to flooding during events where repetitive waves breach the property's relatively low bluff (refer to Photo 1). In addition, the natural ground elevation of the subject property decreases from the current top of bluff towards the residence. With the continued retreat of the bluff, reduced resultant elevation of the bluff face, and the eastward movement of wave runup, the risk of structural damage to the existing residence is significantly increased. The impacts of flooding on the residence are detailed below.

   Given the property's erosion history and potential, low elevation, and vulnerability to flooding caused by wave runup, coupled with the previous ineffective attempts to safeguard the shoreline, there is a reasonable need for robust permanent shoreline protection. This protection aims to stabilize the bluff base, shield the property from wave impacts, and mitigate ongoing undercutting. In addition, halting erosion of the subject bluff will decrease the potential, frequency, and severity of flooding over time. On that basis, we recommend armoring the shoreline with riprap. After the implementation of the proposed SPS, the erosion rates along the property's bluff will be negligible, thereby reducing the progressive increase in flooding risk that would otherwise occur as the bluff continues to erode.

   It is important to note that while the riprap revetment is designed for durability, coastal processes are inherently dynamic. Without regular monitoring and maintenance, riprap structures are susceptible to damage from persistent wave activity. However, with proper upkeep and timely repairs, erosion below the top elevation of the revetment can be effectively minimized.

2. **Regional Seismic Hazard** – Peripheral to the coastal erosion hazard, the change in conditions that would result from a regional seismic event would likely exacerbate coastal erosion impacts. Abundant evidence indicates that a series of large earthquake related to the Cascadia Subduction Zone (CSZ) have occurred

along the coastline of the Pacific Northwest over thousands of years. The Oregon Department of Emergency Management reports on their website that the calculated possibility of a CSZ earthquake will occur in the next 50 years ranges from 7 to 15 percent for a great earthquake affecting the entire Pacific Northwest, to about 37 percent for a major earthquake influencing the southern end of the subduction zone. It is our professional opinion, the proposed project will not contribute to or exacerbate regional seismic hazards.

A CSZ earthquake or other strong seismic event could trigger a tsunami, potentially damaging the proposed riprap revetment. In addition, a design level earthquake could result in severe seismic ground shaking on the subject property lasting for several minutes. Based on geologic deposits from past CSZ earthquake it is possible that broad areas of the coastline could experience rapid co-seismic subsidence or down dropping as accumulated tectonic stress is released during the earthquake. Many low-lying coastal areas may subside below sea level or into flood ways of estuaries and tsunamis, which could change erosional patterns of the area. A subduction zone earthquake would also likely result in soil liquefaction and lateral spreading in loose, saturated sand deposits along the coast and bays.

3. **Climate Change** – Also peripheral to the coastal erosion hazard, climate change will likely contribute to increased coastal erosion and impacts to the properties. Despite offsetting effects of tectonic uplift, sea levels are rising on the northern Oregon coast and global climate models are projecting increasing rates of rise in the future (Guidebook on Erosion Control Practices on the Oregon Coast, State of Oregon Department of Land Conservation and Development [DLCD], 2021). The potential impacts of sea level rise on the subject properties include flooding, increased wave heights, and erosion of the beach and dune slopes. Similar to seismic considerations, climate change will exacerbate the existing erosion susceptibility of the properties. This further supports the need for a robust structural shoreline protection solution, such as riprap, for these properties.

   The impacts of climate change will likely necessitate increased monitoring and maintenance of the revetment to ensure its continued effectiveness. The proposed project aligns with these considerations and will not negatively affect the evolving hazard conditions. Instead, it provides a proactive solution to safeguard the subject properties against future climate-driven challenges.

4. **Impacts of flooding on residence foundations** – As stated above, flooding has been observed on the subject property as a result of wave overtopping and the relatively low elevation the property sits at. From a geotechnical perspective, continued erosion of the bluff will increase the risk of wave overtopping and flooding frequency and severity, which has a negative impact to the existing residence foundations.

   It is our understanding that the existing residence on the subject property is supported by traditional spread footing foundations. Based on our investigation and understanding of the area, we assume the residence foundations are bearing on sandy soils. The potential for flooding, particularly during storm surge events and repetitive wave run-up, poses a significant risk to the long-term integrity of these foundations. This is because floodwaters and repeated wave overtopping may saturate and locally scour the supporting soils. This leads to a reduction in vertical bearing capacity, creation of voids, and loss of soil subgrade strength beneath the structural footings.

Of particular concern is differential settlement, where portions of the foundation system may settle due to the flood-impacted soils (e.g., on the western side of the house) while other foundation segments remain supported. This phenomenon typically results in progressive or catastrophic structural distress, such as cracking of foundation elements (e.g., footings and stem walls), floor sloping, damaged interior elements (e.g., cracked sheetrock, masonry, etc.), door and/or window misalignment, and ultimately irreversible structural damage.

In addition to settlement, additional concerns associated with flooding include:

- Erosion of Foundation Soils: Flooding can wash away the soils that support or surround the residence foundation. This can lead to undermining, where voids form under the footing, leaving portions of the foundation unsupported ultimately compromising the structural stability of the residence.

- Loss of Lateral Support: Foundations rely not only on vertical bearing, but also on lateral confinement from surrounding soils. Saturated or eroded soils provide less resistance to lateral movement, especially during wind or seismic events.

- Corrosion of Embedded Materials: Floodwaters can corrode steel reinforcement within concrete footings or attached structural hardware. Over time, this can degrade the structural integrity of the foundation system and shortens its service life.

As the bluff continues to erode and recede eastward toward the residence, the potential for wave overtopping, flooding, and foundation subgrade saturation increases. Installing a SPS now, before additional bluff retreat, significantly reduces these risks. Maintaining the current horizontal buffer between the bluff face and the structure is critical; waiting to install protection until the bluff encroaches further would escalate the potential for flooding-related damage.

This rationale supports the timely construction of the revetment as a proactive measure not only to mitigate coastal erosion but also to preserve the foundational stability of the residence by preventing exacerbated conditions of flooding events.

As a supplementary protective measure, we recommend the installation of a subsurface drainage system, such as a French drain, along the western property line. A French drain consists of a perforated pipe embedded in gravel or drain rock, typically wrapped in filter fabric, that collects and redirects groundwater and infiltrated surface water away from sensitive areas. At the subject property, this system would serve two key purposes: (1) managing subsurface water; and (2) reducing surface ponding and runoff from wave overtopping. The effectiveness and longevity of this drainage system are closely tied to the condition of the bluff and adjacent shoreline. Without shoreline protection in place, wave action and episodic bluff failures could expose or damage the drain infrastructure, rendering it ineffective. This supplementary drainage infrastructure will help manage floodwater infiltration and reduce the risk of water-related foundation issues, while the revetment will protect both the bluff and any installed infrastructure from erosive forces and instability.

Given the property's documented history of coastal erosion, exposure to high-wave energy and overtopping, relatively low ground elevation, vulnerability to flooding at the residence foundation, and the compounding risks posed by seismic activity and climate change, we strongly recommend the construction of durable, permanent shoreline protection. This recommendation is based on site-specific hazard conditions and is consistent with the approach taken at neighboring properties, where engineered shoreline structures have been implemented to address similar risks (shown in Figure 3). While a range of shoreline protection strategies exist, it is our professional opinion the high-energy environment and ongoing erosion affecting this site make a riprap revetment the appropriate and effective solution.

To address these ongoing and future threats, we recommend the construction of a 50-foot-long, robustly engineered SPS. This structure would stabilize the bluff toe, protect the property from continued slope regression and wave attack, and substantially reduce the risk of flooding-related damage to the existing residence. Without such permanent protection, erosion and flooding are expected to persist, putting the long-term stability of the property and residence at significant risk.

3.2 Riprap Revetment Recommendations

To mitigate future ocean wave erosion and the resulting bluff recession, support the over steepened bluff, and protect the subject house from damage due to flooding, we recommend that a riprap revetement be constructed. The intent of the SPS is to protect only the house and property of TL 400. The proposed revetment will be approximately 50 feet long (i.e. the width of the property beach frontage). We recommend constructing a rip rap revetment in the area shown in Appendix H as the Proposed Revetment Plan. The revised plan in Appendix H includes the Statutory Vegetation Line with respect to the proposed construction (overlain using Figure 2 above). Typical cross-sections and recommended specifications for the proposed revetment are shown in Appendix I as the Typical Cross Section: Revetment and Fill. The elevations used in the cross-sections are based upon the nearby elevation points provided by Google Earth and USGS Maps, and should be considered approximate.

The proposed revetment will generally be constructed of armor rock (riprap), underlain by filter rock (quarry-run bedding), and filter fabric (a woven geotextile). It is our recommendation that the proposed revetment be sloped down to the west at 1.5 Horizontal to 1 Vertical (1.5H:1V), assuming the overexcavation to the east is acceptable (approximately 12 feet). Note that this overexcavation is required to keep the SPS structure on the subject property. Alternatively, the proposed revetment slope can be increased to 1H:1V, however the owner should anticipate the need of increased maintenance and potential reconstruction with the steeper revetment face. In this case, the overexcavation to the east is approximately 4 feet. We understand that the owner has elected to proceed with the 1.5H:1V revetment slope. It should be noted, although this design includes overexcavation of the existing bluff, the face of the completed revetment structure (including filter rock, armor stone, and the vegetated sand blanket) will be approximately aligned with the current bluff face. Furthermore, the crest elevation of the revetment will match the existing top-of-bluff elevation, thereby maintaining the current visual and functional bluff profile. Regarding wave-overtopping, we recommend that the proposed revetment will reduce the impacts of wave overtopping relative to wave energy reduction as compared to the existing bluff slope.

To prepare the subject site, we recommend overexcavating the surficial, compressible silt/sand to expose the medium dense sand encountered at depths ranging from 5.5 to 6 feet bgs. We recommend excavating a 2-foot deep key trench into the medium dense sand. Then, we recommend placing a woven filter fabric (Mirafi Filterweave® 700 or equivalent) from the top of the slope to the bottom of the toe trench and wrap the lowermost armor stones placed in the trench. An approximately 6-inch-thick layer of quarry-run bedding rock, consisting of 4-inch minus rock, should be placed on the filter fabric and lightly compacted (with the bucket of a backhoe/excavator or a jumping jack) to prevent the more angular filter rock from puncturing the filter fabric. Then, we recommend placing riprap armor rock on top of the bedding rock. See Appendix I for the approximate cross-sections for the 1.5H:1V slope condition.

Riprap armor rock should consist of hard, durable, non-weathered basaltic rock, approximately 2 to 8 feet in diameter, and weighing at least 165 pounds per cubic foot. The armor rock should be placed in an interlocking state (i.e. at least 3 points of contact). The armor rock should be embedded into medium dense sand at the approximate elevations shown on the Appendix I cross sections. Toe trench embedment depths must be approved by a representative of Certerra at the time of construction. When installing the armor rock, we recommend that the largest diameter rocks be placed on the face of the structure, with placement sequenced from the bottom to the top of the revetment. The riprap should be moderately compacted with the bucket of the backhoe/excavator (often referred to as "knuckling" the rock into place) to ensure that good particle to particle contact is made

Following placement of the armor rock, the revetment above the beach elevation should be covered with a 1- to 2-foot-thick blanket of sand. The purpose of this layer is entirely aesthetic (i.e. to give the rip-rap revetment the appearance of a vegetated dune). The sand should then be planted with native beach grass, fertilized, and watered as necessary to establish vegetation growth.

Since the excavation may result in excess sand, we recommend that the leftover sand be added to the beach budget by spreading it uniformly over the beach above the Mean High Water (MHW) Level, not in excess of 1 foot in thickness.

While the proposed riprap revetment is intended to be durable, coastal processes are dynamic and it should be anticipated that revetment will need to be maintained and repaired as necessary. If the vegetated sand blanket is elected to be placed, we anticipate that future wave attack will cause surface erosion that will periodically need to be regraded (or sand replenished) and replanted when erosion occurs.

3.3 Summary of Hazards and Project Impact

This section summarizes the known and suspected geologic and seismic hazards present within the project area and describes how the proposed SPS may affect, or be affected by, those hazards. This summary is intended to consolidate hazard-related discussions presented in this report for clarity and regulatory review, and to clearly describe the relationship between existing hazard conditions and the proposed project.

3.3.1 Coastal Erosion Hazard

The project area is mapped entirely within the Very High (Active) Coastal Erosion Hazard Zone, indicating ongoing and future exposure to high-energy wave attack, elevated water levels, and storm-driven shoreline retreat. These processes subject the proposed revetment to cyclic wave loading and potential armor stone displacement, likely requiring long-term maintenance of the proposed revetment.

The proposed riprap revetment is specifically designed to mitigate coastal erosion by armoring the bluff, dissipating wave energy, and reducing direct wave attack on the oversteepened bluff face. While the revetment will not eliminate regional shoreline retreat or alter long-term coastal geomorphic trends, it is expected to substantially reduce the rate of erosion at the property, limit bluff recession, and reduce the likelihood of impacts to the residence on the subject property. The revetment does not create new erosion hazards, but rather addresses an existing, active hazard condition.

3.3.2 Flood Hazard and Wave Overtopping

The subject property is located within FEMA Flood Zone VE, indicating exposure to both inundation and storm-induced wave action. The property's relatively low elevation compared to neighboring lots, combined with ongoing bluff erosion, has resulted in documented wave overtopping and flooding of the upland area during storm events. As described in this report, the land surface elevation landward of the bluff is lower than the existing bluff crest elevation. Continued bluff retreat would reduce the effective elevation of the bluff crest, thereby increasing the frequency, extent, and severity of wave overtopping and floodwater intrusion toward the residence. Therefore, the flood hazard is quickly exacerbated if the bluff were to recede further.

From a geotechnical perspective, repeated flooding and wave overtopping present risks to foundation performance, including prolonged soil saturation, reduction in effective stress and bearing capacity, erosion or loss of supporting soils, and the potential for differential settlement of structural elements.

The proposed SPS is not intended to eliminate flooding or prevent wave overtopping during extreme events. However, by halting further bluff recession and stabilizing the bluff toe, the revetment is expected to limit worsening flood conditions over time. By maintaining the current bluff geometry and horizontal separation between the bluff face and the residence, the SPS serves to limit the progression of flood risk. It is our professional opinion that the proposed SPS construction does not increase flood hazards in the project vicinity as compare to existing conditions.

3.3.3 Earthquake, Liquefaction and Tsunami Hazards

The project area is subject to severe ground shaking from Cascadia Subduction Zone (CSZ) and local crustal earthquake, susceptible to liquefaction during strong seismic shaking, and is located within a mapped tsunami inundation zone. Strong seismic shaking could cause liquefaction, settlement, lateral spreading, or deformation of underlying sandy soils, potentially resulting in localized displacement or distortion of the revetment. Tsunami inundation and post-seismic coastal reconfiguration could damage armor stone placement or alter beach elevations adjacent to the structure.

The proposed revetment will not increase seismic, liquefaction, or tsunami hazards and does not influence earthquake occurrence, tsunami generation, or inundation extent. While the SPS is not designed to resist or prevent earthquake or tsunami forces, its mass and flexibility have a greater chance of withstanding the impacts of a seismic event as compared to a non-structural alternative.

3.3.4 Landslide and Bluff Stability Hazard

Regional landslide susceptibility at the site is mapped as low to moderate, and no deep-seated landslides are mapped on the subject property. It is our professional opinion that landslide risk for this property is relatively low, with the exception of the localized slumping of the oversteepened bluff due to wave attack and coastal erosion.

The proposed revetment will function as a buttress to the oversteepened slope, significantly reducing toe erosion (the primary driver of slope instability at this site). By stabilizing the base of the bluff, the SPS reduces the risk of erosion-induced sloughing and localized slope failures. Once constructed, the existing landslide and bluff stability hazard is not expected to adversely impact the performance or stability of the proposed SPS.

3.3.5 Climate Change and Sea Level Rise

Projected sea level rise and increasing storm intensity are expected to increase wave run-up, inundation frequency, and erosive forces over time, placing additional long-term stress on the revetment and increasing the need for monitoring and maintenance. The proposed revetment does not contribute to climate change or sea level rise but serves as an adaptive response to these evolving conditions. The SPS is intended to provide durable, long-term erosion protection under changing coastal conditions, recognizing that periodic maintenance may be required to maintain effectiveness as hazard intensity increases.

3.3.6 Overall Hazard Interaction and Project Effect

The proposed shoreline protection structure will not create, worsen, or transfer geologic, seismic, or flood hazards. Instead, it mitigates an existing, active erosion hazard that is directly contributing to bluff instability and increasing flood risk at the subject property. While the revetment is not intended to prevent flooding or eliminate damage from extreme seismic or tsunami events, it provides a reasonable, site-appropriate level of hazard mitigation by stabilizing the bluff and preventing further landward retreat that would otherwise exacerbate wave overtopping and flood impacts. This approach is consistent with current regulatory guidance and the site-specific constraints of the property.

4.0 CONSTRUCTION INSPECTIONS AND CONSIDERATIONS

4.1 Recommended Geotechnical Inspections

Certerra should be retained to perform geotechnical construction inspections to verify construction complies with the geotechnical engineering recommendations contained in this report. Certerra cannot accept responsibility for any conditions that deviate from those described in this report, if not engaged to also provide construction observation for this project.

At a minimum, we recommend the following "Special Inspections" be performed by Certerra during construction. Note that the construction team and/or governing jurisdiction may require additional inspections.

1. Observation of subgrade preparation beneath the proposed revetment footprint, including the 2-foot deep key.
2. Observation of filter fabric, filter rock, and armor rock placement (verify material type, thickness, and inclination).
3. Final revetment inspection.

In addition, prior to the start of construction, we recommend that a representative of Certerra attend the pre-construction meeting with the contractor and the Oregon Parks and Recreation Department Permit Specialist to confirm alignment between the approved design, permit conditions, and geotechnical recommendations, and to address construction sequencing or site-specific considerations.

4.2 Construction Considerations

We are providing the following construction considerations for the subject project:

1. **Site Access and Equipment Staging** – Construction equipment, materials, and workers may need to access the site from the beach, depending on tides and site conditions. A detailed plan for equipment staging, material storage, and access routes should be developed to minimize disruption to the surrounding environment and ensure safety.

2. **Managing tidal influences and weather conditions** – Construction should be planned around tidal cycles, with activities scheduled during low tide to reduce the risk of seawater inundation. Coastal weather patterns, particularly storm forecasts, must be closely monitored to avoid construction during adverse conditions. Temporary water control measures, such as berms or barriers, may be necessary to prevent wave overtopping or flooding during excavation activities near the shoreline.

3. **Material handling and placement** – Armor rock must be placed carefully to ensure proper interlocking, with at least three points of contact between each rock to resist displacement from wave action. Filter fabric must be handled carefully during installation to prevent tearing or gaps, ensuring proper prevention of fine material migration.

4. **Erosion control during construction** – Temporary erosion control measures, such as silt fences, sandbags, or straw wattles, should be employed to prevent soil erosion and sediment runoff during construction. As portions of the revetment will be overexcavated to embed the stairway, temporary stabilization measures such as shoring or bracing may be necessary to maintain the integrity of the revetment during construction.

5. **Environmental and regulatory compliance** – All construction activities must comply with local, state, and federal regulations. Ensuring that the necessary permits are in place and that all regulatory requirements are met is critical.

It should be noted, the construction means and methods are ultimately up to the contractor.

5.0 POTENTIAL IMPACTS AND ADDITIONAL CONSIDERATIONS

5.1 Impacts to Sand Source, Supply, and Movement

Sand supplies along the Oregon coast are derived primarily from two sources: (1) from sediments carved by streams and rivers that discharge to coastal areas; and (2) from erosion of bluffs, headlands, and dunes. Due to their relative hardness, the bluff and headland sand supplies are minor compared to those derived from dunes and streams.

During El Niño events, the entire sand supply may be removed from portions of a littoral cell and deposited elsewhere, usually at the northern end, exposing the bluffs and dunes to rapid erosion. The bluff material and talus eroded during the storm events will also disappear, generally by moving offshore, then gradually returning during summer months. When conditions return to normal, it may be several years before the beaches and dunes recover their pre-El Niño configurations. The areal distribution of the bluff and talus material removed during an El Niño event is nearly impossible to determine, and estimating the amount of sand supply loss to the coastal system by this particular structure is very difficult. Like other areas of the northern coast, the beaches in the Cannon Beach area have historically gone through periods of severe erosion and minor dune construction, and the historical record is not sufficient to infer the overall trend. The variability in erosion and deposition of sands is influenced by general ocean currents, waves, rip currents, jetties, spits, and other structures and phenomena, but is ultimately controlled by global climate conditions and the relative elevation of the sea level.

As stated above, we are proposing to construct a new SPS along the property's currently unprotected beachfront. By reducing the supply of erodible material (in this case, the fine-grained exposed bluff soils), there is also inherently a reduction of material supply within the littoral cell. However, based on the relative width of the property (50 feet), the quantity of material that would have been transported from the subject property is a nominal volume relative to the scale of the littoral cell.

5.2 Analysis of Hazard Avoidance

Alternatives to the recommended hazard avoidance measure (SPS construction) considered include each of the non-structural and structural shoreline protection described in the "Guidebook on Erosion Control Practices on the Oregon Coast" (referred to herein as the Guidebook).[13] This includes vegetative stabilization (including burrito structures), dynamic cobble berms, and sand alteration.

As outlined in Section 1.2 above, the subject property has already attempted to protect the coastline of the property by implementing softer solutions. When the residence was constructed, a vegetated berm was placed along the bluff, and more recently two additional mitigation attempts were made, placing approximately 50 cubic yards of cobbles at the base of the bluff as shoreline protection. These "softer" solutions have been reasonably

[13] Hailey Bond, *Guidebook on Erosion Control Practices of the Oregon Coast* (2021), Oregon Department of Land Conservation & Development.

attempted on the subject property, and has proven to be ineffective with ongoing erosion observed at the subject property (up to 5 feet over a 10 year time period).

5.2.1 Vegetative Stabilization Structures

An alternative to the SPS construction we considered in our analysis is vegetative stabilization (also referred to as soil or sand burrito structures, or burrito terraces). This approach can range from simply planting vegetation along the shoreline – potentially in combination with minor regrading, placement of fill, or use of planting media such as topsoil – to more involved methods such as constructing non-structural bank stabilization features (e.g., "burrito" berms made of sand, clay, or soil wrapped in geotextile fabric), which are then planted with native vegetation.

Importantly, the subject property has effectively served as a field demonstration of these types of softer shoreline stabilization approaches. Based on the information provided to us, a vegetated berm was previously constructed along the bluff, and more recently, limited cobble armoring was placed along the bluff toe. Despite these efforts, the bluff has continued to experience active erosion and retreat. The observed performance of these prior measures indicates that the wave energy and erosional processes affecting the site exceed the practical performance limits of these softer shoreline stabilization methods.

While vegetative stabilization may be effective in low-energy environments or areas with limited erosion potential, it is not well-suited to high-energy coastal sites like this one, where wave action and ongoing bluff retreat are too severe to allow for the successful establishment of vegetation or to prevent erosion of the underlying terraced soil structure. In such conditions, these measures are unlikely to provide adequate protection against continued erosion impacts.

It is our understanding that the only attempted implementation of soil burrito structures along the Oregon coast are located in Cannon Beach, where several vegetated clay burrito structures have been installed to varying levels of observed success. As a basic concept of coastal erosion, unconsolidated fine-grained soil (silt and clay) and sand will erode relatively quickly when impacted by ocean waves. From both a geotechnical and coastal erosion control standpoint, the purpose the vegetated soil burrito structure is twofold: (1) the purpose of the soil burritos is to support the slope; and (2) the purpose of the soil-covered, vegetated surface is to try to allow vegetation to take hold and add surficial cover to try to prevent the erosion of the soil burrito structure. Vegetative stabilization can be an alternative to the more robust structural solutions in some areas of the Oregon Coast; however, it is not suited to areas where the erosion conditions are too severe to allow establishment of vegetation, or to prevent erosion of the underlying terraced soil structure.

