Tillamook County

Land of Cheese, Trees and Ocean Breeze

DEPARTMENT OF COMMUNITY DEVELOPMENT
BUILDING, PLANNING & ON-SITE SANITATION SECTIONS

1510 – B Third Street
Tillamook, Oregon 97141
www.tillamook.or.us
Building (503) 842-3407
Planning (503) 842-3408
Sanitation (503) 842-3409
FAX (503) 842-1819
Toll Free 1(800) 488-8280

Neskowin Coastal Hazard Area Permit #851-22-000380-PLNG: LEAHY

NOTICE TO MORTGAGEE, LIENHOLDER, VENDOR OR SELLER:
ORS 215 REQUIRES THAT IF YOU RECEIVE THIS NOTICE,
IT MUST BE PROMPTLY FORWARDED TO THE PURCHASER

NOTICE OF ADMINISTRATIVE REVIEW
Date of Notice: April 5, 2023

Notice is hereby given that the Tillamook County Department of Community Development is considering the following:

#851-22-000380-PLNG: A request for approval of a Neskowin Coastal Hazard Area Permit for the construction of a dwelling on a property located within the Unincorporated Community Boundary of Neskowin, zoned Neskowin Low Density Residential (NeskR-1) and within the Neskowin Coastal Hazards Overlay (Nesk-CH) Zone. The subject property is located at the corner of Breakers Blvd and Amity Ave, both County roads, and designated as Tax Lot 5400 of Section 25CB in Township 5 South, Range 11 West of the Willamette Meridian, Tillamook County, Oregon. The applicant and property owners are Lindley & Justin Leahy.

Notice of the application, a map of the subject area, and the applicable criteria are being mailed to all property owners within 250 feet of the exterior boundaries of the subject parcel for which the application has been made and other appropriate agencies at least 14 days prior to this Department rendering a decision on the request.

Written comments received by the Department of Community Development prior to 4:00p.m. on April 19, 2023, will be considered in rendering a decision. Comments should address the criteria upon which the Department must base its decision. A decision will be rendered no sooner than April 20, 2023.

A copy of the application, along with a map of the request area and the applicable standards/criteria for review are available for inspection on the Tillamook County Department of Community Development website: https://www.co.tillamook.or.us/commdev/landuseapps and is also available for inspection at the Department of Community Development office located at 1510-B Third Street, Tillamook, Oregon, 97141.

If you have any questions about this application, please contact Melissa Jenck, CFM, Land Use Planner II at 503-842-3408 x 3412 or by email: ltone@co.tillamook.or.us.

Sincerely,

Melissa Jenck

Melissa Jenck, CFM, Senior Planner

Sarah Absher, CFM, Director

Enc. Applicable Ordinance Standards/Criteria
Maps

TCLUO SECTION 3.570(4)(e): A decision to approve a Neskowin Coastal Hazard Area Permit shall be based upon findings of compliance with the following standards:

(A) The proposed development is not subject to the prohibition of development on beaches and certain dune forms as set forth in subsection (8) of this section;

(B) The proposed development complies with the applicable requirements and standards of subsections (6), (7), (8), and (10) of this section;

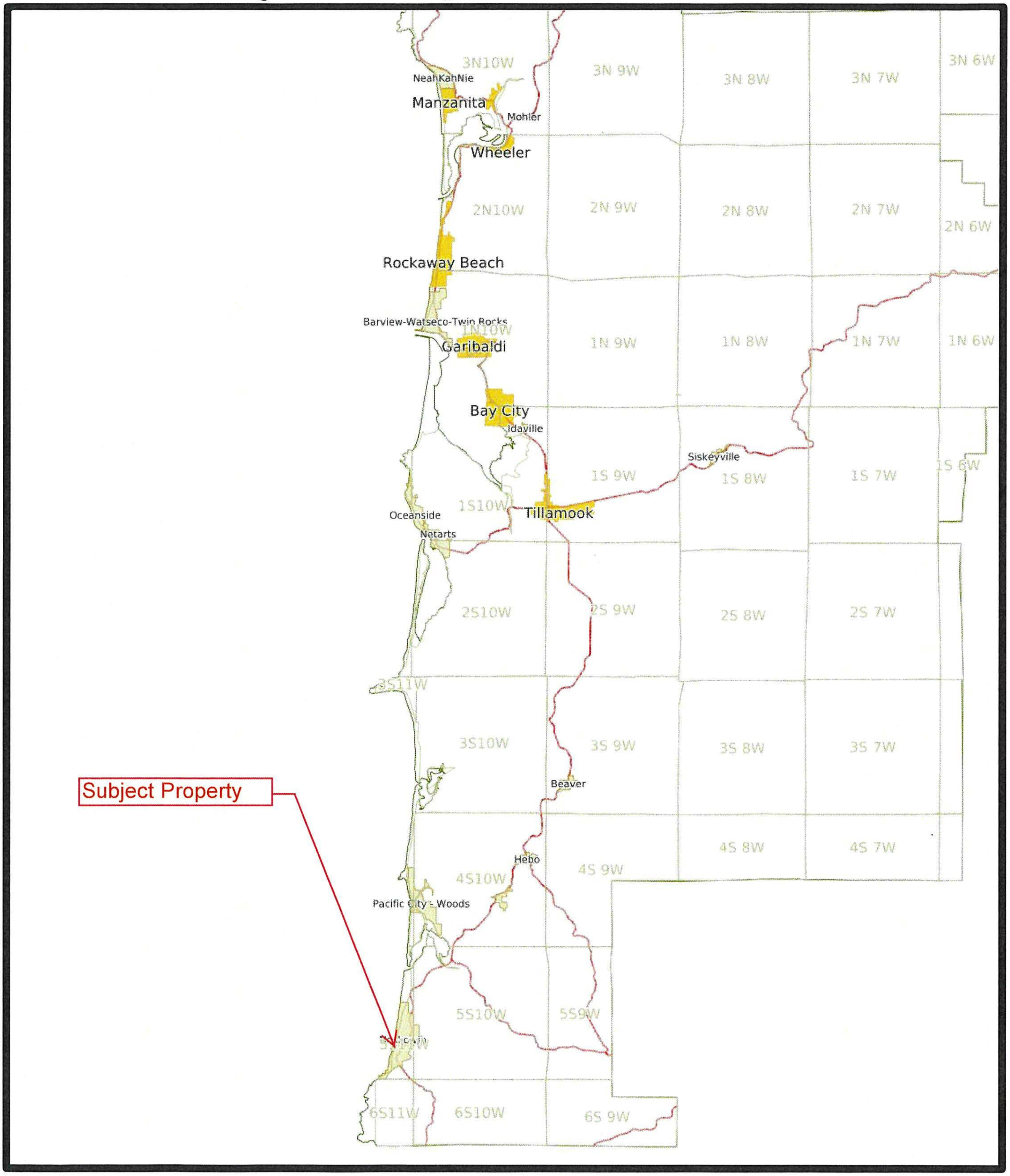
(C) The geologic report conforms to the standards for such reports set forth in subsection (5) of this section;

(D) The development plans for the application conform, or can be made to conform, with all recommendations and specifications contained in the geologic report; and

(E) The geologic report provides a statement that, in the professional opinion of the engineering geologist, the proposed development will be within the acceptable level of risk established by the community, as defined in subsection (5)(c) of this section, considering site conditions and the recommended mitigation.

EXHIBIT A

Vicinity Map



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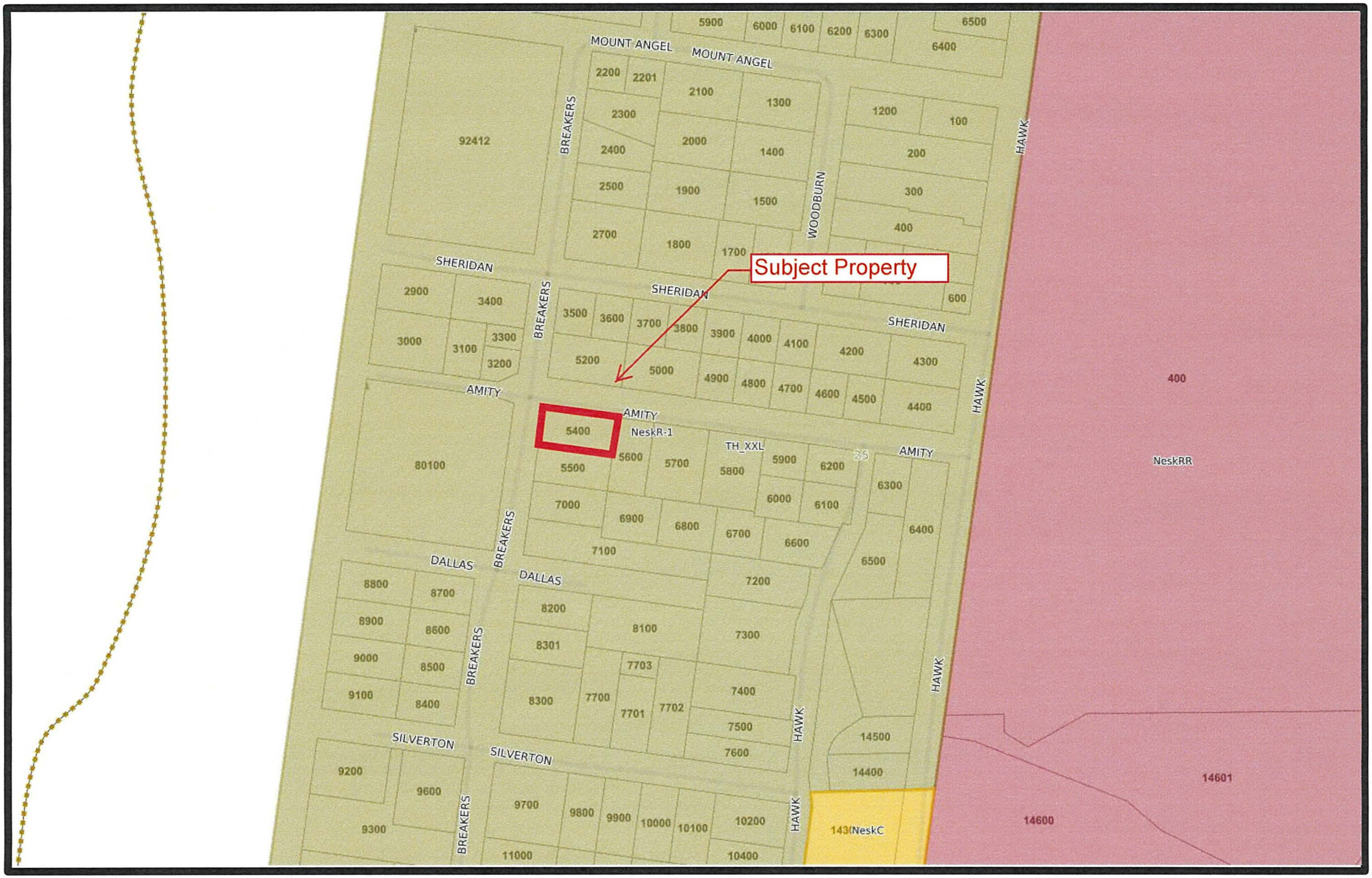
Zoning Map



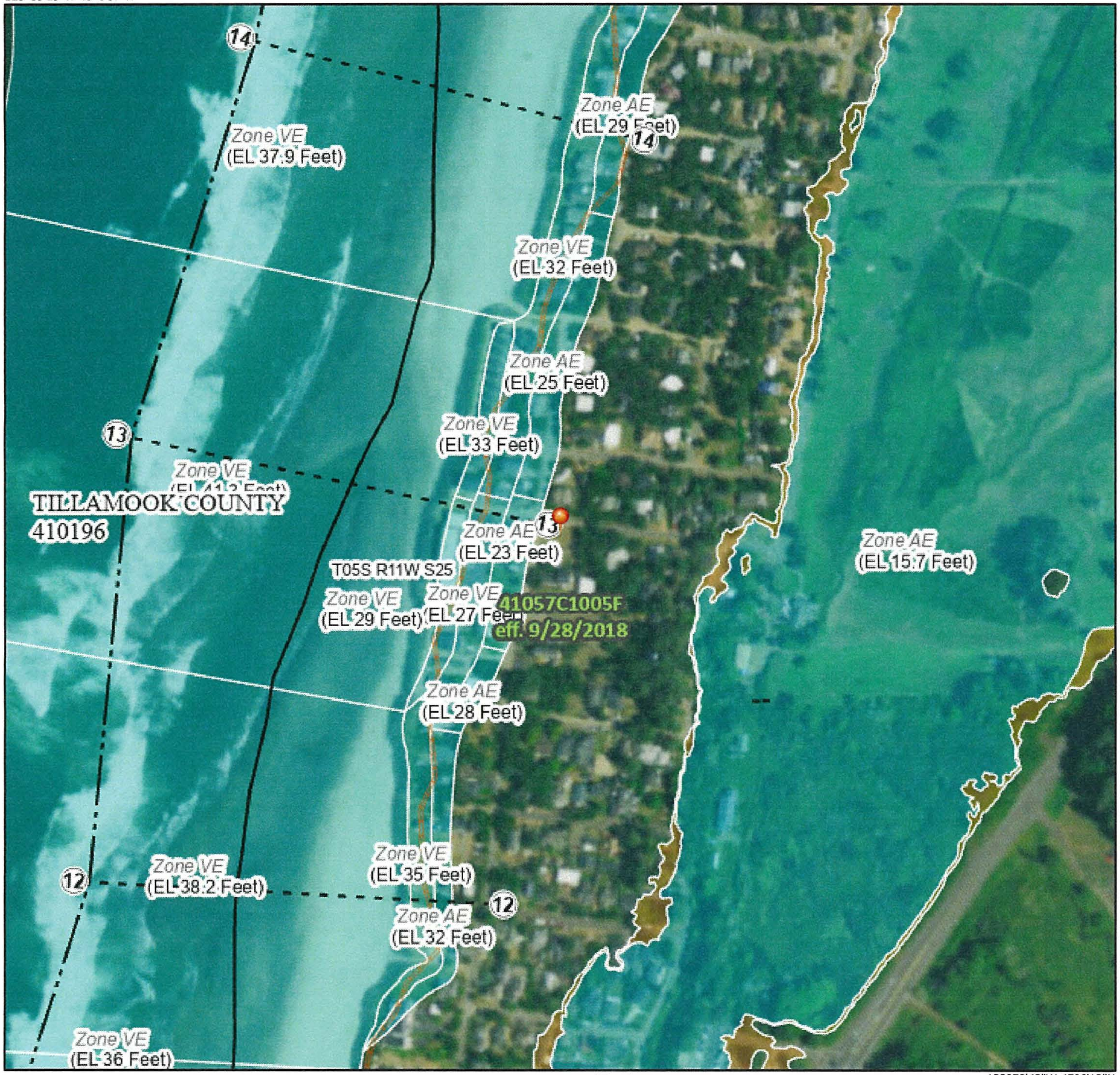
Generated with the GeoMOOSE Printing Utilities

