OREGON PARKS AND RECREATION DEPARTMENT
OCEAN SHORE PERMIT APPLICATION

PIPELINE, CABLE, OR CONDUIT

FOR OFFICIAL USE ONLY

OPRD PERMIT #:	3036
APPLICATION DATE:	3/9/23
DATE POSTED:	3/9/23
COORDINATOR:	Blanchette
60 DAY DUE DATE:	5/8/23

Section 1. Proposed Project

Project type: (Check all that apply)

☐ Installation of pipeline	☒ Installation of conduit
☒ Installation of cable	☐ Other

Does the project utilize existing infrastructure? ☐ Yes ☒ No

Provide a brief description of the project:

To meet the demand of internet services worldwide, AMCS LLC (AMCS), an affiliate of Amazon Web Services (AWS), proposes to install the Bifrost Submarine Fiber Optic Cable System (or "Bifrost"), an ultra-high speed fiber optic telecommunication cable system. Bifrost would provide large capacity direct link between the continental U.S. (Oregon) and Asia (Singapore), crossing the Pacific Ocean via Guam. The cable would be trenched in the seafloor where possible, landing at the Wi-Ne-Ma Christian Camp in Winema/Cloverdale, Oregon via a HDD bore pipe. Upon landing in Winema, the cable would be fed through a new beach manhole (BMH) and transition to a new 235-foot terrestrial conduit build to attach to a newly constructed (as part of a separate effort) terrestrial cable conduit on Wi Ne Ma Road.

Estimated project start date 9/1/23	Estimated project completion date 10/15/23

Section 2. Applicant Information

Applicant	David Selby - AMCS LLC (AMCS)		Agent	Cameron Fisher 48 North Solutions, Inc.	
Mailing Address	410 Terry Avenue North		Mailing Address	1275 12th Avenue NW, Suite 8	
City Seattle	State WA	Zip 98109	City Issaquah	State WA	Zip 98027
Phone (206) 577-6681	Fax		Phone (206) 714-5474	Fax	
Email	See attached narrative.		Email	cfisher@48northsolutions.com	

Primary Contact	☐ Applicant	☒ Agent

Section 3. Property Location and Information

County	Tillamook	Township	5S	Range	11W
Section	12	Subsection	12DC	Tax Lot	6200

Is the Applicant the legal owner of the property/properties? ☐ Yes ☒ No (If no, provide legal owner/owners information)

Name	Wi-Ne-Ma Christian Camp, Inc. (property owner)		Name	Astound (Leasee)	
Mailing address	5195 Wi-Ne-Ma Road		Mailing address	151 E. Olive Street	
City Cloverdale	State OR	Zip 97112	City Newport	State OR	Zip 97365

Current use

☐ Residential	☐ Commercial/Industrial	☐ Public
☐ Vacant (unbuilt)	☒ Other (Explain)	Camp Site

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
See attached narrative.		

Section 4. Beach and Shore Environment

☐ Bluff	☒ Dune	☒ Sandy Beach	☐ Base Rock

☐ Other type of landform (Specify)

Section 5. Project Justification and Impacts

Describe the purpose of the project and why it is necessary:

See attached narrative.

Attach additional pages as necessary

Describe all potential impacts:

See attached narrative.

Attach additional pages as necessary

List the measures that will be taken to minimize the impacts identified above:

See attached narrative.

Attach additional pages as necessary

Section 6. Project Details

Provide the size, design and material details of the proposed project:

See attached narrative.

Attach additional pages as necessary

List all equipment necessary for the construction of and the method of construction:

See attached narrative.

Attach additional pages as necessary

Describe why the project is necessary, and the public benefits from the project, or adverse consequences that may occur if the project is not constructed:

See attached narrative.

Attach additional pages as necessary

Section 7. Additional Permit Requirements

List the agency and type of permit required:

U.S. Army Corps of Engineers—Nationwide Permit #57 / DEQ - S. 401 Water Quality Certification

Department of State Lands—Territorial Sea Fiber Optic Cable Easement; Removal-Fill Permit

Tillamook County—Floodplain Review; Conditional Use Permit

Department of Land Conservation and Development—CZMA Consistency Determination

☐ **No additional agency permit required**

Section 8. 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]

September 19, 2022 | 10:37 AM MDT

Applicant Signature Date

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

[redacted]

September 9, 2022

Agent Signature Date

If the applicant is not the legal property owner, is appropriate authorization included? ☒ ***Yes*** ☐ ***No***

Section 9. 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 shall include:**
  - Scale of drawing and north arrow
  - Existing structures
  - Roads, driveways, etc. (existing, proposed, or temporary access roads)
  - Location of the proposed project in relation to property boundaries, the mean high water line, physical landforms such as bluffs and sea stacks, and nearby structures.
  - Location of proposed improvements in relation to Statutory Vegetation Line and Actual Vegetation Line
  - Length of project across ocean shore
  - 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
  - Equipment staging and materials storage areas

- **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
  - Substrate data to reduce the likelihood of a frack-out

Section 10. Application Fees and Calculation Worksheet (to be submitted with application)

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.

For projects crossing over or under the OSSRA, a $10,000.00 "Just Compensation" fee is required.

For projects *NOT* crossing over or under the OSSRA, the fee shall be determined according to the construction value of the project.

The application processing fee shall be:
(a) $400 for projects with a construction value less than $2,500; or
(b) $400 plus three percent of the construction value over $2,500 for projects with a construction value equal to or greater than $2,500.

Please use the formula below to determine total application fees.

Total construction value of project		$		
Base construction value (Subtractable allowance)	-	$	2500.00	
Subtotal (construction value minus base fee)	=	$		(x .03 =)
3% of subtotal		$		
Add Base Fee	+	$	400.00	
TOTAL APPLICATION FEE	=	$	10,000.00	

EXAMPLE

Total construction value of project		*$*	*10,000.00*	
Base construction value (Subtractable allowance)	-	*$*	*2,500.00*	
Subtotal (construction value minus base fee)	=	*$*	*7,500.00*	*(x .03 = 225.00)*
3% of subtotal		*$*	*225.00*	
Add Base Fee	+	*$*	*400.00*	
TOTAL APPLICATION FEE	=	*$*	*625.00*	

Submitted Ocean Shore Permit Application shall include this completed fee worksheet, as well as, evidence of construction value

CC OTH 00555864 2022 TR

CITY/COUNTY PLANNING DEPARTMENT AFFIDAVIT

Applicant

Last	Selby	First	David	MI

Property Details

Township	5S	Range	11W	Section	12	Subsection	12DC
Tax Lot				6200			

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: (See Attached)

☒ Conditional Use Approval ☐ Zone Change ☐ Plan Amendment

☒ Development Permit ☐ Other (Specify) _____

Comments: CONDITIONAL USE REQUEST #851-22-000388-PLNG + FLOODPLAIN DEVELOPMENT PERMIT #851-22-000373-PLNG ARE UNDER REVIEW. PUBLIC HEARINGS ARE SCHEDULED FOR DECEMBER 8, 2022 + JANUARY 12, 2023.

SARAH ABSHER, CFM — DIRECTOR

Local Planning Official Name **(Please Print)** — Title

[redacted]

Signature — November 23, 2022

Date

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

Tillamook County

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

Land of Cheese, Trees and Ocean Breeze

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 PUBLIC HEARING
TILLAMOOK COUNTY PLANNING COMMISSION

Date of Notice: November 14, 2022

Public hearings will be held by the Tillamook County Planning Commission at 6:30p.m. on Thursday, December 8, 2022, and at 6:30pm on Thursday, January 12, 2023, at the Port of Tillamook Bay Conference Center, 4000 Blimp Boulevard, Tillamook, OR 97141 to consider the following:

#851-22-000388-PLNG & #851-22-000373-PLNG Consolidated review of a Conditional Use request and Floodplain Development Permit request for the installation of a utility (submarine fiber optic cable) on a property accessed via WiNeMa Road, a County road, north of the Unincorporated Community of Neskowin addressed as 5195 WiNeMa Road, Cloverdale, Oregon. The subject property is zoned Recreation Management (RM) and is also within the Flood Hazard Overlay (FH) zone, Shoreland Overlay (SH) zone, Tsunami Hazard Overlay (TH) zone and Beach and Dune Overlay (BD) zone, and is designated as Tax Lot 6200 of Section 12DC, Township 5 South, Range 11 West of the Willamette Meridian, Tillamook County, Oregon. Applicant is AMCS LLA with deeded easement to Astound for development location. Property Owner is Wi-Ne-Ma Christian Camp.

Notice of public hearing, a map of the request area, applicable specific request review criteria and a general explanation of the requirements for submission of testimony and the procedures for conduct of hearing has been mailed to all property owners within 250 feet of the exterior boundary of the subject property for which application has been made at least 10 days prior to the date of the hearing.

The applicable criteria include Tillamook County Land Use Ordinance Section 6.040: Review Criteria, the Development Permit review criteria contained within TCLUO Section 3.510: Flood Hazard Overlay Zone and the Tillamook County Comprehensive Plan. Applicable development standards include TCLUO Section 3.040: Recreation Management Zone and TCLUO Section 3.510: Flood Hazard Overlay Zone. Only comments relevant to the approval criteria are considered relevant evidence.

The hearing will take place at the Port of Tillamook Bay Conference Center with an option for virtual participation. For instructions on how to provide oral testimony at the December 8, 2022 hearing, please visit the Tillamook County Community Development homepage at https://www.co.tillamook.or.us/commdev for instructions and protocol or email Lynn Tone, Office Specialist 2, at ltone@co.tillamook.or.us. The virtual meeting link will be provided at the DCD homepage address as well as a dial in number for those who wish to participate via teleconference but are unable to participate virtually prior to the evening of the hearing.

SECTION 1. PROPOSED PROJECT

Construction Schedule:
Construction of the beach manhole (BMH) and cable conduit via horizontal directional drilling (HDD) under the beach is proposed to start on September 1, 2023. This effort would take approximately 6 weeks, through to mid-October (estimated Oct 15, 2023). The submarine cable is scheduled to land at the beach manhole (BMH) on Lot 6200 in late April 2024, weather-pending.

SECTION 2. APPLICANT INFORMATION

Agent: Cameron Fisher – 48 North Solutions, Inc. (48 NORTH)

Applicant's Email: subsea-interest@amazon.com and infrastructure-contract-notices@amazon.com

SECTION 3. PROPERTY LOCATION AND INFORMATION

The Win-Ne-Ma Church Camp is the property owner where the proposed beach manhole will be located. The Oregon Department of State Lands is the landowner from the lower low water mark, west to three nautical miles. Wave Business Solutions, LCC, now "Astound", signed an easement agreement with Wi-Ne-Ma Christian Camp to allow Astound access to the camp's 28-acre property at 5195 Winema Road, Cloverdale, OR 97112, to provide a variety of communication services, including internet access, ethernet transport, IP transit, wavelengths, dark fiber, and other similar services (**Appendix 1**). This easement also includes establishing and maintaining a BMH and ocean ground bed for a submarine cable landing.

List of names, situs, and mailing addresses of oceanfront landowners with property boundaries common to those of the property (Lot 6200) described in the application:

Name	Property Situs Address	Mailing Address
Arlene Schaefer	No designated address. Map# 5S1112DB00101	6150 OTZEN WAY, CLOVERDALE, OR 97112
Elizabeth Hayes	42520 SUNSET AVE	373 LEDGEVIEW AVE, FOND DU LAC, WI 54935
Alpha Development Inc	42800 SUNSET AVE	2515 SW EDGEMOOR AVE, BEAVERTON, OR 97005
Nathan & Valerie Stoller	42900 SUNSET AVE	42900 SUNSET AVE, CLOVERDALE, OR 97112
Ralph Holcomb	42685 MARINE DR	5407 RIDGEFIELD RD, BETHESDA, MD 20816
Wi-Ne-Ma Christian Camp	5195 WI-NE-MA RD CLOVERDALE, OR 97112 (Lot 1800)	5195 WI-NE-MA RD CLOVERDALE, OR 97112
OR Dept. of State Lands	Offshore	775 SUMMER ST NE, STE 100 SALEM, OR 97301

SECTION 5. BEACH AND SHORE ENVIRONMENT / SECTION 6. PROJECT DETAILS

A) Describe the purpose of the project and why it is necessary:

Recognizing the urgency for greater digitalization, organizations are developing multi-cloud models that can effectively and rapidly support the evolving changing business needs. To meet the demand of global internet services and cloud development, AMCS LLC (AMCS), an affiliate of Amazon Web Services (AWS), proposes to install the Bifrost Submarine Fiber Optic Cable System (or "Bifrost"), an ultra-high speed fiber optic telecommunication cable system. Bifrost would provide large capacity direct link crossing the Pacific Ocean between the continental U.S. (Oregon and California) and Asia (Singapore), via Guam. This cable installation is in response to the increasing demand for broadband and cloud infrastructure. As identified by the Oregon Department of Transportation in their *2022 ODOT Broadband Strategy & Implementation Plan*, broadband technology is a key infrastructure building block for modern transportation systems. Additionally, Oregon's Enterprise Information Services' (EIS) *Cloud Forward: A Framework for Embracing the Cloud in Oregon* (Version 1.0) acknowledged Oregon's communities rely on the State of Oregon to provide essential services that keep them healthy and safe, enabling them to live fulfilling lives. The State of Oregon provides these services utilizing cloud-based services and infrastructure. EIS details that the State is striving to conduct 75% of its business via cloud-based services by 2025.

Overall, Bifrost would benefit the public in multiple ways. There is increasing need for data, fueled by bandwidth-intensive applications (e.g., video and cloud-based services) across the Pacific, as well as globally. The Bifrost submarine fiber optic cable system would connect AWS' U.S. West Coast region in eastern Oregon to its Asia Pacific region in Singapore, creating the largest capacity high-speed transmission across the Pacific Ocean. This would support and accelerate the connectivity needs of the regions by providing seamless direct connectivity. With the increased demand of global internet services, this telecommunication cable would utilize the very latest fiber optic cable technologies to assure extremely high reliability, low latency, network diversity, and long system life. Additionally, the Project would employ a variety of local contractors during construction, bringing jobs to the community.

For the Oregon landing, the cable would be buried in the seafloor (where possible) and land at the Wi-Ne-Ma Christian Camp in Winema/Cloverdale, Oregon (**Figure 1**). The cable would come ashore via a new steel bore pipe and upland beach manhole (BMH). From there, a new 235 foot- (71.6-m- [meter]) long terrestrial conduit system would be constructed (**Figure 2**) to connect to a newly constructed terrestrial underground conduit that services multiple users along Wi Ne Ma Rd (**Appendix 2**).

From Wi Ne Ma Rd, the cable would then connect to one of Astound's existing terrestrial fiber optic cable routes known as the "Salmon Route", a pathway following road systems from the coast roughly east through Grande Ronde and northeast to Hillsboro. Astound is currently developing a new terrestrial fiber path north of the existing Salmon Route that will use a mix of new and existing conduits within established ODOT Highway 6 ROW to connect to Hillsboro. There will be multiple potential customers to this new route, which will facilitate high-speed internet access to rural residents and promote economic development both within the Tillamook region, as well as many remote areas between Tillamook and Hillsboro, that are not currently connected. This new route will be operated and maintained by a local team with Astound. Once constructed, the Bifrost cable could then utilize this new Highway 6 route, as it would provide route diversity

and lower latency between the BMH and Hillsboro compared to the existing Salmon Route. This new route will enable route enhancement for Bifrost between the landing and Hillsboro.

The only permanent project feature in Oregon Parks and Recreation Department's (OPRD's) jurisdiction (i.e., between lower low tide and the statutory vegetation line) would be a ~7-inch (~18-centimeter [cm]) steel bore pipe, which would be installed >20 feet under the beach and serve as the landing conduit into which the submarine cable would be installed (**Appendix 3**). To avoid impacts to the beach, the pipe would be installed using horizontal directional drilling (HDD; described in more detail below). Adverse consequences that may occur if the Project is not completed would be limited to an empty steel bore buried under the beach, which would have no short- or long-term impacts to the human or natural environment.

From the BMH, which would be located on a private vacant lot on the Wi-Ne-Ma Christian Camp (Lot 6200, **Figure 3**), the bore pipe, would extend to a point beyond the active surf zone approximately 4,100 feet (1,250 m) offshore, exiting at a water depth of approximately 50 feet (15 m) (**Appendix 3**). Westerly from the bore exit hole, the cable would be buried beneath the seafloor via a sea plow along its predetermined offshore alignment along the continental shelf.

B) Provide the size, design, and material details of the proposed project:

Construction on Lot 6200 would include grading to install a new, buried BMH, measuring approximately 12 feet (length) x 6 feet (width) x 7 feet (depth) (3.7m x 1.8m x 2.1m) and sited landward of the statutory vegetation line. Site disturbance would be limited to an existing gravel road, parking area, and manicured grass within Lot 6200. Project personnel would return the area to previous conditions upon completion of construction and HDD activities.

Using HDD to install the bore pipe, the pipe, approximately 4,100 feet (1,250 m) in length would extend from the BMH on Lot 6200 to a point beyond the active surf zone, approximately 3,100 feet (945 m) offshore at a water depth of approximately 50 feet (15 m). Entering the ground at an approximate 12-degree angle, the HDD bore would be approximately 20 feet (6 m) below grade at the statutory vegetation line, extending to approximately 80 feet (24 m) below grade near the lower low water mark. From the statutory vegetation line to the lower low water mark, this bore would cross approximately 560 feet (170 m) of beach. The bore pipe would provide the terrestrial-to-marine interface, minimizing possible disturbances to the beach area and nearshore environment. It would also provide maximum protection to the Bifrost cable in the surf zone.

The geotechnical survey identified surficial poorly graded sands and underlying poorly graded gravels near the surface that may be prone to instability in the HDD bore hole. However, the materials appear to become denser at a depth of about 20 feet (6 m) below grade (**Appendix 4**). Due to the changing nature of the geology near the surface, it is expected that an additional temporary casing, called a "surface casing" or "conductor casing", would be installed under the beach for the first portion of the bore (**Appendix 3**). The casing would be approximately 18-20 inches (45-50 cm) in diameter and approximately 180 feet (55 m) in length but could be up to 500 feet (152.4 m). The purpose of the surface casing is to provide a stable path for the landing pipe as it is installed beneath softer, looser surface materials. The casing keeps a bore hole from collapsing and creates a clear path for the drilling mud to return to the terrestrial bore site.

Upon completion of the HDD operations, the surface casing would be removed, creating a void space around the 6-7-inch (15-18-cm) landing pipe. Typically, the void space is naturally filled by the loose materials around the bore pipe. Upon completion of the HDD operation, only the ~7-inch (~18-cm) bore pipe would remain under the beach area for the Bifrost submarine cable to be pulled through.

Where the bore hole is relatively close to the surface (i.e., within approximately 20 feet [~6 m]) and the overburden is loose, it is possible that the void space (i.e., sinkhole) can migrate to the surface because of sand collapsing into the void. This area will be monitored for the presence of voids several weeks after HDD operation are completed (**Appendix 5**).

Based on the geotechnical survey, HDD profiles are technically feasible at the proposed site. However, hydraulic fracturing may occur near the exit hole (approximately 4,000 feet [1,220 m]) offshore. To mitigate this, HDD operations may implement Best Management Practices (BMPs) such as drilling without fluid for the last few rod joints, using air as a drilling fluid, or not exiting the bore hole but digging down to it from the sea floor. To further reduce the potential risk of hydraulic fracturing, the drilling fluid program for this HDD effort would also account for anticipated soil conditions, fluid selection, drill bit and reamer selection, and volume calculations. Overall, BMPs would be selected based on drilling equipment used and project constraints observed during drilling.

C) List all equipment necessary for the construction of and the method of construction:

The HDD construction procedure would begin by first establishing a perimeter and clearly signposting the site, informing the public of the work in progress while limiting access to the site (i.e., the private property). Project equipment necessary for the pit excavation and drilling would be mobilized to site for final positioning and in preparation for HDD operations.