Typical of the Oregon Coast, the Cannon Beach area has locations of variable wave energy environments. While there are examples of clay burrito structures installed in Cannon Beach that have (thus far) been successful (i.e. the vegetation planted on the surface of the clay burrito structure had sufficient time to take hold, and the root system is now contribution to erosion control and bank stabilization), the clay burrito structures in Cannon Beach that we have observed in similar high-wave-energy environments are currently failing (described in more detail below) or there are other unrelated factors contributing to bluff stability (e.g., incidental presence of rock contributing bank stability and erosion control). In higher wave energy environments, planting media and shoreline vegetation planted in these locations has been quickly removed by storm events. Due to the high wave energy, vegetation has not been effective in locations with erosion conditions similar to those of the subject property. As such, it is our professional opinion that soil burrito structures (unique to Cannon Beach, intended for locations of lower wave energy, and with only one successful case that is in a location with dissimilar conditions) are not suitable for this property due to their inability to withstand high-energy wave conditions, prevent bluff undercutting, or address site-specific erosion challenges.

We reviewed two examples of vegetative stabilization, both in Cannon Beach and located at 3188 Pacific Avenue and 3276 Pacific Avenue (both within approximately 0.5 miles of the subject property). These examples were selected for comparison because they are the closest known examples of vegetated sand or soil burrito stabilization to the project site. The following includes our assessment of each of these examples of shoreline protection. We include an explanation of why the vegetative soil stabilization at 3188 Pacific Avenue is not suitable for the subject property and why the shoreline stabilization measure at 3276 Pacific Avenue relies on structural angular basalt rock, not a non-structural vegetative soil stabilization.

Example #1: 3188 Pacific Avenue (2020)

A vegetated sand burrito structure is located at 3188 Pacific Avenue located approximately 0.52 miles north of the subject property. This vegetated soil burrito structure was constructed in 2020. Constructed in 2020, this structure is highlighted in the State of Oregon Department of Land Conservation and Development (DLCD) *Guidebook on Erosion Control Practices on the Oregon Coast* (2021). Based on our observations and understanding of the construction, the structural portion of the berm (i.e. the portion supporting and stabilizing the slope) consists of overlapping "terraces" (horizontal layers) of soil wrapped in a geotextile or geogrid matrix. According to available OPRD permit documents (OPRD File Number 2931-20), the structure as permitted was to be constructed at 1 Horizontal to 1 Vertical (1H:1V), or a 100% slope. As shown in Figure 11 below, the slope as constructed appears to be less steep than 1H:1V, at slope ratio of approximately 1.5H:1V (75% slope). Over the terraces, the OPRD permit documents indicated that the planting media consisted of a minimum 16-inches of sand.

Figure 11: Photo presented in the DCLD (2021) guidance showing the vegetated sand burrito structure at 3188 Pacific Avenue in 2021.

We have observed the shoreline protection at 3188 Pacific Avenue numerous times during the period of September 2022 through present. Most recently, we performed a visual reconnaissance of the vegetated sand burrito structure on December 16, 2024. Our observations during the fall and winter season of 2022/2023, fall and winter season of 2023/2024, and fall and winter season of 2024 indicate that the structure has experienced heavy erosion, with the both lower planting media layer and soil matrices within the geogrid layers (i.e. the structure) being significantly washed out. Most recently, in the fall and winter season of 2024, the structure experienced rapid erosion and structural failure (i.e. removal of plants and sand blanket planting media, exposing and rapidly eroding the clay terrace structure beneath) after reconstruction in the summer season of 2024. This rapid, ongoing degradation is shown in Photo 6 (November 2024) and Photo 7 (December 2024) below.

See Photo 5 below for the site conditions on September 8, 2022 and Photo 6 below for the site conditions on November 21, 2024. As compared to the approximately 1.5H:1V (75%) slope as originally constructed, the average slope of the structure now exhibits a slope that is vertical at the base and has an average slope ratio of approximately 0.5H:1V (or a 200% slope). We understand that replanting has occurred subsequent to construction, and that the structure has lost vegetative cover on the lower half. Because the structural elements (i.e. the internal terraces) have been heavily eroded and degraded, it is our professional opinion that the vegetated soil burrito structure at 3188 Pacific Avenue requires complete reconstruction.

The structure is not working as designed, as the ongoing erosion and undercutting indicate that wave energy at this location is too severe for the establishment and long-term survival of vegetation. Without healthy vegetation, the soil is left unprotected and vulnerable to further erosion. As demonstrated by the comparison between Figure 11 (photo from 2021) and Photo 5 (September 2022), substantial degradation of the structure occurred within just one to two years of original construction. In addition, once repaired, the structure began eroding at the toe within just a few months (shown in Photos 6 and 7). This rapid decline further underscores that the current solution is inadequate for the site's high-energy coastal environment.

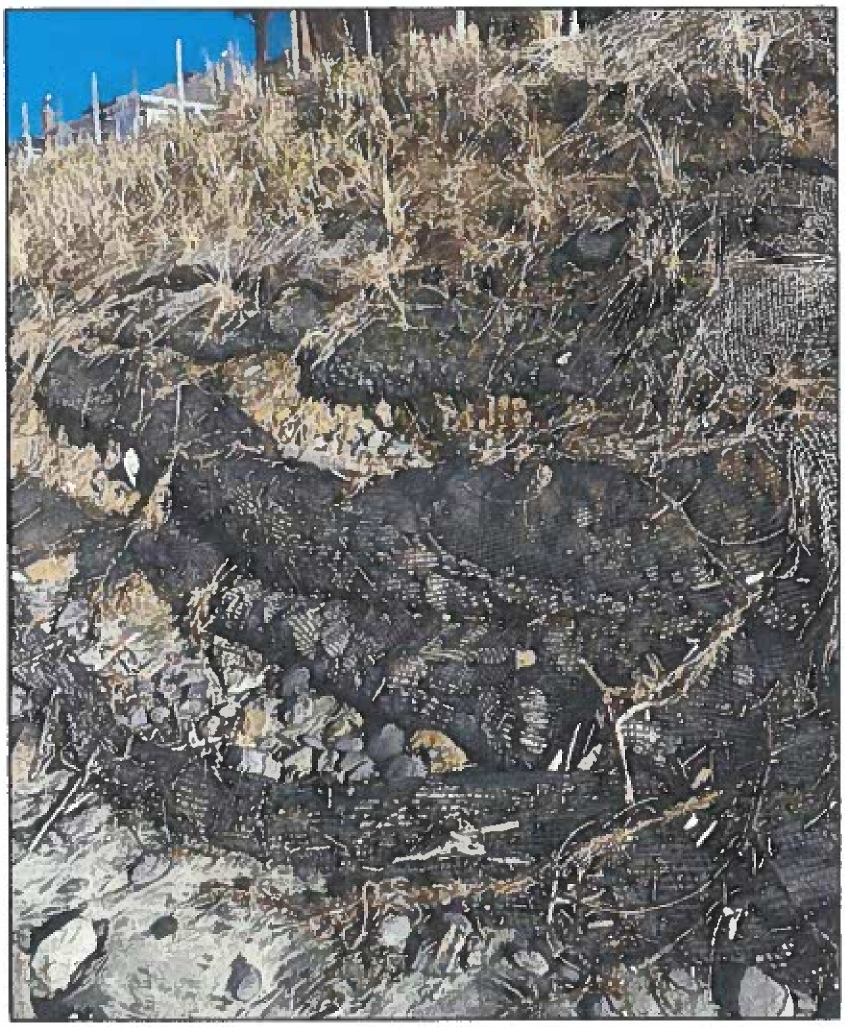


Photo 5: Site conditions at 3188 Pacific Avenue on September 8, 2022 showing the damaged vegetated soil burritos that required reconstruction.

Photo 6: Site conditions at 3188 Pacific Avenue on November 21, 2024, showing the eroded planting media, damaged soil burritos, and oversteepened (~0.5H:1V) eroding bluff slope shortly after reconstruction in summer 2024.

Photo 7: Site conditions at 3188 Pacific Avenue on December 16, 2024, showing the rapid erosion occurring at the base of the bluff slope less than one month after Photo 6 was taken.

It has been suggested by opponents of the subject project that with some degree of increased "maintenance" of the structure at 3188 Pacific Avenue, that the structure as a method of coastal erosion protection would have been effective. For this structure, such maintenance (if necessary) would typically include periodic replacement of eroded planting media and replanting of eroded vegetation. It is our professional opinion that there is no reasonable amount of "maintenance" (e.g. seasonable sand replacement and replanting) that could have prevented the failure of the structure.

Conversely, we recommend that the performance of this structure and rapid degradation over a relatively short period of time demonstrates the presence of conditions of a severity such that maintenance (consisting of seasonal sand replacement and replanting) would have been insufficient to prevent failure. It is our professional opinion that the sand cover and vegetation was quickly washed away, and the burrito structure itself was unable to withstand the high-energy wave conditions at this location in Cannon Beach, leading to erosion of the bluff and structural destabilization.

In conclusion, it is our professional opinion that the example of a vegetated sand burrito structure at 3188 Pacific Avenue demonstrates that this method of shoreline protection would not be effective at 3915 Ocean Avenue, and should not be considered a reasonable alternative in this environment.

Example #2: 3276 Pacific Avenue (2004)

We understand that the shoreline protection structure located at 3276 Pacific Avenue has also been cited as an example of a successful vegetated burrito solution. Unlike the structure at 3188 Pacific Avenue, there is limited available information regarding the design or construction details of the vegetative stabilization example at 3276 Pacific Avenue.

The OPRD permit (BA-580-04) indicates that construction occurred in 2004. The OPRD documents indicate that "clay filled geotextile pillows" were placed on the bluff slope in 2-foot-thick terraces at a slope of 1.5H:1V (75% slope). Vegetative covering was subsequently planted on the terraces.

To garner a more comprehensive understanding of the shoreline protection structure at 3276 Pacific Avenue, we performed a visual reconnaissance of the site, located approximately 0.48 miles north of the subject property, on November 21, 2024. See Photos 8 and 9 below. Based on our observations, the structure observed (as compared to the 2-foot-thick clay terraces described above) has eroded significantly over time.

As shown in Photos 8 and 9 below, the bank does not consist of clay soils (as would be expected as a remnant of clay soil terraces). Rather, the bluff slope and the shoreline in front of the bluff at this property consist predominantly of angular basalt rock, similar to riprap, and are heavily covered in cobble. The presence of this rock is a paramount difference of conditions, unrepresentative of a vegetated sand or soil burrito structure, and dissimilar (and substantially less erodible than) the naturally occurring erodible bank conditions at the subject property (3915 Ocean Avenue).

Despite the apparent supplemental armoring at 3276 Pacific Avenue, the existing bank slope has become steeper than the design slope of 1.5H:1V (75% slope), locally exceeding 1H:1V (100%). The exposed, overlapping geotextile (shown in Photo 9) indicate that the 2-foot-thick clay terraces have washed out (eroded away), leaving only the synthetic geotextile on the rocky material that remains on the bank.

Given the predominant presence of armor rock (i.e. angular basalt boulders, or rip-rap) and cobbles on the bank, the site does not provide a representative example of a vegetated sand/soil burrito structure. In addition, the original vegetated soil burrito structure (i.e. the 2-foot-thick clay terraces described above) appears to have substantially eroded away, leaving only the synthetic geogrid/geotextile on the rocky ground surface. In conclusion, it is our professional opinion that this example *does not* demonstrate that a vegetated soil burrito structure could be effective at 3915 Ocean Avenue, and further reinforces that a vegetated soil burrito structure should not be considered a reasonable alternative in this environment.

Photo 8: Site conditions at 3276 Pacific Avenue on November 21, 2024, showing the angular rock and cobble along the property's shoreline acting as a dynamic revetment for the property.

Photo 9: Site conditions at 3276 Pacific Avenue on November 21, 2024, showing the failing sand burrito, as well as the angular rock and cobble along the property's shoreline.

Vegetated Sand Burrito Conclusion

Based on the information presented herein, it is our professional opinion that the use of vegetated sand or soil burrito structures at 3915 Ocean Avenue will not work, and is not an appropriate shoreline protection alternative for this location based on the site specific erosion and wave energy conditions. This is due to the above referenced failures of similar structures in Cannon Beach under comparable conditions, site-specific challenges including high-energy wave impact, ongoing bluff erosion, and low ground elevation, and their inability to meet the stabilization goals outlined in CBMC 17.42.030. These examples show that vegetated sand and soil burrito structures fail to prevent ocean undercutting at high-energy wave sites like the subject property. The prevention of ocean undercutting is necessary for a properly functioning shoreline protective structure at the subject property.

As a specific example of the conditions prohibitive of maintaining vegetation and planting media on the slope, as referenced above, the cobbles (i.e. earth material that is heavier and substantially less erodible than unconsolidated soil) that were previously placed on the shoreline fronting the subject property washed away within a single season. This observation underscores the intensity and erosive forces of the waves in this area. If the energy is sufficient to mobilize cobbles, it is unlikely that lighter materials such as sand, soil, and planted vegetation could remain in place long enough to provide successful bluff stabilization.

Vegetation may provide supplemental surficial stabilization and ecological benefits where a stable shoreline condition already exists; however, vegetation alone is not capable of resisting the episodic high-energy wave attack, bluff undercutting, and toe scour documented at the subject property. In our opinion, vegetative stabilization measures at this site would require a stable structural base condition to remain viable over the long term. As such, vegetation may be appropriate as a supplemental component integrated with a properly engineered shoreline protection structure, but not as the primary standalone erosion mitigation measure for the subject property.

In our opinion, the prior implementation and subsequent failure of vegetative and limited cobble stabilization measures at the subject property further supports the conclusion that these approaches are not capable of providing reliable long-term protection under the site's high-energy coastal conditions. Pursuing the engineered riprap shoreline protection structure is recommended as a durable and effective shoreline protection measure to safeguard the property against the severe coastal processes present at this site.

5.2.2 Planting of Riparian Vegetation

It should be noted, CBMC 17.86.210(D) provides that the "planting of riparian vegetation" is preferred over a vegetated riprap structure where that intervention will "work" to stop erosion of a shoreline bluff. As outlined in Section 5.2.1 above, while vegetative stabilization may be effective in low-energy environments or areas with limited erosion potential, it is not well-suited to high-energy coastal sites like this one, where wave action and ongoing bluff retreat are too severe to allow for the successful establishment of vegetation or to prevent erosion of the underlying terraced soil structure. In such conditions, these measures will not provide adequate protection against continued erosion impacts.

5.2.3 Cobble Berm

Another non-structural solution we considered in our analysis is a cobble berm (also referred to as a dynamic revetment). Cobble berms are engineered beaches made of cobblestones between 2.5 and 10 inches in diameter, constructed at a low slope angle (e.g., on the order of 11 degrees), and require a substantial footprint to be effective. Given the cobble berm is an engineered beach, not a structure or other mitigation improvement fixed in place for the protection of an individual property, they are not effective at the scale of an individual property.

The effectiveness of a cobble berm is directly tied to its expansive footprint. The most comprehensive study on the potential use of cobble berms on the Oregon coast was prepared by professional geologists/coastal geomorphologists at the Oregon Department of Geology and Mineral Industries (DOGAMI) for the Oregon Department of Transportation.[14] Based on their comprehensive analysis of natural and engineered cobblestone beaches, the authors concluded that dynamic revetments should have a minimum crest elevation of at least 23 feet[15] and width of 66 feet.[16] Furthermore, the only two dynamic cobble revetments on Oregon beaches expand a length of greater than 1,000 feet.[17] The necessary footprint of dynamic cobble berm revetments would

14 Jonathan C. Allan, Ron Geitgey, & Roger Hart, *Dynamic Revetments for Coastal Erosion in Oregon* (Aug. 2005) available at https://www.oregon.gov/odot/Programs/ResearchDocuments/DynamicRevetments.pdf.

15 *Id.* at 64.

16 *Id.* at 69, 71

17 *Id.* at 25.

not work on this site. Because the rocks are designed to move, they would be quickly pushed off the relatively small site. In addition, the dynamic revetment would need to extend more than 50 feet west of the western property line to be effective. We understand that extending the footprint of the proposed structure beyond the property limits would not be allowed based on local and State regulations. It should be noted, our proposed SPS design is located within the subject property limits.

Finally, as recognized in the DOGAMI study and state Guidebook, cobble berms are not recommended in developed areas because the cobblestones may become projectiles during severe storms.[18] This would be a risk to residences located inland of the subject property's bluff.

As previously noted, two separate attempts were made to protect the bluff by placing approximately 50 cubic yards of loose cobble along the shoreline. It is our understanding that the cobbles were displaced and washed away within the year. Although not the scale of a fully engineered cobble berm, the loose cobble placed functioned as a practical pilot test, further demonstrating the limitations of this non-structural mitigation approach at the site. The rapid loss of material highlights the ineffectiveness of cobble berms under the high-energy wave conditions present at the subject property.

It is our professional opinion that the subject property is too small on an individual scale for a cobble berm to be effective. In addition, it is our professional opinion that the high energy waves in this area would remove the stabilizing effects of the cobbles in a short period of time, as was observed with the imported cobble that had previously been placed at the subject property.

5.2.4 Sand Alteration

Another stabilization method outlined in the Guidebook is sand alteration. Sand alteration is fairly common on the east coast of the U.S. where the wave climate is significantly milder; however, this has only been attempted in a few areas of the west coast such as San Diego, California. The process involves moving hundreds of thousands of cubic yards of sand within littoral cells or bringing sand from other sources in attempts to encourage dune building and to shore-up erosion-damaged areas. Typically, this involves large amounts of government spending and long-term commitments. The reality is that intense climatic events such as El Niño and La Niña, or in recent cases, an unusually severe storm or rip embayment, can remove hundreds of thousands of cubic yards of material in a few days' time, again exposing the shorelines to intense erosion. As stated above, the sand alteration at the subject property has not proven to be effective as evidenced by the ongoing erosion of the sand berm at significant rates. The practice of sand alteration usually requires vast areas of beach to be even moderately effective, so this would not be a viable solution for the small subject property.

5.2.5 Relocation of Existing Buildings or Infrastructure

Relocation of the existing residential structure or associated infrastructure was considered as a potential alternative to shoreline protection; however, this option is not considered reasonable or viable for the subject

18 Guidebook at 40

property. The lot is constrained in both size and configuration, and the existing residence is already located at a very limited setback from the Ocean Avenue right-of-way. As a result, there is no feasible landward area within the property boundaries to relocate the structure while maintaining compliance with zoning, setback, and building code requirements.

In addition, relocation of the residence would not eliminate the underlying coastal hazards affecting the site. Continued bluff erosion, wave overtopping, and flooding would persist at the western portion of the property, and further bluff retreat would progressively reduce the usable area of the lot over time. Relocation would therefore provide only a temporary reduction in risk, while failing to address the active coastal erosion and bluff instability that are the primary drivers of the hazard at this location.

Relocation would also require substantial demolition, reconstruction, and utility reconfiguration, resulting in significant economic and environmental costs that are disproportionate to the scale of the property and the level of risk reduction achieved. Given these constraints, relocation does not represent a practical or effective hazard avoidance measure for the subject property.

5.2.6 Other Solutions

As described above, vegetative stabilization, cobble berms, and sand alteration are not sufficient at the subject property to resist the high-energy wave attack in order to substantially slow or halt erosion, and prevent the continued eastward movement of wave runup/flooding.

In addition, we do not believe softer solutions such as sand bags, gravel mounds, logs, or composite revetments would prove effective. Sand tubes have been used on the Atlantic coast with some success by placement offshore, which causes waves to break early and lose energy before reaching the shorelines. However, because of the extremely high wave energy, these structures have not been shown to have acceptable performance during severe storm events and over longer periods of time along the west coast. We do not believe these softer solutions have been satisfactorily proven to work in the type of coastal environment found at the site.

5.2.7 Conclusion

Based on our evaluation of non-structural shoreline protection alternatives outlined in the DLCD Guidebook, including vegetative stabilization, dynamic cobble berms, and sand alteration, it is our professional opinion that none of these approaches are a viable or effective solution for the subject property at 3915 Ocean Avenue. While non-structural and nature-based alternatives can be effective in lower-energy environments or in combination with other measures, they do not provide sufficient protection for the subject property given the site's exposure to high-energy wave action, wave overtopping, and the ongoing risk of flooding and erosion. Given the demonstrated inadequacy of non-structural measures and the site-specific challenges, we conclude that these alternatives do not meet the stabilization objectives outlined in CBMC 17.42.030. Therefore, a more robust and durable structural solution, such as the proposed shoreline protective structure (SPS), is warranted to safeguard the subject property from ongoing and future erosion.

5.3 Additional Considerations

The purpose of this section is to discuss additional considerations and potential impacts this project may have in the short and long-term to neighboring properties, to recreation, scenic, safety, and natural resources of the ocean shore. The potential impacts, including impacts from the SPS and impacts from the construction activities, are as follows:

1. **Project Need** – Based on the observed conditions, erosion potential, high wave energy, and impacts of flooding on the existing structure, there is a reasonable need for the implementation of a robust SPS at the subject property. In addition, the prevalence of riprap revetments constructed in the project vicinity is evidence that there has been historical erosion in the area and a need for such protection. The proposed SPS will minimize the risk of erosion, shield the slope from wave attack, and the property protect from severe storm events. In the absence of the SPS construction, potential for continued erosion and damage from storm events will continue.

2. **Future Monitoring** – As stated above, a representative of the Geotechnical Engineer will be on site during the construction activities to verify construction aligns with the recommendations in this report. In addition, a comprehensive annual inspection of the overall SPS condition will be performed by the Geotechnical Engineer of Record.

   With respect to the surficial vegetated sand blanket, we recommend that it be monitored and maintained for a period of five years following construction. As part of this effort, the condition of the sand blanket and vegetation should be assessed during the annual inspection of the overall SPS. Following the annual engineering review, any necessary maintenance (such as replanting, sand redistribution, or other minor adjustments) should be completed before the onset of the wet season.

   However, given the high-energy coastal setting and the challenges observed at similar sites, we recommend that the City allow for a formal reassessment at the end of the five-year monitoring period. If, at that time, continued maintenance of the vegetation and sand blanket is found to be infeasible due to persistent storm damage, wave overtopping, or wind erosion, we recommend discontinuing active maintenance, as it will have proven impractical under site-specific conditions. This approach ensures that the aesthetic goals of the design are pursued in good faith during the initial years, while also providing a reasonable and adaptive long-term strategy for addressing the realities of this dynamic shoreline environment.

3. **Protection of Public Rights** – The proposed SPS construction will be constructed on private property and no public beach access will be obstructed or lost as part of the revetment installation. A Construction, Staging, and Safety Plan should be prepared to limit impacts to the public beach access and recreation. The work area will be clearly delineated with access to the Oregon Coast to be maintained during construction (e.g., a minimum 10-feet-wide delineated easement will be maintained between the ocean and the work area at high tide) and OPRD will be notified of the construction activities on the beach. For these reasons, the project is protective of public rights.

4. **Public Laws** – The project meets Statewide Planning Goal 18 criteria, therefore the subject property is eligible for a shoreline protective structure to be permitted. A request for Construction Equipment and Staging on the Ocean Shore is planned to be submitted with the permit application. In addition, to proceed with the SPS permit application, a Conditional Use Permit is planned to be obtained from the Cannon Beach Planning Commission. Regarding compliance with other federal and state law, a permit from the U.S. Army Corps of Engineers (USACE) or the Oregon Department of State Lands (DSL) is not required for this project. As such, the project will be in compliance with applicable federal, state, and local laws.

5. **Alterations and Project Modifications** – As described in Section 5.2 above (Analysis of Hazard Avoidance), alternative protective measures were considered and none of these alternatives are recommended as effective or practical solutions for mitigation of the severe erosion affecting the subject property. As previously described, there is a need for the SPS construction at this location, the subject property is eligible for a structural solution, and the proposed solution (rip-rap revetment construction) is the lowest impact "reasonable" alternative. In terms of the structural solution proposed, the structure is designed to stay within the subject property boundaries. Based on the alternatives analysis and findings.