N.W.1/4 S.W.1/4 SEC.25 T.5S. R.11W. W.M.
TILLAMOOK COUNTY
1"=100'
THIS MAP WAS PREPARED FOR ASSESSMENT PURPOSE ONLY
SEE MAP 5S 11W 25BC
MT ANGEL AVE
BREAKERS CONDOMINIUM
92401 TO 92412
SEE SUPP. MAP NO. 2
BOULEVARD
BROWN'S
WOODBERN WAY
Subject Property
SHERIDAN AVE
AMITY AVE
PACIFIC SANDS CONDOMINIUM
80100 TO 80324
SEE SUPP. MAP NO. 1
DALLAS AVE
SILVERTON AVE
INDEPENDENCE AVE
YAMHILL AVE
SEE MAP 5S 11W 25CC
OCEAN DRIVE
BREAKERS BOULEVARD
NESKOWIN
HAWK DRIVE
HAWK STREET
CREEK
APPROXIMATE ZONE LINE
TI-7-234A
TI-7-235
SEE MAP 5S 11W 25
CANCELLED
900
1000
1100
2600
2800
5100
5300
7800
7900
7901
8000
8001
9601
12100
10300
22-7
14300
1.20 AC.
14400 USA
14500
14600
14601
COAST HIGHWAY 101
05S11W25
NESKOW

National Flood Hazard Layer FIRMette

FEMA

123°59'19"W 45°6'37"N



123°58'42"W 45°6'12"N

Feet
0 250 500 1,000 1,500 2,000

1:6,000

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS
- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD
- 0.2% Annual Chance Flood Hazard, Area of 1% annual chance flood with average depth less than one foot or with drainag areas of less than one square mile *Zone*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS
- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zon*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES
- B 20.2 17.5 Cross Sections with 1% Annual Chance Water Surface Elevation
- 8 Coastal Transect
- 513 Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

MAP PANELS
- Digital Data Available
- No Digital Data Available
- Unmapped

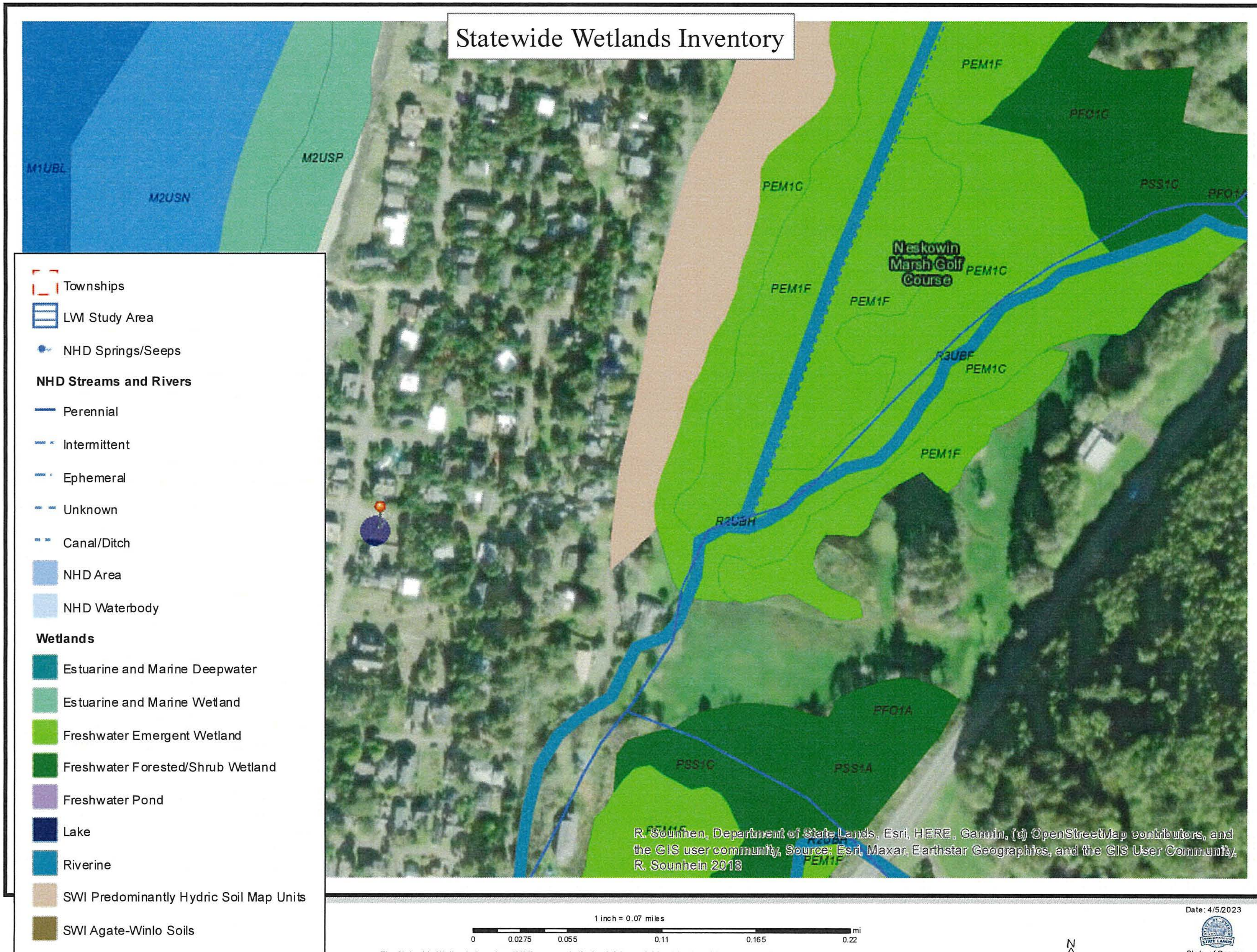
N

The pin displayed on the map is an approximat point selected by the user and does not represe an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 4/5/2023 at 3:08 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.



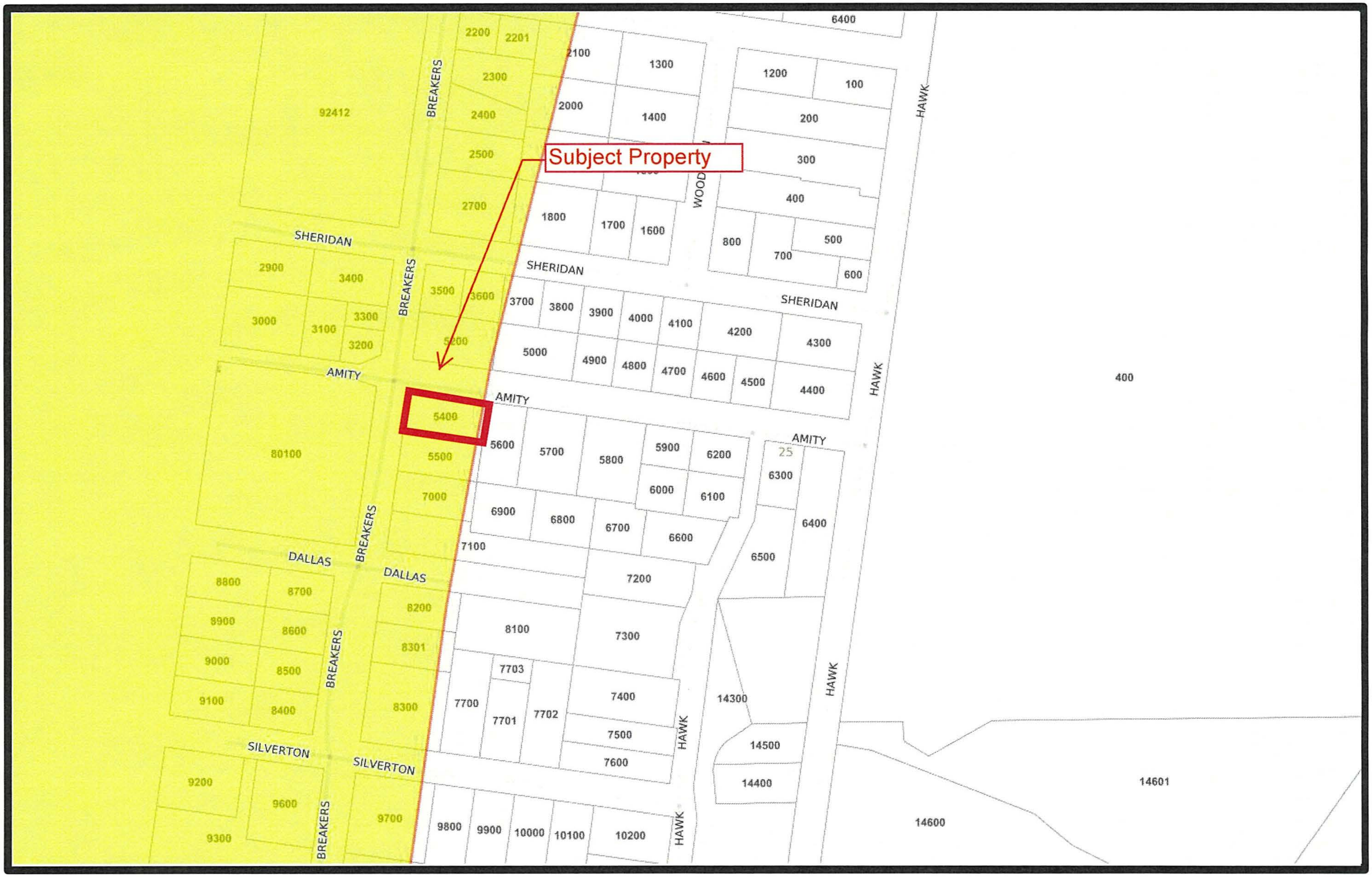
The Statewide Wetlands Inventory (SWI) represents the best data available at the time this map was published and is updated as new data becomes available. In all cases, actual field conditions determine the presence, absence and boundaries of wetlands and waters (such as creeks and ponds). An onsite investigation by a wetland professional can verify actual field conditions.