Approximately 20.1 yd^3 (15.3 m^3) of underlying soils would be removed to install the underground BMH, ocean ground bed (OGB), and cable, enabling drilling operations. To install the underground infrastructure, a partially vegetated area (manicured grasses) would be cleared on the property using a bobcat. This would enable construction machinery to bury infrastructure. The cleared area would be restored to pre-existing conditions upon completion of construction.

An HDD rig and ancillary equipment would be brought to the site, including power generators, drill pipe and racks, storage tanks for the drilling muds, and clean water storage tanks. Water for the drilling operation would likely come from a municipal source. Typical mobilization and demobilization construction traffic would include 5-6 semi-truck loads of equipment and materials. Equipment typically used may include:

- An inadvertent return tank
- Mud tank
- Drilling rig
- Control cab with power unit
- Recycling unit
- Vac-truck

- Mud pump units
- Jetting assembly
- Job trailer
- Crane
- Steel drill pipe (approximately 28 feet x 7 inches [8.5 m x 17.8 cm])
- Bio-degradable bentonite mud
- Equipment storage area

Once staged, the drill entry pit would be formed in line with the HDD rig. A mud pump would be set in place next to the mud receiving drill entry pit to pump out the returning fluid, feeding it to the recycling unit for further treatment, adjustment, and reuse. At the bore site, the cuttings from the bore hole would be removed from the drilling mud and the drilling mud reused. The cuttings would be hauled offsite to an approved disposal site. The location of the drill bit would be continuously monitored using an electronic transmitter in the drill head to send information to the drill operators. Based on monitoring information, the operator will know the drill head's location at all times and will be able to maintain the pre-planned path of the bore.

The drilling mud (known as "bentonite mud"), would primarily consist of fresh water (~92-94%) and bentonite (~6-7%). A polymer additive would be available on-site to be employed in the bentonite mud in negligible (~1% or less) concentrations. All components are biodegradable and non-toxic.

In the event of an unavoidable inadvertent return of bentonite mud, it would be addressed as outlined in the Inadvertent Return Contingency Plan (**Appendix 5**). Upon completion of installation operations, all materials and equipment would be retrieved, and the site area would be cleaned, cleared, and returned to previous conditions.

D) Describe all potential impacts:

If the project is not completed, long-term adverse consequences that may occur could include a vacant HDD bore remaining under the beach. However, the presence of the bore would not impact the beach area. Due to the depth the bore would be under the beach (i.e., 20 to 80 feet below grade), it is highly unlikely the bore would be exposed unless a catastrophic event (e.g., massive earthquake) occurred creating a significant earth movement event.

Short-term impacts related to construction activities may include the following:

Beach/Lot 6200/Oregon Coast Trail (OCT)
Construction-related disturbance — BMH installation and HDD activities would take approximately 6 weeks to complete, however, deviations from standard operating pace, such as equipment breakdowns or delays in shipments, could add to this timeline. Typically, 1 week would be required for mobilization and setup, 4 weeks to install the HDD landing pipe, and 1 week to demobilize.

Drilling of the bore would involve beach operations. A guide wire would be laid across the beach during drilling. All drilling would originate from Lot 6200 and be restricted to under the beach surface. At the

construction site on Lot 6200, temporary increases in noise, reduced aesthetics, and limited short-term effects on ambient air quality are anticipated.

The HDD operations and grading activities on Lot 6200 would increase traffic along Wi Ne Ma Road/OCT temporarily. The mobilization and demobilization process would include 5 to 6 semi-truck loads of equipment and materials. During construction it is expected there would be the following vehicles frequenting the site:

- Water truck: daily
- Fuel truck: every 2 to 3 days
- Dump truck: every 2 to 3 days
- Work pickup and utility vehicles: daily

Alteration of nearshore/beach habitat — A guide wire would be laid on the beach to help drilling operation. However, using HDD, the installation of the conduit below the beach would avoid disturbance to the beach. Depth and angle of the HDD bore would be engineered based on findings from the geotechnical study (see Section 5c for more details).

Inadvertent return — An inadvertent return is an unintended transfer of bentonite mud to the surface during HDD operations through fractures or fissures that occur naturally (i.e., not because of boring operations). An inadvertent return is possible during any project-related HDD operation, which is planned in the nearshore, beach, and upland areas. Inadvertent returns are unlikely to impact habitat and wildlife if the mud used in the HDD process (a mixture of nontoxic bentonite clay and water) is discharged. In the event of an inadvertent return, there is also an extremely low potential for the HDD drilling pipe to break, resulting in drill tooling (approximately 6-inch steel) to be left 20-80 feet below the beach/seafloor (**Appendix 5**).

Sinkholes – Although rare, sinkhole formation (i.e., beach voids) may occur due to ground vibrations from heavy equipment or HDD activities. These voids are likely the result of sand collapsing into the space created by the removal of the guide casing used during the installation of the permanent bore pipe that houses the submarine telecommunication cable. Induced sinkholes are typically small, spanning only a few feet wide and deep. And would be filled in if they occurred.

Offshore

Increased turbidity — The installation of the cable could temporarily increase turbidity levels at the site of the HDD exit bore. Seafloor sediment may also be disturbed by the sea plow equipment during burial operations while on the continental shelf.

Hard bottom impacts — Installation of a cable across a hard substrate (e.g., boulder field) could potentially result in suspension of the cable between two raised areas and, consequently, disturb marine life.

E) List the measures that will be taken to minimize the impacts identified above:

The Project is committed to working with the appropriate regulatory agencies to ensure all applicable permits are obtained prior to construction. Prior to this application submittal, AMCS engaged in pre-application meetings with Tillamook County, OPRD, Department of State Lands (DSL), and Oregon

Department of Fish and Wildlife (ODFW). Furthermore, the Authorized Agent also met with the U.S. Army Corps of Engineers (USACE), Department of Land Conservation and Development (DLCD), and Department of Environmental Quality (DEQ) to discuss permitting requirements for this project.

AMCS has also closely coordinated with the Oregon Fishermen's Cable Committee (OFCC) to target a favorable cable route for both the marine environment and fishing community. An OFCC representative was onboard during the cable route survey to provide additional input and guidance on route selection. This route was further reviewed with ODFW. AMCS representatives also met with other members of the fishing community, including the Pacific City Dorymen's Association.

In addition, AMCS has undergone an extensive stakeholder engagement effort, working closely with the local community to understand their concerns. This included AMCS staff meeting with Representatives Weber and Gomberg and hosting two community open houses in Pacific City, Oregon on 06/27/22 to introduce the project to the public and understand any questions they may have had. Letters were also mailed to landowners within 0.5 miles (0.8 kilometers [km]) of the project site prior to the community open houses.

Beach/Lot 6200/Oregon Coast Trail (OCT)

Construction-related disturbance – HDD operations would be performed quickly and efficiently to limit disturbances. Upon completion of the HDD operations, any vegetation removed for placement of the underground BMH and OGB would be replaced. The Project would avoid impacting any terrestrial wetlands and avoid crossing any streams in the area (**Appendix 6**).

AMCS has worked closely with Astound and the Wi-Ne-Ma Christian Camp to ensure project activities would be conducted at a time and in a manner that minimizes disturbance to camp activities. Construction activities have been scheduled to avoid peak activities at the camp. In addition to campers and camp staff, Winema Beach and the access to the beach is also utilized by birders, OCT hikers, trail runners, and other beach recreators. Prior to construction, signs would be posted notifying users of construction activities and scheduled days, if applicable. The use of HDD and construction activities would avoid unnecessary beach closures or beach access restrictions to the public along segments of the beach during construction.

A traffic impact analysis would be conducted, and a traffic control plan implemented prior to construction activities, if required. Local tsunami routes and emergency vehicle access (e.g., ambulance, fire truck) would not be affected by project-related activities or traffic. The local community would be notified of the project prior to construction activities and the construction site clearly signposted. The project has been sited away from residences to reduce potential construction-related impacts; the nearest residences are a minimum of 500 feet (152 m) from the proposed drilling location. Construction-related noise would be dampened for beach users because of the vegetation and dunes located between the HDD equipment and the beach.

Aesthetics would be reduced temporarily on the Wi-Ne-Ma Christian Camp property, however, the BMH parcel is sited in a parking lot so no permanent impacts to aesthetics are anticipated. The site would be restored to pre-existing conditions after construction has been completed. Note also that very few

residences are within sight line of the project site (see **Photolog**)**.** Of those in the surrounding area, they are elevated above the project site, along the top of the nearby bluffs.

Ambient air quality effects would be in the form of temporary mobile emissions from the cable-laying vessel, as well as vehicle and machinery (e.g., HDD drill rig) emissions and dust from the terrestrial portion of the project. These emissions are likely to be indistinguishable from other local sources of airborne particulates, including other marine traffic, motor vehicle emissions, and dust from motor vehicle traffic. This would represent a minor increase in the number of vehicles traversing the area daily and would not result in the project area coming out of attainment.

An extensive stakeholder outreach plan has also been implemented to inform the local community of construction timelines and address any concerns. A Point of Contact has been established to address any project-related concerns efficiently and effectively during construction. AMCS will maintain rapport with the local community and ensuring local perspectives are considered throughout the entire construction process.

Alteration of nearshore/beach habitat – The project would avoid impacting the nearshore and beach habitat by utilizing HDD installation methods. The angle and depth at which the HDD bore would be drilled at is based on findings from the geotechnical survey. The depth under the beach (from 20 to 60 feet [6 to 18 m]) would be at a depth that would avoid future disruptions related to seasonal beach erosion.

The cable conduit would be buried deeper than by other methods (e.g., open trench), resulting in enhanced safety and protection from potential third-party damage and minimizing risk of needing to return to the beach for repairs.

Inadvertent return — HDD would be utilized because it is widely considered the most environmentally-friendly and preferred method of construction; it has been used for decades with high levels of success. Unlike open trenching and other methods, ground disturbance via HDD is confined to the drill entry site and the exit site, avoiding impacts to vegetation or sensitive habitats along the bore path.

The mud mixture used during HDD operations would consist predominantly of water (~92-94% of the mixture, which would adhere to safe drinking standards) and bentonite clay (~6-7%), a naturally occurring, nontoxic clay that is commonly used in farming practices. Biodegradable additives (~1% or less) would be used in the bentonite mud. During typical operations, this bentonite mud would be fully contained; it would only be released in the event of an unpreventable inadvertent return.

To inform the proposed HDD installations, an in-depth site-specific geophysical and geotechnical investigation, consisting of a combination of marine and terrestrial based surveys, was conducted in May and July 2022 (OPRD Scientific Permit No. 311) to improve understanding of the geology within the drill profile. Specifically, the surveys provided data identifying unfavorable sediment layers (e.g., rock, boulders, interchanging soils), allowing engineers to account for or avoid these sediment layers and amend/augment drill plan (as necessary) to minimize the risk of inadvertent return. This investigation found conditions are favorable for cable installation. The complete results of this investigation are attached as **Appendix 4**.

In the event of an unavoidable inadvertent return, operations would shut down immediately with clean-up occurring immediately and all appropriate agencies would be notified within 24 hours. An Inadvertent Return Contingency Plan was developed for the Project and is provided in **Appendix 5**. This plan outlines the procedures to be implemented in the event of an inadvertent return to avoid potential impacts to the surrounding environment and species. Construction personnel would be provided detailed constructions plans for each HDD activity and would be required to implement all erosion and sedimentation controls.

For most inadvertent returns, the amount of fluid released is relatively minor and can be easily and/or quickly recovered/maintained. Generally, concerns are heightened when there are wetlands nearby that could be affected. At the project site, there is only one freshwater pond (i.e., Winema/Daley Lake) and a small riverine wetland nearby. Winema Lake (PUBH) and the riverine wetland (R4SBC) are 435 feet (132 m) and 760 feet (232 m) away, respectively, from the closest project element, the fronthaul terrestrial conduit to be installed via HDD. Personnel would have spill kits, hay bales, and a vac truck on site to prevent the potential migration of nearshore inadvertent returns into these features.

A wetland delineation confirmed no sensitive areas (e.g., wetlands, streams) occur within the proposed BMH/HDD bore site (**Appendix 6**). The proposed terrestrial cable route, from the BMH to the newly constructed underground conduit along Wi Ne Ma Road (in an effort separate to this project) was investigated and no wetlands are near (i.e., within 200 feet) of the proposed action. The cable would be installed in an either new and/or existing, underground terrestrial conduit within an existing road right of way. The HDD entry hole, BMH location, and staging/construction areas would occur within a private parking lot dominated by bare ground, scrub/shrub, and/or grasses. No archeological/cultural resources are within the project boundary (**Appendix 7**).

Best management practices (BMPs) would be implemented to increase robustness around HDD construction planning and to minimize the risk of an inadvertent return occurring. BMPs include, but are not limited to, cleaning the borehole, maintaining bentonite mud recirculation, selecting the right mix and dilution of bentonite mud, properly monitoring drilling operations, increasing the number of critical spares on site (e.g., drill bits, mud motors), and exclusively employing experienced equipment operators.

In the unlikely event of a drill break or another scenario that requires project equipment to be abandoned under the seafloor, potential impacts to the surrounding environment have been considered (**Appendix 5**). No adverse environmental, scenic, recreational, or economic impacts would likely result from a drill break or the presence of any other remaining materials below the seafloor, nor is there a reasonably conceived scenario (e.g., earthquake, tsunami, long-term coastal erosion) that would expose the materials to the surrounding environment and result in future impacts. For this reason, the recommended environmentally preferred alternative is to leave the materials in place.

The steel bore pipe is designed to remain in the environment and protect the submarine cable and therefore has long-term durability. The solid alloy of the pipe is not expected to migrate into sediments. Additionally, an internal plastic coating would further prevent corrosion. Eventually, the steel would begin to react with oxygen and corrode in place. However, corrosion would occur at a very slow rate given the low levels of oxygen and seawater at such depths. Furthermore, the pipe would be encased in hardened bentonite mud, creating a shell around the metal, and preventing migration to the seafloor or seawater. To

the same degree that a utilized bore pipe with cable would not affect the surrounding environment, an abandoned bore pipe would have no effect.

The drill head and associated components are all solid metal pieces and would not be expected to migrate if abandoned under the seafloor. If these components were broken down to their constituent parts, which would occur over an indeterminate period, they would still be encased in the hardened mud borehole, preventing migration to the seafloor or seawater, and therefore preventing impacts to water quality and natural resources.

Overall, all project materials are built for stability and durability and would not be expected to migrate to any degree if the project were forced to abandon them under the seafloor. There would be no impacts to any species from a drill break incident due to the lack of an exposure route from the borehole to the ecological receptors. Any unexpected construction incident and abandoned materials would be promptly reported to the appropriate agencies.

Sinkholes – If a sinkhole is detected, it would be addressed promptly. Agencies would be notified when the sinkhole is detected, and corrective action would be taken as necessary. The area would be assessed for additional voids, cavities, or sinkhole features under the beach. Prior to the start of any remedial action, the team would create a clearly defined perimeter around the work area while still allowing free flow of public traffic along the beach. Corrective actions are detailed in the Beach Void Monitoring and Response Plan (**Appendix 5**) and include either filling in the sinkhole by hand or using a handheld compactor to compact the beach sand to directly address closure of any spaces around the bore pipe and eliminate the propagation of voids to the surface. Even in the event of sinkholes developing, no long-term impacts are expected, and upon completion of any corrective action, the beach is anticipated to return to pre-construction conditions. AMCS would provide updates to OPRD staff if any additional sinkholes were observed in the future.

Access for those using the OCT would not be restricted if the Applicant is responding to either an inadvertent return, drill break, and/or sinkhole. Access from Winema Road to the beach would be continuously maintained.

Offshore

Increased turbidity — Due to the temporary and benign nature of the installation process, as well as significant natural ocean currents in the region, turbidity impacts would be negligible. HDD would be utilized where possible to reduce turbidity levels because, during HDD boring, the seabed would be disturbed at the location of the HDD exit point exclusively. Approximately 1-2 cubic yards (yd^3; 0.8-1.5 cubic meters [m^3]) of seafloor sand/silt material would be discharged from the HDD exit hole. From the HDD exit hole, the cable would then be buried approximately 5 feet (1.5 m) below the seafloor while on the continental shelf using a sea plow towed from a cable laying vessel. Plowing is conducted at slow vessel speeds. Typical operational boat speeds during sea plowing generally range from 0.3 to 0.6 knots, and up to 1 knot depending on the stiffness of the seabed and other factors. For those areas proposed for seafloor surface laying of the cable, ship speeds range up to 5 knots. End of burial would be approximately 53 nautical miles (61 statute miles; 98 km) offshore.

Temporary increases in turbidity are expected to be minor, as sediments would rapidly disperse and/or settle back to the seabed. Once installed, the cable would not result in any subsequent alterations in suspended sediments or turbidity levels. Overall, project-related increases in turbidity would be minor, localized, and quickly dissipate with the currents in the water column.

Hard bottom impacts — As part of the Bifrost cable design, an extensive offshore geophysical survey was conducted to identify a route that maximizes burial. During the operation, the OFCC and ODFW were consulted to avoid known fish habitats to the greatest extent possible. Coordination with the OFCC and ODFW enabled AMCS to identify a cable route that would optimize burial feasibility, avoid rocky reef areas, and protect both EFH and fish species.

Working closely with the OFCC, AMCS revise the cable route to minimize impacts to fishing grounds and avoid rock outcrops and important fish habitat, while at the same time providing protection to the cable system. Upon exiting the HDD hole, the Bifrost cable would be laid and buried below the seabed into 3.3-foot- (1-m) wide and 5-foot- (1.8-m) deep furrow created by a sea plow towed by the cable ship. The cable would be buried in the sediment where possible while on the continental shelf. Sediment would either slough back into the furrow immediately after the cable is laid, be pushed to the sides to refill the furrow from current action over time, or temporarily suspend in the water column, eventually settling out at varying distances from the furrow.

By controlling cable slack, burying the cable, and avoiding reef areas, the cable would avoid the possibility of cable suspensions. Cable suspensions can adversely affect reef habitat and marine life while at the same time compromise the cable's integrity.

Figures

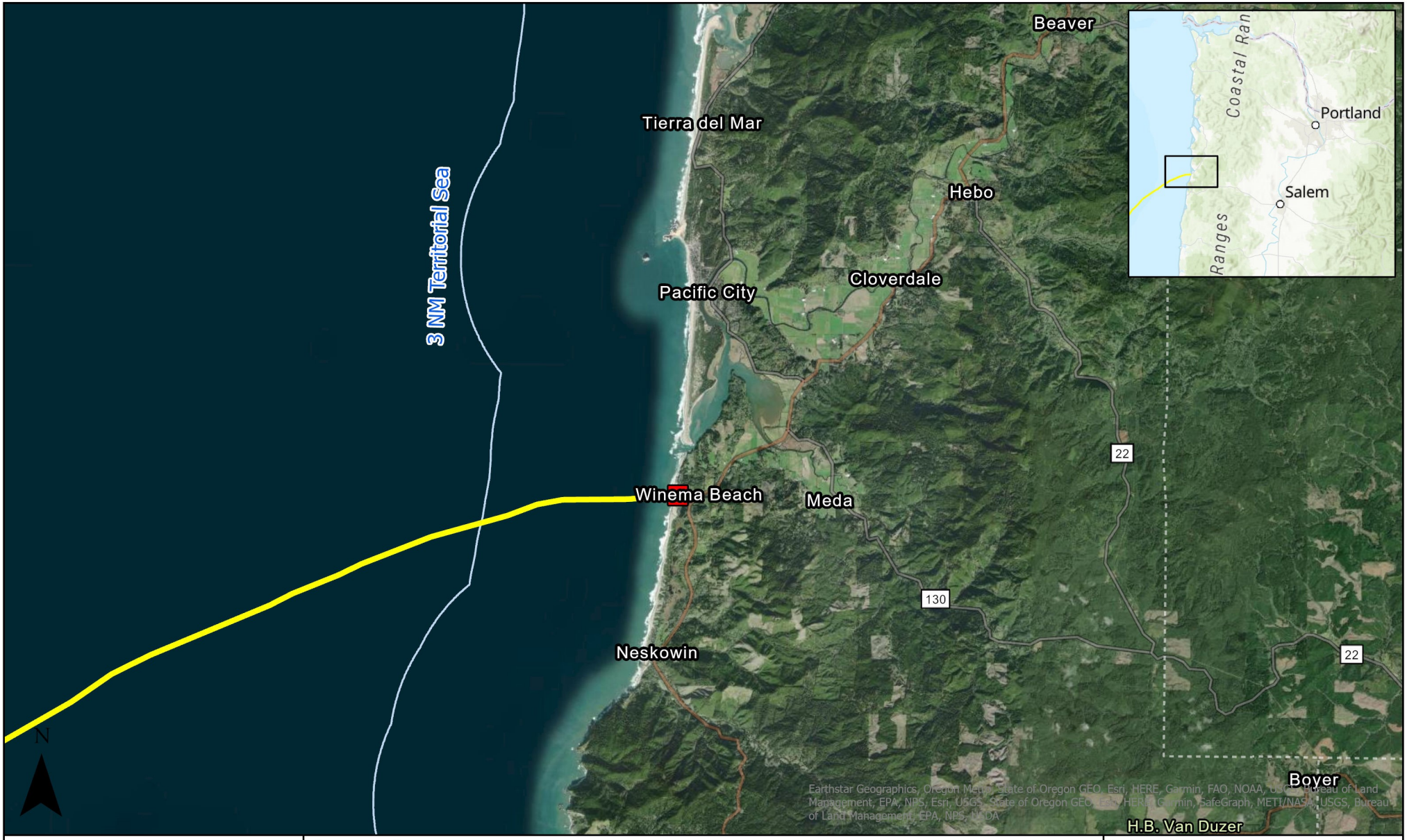


Fig. No. 1
Vicinity Map

Cloverdale, Oregon
Bifrost Submarine Cable

Prepared by: 48 north solutions

Legend

- Beach Manhole
- Proposed Submarine Route

0 2 4 8 Miles

Scale: 1:160,000
Source: ASN, 48 NORTH
Date: 5/30/2022 11:59 AM
Spatial Reference:
PCS: NAD 1983 UTM Zone 10N

DISCLAIMER
The accuracy of source information cannot be verified; therefore, all linework, labeling, and markings appearing on this figure may be subject to errors or omissions in positions, classifications, and interpretations. This figure should only be used as a visual guide for general overview purposes.