6. **Public Costs** – The proposed SPS will be constructed on private property and maintained by the property owner. Therefore, there are no substantive public costs associated with this project. Further, the owner will bear all costs for the revetment construction, and for any construction restoration activities performed after the revetment has been completed. Non-structural alternatives have been considered and are not recommended, as previously described. There will be no direct or indirect cost to the public as a result of the SPS construction.

7. **Scenic Concerns** – The project will closely follow existing revetments and bluff profiles in the area and will not alter any major landforms. Although no significant vegetation presently exists at beach level, we are providing the option to the property owner that they vegetate the revetment face with naturally occurring plantings. Several lots to the south of Tolovana Park already have an SPS in place, therefore this structure would be an aesthetic improvement over the exposed seawalls and exposed riprip structures already existing. The structure will not obstruct views of the ocean or beach from adjacent properties and will be consistent with other revetments in the area.

8. **Recreation Use and Access** – The proposed SPS will be constructed on private property, and the future existence of this structure would correspondingly not be a detriment to public recreation use opportunities. Construction activities will be conducted on weekdays and will not occur during peak summer months (June, July, or August) to facilitate minimal impact to public beach users. In addition, the project will require a relatively limited staging area during active construction based on the relatively small scale of the construction, and strategy of only importing the volume of material that will be used on a daily basis. Finally, the construction area will be clearly delineated.

   The proposed SPS will not impact any existing public access routes as there is no public access to the beach from the subject property. During the worst of conditions, high tides and storm waves cover the beach up to the base of the existing revetments and beachfront slopes. During normal and summer conditions, the beach may be as much as 300 yards wide at low tide. This structure will not alter or worsen the existing conditions. During normal seasonal weather patterns, the usage of the beach in this area will not change because of this structure. The Construction, Staging, and Safety Plan should define that construction activities are being sequenced and timed to minimize impacts to public beach access.

9. **Structural Safety** – The proposed SPS construction was designed by a Certified Engineering Geologist and Licensed Geotechnical Engineer in accordance with current engineering standards. The design is for a robust structure with heavy armor rock that is intended to withstand extreme conditions of coastal erosion and wave overtopping. Periodic inspection will be conducted by the engineer of record (EE) during construction to confirm that the structure is constructed in accordance with the design, with inspections documented in daily field reports and a Final Summary Report at the end of construction. The design is structurally safe and proper implementation will be verified by the engineer of record during construction.

10. **Neighboring Properties** – Several lots in the project vicinity already have an SPS in place. Based on the principles of sand source, supply, and movement within a littoral cell, the presence of these other revetments has increased the potential for future wave erosion and continued rapid bluff retreat on the subject property. The continued erosion at the subject property without a SPS could negatively impact the neighboring properties by exacerbating erosion along the bluff slope. This could ultimately compromise the stability of the existing neighboring SPS. The proposed revetment will protect the properties and provide a smooth line of shoreline protection along the beachfront in this area, graded to match the current embankment slope of the neighboring properties. Constructing an SPS to protect the subject property is unlikely to have a measurable negative effect on the neighboring properties.

11. **Property Protection** – As presented above, the proposed SPS will improve the safety of the subject property by mitigating future erosion, scouring, recession, and potential slope failure of the subject bluff. The project improves the protection of the subject property, and on that basis this criterion is met.

12. **Fish and Wildlife Resources** – It is anticipated that the proposed project, including the proposed SPS and the related construction activities, will not substantively alter the habitat of any fish and wildlife resources (including that of rare, threatened or endangered species). The Oregon Department of Fish and Wildlife (ODFW) will be informed of this application during the review process to verify the presumed absence of rare, threatened, or endangered fish or wildlife species at the project site to ensure that this criterion is met.

13. **Estuarine Values and Navigation Interests** – Based on publicly available mapping from the Oregon Coastal Management Program, the area of Cannon Beach is not located within any mapped estuary management areas. As such, the proposed project will not impact any estuary ecosystems.

14. **Historic, Cultural and Archeological Sites** – It is anticipated that the implementation of the proposed project (i.e. the construction of the SPS) will not encounter or impact historic, cultural or archaeological resources. Beyond the presumption of the absence of these resources, the applicants acknowledge the requirement that these resources must not be impacted as a result of this project. If historic, cultural, or archeological artifacts are inadvertently discovered during construction, the project will cease, and the

Oregon State Historic Preservation Office will be contacted. During the application review, notice and opportunity for comment will be provided to the Oregon State Historic Preservation Office, as well as the indigenous tribe that included the northern and central Oregon coast within their homelands (the Confederated Tribes of Siletz Indians and the Confederated Tribes of Grand Ronde).

15. **Air and Water Quality** – The proposed SPS, as well as the construction activities, will not impact the air and water quality of the ocean shore. Measures to ensure this will include verifying that construction materials are brought to the site free of debris, and equipment will not be fueled or maintained on the beach.

16. **Areas of Geologic Interest, Fossil Beds, and Ancient Forest Remnants** – The subject property is not in a known area of geologic interest, fossil bed, or ancient forest remnant. If evidence of such features is identified by construction workers or Certerra geologists onsite during construction inspections, the project will cease, and the Oregon Department of Geology and Mineral Industries (DOGAMI) will be contacted.

6.0 REPORT LIMITATIONS

As is standard practice in the geotechnical industry, the conclusions contained in our report are considered preliminary because they are based on assumptions made about the soil, rock, and groundwater conditions exposed at the site during our subsurface investigation. A more complete extent of the actual subsurface conditions can only be identified when they are exposed during construction. Therefore, Certerra should be retained as your consultant during construction to observe the actual conditions and to provide our final conclusions. If a different geotechnical consultant is retained to perform geotechnical inspection during construction, then they should be relied upon to provide final design conclusions and recommendations, and should assume the role of geotechnical engineer of record.

The subject property is located on a bluff fronting the Pacific Ocean. This property is subject to very dynamic forces (i.e. powerful winter storms, ocean currents, and earthquakes). The conditions of the subject property could change drastically in the future due to these forces and cannot be entirely predicted, nor can they be fully mitigated. These risks are common to other similar properties in the area, which have already been developed with similar residential homes.

The geotechnical recommendations presented in this report are based on the available project information and the subsurface materials described in this report. If any of the noted information is incorrect, please inform Certerra in writing so that we may amend the recommendations presented in this report if appropriate and if desired by the client. Certerra will not be responsible for the implementation of its recommendations when it is not notified of changes in the project.

The Geotechnical Engineer warrants that the findings, recommendations, specifications, or professional advice contained herein have been made in accordance with generally accepted professional geotechnical engineering practices in the local area. No other warranties are implied or expressed.

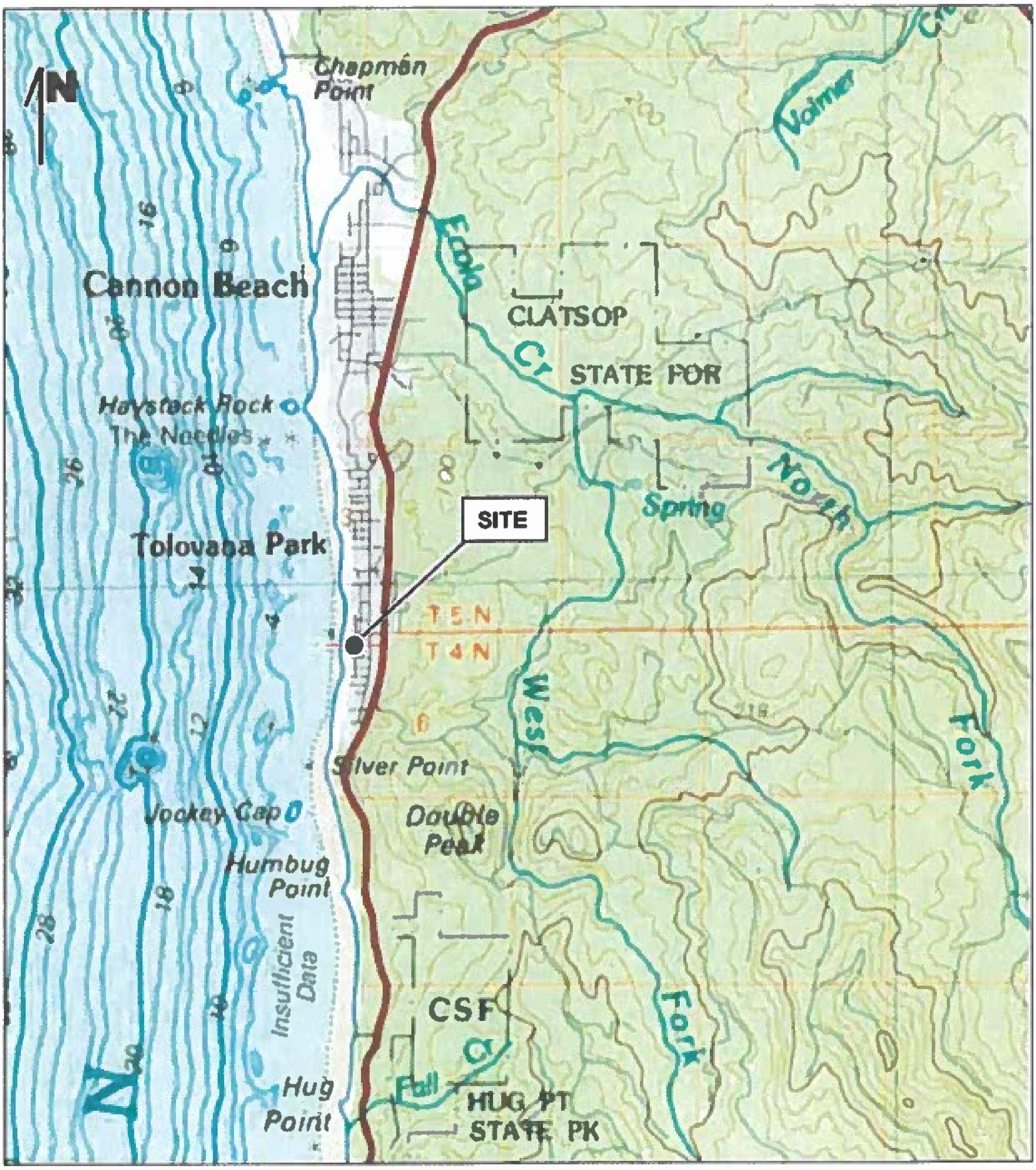
The subsurface explorations performed for this geotechnical study represent the subsurface conditions at discrete locations on the project site. The number of explorations were sufficient to provide geotechnical engineering recommendations for the proposed retaining wall project, but may not be sufficient to eliminate all risk of differing or unanticipated subsurface conditions elsewhere along the proposed retaining wall alignment. When developing the construction schedule and budget, it should be assumed that the subsurface could conditions may vary across the site. To reduce the risk of encountering differing or unanticipated conditions during construction, we are available to perform additional subsurface explorations upon request.

This report has been prepared for the exclusive use of Maxine M. Siegel for the specific application to the proposed riprap revetment within the property located at 3915 Ocean Avenue in Cannon Beach, Oregon. Certerra does not authorize the use of the advice herein nor the reliance upon the report by third parties without prior written authorization by Certerra.

APPENDICES

Appendix A – Site Location Plan

APPENDIX A – SITE LOCATION PLAN



CERTERRA EARTH ENGINEERS	Proposed Shoreline Protection Structure 3915 Ocean Avenue Cannon Beach, Clatsop County, Oregon	Report No. 10-230860-01-R5
		January 19, 2024 (revised June 11, 2026)

Appendix B – Exploration Location Plan

APPENDIX B – SITE EXPLORATION PLAN

= Approximate Test Pit Location

Base image source: Google Earth.

CERTERRA EARTH ENGINEERS	Proposed Shoreline Protection Structure 3915 Ocean Avenue Cannon Beach, Clatsop County, Oregon	Report No. 10-230860-01-R5	January 19, 2024 (revised June 11, 2026)

Appendix C – Test Pit Logs

Appendix C: Test Pit TP-1

Sheet 1 of 1

Earth Engineers, Inc.

Client: Maxine M. Siegel
Project: Proposed Shoreline Protection Structure
Site Address: 3915 Ocean Avenue
Cannon Beach, Clatsop County, Oregon
Location of Exploration: See Appendix B
Logged By: Jacqui Boyer

Report Number: 23-086-1
Excavation Contractor: Bob McEwan Construction
Excavation Method: Test Pit Excavation
Excavation Equipment: Excavator w/2-foot wide bucket
Approximate Ground Surface Elevation (ft msl): 17
Date of Exploration: July 28, 2023

Depth (ft)	Water Level	Geologic Description of Soil and Rock Strata (Lithology)	Digging Effort	Drive Probe Blows Per 6 Inches	Pocket Pen. (tsf)	Moisture Content (%)	% Passing #200 Sieve	Liquid Limit	Plastic Limit	Remarks
0		Sand - brown to gray beach sand with trace fines, dry, loose	Easy	2						
1				7		4				
1.5		Silt (ML) - brown to gray clayey silt with few sand, orange mottling, moist to wet, soft		4						
2				4		60	90	45	29	
2.5				2						
3		Silt (ML) - blue-gray clayey silt with orange mottling, moist to wet, medium stiff to very stiff		5		50				
3.5				7						
4				8						
4.5				12						
5				17						
5.5				16						
6		Sand (SM) - brown-gray silty sand, moist to wet, medium dense to dense		15		43				
6.5				19						
7				20						
7.5				21						
8			Mod.	20		35	48			
8.5				30						
9				35						
9.5				31						
10	▼	Sand (SP) - blue-gray to brown sand, wet to saturated, dense		32						water seeping into test pit
10.5				35						
11				36		36	5			
11.5				39						

Notes: Test pit and drive probe terminated at a depth of approximately 12 feet bgs. Groundwater encountered at a depth of 10 feet bgs. Test pit loosely backfilled with excavated soil on 7/28/23. Approximate elevation based on Google Earth.

Appendix C: Test Pit TP-2

Earth Engineers, Inc.

Client: Maxine M. Siegel
Project: Proposed Shoreline Protection Structure
Site Address: 3915 Ocean Avenue
Cannon Beach, Clatsop County, Oregon
Location of Exploration: See Appendix B
Logged By: Jacqui Boyer

Report Number: 23-086-1
Excavation Contractor: Bob McEwan Construction
Excavation Method: Test Pit Excavation
Excavation Equipment: Excavator w/2-foot wide bucket
Approximate Ground Surface Elevation (ft msl): 16
Date of Exploration: July 28, 2023

Depth (ft)	Water Level	Lithologic Symbol	Geologic Description of Soil and Rock Strata	Sample Number	Digging Effort	Drive Probe Blows Per 6 Inches	Pocket Pen. (tsf)	Moisture Content (%)	% Passing #200 Sieve	Liquid Limit	Plastic Limit	Remarks
0			Sand - brown to gray beach sand with trace fines, dry, loose		Easy							
1								3				
1.5			Silt (ML) - brown to gray clayey silt with few sand, orange mottling, moist to wet, soft									
2.5								44				
3			Sand (SP) - brown sand with trace silt, orange veins, moist to wet, medium dense to dense									
4								15	4			
5.5			Sand (SP) - blue-gray to gray clayey sand, moist to wet, medium dense to dense		Mod.			30				
9								34	4			
10												

Notes: Test pit terminated at a depth of approximately 10 feet bgs. Groundwater was not encountered at the time of our exploration. Test pit loosely backfilled with excavated soil on 7/28/23. Approximate elevation based on Google Earth.

Appendix D – Soil Classification Legend

APPENDIX D: SOIL CLASSIFICATION LEGEND

APPARENT CONSISTENCY OF COHESIVE SOILS (PECK, HANSON & THORNBURN 1974, AASHTO 1988)				
Descriptor	SPT N_{60} (blows/foot)*	Pocket Penetrometer, Qp (tsf)	Torvane (tsf)	Field Approximation
Very Soft	< 2	< 0.25	< 0.12	Easily penetrated several inches by fist
Soft	2 – 4	0.25 – 0.50	0.12 – 0.25	Easily penetrated several inches by thumb
Medium Stiff	5 – 8	0.50 – 1.0	0.25 – 0.50	Penetrated several inches by thumb w/moderate effort
Stiff	9 – 15	1.0 – 2.0	0.50 – 1.0	Readily indented by thumbnail
Very Stiff	16 – 30	2.0 – 4.0	1.0 – 2.0	Indented by thumb but penetrated only with great effort
Hard	> 30	> 4.0	> 2.0	Indented by thumbnail with difficulty

* Using SPT N_{60} is considered a crude approximation for cohesive soils.

APPARENT DENSITY OF COHESIONLESS SOILS (AASHTO 1988)	
Descriptor	SPT N_{60} Value (blows/foot)
Very Loose	0 – 4
Loose	5 – 10
Medium Dense	11 – 30
Dense	31 – 50
Very Dense	> 50

MOISTURE (ASTM D2488-06)	
Descriptor	Criteria
Dry	Absence of moisture, dusty, dry to the touch, well below optimum moisture content (per ASTM D698 or D1557)
Moist	Damp but no visible water
Wet	Visible free water, usually soil is below water table, well above optimum moisture content (per ASTM D698 or D1557)

PERCENT OR PROPORTION OF SOILS (ASTM D2488-06)	
Descriptor	Criteria
Trace	Particles are present but estimated < 5%
Few	5 – 10%
Little	15 – 25%
Some	30 – 45%
Mostly	50 – 100%
Percentages are estimated to nearest 5% in the field. Use "about" unless percentages are based on laboratory testing.	

SOIL PARTICLE SIZE (ASTM D2488-06)	
Descriptor	Size
Boulder	> 12 inches
Cobble	3 to 12 inches
Gravel - Coarse Fine	¾ inch to 3 inches No. 4 sieve to ¾ inch
Sand - Coarse Medium Fine	No. 10 to No. 4 sieve (4.75mm) No. 40 to No. 10 sieve (2mm) No. 200 to No. 40 sieve (.425mm)
Silt and Clay ("fines")	Passing No. 200 sieve (0.075mm)

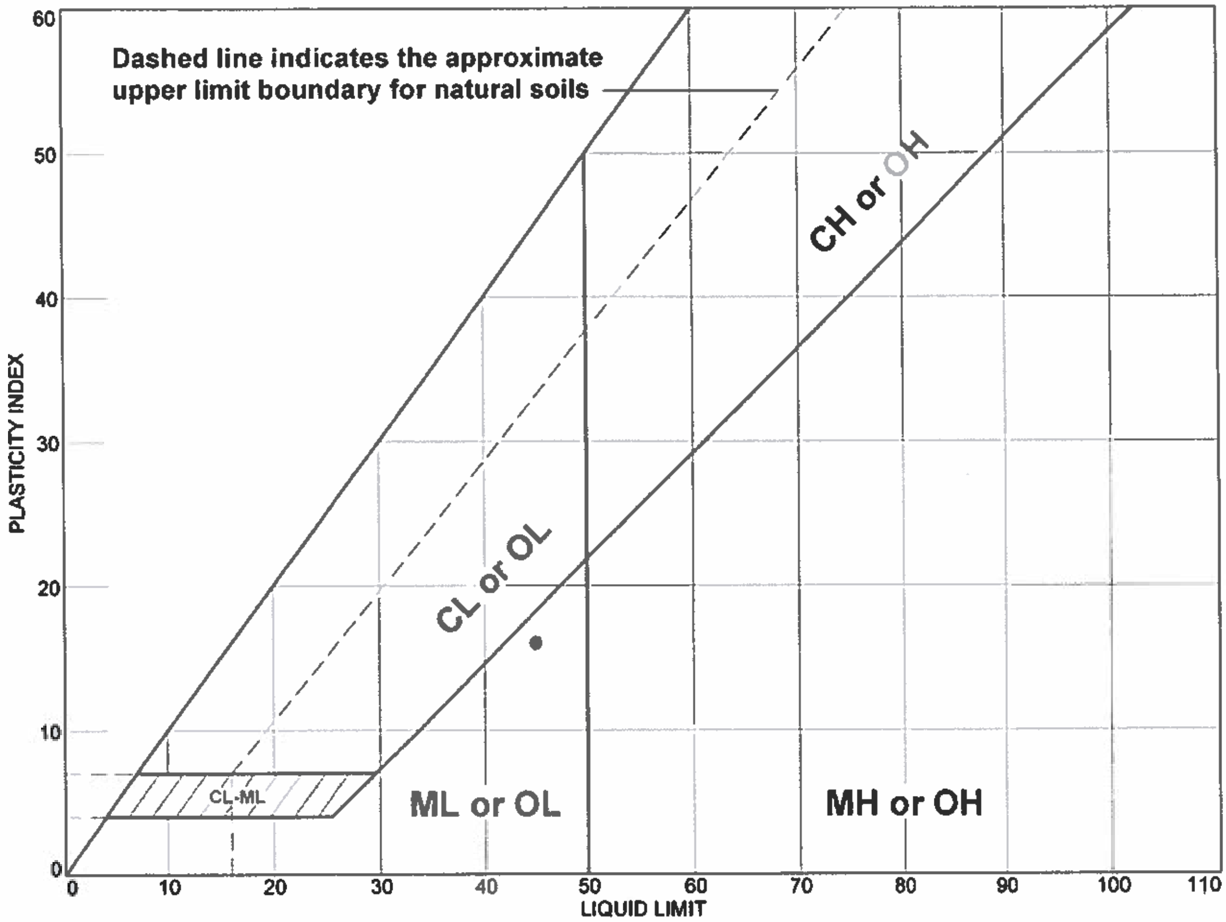
UNIFIED SOIL CLASSIFICATION SYSTEM (ASTM D2488)				
Major Division			Group Symbol	Description
Coarse Grained Soils	Gravel (50% or more retained on No. 4 sieve)	Clean Gravel	GW	Well-graded gravels and gravel-sand mixtures, little or no fines
			GP	Poorly graded gravels and gravel-sand mixtures, little or no fines
		Gravel with fines	GM	Silty gravels and gravel-sand-silt mixtures
			GC	Clayey gravels and gravel-sand-clay mixtures
(more than 50% retained on #200 sieve)	Sand (> 50% passing No. 4 sieve)	Clean sand	SW	Well-graded sands and gravelly sands, little or no fines
			SP	Poorly-graded sands and gravelly sands, little or no fines
		Sand with fines	SM	Silty sands and sand-silt mixtures
			SC	Clayey sands and sand-clay mixtures
Fine Grained Soils	Silt and Clay (liquid limit < 50)		ML	Inorganic silts, rock flour and clayey silts
			CL	Inorganic clays of low-medium plasticity, gravelly, sandy & lean clays
			OL	Organic silts and organic silty clays of low plasticity
(50% or more passing #200 sieve)	Silt and Clay (liquid limit > 50)		MH	Inorganic silts and clayey silts
			CH	Inorganic clays or high plasticity, fat clays
			OH	Organic clays of medium to high plasticity
Highly Organic Soils			PT	Peat, muck and other highly organic soils

EARTH ENGINEERS
An RIMA Company

GRAPHIC SYMBOL LEGEND	
GRAB	Grab sample
SPT	Standard Penetration Test (2" OD), ASTM D1586
ST	Shelby Tube, ASTM D1587 (pushed)
DM	Dames and Moore ring sampler (3.25" OD and 140-pound hammer)
CORE	Rock coring

Appendix E – Report of Atterberg Limits Testing

APPENDIX E - LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	gray silt	45	29	16	100	90.3	ML