Date: 4/5/2023

State of Oregon
Department of State Lands
775 Summer Street, NE, Ste 100
Salem, OR. 97301-1279
(503) 986-5200

https://www.oregon.gov/dsl/WW/Pages/SWI.aspx

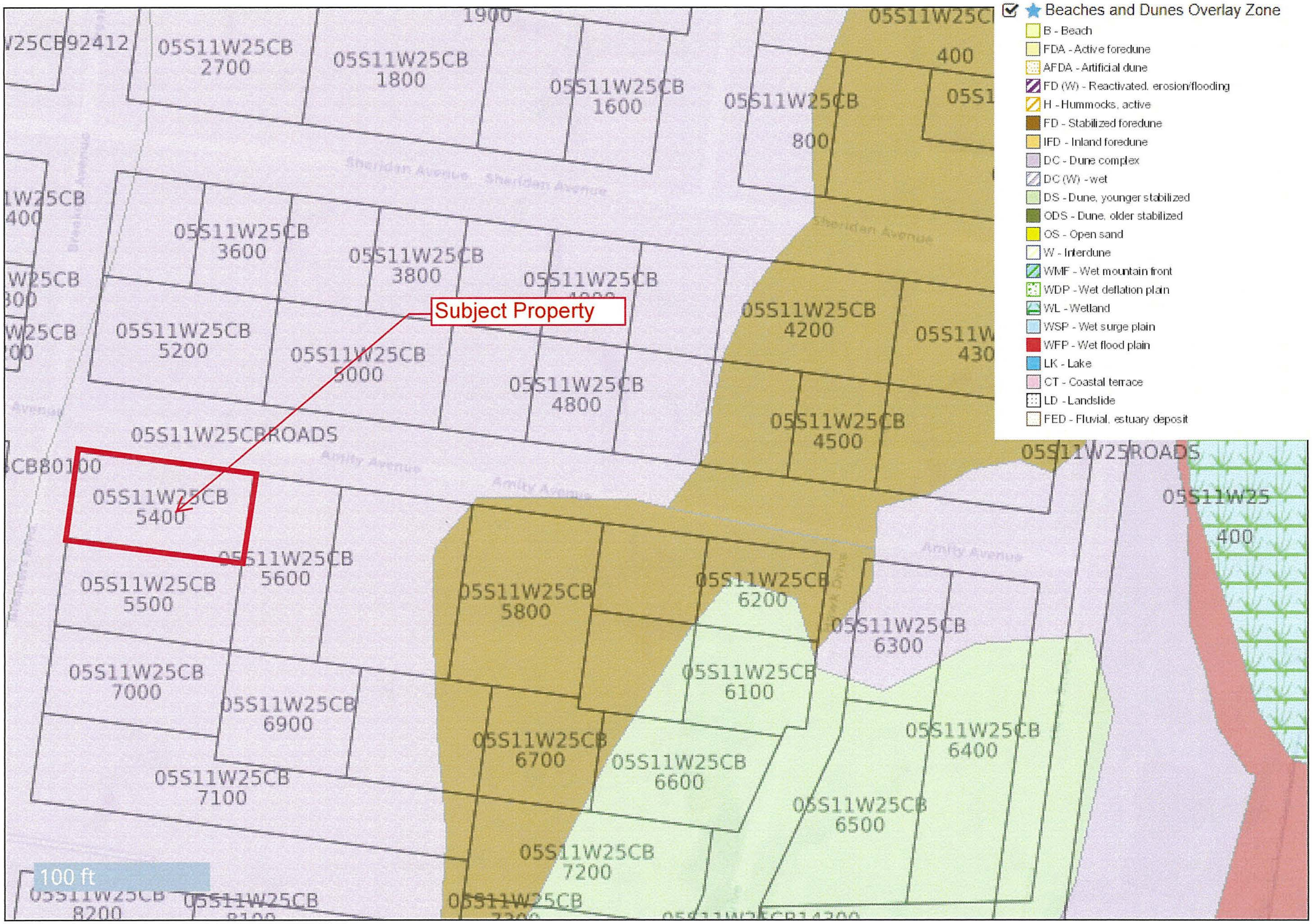
Neskowin Coastal Hazards Map



Generated with the GeoMOOSE Printing Utilities

Leahy Hazard Map

Oregon Coastal Atlas



Disclaimer: The spatial information hosted at this website was derived from a variety of sources. Care was taken in the creation of these themes, but they are provided "as is". The state of Oregon, or any of the data providers cannot accept any responsibility for errors, omissions, or positional accuracy in the digital data or underlying records. There are no warranties, expressed or implied, including the warranty of merchantability or fitness for a particular purpose, accompanying any of these products. However, notification of any errors would be appreciated. The data are clearly not intended to indicate the authoritative location of property boundaries, the precise shape or contour of the earth or the precise location of fixed works of humans.

Printed 4 / 5 / 2023

EXHIBIT B

Tillamook County Department of Community Development
1510-B Third Street. Tillamook, OR 97141 | Tel: 503-842-3408 Fax: 503-842-1819
www.co.tillamook.or.us

PLANNING APPLICATION

OFFICE USE ONLY
Date Stamp
☐Approved ☐Denied
Received by:
Receipt #:
Fees: 1300.—
Permit No: 851-22-000380PLNG

Applicant ☐ *(Check Box if Same as Property Owner)*

Name: Stephanie [illegible] Phone: 503 930 4201
Address: PO Box 4552
City: Salem State: OR Zip: 97302
Email: mcmssmith@aol.com

Property Owner

Name: Lindley & Justin Leahy Phone: 815-777-2373
Address: 11195 NW Foothills Rd
City: Carlton State: OR Zip: 97111
Email: LindleyLeahy@gmail.com

Request: Review plans for permitting

Type II	Type III	Type IV
☐ Farm/Forest Review	☐ Appeal of Director's Decision	
☐ Conditional Use Review	☐ Extension of Time	☐ Appeal of Planning Commission Decision
☒ Variance	☐ Detailed Hazard Report	☐ Ordinance Amendment
☐ Exception to Resource or Riparian Setback	☐ Conditional Use (As deemed by Director)	☐ Large-Scale Zoning Map Amendment
☐ Nonconforming Review (Major or Minor)	☐ Ordinance Amendment	☐ Plan and/or Code Text Amendment
☐ Development Permit Review for Estuary Development	☐ Map Amendment	
☐ Non-farm dwelling in Farm Zone	☐ Goal Exception	
☐ Foredune Grading Permit Review		
☒ Neskowin Coastal Hazards Area		

Location:

Site Address: NA

Map Number:	5S	11	25CB	~~45~~ 5400
	Township	Range	Section	Tax Lot(s)

Clerk's Instrument #: ______________________

Authorization

This permit application does not assure permit approval. The applicant and/or property owner shall be responsible for obtaining any other necessary federal, state, and local permits. The applicant verifies that the information submitted is complete, accurate, and consistent with other information submitted with this application.

[signature] 9/12/22
Property Owner Signature (Required) Date

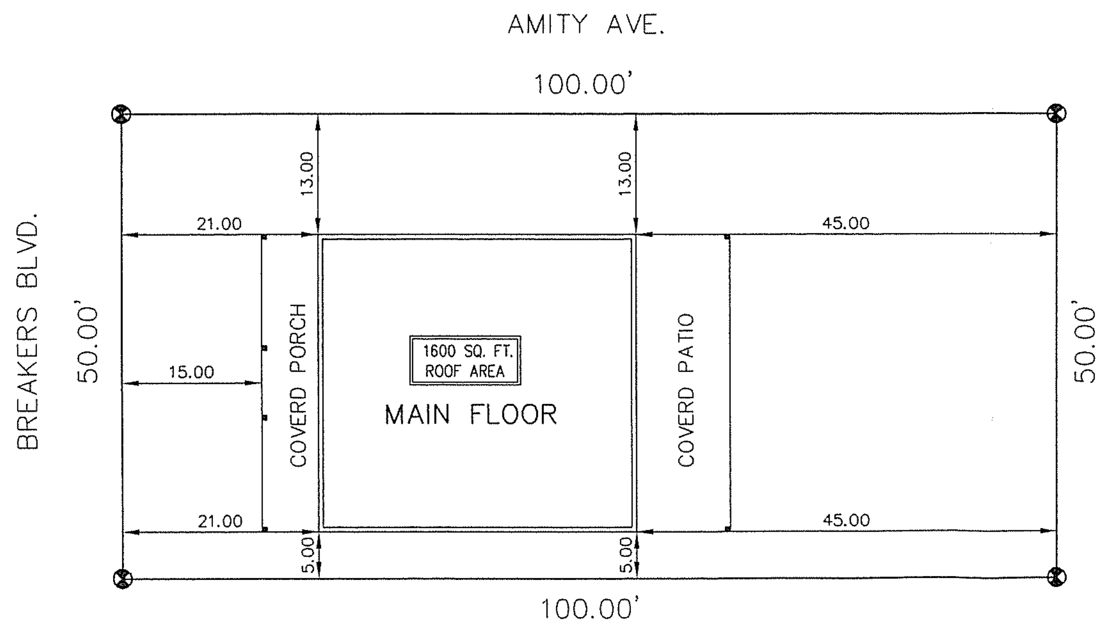
[signature] 8/25/22
Applicant Signature Date

SITE PLAN

CONTRACTOR:
MIGAR CORP.
503-932-3670

N

1"=20'



* CONTRACTOR TO VERIFY ALL DIMENSIONS IN FIELD*

* ALL UTILITY LOCATIONS ARE TO BE DETERMINED BY CONTRACTOR.*

* ALL PROPERTY ELEVATIONS ARE TO BE DETERMINED BY CONTRACTOR.*

SITE PLAN
TAXLOT# 5400 BREAKERS BLVD.
NESKOWIN, OREGON
SCALE: 1" = 20.00'

SUBDIVISION: ____ LOT: ____ BLK: ____
NAME: ____ PH. # ____
ADDRESS: ____ CDA: ____
ASBUILT # ____ MAP # ____
STORM DRAINAGE: ____
WATER SERVICE LEVEL: ____ CODE: ____ PS: ____
SIDEWALK: ____

APPROVAL STAMPS

Geologic Hazards and
Geotechnical Investigation
Tax Lot 5400, Map 5S-11W-25CB
Breakers Boulevard
Neskowin, Oregon

Prepared for:
Lindley Leahy
11195 NW Foothills Road
Carlton, Oregon 97111

Project #Y214521

January 6, 2022

H.G. Schlicker & Associates, Inc.

H.G. Schlicker & Associates, Inc.
607 Main Street, Suite 200 · Oregon City, Oregon 97045
(503) 655-8113 · FAX (503) 655-8173

Project #Y214521 January 6, 2022

To: **Lindley Leahy**
11195 NW Foothills Road
Carlton, Oregon 97111

Subject: **Geologic Hazards and Geotechnical Investigation**
Tax Lot 5400, Map 5S-11W-25CB
Breakers Boulevard
Neskowin, Oregon

Dear Ms. Leahy:

The accompanying report presents the results of our geologic hazards and geotechnical investigation for the above subject site.

After you have reviewed our report, we would be pleased to discuss it and to answer any questions you might have.

This opportunity to be of service is sincerely appreciated. If we can be of any further assistance, please contact us.

H.G. SCHLICKER & ASSOCIATES, INC.

J. Douglas Gless, MSc, RG, CEG, LHG
President/Principal Engineering Geologist

JDG:mgb

TABLE OF CONTENTS

TABLE OF CONTENTS(continued)

Page

TABLE OF CONTENTS(continued)

Page

TABLE OF CONTENTS(continued)

FIGURES

APPENDICES

H.G. Schlicker & Associates, Inc.
607 Main Street, Suite 200 · Oregon City, Oregon 97045
(503) 655-8113 · FAX (503) 655-8173

Project #Y214521 January 6, 2022

To: **Lindley Leahy**
11195 NW Foothills Road
Carlton, Oregon 97111

Subject: **Geologic Hazards and**
Geotechnical Investigation
Tax Lot 5400, Map 5S-11W-25CB
Breakers Boulevard
Neskowin, Oregon

Dear Ms. Leahy:

1.0 Introduction

At your request and authorization, a representative of H.G. Schlicker and Associates, Inc. (HGSA) visited the subject site on December 22, 2021, to complete a geologic hazards and geotechnical investigation of Tax Lot 5400, Map 5S-11W-25CB located in Neskowin, Oregon (Figures 1 and 2; Appendix A). It is our understanding that you are planning to construct a new house at the site.

This report addresses the engineering geology and geologic hazards at the site with respect to the proposed construction. The scope of our work consisted of a site visit, site observations and measurements, subsurface exploration with hand augered borings, a slope profile, limited review of the geologic literature, interpretation of topographic maps, lidar and stereo aerial photographs, and preparation of this report of our findings, conclusions and geotechnical recommendations for home construction.

2.0 Site Description

The subject site is a vacant approximately 0.11-acre rectangular-shaped lot located on a younger stabilized dune in the community of Neskowin, Oregon (Figure 1). The property consists of Tax Lot 5400, Map 5S-11-25CB, approximately 50 feet wide and 100 feet deep. An oceanfront protective structure (riprap revetment) is located on the dune slope approximately 260 feet west of the site; this revetment is contiguous with other revetments to the north and south (Appendix A). The site is bounded to its south and east by developed lots, to its north by Amity Avenue and to its west by Breakers Boulevard.

This non-oceanfront site is located on the central portion of a dune, approximately one block east of the nearby beach and the Pacific Ocean. A shallow depression occupies the center of the site. At the time of our site visit, during heavy rainfall, standing water was present in this area (Appendix A).

2.1 The history of the site and surrounding areas, such as previous riprap or dune grading permits, erosion events, exposed trees on the beach, or other relevant local knowledge of the site

The site is located on loose dune sand, which is easily eroded by ocean wave activity, and wind when devoid of vegetation. During the winters of 1998, 1999, 2000 and 2001, severe storms resulted in substantial ocean wave erosion, which removed active dunes present west of the subject lot and eroded the western part of the dune on which the property lies. As reported by local residents, up to 10 feet of erosion has been observed during a single storm event. Ocean wave erosion has also resulted in lowering of the beach elevation by several feet, allowing higher energy waves to impact the dune. The increase in ocean wave erosion observed along much of the Oregon Coast in the recent past is a consequence of the mid- to late 1990s El Niño/La Niña events, which altered ocean currents and transported much of the beach sand offshore. There has been some rebuilding of the beach in the last few years, but this has been a slow process. As a result, nearly all of Neskowin's oceanfront residences have had oceanfront protection installed. In the area of this site, the oceanfront has been protected with riprap revetments for hundreds of feet to the north and south.