Fig. No. 2
Proposed New and Existing Build

Cloverdale, Oregon
Bifrost Submarine Cable

Prepared by: 48 north solutions

Legend

- Proposed Beach Manhole
- Proposed New HDD Landing Pipe
- Proposed New Terrestrial Conduit
- Existing Astound Conduit System

N

0 375 750 1,500 Feet

Scale: 1:4,500
Source: ASN, 48 NORTH
Date: 2/14/2023 4:11 PM
Spatial Reference:
PCS: NAD 1983 UTM Zone 10N

DISCLAIMER
The accuracy of source information cannot be verified; therefore, all linework, labeling, and markings appearing on this figure may be subject to errors or omissions in positions, classifications, and interpretations. This figure should only be used as a visual guide for general overview purposes.

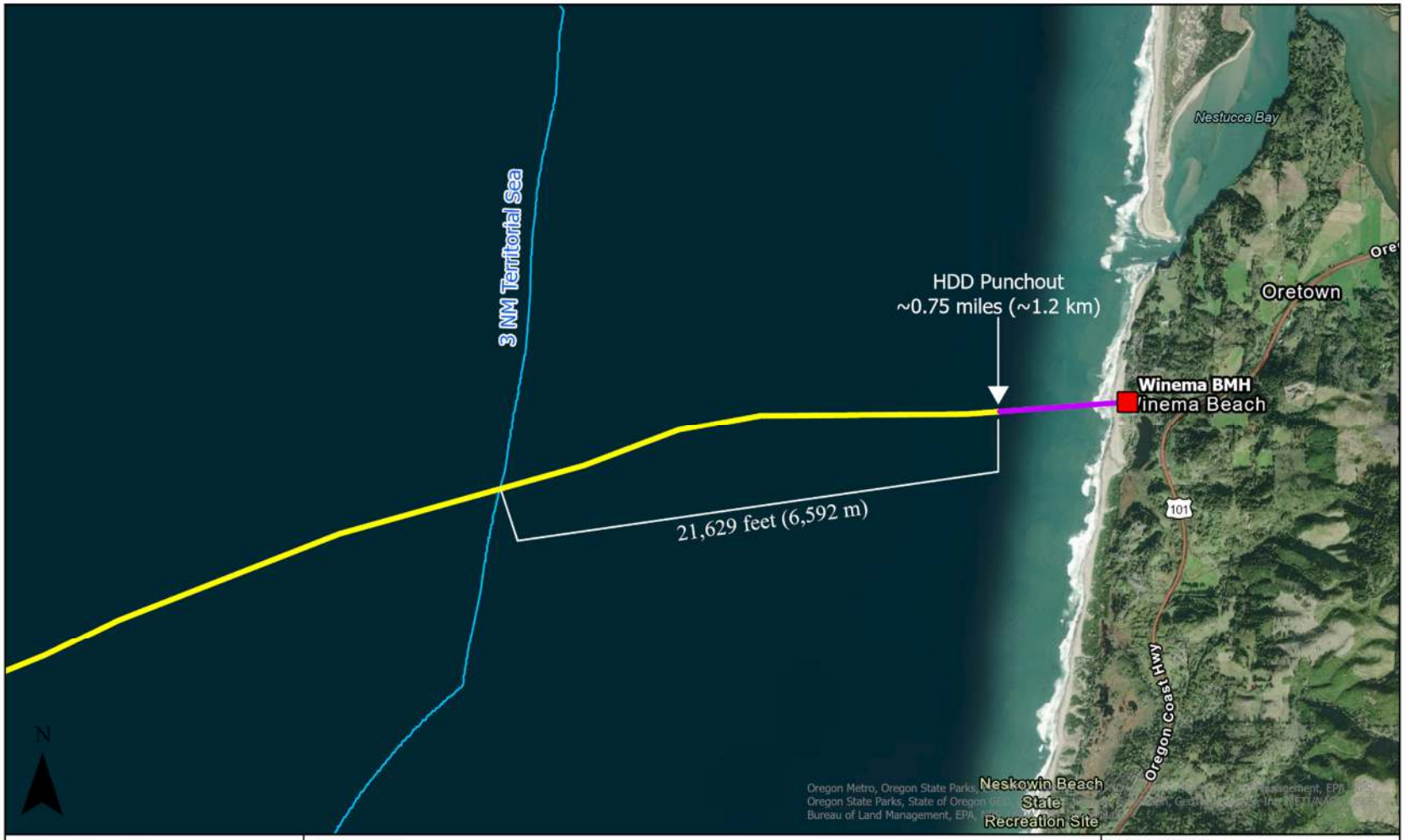


Fig. No. 3
Offshore Extent of
Horizontal Directional Drill

Cloverdale, Oregon
Bifrost Submarine Cable

Prepared by: 48 north solutions

Legend

- Beach Manhole
- HDD Extent
- Proposed Submarine Route

N

0 0.75 1.5 3 Miles

Notes:
The accuracy of source information cannot be verified, therefore all linework, labeling, and markings appearing on this map may be subject to errors or omissions in position, classifications, and interpretations. This map should only be used as a visual guide for general overview purposes.

Scale: 1:50,000
Source: ASN, 48 NORTH
Date: 2/14/2023 4:23 PM
Spatial Reference:
PCS: NAD 1983 UTM Zone 10N

DISCLAIMER
The accuracy of source information cannot be verified; therefore, all linework, labeling, and markings appearing on this figure may be subject to errors or omissions in positions, classifications, and interpretations. This figure should only be used as a visual guide for general overview purposes.

Fig. No. 4
Tax Parcel Map of Proposed Beach Manhole Location
Bifrost Submarine Cable Network

Beach Manhole

Building

N

48 north solutions

Photolog

PHOTOGRAPHIC LOG: 1

Client name: RTI Solutions	**Site Location:** Winema, Oregon	**Project No.:** 2108-RTI-01

Date: June 27, 2022

Direction of Photo: West

Description: General site conditions of BMH location.

PHOTOGRAPHIC LOG: 2

Client name: RTI Solutions	**Site Location:** Winema, Oregon	**Project No.:** 2108-RTI-01

Date: June 27, 2022

Direction of Photo: West

Description: Staging/OGBs site

PHOTOGRAPHIC LOG: 3

Client name: RTI Solutions	**Site Location:** Winema, Oregon	**Project No.:** 2108-RTI-01
Date: June 27, 2022		
Direction of Photo: Southeast		
Description: Entrance to BMH site, facing Wi Ne Ma Road.		

PHOTOGRAPHIC LOG: 4

Client name: RTI Solutions	**Site Location:** Winema, Oregon	**Project No.:** 2108-RTI-01
Date: June 27, 2022		
Direction of Photo: Northeast		
Description: Cliffs adjacent the BMH site. (Note: building in picture is the BMH property owners)		

PHOTOGRAPHIC LOG: 5

Client name: RTI Solutions	**Site Location:** Winema, Oregon	**Project No.:** 2108-RTI-01
Date: June 27, 2022		
Direction of Photo: Southeast		
Description: Residences to the southeast of the proposed BMH location		

PHOTOGRAPHIC LOG: 6

Client name: RTI Solutions	**Site Location:** Winema, Oregon	**Project No.:** 2108-RTI-01
Date: June 27, 2022		
Direction of Photo: North		
Description: Beach adjacent the BMH location		

PHOTOGRAPHIC LOG: 7

Client name: RTI Solutions	**Site Location:** Winema, Oregon	**Project No.:** 2108-RTI-01
Date: June 27, 2022		
Direction of Photo: West		
Description: Beach adjacent the BMH location		

PHOTOGRAPHIC LOG: 8

Client name: RTI Solutions	**Site Location:** Winema, Oregon	**Project No.:** 2108-RTI-01
Date: June 27, 2022		
Direction of Photo: South		
Description: Beach adjacent the BMH location		

Appendix 1
Landownership Authorization

Tillamook County, Oregon
08/16/2022 08:34:03 AM
DEED-EUTLA
$55.00 $11.00 $61.00 $10.00 - Total =$137.00

2022-005186

00228900202200051860110111

I hereby certify that the within instrument was received for record and recorded in the County of Tillamook, State of Oregon.

Tassi O'Neil, Tillamook County Clerk

Return Address:

ATTN: Bree Urban
Wave Business Solutions, LLC
3700 Monte Villa Parkway
Bothell, WA 98021

Document Title(s) (or transactions contained therein):
Utility Easement

Reference Number(s) of Documents assigned or released: N/A

Grantor(s) (Last name first, then first name and initials):
Wi-Ne-Ma Christian Camp, Incorporated, an Oregon non-profit corporation

Grantee(s) (Last name first, then first name and initials):
Wave Business Solutions, LLC, a Washington limited liability company

Legal description (abbreviated: i.e. lot, block, plat or section, township, range)
Ptn. Lot 30 and Lot 31, Sect. 12, Twp. 5S, Rge. 11W, W.M.
☒ Full legal description is on page 6 of document.

Assessor's Property Tax Parcel/Account Number
APN# 308642

Appendix 2
Project Components

DESCRIPTION OF PROJECT COMPONENTS

Introduction

The proposed Bifrost Subsea Cable Project (Project) includes the installation of a submarine fiber optic cable with state waters in the Pacific Ocean, making landfall and connecting to a Cable Landing Station (CLS) in Winema, Oregon. The Project is described herein and includes both terrestrial and marine components. This project implementation will include both marine and terrestrial works as described herein.

Terrestrial Project Components

The following terrestrial Project components will be needed on land above the ordinary high-water mark:

- Cable Landing Site. The fiber optic cable coming from the ocean would land in a vacant area lot on the Wi-Ne-Ma Christian Camp (Lot 6200). Approximately 0.5-acre of space will be needed to stage the various activities necessary to complete the terrestrial portions of the work.
- Landing Pipe (LP). One landing pipe, approximately 7 inches in diameter and 4,100 feet in length, will be installed from the beach manhole (BMH) to offshore using the horizontal directional drilling (HDD) construction method. Using HDD methods allows the LP to be installed below the beach and surf zone and out into the ocean without surface disturbance along the alignment. The HDD process utilizes a large bore machine to drill a bore hole, starting at the ground surface, down to a depth of at least 20 feet by the time it reaches the sand dunes and 80 feet at the extreme low water mark, then leveling off until it needs to be guided back up to the ocean floor.
- Beach Landing Manhole. A buried BMH, also known as a landing manhole, will be installed at the landward end of the LP once it is installed. The BMH will serve as the access point to the LP and contain the splice between the marine fiber optic cable system and the terrestrial system. It will also provide access to the landing pipe for maintenance-related activities. An excavator will be used to excavate the hole into which the BMH will be placed. Once installed the BMH will be completely buried with only an access lid visible at ground level.
- Ocean Ground Bed (OGB). Since the fiber optic cable will be energized, it will need to be grounded. The OGB will be installed near the BMH on Lot 6200. The OGB system will consist of four to six ground anodes placed in a row and be connected by a ground cable to the CLS. Using an auger bit attached to an excavator, a hole approximately 12-inch in diameter, will be drilled into the ground to a depth of approximately 30 feet below surface. A grounding anode will be installed into the hole and connected back to the BMH. This would be repeated for each anode.

- Underground Conduit System. An underground conduit approximately 235 feet in length, will connect the BMH to a telecommunications conduit system along Winema Road. This underground conduit system will be a conduit bundle (approximately 8 to 10 inches in diameter) buried at least 3 feet deep using standard utility trenching methods. It will connect to an existing conduit along Winema Road that provides internet service the Church Camp and residential neighbors.
- Power Feed Hut (PFE). A PFE is needed to support powering the conduit system along Winema Road and surrounding area. This equipment will be utilized to power the submarine fiber optic cable. The PFE is located approximately one-half mile from the BMH, near the intersection of Winema Road and Highway 101. The facility houses power generation, telecommunications and ancillary equipment needed to operate Astound's residential infrastructure, as well as the marine cable. From here, the telecommunications traffic will be connected into Astound's existing telecommunications network to Hillsboro.

Marine Project Components

The marine components include the LP and the submarine fiber optic cable.

- Landing Pipe (LP). The LP begins on land and ends in the ocean. It is addressed under the terrestrial section above.
- Marine Fiber Optic Cable. The marine fiber optic cable will be buried beneath the seafloor to a depth of approximately 3 to 5 feet while on the Continental Shelf. Beyond the shelf, the cable is laid directly on the ocean floor. The cable on the shelf will measure approximately 1- to 1.5-inches in diameter and consist of the fiber optic cores, a copper conductor, stainless steel strength members, and waterproofing. The cable will be installed using either a plow or remote operated vehicle (ROV):
    - Cable Plowing: Most of the cable will be installed using a plow. The plow is supported by four skids that rest on the ocean floor. As the plow is towed by the cable ship, a plow shank on the back of the plow slices a furrow into the ocean floor to a depth of approximately three to five feet. The fiber optic cable is installed immediately behind the plow shank and into the plow furrow.
    - Remote Operated Vehicle: For areas where the plow cannot operate, the cable is buried using an ROV. The ROV is tethered to the cable ship and is placed on the ocean floor directly over the cable. The ROV tracks along the cable under its own power and uses water jets to bury the cable.

Appendix 3
Engineering Plans

BIFROST SUBSEA CABLES PROJECT

LANDING PIPE, BHM, AND OGB DRAWINGS

SHEET INDEX

WINEMA, OREGON

RTI—I

PERMIT ISSUE
JANUARY 19 2022

CIVIL ENGINEERING / SURVEYING / UTILITIES
7101 College Boulevard, Suite 400
Overland Park, Kansas 66210
913-663-1900

PROJECT CONTACTS

OWNER'S REPRESENTATIVE
WAVE NETWORKS
MATT UPDENKELDER, PMP
PHONE: (541)–760–9822

TAX LOT:
05S11W12DC–6200

SYMBOLOGY

UGE — BURIED ELECTRICAL LINE

T — BURIED TELECOM LINE

W — BURIED WATER LINE

PROPERTY LINE

EASEMENT

TEMPORARY STAGING AREA

CONTRACTOR IS RESPONSIBLE FOR CALLING OREGON 811 AT LEAST 48 HOURS PRIOR TO ANY EXCAVATION AND FOR LOCATING ALL EXISTING UTILITIES PRIOR TO CONSTRUCTION. CONTRACTOR SHALL TAKE ALL NECESSARY PRECAUTIONS TO PROTECT EXISTING UTILITIES AND ANY DAMAGE TO THE UTILITIES SHALL BE IMMEDIATELY REPAIRED AT THE CONTRACTORS EXPENSE.

RIGHT OF WAY INFORMATION SHOWN IS APPROXIMATE.

ALL EXCAVATIONS AND WORK IN CONFINED SPACES SHALL BE PERFORMED IN ACCORDANCE WITH CURRENT OSHA REQUIREMENTS AND REGULATIONS.

THE CONTRACTOR SHALL COMPLY WITH ALL REQUIREMENTS OF THE VARIOUS PERMITS OBTAINED FOR THE PROJECT. MAINTAIN 36" MINIMUM CLEARANCE OVER OR UNDER WATER, STORM & SANITARY SEWERS.

THE CONTRACTOR SHALL BE RESPONSIBLE AT ALL TIMES FOR THE MAINTENANCE OF STREETS AND OTHER UTILITIES AFFECTED BY CONSTRUCTION OPERATIONS, DEBRIS AND RUBBISH SHALL NOT BE PERMITTED TO ACCUMULATE, AND ALL PREMISES SHALL BE MAINTAINED IN A NEAT AND WORKMANLIKE CONDITION.

THERE SHALL BE ADEQUATE VEHICLE AND PEDESTRIAN ACCESS FOR INGRESS AND EGRESS FROM THE PROPERTIES ADJACENT TO THE PROJECT AT ALL TIMES.

DURING NON–WORKING HOURS, THE CONTRACTOR SHALL KEEP THE EXISTING TRAFFIC LANES CLEAR FOR TRAFFIC WITHOUT INTERFERENCE FROM HIS OPERATIONS INCLUDING ALL APPROACHES AND INTERSECTIONS.

THE REQUIREMENTS OF THE OCCUPATIONAL SAFETY AND HEALTH ACT (OSHA) APPLY TO ALL EXCAVATION, TRENCHING, AND DITCHING OPERATIONS ON THIS PROJECT. ALL TRENCHES FOUR (4) FEET IN DEPTH SHALL BE SHORED IN COMPLIANCE WITH APPLICABLE FEDERAL AND/OR STATE REGULATIONS AS A GENERAL RULE, SHORING SHALL BE REQUIRED IN ALL STREET AREA EXCAVATIONS, AND SLOPING TO THE ANGLE OF REPOSE WILL BE PERMITTED ONLY IN NON–CRITICAL, OFF–STREET AREAS.

NO TRENCH OR EXCAVATION IN PUBLIC RIGHT OF WAY SHALL BE LEFT OPEN OVERNIGHT OR UNATTENDED.