Project No. *10*-23086-1-*R2* **Client:** Maxine Siegel

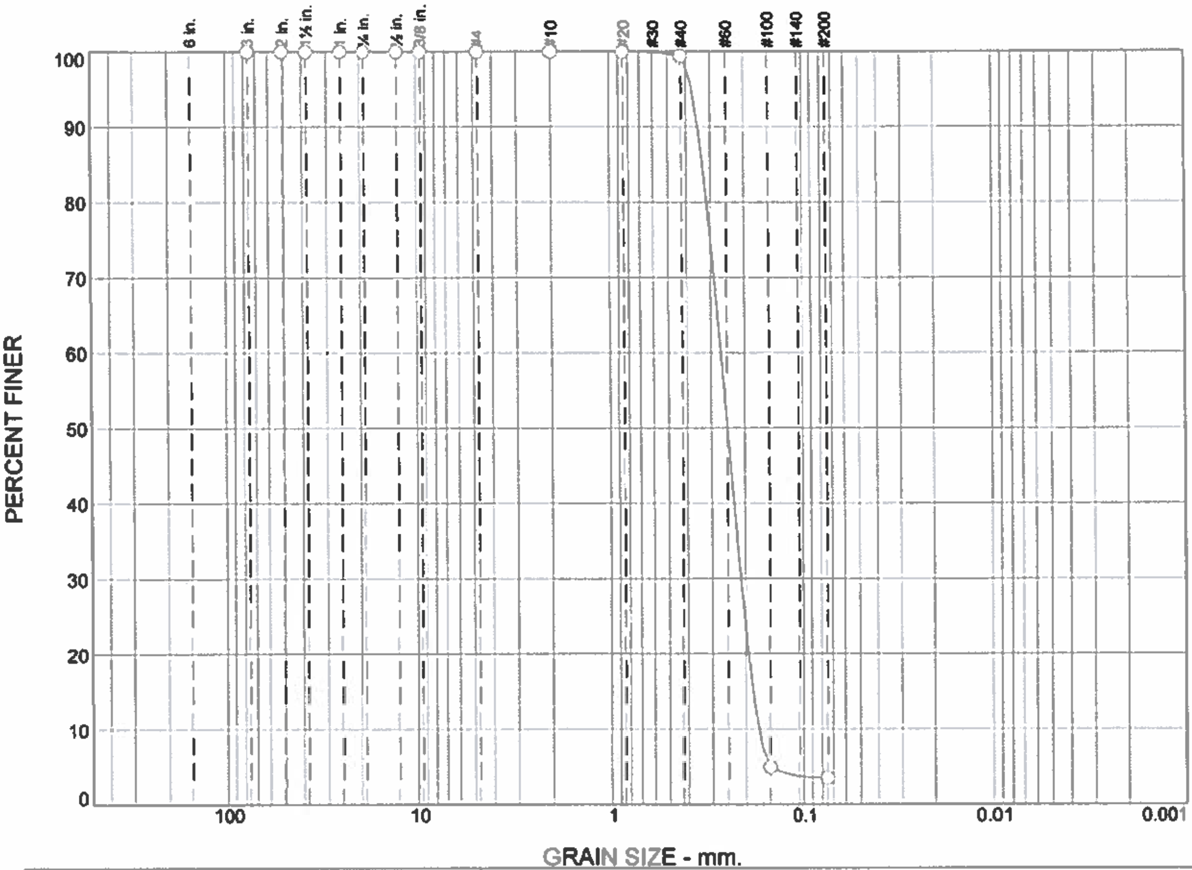
Project: Proposed Shoreline Protection Structure

● **Source of Sample:** Test Pit TP-1 **Depth:** 2' **Sample Number:** Grab 2

EARTH ENGINEERS
An RMA Company

Appendix F – Report of Gradation

APPENDIX F - PARTICLE SIZE DISTRIBUTION REPORT



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	0.0	0.0	0.6	95.9	3.5	

SOIL DATA

	SOURCE	SAMPLE NO.	DEPTH (ft.)	Material Description	USCS
○	Test Pit TP-2	Grab 5	9'	poorly graded sand	SP

EARTH ENGINEERS

Client: Maxine Siegel

Project: Proposed Shoreline Protection Structure

Project No.: *10-23086-1-R2*

Appendix G – Nearby Historic Well Logs

STATE OF OREGON
GEOTECHNICAL HOLE REPORT
(as required by OAR 690-240-035)

RECEIVED AUG 2 2 2001
WATER RESOURCES DEPT
SALEM, OREGON

CLAT 51190

Hole Number 2

(1) OWNER/PROJECT:
Name STEVE MARTIN MAG CO
Address PO BOX 219
City CANNON BEACH State OR Zip 97110

(2) TYPE OF WORK
[X] New [ ] Deepening [ ] Alteration (repair/recondition) [ ] Abandonment

(3) CONSTRUCTION:
[ ] Rotary Air [ ] Hand Auger [ ] Hollow Stem Auger
[X] Rotary Mud [ ] Cable Tool [ ] Push Probe [ ] Other

(4) TYPE OF HOLE:
[X] Uncased Temporary [ ] Cased Permanent
[ ] Uncased Permanent [ ] Slope Stability [ ] Other

(5) USE OF HOLE:
GEOTECH

(6) BORE HOLE CONSTRUCTION:
Special Construction approval [ ] Yes [X] No Depth of Completed Hole 40 ft.

HOLE Diameter	From	To	SEAL Material	From	To	Sacks or pounds
5"	40	0	Bent Grout	40	20	20 Gal
			Bent Chip	20	1	4 Sk
			Concrete			

Backfill placed from ___ ft. to ___ ft. Material ___
Filter Pack placed from ___ ft. to ___ ft. Size of pack ___

(7) CASING/SCREEN:

	Diameter	From	To	Gauge	Steel	Plastic	Welded	Threaded
Casing:					[ ]	[ ]	[ ]	[ ]
					[ ]	[ ]	[ ]	[ ]
					[ ]	[ ]	[ ]	[ ]
		NA			[ ]	[ ]	[ ]	[ ]
Screen:					[ ]	[ ]	[ ]	[ ]
					[ ]	[ ]	[ ]	[ ]

Slot size ___

(8) WELL TEST:
[ ] Pump [ ] Bailer [ ] Air [ ] Flowing Artesian
Permeability ___ Yield ___ GPM ___
Conductivity ___ PH ___
Temperature of water 58 °F/C Depth artesian flow found ___ ft.
Was water analysis done? [ ] Yes [X] No
By whom? ___
Depth of strata analyzed. From ___ ft. to ___ ft.
Remarks: ___

(9) LOCATION OF HOLE by legal description:
County Clatsop Latitude ___ Longitude ___
Township 5 (N) or S Range 10 E or (W) WM.
Section 31 SE 1/4 SW 1/4
Tax Lot 1200 Lot ___ Block ___ Subdivision ___
Street Address of Well (or nearest address) INTERSEC. OF PACIFIC HWY 101 & MELCHENA AVE
Map with location identified must be attached

(10) STATIC WATER LEVEL:
8½ ft. below land surface. Date 7/25/01
Artesian pressure ___ lb. per square inch. Date ___

(11) SUBSURFACE LOG:
Ground Elevation ___

Material Description	From	To	SWL
~~Base Rock~~ Asphalt/Base	0	1½	
Silt & Wood	1½	19	8½
Sand Grey	19	38	
Grey Mud Stone	38	40	

Date Started 7/25/01 Date Completed 7/25/01

(12) ABANDONMENT LOG:

Material Description	From	To	Sacks or Pounds
Bent Grout	40	20	20 Gal
Bent Chips	20	1	4 Sks
Concrete	1	0	

Date started 7/25/01 Date Completed 7/25/01

Professional Certification
(to be signed by a licensed water supply or monitoring well constructor, or Oregon registered geologist or civil engineer).

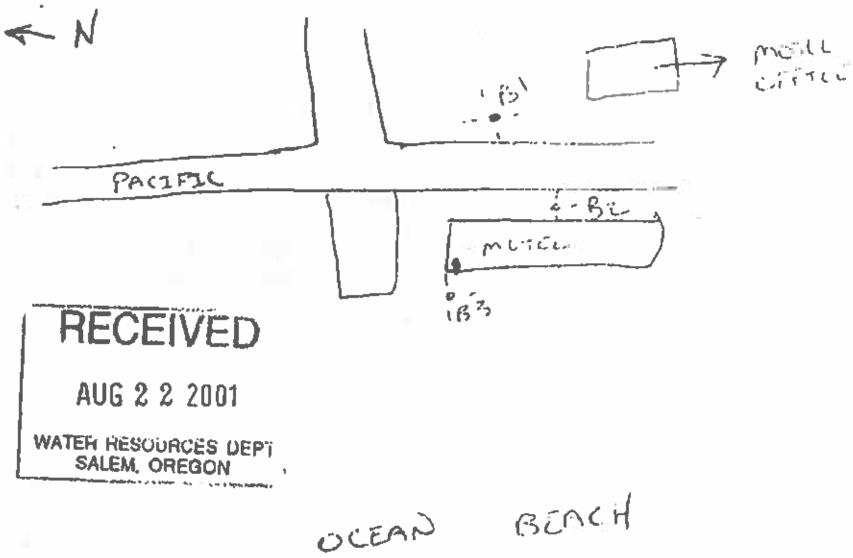
I accept responsibility for the construction, alteration, or abandonment work performed during the construction dates reported above. All work performed during this time is in compliance with Oregon's geotechnical hole construction standards. This report is true to the best of my knowledge and belief.

License or Registration Number 10306
Signed [redacted] Date 8-10-01
Affiliation SUBSURFACE TECH.

THIS REPORT MUST BE SUBMITTED TO THE WATER RESOURCES DEPARTMENT WITHIN 30 DAYS OF COMPLETION OF WORK

ORIGINAL - WATER RESOURCES DEPARTMENT FIRST COPY - CONSTRUCTOR SECOND COPY - CUSTOMER

CLAT 51190

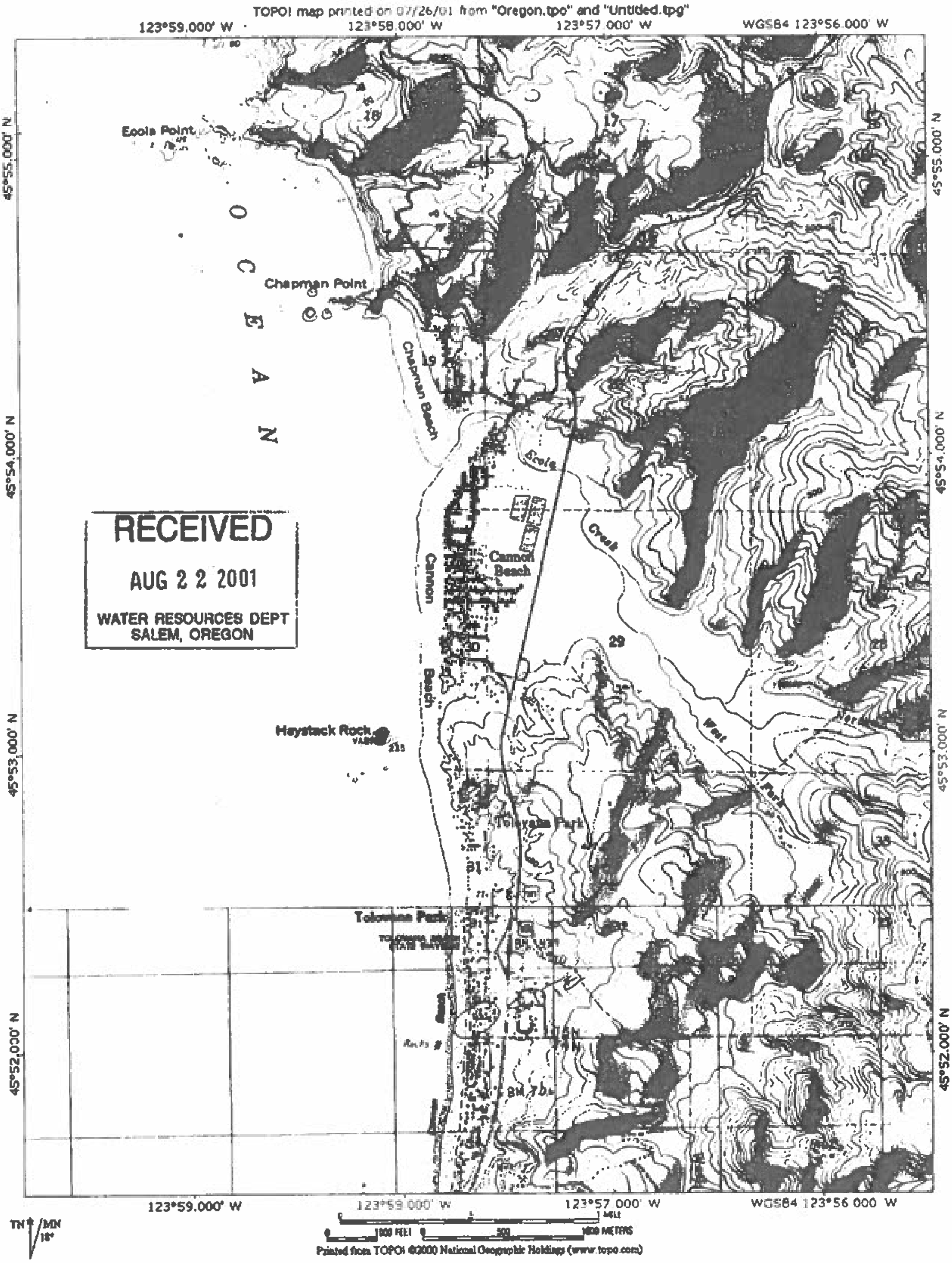


RECEIVED
AUG 2 2 2001
WATER RESOURCES DEPT
SALEM, OREGON

1" = 50'

CLAT 51190

TOPO! map printed on 07/26/01 from "Oregon.tpo" and "Untitled.tpg"



RECEIVED

AUG 2 2 2001

WATER RESOURCES DEPT
SALEM, OREGON

CLAT 51189

STATE OF OREGON
GEOTECHNICAL HOLE REPORT
(as required by OAR 690-240-035)

(1) OWNER/PROJECT: Hole Number B1
Name STEVE MARTIN MAG CO
Address PO BOX 219
City CANNON BEACH State OR Zip 97110

(2) TYPE OF WORK
[X] New [ ] Deepening [ ] Alteration (repair/recondition) [ ] Abandonment

(3) CONSTRUCTION:
[ ] Rotary Air [ ] Hand Auger [ ] Hollow Stem Auger
[X] Rotary Mud [ ] Cable Tool [ ] Push Probe [ ] Other

(4) TYPE OF HOLE:
[X] Uncased Temporary [ ] Cased Permanent
[ ] Uncased Permanent [ ] Slope Stability [ ] Other

(5) USE OF HOLE:
GEOTECH

(6) BORE HOLE CONSTRUCTION:
Special Construction approval [ ] Yes [X] No Depth of Completed Hole 30 ft.

HOLE			SEAL			
Diameter	From	To	Material	From	To	Sacks or pounds
5"	0	30	BENT CHIPS	30	0	6

Backfill placed from ____ ft. to ____ ft. Material ____
Filter Pack placed from ____ ft. to ____ ft. Size of pack ____

(7) CASING/SCREEN:

	Diameter	From	To	Gauge	Steel	Plastic	Welded	Threaded
Casing:					[ ]	[ ]	[ ]	[ ]
					[ ]	[ ]	[ ]	[ ]
		NA			[ ]	[ ]	[ ]	[ ]
					[ ]	[ ]	[ ]	[ ]
Screen:					[ ]	[ ]	[ ]	[ ]
					[ ]	[ ]	[ ]	[ ]

Slot size

(8) WELL TEST:
[ ] Pump [ ] Bailer [ ] Air [ ] Flowing Artesian
Permeability ____ Yield ____ GPM
Conductivity ____ PH ____
Temperature of water 58 °F/C Depth artesian flow found ____ ft.
Was water analysis done? [ ] Yes [X] No
By whom?
Depth of strata analyzed. From ____ ft. to ____ ft.
Remarks:

(9) LOCATION OF HOLE by legal description:
County CLATSOP Latitude ____ Longitude ____
Township 5 N or S Range 10 E or W WM.
Section 31 SE 1/4 SW 1/4
Tax Lot 1200 Lot ____ Block ____ Subdivision ____
Street Address of Well (or nearest address) INTERSECT. OF PACIFIC ST & MELCHING AVE

Map with location identified must be attached

(10) STATIC WATER LEVEL:
9 ft. below land surface. Date 7/25/01
Artesian pressure ____ lb. per square inch. Date ____

(11) SUBSURFACE LOG:
Ground Elevation ____

Material Description	From	To	SWL
BR SILT	0	18	9
BR SAND	18	30	

Date Started 7/25/01 Date Completed 7/25/01

(12) ABANDONMENT LOG:

Material Description	From	To	Sacks or Pounds
BENT CHIPS	30	0	6

RECEIVED
AUG 22 2001
WATER RESOURCES DEPT
SALEM, OREGON

Date started 7/25/01 Date Completed 7/25/01

Professional Certification
(to be signed by a licensed water supply or monitoring well constructor, or Oregon registered geologist or civil engineer).

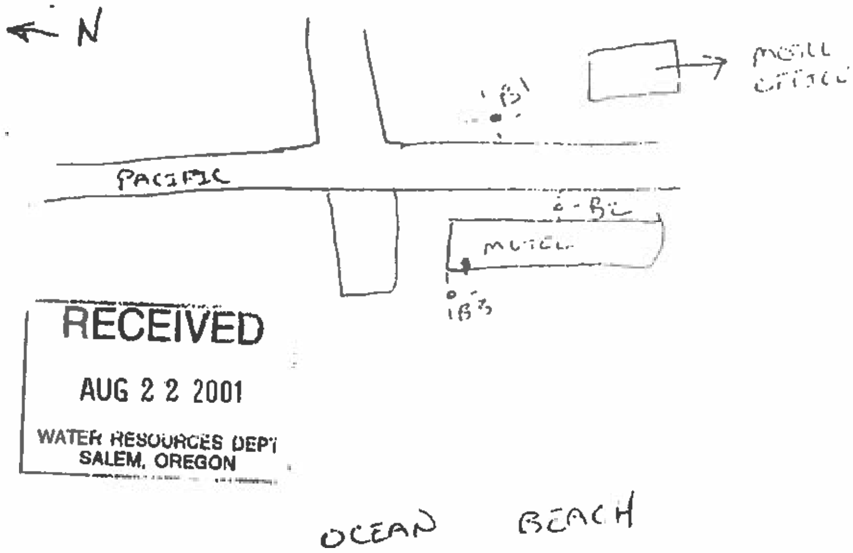
I accept responsibility for the construction, alteration, or abandonment work performed during the construction dates reported above. All work performed during this time is in compliance with Oregon's geotechnical hole construction standards. This report is true to the best of my knowledge and belief.

License or Registration Number 10306
Signed [redacted] Date 8-10-01
Affiliation SUBSURFACE TECH.

THIS REPORT MUST BE SUBMITTED TO THE WATER RESOURCES DEPARTMENT WITHIN 30 DAYS OF COMPLETION OF WORK

ORIGINAL - WATER RESOURCES DEPARTMENT FIRST COPY - CONSTRUCTOR SECOND COPY - CUSTOMER

CLAT 51189

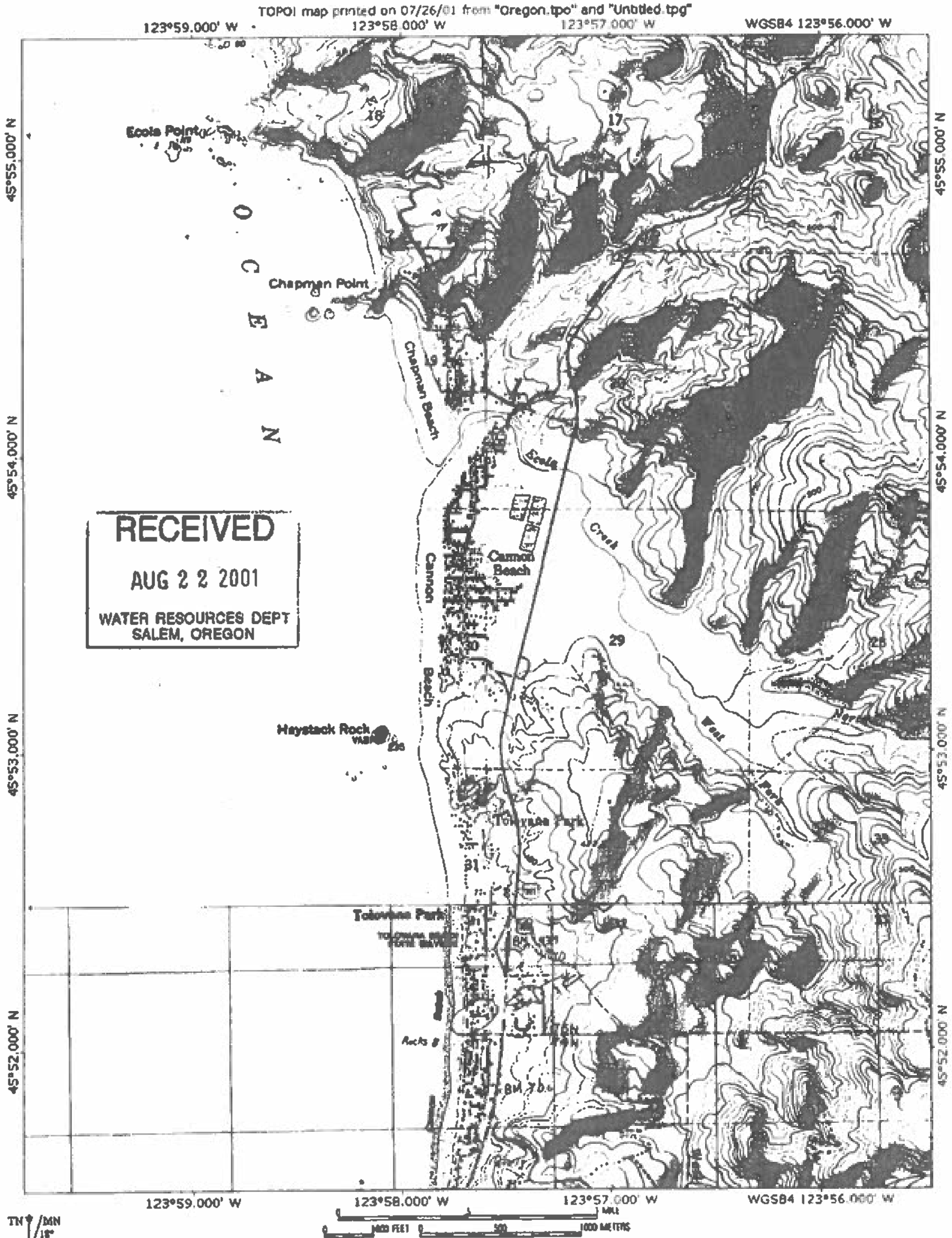


RECEIVED
AUG 2 2 2001
WATER RESOURCES DEPT
SALEM, OREGON

1" = 50'