Severe storms in the winter of 2007–2008 partly undermined many of the revetments in the Neskowin area. The riprap revetments greatly reduce the potential for erosion when maintained and repaired as necessary.

Based on a review of satellite and "street view" imagery, the site appears to have been subject to vegetation removal and minor grading in the past.

2.2 Topography, including elevations and slopes on the property itself

The site is located on the central portion of a younger stabilized dune. Elevations on the site range from approximately 22 feet (NAVD 88) near the western portion of the property to approximately 19 feet (NAVD 88) near the south-central portion of the property. The site slopes gently to the southeast at approximately a few degrees. (Figures 3 and 4; Appendix A).

2.3 Vegetation cover

The site is sparsely vegetated with lawn grass and weeds with a few mature shorepine near the eastern property boundary (Appendix A).

2.4 Subsurface materials – the nature of the rocks and soils

Subsurface exploration was completed by advancing three hand-augered borings to depths up to approximately 4 feet below the ground surface (bgs). The borings generally encountered approximately 2 feet of very loose organic-rich silty sands and fill overlying loose dune sand. Subsurface materials are discussed in detail in Section 4.1.

2.5 Conditions of the seaward front of the property, particularly for sites having a sea cliff

The property's western boundary (seaward front) is located approximately 260 feet east of the revetment in the central portion of a younger vegetated dune. The general area of the site is densely developed with existing homes with varying amounts of vegetation, and properties west of the site are protected by a riprap revetment. The riprap revetment appeared to be in generally good condition. The quality of the armor stone used for the construction of the revetment was variable and consisted of a mixture of highly fractured basalt breccia and relatively unfractured basalt (Appendix A). Additional observations are addressed and illustrated in Sections 3.0 and Appendix A.

2.6 Presence of drift logs or other flotsam on or within the property

At the time of our site visit, we did not observe drift logs or flotsam on the beach to the west of the property. However, a small log was wedged in the rip rap boulders in the lower portion of the revetment west of the site.

2.7 Description of streams or other drainage that might influence erosion or locally reduce the level of the beach

Neskowin Creek discharges onto the beach approximately 0.5 mile south of the site (Figure 1). Historical satellite imagery from Google Earth indicates that although Neskowin Creek's stream channel meanders approximately 500 feet north and south on the beach, the stream generally enters the ocean near the east side of proposal rock and does not appear to influence the level of the beach west of the subject site.

2.8 Proximity of nearby headlands that might block the long shore movement of beach sediments, thereby affecting the level of the beach in front of the property

The site is located approximately 1 mile north of the Cascade Head headlands and approximately 7.5 miles south of Cape Kiwanda. Proposal Rock, located approximately 0.45 miles south of the site, can be considered the nearest headland and does not appear to affect the subject site substantially.

2.9 Description of any shore protection structures that may exist on the property or on nearby properties

An existing riprap revetment is present approximately 260 feet west of the subject site and is connected to other oceanfront revetments which extend for hundreds of feet to the north and south along Neskowin Beach.

2.10 Presence of pathways or stairs from the property to the beach

There are no pathways or stairs that directly lead from the site to the beach. However, the nearest public beach access occupies the western end of Amity Avenue, approximately 260 feet west of the site.

2.11 Existing human impacts on the site, particularly any that might alter the resistance to wave attack

Human impacts are not contributing to alteration of the resistance of the riprap revetment to wave attack west of the site.

3.0 Description of the Fronting Beach

Neskowin Beach fronts the properties west of the site. Detailed descriptions of the characteristics of the beach are provided below.

3.1 Average widths of the beach during the summer and winter

The beach near the site has a highly variable width, which is primarily dependent upon tide levels, and it tends to be narrower in the winter than in the summer. Although the beach can be more than 300 feet wide, at high tide, there is often no walkable beach. The beach here is very dynamic and changes morphology frequently, primarily due to rip current formation.

3.2 Median grain size of beach sediment

During our site visit, we observed fine-grained to medium-grained beach sand.

3.3 Average beach slopes during the summer and winter

Beach slopes vary from approximately 2 to 5 degrees depending upon recent accretion or erosion. The beaches tend to be flatter in the summer.

3.4 Elevations above mean sea level of the beach at the seaward edge of the property during summer and winter

The property's western edge lies approximately 260 feet east of the upper edge of the riprap revetment west of the site. Lidar data from 2016 shows the junction between the beach and the revetment was at approximately 8 feet (NAVD 88). Allan and Hart (2005) surveyed the elevation of the beach/dune junction in 1997, 1998, and 2002 at approximately 20 feet, 20 feet, and 17 feet, respectively. Winter elevations primarily depend on beach profiles formed by storm conditions.

3.5 Presence of rip currents and rip embayments that can locally reduce the elevation of the fronting beach

Rip currents and rip current embayments commonly contribute to erosion along the oceanfront in Neskowin. Narrow beaches and near-shore relatively deep water conditions contribute to rip current and rip current embayment formation.

3.6 Presence of rock outcrops and sea stacks, both offshore and within the beach zone

Proposal Rock is located approximately 0.45 miles south of the site.

3.7 Information regarding the depth of beach sand down to bedrock at the seaward edge of the property

Based on our experience with Neskowin sites in the vicinity, we estimate that bedrock lies more than 40 feet below beach level.

4.0 Geologic Hazards Analysis

Our geologic hazards analysis is presented below.

4.1 Subsurface Materials

The site lies in an area that has been mapped as Pleistocene beach sand (Schlicker et al., 1972). Neskowin lies on a large dune complex which is approximately 4 miles long, north to south and extends from the coastline east to the base of the hills. This dune complex consists of numerous individual dunes which vary in age and stability. The area of the site has been mapped as a younger stabilized dune (open dune sand conditionally stable) which is a dune that has become conditionally stable regarding wind erosion (USDA et al., 1975). The dune consists of tan, loose, fine-grained sand with a thin, moderately developed topsoil. Based on our previous review of stereo pairs of aerial photographs prior to 1998, active dunes had been present west of the site but were eroded by ocean wave activity in the late 1990s, threatening the property, and as a result, oceanfront protection (a riprap revetment) was constructed.

At the time of our December 22, 2021 site visit, we completed subsurface exploration with three hand-augered borings logged by a geologist from our office who visually classified the soils encountered according to the Unified Soil Classification System (USCS) as follows:

	Depth (ft.)	USCS	Description
B-1	0.0– 0.3	ML	Clayey SILT; dark brown, moist, medium stiff. With organic debris and grass roots.
	0.3– 2.0	SM	Silty SAND; brown, moist, very loose to loose. With organic debris.
	2.0 – 4.0	SW	SAND, tan, moist, loose to slightly dense, medium to fine-grained; Unconsolidated.

	Depth (ft.)	USCS	Description
B-2	0 – 1.0	ML (FILL)	Clayey SILT (FILL); brown, moist, loose to stiff. With organic debris, roots, and frequent ¾ inch minus rock fragments. Refusal on rock fragment.

	Depth (ft.)	USCS	Description
B-3	0 – 1.3	GW(FILL)	GRAVEL (FILL); dark brown, moist, dense. With clayey silt. Refusal on rock fragment.

Boring B-1 generally encountered approximately 2 feet of brown, very loose to loose, organic-rich silt and silty sand overlying tan, loose to slightly dense moist dune sand. Borings B-2 and B-3, on the west side of the lot, both met refusal at shallow depths due to rock fragments. We anticipate that undocumented fill at least two feet thick will be encountered throughout the western portion of the site. Probing of the center of the site encountered moderate resistance at depths of approximately 2 feet.

4.2 Structure

Structural deformation and faulting along the Oregon Coast is dominated by the Cascadia Subduction Zone (CSZ) which is a convergent plate boundary extending for approximately 680 miles from northern Vancouver Island to northern California. This convergent plate boundary is defined by the subduction of the Juan de Fuca plate beneath the North America Plate and forms an offshore north-south trench approximately 60 miles west of the Oregon coast shoreline. A resulting deformation front consisting of north-south oriented reverse faults is present along the western edge of an accretionary wedge east of the trench, and a zone of margin-oblique folding and faulting extends from the trench to the Oregon Coast (Geomatrix, 1995).

A northwest-trending strike-slip fault is mapped near the site, extending from Proposal Rock to the southeast approximately 4 miles (Snavely et al., 1996). Based on mapping, the fault appears to offset middle Tertiary geologic units.

An unnamed offshore fault is mapped approximately 10 miles west of the site (Personius et al., 2003). The faults are part of a mapped group of left- and right-lateral strike-slip, normal, and reverse faults which offset accretionary wedge sediments underlying the continental shelf and slope in the forearc of the Cascadia Subduction Zone; some of the faults in this group also offset the overlying sedimentary section and underlying oceanic basalts of the subducting Juan de Fuca Plate (Personius et al., 2003). Most of the offshore faults in this group have strikes oblique to the Cascadia deformation front, suggesting a strong lateral component of slip. No detailed information on the ages of faulted deposits has been published, but similar offshore structures offset late Pleistocene and Holocene sediments (Personius et al., 2003). An offshore thrust fault is also mapped approximately 2 miles west of the site (Personius et al., 2003).

The nearest mapped potentially active faults are located in the Tillamook Bay fault zone approximately 30 miles north of the site, which are northwest-striking faults that offset the Eocene Tillamook Volcanics on the west flank of the Coast Range. No displacements in Quaternary deposits have been documented, but the fault zone parallels the mountain front that controls the northeastern margin of Tillamook Bay and thus has geomorphic expression consistent with Quaternary displacement (Personius et al., 2003).

4.3 Slopes

Slopes are discussed in detail in Section 2.2 above.

4.4 Orientation of Bedding Planes in Relation to the Dip of the Surface Slope

The site lies in an area mapped as dune sands which have beds of varying dip related to the surface slope. The underlying Basalt of Cascade Head has been mapped as dipping down to the north-northwest from 30 to 45 degrees (Snavely et al., 1996). Grades at the subject site are primarily related to past grading and fill activities rather than the orientation of underlying units.

4.5 Site Surface Water Drainage Patterns

Stormwater at the site generally flows towards the center of the site. At the time of our site visit, we observed no streams at the site. The nearest stream is Kiwanda Creek, located approximately 680 feet east of the site. Kiwanda Creek joins Neskowin creek and discharges onto the beach approximately 0.5 miles south of the site.

4.6 Dune Stability and Erosion

The site is located on loose dune sand, which is easily eroded by ocean wave activity, and wind when devoid of vegetation. During the winters of 1998, 1999, 2000 and 2001, severe storms resulted in substantial ocean wave erosion, which removed active dunes present west of the subject lot and eroded the western part of the dune on which the property lies. As reported by local residents, up to 10 feet of erosion has been observed during a single storm event. Ocean wave erosion has also resulted in lowering of the beach elevation by several feet, allowing higher energy waves to impact the bluff. The increase in ocean wave erosion observed along much of the Oregon Coast in the recent past is a consequence of the mid- to late 1990s El Niño/La Niña events, which altered ocean currents and transported much of the beach sand offshore. There has been some rebuilding of the beach in the last few years, but this has been a slow process. As a result, nearly all of Neskowin's oceanfront residences have had oceanfront protection installed. In the area of this site, the oceanfront has been protected with riprap revetments for hundreds of feet to the north and south.

The existing revetments located west of the subject site consist of angular basalt boulders. (Appendix A). Severe storms in the winter of 2007–2008 partly undermined the revetments in areas located along Neskowin Beach. The riprap revetment greatly reduces the potential for erosion when maintained and repaired as necessary.

Mapping by Allan and Priest (2001) identifies the site within the Moderate Hazard Zone. The dune slope and revetment areas west of the site are mapped in the active and high coastal erosion hazard zones. The active coastal erosion hazard zone is defined as an area that is being actively eroded by ocean waves and the mass movements directly caused by wave action, and the high coastal erosion hazard zone is defined as an area having a high probability that it could be affected by active erosion in the next ~ 60 to 100 years. The moderate coastal erosion zone is defined as an area with a moderate probability of being affected by active erosion in the next ~ 60 to 100 years (Allan and Priest, 2001). It should be noted that mapping done for the 2001 study was intended for regional planning use, not for site-specific hazard identification.

4.7 Regional Seismic Hazards

Abundant evidence indicates that a series of geologically recent large earthquakes related to the Cascadia Subduction Zone have occurred along the coastline of the Pacific Northwest. Evidence suggests that more than 40 great earthquakes of magnitude 8 and larger have struck western Oregon during the last 10,000 years. The calculated odds that a Cascadia earthquake will occur in the next 50 years range from 7–15 percent for a great earthquake affecting the entire Pacific Northwest, to about a 37 percent chance that the southern end of the Cascadia Subduction Zone will produce a major earthquake in the next 50 years (OSSPAC, 2013; OSU News and Research Communications, 2010; Goldfinger et al., 2012). Evidence suggests the last major earthquake occurred on January 26, 1700, and may have been of magnitude 8.9 to 9.0 (Clague et al., 2000).