ANY STREETS OR SIDEWALKS DISTURBED BY CONSTRUCTION SHALL BE REPAIRED OR REPLACED AND THE SURROUNDING AREA SEEDED AT THE DIRECTION OF THE LOCAL AUTHORITY SPECIFICATIONS

Rev.	Date	Description	By	Ckd	App
0	xx-xx-xx	xxx	xxx	xxx	xxx

RTI–I

CIVIL ENGINEERING / SURVEYING / UTILITIES

Project:
BIFROST
SUBSEA CABLES
WINEMA OREGON

Site Address:
45.146800° N
-123.973667° W

Sheet Title:
GENERAL NOTES AND SYMNOLOGY

Project No.:

Date Drawn:

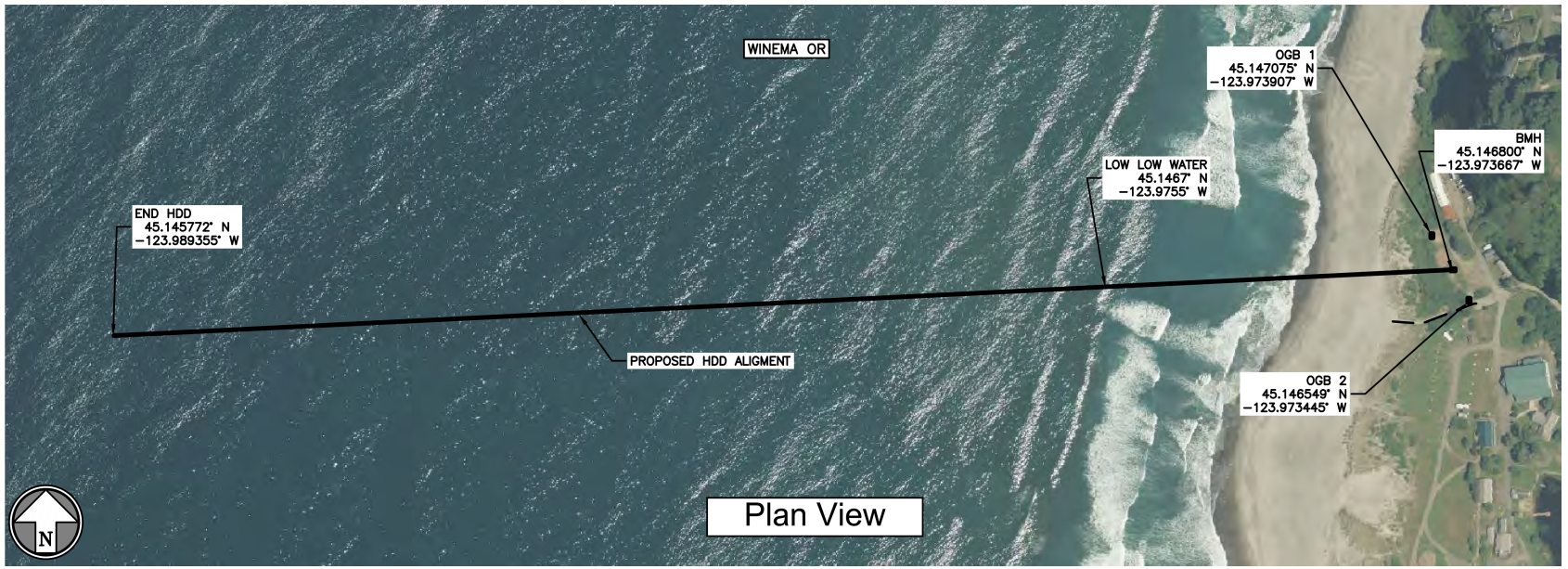
Drawn:

Checked:

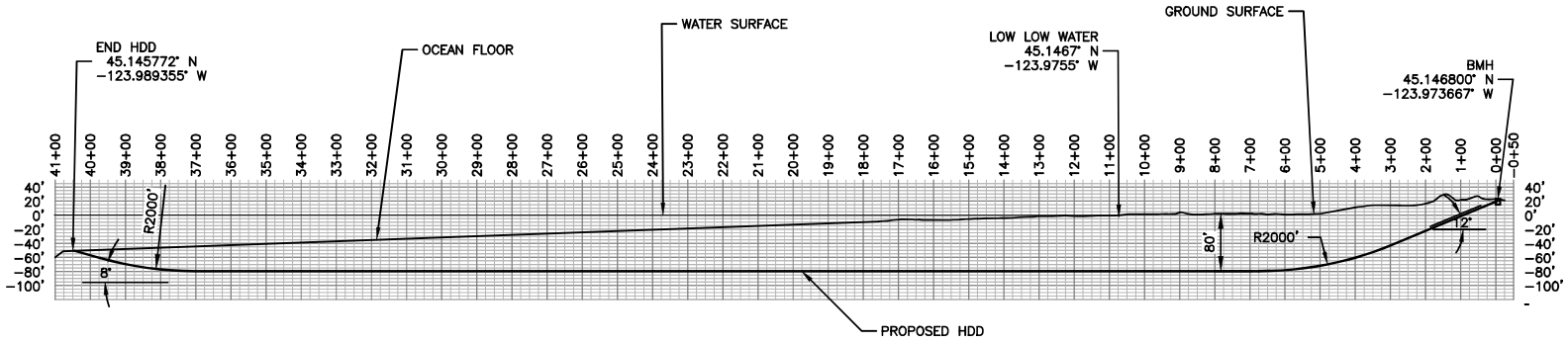
Approved:

Scale:

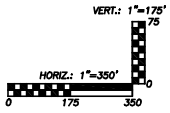
Sheet:
2
2 of 7



Plan View



Profile View



Rev.	Date	Description	By	Ckd	App

RTI–I

CIVIL ENGINEERING / SURVEYING / UTILITIES

Project:
BIFROST
SUBSEA CABLES
WINEMA OREGON

Site Address:
45.146800° N
-123.973667° W

Sheet Title:
HDD AND LANDING SITE

Project No.:

Date Drawn:

Drawn:

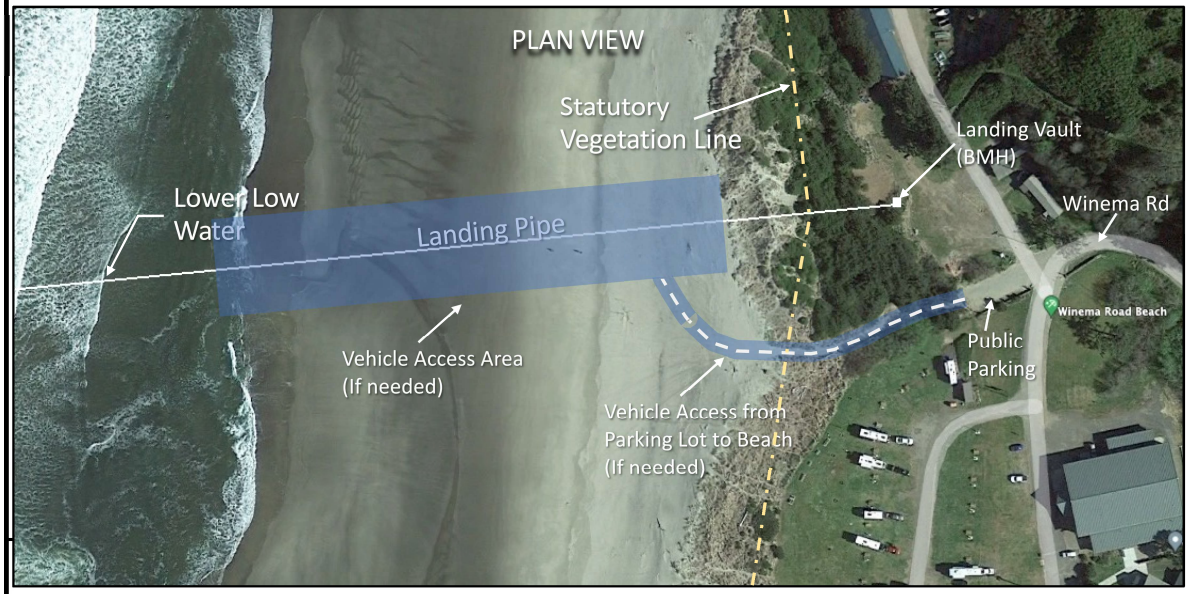
Checked:

Approved:

Scale:

Sheet:
3
3 of 7

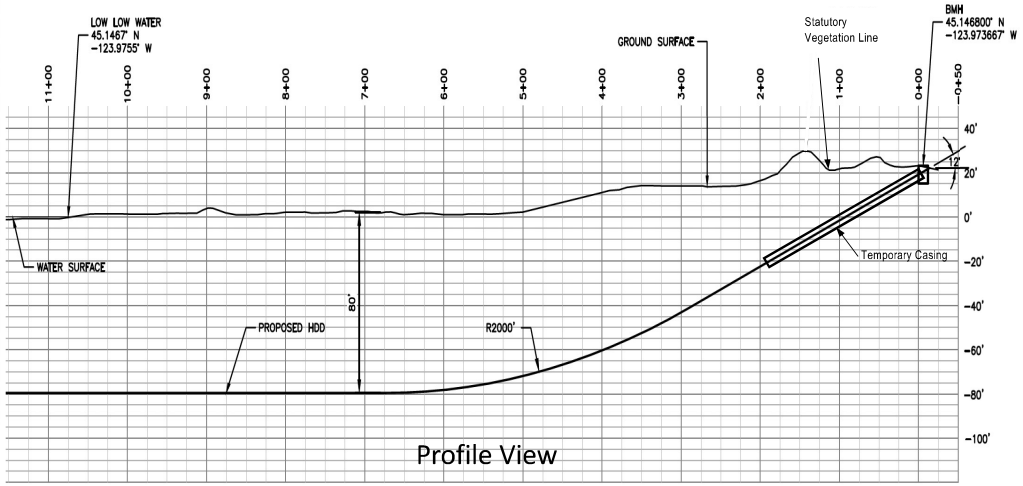
OPDR JURISDICTION & BEACH ACCESS

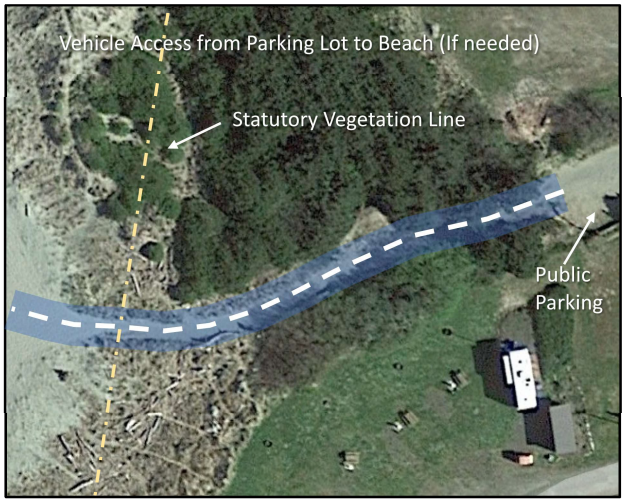


N

Not to Scale

Note: Edge of Tree Line to Lower Lower Water = ~1,100 feet (335m)





Rev.	Date	Description	By	Ckd	App
0	xx-xx-xx	xxx	xxx	xxx	xxx

RTI–I

BHC CIVIL ENGINEERING / SURVEYING / UTILITIES

Project:
BIFROST
SUBSEA CABLES
WINEMA OREGON

Site Address:
45.146800° N
-123.973667° W

Sheet Title:
HDD AND LANDING SITE

Project No.:

Date Drawn:

Drawn:

Checked:

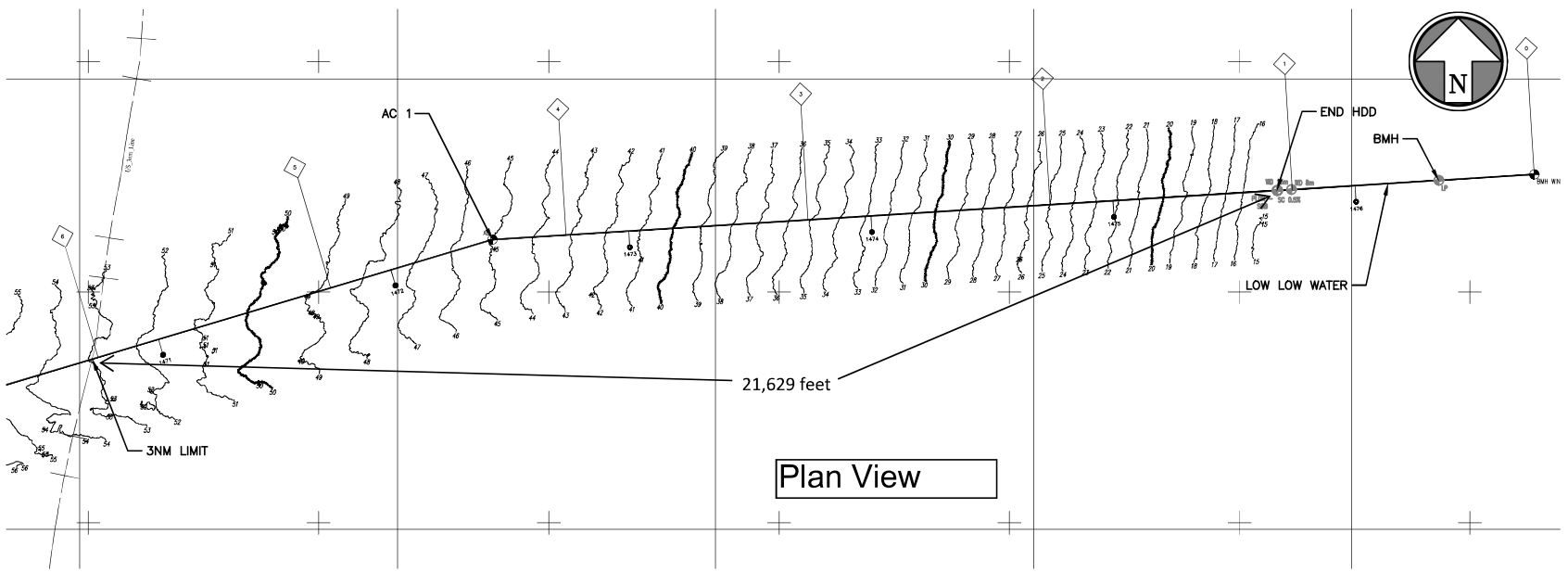
Approved:

Scale:

Sheet:
3.1
3 of 7

WINEMA OR

SEGMENT	START LATITUDE	START LONGITUDE	END LATITUDE	END LONGITUDE
LOW LOW WATER TO END HDD	45.1467° N	-123.9755° W	45.1458° N	-123.9894° W
END HDD TO AC 1	45.1458° N	-123.9894° W	45.1420° N	-124.0321° W
AC 1 TO 3NM	45.1420° N	-124.0321° W	45.1386° N	-124.0513° W



Plan View

Rev.	Date	Description	By	Ckd	App
1	8/19/2022	3NM_LIMIT	RV	CS	

RTI—I

BHC CIVIL ENGINEERING / SURVEYING / UTILITIES

Project:
BIFROST
SUBSEA CABLES
WINEMA OREGON

Site Address:
45.146800° N
-123.973667° W

Sheet Title:
SHORE TO 3NM

Project No.:

Date Drawn:

Drawn:

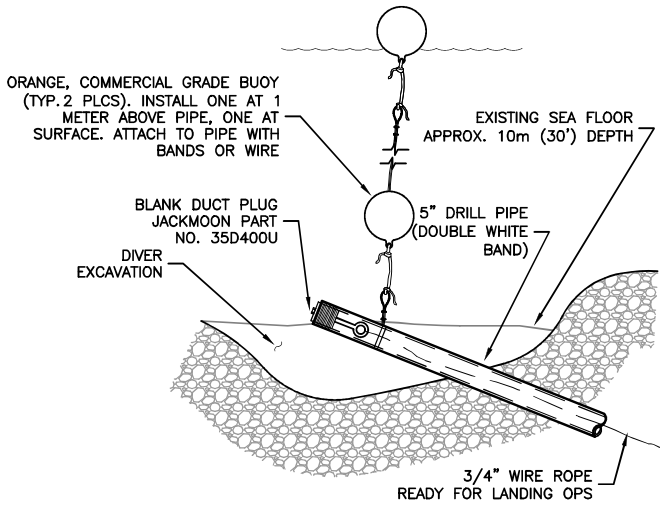
Checked:

Approved:

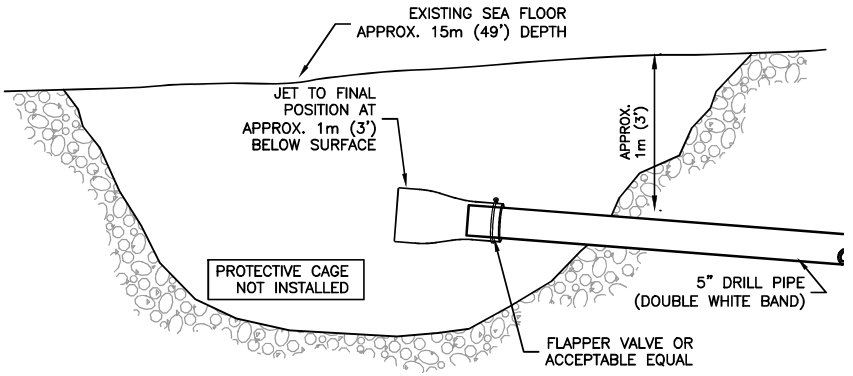
Scale:

Sheet:
4
4 of 7

Aug 19, 2022 - 10:50am Plotted By: Robert Vaccaro T:\027030.01.01- Grover Beach Cable Landing\DWG\Eng\Sheet\Winema\Prelim_For_Permit.dwg Layout: 3NM



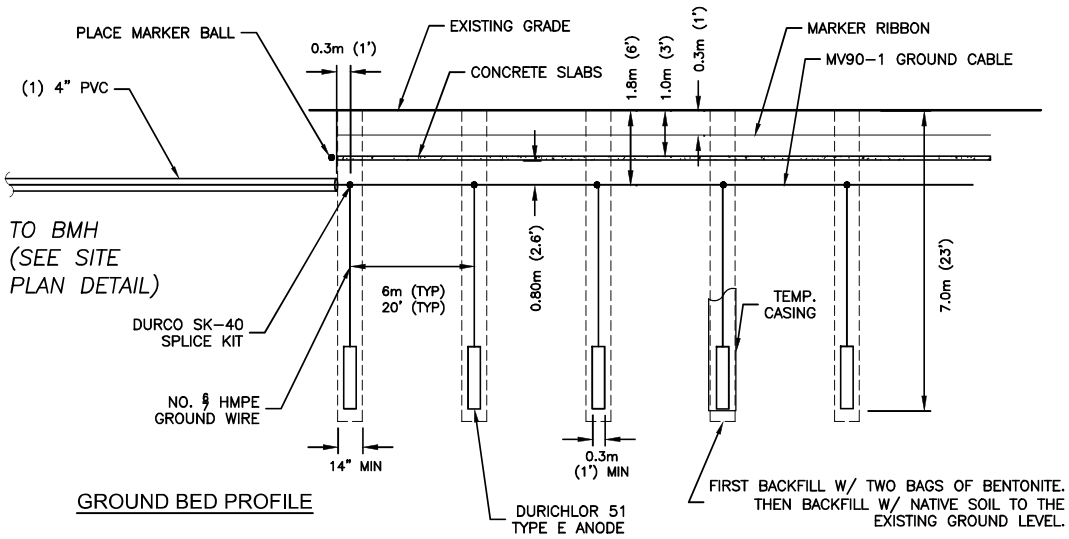
END OF BORE PIPE - NO 1.
PREPARED FOR LANDING
CONDITION



END OF BORE PIPE
WITH CHECK VALVE ASSEMBLY

NOTES: 1. NO PULL ROPE EXISTS INSIDE BORE PIPE

2. CONTRACTOR TO FORCE COMPRESSED AIR THROUGH BORE PIPE. EXISTING 200 PSI AIR HOSE INSIDE USING BMH–CONNECTED TO BORE PIPE WITH FLANGE ND NIPPLE CONNECTION



GROUND BED PROFILE

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0	xx-xx-xx	xxx	xxx	xxx	xxx

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Project:
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SUBSEA CABLES
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-123.973667° W

Sheet Title:
OGB AND HDD END

Project No.:

Date Drawn:

Drawn:

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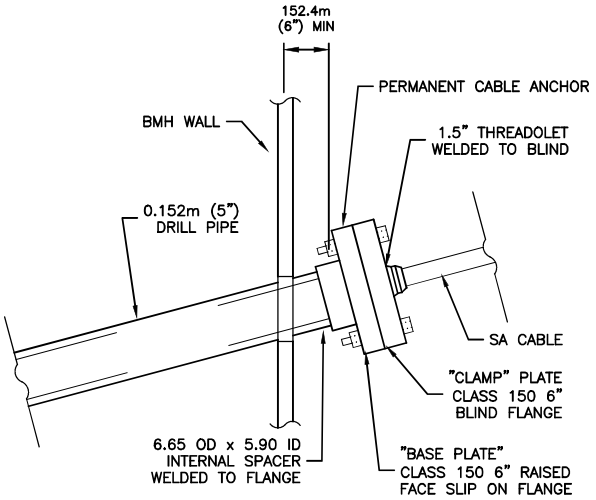
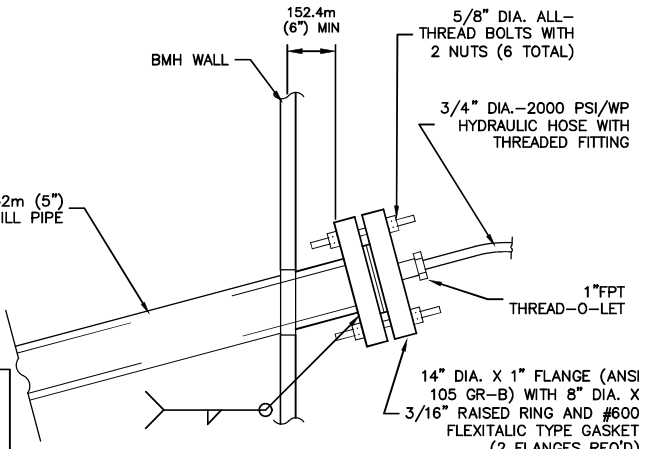
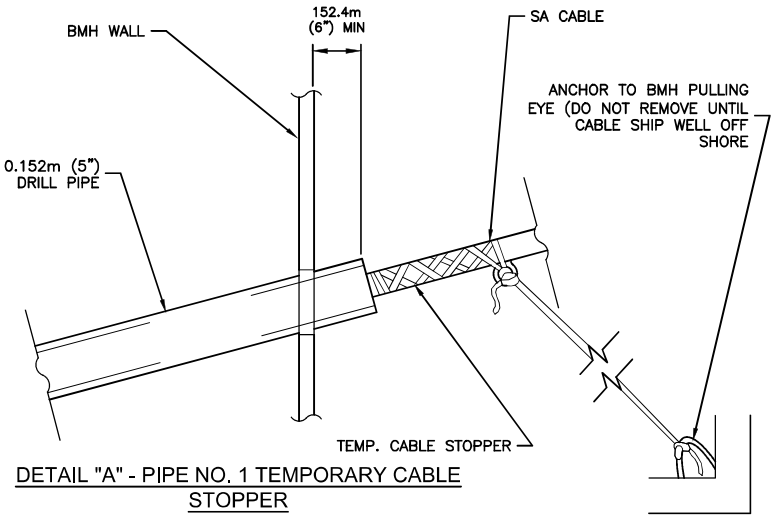


DETAIL "B" - PIPE NO. 1 PERMANENT CABLE ANCHOR



ATTACH RING TO BACK OF FLANGE FOR PULL ROPE. NOT SHOWN FOR CLARITY.