CLAT 51189

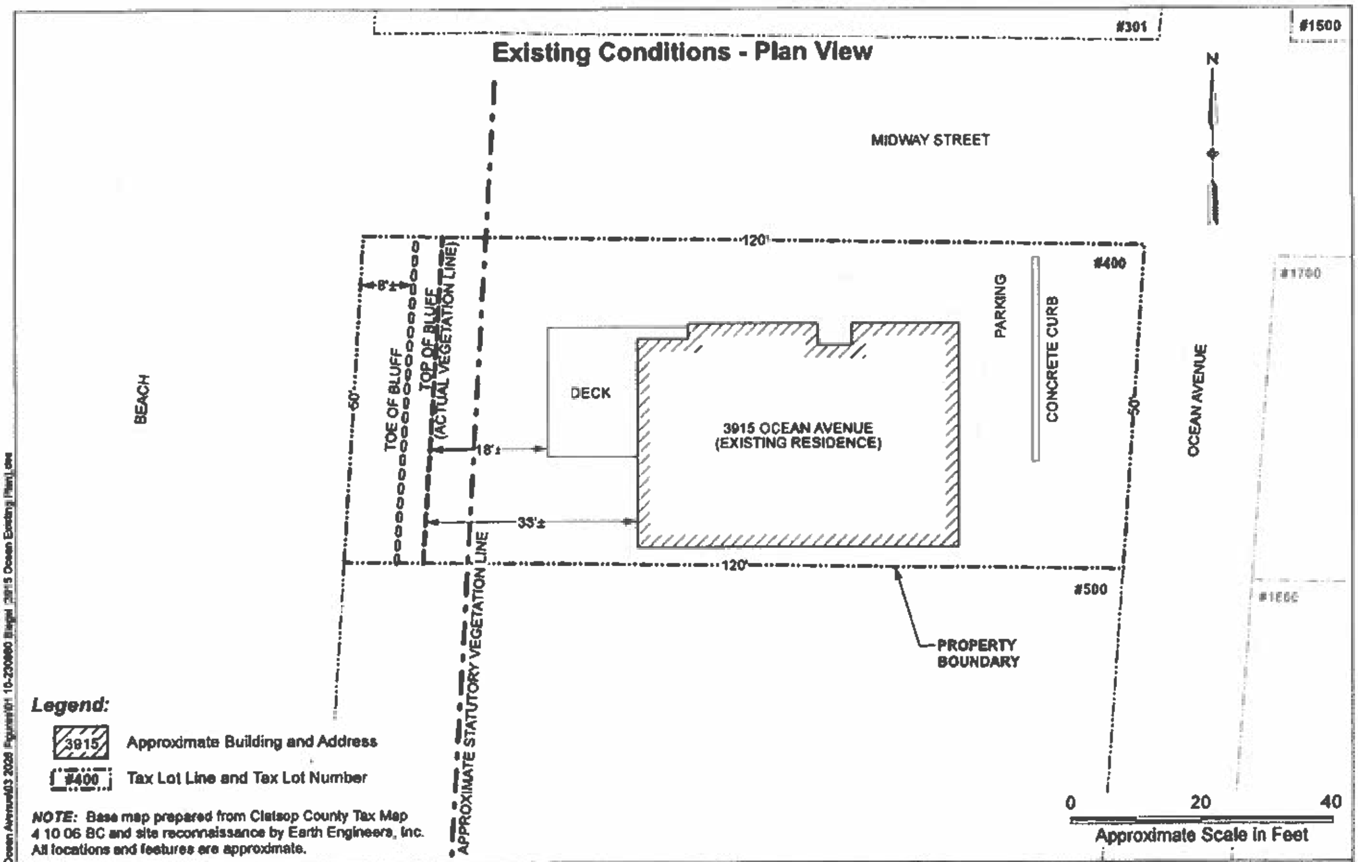
TOPO! map printed on 07/26/01 from "Oregon.tpo" and "Untitled.tpg"



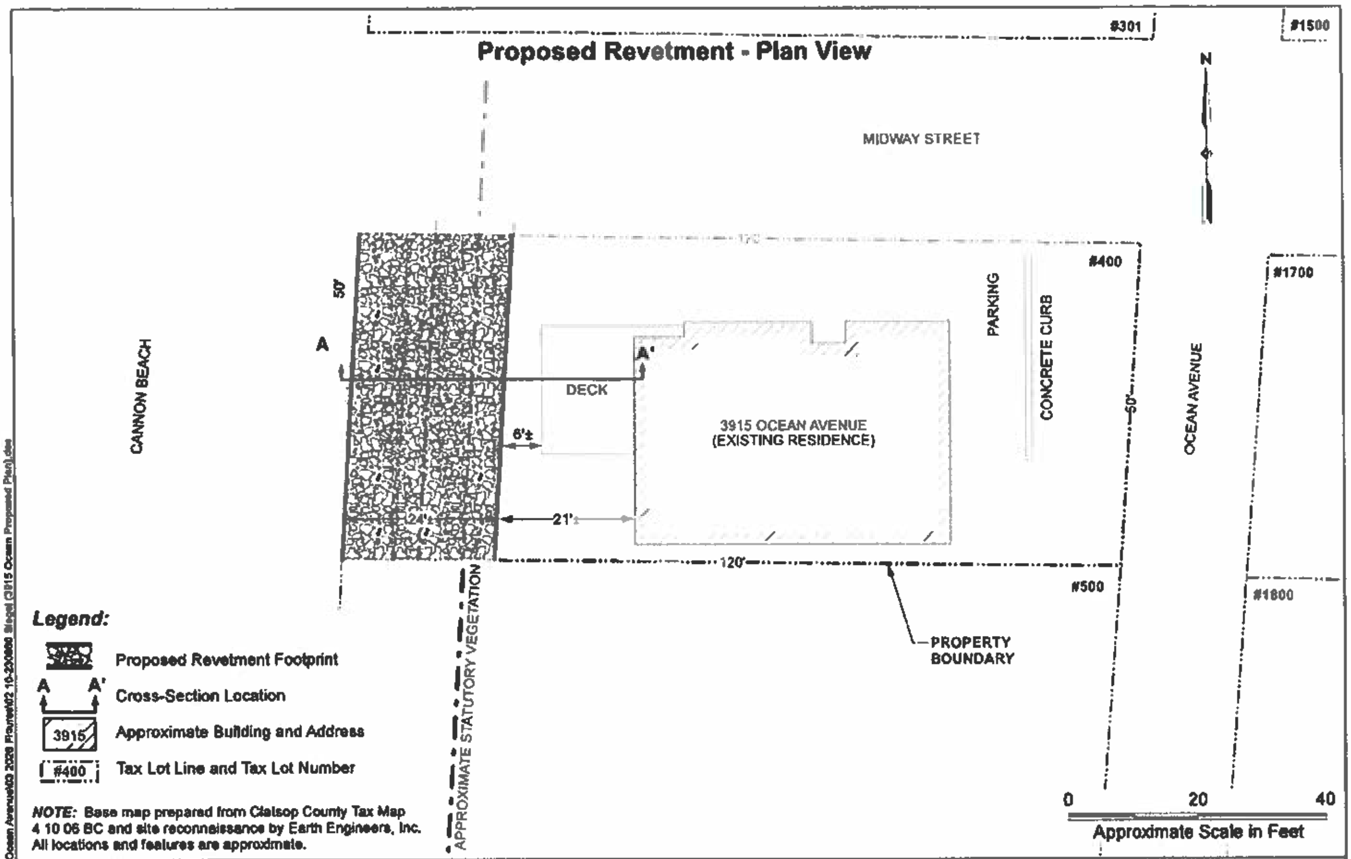
Printed from TOPO! ©2000 National Geographic Holdings (www.topo.com)

Appendix H – Proposed Revetment Plan View

Existing Conditions - Plan View



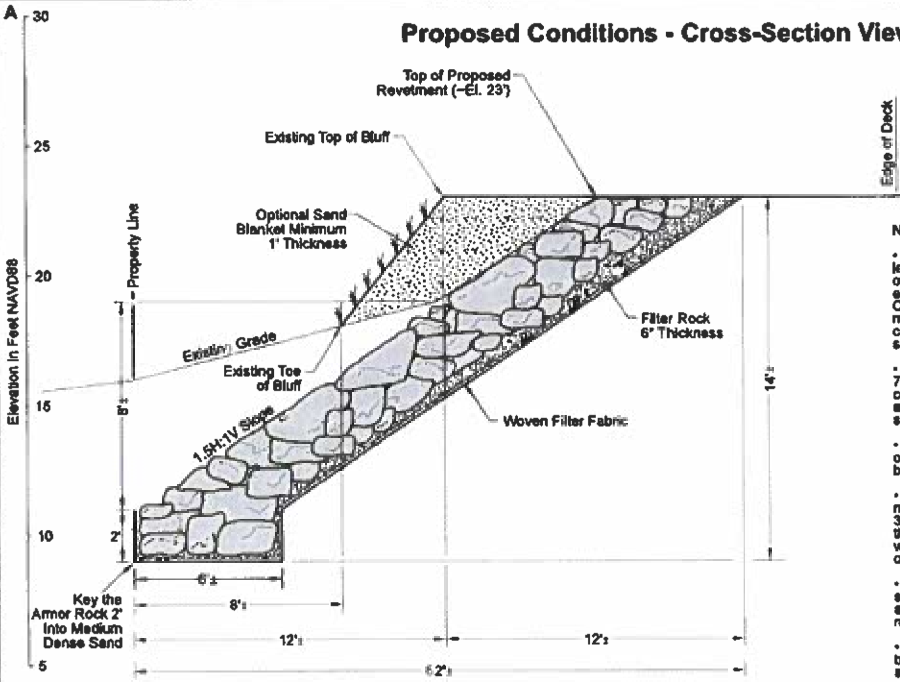
CERTERRA EARTH ENGINEERS	Proposed Shoreline Protection Structure 3915 Ocean Avenue Cannon Beach, Clatsop County, Oregon	Report No. 10-230860-01-R5	June 11, 2026



CERTERRA EARTH ENGINEERS	Proposed Shoreline Protection Structure 3915 Ocean Avenue Cannon Beach, Clatsop County, Oregon	Report No. 10-230860-01-R5	June 11, 2026

Appendix I – Proposed Revetment Section View

Proposed Conditions - Cross-Section View



NOTES:

- The base of the riprap should be embedded at least 2 feet into dense sand (i.e., at an elevation of approx. 8 to 9 feet NAVD88). The final toe elevation should be verified and approved by Certerra during construction, as field conditions may warrant adjustment. If embedment depths cannot be achieved due to heaving or flowing sands, dewatering will be necessary.
- A woven geotextile filter fabric (Mirafi Filterweave 700, or approved equivalent) shall be installed continuously between the native subgrade soils and the overlying filter rock, with seams overlapped sufficiently to prevent migration of fines.
- Overlying the filter fabric, a 6-inch-thick layer of pit run (approximately 4-inch minus) shall be placed at a slope angle of 1.5H:1V.
- An armor rock layer composed of durable, non-weathered, angular basalt ranging from 3 to 8 feet in diameter shall be installed over the filter rock to a minimum thickness of 7 feet, with individual rocks interlocked at a minimum of three points of contact.
- The revetment slope exposed to wave action shall be constructed at approximately 1.5H:1V, and the crest of the revetment shall be built to a minimum elevation of 23 feet (NAVD88).
- Following construction, the revetment should be covered with a 1 to 2-foot thick blanket of sand and planted with native vegetation.

Legend:

Proposed Armor Rock

Proposed Filter Rock with Filter Fabric

Proposed Pit Run Fill

0 5 10

Approximate Scale in Feet

CERTERRA EARTH ENGINEERS	Proposed Shoreline Protection Structure 3915 Ocean Avenue Cannon Beach, Clatsop County, Oregon	Report No. 10-230860-01-R5	June 11, 2026

David P. Simpson
Coastal Engineer

May 19, 2025

William Rasmussen, Partner
Miller Nash LLP
1140 S.W. Washington St., Suite 700
Portland, OR 97205

Dear Mr. Rasmussen:

This letter is to provide a coastal engineering opinion on two aspects pertinent to the Siegel oceanfront residence at 3915 Ocean Avenue, Cannon Beach, Oregon. The first is likely risks from damage by ocean storm waves attacking the shoreline and bluff that fronts the residence. The second is examination of measures that could mitigate those risks which leads to a recommendation regarding bluff protection. My opinion contained here is based on my familiarity with coastal processes on the Oregon coast, particularly on the northern coast; on reading the Geotechnical Investigation and Design Report by Earth Engineers Inc. dated January 30, 2024 (EEI report); on reviewing the Council presentation slides created by William Rasmussen dated March 5, 2025; and my professional experience in performing coastal engineering projects since 1978. I performed a site visit on May 10, 2025, to assess this specific property and its coastal processes setting. This letter is submitted to Miller Nash LLP by agreement between William Rasmussen, Esq. and David Simpson, P.E.

Professional Background

My engineering experience has been in consulting, government and research. I served as project engineer, project manager, and senior reviewer for waterfront structure, coastal processes, shore protection, and nearshore restoration projects since 1978. My training and experience focused on wave mechanics, hydraulics, sediment transport, wave runup and forces on structures, wave transmission past structures, numerical modeling of coastal processes, and design of coarse grain beaches. I have conducted coastal flooding studies and Flood Insurance Rate Map revisions since 1992.

<u>Education</u>
MS, Ocean Engineering, University of Washington, 1976
BS, Oceanography, University of Washington, 1974
BS, Geology, University of Washington, 1974
Completed coursework for Ph.D. in Coastal Engineering, University of Florida, 1988

<u>Registrations</u>
Professional Engineer, Washington State #23527, since 1986
Licensed Geologist, Washington State #2333, since 2003

Memberships
Coastal Research and Education Foundation (CERF)
Society for Sedimentary Geology (SEPM)
Tau Beta Pi Association (Engineering Honor Society)

Employment History
I began professional work in 1976 at the Portland District of the U.S. Army Corps of Engineers. In 1978 I began conducting planning studies and preliminary designs of coastal projects. In 1986 I transferred to the Corps' laboratories, working as a Research Hydraulic Engineer in Coastal Processes Branch of the Coastal Engineering Research Center. In 1990 I entered consulting engineering and performed analyses, modeling, and designs of coastal projects around the world. I have authored or co-authored more than 30 professional papers and conference presentations in the areas of coastal engineering, hydraulics, and sediment transport. In 2020 I retired from full-time employment.

Project Setting
The Siegel residence location and associated geological setting are described in the Geotechnical Investigation and Design Report (EEI report). The residence is situated in a littoral cell that has a continuous beach of medium-size sand that extends from Ecola Point in the north to Arch Cape in the south. Measurements taken on May 10, 2025, of the bluff fronting the Siegel residence show that a clay layer is present to a height of about 30 inches above beach level. The exposed clay layer shows evidence of material loss by wetting and drying and erosion, but it is more resistant than the overlying sand. The seaward slope of the clay layer was about 30 degrees from horizontal. The sand layer was eroded farther into the bluff than the clay layer and stood at a vertical slope although material was easily scraped from the exposed surface. The sand layer consists of nearly all sand, with only an occasional gravel-size piece. The sand layer was devoid of vegetation for a height of about 37 inches above the clayey layer except for rhizomes of beach grass that grows above. Figure 1 shows the bluff features on the ocean side looking south.

The basalt rock in the photograph is at the toe of the bluff of the neighboring property to the south and is interpreted to be from a failed structure. Measurements of those rock dimensions and assumption of usual basalt unit weight led to the estimation that the largest rock weighed about 275 pounds. The average estimated weight of those measured was about 140 pounds. At the third and fourth property south of Siegel's a rock revetment has been constructed at the toe of the bluff. The rock is of good quality, good aspect ratio (close to cubical), was moderately well placed, and appears stable and effective in protecting the bluff. Measurements of rock dimensions indicate the average weight is about 450 pounds. The largest size is estimated to be 1000 pounds. Two open-ended pipes for discharging upland water runoff were observed to penetrate the bluff to the south of Siegel's residence in the distance to the next beach access point. The four-inch-diameter polypropylene pipe is about 40 inches above beach level. Large drift logs are abundant on the fronting beach. A log in front of the Siegel bluff measured 30 inches in diameter by 18 feet long.

Figure 1. Unvegetated clay layer and sand exposed at Siegel bluff. Folding rule is one-foot square, for scale. May 10, 2025.

A large stormwater discharge facility with a flap gate is located a short distance north of the beach stairs that abuts the Siegel residence. Cobbles have been spread over the path of water discharged from this municipal outfall and they appear to effectively control beach erosion at that spot. No shore protection structure was observed north of the stormwater outfall. Two predominantly clay layers are exposed in this northern shoreline reach, and are marked by different color material. They are somewhat resistant but evidently are eroded frequently enough that vegetation does not root in the exposed face.

Coastal Processes Affecting the Site

Wave Climate. The DOGAMI report Coastal Flood Hazard Study, Clatsop County, Oregon (Open-File Report O-15-5, page 75) states: "The wave climate offshore from the Oregon coast is one of the most extreme in the world, with winter storm waves regularly reaching heights in excess of several meters." The study developed a synthesized offshore wave climate for use in numerical modeling of waves reaching the shore at this site and running up on the shore as a source of flooding as a step in creating FEMA floodmaps. Wave information was developed from measurements at data buoys offshore of Oregon. A portion of Figure 5-7 from the report, shown in Figure 2 below, illustrates the simulated significant wave heights for the years 1980 to 2012. Hs, the significant wave height (average of the highest one-third of the waves in the wave field) is given in meters. The figure shows the simulated occurrence of many significant wave heights exceeding 10 meters (32 feet) and two occurrences of Hs reaching 14 meters (46 feet) in that 33-year period. The resulting wave height that reaches the shore, after energy loss through many mechanisms, depends greatly on the water level occurring at the time.

Figure 2. Numerically simulated values for significant wave height 1980-2012 at offshore boundary of Clatsop County Flood Insurance Study. Source: DOGAMI Open-File Report O-15-5)

Sediment Dynamics. Net sediment transport in Oregon littoral cells, accounting for generally northward transport in the winter and southward transport in the summer and averaged over many years, is essentially zero according to Komar (*Living with the Shores of Oregon and Washington*, 1997, Duke University Press) and many other researchers. El Nino winters are responsible for intense transport from the southern end of a cell to the northern end where the sand accumulates, until a different climatological mechanism causes the sand to move southward. Allen, Gabel, and O'Brien (Beach and Shoreline Dynamics in the Cannon Beach Littoral Cell: Implications for Dune Management, 2018, DOGAMI Special Report 49) conclude that sand is being removed from the Tolovana Park part of the Cannon Beach littoral cell, which contains the project site, and is accumulating in the northern part of the Cannon Beach cell. Relative beach width at the two locations as observed in aerial photographs is consistent with that conclusion. The change in dry beach width is at Haystack Rock.

Allen and others state that sand supply to the beach segment in Tolovana Park is primarily from bluff erosion and note that much of the bluff toe in this reach is hardened with erosion control structures. The question naturally arises whether erosion control structures deny sediment to the littoral system and significantly exacerbate erosion downdrift. A plot of net shoreline change in the Tolovana Park portion of the cell for the years 1997 to 2009 (DOGAMI Open-File Report O-15-5, Coastal Flood Hazard Study, Figure 3-14) shows shoreline retreat of about 10 feet. The EEI report states the Stiegel bluff retreated 10 feet in 10 years. These are somewhat consistent numbers that yield an average of about one foot of bluff retreat per year. Average rates, however, do not represent the year-to-year variability. Randomness of storm wave heights over time leads to the finite probability that in any year the bluff's protective ability could be completely compromised. As a means of visualizing the order of magnitude of the process, the average rate applied over a six-foot-high bluff of a 50-foot-wide lot yields 11 cubic yards of sediment annually, or 0.22 cubic yards per foot of beach alongshore. Allen reports an estimate by Peterson and others that in the 1982-83 El Nino 6,300,000 cubic yards of sand was displaced in the 4.6-mile beach from Yachats to Seal Rock. That averages to about 260 cubic yards per foot of beach. Realizing there are great differences between these locations, the El Nino was extreme, and that Peterson's methodology might have been non-conservative, comparison of these two volumetric rates gives some sense of proportion, and point to natural surfzone processes as far overshadowing bluff erosion in Tolovana Park as the sediment source for the littoral cell.

The abundance of sediment in the downdrift end of the cell (north of Haystack Rock and especially north of the Ecola Creek mouth) is worthy of examination in possible relation to shore protection structures in Tolovana Park. The Coastal Flood Hazard Study dismissed with only qualitative consideration any sediment contribution of Ecola Creek to the northern part of the cell. The width of the beach at the creek mouth and the nearly uniform channel width to the mouth should indicate that the creek is a sediment contributor of some magnitude. Stream gauging or use of precipitation runoff modeling and a sediment rating curve developed for Ecola Creek could help confirm the influence of Ecola Creek on sediment supply to the cell.

Aerial photographs reveal a distinct difference in dry beach width between the segments north and south of Haystack Rock. The salient that formed behind Haystack Rock shows that the Rock influences wave direction and sediment transport intensity. When waves approach from the northerly quarter, waves diffracting around the south side of the rock will have a component to the north in the lee of the rock. A wave shadow will also exist behind Haystack Rock. Thus, north-to-south transport in the segment north of Haystack Rock will slow because of the opposing component of wave forces and decreased wave energy at that point. South-to-north sand transport along the beach is also slowed at Haystack Rock but the supply rate to the Tolovana Park reach is evidently lower than to the Cannon Beach reach. This would be an explanation for the narrower beach south of Haystack Rock than north of it.

In summary, my opinion is that natural processes are a greater source of sediment budget deficit at this location, and not prevention of bluff erosion in front of developments. More sand is transported northward from Tolovana Park than is added to this location by all sources. Sand added to the littoral stream by bluff erosion at Tolovana Park will eventually be transported northward and not nourish the fronting beach. Southward transport of sand from Cannon Beach is inhibited by natural processes. Comparing the volumetric rates involved, preventing bluff erosion at the Siegel property will have no measurable effect on the sediment budget. The cumulative effect of existing bluff protection structures is unlikely to be measurable, either.

Potential for Damage of Siegel Residence

Flooding Risk. FEMA's Flood Insurance Rate Map panel 41007C0652F, effective date June 20, 2018, shows the deck which is connected to the residence is in Coastal Flood Hazard Zone VE, Elevation 23 ft (based on NAVD 88 datum), as shown in Figure 3. The designation Zone VE is described by the National Flood Insurance Program (44 CFR Ch. 1 Section 64.4) as "Area of special flood hazards, with water surface elevations determined and with velocity, that is inundated by tidal floods (coastal high hazard area)". Criteria for mapping a coastal zone subject to wave runup and overtopping as VE are determined according to the type of wave overtopping onto the upland in the one-percent-average-annual chance wave storm and water level event (Base Flood Event, BFE). VE Zones are where wave action and/or high-velocity water can cause structural damage to a typically built house in the BFE.

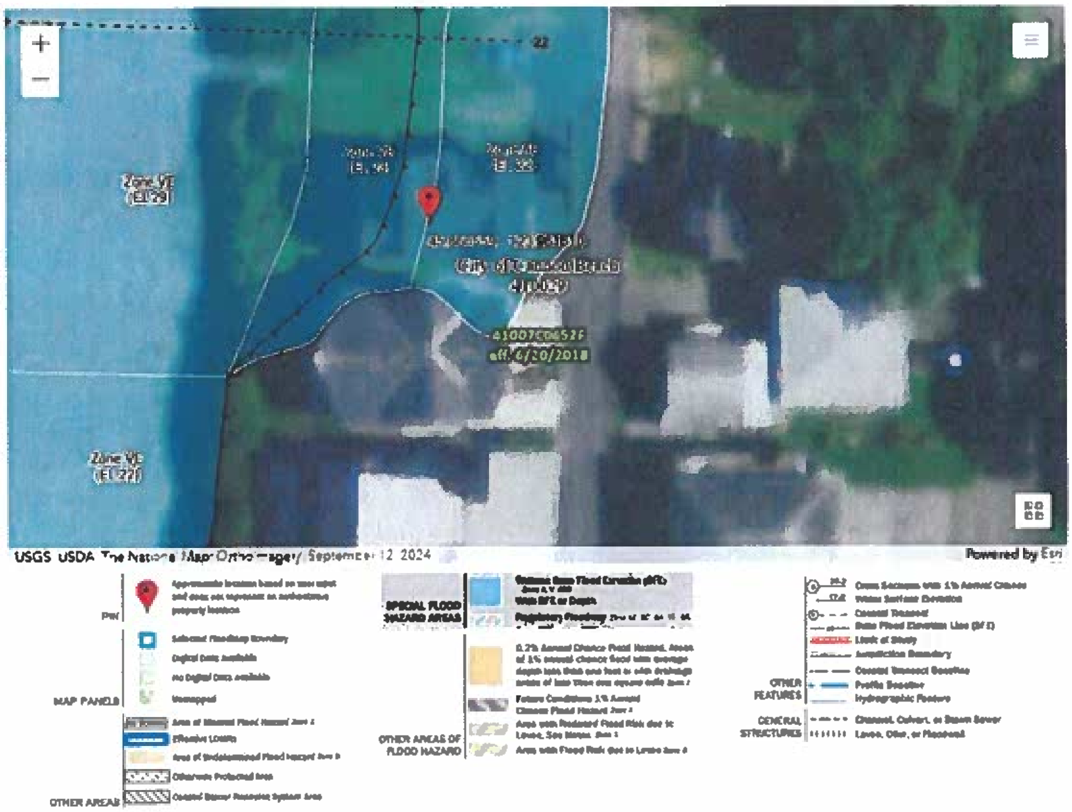


Figure 3. Portion of Flood Insurance Rate Map including the Siegel residence

Considering the 23-foot V Zone elevation and the ground profile shown in Appendix I of the EEI report, I conclude that the type of wave overtopping that was simulated for mapping hazard zones at this site was splash overtopping. Debris on the lawn shown in

Photo 2 of the report verifies the occurrence of splash overtopping. Splash overtopping occurs when waves break seaward of the face of the structure, or where the barrier is high in relation to the wave height, and overtopping is a stream of droplets. Splash overtopping water and debris can be carried over the barrier under its own momentum or may be driven by onshore wind. Hazard zones in the case of splash overtopping are determined based on inland extent of the overtopping water flow and on the depth and force of flow in any sheet flow areas.
Structural Damage Risk. Types of structural damage from coastal wave storms to which the Siegel residence is vulnerable include direct force of flowing water, impact by wave-carried debris, inundation by overland flowing water as specified in the definition of a VE Zone, and weakening of foundation soil strength which was addressed in the Earth Engineers report. Primary concern about the property and residence should be to control further erosion of the low bluff that fronts the property and protects it from all but extreme storms. Figures 3 and 4 in the Earth Engineers report show evidence of erosion at the bluff toe. Beach sand levels vary seasonally, but the observed loss of more competent and vegetated bluff material represents permanently diminished protection for the residence unless the bluff toe is reinforced with a properly engineered feature.