There is now increasing recognition that great earthquakes do not necessarily result in a complete rupture along the full 1,200 km fault length of the Cascadia subduction zone. Evidence in the paleorecords indicates that partial ruptures of the plate boundary have occurred due to smaller earthquakes with moment magnitudes (Mw) < 9 (Witter et al., 2003; Kelsey et al., 2005). These partial segment ruptures appear to occur more frequently on the southern Oregon coast, as determined from paleotsunami studies. Furthermore, the records have documented that local tsunamis from Cascadia earthquakes recur in clusters (~250–400 years) followed by gaps of 700–1,300 years, with the higher tsunamis associated with earthquakes occurring at the beginning and end of a cluster (Allan et al., 2015).

These major earthquake events were accompanied by widespread subsidence of a few centimeters to 1–2 meters (Leonard et al., 2004). Tsunamis appear to have been associated with many of these earthquakes. In addition, settlement, liquefaction, and landsliding of some earth materials are believed to have been commonly associated with these seismic events.

Other earthquakes related to shallow crustal movements or earthquakes related to the Juan de Fuca plate have the potential to generate magnitude 6.0 to 7.5 earthquakes. The recurrence interval for these types of earthquakes is difficult to determine from present data, but estimates of 100 to 200 years have been given in the literature (Rogers et al., 1996).

The expected strength of shaking to occur at the site during an earthquake in a 500-year period has been mapped as severe (DOGAMI Oregon HazVu website, accessed January 2022). "Severe" is the second-highest level of a six-level gradation from "Light" to "Violent" in this mapping system.

Liquefaction and Settlement

Liquefaction occurs when saturated, cohesionless soils are subjected to ground vibrations, resulting in a decrease in the volume of the soil. If drainage is unable to occur, the tendency to decrease in volume results in an increase in pore water pressure, and if the pore water pressure builds up to the point at which it is equal to the overburden pressure, the effective stress becomes zero, and the soil loses its strength and develops a liquefied state. Liquefaction is most common in saturated, loose, granular soils, sand or silty sand materials. Cohesive soils, such as clayey silt and clay, will generally not liquefy during earthquakes. Older sediments are also more resistant to liquefaction than recently deposited sediments (Idris and Boulanger, 2008).

DOGAMI's HazVu website (https://gis.dogami.oregon.gov/maps/hazvu/) has mapped the area of the site as having a high susceptibility to liquefaction. DOGAMI states: "Buildings and infrastructure sitting on these soils are likely to be severely damaged in an earthquake."

Settlement can be the result of liquefaction of saturated soils or simply a result of dry soil densifying under vibration (volumetric compression). Volumetric compression during an earthquake is the result of vibrations of the soil, which cause soil particles to settle into a denser state, decreasing the volume of the soil. The degree of settlement is primarily dependent upon the initial density of the soil and the magnitude and duration of ground vibration (shaking). Settlement caused by liquefaction is commonly differential, and the magnitude of settlement typically varies throughout a site, whereas settlement caused by volumetric compression tends to be more uniform.

4.8 Flooding Hazards

Based on the 2018 Flood Insurance Rate Map (FIRM, Panel #41057C1005F), the site lies in an area rated as Zone X, defined as an area of minimal flood hazard. The western portion of Breakers Boulevard near the western portion of the site appears to lie in an area mapped as a Special Flood Hazards Area (SFHA) Zone AE with Base Flood Elevations determined at 23 feet.

Based on the Oregon Department of Geology and Mineral Industries mapping (DOGAMI, 2012), the subject site lies within the tsunami inundation zone resulting from an approximately 8.7 and greater magnitude Cascadia Subduction Zone (CSZ) earthquake. The 2012 DOGAMI mapping is based upon 5 computer-modeled scenarios for shoreline tsunami inundation caused by potential CSZ earthquake events ranging in magnitude from approximately 8.7 to 9.1. The January 1700 earthquake event (discussed in Section 4.7 above) has been rated as an approximate 8.9 magnitude in DOGAMI's methodology. More distant earthquake source zones can also generate tsunamis.

4.9 Climate Change

According to most of the recent scientific studies, the Earth's climate is changing as the result of human activities which are altering the chemical composition of the atmosphere through the buildup of greenhouse gases, primarily carbon dioxide, methane, nitrous oxide, and chlorofluorocarbons (EPA, 1998). Although there are uncertainties about exactly how and when the Earth's climate will respond to enhanced concentrations of greenhouse gases, scientific observations indicate that detectable changes are underway (EPA, 1998; Church and White, 2006). Global sea level rise, caused by melting polar ice caps and ocean thermal expansion, could lead to flooding of low-lying coastal property, loss of coastal wetlands, erosion of beaches and bluffs, and saltwater contamination of drinking water. Global climate change and the resultant sea level rise will likely impact the subject site through accelerated coastal erosion and more frequent and severe flooding.

4.10 Analyses of Erosion and Flooding Potential

4.10.1 Analysis of DOGAMI beach monitoring data available for the site (if available).

DOGAMI beach monitoring data has been collected for Neskowin beach, approximately 900 feet south of the site, regularly since 1997. Following the winter storms of 1998-99 and construction of the revetments along the beach, beach elevations have varied by several feet from minimum to maximum over the monitored period of 1997 to 2021 (Allan and Hart, 2005; Allan and Hart, 2007; Allan and Hart, 2008; Allan et al., 2015; NANOOS, accessed January 2022).

4.10.2 Analysis of human activities affecting shoreline erosion.

We did not observe any human activities along the revetment west of the site that are affecting the shoreline erosion near the site. See Section 2.11 above.

4.10.3 Analysis of possible mass wasting, including weathering processes, landsliding, or slumping.

The erosive processes affecting the site are discussed in detail in Section 4.6 (above).

4.10.4 Calculation of wave run-up beyond mean water elevation that might result in erosion of the sea cliff or foredune.

Coastal erosion rates and hazard zones (as referenced in Allan and Priest, 2001) were presented in Section 4.6 Dune Stability and Erosion (above). In the dune-backed shoreline recession methodology applicable to the subject site, the total water level produced by the combined effect of wave runup plus the tidal elevation must exceed some critical elevation of the fronting beach, typically the elevation of the beach-dune junction. Wave runup elevation can change with many variables such as changing beach elevations, presence of transient dunes, etc. The dune is protected by the riprap revetment near the subject site, and this shoreline recession methodology is not appropriate for the site.

4.10.5 Evaluation of frequency that erosion-inducing processes could occur, considering the most extreme potential conditions of unusually high water levels together with severe storm wave energy.

On this stretch of dune-backed shoreline, erosion inducing processes are daily in the form of constant wave attack at the base of the revetment at high tide. High water levels and severe storms can cause rip currents which have the potential to undermine the revetment west of the site.

4.10.6 For dune-backed shoreline, use an established geometric model to assess the potential distance of property erosion, and compare the results with direct evidence obtained during site visit, aerial photo analysis, or analysis of DOGAMI beach monitoring data.

Not applicable to the subject site or nearby area, which is east of a dune-backed shoreline that has been extensively riprapped; see Section 4.10.4 (above).

4.10.7 For bluff-backed shoreline, use a combination of published reports, such as DOGAMI bluff and dune hazard risk zone studies, aerial photo analysis, and fieldwork, to assess the potential distance of property erosion.

Not applicable to the subject site, which lies in a dune-backed shoreline area.

4.10.8 Description of potential for sea level rise, estimated for local area by combining local tectonic subsidence or uplift with global rates of predicted sea level rise.

Based on data from NOAA monitoring stations at South Beach and Garibaldi, this general area of Oregon's coastline has a mean sea level rise of approximately 2.13 mm/year, which includes the combined effects of global rates of sea level rise and landmass elevation changes (NOAA Tides & Currents Sea Level Trends http://tideshttp://tidesandcurrents.noaa.gov/sltrends/sltrends.html). Additional observations are addressed in Section 4.9 of this report.

4.11 Assessment of Potential Reactions to Erosion episodes

4.11.1 Determination of legal restrictions of shoreline protective structures (Goal 18 prohibition, local conditional use requirements, priority for non-structural erosion control methods).

As previously noted, riprap revetments are present west of the subject site and for hundreds of feet to the north and south in this oceanfront area of Neskowin. Lots west of the site were generally 'developed' on January 1, 1977. According to the Ocean Shores Viewer (http://www.coastalatlas.net/oceanshores/, accessed January 2022), the site appears to lie outside and east of the Goal 18 Eligibility Inventory.

4.11.2 Assessment of potential reactions to erosion events, addressing the need for future erosion control measures, building relocation, or building foundation and utility repairs.

Residential development recommendations, including erosion control and foundation design recommendations, are presented in Section 5. The potential to move the house will depend on the design and placement on the lot.

5.0 Development Standards and Recommendations

The main engineering geologic concerns at the site are:

1. A few feet of uncontrolled fill and unsuitable soil are present throughout the site.

2. The site lies on dune sands that are poorly consolidated and subject to settlement and liquefaction, as well as ongoing coastal erosion if the revetment is damaged. Inherent risks of seismic hazards, coastal erosion, and future sand movement, including accretion at this site, must be accepted by the owner, future owners, developers, and residents. Construction of a single-family house is feasible provided that all of the recommendations presented below are adhered to.

3. There is an inherent regional risk of earthquakes along the Oregon Coast, which could cause harm and damage structures. Ground shaking during an earthquake can cause soil consolidation resulting in settlement of the structures and can cause soils to liquefy, resulting in the loss of bearing capacity and structural damage. The site also lies in a mapped tsunami hazard zone. A tsunami impacting the Neskowin area could cause harm, loss of life, and damage to structures. Hazards associated with tsunami flooding resulting from a large seismic event cannot be economically mitigated for. These risks must be accepted by the owner, future owners, developers, and residents of the site.

Recommendations

During construction, disturbed, dry sands may be blown by winds, which can result in the transport and deposition of sands off-site. Therefore, periodic watering or covering of exposed areas may be required to control blowing sands during windy conditions. Vegetation should be removed only as necessary, and exposed areas should be replanted following construction.

Provided the recommendations presented in this report are incorporated into design and construction, we believe that the proposed structure will be reasonably protected from the described erosion hazard for the life of the structure.

5.1 Development Density

It is our understanding that a new single-family house will be located at the site.

5.2 Setback

Based on our knowledge of the area, with proper maintenance, the existing riprap revetments west of the site will prevent significant dune erosion at the site. The western property line of the site lies approximately 260 feet east from the top of the revetment. Other than standard property line setbacks, no additional geologic hazards setback is required.

5.3 Grading Practices

We recommend the following grading practices:

5.3.1 Site Preparation

All existing fills and debris should be stripped and removed from building, slab and driveway areas prior to construction so that new foundations and structural fill materials can rest on dense native sand soils, recompacted fill sands at the site or imported granular fills. Fills need to be properly moisture conditioned when compacting.

We anticipate stripping depths to be approximately 2 feet. However, depths may vary depending on the variable thickness of the fills present on site, particularly on the western portion of the site.

Any tree stumps, including the root systems, shall be removed from beneath footing, slab and pavement areas, and the resulting holes backfilled with compacted non-organic structural backfill as recommended below.

The site will likely need to have a fill pad constructed to place the house on to improve drainage.

5.3.2 Cut and Fill Slopes

We do not anticipate any temporary or permanent cut slopes related to the proposed development.

However, temporary unsupported cut and fill slopes less than 8 feet in height should be sloped no steeper than 1½ horizontal to 1 vertical (1½ H:1V). If temporary slopes greater than 9 feet high are desired, or if water seepage is encountered in cuts, HGSA should be contacted to provide additional recommendations. Temporary cuts in excess of 5 feet high and steeper than 1½ H:1V will likely require appropriate shoring to provide for worker safety, per OSHA regulations. Temporary cuts should be protected from inclement weather by covering them with plastic sheeting to help prevent erosion and/or failure.

Permanent unsupported cut and fill slopes shall be constructed no steeper than 2 horizontal to 1 vertical (2H:1V).

5.3.3 Structural Fill

Structural fills supporting building loads should consist of granular material, free of organics and deleterious materials, and contain no particles greater than 1 inch in diameter so that nuclear methods (ASTM D2922 &ASTM D3017) can be easily used for field density testing. Structural fill should be placed and compacted in 8-inch lifts maximum and compacted to a minimum of 95 percent of the maximum dry density as determined by ASTM D1557, at or near the optimum moisture content. All areas to receive fill should be stripped of all soft soils, organic soils, organic debris, existing fill, disturbed soils, and construction debris.

STRUCTURAL FILL	
Compaction Requirements	95% ASTM D1557, compacted in 8-inch lifts maximum, at or near the optimum moisture content.

Proper test frequency and earthwork documentation usually require daily observation during stripping, rough grading, and placement of structural fill. Field density testing should generally conform to ASTM D2922 and D3017, or D1556. To minimize the number of field and laboratory tests, fill materials should be from a single source and of a consistent character. Structural fill should be approved and periodically observed by HGSA and tested by a qualified testing firm. Test results will need to be reviewed and approved by HGSA. We recommend that one density test be performed for at least every 18 inches of fill placed and every 200 cubic yards, whichever requires more testing. Because testing is performed on an on-call basis, we recommend that the earthwork contractor schedule the testing. Relatively more testing is typically necessary on smaller projects.