DETAIL "C" - PIPE NO. 2 AIR HOSE CONNECTION



DETAIL "A" - PIPE NO. 1 TEMPORARY CABLE STOPPER

Rev.	Date	Description	By	Ckd	App
0	xx-xx-xx	xxx	xxx	xxx	xxx

RTI-I

CIVIL ENGINEERING / SURVEYING / UTILITIES

Project:
BIFROST
SUBSEA CABLES
WINEMA OREGON

Site Address:
45.146800° N
-123.973667° W

Sheet Title:
AIR HOSE PIPE AND CABLE ANCHOR

Project No.:

Date Drawn:

Drawn:

Checked:

Approved:

Scale:

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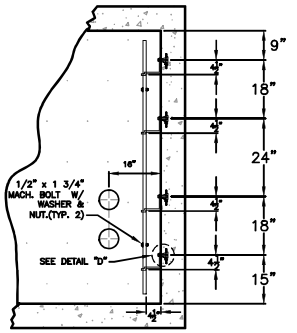
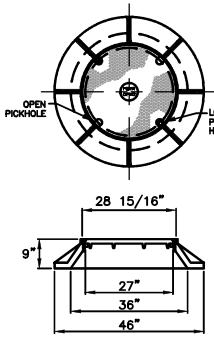
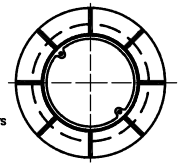
6 of 7



CABLE RACK MOUNTING DETAIL "C"

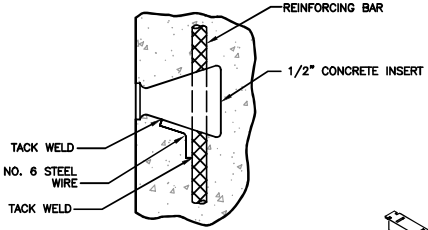
NOTE: TYP. ALL CABLE RACKS



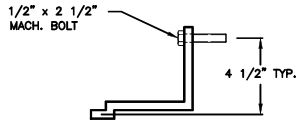


MANHOLE WITH COVER OFF

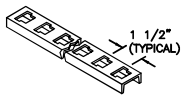
MANHOLE COVER DETAIL "A"



CONCRETE INSERT DETAIL "D"

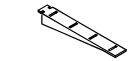


S CABLE RACK SUPPORT DETAIL "E"



GALVANIZED CUT RACKING
SCALE: N.T.S.

MANHOLE:
46 HOLE – 1,981.20mm (6'–6")

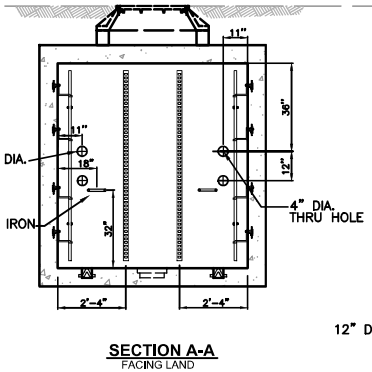


CABLE SUPPORT ARMS
SCALE: N.T.S.

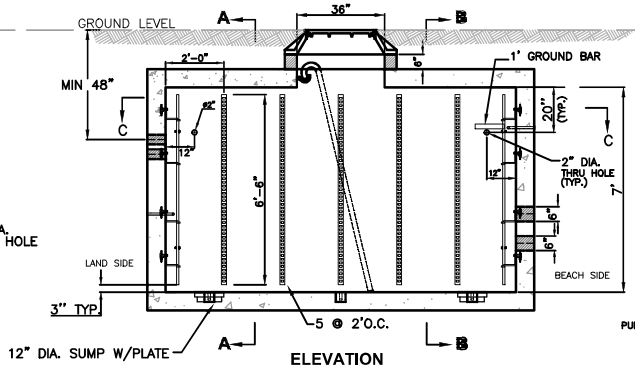
FORMED FROM 4.762mm(3/16") GALVANIZED STEEL
LENGTHS:
101.6mm (4") BEACH MANHOLE (6)
190.5mm (7 1/2") BEACH MANHOLE (4)
328.0 mm (12") BEACH MANHOLE (6)

GALVANIZED SPRING NUT AND SCREW
SCALE: N.T.S.

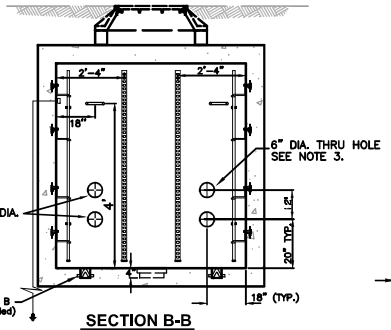
12.7mm (1/2") NUT
12.7mm (1/2") x 31.75mm (1 1/4") PLATED CAP SCREW
(AS NECESSARY TO ACCOMMODATE RACKING)



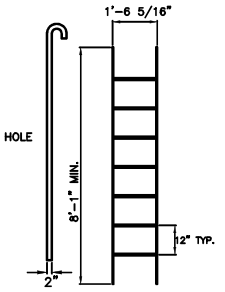
SECTION A-A
FACING LAND



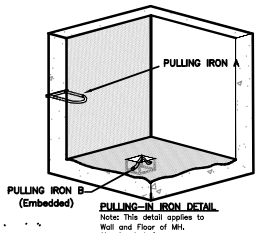
ELEVATION



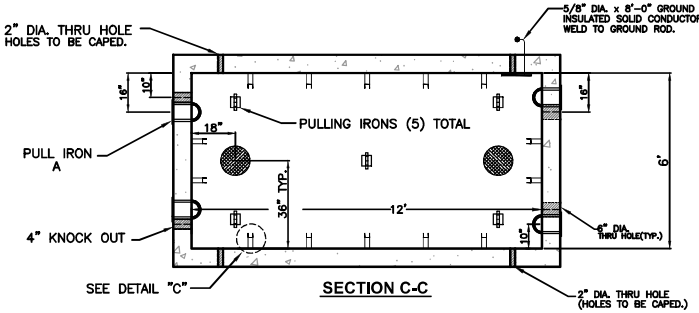
SECTION B-B
FACING SEA



LADDER DETAIL



PULLING-IN IRON DETAIL
Notes: This detail applies to Wall and Floor of MH. Use local design.
N.T.S.



SECTION C-C

NOTE:
1. MINIMUM PULL IRONS SHOWN. ADD ADDITIONAL PULL IRONS AS DEEMED NECESSARY.
2. THIS DRAWING IS NOT A CONSTRUCTION DRAWING. IT IS INTENDED TO SHOW INTERNAL MINIMUM DIMENSIONS, RACKING, AND OTHER TYPICAL FEATURES.
3. SIX INCH HOLES ARE REQUIRED FOR BEACH DUCTS OF 6" DIAMETER AND LONG LENGTH. IF THE DUCT TO THE BEACH IS LESS THAN 50 FEET AND IS 4" OR NO CONDUIT EXISTS THEN DUCT CAN BE 4".

Rev.	Date	Description	By	Ckd	App
0	xx-xx-xx	xxx	xxx	xxx	xxx

RTI–I

BHC
CIVIL ENGINEERING / SURVEYING / UTILITIES

Project:
BIFROST
SUBSEA CABLES
WINEMA OREGON

Site Address:
45.146800° N
-123.973667° W

Sheet Title:
BEACH MANHOLE

Project No.:

Date Drawn:

Drawn:

Checked:

Approved:

Scale:

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Appendix 4
Site Specific Geotechnical Report

GEOTECHNICAL INVESTIGATION REPORT
OFFSHORE CABLE LANDING
HORIZONTAL DIRECTIONAL DRILL INSTALLATIONS
WINEMA BEACH, OREGON

August 10, 2022

www.kleinfelder.com
KLEINFELDER 3649 W. Holland Ave. Suite 105, Fresno, CA 93722 **p|** 559.486.0750 **f|** 559.442.5081

August 10, 2022
Project No. 20230058.001A

Mr. Chris Brungardt
RTI Solutions, Inc.
7 Turtleback Lane
Westport, CT 06880

Subject: **Geotechnical Investigation Report**
Offshore Cable Landing
Horizontal Directional Drill Installations at Winema Beach
Cloverdale, Oregon

Dear Mr. Brungardt:

Kleinfelder is pleased to present the results of a geotechnical investigation for the proposed cable duct installations that are part of the offshore cable landing project at Winema Beach near Cloverdale, Oregon. The new cable ducts are planned to be installed using horizontal directional drill (HDD) techniques.

The purpose of this study was to evaluate the subsurface conditions near the proposed trenchless installation alignments to characterize the subsurface materials likely to be encountered during HDD drilling. At this time, a pipeline alignment has not been finalized. Therefore, Kleinfelder has prepared a conceptual bore profile for HDD and completed appropriate analyses to evaluate a constructable bore path for this cable landing. Based on our evaluation of the data discussed in this report, it is our professional opinion that the proposed cable landing installation should be feasible provided the geotechnical recommendations presented are incorporated into design and construction. The primary geotechnical design and construction issue associated with the project is the presence of clean sands, gravels, cobbles and boulders above the bedrock surface that may cause instability in the borehole and difficult drilling conditions. The designer(s) and contractor(s) should be aware this issue and all other subsurface conditions as they will affect design and construction, as described herein.

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Kleinfelder appreciates the opportunity to provide services for this project. If you have questions regarding this report, please contact the undersigned.

Respectfully submitted,

KLEINFELDER, INC.

[redacted]

Pedro Rivas
Staff Engineer II

[redacted]

Tyler S. DeSouza
Project Engineer / Project Manager

[redacted]

Kenneth G. Sorensen
Sr. Principal Geotechnical Engineer

[redacted]

Samuel R. Christie, PE, GE
Principal Geotechnical Engineer

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Section

1 INTRODUCTION

1.1 GENERAL

This report presents the results of a geotechnical investigation conducted for the proposed cable duct installations for the offshore cable landing project at Winema Beach near Cloverdale, Oregon. The purpose of this investigation was to evaluate the subsurface conditions near the project alignment and to characterize the subsurface materials likely to be encountered during trenchless construction activities. The approximate location of the cable landing alignment is shown on Figure 1, Site Vicinity Map.

This report includes our recommendations related to the geotechnical aspects of project planning, design, and construction of the proposed trenchless cable landing installation. Conclusions and recommendations presented in this report are based on the subsurface conditions encountered at the locations of the explorations at the project site and geophysical surveys performed along the alignment. Recommendations presented herein should not be extrapolated to other areas or used for other projects without our prior review.

1.2 PROJECT DESCRIPTION

Kleinfelder understands that the proposed project includes the installation of a cable landing at Winema Beach, Oregon. It is proposed to install 2 or more cable ducts from the shore housing (Manhole) to about 4,000 feet out to sea using HDD techniques. In this case, the hollow steel drill rods used for HDD will be left in place for use as conduits, so there is no reaming or hole opening once the pilot hole is drilled. The HDD bottom hole assemblies (BHAs) will be removed once the bores exit. This does not require pulling in of conduit after the bore is drilled. After removal of the BHAs, the cables will be pulled into the open drill rod conduits.

1.3 SCOPE OF SERVICES

As authorized by RTI Solutions Inc., our scope of services included providing a report with the following items:

- A description of the proposed project, including a site vicinity map and a site plan showing the location of the subsurface explorations and proposed entry and exit points for the HDD alignments.

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- A description of the site geologic setting and potentially adverse geologic hazards that could impact the project such as soil liquefaction, ground shaking and ground rupture due to earthquake activity.
- A site geology map along the proposed HDD crossing alignment depicting the anticipated geologic conditions as revealed by the boring and geophysical investigations.
- A description of the site surface and subsurface conditions encountered during the field investigation, including boring logs
- A summary of the field exploration and laboratory testing programs
- Analysis of the potential for hydraulic fracturing and inadvertent fluid releases from the HDD bore
- Recommendations related to the geotechnical aspects of HDD including:
    - Anticipated drilling conditions
    - Soil characteristics, bit, and tool selection
    - Drilling fluid considerations including effects of saline water
    - Solids and fluid volume
    - Equipment support
    - Recommendations for control of inadvertent fluid releases and related contingency planning
- Recommendations for Contractor selection and pre-bid services
- Appendices with logs of borings and laboratory test results
- Appendix including finding of geophysical work.

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2 FIELD INVESTIGATION AND LABORATORY TESTING

2.1 SITE DESCRIPTION

The proposed cable landing alignment is located adjacent to Winema Beach, west of Highway 101 in Cloverdale, Oregon. The proposed entry point for the HDD and manhole is located in a private lot north of Winema Road, east of the beach foredune. The alignment will run in a southwesterly direction from the manhole area and extend offshore underneath the Pacific Ocean for about 4,000 feet before reaching the pipe exit point. The topography is generally flat to gently rolling near the foredune located between the beach and manhole location. This area has the highest ground surface elevation along the alignment. From the foredune, the ground slopes away to the west. The project location is shown on Figure 1.

2.2 FIELD EXPLORATION PROGRAM

The field exploration program included both terrestrial and over-water explorations, as discussed below. The terrestrial field exploration program was conducted between May and June, 2022. The exploration program included drilling one (1) geotechnical boring at the proposed manhole location and conducting a geophysical survey, including MASW, ERT, and downhole seismic surveys. These exploration locations are shown on Figure 2, Exploration Location Map. Daily field report logs and available exploration equipment specification and/or calibration sheets are shown in Appendices A & B, respectively.

2.2.1 Exploratory Boring

The subsurface conditions at the site were explored on May 16th through 19th, 2022 by drilling one (1) boring utilizing a CME-75 truck-mounted drill rig equipped for mud rotary drilling and rock coring techniques. The boring was drilled near the proposed cable landing manhole location to a depth of approximately 151½ feet below the ground surface. Further, upon completion of the boring, downhole seismic testing was completed within the boring. This survey method is discussed in further detail in Section 2.2.3 below.

The boring was located in the field with a GPS unit, as well as visual sighting and/or pacing from existing site features. Therefore, the location of the boring shown on Figure 2 should be considered approximate and may vary slightly from those indicated.

A Kleinfelder professional maintained a log of the boring, visually classified the soils encountered according to the Unified Soil Classification System (American Society for Testing and Materials International [ASTM] D2488 visual-manual procedure) and obtained samples of the subsurface materials. Kleinfelder field personnel also completed logs of the bedrock by visually classifying the types of rock encountered according to the Rock Classification Systems for Engineering Purposes (American Society for Testing and Materials International [ASTM] STP984-EB visual-manual procedure) and obtained relatively undisturbed rock core samples. A Soil Description Key is provided on Figure C-2. A Rock Description Key is provided on Figure C-3. The boring log is presented on Figure C-4.

2.2.2 Sampling Procedures

Relatively undisturbed samples were obtained from the borings at selected depths by driving a 2.5-inch inside diameter (I.D.), split-barrel, California sampler containing stainless steel and brass liners into undisturbed soil with a 140-pound automatic hammer free-falling a distance of 30 inches. The California sampler was in general conformance with ASTM D3550. Soil sampled using this method may have experienced some minor disturbance due to hammer impact, retrieval, and handling. Disturbed samples were also obtained at selected depths by driving a 1.4-inch I.D. Standard Penetration Test (SPT) sampler into undisturbed soil with a 140-pound automatic hammer free-falling a distance of 30 inches. The SPT sampler was in general conformance with ASTM D1586. The rock core samples were obtained from the boring using a NQ core bit with a borehole diameter of 3.0 inches.

Blow counts were recorded at 6-inch depth intervals for each driven sample attempt and are reported on the logs. Blow counts shown on the boring logs have not been corrected for the effects of overburden pressure, rod length, sampler size, or hammer efficiency. Sampler size correction factors were applied to estimate the sample apparent density noted on the boring logs. The consistency terminology used in soil descriptions for cohesive soils is based on field observations (see Figure B-2). Disturbed soil samples and relatively undisturbed rock samples obtained from the boring were packaged and sealed in the field to reduce moisture loss and disturbance and returned to our laboratory for further testing. After the boring was completed, it was backfilled with neat cement grout.

The boring location was intentionally offset from the proposed HDD alignment in order to reduce the risk of creating a preferential conduit for inadvertent return of drilling fluid to the ground surface during HDD drilling operations. Upon completion, the boring was abandoned by placing a cement and bentonite grout mix from the bottom of the hole to the ground surface using tremie methods.

Following grouting, the boring was covered with native soil. The HDD contractor should monitor the exploration borehole location for fluid returns during HDD drilling.

Photographs of the samples recovered were taken in the field during the drilling program. A compilation of the sample photos taken in the field are provided in Figures C-5 to C-19.

2.2.3 Onshore Geophysical Survey

A geophysical survey was performed onshore between May 16th and 18th, 2022 and June 11th by Global Geophysics of Redmond, Washington. Geophysical survey methods, including Multichannel Analysis of Surface Waves (MASW), Electrical Resistivity Tomography (ERT) and Downhole Seismic Survey, were utilized along the terrestrial portion of the HDD alignment to evaluate the depth to bedrock and to characterize soil and rock stiffness and excavation characteristics. The MASW method determines variations in surface wave velocities with increasing distances and wavelengths. The data from these measurements are used to model the shear waves velocities of the subsurface. This information can then be used to infer rock/soil types, stratigraphy and soil conditions. The ERT maps differences in the electrical properties of geologic materials. These differences can result from variations in lithology, water content, pore-water chemistry, or voids. The seismic downhole method provides a designer with information pertinent to the seismic wave velocities of the materials in question. The S-wave velocities are directly related to important geotechnical properties such as of Poisson's ratio, shear modulus, bulk modulus, and Young's modulus.