FEMA's Coastal Construction Manual, Chapter 4, states that for a building in coastal areas to be a success it must be capable of resisting damage from coastal hazards and coastal processes over a period of decades. The statement implies that the impacts of a design level flood, storm, wind, or erosion event (or series of lesser events with combined impacts equivalent to a design event) will be limited to the following:

- The building foundation should remain intact and functional.
- The envelope (lowest floor, walls, openings and roof) should remain structurally sound and capable of minimizing penetration by wind, rain, and debris.
- The lowest floor elevation must be sufficient to prevent floodwaters from entering the elevated building envelope during the design event.
- The utility connections (e.g. electricity, water, sewer, natural gas) should remain intact or be restored easily.
- The building should be accessible and usable following a design-level event.
- Any damage to enclosures below the design flood elevation should not result in damage to the foundation, the utility connections, or the elevated portion of the building.

If the bluff fronting the Siegel residence becomes completely compromised by erosion, structural damage to the house would likely result from occurrence of the Base Flood Event or a series of extreme storms, as enumerated in the vulnerabilities above. The effect of direct force of flowing water, even for a lesser storm than a BFE, is illustrated in Figure 4.

Figure 4. Damage by overtopping waves reaching a building (Discovery Bay, 2025)

The effect of impact by wave-carried debris is illustrated in Figure 5.

Figure 5. Potential for damage caused by debris carried onshore (Burien, 2007)

The effect of inundation by overland flowing water is illustrated in Figure 6.

Figure 6. Inundation of lawn and house foundation by waves (West Seattle, 2006)

The effect of foundation saturation and loss of soil strength is illustrated in Figure 7.

Figure 7. Settling and foundation failure from soil saturation (Fox Island, approx. 2000)

Planning and Design of Bluff Protection Measures

Purpose and Need. Two factors are listed in the EEI report (page 1) that are interpreted as the problem statement which bluff protection must address. The factors are the structure must protect the property from 1) ocean flooding and 2) structural damage caused by impact by ocean storm waves and debris and by erosion of foundation material. The bluff protects the property up to a certain intensity of ocean waves combined with tide level. As the bluff erodes farther inland the risk of loss of protection increases. Therefore, protection of the property against the two risks is most directly accomplished by protecting the bluff. Because of the random occurrence of storms and their intensity, the Siegel property faces a certain percent chance every year of experiencing an extremely damaging storm (often back-to-back storms) that would remove much of the bluff and expose the residence to direct attack. For this reason averaging a bluff retreat rate over a long time and assuming that is the rate that will happen next year is unwise. One must establish a storm intensity (statistically tied to a percent chance occurrence—the return-period storm) to which protection must function and maintain that level of protection every year.

The bluff's existing condition, with undercut bluff face and overhanging vegetation, is shown in Figure 8. The measured distance from the eroded face to the crest in cross-section is 9 ½ feet. The measured distance from the eroded face to the juncture of the landward slope with the flat lawn is 25 feet. If bluff retreat is allowed to continue to the back side the bluff elevation will begin to decrease, exposing the Siegel residence to even greater risk of wave overtopping and structural damage.

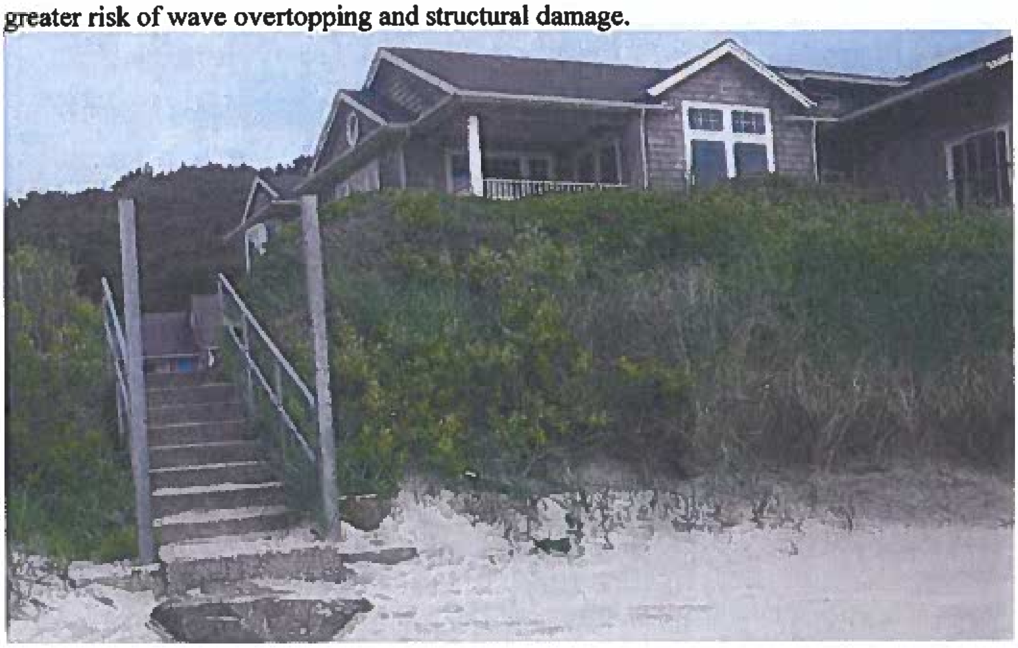


Figure 8. Eroding bluff that fronts the Siegel residence, May 10, 2025

<u>Alternatives for Bluff Protection.</u> Performance criteria must be established prior to and as a means of guiding development of alternative concepts for bluff protection. A project can be judged to operate successfully by meeting performance criteria. Any intervention to assure the integrity of the bluff must remain functioning in a storm environment up to the same level, at least, as the bluff's current protection of the property.

Frequency of occurrence and magnitude of event for ocean wave heights follow a probability distribution. Terms such as 100-year storm or 50-year storm are intuitively understood by most people. Those terms indicate a one-percent chance and two-percent chance of occurrence in any one year and imply very high magnitude events. Those would be historic storms. Public Law 93-251 authorized a demonstration program for constructing low-cost methods of shore protection at several sites in the US for monitoring performance and disseminating that information. Most of the device failures occurred during the Program's monitoring phase. A conclusion from the observations was that structures that can remain in place for the first few years will tend to remain in place for much longer than ten years. Design flaws seem to take their toll quickly. In view of this a **minimum 25-year design storm** was deemed warranted for shore protection structures (Shoreline Erosion Control Demonstration Program – Revisited, by Combe, Adrian J. III et. al, Office of the Chief of Engineers, USACE, Washington, D. C. 1988). Therefore, functioning according to design and without damage in a 25-year storm should be a minimum performance criterion for developing and analyzing alternative bluff protection alternatives. If one assumes a 30-year design life of a structure (typical length of a mortgage), there is a 70 percent chance of a 25-year storm occurring in that period. Those odds should indicate the seriousness of requiring a high level of certainty for designing protection for a bluff when the bluff is the last line of defense against flooding and damage of a residence.

Data used in developing exceedance frequency statistics (return periods for randomly distributed events) are measurements of past events. Analysis of long-term wave buoy data and other evidence indicate the wave climate of the West Coast of the U.S. is experiencing a secular increase in storminess. The annual highest waves appear to be slowly increasing. How long this will continue cannot be predicted. Including data as far back as the 1980s might narrow the uncertainty bounds for long return-period events, but introduces underprediction by missing the trend within the data. By using only more recent data inaccuracies are introduced by having large confidence bounds in predictions. The point is that choosing a minimum return-period event in developing performance criteria would result in nonconservative level of protection if those statistics are developed from long wave records. This would leave projects susceptible to unexpected flooding and damage from wave storms. For that reason selecting a design storm of greater magnitude than a 25-year return-period is recommended for bluff protection criteria.

Shore protection structure types are typically categorized as hard structures or alternative measures (sometimes called soft solutions). Examples of hard structures are seawalls and rock revetments. Examples of alternatives to hard structures include dynamic revetments, log structures, sand-filled geotextile structures, revegetation, and beach nourishment. Soft solutions have emerged because they are thought to deform while dissipating wave energy, thus causing less sand transport on the fronting beach. They are appropriate in many low-energy environments and where the sediment budget deficit is not large.

Many decades of research and design experience have gone into designing with rock. Established procedures exist for designing particular slope angles and cross-section configurations with rock of specified size to achieve stability in a specified wave environment (US Corps of Engineers Coastal Engineering Manual, EurOtop software, and others for example). Equivalent design procedures are not known to exist for soft solutions. Design is guided by field experience. Washington Department of Fish and Wildlife's Marine Shoreline Design Guidelines strongly promotes use of soft solutions instead of hard structures to control shore erosion, but does contain the statement that soft solutions are inappropriate for highly energetic shorelines.

Qualitative Assessment of Bluff Protection Measures. It appears that dynamic revetments have been tried in this part of the Tolovana Park shoreline. The EEI report stated that two attempts at installing a dynamic revetment at the toe of the Siegel bluff were not successful. Figure 9 shows a treatment of cobbles at the beach stairs south of the Siegel residence. The high wave energy and mixture with sand prevent the cobbles from reaching a height to protect the exposed bluff, so cannot be considered a proper dynamic revetment. Cobbles probably originating from this placement were found scattered northward for several properties, indicating maintenance is required to keep a dynamic revetment functioning. The cobbles do at least temporarily protect the toe of the rock wall and indicate that such material, if properly specified, could be effective in the transition between a structure and natural bluff.

Figure 9. Cobbles placed at the Braillier Street beach access, May 10, 2025

Log structures at the back of a beach can be made to appear natural. The difficulty is they tend to move in the design event. A structure moving under wave attack on a sandy beach, however, means that loss of stability can be progressive to the point of not meeting performance criteria. Logs are sometimes anchored, but figure 10 illustrates how an anchored log failed to prevent sand from being eroded beneath it.

Figure 10. Anchored log shore protection structure with sand eroded from beneath

Sand filled geotextile structures might be designed to remain stable in the design storm event. However, if it does not move and is not undercut, this soft solution will have about the same effect of preventing bluff erosion as a rock revetment. Because the revetment would reduce runup and rundown by its roughness and porosity and the geotextile structure would not, the soft solution could well have greater impact to the fronting beach than would the rock revetment. Geotextile is susceptible to damage by debris and vandalism.

Revegetation is mentioned for completeness but the appearance of the erosional surface of the bluff makes it obvious that trying to re-establish vegetation on the same actively eroding surface would not be successful. The EEI report states that a vegetated berm was installed at the Siegel bluff in an attempt to control erosion but that measure failed.

Beach nourishment, to be successful at restoring the sand volume at Tolovana Park necessary to prevent bluff erosion, would be an enormously impractical undertaking. Finding the source of sand and transporting it to the beach would be problematic. During renourishment operations the beach would be unusable for recreationists. It is not considered a realistic measure for this site.

I have seen several failed soft shore protection installations and they were all in lower energy environments than the Tolovana Park shoreline. Typically, soft shore solutions are not meant to "work" (meet performance criteria) in open ocean environments when the intention is to prevent flooding and damage to a residence during extreme storms. The meaning of whether a protection measure will work or won't work is connected to the performance criteria. Criteria based on information gathered to this point are the bluff protection measure must assure the bluff can protect the residence from flooding and from structural damage caused by storm waves. The magnitude of the storm, however, has not been specified. A standard recommendation for specifying a design storm for shore protection structures is a minimum 25-year event. My observations and recommendations stated in manuals that promote soft shore solutions indicate that no soft solution is expected to function in a 25-year storm on the open ocean coast.

Rock structures are routinely designed for waves greater than a 25-year storm. A sloping rock revetment was installed at the bluff toe about 4 houses north of the Siegel residence. The rock has not been displaced, the structure appears to function as it should, and no detectable effect is apparent at the fronting or adjacent beach. Although this might be a short service period so far, the design appears to be successful.

A porous rock revetment dissipates energy of both the uprushing and downrushing wave. The Corps of Engineers published a wave runup reduction factor of 0.505 to apply to an equation for runup on a smooth slope in order to account for runup on a rough, impermeable slope for the same wave and slope parameters (Hughes, 2005, Estimating Irregular Wave Runup on Rough, Impermeable Slopes, CHETN-III-70). When a breaking wave is allowed to run up and dissipate entirely on a slope, a rough slope reduces by half the runup height on a smooth slope. The rate at which wave energy is dissipated at the structure determines the height of runup, the volume of overtopping water, and the travel distance landward of the overtopping water. Depending on the location of wave breaking on the profile and the steepness of the profile, water and debris can be thrown high (relative to the incident wave height) into the air, where wind can carry it inland. Figure 11 shows breaking waves overtopping of a vertical seawall. A rough, porous, sloping structure dissipates wave energy over a greater distance and, even in the event of overtopping, the runup height and water volume is less because less energy is available at the point of overtopping than for a wave breaking on a steep face.

Water from wave overtopping at the Siegel residence could be managed by collecting the water in a French drain and piping the water through the bluff and bluff protection structure to the beach. The drainage system must be protected from damage by wave and debris forces because drainage of overtopping water away from the residence is crucial to meeting project performance criteria. The pipe that discharges water to the beach must be incorporated into the bluff protection structure to achieve the required protection. Water discharge should be managed to prevent scouring a localized spot at the beach.

Figure 11. Storm wave overtopping of a steep shore structure

Concluding Discussion

The Siegel residence is situated in an area that is officially recognized by the Federal Insurance Administration (overseen by the Federal Emergency Management Agency) as subject to ocean wave flooding and damage in the occurrence of the one-percent-average-annual-chance storm event. Analysis that resulted in that designation in 2018 accounted for an extant bluff fronting the property. Current observations reveal the ocean facing toe of the bluff is eroding. The owners have attempted to halt erosion by more "nature compliant" means but erosion has continued. Recognizing the relatively low elevation of the property and the small volume of competent material comprising the bluff, the likelihood of wave storm damage to the residence will increase as erosion of the bluff toe continues. Stabilizing and reinforcing the bluff appears to be the most practical means of minimizing future risks of flooding and structural damage to the Siegel property.

Bluff protection measures were investigated for their practicality at meeting performance criteria in the wave and sediment regime of Tolovana Park. Those criteria are the measure must function by preventing bluff erosion and not sustain significant damage in a minimum 25-year storm that represents current statistics. In my opinion and for reasons stated on pages 11 through 13, soft solutions or alternative measures (alternatives to rock) will not meet performance criteria, which is to say they will not work. The basis for that conclusion is admission by proponents that soft solutions are not appropriate for highly energetic shorelines, my observation of failed soft solutions in even moderate-energy environments, and the basic incompatibility of the requirement that a solution deform in response to waves and substrate movement on the one hand, and the requirement to protect a beloved family home on the other hand. I have designed and published monitoring results of environmentally compliant shore protection and recommend against such designs for meeting criteria for the Siegel property. A riprap structure can be designed to meet specific criteria and appears to be the most practical stabilization strategy.

I appreciate the opportunity to comment on this project. If you have questions or need more information, you may reach me at 425.359.8634.

Sincerely,

[redacted]

David P. Simpson, P.E., L.G.

Exhibit A-16

David P. Simpson
Coastal Engineer

September 4, 2025

William Rasmussen, Partner
Miller Nash LLP
1140 S.W. Washington St., Suite 700
Portland, OR 97205

Dear Mr. Rasmussen:

This letter is to provide a response based on coastal engineering experience to a comment made at a Cannon Beach Planning Commission hearing on the permit application for shore protection at the Siegel oceanfront residence at 3915 Ocean Avenue, Cannon Beach, Oregon. The comment expressed the belief that because the floor of the house was elevated above the Base Flood Elevation as mapped by FEMA, there is no flooding risk. However, as explained in my May 19, 2025 letter, structural threats to the house exist in addition to the water level that would be reached in a base flood event. Those threats are explained in my May 19 letter and below.

Comment Regarding Minimal Risk to Siegel Property

The public commenter asserted that flood waters could inundate the property up to the mapped flood elevation because of the small lift of the house without damaging the house. Under this commenter's theory, conditions must exist that would allow flood water to flow into and then to exit from the crawl space below the floor without damaging the structure or interior of the house during a storm event. This assertion is mistaken based on the characteristics of the house and hazards facing it.

Meaning of Zone VE Mapped for Siegel Property

Analysts who created and approved the effective coastal flood map that includes the Siegel property determined that the one-percent-chance ocean flooding event would cause hazards to the Siegel property by inundation and water velocity. That is apparent from the fact that the VE zone limit extends onto the house footprint. In terms of water flow speed Zone VE is defined as flow speed exceeding 3 feet per second. Zone AE is mapped where the flow speed of flood waters drops below 3 feet per second, as is shown for the rest of the house and property to the street on the effective Flood Insurance Rate Map (FIRM). A portion of the FIRM is shown in Figure 1. Ocean flooding in the absence of the dune exposes the house to several threats. Threats from individual sources are described below.

Figure 1. Portion of Flood Insurance Rate Map including the Siegel residence

Drift Log Impact

Water flowing inland at the minimum of 3 feet per second and reaching the house should be expected to carry drift logs commonly present in this area in the flow at nearly the same speed. FEMA's Coastal Construction Manual (fema55_volii_combined_rev.pdf) provides official guidance on calculating horizontal loads due to impact from debris carried in a flow. A drift log 30 inches in diameter and 18 feet long was measured on the beach in front of the Siegel residence on the May 10, 2025 site visit. A log this size is assumed to represent the size of debris that could impact the Seigel residence masonry support. A typical support is visible at the left side of Figure 2. Following procedures provided in the manual, impact load on the vertical support can range from a low of 1,845 pounds to a high of 3,014 pounds, depending on how flow speed is determined. Even the lower amount of impact loading, which should be expected to be repeated in a flood event, would certainly damage the masonry support, which would jeopardize the house.

Figure 2. Ground at seaward side of Seigel residence

Utilities Impact

Utilities are hung below floor level, as shown in Figure 3, and appear to be near ground level. If a flow speed of 3 feet per second, the minimum for designation as Zone VE, were to impact these utilities they would certainly be damaged and especially so if debris were carried in the flow as is expected.

Figure 3. Utilities exposed below floor level at Siegel residence

Scour Below and Seaward from Residence

Soil type at the edge of the house footprint and the opening size below the floor level are shown in a photo at the Siegel residence shown in Figure 2. A reasonable interpretation is that the soil is sandy and that vegetation provides little stability to the surface. The ground level is nearly the same as the bottom of the opening under the house, which would allow a hydraulic bore, which results from uprush of a broken wave, to travel under the house and impact posts that are elements of the foundation. This can cause structural damage as documented in my May 19 letter.

Observation of the soil type on the seaward side of the residence and the exposure of the crawl space and posts supporting the house, some of which are visible in Figure 3, indicate that a Zone VE flow speed would cause scour of the soil generally in the flow path. Scour caused by wave action reaching the house would remove soil in front of the house and expose more of the textured blocks that form part of the support for the house. Sour would concentrate around the posts under that portion of the house that is in the V Zone. As described in Section 8.5.11 of the Coastal Construction Manual, scour depth below original soil level could be expected to be as much as twice the width of the post. Depending on storm and construction conditions, scour under the house could lead to complete loss of support. Even short of a complete loss of soil, this type of scour would decrease the posts' bearing capacity.

Soil Saturation Causing Foundation Failure

The risk from soil saturation observed at this site potentially causing settling and foundation failure is documented in my May 19 letter and Certerra's July 21, 2025 report. This risk would be exacerbated and compounded by increased water flowing and ponding around the foundation of the Siegel house resulting from further bluff erosion during an extreme storm. The small increased elevation of the house on posts does nothing to reduce the amount of structural damage that could occur at this site caused by soil saturation potentially leading to subsidence and foundation failure.

Summary

The Siegel residence was mapped in Zone VE because ocean flooding in the base flood event presents hazards to the property. In the case of loss of the fronting dune those hazards would be exacerbated. That condition would expose the residence to threats of direct debris impact damage to the structure, damage to utilities by debris and hydrodynamic forces, scour of soil from in front of the house and around foundation posts, and soil saturation causing foundation failure. These threats of damage exist in the absence of the dune irrespective of the house's floor elevation. I reiterate from my May 19, 2025 letter that protecting the dune is essential for protecting the house from these

Exhibit A-16

several threats and that controlling further dune erosion here would have no measurable effect on the littoral system.

I appreciate the opportunity to provide coastal engineering information on this project. If you have questions or need more information, you may reach me at 425.359.8634.

Sincerely,

[redacted]

David P. Simpson, P.E., L.G.

Nico*terra*
Ecological Restoration, Arboriculture

2802-21st Avenue South
SEATTLE, WA. 98144
UBI#603 324 874

FM: Daniel Collins, proprietor Nicoterra
TO: Maxine M. Siegel

Date: July 29, 2025

RE: Ecological Enhancements Possible with a Vegetated Rock Revetment at : 3915 Ocean Ave Cannon Beach, OR.

On February 11th, 2025, I testified based on my expertise in establishing willows and shoreline stability from professional experience and materials provided by your consultants for Permit CU24-04. Since that time I have made site visits to your property in Canon Beach Oregon and observed other SPS structures in the vicinity of this site. I have also reviewed more information outside the supply of "on the record" materials and offer this assessment:

The extent of the erosion and threats caused by wave action at your bluff were confirmed: this is a high energy shoreline. This condition jeopardizes non-engineered techniques/methods for restoring shoreline slope stability. To be frank, in my opinion vegetative planting alone or as part of a burrito-type erosion mitigation measure would not work at your site.

If an engineered rock revetment were constructed in place of the failing slope, according to the slope aspect presented as 1.5H:1V, I believe that a mixture of native plants could be established with the protections afforded by a resistant sub-base of rock. Your planned vegetated revetment could accommodate a mix of localized sandy loam soils to support salt tolerant shore grasses. This would be accomplished with laying down coconut coir mat or equivalent biodegradable mat and applying soils to support plants. An irrigation system would also necessarily be part of this system. Additional plants recommended for this SPS structure include salal, Oregon grape, pacific strawberry, and hooker willow to create more biodiversity and support strong woody growth above and below the high tide mark. These plant types would add to the plant mix with several neighboring properties in a landscaped plant continuity.