5.4 Vegetation Removal and Re-Vegetation Practices

Vegetation should be removed only as necessary, and exposed areas should be replanted following construction. Disturbed ground surfaces exposed during the wet season (November 1 through April 30) should be temporarily planted with grasses or protected with erosion control blankets or hydromulch. Existing vegetation should be left undisturbed as much as possible.

Temporary sediment fences should be installed around any disturbed areas of the site until permanent vegetation cover can be established. See Figure 5 for design criteria for the construction of a sediment fence.

Exposed sloping areas steeper than 3 horizontal to 1 vertical (3H:1V) should be mulched, seeded, and fertilized to provide erosion protection until permanent vegetation can be established. Erosion control blankets should be installed as per the manufacturer's recommendations.

5.5 Foundation Recommendations

Building loads may be supported on individual and/or continuous spread footings bearing on undisturbed, native, non-organic, firm soils or properly designed and compacted structural fill placed on these soils.

Although not required, we recommend mitigation of possible liquefaction hazards during a major earthquake be accomplished through tying the foundation together and reinforcement of foundation elements as per OSSC 2019 1809.13 Footing Seismic Ties.

All footing areas should be stripped of all organic and loose soils, organic debris, and any existing fills. We anticipate that non-organic, sandy soils will be encountered throughout the excavation. The footprint area should be protected with a 2- to 3-inch layer of crushed rock compacted with a minimum of 3 passes of a vibratory compactor. Footing excavations should be completed using a smooth edge bucket to minimize disturbance of the subgrade.

Footings bearing in undisturbed, native, non-organic, firm soils or properly compacted structural fill placed on these soils may be designed for the following:

ALLOWABLE SOIL BEARING CAPACITIES	
Allowable Dead Plus Live Load Bearing Capacity [a]	1,500 psf
Passive Resistance	150 psf/ft embedment depth
Lateral Sliding Coefficient	0.35
[a] Allowable bearing capacity may be increased by one-third for short term wind or seismic loads.	

We recommend that the house be constructed with an elevated floor and crawlspace design. For conventional light-frame construction*, our recommended minimum widths and embedment depths for continuous footings are as follows:

MINIMUM FOOTING WIDTHS & EMBEDMENT DEPTHS			
Number of Stories	One	Two	Three
Minimum Footing Width	12 inches	15 inches	23 inches
Minimum Exterior Footing Embedment Depth [a]	15 inches	18 inches	24 inches
Minimum Interior Footing Embedment Depth [b]	6 inches	6 inches	6 inches

[a] All footings shall be embedded as specified above, or extend below the frost line as per Table R301.2(1) of the 2021 ORSC, whichever provides greater embedment.

[b] Interior footings shall be embedded a minimum of 6 inches below the lowest adjacent finished grade, or as otherwise recommended by our firm. In general, interior footings placed on sloping or benched ground shall be embedded or set back from cut slopes in such a manner as to provide a minimum horizontal distance between the foundation component and face of the slope of one foot per every foot of elevation change.

*Please contact us for additional recommendations if brick veneer, hollow concrete masonry, or solid concrete or masonry wall construction is incorporated in the design of the house.

Isolated footings should meet Section R403.1.7 of the 2021 Oregon Residential Specialty Code (ORSC) requirements.

Deck footings should meet or exceed the minimum sizes set forth in Table R507.3.1 of 2021 ORSC.

5.6 Slab-on-Grade

All areas beneath slabs for driveways and garages shall be excavated a minimum of 6 inches into native, non-organic, firm soils. The exposed subgrade in the slab excavation shall be cut smooth, without loose or disturbed soil and rock remaining in the excavation.

SLABS-ON-GROUND	
Minimum thickness of 3/4 inch minus crushed rock beneath slabs	6 inches
Compaction Requirements	Minimum of 95% ASTM D1557, compacted in 8-inch lifts maximum

The slab excavation shall then be backfilled with a minimum of 6 inches of ¾ inch minus, clean, free-draining, crushed rock placed in 8-inch lifts maximum, which are compacted to a minimum of 95 percent of the Modified Proctor (ASTM D1557). Reinforcing of the slab is recommended, and the slab shall be fully waterproofed in accordance with structural and architectural design considerations. An underslab drainage system may be necessary, as per the architect's recommendations.

5.7 Retaining Wall Recommendations

We do not anticipate the need for free-standing retaining walls. Please contact us for retaining wall recommendations if necessary.

5.8 Drainage and Storm Water Management

Surface water should be diverted from building foundations and walls to approved disposal points by grading the ground surface to slope away a minimum of 2 percent for at least 6 feet towards a suitable gravity outlet to prevent ponding near the structures. Permanent subsurface drainage of the building perimeter using footing drains is recommended.

Footing drains should be installed adjacent to the perimeter footings and sloped a minimum of 1.0 percent to a gravity outlet. A suitable perimeter footing drain system would consist of a 4-inch diameter, perforated PVC pipe (typical) embedded below and adjacent to the bottom of footings and backfilled with approved drain rock. The type of pipe to be utilized may depend on building agency requirements and should be verified prior to construction. HGSA also recommends lining the drainage trench excavation with a non-woven geotextile filter such as Mirafi® 140N or equivalent to increase the life of the footing drain and prevent the drain from being clogged by soil. The perimeter drain excavation should be constructed in a manner which prevents undermining of foundation or slab components or any disturbance to supporting soils.

All crawlspaces will need to be vented as per ORSC requirements.

All roof drains should be collected and tightlined in a separate system independent of the footing drains, or an approved backflow prevention device shall be used. All roof and footing drains should be discharged to an approved disposal point. If water will be discharged to the ground surface, we recommend that energy dissipaters, such as splash blocks or a rock apron, be utilized at all pipe outfall locations. Water collected on the site should not be concentrated and discharged to adjacent properties. We recommend that all collected water be tightlined and discharged to the local stormwater system or to splash blocks.

5.9 Erosion Control

As detailed above (Section 5.4), vegetation should be removed only as necessary, and exposed areas should be replanted following construction. Disturbed ground surfaces exposed during the wet season (November 1 through April 30) should be temporarily planted with grasses or protected with erosion control blankets.

A temporary sediment fence should be installed around any disturbed areas of the site until permanent vegetation cover can be established. See Figure 5 for design criteria for the construction of a sediment fence.

As recommended above, exposed sloping areas steeper than 3 horizontal to 1 vertical (3H:1V) should be protected by hydroseeding or the use of rolled erosion control products (RECP's), aka "erosion control blankets," to provide erosion protection until permanent vegetation can be established. Erosion control blankets should be installed as per the manufacturer's recommendations.

Periodic watering of exposed areas may be required during construction to control blowing sands during windy conditions and prevent transport and deposition of disturbed or dry sands off-site.

The riprap revetment should be maintained and repaired as necessary to ensure its continued performance in reducing the potential for erosion at the site; however, this is typically the responsibility of the property owner adjacent to the riprap.

5.10 Flooding Considerations

Flooding hazards at and near the site are discussed in Section 4.8 above.

5.11 Seismic Considerations

The structure and all structural elements should be designed to meet current Oregon Residential Specialty Code (ORSC) seismic requirements. Based on our knowledge of subsurface conditions at the site and our analysis using the guidelines recommended in the ORSC, the structure should be designed to meet the following seismic parameters:

SEISMIC DESIGN PARAMETERS	
Site Class	D
Seismic Design Category	D_2
Mapped Spectral Response Acceleration for Short Periods	S_S = 1.295g
Site Coefficients	F_a = 1.200 F_v = 1.700
Design Spectral Response Acceleration at Short Periods	S_{DS} = 1.036 g

5.12 Plan Review and Construction Observations

Prior to construction, we should be provided the opportunity to review all site development, foundation, drainage, erosion control, and grading plans to assure conformance with the intent of our recommendations (Appendix B). All site plans, details, and specifications should clearly show that the above recommendations have been implemented into the design.

A representative of HGSA should observe all footing and slab excavations prior to placing structural fill, and/or forming and pouring concrete to assure that suitable bearing materials have been reached (Appendix B). Please provide us with at least 5 (five) days' notice prior to any needed site observations. There will be additional costs for these services.

5.13 Worker Safety

All construction activities should be completed in accordance with OSHA standards, and all State and local laws, rules, regulations, and codes.

6.0 Summary Findings and Conclusions

HGSA certifies that all applicable content requirements of Tillamook County Land Use Ordinance Section 3.570(5) have been addressed above, and it is the undersigned engineering geologist's professional opinion that the proposed development will be within the acceptable level of risk established by the community, considering the site conditions and the above recommendations.

Our summary findings and conclusions are presented below:

6.1 Proposed Use

The proposed project consists of constructing a house on the site. No additional roads are anticipated other than a driveway. No adverse impacts are anticipated to occur on adjacent lots as a result of the development of this site, provided that the recommendations detailed in this report are adhered to.

6.2 Hazards to Life, Property, and the Environment

Geologic hazards to life, property, and the environment associated with this proposed use include stormwater erosion, ocean wave and wind erosion, and seismic hazards. Recommendations for mitigation of flooding and stormwater erosion have been incorporated into this report. Please note that the risk of these hazards is inherent with development and construction in this part of Neskowin and must be assumed by the owner, future owners, developers, and residents.

6.3 Off-Site Protection

Adverse effects of this development on surrounding areas will be minimized when all the stormwater, foundation, vegetation, and erosion control recommendations detailed in this report are adhered to.

6.4 Stabilization Programs

Stabilization programs for this site include vegetation and erosion stabilization as addressed in Sections 5.4 and 5.9 of this report, surface water collection as addressed in Section 5.8 of this report, and maintenance of the riprap revetment as addressed in Section 5.9 of this report.

6.5 Conclusions Regarding Hazards and Adverse Environmental Effects

Adverse environmental effects will be minimized by following the recommendations detailed in this report during the design and construction of the proposed project.

6.6 Recommendations for Further Work

Assuming all the recommendations above are adhered to, no additional investigation or analysis is required by our firm other than review of site development plans, and observation of foundation excavations as detailed in Section 5.12 and Appendix B of this report.

7.0 Additional Services

Design Review

This report pertains to a specific site and development. It is not applicable to adjacent sites nor is it valid for types of development other than that to which it refers. Any variation from the site or development plans necessitates a geotechnical review in order to determine the validity of the design concepts evolved herein.

HGSA's review of final plans and specifications is necessary to determine whether the recommendations detailed in this report for the site have been properly interpreted and incorporated in the design and construction documents. At the completion of our review, we will issue a letter of conformance to the client for the plans and specifications.

Construction Monitoring

Because of the judgmental character of geotechnics, as well as the potential for adverse circumstances arising from construction activity, observations during site preparation, excavation, and construction will need to be carried out by a representative of HGSA or our designate. These observations may then serve as a basis for confirmation and/or alteration of geotechnical recommendations or design guidelines presented herein to the benefit of the project. Field observations become increasingly important should earthwork proceed during adverse weather conditions.

8.0 Limitations

The Oregon Coast is a dynamic environment with inherent unavoidable risks to development. Landsliding, erosion, tsunamis, storms, earthquakes and other natural events can cause severe impacts to structures built within this environment and can be detrimental to the health and welfare of those who choose to place themselves within this environment. The client is warned that, although this report is intended to identify the geologic hazards causing these risks, the scientific and engineering communities' knowledge and understanding of geologic hazards processes is not complete.

Our investigation was based on engineering geological reconnaissance, limited review of published information, and our subsurface exploration and analyses. The data presented in this report are believed to be representative of the site. The conclusions herein are professional opinions derived in accordance with current standards of professional practice and budget constraints. No warranty is expressed or implied. The performance of the site during a seismic event has not been evaluated. If you would like us to do so, please contact us.

The boring logs and related information depict generalized subsurface conditions only at these specific locations and at the particular time the subsurface exploration was completed. Soil, rock, and groundwater conditions at other locations may differ from the conditions at these boring locations. Also, the passage of time may result in a change in the soil and groundwater conditions at the site.

This report pertains to the subject site only, and is not applicable to adjacent sites nor is it valid for types of development other than that to which it refers. Geologic conditions including materials, processes, and rates can change with time and therefore, a review of the site and/or this report may be necessary as time passes to assure its accuracy and adequacy. This report may only be copied in its entirety.

9.0 Disclosure

H.G. Schlicker & Associates, Inc. and the undersigned Certified Engineering Geologist have no financial interest in the subject site, the project or the Client's organization.

10.0 References Cited

Allan, J. C. and Hart, R., 2005, A geographical information system (GIS) data set of beach morphodynamics derived from 1997, 1998, and 2002 LIDAR data for the central to northern Oregon coast: Technical Report to the Oregon Department of Land Conservation and Development: Oregon Department of Geology and Mineral Industries, Open-File Report O-05-09, 16 pages.

Allan, J. C. and Hart, R., 2007, Assessing the temporal and spatial variability of coastal change in the Neskowin littoral cell: developing a comprehensive monitoring program for Oregon beaches: Technical Report to the Oregon Department of Land Conservation and Development: Oregon Department of Geology and Mineral Industries, Open-File Report O-07-01, 27 pages.