The results of the ERT and the shear wave velocity measurements were used along with soil boring and geologic data to characterize the site for geotechnical design. Results of the geophysical survey are provided in Appendix E of this report.

2.2.4 Offshore Geophysical Survey

An offshore geophysical survey was performed between July 7th and 9th by Global Geophysics. The geophysical survey methods for the offshore section of the alignment included ERT and overwater profiling. These methods were used to evaluate the depth to bedrock and characterize soil and rock characteristics. The offshore ERT is performed in a similar manner as the terrestrial survey, however the measured values are much lower in sea water due to large current output. Overwater Profiling provides a continuous subsurface image of the seabed, the underlying stratigraphy and major structure features in the bedrock.

In general, higher resistivity readings indicate finer-grained and/or clayey material in soil or rock.

The results of the offshore ERT and overwater profiling are provided in Appendix E of this report.

2.3 LABORATORY TESTING

Laboratory tests are currently being performed on selected samples recovered from the boring to evaluate physical and engineering properties. The geotechnical laboratory testing program includes the following tests:

- Unit Weight (ASTM D2937)
- Moisture Content (ASTM D2216)
- Percent Finer Than No.200 Sieve (ASTM D1140)
- Sieve Analysis (ASTM D6913)
- Atterberg Limits (ASTM D4318)
- Uniaxial Compressive Strength of Intact Rock (ASTM D7012 Method C)

Unit weight, moisture content, percent passing the No. 200 sieve, and Atterberg limits results are summarized on the boring logs presented in Appendix C. The results of all laboratory tests are included in Appendix D.

3 SITE CONDITIONS

3.1 REGIONAL GEOLOGY

The site is located within the Coast Range geologic province of Central Oregon. Along the west margin of Oregon, the oceanic Juan de Fuca Plate is undergoing subduction by the continental North American plate along the Cascadia Subduction Zone, located offshore approximately 70 miles to the west of the site. The Cascadia Subduction Zone extends south from Queen Charlotte Sound in British Columbia, through Washington and Oregon, terminating at the Mendocino Triple Junction in Northern California. The basement rock in the central portion of this province consists dominantly of the Siletz Terrane (Siletz River Volcanics), an accreted island arc composed dominantly of early Eocene age (approximately 50 to 56 million years old) pillow basalt, volcanic breccia with interbedded sedimentary units. Subsequent to accretion of the Siletz Terrane, the Cascadia Subduction Zone shifted westward, generating a volcanic arc across the eastern two thirds of the state. Volcanism continued throughout the Oligocene and Miocene epochs (approximately 34 to 5 million years ago), depositing abundant volcanic flows along with interlayered lake and river deposits throughout the area. Concurrent with, and following conclusion of the volcanism, the forearc basin west of the shoreline infilled with oceanic sedimentary deposits. The Cascadia Subduction Zone has created a compressional tectonic regime, resulting in regional uplift east of the subduction zone. This regional uplift in concert with eustatic sea level change has exposed the forearc oceanic sediments throughout much of the Coast Range province. In the vicinity of the site, the deposits are overlain by and/or juxtaposed with mid to late Tertiary age (approximately 40 to 2.6 million years old) volcanic and non-marine deposits, and by younger Quaternary (approximately 2.6 million years old to present day) landslide, colluvial, alluvial, dune and beach deposits.

3.2 SITE GEOLOGY

Geologic mapping compiled by the USGS (Snavely et al, 1996) presents the surficial site geology as Holocene and Pleistocene aged beach and dune sands. The underlying bedrock at the crossing location is mapped as basaltic sandstone of the Alsea Formation. The native soils and bedrock encountered at the site during our field investigation are consistent with published geologic mapping. The Geology Map can be seen in Figure 3 and detailed description of the soils and bedrock encountered in our boring is contained on the boring log in Appendix C of this report.

3.3 SEISMICITY AND FAULTING

Hazard mapping completed by the Oregon Department of Geology and Mineral Industries indicates that the proposed crossing location is in an area of earthquake hazards, specifically ground shaking. The Cascadia fold and fault belt is located approximately 2¼ miles west of the project site. The site is expected to experience very strong to severe ground shaking during a seismic event. Discussion of associated liquefaction and lateral spreading potential at the site is discussed in Section 4 below.

3.4 SUBSURFACE CONDITIONS

The following descriptions provide a general summary of the subsurface conditions encountered during the field exploration program, as well as detailed descriptions of the conditions at the crossing location. For more detailed descriptions of the actual conditions encountered at specific boring locations, refer to the boring logs presented in Appendix C.

Based on information gathered from the boring, geophysical survey, and geologic review, the site subsurface conditions are generally consistent with the mapped surficial geology referenced in the site geology section of this report. At Boring B-1, located just north of the proposed cable landing manhole, surficial soils consist of medium dense sands in the upper 20 feet, which were then underlain by dense poorly-graded gravels to a depth of about 38 feet. Very dense sands were then encountered to a depth of 60 feet before transitioning to sandstone bedrock to the boring termination depth of about 151½ feet.

The MASW survey performed onshore indicates approximately 50 to 70 feet of overburden material underlain rock with a shear wave velocity of approximately 1,400 to 2,100 feet per second (fps). Based on the geophysical results of the survey line, the overburden and bedrock transitional zone is generally more gradual, occurring over a vertical distance of approximately 20 to 40 feet. The onshore ERT results suggest a similar thickness of overburden, approximately 55 to 70 feet.

The results of the offshore geophysical survey indicate approximately 35 to 50 feet of overburden material along the alignment underlain by the basal sandstone layer. Additionally, the ERT results show variation in resistivity of the basal layer which could indicate changes in lithology such as density or composition of the rock along the alignment.

It should be noted that interbedded lenses of cobbles and boulders up to 18 inches across were encountered within the gravel layer found between approximately 20 feet to 38 feet below the ground surface within Boring B-1. Caving and/or fluid loss conditions were not noted during drilling

within this layer but are common occurrences during HDD construction in such conditions. It is not known if this layer persists along the entire alignment. Further discussion on the impact of these conditions with regard to HDD design and construction is provided in Section 4.

3.5 GROUNDWATER CONDITIONS

Groundwater levels at the site were about 11 feet below the ground surface during the drilling of Boring B-1. It is possible that groundwater conditions at the site could change due to variations in sea tides, or other factors not apparent at the time the explorations were performed.

4 DISCUSSIONS, CONCLUSIONS AND DESIGN CONSIDERATIONS

4.1 GENERAL CONCLUSIONS

Based on our geotechnical investigation and evaluation of the data discussed in this report, it is our professional opinion that the proposed trenchless crossing should be feasible provided the geotechnical recommendations presented in this report are incorporated into design and construction. Conclusions and recommendations for trenchless design and construction are provided below.

4.2 LIQUEFACTION AND LATERAL SPREADING POTENTIAL

4.2.1 Liquefaction

Liquefaction describes a condition in which saturated soil loses shear strength and deforms as a result of increased pore water pressure induced by strong ground shaking during an earthquake. Dissipation of the excess pore water pressures will produce volume changes within the liquefied soil layer, which causes settlement. Factors known to influence liquefaction potential include soil type, structure, grain size, relative density, confining pressure, depth to groundwater and the intensity and duration of ground shaking. Soils most susceptible to liquefaction are saturated, loose sandy soils, and low plasticity clays and silts. If liquefaction occurs, structures above the liquefiable layers may undergo settlement.

For layers that meet the compositional criteria, liquefaction triggering (factor of safety) analyses were performed using methodologies proposed by Youd et al. (2001), Cetin et al. (2004), and Idriss & Boulanger (2006, 2008). The analyses utilized sample blow count data from the rotary-wash borings drilled for this study. In order to perform liquefaction analysis, estimates of earthquake magnitude and peak ground acceleration (PGA_M) are needed. Using the U.S. Geological Survey (USGS) interactive deaggregation website, the modal earthquake magnitude M_w = 9.1 was estimated. It should be noted that the simplified liquefaction triggering analysis is valid for earthquake magnitudes of M_w = 8.5 or less and therefore a Magnitude of M_w = 8.5 was used in the simplified analysis. The peak ground acceleration (PGA_M) value for our analyses was calculated based on Equation 11.8-1 in Section 11.8.3 of ASCE 7-16 for the Risk-Targeted Maximum Considered Earthquake (MCE_R). The PGA_M value was calculated using the US Seismic Design Maps application assuming a Site Class C. The calculated PGA_M value is 0.88g for the MCE_R.

The results of the liquefaction analysis and shear wave velocity measurements indicate the potential for liquefaction at the site is low.

4.2.2 Lateral Spreading

Lateral spreading is a term describing the permanent deformation of sloping ground that occurs during earthquake shaking as a result of soil liquefaction. This typically occurs on sloping ground and adjacent to free faces such as river or canal banks. Based on the conditions encountered in the boring, the risk of lateral spreading deformation affecting the conduit due to a design-level earthquake is characterized as low due to the absence of liquefiable soils and the relatively level ground surface.

4.3 HDD CONSIDERATIONS

4.3.1 General Discussion

The proposed HDD alignment is currently planned to be approximately 4,000 feet long. Kleinfelder created a conceptual profile (shown on Figure 4a), which considers the HDD profile to cross primarily through the sandstone. This preliminary profile utilizes the stationing and approximate topographic and bathymetric survey data provided by Global Geophysics in the geophysical survey report in Appendix E. Based on our review of the pipeline alignment, subsurface conditions, and our preliminary inadvertent returns analysis, the HDD bore path appears technically feasible. However, there are several design and constructability issues that should be addressed. Discussion of these issues can be found in the sections below.

4.3.2 Anticipated Drilling Conditions

As stated previously, presence of coarse gravel to cobble-sized material with probable boulders increases the risk of loss of circulation and difficulty advancing the drill string during drilling in these materials. The installation of conductor casings extending through these large granular near-surficial soils could help to mitigate these issues. The Contractor should ultimately determine means and methods of construction. When driving external casings, the contractor should be prepared with appropriate contingency plans, including remedial actions (e.g., having multiple casing sizes on hand, lead sections with reinforcement or cutting edges, concentric auger assemblies, etc.), to install the casing through the coarse gravel to probable boulder sized materials encountered in the boring.

Mud motors will be needed in the very dense sands and gravels, and within the sandstone rock unit. The soil and rock conditions encountered in the exploratory boring is shown on the boring log in Appendix C. The Contractor should carefully evaluate the ground conditions identified in this report and should use means and methods including drilling fluid additives and drill bits that are appropriate for these ground conditions.

4.3.3 Drill Bit Selection

Drill bits should be selected based on anticipated subsurface conditions and previous experience. The drilling contractor should be prepared with a variety of bits that have worked well in similar soil and rock conditions. The use of mud motors should be considered in soils with Standard Penetration Test blow counts exceeding 50 blows per foot. The radius of the pilot hole curves should be no less than 1,000 feet to accommodate the use of a mud motor unless the characteristics of the mud motor that will be used during construction allow for a tighter turning radius.

4.3.4 Steering

The density and consistency of soils encountered at the proposed crossing site were variable and would be expected to cause difficult steering conditions for HDD drilling. The use of conductor casings advanced through the upper soils will help to reduce risk associated with steering or maintaining tangent through the large granular materials encountered.

The sandstone bedrock at the proposed crossing includes an upper, decomposed zone encountered in Boring B-1. In general, degree of weathering, and strength (including potential anisotropic rock strength, or differing strength in vertical vs horizontal direction) will be variable along the bore path as geometry transitions between tangents, vertical and horizontal curves. Localized, “mixed face” or transition conditions may result at the drill head and cause difficulty in steering or maintaining a tangent.

4.3.5 Borehole Instability

The surficial poorly graded sands and underlying poorly-graded gravels may be prone to instability in the HDD borehole. As recommended previously in Section 4.3.2, the use of conductor casing installed through these soils will mitigate these concerns. The materials appear to become denser at a depth of about 20 feet. We suggest that be considered when evaluating casing needs. The contractor should carefully evaluate the subsurface conditions identified in this report and should use means and methods including drilling fluids appropriate for these ground conditions.

4.3.6 Loss of Circulation

Loss of circulation and/or fluid loss typically occurs when the drill bit encounters large interstitial pore spaces in coarse soil materials (i.e., gravels, cobbles and boulders). Loss of returns is recognized by a decrease of drilling fluid returns, or a drop in drilling fluid pressure. If interstitial pore spaces are small or discontinuous, they may fill with solids contained in the drilling fluid returns as drilling progresses beyond them. Once the pore spaces are filled, fluid will return up the bore hole again and fluid pressure will increase until another gravel layer is encountered. If open-graded layers are continuous to the surface, drilling fluid may inadvertently return to the surface.

As shown on the boring log in Appendix C, surficial layers of loose poorly graded sand and underlying poorly graded gravels with varying amounts of sand, cobbles and boulders were encountered near the proposed HDD entry point in the upper 40 feet. The use of conductor casing installed through these soil layers will help to mitigate the risk of loss of circulation in these materials.

The consolidated rock units that were encountered consist primarily of sandstone. During our exploration program, the rock was cored to a depth of approximately 151 feet. The rock was generally slightly fractured with some joints and bedding planes. RQD values were variable (31% to 100%) due to the variable rock strength, weathering, and mechanical disturbance along the horizontal bedding planes due to the drilling process.

The drilling contractor should be prepared with drilling fluid additives to address the potential for loss of circulation in the consolidated rock. Some small lenses of granular material or fractures within the rock may be encountered, resulting in temporary loss of circulation or fluid loss. Larger gravel layers or bedrock fractures may present greater difficulty in maintaining circulation. Product data sheets and Material Safety Data Sheets for loss of circulation materials should be submitted to the owner for approval by jurisdictional regulators prior to mobilization.

4.3.7 Drilling Fluid Construction Considerations

An appropriate drilling fluid mix is necessary to maintain a clean borehole and reduce the potential for borehole instability issues which can result in poor drilling returns and partial or complete plugging of the borehole. This results in higher fluid pressures within the bore and can lead to hydraulic fracturing and inadvertent fluid returns to the ground surface. Furthermore, hydraulic fracturing is likely to occur near the bore exit point as the drill bit approaches the ground surface. This is a common risk of HDD and countermeasures should be in place to mitigate this condition.

A proper drilling fluid pressure should be maintained throughout the entire length of the bore and should be reduced as much as practical near the exit point. A pressure sensing sub several feet behind the drill bit can be used to monitor drilling fluid pressures in the bore hole and compare them to the maximum predicted allowable pressures. This can be used to help avoid inadvertent fluid releases. The pressure sub provides real-time monitoring of fluid pressures within the borehole and is useful in detecting a spike in drilling pressure that may result from a borehole that is not well cleaned and/or becomes blocked with the drilling solids. Furthermore, the pressure data allows the driller to understand when modifications to the drilling method may be needed to avoid a fluid release.

4.3.8 Inadvertent Returns of Drilling Fluid

Hydraulic fracturing occurs when borehole pressure causes plastic deformation of the soil surrounding the borehole, initiating and propagating fractures in the soil mass. The resistance to plastic deformation and fracturing is a function of soil strength, overburden pressure, and pore water pressure. Hydraulic fracturing can result in drilling fluid inadvertently returning to the ground surface or running horizontally away from the borehole. Allowable borehole pressure was evaluated using the Delft Geotechnics equation and the methods presented in the NASTT Good Practices Guidelines, 4th edition. The estimated allowable borehole pressure was compared to predicted borehole pressure in our analyses.

A preliminary hydraulic fracturing analysis was performed for the proposed alignment, as shown on Figure 4. A pilot-hole diameter of 12¼ inches, a drill rod diameter of 5-7/8 inches, and a mud pump output of up to 400 gallons per minute was used. Target up-hole fluid velocities in the analyses range from about 85 to 95 feet per minute in our analysis. The drilling fluid density was estimated to be about 10 to 12 pounds per gallon. Changes in the drilling fluid properties and drilling equipment affect the analysis results.

Once layout of the alignment is complete and the contractor's equipment has been selected, finalized inadvertent returns and pipe stress analyses to confirm the adequacy of the selected bore path should be performed.

Borehole instability issues and/or the contractor not maintaining a clean borehole can result in poor drilling returns and partial or complete plugging of the borehole. This will result in higher fluid pressures within the bore and can lead to hydraulic fracturing and inadvertent fluid returns to the ground surface.

Based on our preliminary inadvertent returns analysis (see Appendix C), the HDD profiles are technically feasible. However, hydraulic fracturing could occur and would be expected to occur near the bore exit point as the drill bit approaches the ground surface. This is a common risk of HDD and countermeasures should be in place to mitigate this condition. Measures such as drilling without fluid for the last few rod joints, using air as a drilling fluid, or not exiting the bore hole and digging down to it from the sea floor are several ways to approach this issue. The contractor should select the appropriate methods to use based on their equipment and project constraints.

4.4 DRILLING FLUID PROGRAM

4.4.1 General

The drilling contractor should develop a Drilling Fluid Program (DFP) as part of the HDD Bore Plan. A properly designed drilling fluid program can substantially reduce losses due to hydraulic fracturing, stuck product pipe, or loss of tooling. The drilling fluid program should account for anticipated soil conditions, fluid selection, drill bit and reamer selection, and volume calculations. For this project we recommend a drilling fluid engineer be on site during drilling to make needed adjustments in drilling fluid properties based on the encountered conditions.

4.4.2 Borehole Slurry Density

The density of the slurry in the borehole directly affects the buoyancy force and therefore the normal force between the pipe and the wall of the borehole. The density of drilling returns is a function of ground conditions, penetration rate, mud flow rate, drilling fluid composition, and efficiency of the mud cleaning system. In general, drilling return density with about 20% solids varies between 9 and 11 pounds per gallon in soil and up to about 12 pounds per gallon in rock. In coarse gravel and cobbles, drilling fluid densities can approach 13 pounds per gallon.

For this project we anticipate drilling fluid return density will be on the order of 10 to 12 pounds per gallon where good returns are achieved, and drilling is performed in accordance with the NASTT's HDD Good Practices Guidelines (2017).

4.4.3 Soil Conditions for Drilling Fluid Design

For the purpose of drilling fluid design, earth materials are divided into two categories: Inert, including sand and gravel; and reactive, including clay. Information regarding subsurface conditions likely to be encountered at the site is provided in the Subsurface Conditions section of this report as well as in the boring log for the exploration performed for this study in Appendix C.

4.4.4 Drilling Fluid Selection

Drilling fluid program base fluid should be designed for site-specific soil conditions. The base fluid may consist of either a bentonite or polymer and water, with additives to achieve specific fluid properties.

The drilling contractor should submit a base fluid design with a list of additives, loss of circulation materials, and grouting materials that may be used on the project and SDS sheets for approval at least two (2) weeks prior to mobilization. Assistance with drilling fluid selection can be obtained from reputable drilling fluid suppliers.

4.4.5 Soil and Fluid Volume

The volume of soil to be removed can be estimated as follows:

$$\frac{(\text{Hole Diameter in Inches})^2}{25} = \text{Volume in Gallons per Foot}$$

Sufficient fluid should be pumped during drilling and reaming operations to maintain flow. Drilling rates and drilling fluid flow rates may be adjusted in the field to match varying site conditions. However, an estimate of drilling fluid demand is useful when sizing drilling equipment, mud pumps, and solids removal systems, and can be particularly helpful in determining realistic drilling rates. Drilling fluid demand can be estimated based on the bore hole volume and the following ratios:

Fluid Volume: Soil Volume	Ratio
Sand, Gravel, Cobble, Rock	1:1
Above, mixed with Clay	2:1
Clay or reactive Shale	3-5:1

Drilling rates can be estimated based on the drilling fluid demand and the pump output at the design base fluid viscosity.

4.5 SOLIDS SEPARATION PLANT

Fine-grained silts and clays are generally the most difficult to remove from drilling fluids. Silts and clays are present on this site and use of desilters/centrifuges may be needed to remove the fine soils from the drilling fluids.