The benefits of this system over a clay terracing system are: early plant establishment using seed, live stakes or potted plants, enhanced biodiversity by the greater range of plant types, and likely reduced maintenance during the long plant establishment period.

Soil disturbance and root damage are the biggest threats to success in vegetated SPS systems. By installing a rock revetment with pieces as large as 2-3 man size rock, it is believed that plants could establish with stable root structures.

In short, I believe that a vegetated rock revetment could offer the best combination of shoreline slope stability and plant biodiversity among the alternatives available. If you have further questions please don't hesitate to contact me.

Regards,
Daniel Collins, Nicoterra

For Reference
My CV
Certified Consulting Arborist ISA PN-8028A,
10 ten years creating willow programs in King County, Washington,

- Green River: willow stakes from kayaks-King County Flood Control District.
- willow fascines and spiling for public/private clients-

Geographic Information Systems GIS and aerial photo interpretation
Ecological Restoration: Certified South Seattle College
Masters Degree Planning Public Policy and Management University of Oregon
Bachelors Degree Urban and Regional Planning Eastern Washington University

SOURCES:
Oregon Coastal Management Program
Stage o Restoration Practices in California and Oregon: Seagrant Oregon OSU, Schneider, C. Flitcroft, R. Giannico, G.
North Coast Land Conservancy
Massachusettes Climate Action Tool climateactiontool.org
Wilkenson Ecological Design, Massachusetts

From: Cannon Beach Oregon <noreply@civicplus.com>
Sent: Friday, February 14, 2025 4:48 PM
To: Jennifer Barrett <barrett@ci.cannon-beach.or.us>
Subject: Testimony on Tuesday City Council CU-2405 Request by City Attorney for references

Name: daniel m collins
Email: dmcollins1962@gmail.com

Message: Hello, I am providing documentation for my proponent testimonial for the Siegel request for Conditional Use Permit below, thank you. I reviewed all of the material in the records regarding the potential use of willow vegetation to stabilize this site: Information provided by Earth Engineers shows that erosion from wave action is advancing on the property for a variety of reasons: low elevation sandy bluff, localized wave energy from nearby revetments, and regional ocean influences related to climate change and outside the control of the property owner; all of which put at-risk an entire proposed SPS system based on willows, Reference Geotechnical Report Page 21 Item #3 Climate change...the potential impacts exacerbate the erosional susceptibility of the subject property... The shoreline is characterized as high energy because it faces the uninterrupted wave action of the Pacific with a very long fetch. Storm impacts and King Tides are key threats. Only strong, rigid, interlocking structures can withstand these forces given the limited depth of shoreline. Wave action cuts at the base of most structures. Wave action pulls soils out from below plant roots leading to collapse Undercutting can begin with the first strong storm event Reference Geotechnical Report Pages 7 and 8 Photos 3 and 4 evidence showing that softer flexible vegetative structures cannot withstand high energy wave impacts. I Noted the history of multiple plantings being attempted at this bluff, including willows with the 2022 and 2023 efforts; approvals given by Cannon Beach, as shown in the record, For plants including willows to become bio-engineered components, they must be well established- En Masse before they can truly bind soils together and provide the skin friction to slow the erosive force of water. These efforts showed that early failures are common....To Be Clear, vegetative structures losing soil are in failure mode!!! Reference Geotechnical Report Page 11 paragraph 3: "unless the bluff base is stabilized and shielded from wave attack, slope regression and flooding will continue on the subject property". This statement implies the need for a structural element at the base of the bluff to reduce undercutting, not vegetative materials. I also Noted the scouring and vertical slope of bluff at this location, which is caused by high energy waves impacting the bluff; adding a heavy clay terrace on a sub-base of sand may result in structural shifting during storm events

Reference Engineering Report OS-514 Page 2 Item#5 "This segment of the Cannon Beach shoreline frontage lies within a known creep zone...From a geologic perspective, there can be no guarantee that this slope will not continue to creep, however episodically." Opinion: taking a known geologic feature of movement through "creep" and applying a dense and heavy clay terrace along with wave action on that material may cause structural shifting. In addition, I note that there are inadequate remedies to repair bio-engineered ocean shorelines if they fail: they are difficult to assess and often require a complete rebuild. This point does not have substantial material in the record and is opinion based on experience. Overall having read the Earth Engineers reports and reflecting on my experience with willows I do not think installing willow stakes above a clay terraced slope would curtail the erosive wave energy at this location, I therefore do not think the City can conclude that a bio-engineered solution relying on willow, will work at this site. If the City wants to use willow vegetation, it is more appropriate behind the revetment, where it can provide better more sustained ecological services Ultimately this is a problem of high wave energy exceeding the limits of soft armoring along a beach littoral zone and I urge you to reconsider the Planning Commissions decision

Proposal Acceptance

Project: **Revised Proposal for Geotechnical Investigation and Revetment Design**
Proposed Shoreline Protection Structure
3915 Ocean Avenue
Cannon Beach, Clatsop County, Oregon
EEI Proposal No. 23-P149

Lump Sum Fee: **$9,950.00**

Deposit: **$2,500.00**

By signing below, Client authorizes Earth Engineers, Inc. to proceed in accordance with this proposal, including the General Conditions.

Client Name: MAXINE M SIEGEL

Mailing Address: 9515 SE 15TH ST
BELLEVUE, WA 98004

Telephone: 425-786-8266

Fax:

E-mail: MIMI.SIEGEL@KINDERING.ORG

Signed By (print): MAXINE M SIEGEL

Signature: [redacted]

Title:

Date Signed: 4-28-2023

Thoreson Excavating, LLC

PO Box 1350
Astoria, Or. 97103
503-440-1594
CBC# 216409

Estimate

Date	Estimate #
2/5/2025	219

Name / Address
Mimi Siegel

Project

Description	Qty	Rate	Total
RIP RAP REVETMENT			
Haul in equipment	1	1,000.00	1,000.00
Dig out and place materials	120	160.00	19,200.00
Haul materials	200	145.00	29,000.00
Spoils dump fee	708	15.00	10,620.00
578 tons of rip rap	578	75.00	43,350.00
98 tons of base rock	98	19.20	1,881.60
18 tons of drain rock	18	22.20	399.60
130 yards of sand	130	30.00	3,900.00
Flag and set up	100	75.00	7,500.00
1800 sqf of fabric	3,000	0.40	1,200.00
water pump rental	8	100.00	800.00
fencing and related materials	1	1,800.00	1,800.00
Enviro fee for Dump site	59	6.00	354.00

" Prices Subject to Change"

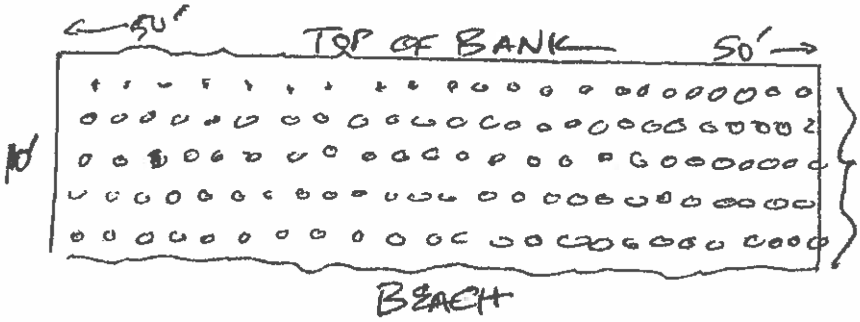
	Total	$121,005.20

MIMI AND MARTIN SIEGAL

SHORELINE PROTECTION LANDSCAPE PLAN

SCALE 1" = 10'

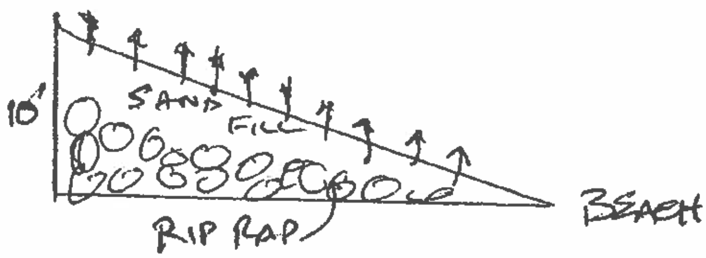
OVERHEAD VIEW



5 ROWS OF HOOKER* WILLOWS 25 @ ROW
125 TOTAL
2FT POTS

* SALIX HOOKERIANA

SIDE VIEW



WILLOWS SHOULD BE PLANTED 1½'-2' DEEP AND MULCHED TO CONSERVE MOISTURE IN THE AREA AROUND THE PLANTS.

COST ESTIMATE:

125 WILLOWS IN 2 GAL POTS FULLY ROOTED

$10 X 125 = $1,250

LABOR: 24 HRS x $65 = $1,560

TOTAL: $2,810

Mossberger, Laura

From:	Mimi Siegel <mimi.siegel@kindering.org>
Sent:	Wednesday, July 22, 2026 3:01 PM
To:	Rasmussen, William
Subject:	Fwd: Beach Protection Estimate

Mimi Siegel.
Phone 425-786-8266

Begin forwarded message:

> **From:** Mike Morgan <hminc@pacifier.com>
> **Date:** July 22, 2026 at 2:56:29 PM PDT
> **To:** MAXINE SIEGEL <mimi.siegel@icloud.com>
> **Subject: Beach Protection Estimate**
>
> Ms Siegal:
> It is my estimate as a professional landscaper that the annual maintenance of your revetment in terms of plant replacement (willows and beach grass) will be $500.
> Sincerely,
> Mike Morgan
> Sent from my iPhone

CANNON BEACH CITY COUNCIL

IN THE MATTER OF AN APPEAL OF A PLANNING COMMISSION DECISION DENYING A CONDITIONAL USE APPLICATION FOR THE PLACEMENT OF A NEW SHORELINE STABILIZATION STRUCTURE ON THE FOLLOWING PROPERTY:

Tax lot# 41006BC00400
3915 Ocean Avenue

FINDINGS OF FACT, CONCLUSIONS AND ORDER NUMBER – APP# 25-03 (CU#25-06)

Applicant: Miller Nash, LLP on behalf of
The Martin and Maxine Siegel Living Trust
1140 SW Washington Street, Ste 700
Portland, OR 97205

Appellant: Miller Nash, LLP on behalf of
The Martin and Maxine Siegel Living Trust
1140 SW Washington Street, Ste 700
Portland, OR 97205

Zone: Residential Moderate Density (R1)
Oceanfront Management Overlay (OM)

The applicant requested conditional use approval for the installation of a vegetated rip-rap shoreline stabilization structure for the purpose of erosion control. The property is referred to as Tax lot# 41006BC00400, located at 3915 Ocean Avenue. The property is owned by The Martin and Maxine Siegel Living Trust.

The proposed conditional use application was reviewed against the criteria of the Cannon Beach Municipal Code (CBMC), including 17.86.080, which contains the standards applied to all conditional use applications and Section 17.86.210, which contains the standards applied specifically to shoreline stabilization applications.

The public hearing on the above-entitled matter was opened before the Planning Commission on 08/28/2025 and the record was left open until 09/18/2025; the Planning Commission deliberated at its 09/25/2025 meeting and voted 6 to 1 to deny the application. The Planning Commission held a special meeting on 10/02/2025 to adopt the written findings in support of its decision.

The applicant sought review of the Planning Commission's decision by the City Council.

The City Council held a Scope of Review meeting on 10/24/25 and determined that the appeal would be heard on the record under the provisions of CBMC 17.18.050, Review on the Record.

The public hearing on the appeal was opened before the City Council on 11/04/25. The City Council closed the public hearing at the 11/04/25 meeting, deliberated on the appeal and voted 3-to-2 to uphold the appeal and approve the application. The City Council met on 11/13/25 to adopt these written findings and conditions in support of its decision.

THE CITY COUNCIL HEREBY ORDERS that the CONDITIONAL USE PERMIT is APPROVED WITH CONDITIONS and adopts the findings of fact, conclusions and conditions contained in Exhibit "A." The effective date of this ORDER is 21 days following the signing of this order.

This decision may be appealed to the State of Oregon Land Use Board of Appeals (LUBA) by an affected party by filing a notice of intent to appeal a land use decision within 21 days after the date of the decision sought to be reviewed becomes final.

The complete case, including the final order is available for review at the city.

CANNON BEACH CITY COUNCIL

[redacted] 11-14-25

Mayor Barb Knop Date

ATTACHMENT A

Findings of Fact and Conclusions of Law

BACKGROUND

William Rasmussen of Miller Nash LLP, on behalf of the Martin and Maxine Siegel Living Trust, CU#25-06, applied for a conditional use permit for the placement of a new shoreline stabilization structure for the purpose of erosion control at 3915 Ocean Ave., Taxlot 41006BC00400. The Planning Commission denied application. The Applicant requested a review of the decision in an appeal application that was received by the City on October 15, 2025.

The City Council held a Scope of Review meeting on October 24, 2025 and determined that the appeal would be heard on the record under the provisions of Cannon Beach Municipal Code (CBMC) 17.18.050, Review on the Record. CBMC 17.18.050(C) requires the City Council to "make its decision based upon the record after first granting the right of argument, but not the introduction of additional evidence, to parties to the hearing." Prior to the November 4, 2025 hearing to consider the merits of the appeal, multiple persons submitted documents into the record. In addition, the applicant and members of the public testified at the hearing on November 4, 2025. Consistent with CBMC 17.18.050(C), in reaching this decision, the City Council has considered only the record of the Planning Commission decision, and argument included in documents submitted into the record and in public testimony at the hearing, but did not include any new evidence.

PROPERTY AND APPLICATION

The Property is located in south Cannon Beach, on Ocean Avenue between West Orford Street and Braillier Street. It is adjacent to the undeveloped Midway Street right-of-way, which provides public beach access. The Property is zoned R1 (Residential Moderate Density) and is within the oceanfront management overlay of the City. The Property has approximately 50 feet of beach frontage with a short bluff that ranges from five to seven feet high. The property is within two FEMA inventoried flood hazard areas, the VE Coastal High Risk and AE High Flood Risk. Elevations range from approximately 15 feet above sea level on the west to approximately 24 feet on the east. Due to its location in the FEMA VE and AE Zones, the property is understood to be at risk of flooding during storm surge and other extreme high tide events.

CBMC 17.04 defines shoreline stabilization structures as "the protection of the banks of tidal or inter-tidal streams, rivers, estuarine waters and the oceanfront by vegetative or structural means." The subject property is eligible for a shoreline stabilization structure as development existed on the subject property on January 1, 1977. CBMC 17.86.210(F).

CMBC 17.30.030 and 17.100.020(B) require that shoreline stabilization structures in the R1 Zone and the OM Zone receive a conditional use permit prior to construction. Under the CBMC, a conditional use must meet the overall standards found in CBMC 17.86.080 as well as any conditional use standards for the use under consideration to the extent that the code contains standards addressing that use. In this case, the code has specific standards for shoreline stabilization structures, and these are detailed in CBMC 17.86.210.

FINDINGS

Conditional Uses for Shoreline Stabilization

17.86.080 Conditional Uses, Overall Use Standards

Before a conditional use is approved, findings will be made that the use will comply with the following standards:

A. *A demand exists for the use at the proposed location. Several factors which should be considered in determining whether or not this demand exists include: accessibility for users (such as customers and employees), availability of similar existing uses, availability of other appropriately zoned sites, particularly those not requiring conditional use approval, and the desirability of other suitably zoned sites for the use.*

Finding: CBMC 17.04 does not define the word "demand." Therefore, Council relies on the definition of "demand" in *Websters Third New Int'l Dictionary*, as relevant here:

> "**1 a** : the act of demanding or asking esp. with authority : a peremptory request <wishes turned into ~s for obedience> **b(1)** : the asking or seeking for what is due or claimed to be due **(2)** : the right or title in virtue of which something may be claimed <hold a ~ against a person> **(3)** : a thing or amount claimed to be due 2 archaic : earnest inquiry : QUESTION, QUERY **3a** : a manifested desire for ownership or use (as of a commodity) : a need or request for a commodity **b** : willingness and ability to purchase a commodity or service **c** : the quantities of goods or service that would be purchased at each of various possible prices at a given time **d** : the sum spent on or the quantity purchased of a commodity or service **4a** : a seeking or state of being sought after esp. with authority or insistence <his eloquence brought him into frequent ~ as an occasional speaker – Ella Lonn><nickel is in great ~> **b**: urgent need : REQUIREMENT <increased ~s for manpower>." *Webster's Third International New International Dictionary* (unabridged ed. 2002).

Council finds that the most applicable meaning of "demand" is "requirement," and the Applicant has shown that there is a "demand" or requirement for the proposed shoreline stabilization use at the Property. Council additionally finds that the list of factors that "should be considered" is aspirational, and is not absolutely required to be considered where the CBMC includes a specific standard that applies to the specific use under consideration, here, CBMC 17.86.210 and shoreline stabilization.

The Applicant's Geological/Geotechnical engineering firm, Certerra Earth Engineers (Certerra) prepared a Geotechnical Investigation and Design Report (Geotechnical Report) that documents bluff retreat of approximately five feet over the past decade, based on site observations, despite multiple efforts to stop that erosion (Geotechnical Report, p. 13). The September 10, 2025 Response from Certerra states that the shoreline erosion rate in Cannon Beach is unpredictable, and that for very low lying properties, like the subject property, episodic storm events "can cause sudden bluff undercutting, rapid collapse of vertical bluff faces, and flooding from wave overtopping" without appropriate protection (citing Geotechnical Report, p. 12). Council finds the Geotechnical Report to be credible evidence that there is a demand or requirement for the use. The

Council chooses to rely on the Geotechnical Report instead of other expert evidence in the record to find that the Applicants have shown by a preponderance of the evidence that there is a demand for the shoreline stabilization structure.

This criterion is met.

B. The use will not create excessive traffic congestion on nearby streets or overburden the following public facilities and services: water, sewer, storm drainage, electrical service, fire protection and schools.

Finding: The proposed shoreline stabilization will not generate any pedestrian or vehicular traffic or affect off-street parking in its vicinity. A stormwater outfall is present on the northern portion of the Midway St. public right-of-way, which is 30 feet wide. There are no identified impacts to the ability of the outfall to perform its function that would result from this project.

This criterion is met.

C. The site has an adequate amount of space for any yards, buildings, drives, parking, loading and unloading areas, storage facilities, utilities or other facilities which are required by city ordinances or desired by the applicant.

Finding: Council finds that the protective structure will be constructed within the same approximate area as the existing bluff, in line with the adjacent riprap structures, and at a height that matches the ocean yard grade east of the bluff. This area is currently unstable and unsafe for the construction of improvements or general use. Accordingly, Council finds that the development will have no impact on the amount of space available for building, utilities, or other facilities.

This criterion is met.

D. The topography, soils and other physical characteristics of the site are appropriate for the use. Potential problems due to weak foundation soils will be eliminated or reduced to the extent necessary for avoiding hazardous situations.

Finding: Council finds that the protective structure has been designed based on the Property's topography, soils, and other physical characteristics and that the site has physical components necessary to safely support the protective structure. As described in the Applicant's materials, the design calls for "overexcavating the surficial, compressible silt/sand to expose the medium dense sand encountered at depths ranging from 5.5 to 6 feet bgs [, as well as] excavating a 2-foot deep key trench into the medium dense sand[,]" followed by placement of a "woven filter fabric (Mirafi Filterweave® 700 or equivalent) from the top of the slope to the bottom of the toe trench and wrap the lowermost armor stones placed in the trench." Geotechnical Report at 29. Council finds that this design will avoid hazardous situations.

This criterion is met.

E. An adequate site layout will be used for transportation activities. Consideration should be given to the suitability of any access points, on-site drives, parking, loading and unloading areas, refuse collection and disposal points, sidewalks, bike paths or other transportation *facilities required by city ordinances or desired by the applicant. Suitability, in part, should be determined by the potential impact of these facilities on safety, traffic flow and control and emergency vehicle movements.*

Finding: The proposed shoreline stabilization structure will not interfere with the Midway St. public beach access or impede access to the beach at that location.

This criterion is met.

F. The site and building design ensure that the use will be compatible with the surrounding area.

Finding: Council finds that the two properties immediately to the south of the subject property (3923 and 3947 Ocean Ave.) are known to have shoreline stabilization structures consisting of rip-rap and supporting vegetation such as willow. The bluff of the property to the north of the Midway St. right-of-way (3887 Ocean Ave.) is largely covered in vegetation and it is unknown if rip-rap is present. The adjacent property (3863 Ocean Ave.) does not have a shoreline stabilization or significant presence of vegetation, a conditional use permit for a non-structural shoreline stabilization was approved on that property in 2022. The vegetated rip rap will work with the adjacent and surrounding stabilization measures, and there is no evidence in the record to suggest that it will not.

This criterion is met.

17.86.210.C Shoreline Stabilization

The city's review of beachfront protective structures, both landward and seaward of the Oregon Coordinate Line, shall be coordinated with the Oregon Parks and Recreation Department. The city's review of shoreline stabilization along Ecola Creek Estuary shall be coordinated with the U.S. Army Corps of Engineers and the Oregon Division of State Lands.

Finding: Due to the project's location on the border of the state vegetation line, the project will require coordination with the Oregon Parks and Recreation Department. Condition of approval #1 requires the applicant to obtain both a Shoreline Alteration Permit and Drive on Beach Permit from OPRD prior to the start of work.

With a condition, this criterion is met.

17.86.210.D.1 Shoreline Stabilization Priorities

1. The priorities for shoreline stabilization for erosion control are, from highest to lowest:

a. Proper maintenance of existing riparian vegetation;

b. Planting of riparian vegetation;

c. Vegetated rip-rap;

d. Nonvegetated rip-rap; and

e. Bulkhead or seawall.

2. Where rip-rap, bulkheads or seawalls are proposed as protective measures, evidence shall be provided that high priority methods of erosion control will not work.

Finding: Council interprets CBMC 17.86.210(1) to establish a progressive prioritization for different types of erosion control measures. CBMC 17.86.210(D)(2) requires that proposals for structural erosion control measures demonstrate that higher priority methods "will not work." Council interprets the phrase "will not work" to mean that the Applicant must establish by a preponderance of the evidence that the lower priority measures will not accomplish the goal of controlling erosion of the bluff. The CBMC does not include definitions or performance standards to be used to demonstrate that higher priority methods of erosion control are insufficient for a specific location. As such, each application is evaluated on a case-by-case basis, and a determination of that higher priority methods will be insufficient is based on evidence, such as geotechnical reports.

Council finds that the CBMC does not require an applicant for a lower priority shoreline stabilization structure to prove that they "tried and failed" at higher priority measures before applying to use lower priority measures. If the CBMC intended that requirement, it would use the phrase "have not worked." However, CMBC 17.86.210(D)(2) uses the future tense "will not work," meaning that an Applicant must demonstrate through evidence in the record that high priority methods will not, in the future, work. That evidence can include, but is not required to include, evidence that lower priority methods have been tried and have failed.

However, even if the CMBC did require a "try and fail" approach, Council finds that the Applicant has demonstrated that they have tried and failed at a higher priority type of shoreline stabilization, planting of riparian vegetation, with evidence that sand and cobble in which willows were planted were twice fully washed out in a single storm season. Certerra Report at 12.

Council finds that the Applicant has demonstrated by a preponderance of the evidence that other methods such as sand or soil burritos will not work, as required by CBMC 17.86.210(D)(1) and (2). The City Council specifically relies on the following expert evidence submitted by the Applicant: (1) Geotechnical Investigation and Design Report prepared by Certerra (the "Geotechnical Report") (2) Coastal engineering opinion letter by coastal engineer David Simpson (the "Coastal Engineering Opinion"); and (3) Opinion Letter from Certified Habitat Restoration Expert and Arborist Nicoterra. Council relies on that evidence over the expert evidence provided by Blue Coast Engineering. The Applicant's expert Certerra, Coastal engineer Simpson, and Nicoterra provided evidence that demonstrated that proper maintenance of existing vegetation or new planted vegetation will not work.