Allan, J.C., and Hart, R., 2008, Oregon beach and shoreline mapping and analysis program: 2007-2008 beach monitoring report: Oregon Department of Geology and Mineral Industries Open file report O-08-15, 60 p.

Allan, J.C., Ruggiero, P., Garcia, G., O'Brien, F. E., Stimely, L. L., and Roberts, J. T., 2015, Coastal Flood Hazard Study, Tillamook County, Oregon: Oregon Department of Geology and Mineral Industries Special Paper 47, 274 p.

Allan, J. C. and Priest, G. R., 2001, Evaluation of coastal erosion hazard zones along dune and bluff backed shorelines in Tillamook County, Oregon: Cascade Head to Cape Falcon: Oregon Department of Geology and Mineral Industries, Open-File Report O-01-03, 126p., maps.

Church, J. A., and White, N. J., 2006, A 20th century acceleration in global sea-level rise; Geophysical Research Letters, v. 22, LO1601, 4 p.

Clague, J. J., Atwater, B. F., Wang, K., Wang, Y., and Wong, I., 2000, Penrose Conference 2000 - Great Cascadia Earthquake Tricentennial, Programs Summary and Abstracts: Oregon Department of Geology and Mineral Industries, Special Paper 33, 156 p.

DOGAMI, 2012, Tsunami inundation maps for Neskowin, Tillamook County, Oregon: Oregon Department of Geology and Mineral Industries, TIM-Till-14, maps.

EPA, 1998, Climate Change and Oregon: Environmental Protection Agency, EPA 236-98-007u, 4 p.

Geomatrix Consultants, 1995, Seismic design mapping, State of Oregon, final report: Prepared for the Oregon Department of Transportation, Project No. 2442.

Goldfinger, C., Nelson, C. H., Morey, A. E., Johnson, J. E., Patton, J. R., Karabanov, E., Gutiérrez-Pastor, J., Eriksson, A. T., Gràcia, E., Dunhill, G., Enkin, R. J., Dallimore, A., and Vallier, T., 2012, Turbidite event history—Methods and implications for Holocene paleoseismicity of the Cascadia subduction zone: U.S. Geological Survey Professional Paper 1661–F, 170 p.

Idris, I. M., and Boulanger, R. W., 2008, Soil Liquefaction During Earthquakes: Earthquake Engineering Research Institute, 243 p.

Kelsey, H. M., Nelson, A. R., Hemphill-Haley, E., and Witter, R. C., 2005, Tsunami history of an Oregon coastal lake reveals a 4600 yr record of great earthquakes on the Cascadia subduction zone: Geological Society of America Bulletin, v. 117, no. 7/8, p. 1009-1032.

Leonard, L. J., Hyndman, R. D., and Mazzotti, S., 2004, Coseismic subsidence in the 1700 great Cascadia earthquake: Coastal estimates versus elastic dislocation models: Geological Society of America Bulletin, May/June 2004, v. 116, no. 5/6, pp. 655–670.

NANOOS, Beach Monitoring Data, http://nvs.nanoos.org/BeachMapping, Oct 1997 to Sep 2021.

Oregon Seismic Safety Policy Advisory Commission (OSSPAC), February 2013, The Oregon Resilience Plan: Reducing Risk and Improving Recovery for the next Cascadia Earthquake and Tsunami—Report to the 77th Legislative Assembly: State of Oregon Office of Emergency Management, 341 p.

OSU News and Research Communications, May 24, 2010, Odds are 1-in-3 that a huge quake will hit Northwest in next 50 years: Oregon State University, Corvallis http://oregonstate.edu/ua/ncs/archives/2010/may/odds-huge-quake-Northwest-next-50-years

Personius, S. F., Dart, R. L., Bradley, L-A, Haller, K. M., 2003, Map and data for Quaternary faults and folds in Oregon: U.S. Geological Survey, Open-File Report 03-095, 556 p., map.

Rogers, A. M., Walsh, T. J., Kockelman, J., and Priest, G. R., 1996, Earthquake hazards in the Pacific Northwest - an overview: U.S. Geological Survey, Professional Paper 1560, p. 1- 54.

Schlicker, H. G., Deacon, R. J., Beaulieu, J. D., and Olcott, G. W., 1972, Environmental geology of the coastal region of Tillamook and Clatsop Counties, Oregon: Oregon Department of Geology and Mineral Industries, Bulletin 74, 164 p., maps.

Snavely, P. D., Niem, A., Wang, F. L., MacLeod, N. S., and Calhoun, T. K., 1996, Geologic map of the Cascade Head Area, Northwestern Oregon Coast Range (Neskowin, Nestucca Bay, Hebo, and Dolph 7.5 minute Quadrangles): U.S. Geological Survey, Open-File Report 96-0534, 16 p., maps.

USDA Soil Conservation Service, and Oregon Coastal Conservation and Development Commission, 1975, Beaches and dunes of the Oregon Coast: 161 p.

Witter, R. C., Kelsey, H. M., and Hemphill-Haley, E., 2003, Great Cascadia earthquakes and tsunamis of the past 6700 years, Coquille River estuary, southern coastal Oregon: Geological Society of America Bulletin, v. 115, p. 1289-1306.

It has been our pleasure to serve you. If you have any questions concerning this report, or the site, please contact us.

Respectfully submitted,

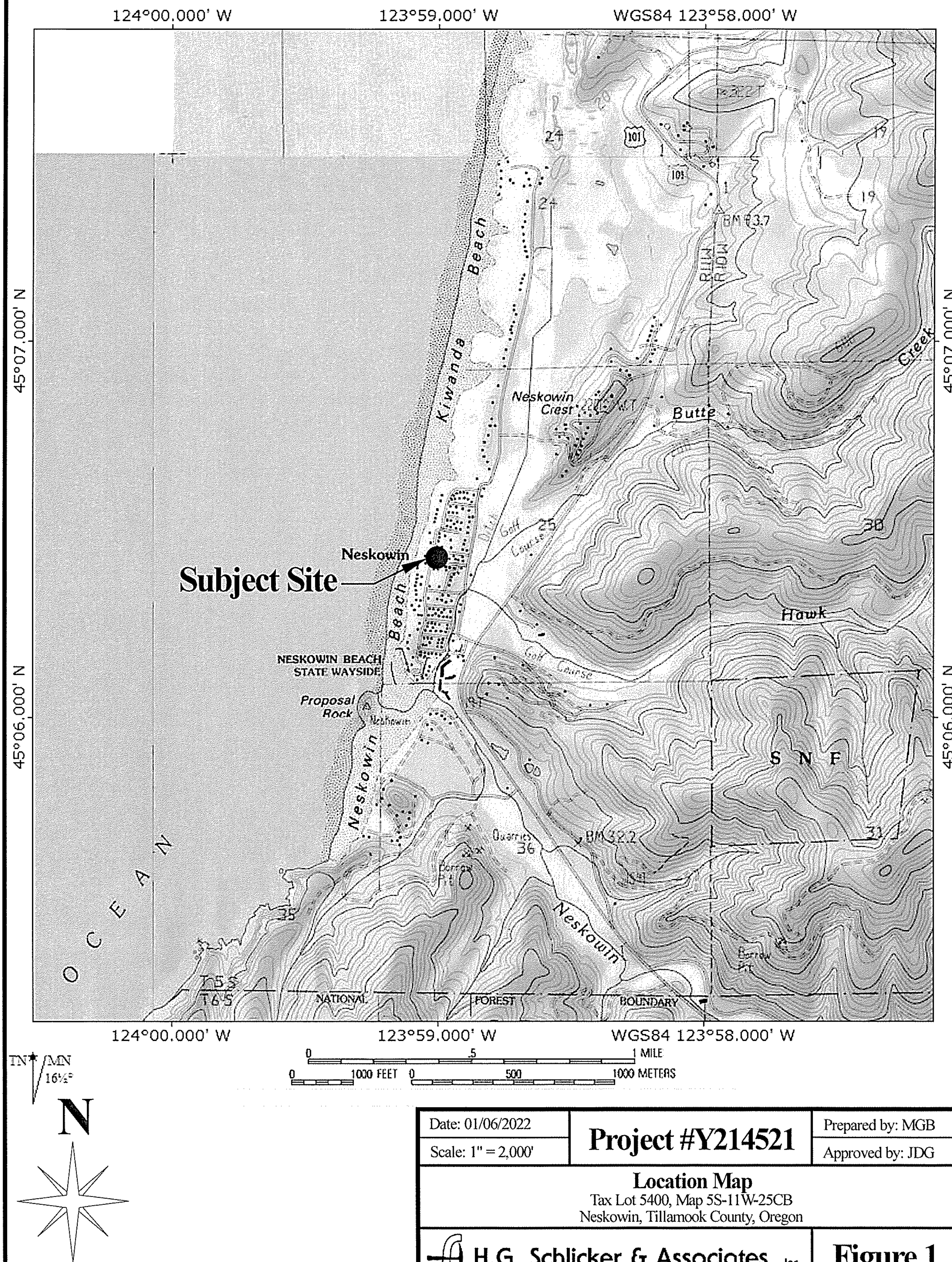
H.G. SCHLICKER AND ASSOCIATES, INC.

CERTIFIED
OREGON
J. DOUGLAS GLESS
E-902
ENGINEERING GEOLOGIST

EXPIRES: 10/31/2022

J. Douglas Gless, MSc, RG, CEG, LHG
President/Principal Engineering Geologist

JDG:mgb



Date: 01/06/2022	**Project #Y214521**	Prepared by: MGB
Scale: 1" = 2,000'		Approved by: JDG

Location Map

Tax Lot 5400, Map 5S-11W-25CB

Neskowin, Tillamook County, Oregon

H.G. Schlicker & Associates, Inc.

Figure 1

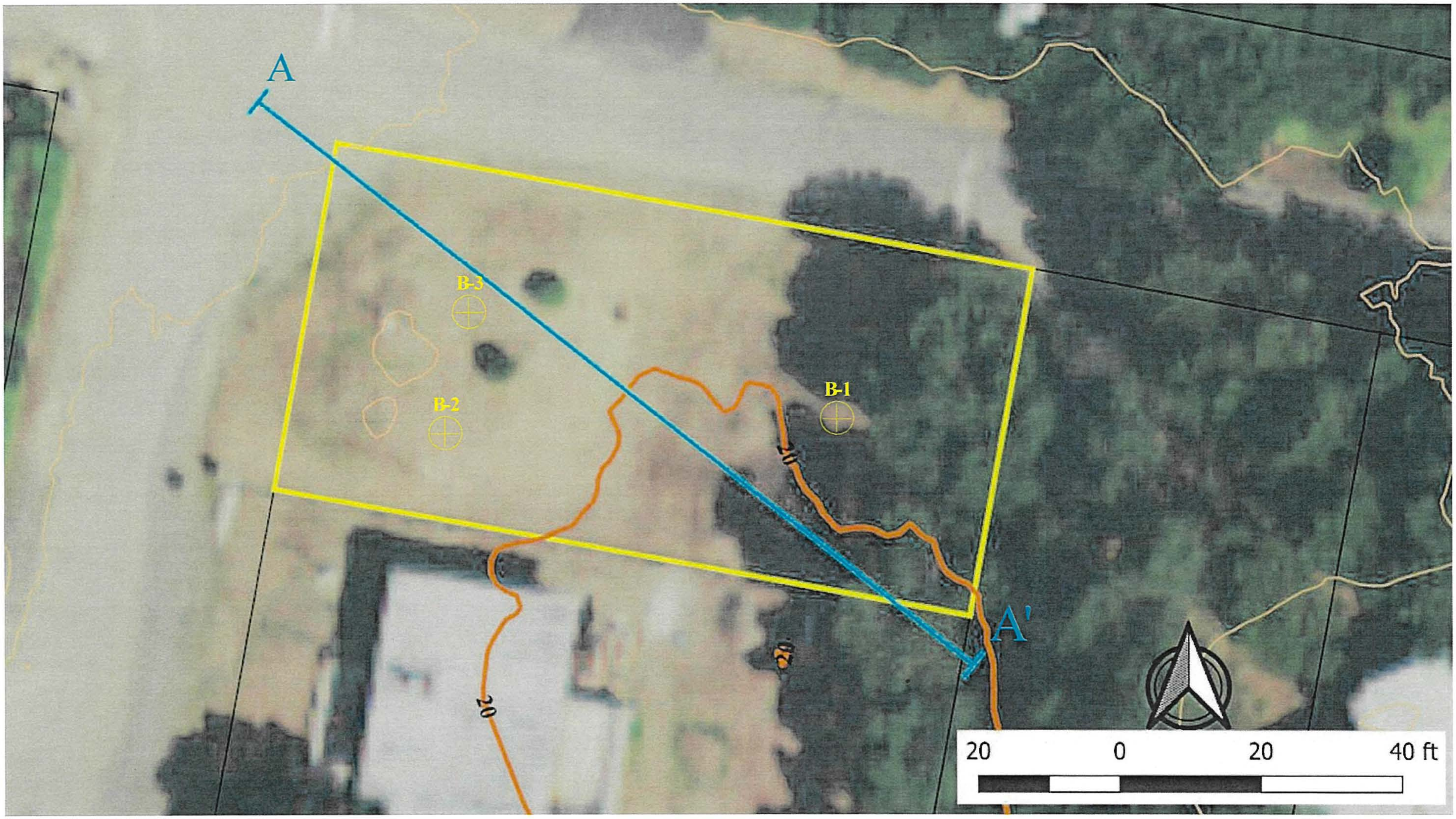
Modified from the Tillamook County assessor's plat
5S-11W-25CB
All locations and dimensions are approximate.