4.6 DRILL PAD SUPPORT

Surface conditions in the vicinity of the HDD entry points likely consists of medium dense sands and are not likely to provide adequate support for HDD drilling equipment. The contractor should conduct a pre-bid site visit to determine the suitability of site conditions for their equipment. Use of a gravel surface course underlain by a geotextile is recommended where heavy truck and equipment traffic is planned. This may also be needed for a storm water pollution prevention plan (SWPPP). We recommend the contractor evaluate the site access for their equipment and select an appropriate base course for the access road and rig area.

4.7 UTILITIES AND WELL CLEARANCE

The location of existing utilities and water wells was beyond the scope of this report. There should be an attempt to locate all underground utilities near the alignment during the design phase and certainly prior to construction. These utilities should be protected by the Contractor so as not to be impacted by the trenchless crossings. The bore profiles should be designed to allow sufficient clearance from all underground utilities to avoid entering an existing utility trench or pipe zone materials or causing excessive settlement of the utilities above the bore. If existing utilities are within about 25 feet of the bore entry and exit pits, conductor casings should be used to help contain HDD drilling fluids and keep them out of adjacent utility areas.

Nearby water wells may exist and must be located and protected to prevent being impacted by HDD construction. The HDD bore profile should be designed to allow sufficient clearance from nearby wells to avoid drilling fluid releases contaminating them. In general, we recommend wells be located at least 100 feet from the HDD bore path for this type of HDD installation. If a well becomes impacted with drilling fluid, the well may need to be re-developed or replaced.

4.8 CONTRACTOR SELECTION

The success of the project will be substantially dependent on the experience and performance of the specialty contractor retained to perform the work. We recommend the use of a specialty contractor with a minimum of three (3) years construction experience in the field of horizontal directional drilling in similar drilling conditions on projects of similar scope (i.e. diameter, length, and depth). The HDD contractor should be familiar with the use of drilling mud and additives and conductor casings and should provide examples of projects they have successfully completed installing similar utilities in similar conditions.

5 ADDITIONAL SERVICES

5.1 PLANS AND SPECIFICATIONS

It is recommended that Kleinfelder conduct a general review of final plans and specifications to evaluate that our recommendations have been properly interpreted and implemented during design. In the event Kleinfelder is not retained to perform this recommended review, no responsibility will be assumed for misinterpretation of the given recommendations.

5.2 PROJECT BID DOCUMENTS

Kleinfelder's experience is that contractors bidding on the project often contact us to discuss the geotechnical aspects of the project. Informal contacts between Kleinfelder and an individual contractor could result in misleading or incomplete information being provided to the contractor. Therefore, it is recommended that a pre-bid meeting be held to answer any questions about the report prior to submittal of bids. If this is not possible, questions or clarifications regarding this report should be directed to the project owner or his/her designated representative. After consultation with Kleinfelder, the project owner (or his/her representative) should provide clarifications or additional information to all contractors bidding the job.

5.3 EXCECUTION PLAN AND PERMIT ASSISTANCE

In order to facilitate best management practices and obtaining the required permits for the trenchless crossings, a project execution plan should be developed prior to construction. The plan should include layout of equipment, MSDS sheets for all proposed drilling fluids and additives, development of a drilling fluid containment and contingency plan in case of inadvertent fluid returns, and discussion of any other site-specific constraints relative to the project.

5.4 CONSTRUCTION OBSERVATION AND TESTING

It is recommended that all trenchless construction be monitored by a representative from Kleinfelder. The purpose of these services is to observe the soil and drill mud conditions encountered during construction, evaluate the applicability of the recommendations presented in this report to the soil conditions encountered, and recommend appropriate changes to the owner in design or construction procedures if conditions differ from those described herein.

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6 LIMITATIONS

This work was performed in a manner consistent with that level of care and skill ordinarily exercised by other members of Kleinfelder's profession practicing in the same locality, under similar conditions and at the date the services are provided. Our conclusions, opinions, and recommendations are based on a limited number of observations and data. It is possible that conditions could vary between or beyond the data evaluated. Kleinfelder makes no other representation, guarantee, or warranty, express or implied, regarding the services, communication (oral or written), report, opinion, or instrument of service provided.

This report may be used only by the Client and the registered design professional in responsible charge and only for the purposes stated for this specific engagement within a reasonable time from its issuance, but in no event later than two (2) years from the date of the report. The work performed was based on project information provided by Client. If Client does not retain Kleinfelder to review any plans and specifications, including any revisions or modifications to the plans and specifications, Kleinfelder assumes no responsibility for the suitability of our recommendations. In addition, if there are any changes in the field to the plans and specifications, Client must obtain written approval from Kleinfelder's engineer that such changes do not affect our recommendations. Failure to do so will vitiate Kleinfelder's recommendations.

Kleinfelder offers various levels of investigative and engineering services to suit the varying needs of different clients. Although risk can never be eliminated, more detailed and extensive studies yield more information, which may help understand and manage the level of risk. Since detailed study and analysis involves greater expense, our clients participate in determining levels of service, which provide information for their purposes at acceptable levels of risk. The client and key members of the design team should discuss the issues covered in this report with Kleinfelder, so that the issues are understood and applied in a manner consistent with the owner's budget, tolerance of risk and expectations for future performance and maintenance.

Recommendations contained in this report are based on our field observations and subsurface explorations, limited laboratory tests, and our present knowledge of the proposed construction. It is possible that soil and/or groundwater conditions could vary between or beyond the points explored. If soil or groundwater conditions are encountered during construction that differ from those described herein, Kleinfelder should be notified immediately so that we may re-evaluate the recommendations of this report as appropriate. If the scope of the proposed construction, including the estimated building loads, and the design depths or locations of the foundations changes from that described in this report, the conclusions and recommendations contained in

this report are not considered valid unless the changes are reviewed, and the conclusions of this report are modified or approved in writing, by Kleinfelder.

As the geotechnical engineering firm that performed the geotechnical evaluation for this project, Kleinfelder should be retained to confirm that the recommendations of this report are properly incorporated in the design of this project, and properly implemented during construction. This may avoid misinterpretation of the information by other parties and will allow us to review and modify our recommendations if variations in the soil conditions are encountered.

7 REFERENCES

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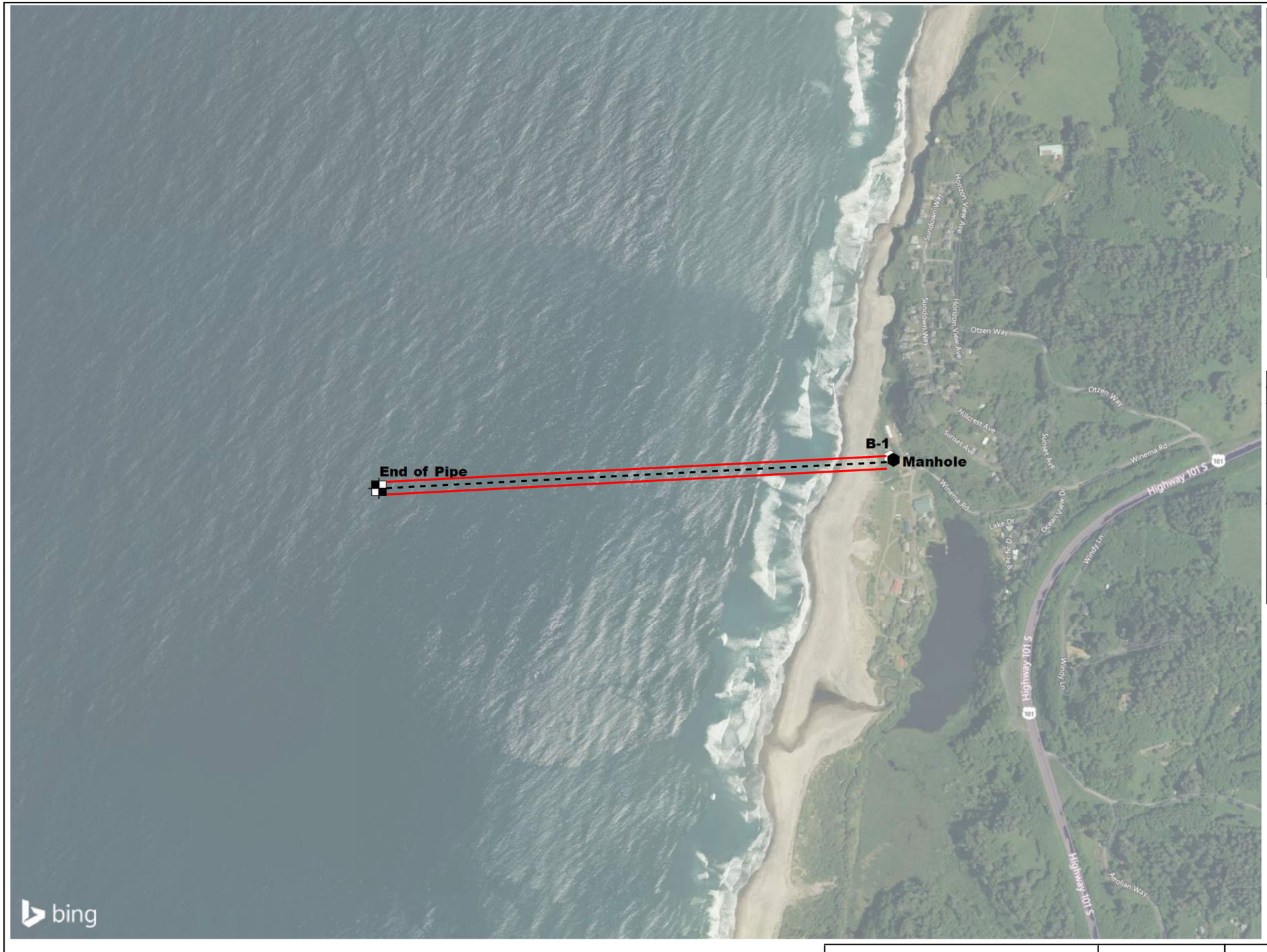
FIGURES

LIST OF ATTACHMENTS

The following figures are attached and complete this appendix.

Figure 1	Site Vicinity Map
Figure 2	Exploration Location Map
Figure 3	Geologic Map



VICINITY MAP

NOT TO SCALE

NOTE:
BASE MAPPING AND VICINITY MAP CREATED FROM LAYERS COMPILED BY ESRI PRODUCTS AND 2022 MICROSOFT CORPORATION.
COORDINATE SYSTEM: NAD 1983 2011 STATEPLANE OREGON NORTH FIPS 3601

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KLEINFELDER
Bright People. Right Solutions.

PROJECT NO. 20230058.001A

DRAWN BY: tdesouza

CHECKED BY: T. DeSouza

DATE: 06-06-2022

SIT□ □ICI□ITY M□P

OFFSHORE CABLE LANDING
HORIZONTAL DIRECTIONAL DRILL INSTALLATIONS
WINEMA BEACH, CLOVERDALE, OREGON

FIGURE 1

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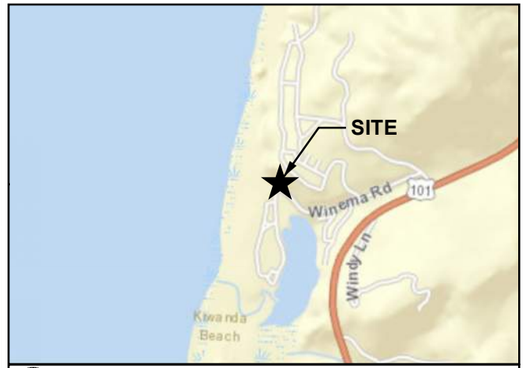

VICINITY MAP NOT TO SCALE

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1 " = 100 SCALE IN FEET

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PROJECT NO. 20230058.001A
DRAWN BY: tdesouza
CHECKED BY: T. DeSouza
DATE: 06-06-2022

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OFFSHORE CABLE LANDING
HORIZONTAL DIRECTIONAL DRILL INSTALLATIONS
WINEMA BEACH, CLOVERDALE, OREGON

FIGURE
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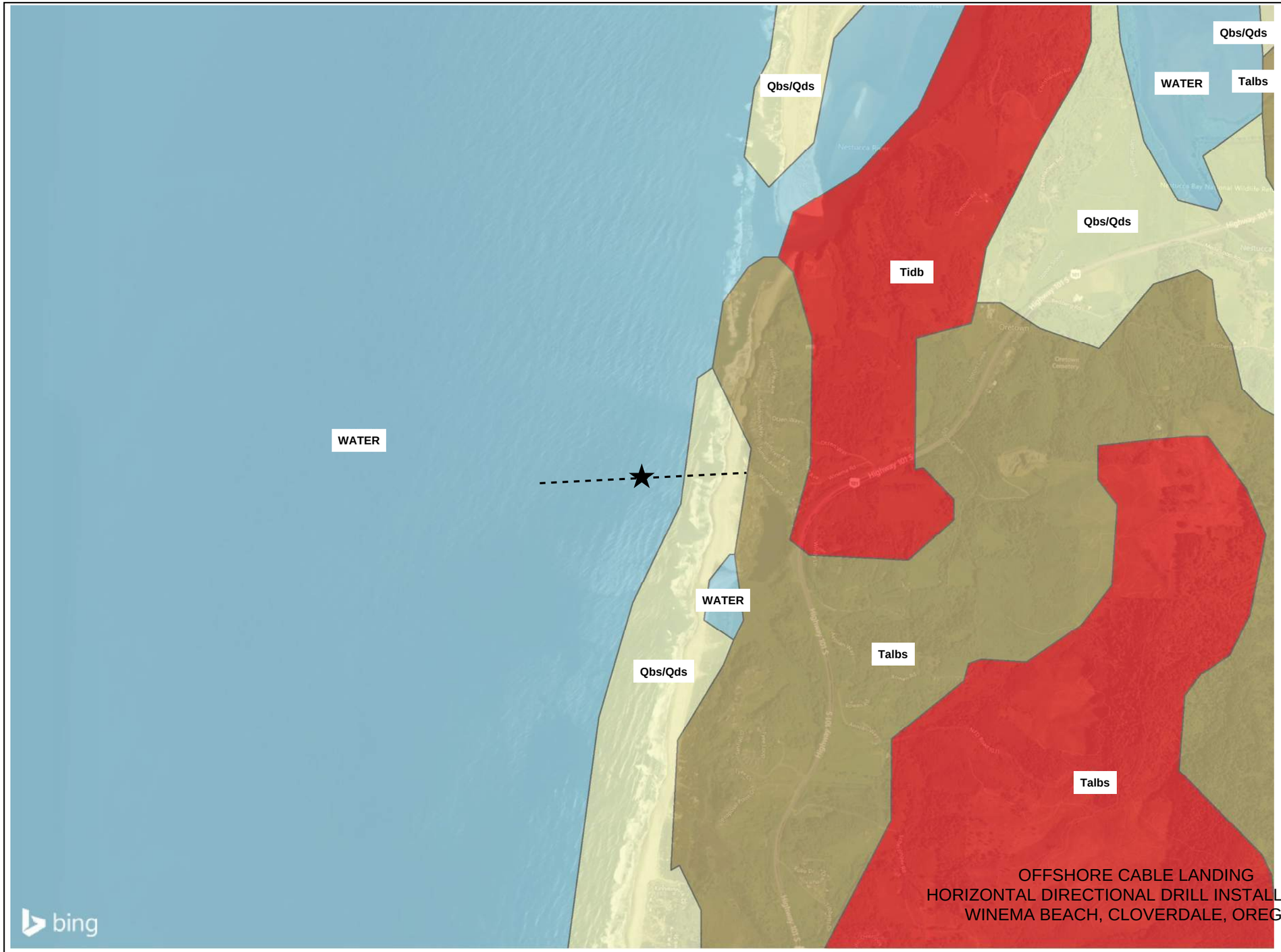


LEGEND

- Cable La□di□g HDD □lig□me□t
- **Tidb** — Depoe Bay Basalt
- **Talbs** — Basaltic Sa□dsto□e □□lsea Formatio□□
- **Qbs/Qds** — □llu□ial Beach a□d Du□e Sa□ds
- **WATER** — Water

NOTE:
BASE MAPPING AND VICINITY MAP CREATED FROM LAYERS COMPILED BY ESRI PRODUCTS AND 2022 MICROSOFT CORPORATION.
COORDINATE SYSTEM: NAD 1983 2011 STATEPLANE OREGON NORTH FIPS 3601
THE STATE GEOLOGIC MAP COMPILATION OF THE CONTERMINOUS UNITED STATES WAS DEVELOPED BY THE U.S. GEOLOGICAL SURVEY MINERAL RESOURCES PROGRAM (MRP).

N

0 2000 4000

1 " = 2000 SCALE IN FEET

OFFSHORE CABLE LANDING
HORIZONTAL DIRECTIONAL DRILL INSTALLATIONS
WINEMA BEACH, CLOVERDALE, OREGON

KLEINFELDER
Bright People. Right Solutions.

PROJECT NO. 20230058.001A
DRAWN BY: tdesouza
CHECKED BY: T. DeSouza
DATE: 06-06-2022

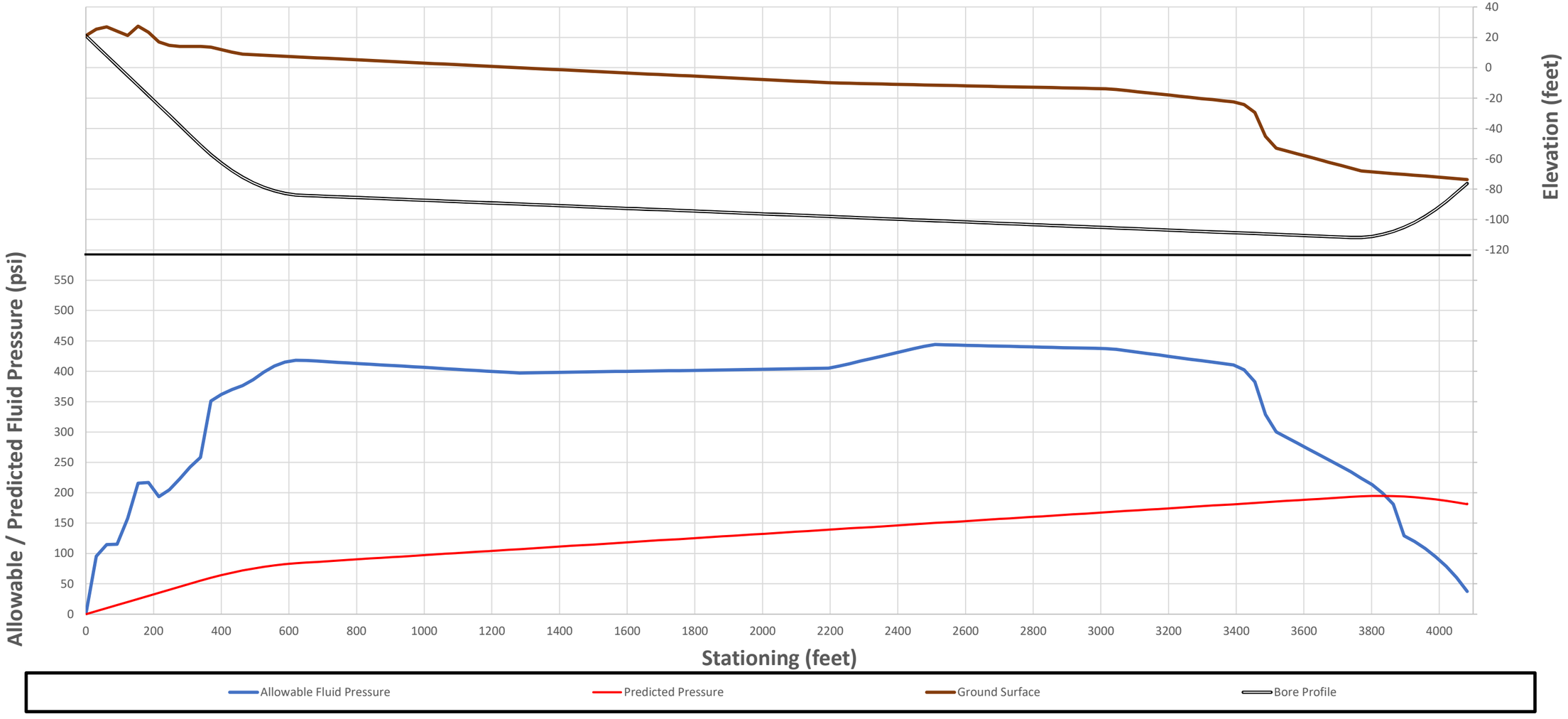
G□OLOGY M□P

OFFSHORE CABLE LANDING
HORIZONTAL DIRECTIONAL DRILL INSTALLATIONS
WINEMA BEACH, CLOVERDALE, OREGON

FIGURE □

GIS FILE PATH: \\azrgisstorp01\working_clients_Automated_Exploration Plans\20230058.001A_OFFSHORECABLELANDING_20220606_tdesouza\MXD\
GIS FILE NAME: 20230058.001A_ELP_SG_11x17_2021_20220606_2057_td
PLOTTED: 6/6/2022 8:58:18 PM BY: TDESOUZA

Hydrofracture Risk Analysis for the Pilot Bore with Alignment Profile



ASSUMPTIONS

ANALYSIS WAS BASED ON:

A. ENTRY ANGLE OF 12 DEGREES.

B. EXIT ANGLE OF 11 DEGREES.

C. A PILOT HOLE DIAMETER OF 12.25 INCHES.

D. A DRILL ROD DIAMETER OF 5.875 INCHES.

E. A MUD PUP OUTPUT OF UP TO 400 GALLONS PER MINUTE.

F. A MUD UNIT WEIGHT OF 12 POUNDS PER GALLON.

G. TARGET UP-HOLE FLUID VELOCITIES IN THIS ANALYSIS ARE APPROXIMATELY 85 FEET PER MINUTE.

H. CHANGES IN THE DRILLING FLUID PROPERTIES AND DRILLING EQUIPMENT WILL AFFECT THE ANALYSIS RESULTS.

I. A FACTOR OF 5 WAS APPLIED TO CALCULATE THE RADIUS OF THE PLASTIC ZONE USING THE DELFT EQUATION.

Calculation performed with HDD CALC Version v.3.0.0.