Opponents advocated for the Council to require the Applicant to attempt shoreline stabilization by "vegetated burritos," also called "sand burritos" or "clay burritos." This erosion-control method consists of a biodegradable fabric or geotextile "burrito" filled with soil material, wrapped tightly to form a stable structure, that is placed along a bluff face in a terraced manner and then planted with native vegetation. The State of Oregon's working definition of a "beachfront protective structure" is found in the Guidebook on Erosion Control Practices of the Oregon Coast produced by the Oregon Department of Land Conservation and Development (DLCD), which states that a beachfront protective structure is:

> "A static structure that is intended to remain in a fixed position with the purpose of redirecting wave energy and to minimize or eliminate coastal erosion risk to development. BPS are purposefully constructed and intended to maintain that form over time. This includes, but is not limited to, rip-rap revetments, seawalls, groins, breakwaters, jetties, bulkheads, geotextile sandbags, sand burritos, gabions, and concrete or mortar reinforcement such as shotcrete. Beachfront protective structures do not include dynamic treatments such as sand nourishment, cobble revetments, and similar non-structural or non-fixed erosion mitigation measures." (Emphasis added.)

Council finds that the Applicant's expert evidence demonstrates why a vegetated sand or soil (clay) burrito will not work - because it would not be able to withstand high wave energy at the property's shoreline, and specifically that vegetated sand or soil burritos are intended for lower wave energy environments. That evidence is also consistent with the DLCD Guidebook, which states that vegetated soil burritos are only suited for areas with mild to moderate erosion and that in high-energy wave environments, such as the subject Property, vegetated berms or "sand tubes" are easily destroyed and removed by large waves and storm events, which limits the ability of the planted vegetation to take root and results in slope steepening, thus exacerbating the erosion. DLCD Guidebook at 36-37. The Council chooses to rely on the Applicant's expert's evidence instead of other expert evidence in the record regarding vegetated sand or soil (clay) burritos.

This criterion is met.

17.86.210.E.1 Qualifications for Beachfront Protection

1. Structural shoreline stabilization methods for beachfront protection shall be permitted only if:

a. There is a critical need to protect property that is threatened by erosion hazard;

Finding: Council finds that the evidence in the record demonstrates a critical need to mitigate wave run-up and overtopping that is causing flooding of the property, that creates an imminent risk of structural damage to Applicant's home; and to protect the house and it's occupants from a sudden failure or recession of the bluff resulting in direct wave effects on the home and loss of lateral support, resulting in the potential collapse of the structure. Council finds that the "critical need" standard does not impose a requirement that a structure is in imminent danger. That type of situation is identified in CBMC 17.86.210(J) as allowed outright without a permit ("[t]he emergency placement of rip-rap to protect buildings from an imminent threat shall be permitted without a permit.")

Council also finds that the requirement for a "critical need" is not restricted to only the protection of homes. It requires that there "is a critical need to protect **property** that is threatened by erosion hazard[.]" By contrast, CBMC 17.116.070(2)(a), which includes the code provisions governing the placement of structural bank in a stream corridor, specifically requires that "[t]here is a critical need **to protect a structure** from an erosion hazard[.]"

This criterion is met.

b. Impacts on adjacent property are minimized;

Finding: Council finds that the riprap revetment will match and tie into the existing revetment to the south, not exceed the bluff height, and be covered in sand planted with native vegetation. The Applicant's evidence also demonstrates that the proposed revetment will have no impact on surrounding properties or the adjacent beach. In particular, Certerra determined that construction of the riprap revetment would not adversely affect sand movement or sediment supply in the littoral cell, nor would it negatively impact adjacent properties, given the revetment's modest footprint, limited scale, and alignment with existing protection structures nearby. Similarly, the Coastal Engineering Opinion describes in detail how the proposed revetment will have no measurable impact on the sediment budget of the broader shoreline area or surrounding beach width.

This criterion is met.

c. Visual impacts are minimized;

Finding: Council finds that the same evidence described above in b. also supports a conclusion that visual impacts are minimized.

This criterion is met.

d. Access to the beach is maintained;

Finding: Council finds that the proposed protective structure will not impact the existing beach access stairs at the end of the undeveloped Midway Street right-of-way.

This criterion is met.

e. Long-term or recurring costs to the public are avoided;

Finding: Council interprets the word "costs" in this standard to require an applicant to demonstrate that the proposed shoreline stabilization method will avoid financial costs to the public. This interpretation is supported by the text and context of the provision when considering all of the other subsections that require an applicant to address nonfinancial types of impact: the other subsections cover "[i]mpacts on adjacent property," "[v]isual impacts," maintenance of existing access to the beach, and preservation of riparian vegetation. Council finds that the evidence in the record demonstrates that the application meets this standard because the protective structure will be maintained by a private party.

However, even if this standard covered all types of non-economic "costs," Council finds it would still be satisfied because the revetment will have no meaningful impact on the public's interests. As shown in the design plans, the proposed structure will extend west approximately ten feet from the existing bluff, but almost all of that portion of the riprap structure will be buried below current grade. Therefore, this rip rap will be invisible to the viewing public. Further, the property's bluff is an embayment in relation to the property immediately to the south that is protected by riprap, and therefore the proposed riprap will be in line with the existing 500 feet of riprap revetment stretching to the south. The Council rejects opponents arguments that the revetment will make it more difficult to walk on the beach during high tide and will in time speed up loss of the beach as demonstrating that there will be long term costs to the public. First, without establishing any similarities between the beach and the beach in Cannon Beach, the photographic evidence from a different beach in Lincoln County does not provide substantial evidence that a reasonable person would rely on to conclude that these improvements will have any negative impact. Second, approximately 1,300 of the 1,500 feet of shoreline to the south and 3,500 of the 4,000 feet of shoreline to the north is already protected by rip rap, and the beach is generally usable in that location even during high tide.

This criterion is met.

and

f. Riparian vegetation is preserved as much as possible.

Finding: Council finds that the evidence in the record is that the existing vegetation will be preserved as much as possible during construction, and will be replaced by native beach grass or similar vegetation as required in Condition 3, which will be fertilized and watered as necessary to establish growth.

This criterion is met.

H. Rip-rap shall be placed in accordance with the city's design criteria. Structural shoreline stabilization shall be designed by a registered engineer if the city's design criteria for rip-rap are not used, or if landslide retention is a factor in the placement of the shoreline protection structure. All structural shoreline stabilization shall be covered with fill material such as soil, clay or sand and revegetated with beach grass, willow or other appropriate vegetation.

Finding: Council finds that the evidence in the record is that the proposed structure has been designed to integrate visually and structurally with the surrounding area. The structure was designed by geotechnical engineer Troy Hull, P.E., G.E., and engineering geologist Adam Reese, R.G., G.E.G., of Certerra. The proposed design includes a cover with sand and revegetation with native grass, or similar vegetation.

This criterion is met.

I. The shoreline protection structure shall be the minimum necessary to provide the level of protection required.

Finding: Council finds that the evidence from Applicant set out in detail in Geotechnical Report and Coastal Engineering Opinion demonstrates that the protective structure is the minimum necessary to provide the level of protection required and that alternatives such as beach nourishment, vegetation restoration, clay burritos, and dynamic revetments will not provide the level of protection required, due to the Property's high wave energy environment, small bluff, low elevation, and narrow beach width.

This criterion is met.

Section 17.100.050 General standards.

B. The uses and activities permitted in beach and dune areas contained in the OM zone are subject to the following additional standards:

1. For uses and activities located in beach and dune areas, other than older stabilized dunes, findings shall address the following:

a. The adverse effects the proposed development might have on the site and adjacent areas[.]

Finding: Council finds that the proposed protective structure will not adversely affect the site; it is intended to stop the bluff erosion and flooding occurring at the Property.

Council finds that shoreline protective structures can have adverse effects on the beach and adjacent properties, including increased erosion at the ends of the structure, aesthetic impacts, view obstruction, and interference with public use of the beach if not designed properly. Council finds that here, the riprap structure has been designed and will be constructed to avoid these potential adverse effects, as follows:

First, the revetment will tie into the existing revetments to the south and will not create increased erosion at the south end of the revetment. This will create a smooth line of shoreline protection along the beachfront, providing further protection to these southern properties. The Property is bounded to the north by the undeveloped Midway Street public right-of-way. The revetment will either tie into the existing access stairs in the right-of-way, or taper into the bluff, to avoid redirection of wave energy onto the bluff of the right-of-way. Council finds that the structure is unlikely to have an adverse effect on the neighboring properties.

Second, Council finds that the evidence in the record demonstrates that the structure will not obstruct ocean views of adjacent properties or interfere with public use of the beach structure. The design includes covering the revetment with a blanket of sand and planting of native grasses. The revetment has also been designed to match the existing bluff height and be in line with other revetments immediately adjacent and slightly further to the north and south of the property.

Finally, the evidence in the record is that the revetment will have no impact on the width of the adjacent beach—even when considered cumulatively with all the other existing revetments.

This criterion is met.

b. Temporary and permanent stabilization proposed and the planned maintenance of new and existing vegetation[.]

Finding: The protective structure is designed to provide permanent stabilization of the bluff. The revetment will be planted with native grass as required in Condition 3, which will be fertilized and watered as necessary to establish growth and maintained thereafter.

This criterion is met.

c. Methods for protecting the surrounding area from any adverse effects of the development[.]

Finding: As described in subsection (a) above, the revetment has been designed to modern standards in order to avoid adverse effects on the surrounding area, including dimensions that match the bluff and existing revetment structures, tying the revetment into existing structures or tapering the end to avoid redirection of wave energy, as well as a sand covering planted with native vegetation.

Accordingly, Council finds that the primary impact of the proposed protective structure on the surrounding area will be positive, and adverse impacts will be minimal.

This criterion is met.

d. Hazards to life, public and private property, and the natural environment which may be caused by the proposed use.

Finding: Council finds that the protective structure is intended to eliminate a significant threat to property and persons. Further, the evidence in the record in the Geotechnical Report and Coastal Engineering Opinion demonstrates that the structure will not impact the surrounding natural environment.

This criterion is met.

2. For uses and activities located on beaches, active dunes, on other foredunes which are conditionally stable and that are subject to ocean undercutting or wave overtopping, and on interdune areas that are subject to ocean flooding, findings shall address the following:

a. The standards of subsection (B)(1) of this section[.]

Finding: Council incorporates the findings for the standards in subsection (B)(1).

This criterion is met.

b. The development is adequately protected from any geologic hazards, wind erosion, undercutting, ocean flooding and storm waves; or is of minimal value[.]

Finding: Council finds that the purpose of the protective structure is to protect the property and house from erosion/undercutting, ocean flooding, and storm waves. Council finds that the protective structure has been designed by Certerra to accomplish these objectives.

This criterion is met.

c. The development is designed to minimize adverse environmental effects.

Finding: Council finds that the evidence in the record in the Geotechnical Report demonstrates that the revetment structure has been designed to minimize adverse environmental effects. Council rejects opponents' summary of the purpose of the OM zone in CBMC 17.100.010 as an incomplete description of the purpose, which includes multiple purposes, some of which may conflict on a case by case basis: "[t]he intent of the oceanfront management overlay (OM) zone is to regulate uses and activities in the affected areas in order to: ensure that development is consistent with the natural limitations of the oceanshore; to ensure that identified recreational, aesthetic, wildlife habitat and other resources are protected; to conserve, protect, where appropriate develop, and where appropriate restore the resources and benefits of beach and dune areas; and to reduce the hazards to property and human life resulting from both natural events and development activities." Moreover, Council finds that shoreline stabilization is a permitted use in the OM zone as long as the use meets the standards in CBMC 17.86.210. CMBC 17.100.030(C)(1).

This criterion is met.

DECISION AND CONDITIONS

Councilor Ostrander moved to tentatively approve the appeal and overturn the planning commission's decision with the following conditions; Hayes seconded the motion.

Vote: Hayes, Hammond and Ostrander voted AYE. Kerr and Knop voted NAY. The vote was 3:2 and the motion carried.

CONDITIONS OF APROVAL:

1. The applicant shall coordinate this project with Oregon Parks and Recreation Department and obtain all permits required for this work including beach access for vehicles prior to beginning any construction.

2. The revetment shall not include any French drains that drain onto the beach.

3. The applicant shall provide a written vegetation management and maintenance plan prepared by a landscape professional that includes use of native willows and that minimizes the use of non-native species. For 10 years from the date construction is completed, the Applicant shall submit a report to the city planning department annually not later than March 31 of each year that documents both in writing and with photographic evidence all maintenance activities during the previous year. If applicant fails to comply with this condition, the city Building Official may issue a notice of civil violation and impose an administrative civil penalty pursuant to CBMC 15.04.140.

4. As-built plans of the revetment shall be provided to the City upon the completion of construction.

5. City staff shall be notified prior to the start of work and be present during construction.

CANNON BEACH PUBLIC WORKS DEPARTMENT

P.O. Box 368, Cannon Beach, OR 97110 **R-O-W Permit** Phone: (503) 436-8068 Fax 800-761-6931

Required for all activities in the public right-of-way or public easements
Please print clearly and fill in all that apply
72 HOURS NOTICE REQUIRED – WEEKENDS EXCLUDED

Permit No. 26-31 Thor

PLEASE PRINT CLEARLY

Address/Location/Description/Tax Lot ID: 3915 Ocean Ave.			
Applicant: Troy K. Thoreson		Daytime Phone: 503.440.1594	Evening Phone:
Applicant Address: 91594 Youngs River Rd		Fax Number and/or email: thorex17@outlook.com	
Contractor Name: Thoreson Excavating LLC		Daytime Phone: 503.440.1594	Evening Phone:
Contractor Address: PO Box 1350 Astoria Or. 97103		Fax Number and/or email:	
Contractor Contact Person: Troy Thoreson		Daytime Phone: same	
Oregon CCB# (or equal): 216409	Pavement Cut ?(check) YES ☐ NO ☒	Start Date: 9.1.26 End Date: 9.30.26	Start Time: 8:00 End Time: 5:00

Written Description of Work To Be Done (no drawings in this box):

To use Midway Beach access to place materials and equipment

Required Attachment:
Attach 8-1/2 x 11 or 11X17 plan/drawing/sketch of proposed work sufficient to identify work and area involved (Show ROW, easement(s), existing utilities, dimensions of area, north arrow, etc.) (1"=20' is the preferred scale)

Read Carefully - Standard Conditions of Approval:

1. **EXCAVATOR ATTENTION**: Oregon law requires you to follow rules adopted by the Oregon Utility Notification Center. Those rules are set forth in OAR 952-001-0010 through 952-001-0090. Copies of the rules may be obtained by calling the Center (503-232-1987).
2. Permittee shall follow the signing requirements of the latest versions of the "Manual on Uniform Traffic Control Devices" and the ODOT "Short Term Traffic Control Handbook" and provide any other traffic control requirements as needed or specified.
3. Permittee shall perform in accordance with all applicable provisions of federal, state and local law, ordinance and administrative rule.
4. All work in public rights-of-way and easements connected, directly or indirectly, to the City water, sanitary sewer, storm sewer, roadway, and sidewalk shall be constructed in accordance with applicable current APWA Oregon Chapter Standards and City Construction Standards.
5. Permittee shall restore surfaces to as good as, or better than, pre-construction condition, to the City's satisfaction.
6. Permittee shall provide 48 hours minimum notice to the City of the work/activity for inspections. Contact the Public Works Department at (503) 436-2045 for inspections.
7. This permit may be revoked at any time by the Director of Public Works or designee.
8. Application expires 60 days from date of issue. Applicant must resubmit if work or improvement is not started within 60 days.
9. Permittee shall comply with the insurance requirements specified on page 2 of this permit. Insurance documentation must be submitted at time of permit application. Call City if in doubt of your insurance requirement.

SIGNATURE REQUIRED ON (PAGE 3)

Insurance Requirements

26-31Thor

The Permittee agrees to defend, indemnify and hold harmless the City, its agents, officers, elected officials and employees from and against all claims, demands and judgements (including attorney fees) made or recovered against them including, but not limited to, damages to real or tangible property or for bodily injury or death to any person arising out of, or in connection with, this Permit to the extent such damage, injury or death is caused or sustained in connection with the negligent performance or willful misconduct of Permittee, or its employees, agents or subcontractors.

☐ **Tier 1 - Work Performed by Homeowners/Property Owners**

Permittee shall at all times, while performing work associated with the above referenced permit, carry a homeowner's insurance policy for at least $500,000 combined single limit for Bodily Injury, Property Damage, and Personal Injury. This insurance must be primary to and non-contributory with any insurance, including any self-insurance or retentions carried by the City.

The permittee shall deliver to the City, at application and prior to the commencement of the work, a certificate of insurance or copy of the Declaration Page(s) evidencing the insurance required by this Permit.

☑ **Tier 2 - Work Performed by Contractors**

Permittee shall at all times, while performing work associated with the above referenced permit, carry a Commercial General Liability insurance policy for at least $2,000,000 combined single limit per occurrence and at least $2,000,000 in the aggregate per project, for Bodily Injury, Property Damage, and Personal Injury. This insurance must be primary to and non-contributory with any insurance, including any self-insurance or retentions carried by the City.

The permittee shall deliver to the City, at application and prior to the commencement of the work, a certificate of insurance and/or certificate of self-insurance (or equal) evidencing this insurance and an insurance policy endorsement listing ***"City of Cannon Beach, its agents, elected officials and employees"*** as additional insured. **This statement on the insurance certificate only, without also providing the endorsement, is not sufficient.**

It is understood and agreed that this insurance shall not terminate or be cancelled prior to the completion of the permitted activity without first giving 30 days written notice of the intention to terminate or to cancel said insurance to the City. Furthermore, this Permit is automatically revoked without further action if the insurance is permitted to lapse, is cancelled or for any other reason becomes inoperative.

The City reserves the right to require higher insurance amounts when the City deems necessary.

CANNON BEACH PUBLIC WORKS DEPARTMENT

P.O. Box 368, Cannon Beach, OR 97110 **R-O-W Permit** Phone: (503) 436-8068 Fax 800-761-6931

Permit No. 26-31 Thor

PERMIT APPROVAL SUBJECT TO THE ADDITIONAL REQUIRED CHECKED CONDITIONS:

REQUIRED (IF CHECKED)	Condition
	Submit traffic control plan
✓	Contractor shall be responsible for communicating with affected community regarding the disruption of traffic flow.
✓	Contractor shall strictly adhere to the "Standard Conditions of Approval" as noted on the permit face.
	Pavement shall be T-cut per USA drawing #210-ch5
	Contractor shall adhere to OAR 333-061-0050 (10), Water line/Sewer Line separation.
	All excavated material shall be hauled away and shall not be returned to the excavation.
	Excavation(s) shall be backfilled with 3/4 -minus crushed rock and compacted in 6-inch lifts to 95% relative compaction (method A of AASHTO T99).
	Road cuts must be temporarily cold patched within 7 days and permanently hot patched and tack sealed within 6 mos. Thickness to match existing pavement.
	Pavement shall be restored in accordance with USA Chapter 5.03
	Contractor shall be responsible for the maintenance of (or repair to) disturbed area for a period of 2 years.
	Submit erosion control plan
	Call for Final (503-436-8042)
	Bore utility
	Land-use compatibility statement
	No excavations on Saturdays, Sundays, Holidays, or Fridays after 1:00 p.m.
✓	City Business License / Certificate of Liability Insurance / Tier 1 / Tier 2 ✓ / Tier 3
	Provide Erosion Control

Comments:

Any damage done to existing 50' Midway Row

needs to be restored to original state after construction.

Pedestrian beach access must always remain open.

Contractor must communicate with adjacent property

owners before construction begins.

☑ APPROVED

City Of Cannon Beach
Department Of Public Works
7/31/26

The City incurs no future liability for damages, repairs, or losses for, to, or from any improvement or asset placed in its public right-of-ways in association with this permit. Applicant/Permittee bears entire liability.

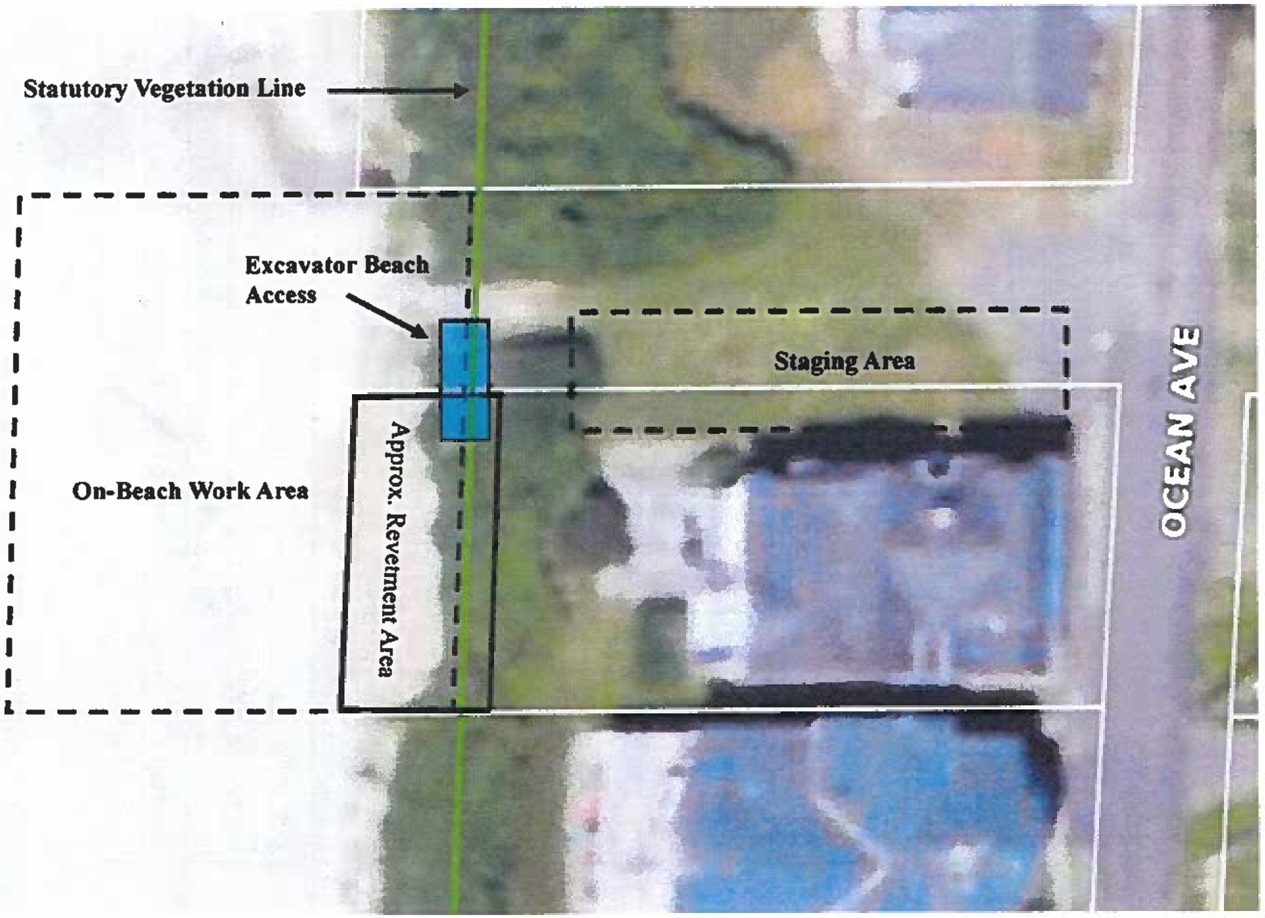
PRINTED NAME: Troy K Thoreson **TITLE:** MEMBER

[redacted]

Date: 7/30/26

Construction and Staging Site Plan

3915 Ocean Ave, Cannon Beach, OR 97145



26-31Thor