Date: 01/06/2022	**Project #Y214521**	Prepared by: MGB
Scale: 1" = 100'		Approved by: JDG

Plat Map
Tax Lot 5400, Map 5S-11W-25CB
Neskowin, Tillamook County, Oregon

H.G. Schlicker & Associates, Inc.

Figure 2

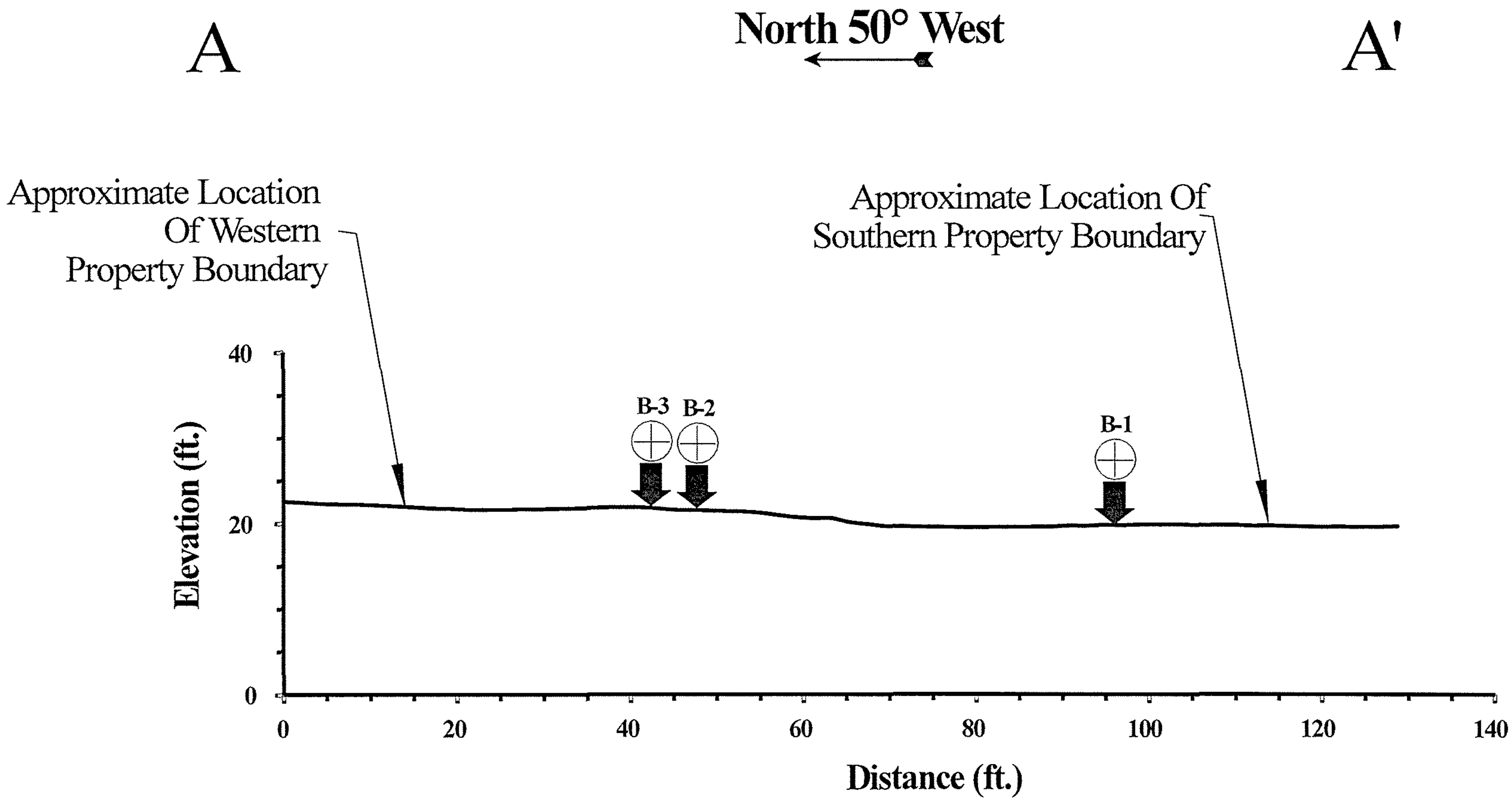


A —— A' = Approximate trend of profile line

B-1 ⊕ = Approximate location of boring

Imagery provided by Google.
Topographic data derived from West_Coast_2016_El_Nino Lidar data from NOAA.
All locations and dimensions are approximate.

Date: 01/06/2022	Project #Y214521	Prepared by: MGB	Site Topographic Map	H.G. Schlicker & Associates, Inc.	Figure 3
Scale: 1" = 20'		Approved by: JDG	Tax Lot 5400, Map 5S-11W-25CB Neskowin, Tillamook County, Oregon		



B-1

= Approximate location of boring

All dimensions, elevations and locations are approximate.
Slope profile derived from West_Coast_2016_El_Nino
Lidar data from NOAA.

Date: 01/06/2022 Scale: 1" = 20'	**Project #Y214521**	Prepared by: MGB Approved by: JDG
Slope Profile, A-A' Tax Lot 5400, Map 5S-11W-25CB Neskowin, Tillamook County, Oregon		
H.G. Schlicker & Associates, Inc.		**Figure 4**

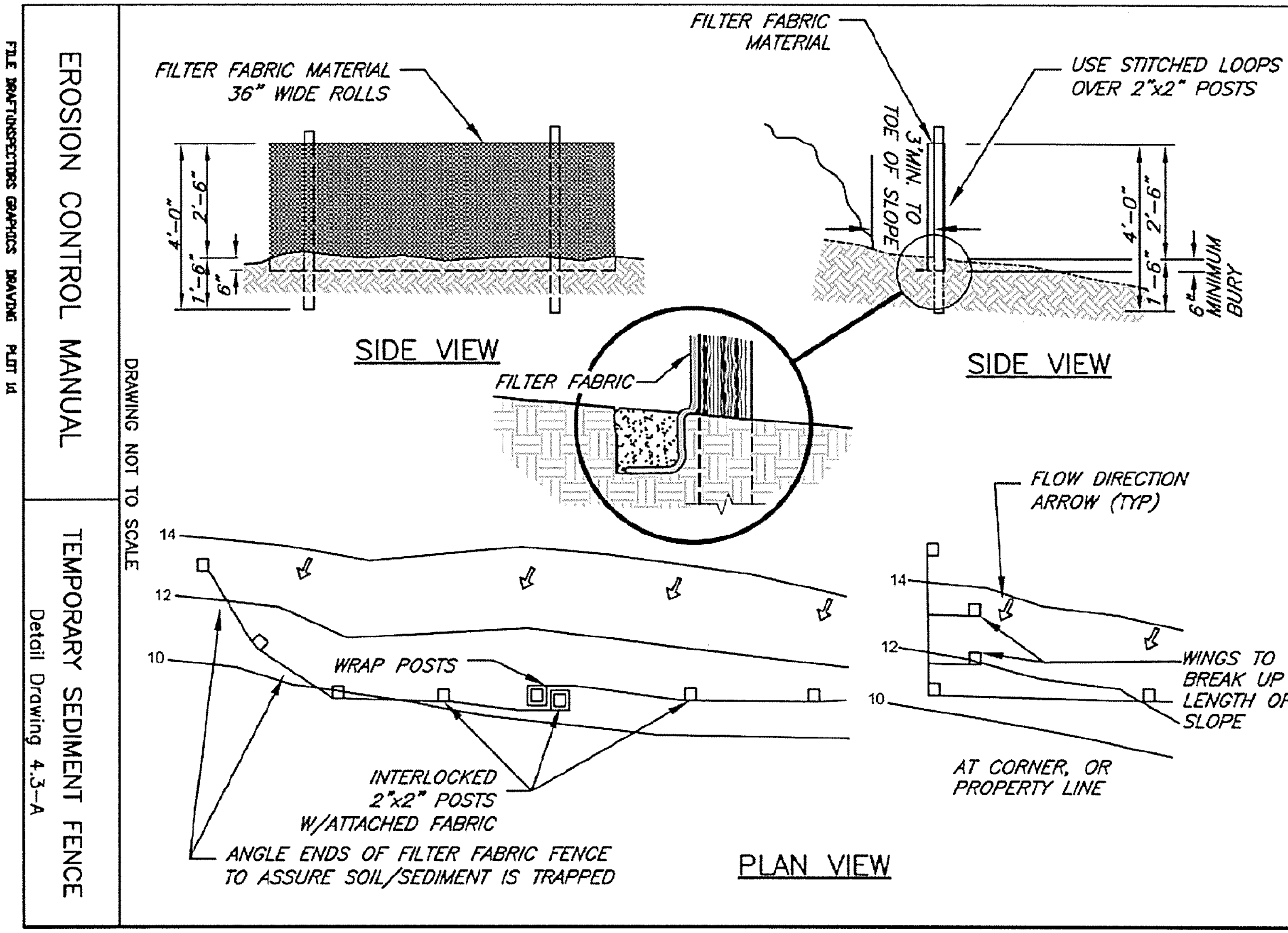


Figure 4.3-A Temporary Sediment Control (Silt) Fence

Date: 01/06/2022 Scale: As Shown	**Project #Y214521**	Prepared by: AML Approved by: JDG
Sediment Fence Detail Tax Lot 5400, Map 5S-11W-25CB Neskowin, Tillamook County, Oregon		
H.G. Schlicker & Associates, Inc.		**Figure 5**

Drawing modified from Erosion and Sediment Control Manual, City of Portland Bureau of Environmental Services, 2008.

Refer to Original Source for Design Criteria/ Specifications

Project #Y214521

Appendix A
- Site Photographs –

Photo 1 – Easterly view of the site from Breakers Boulevard.

Photo 2 – Southwesterly view of the site from Amity Avenue.

Photo 3 – Westerly view along the southern boundary of the site. Note the standing water in the shallow depression in the center of the site (indicated with yellow arrow).

Photo 4 – Close-up view of the silty fill soils encountered in borings B-2 and B-3 on the western portion of the site.

Photo 5 – Easterly view of the riprap revetment at the end of Amity Avenue near the site.

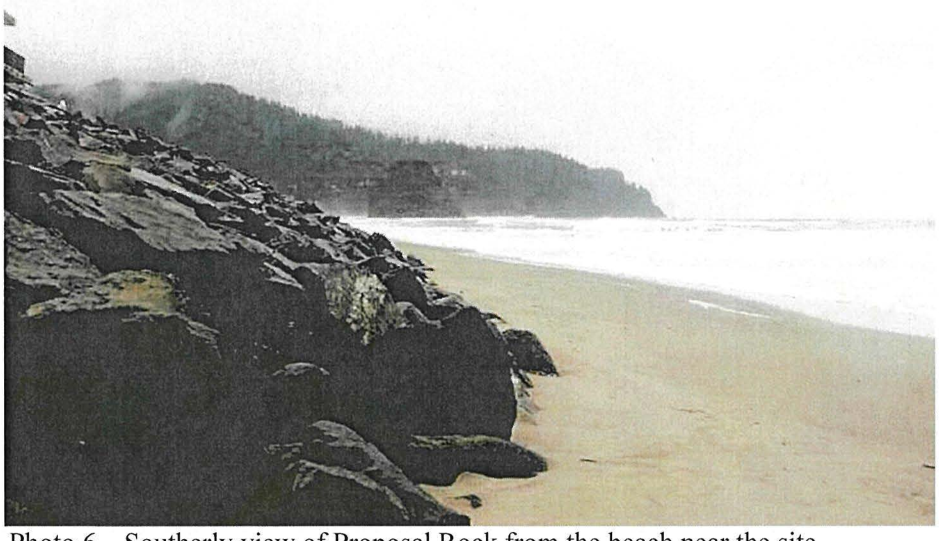


Photo 6 – Southerly view of Proposal Rock from the beach near the site.

Appendix B

- Checklist of Recommended Additional Work, Plan Reviews and Site Observations -

APPENDIX B
Checklist of Recommended Additional Work, Plan Reviews and Site Observations To Be Completed by a Representative of H.G. Schlicker & Associates, Inc.

Item No.	Date Done	Procedure	Timing
1*		Review site development, foundation, drainage, grading and erosion control plans.	Prior to permitting and construction.
2*		Observe foundation excavations.	Following excavation of foundations, and prior to placing fill, and forming and pouring concrete.**
3*		Review Proctor (ASTM D1557) and density test results for all fills placed at the site.	Following compaction, and prior to forming and pouring.

* There will be additional charges for these services.
** Please provide us with at least 5 days' notice prior to all site observations.