KLEINFELDER
Bright People. Right Solutions.

Proj. No.	20230058.001A
Drawn By	PR
Check By	KS
Date	7/29/2022

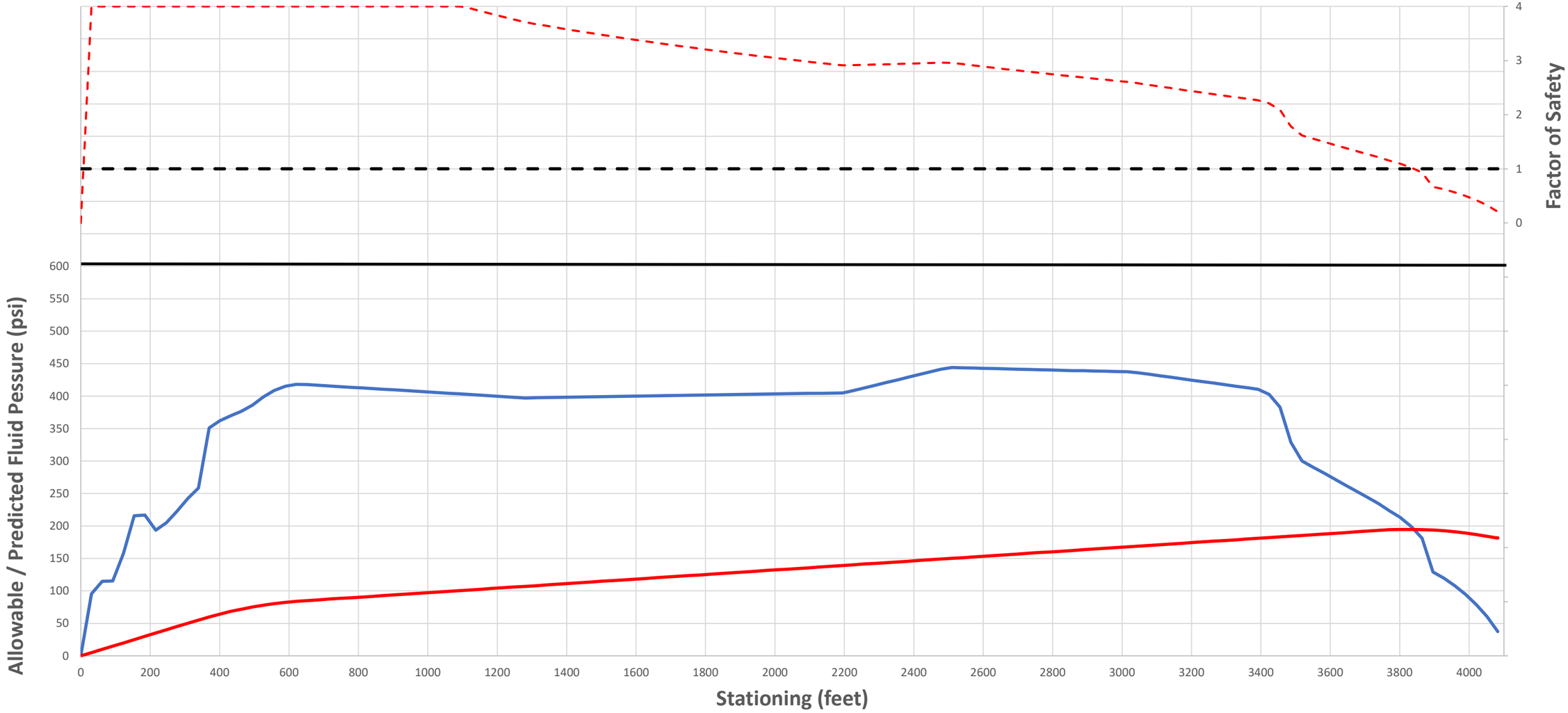
HYDROFRACTURE RISK ANALYSIS OF THE PILOT BORE

OFFSHORE CABLE LANDING
HORIZONTAL DIRECTIONAL DRILL
WINEMA BEACH, OREGON

FIGURE

4a

Hydrofracture Risk Analysis for the Pilot Bore with Factor of Safety Plot



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I. A FACTOR OF 5 WAS APPLIED TO CALCULATE THE RADIUS OF THE PLASTIC ZONE USING THE DELFT EQUATION.

Calculation performed with HDD CALC Version v.3.0.0.

KLEINFELDER
Bright People. Right Solutions.

Proj. No.	20230058.001A
Drawn By	PR
Check By	KS
Date	7/29/2022

HYDROFRACTURE RISK ANALYSIS OF THE PILOT BORE

OFFSHORE CABLE LANDING
HORIZONTAL DIRECTIONAL DRILL
WINEMA BEACH, OREGON

FIGURE

4b

APPENDIX A

FIELD INVESTIGATION DAILY FIELD REPORTS

Daily Field Report

Project Name	Winema HDD Cable Landing			Date	5/16/2022
Project No.	20230058.001A			Bldg. Permit No.	
Location	Winema Beach, Oregon			Time Arrived	0820
Client	RTI			Time Departed	1700
Contractor	Western States, Global Geophysics			Travel Time	1 hr
Equipment Observed	CME 75 Truck Rig			Mileage	
Reviewed By	T. DeSouza	Date Reviewed	5/17/2022	Weather	Sunny

Observations/Remarks:

0820: Arrive on site.
0840: Western States crew arrives on site. Western States crew comprised of Adonis Pablo and Collin.
0845: Evangeline Johnston with Global Geophysics arrives on site.
0900: Meet with Nathan Stoller of Winema Church Camp to discuss plan for the week and access to site
0905: Safety kickoff with entire crew. Frank Cuccio with DRG and Matt Updenkeld with Wave present onsite.
0920: Begin setting up drill rig. Global Geophysics begins clearing a path through vegetation to beach for ERT line.
1010: Begin drilling using mud rotary techniques.
1300: Global begins setting up ERT line.
1400: Discussion with Frank, Matt and Evangeline. Decided to move geophysics line closer to proposed manhole which will require making a new access path through vegetation. Begin clearing new path.
1600: Finish drilling for the day at a depth of 70 ft. Will resume tomorrow using rock coring techniques. Drillers offsite.
1700: New path cleared for geophysics lines, ready to set up in the morning. Offsite.

Pedro Rivas
Kleinfelder Representative *Print Name*

Daily Field Report

Project Name	Winema HDD Cable Landing			Date	5/17/22
Project No.	20230058.001A			Bldg. Permit No.	
Location	Winema Beach, Oregon			Time Arrived	0630
Client	RTI			Time Departed	1700
Contractor	Western States, Global Geophysics			Travel Time	1 hr
Equipment Observed	CME 75 Truck Rig			Mileage	
Reviewed By	T. DeSouza	Date Reviewed	5/18/2022	Weather	Sunny

Observations/Remarks:

0630: Arrive on site. Evangeline with Global Geophysics already on site setting up ERT line from proposed manhole to the beach.
0720: Western states crew arrives on site. Begin setting up outer casing to 65' prepare for coring.
0840: Outer casing set. Begin coring.
1300: Finished ERT, clean up and set up MASW line from manhole to the beach.
1430: Global geophysics on standby waiting for drill rig to finish since the vibrations from the rig provide too much noise on data to continue work.
1515: Drill crew runs out of water for drill rig. End drilling for the day at a depth of 120 ft. to go and refill water tank. Resume geophysics work.
1530: Drillers offsite.
1645: Finish MASW, clean up.
1700: Everyone offsite.

Pedro Rivas
Kleinfelder Representative *Print Name*

Daily Field Report

Project Name	Winema HDD Cable Landing			Date	5/18/22
Project No.	20230058.001A			Bldg. Permit No.	
Location	Winema Beach, Oregon			Time Arrived	0700
Client	RTI			Time Departed	1900
Contractor	Western States, Global Geophysics			Travel Time	1 hr
Equipment Observed	CME 75 Truck Rig			Mileage	
Reviewed By	T. DeSouza	Date Reviewed	5/19/2022	Weather	Rain

Observations/Remarks:

0700: Arrive on site.
0710: Global geophysics arrives on site and sets up MASW on the beach during low tide. Informed that ERT work performed yesterday did not successfully obtain data due to equipment issues. Will perform ERT during second mobilization for offshore work.
0715: Western States arrives on site and prepares to resume drilling.
0740: Resume coring.
1000: Terminate boring at a depth of 151.5'. Begin removing inner drill rods.
1100: Drill crew on standby waiting for Global geophysics to perform downhole MASW test in boring.
1200: Begin downhole test.
1530: Finish downhole MASW. Global Geophysics cleans up. Western States sets up to grout boring.
1630: Finished grouting boring with a bentonite grout mix pumped via tremie pipe for entire depth of boring. Begin cleaning up. Global Geophysics offsite
1830: Boring topped off with native soil and site restored to original condition. Met with Nathan Stoller with the church camp and received his approval of the site conditions prior to leaving.
1900: Offsite.

Pedro Rivas
Kleinfelder Representative *Print Name*

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Daily Progress Report

Project Name	Winema HDD Cable Landing			Date	6/11/22
Project No.	20230058.001A			DPR No.	001
Location	Winema Beach, Oregon			Time Arrived	
Client	RTI			Time Departed	
Contractor	Global Geophysics			Travel Time	
Equipment Observed	N/A			Mileage	
ASN Representative	Dave Edgington	Date Reviewed	6/11/22	Weather	

Observations/Remarks:

Summary:
Last 24 hours: N/A
Progress to Date: N/A
Next 24 hours: Perform ERT test on the beach

Notes:
No work carried out. DPR started to maintain consistency with ASN's DPR numbers. On hire from 6/12/22

[redacted]

ASN Representative

Pedro Rivas
Kleinfelder Representative

Daily Progress Report

Project Name	Winema HDD Cable Landing			Date	6/12/22
Project No.	20230058.001A			DPR No.	002
Location	Winema Beach, Oregon			Time Arrived	0530
Client	RTI			Time Departed	0930
Contractor	Global Geophysics			Travel Time	1 hr
Equipment Observed	N/A			Mileage	
ASN Representative	Dave Edgington	Date Reviewed	6/12/22	Weather	Light Rain

Observations/Remarks:

Summary:
Last 24 hours: Mobilize to project site
Progress to Date: Perform ERT test on the beach
Next 24 hours: Demobilize

Personnel Onsite:

Name	Association	Phone	Hours Worked
Pedro Rivas	Kleinfelder	559.360.0247	4
John Liu	Global Geophysics	425.890.4321	4
Matthew Updenkelder	Wave	541.760.9822	4
		Total Hours Worked	12

Events Log:
0530: Tailboard meeting
0540: Begin set up of onshore ERT test
0720: Finish set up and begin test
0830: Finish test, clean up
0930: Offsite

Notes:
Offshore geophysics was delayed per boat captain noting conditions not being suitable for work. Date for remobilization to be determined

ASN Representative

Pedro Rivas
Kleinfelder Representative

KLEINFELDER
Bright People. Right Solutions.

Weather Forecast

	TODAY				TOMORROW								TUE, JUN 14							
Time	14	17	20	23	02	05	08	11	14	17	20	23	02	05	08	11	14	17	20	23
Wind direction	↘	↘	↘	↘	↘	↘	→	→	→	→	→	→	→	→	↘	↘	↘	↘	↘	↙
Wind speed (knots)	13	12	11	13	14	10	9.7	7.8	9.3	8.5	8.1	8.1	8.9	8.3	11	10	8.7	8.0	4.8	2.9
Wind gusts (knots)	14	14	15	17	17	15	13	11	12	11	12	12	13	13	15	12	9.5	8.5	6.0	3.7
Temperature (°C)	13	13	12	11	11	10	11	11	13	13	12	11	11	11	11	12	13	13	12	9.7
Cloud coverage																				
Precipitation (mm/3h)	0.3	0.2	0.3	0.8	2.4	1.8	0.7	0.9	1.2	0.8	0.4	0.6	0.8	0.7	0.8	0.9	0.4	0.2	-	-
Waves direction	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→
Waves height (m)	1.4	1.4	1.5	1.6	1.6	1.6	1.6	1.5	1.5	1.5	1.4	1.4	1.4	1.4	1.5	1.4	1.4	1.4	1.4	1.3
Waves period (s)	7s	7s	8s	8s	6s	6s	6s	5s	6s	6s	6s	6s	6s	6s	6s	6s	6s	6s	6s	6s

ERT test set up on the beach

Daily Progress Report

Project Name	Winema HDD Cable Landing	Date	7/7/22
Project No.	20230058.001A	DPR No.	003
Location	Winema Beach, Oregon	Time Arrived	0545
Client	RTI	Time Departed	1400
Contractor	Global Geophysics	Travel Time	2 hr
Equipment Observed	N/A	Mileage	
ASN Representative	N/A	Date Reviewed	
Weather	Overcast/Cool		

Observations/Remarks:

Summary:
Last 24 hours: Mobilize to project site
Progress to Date: Attempted ERT test offshore
Next 24 hours: Continue ERT test offshore

Personnel Onsite:

Name	Association	Phone	Hours Worked
Pedro Rivas	Kleinfelder	559.360.0247	8
John Liu	Global Geophysics	425.890.4321	8
Evangeline Johnston	Global Geophysics	-	8
Demar Hagger	Big Bites Charters	503.333.4634	8
David Tindall	Big Bites Charters	-	8
Aaron McCann	Big Bites Charters	-	8
		Total Hours Worked	48

Events Log:
0545: Onsite, charter boat being offloaded at the marina
0600: Tailboard meeting with Global Geophysics and Big Bites Charters crews.
0610: Geophysics equipment is loaded onto boats
0630: Boats depart marina
0930: Crew arrives at project site. Had difficulty traversing high waves. Scopes out and verifies alignment.
1000: Begin setting up to perform ERT
1140: Crew mentions having trouble anchoring.
1200: Due to anchoring problem, ERT cable head is pulled into the water and possibly damaged. Unable to continue for the day. Head back to marina
1330: Arrive at marina, offload equipment
1400: Offsite

Notes:
ERT cable was pulled into ocean due to the boat not being anchored properly. Sensitive sensors at the cable head were submerged underwater and deemed unusable until fixed. Work is planning to continue with backup cables. Charter boat plans to acquire heavier anchors by tomorrow to keep the boat stable and continue work.

ASN Representative

Pedro Rivas
Kleinfelder Representative

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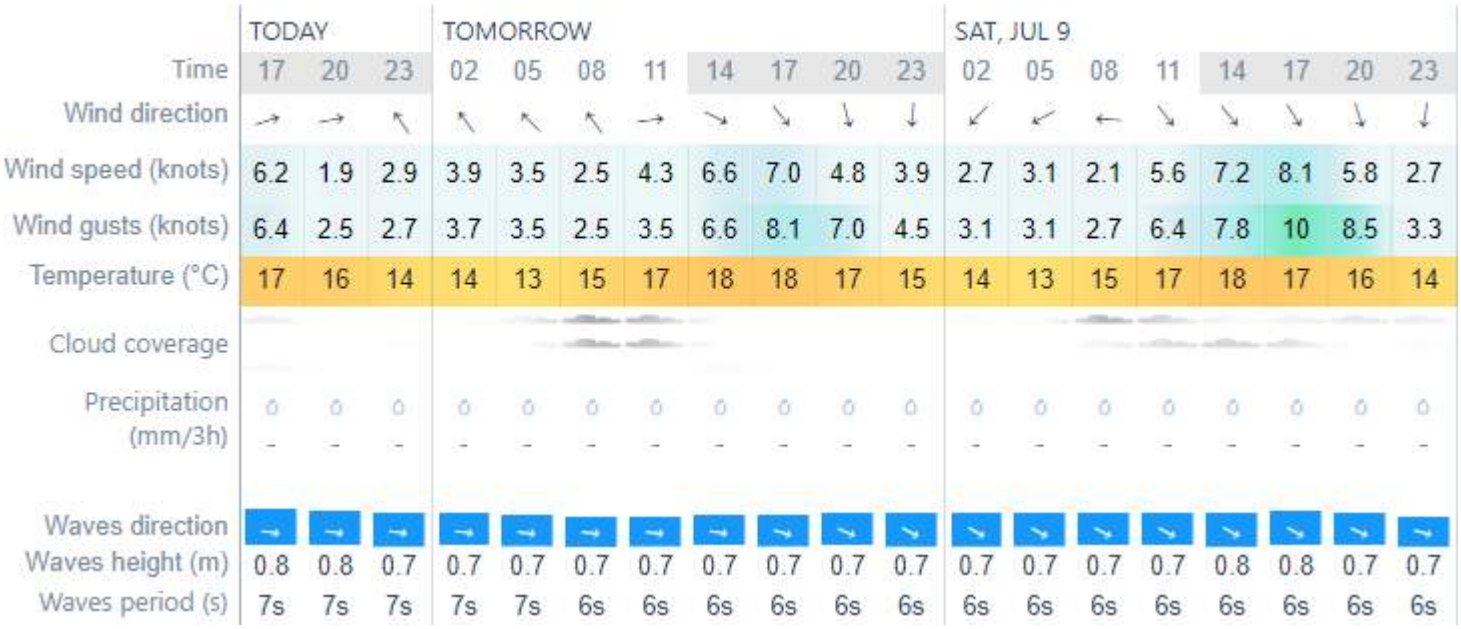
Weather Forecast



	TODAY			TOMORROW								SAT, JUL 9							
Time	17	20	23	02	05	08	11	14	17	20	23	02	05	08	11	14	17	20	23
Wind direction	→	→	↖	↖	↖	↖	→	↘	↘	↓	↓	↙	↙	←	↘	↘	↘	↓	↓
Wind speed (knots)	6.2	1.9	2.9	3.9	3.5	2.5	4.3	6.6	7.0	4.8	3.9	2.7	3.1	2.1	5.6	7.2	8.1	5.8	2.7
Wind gusts (knots)	6.4	2.5	2.7	3.7	3.5	2.5	3.5	6.6	8.1	7.0	4.5	3.1	3.1	2.7	6.4	7.8	10	8.5	3.3
Temperature (°C)	17	16	14	14	13	15	17	18	18	17	15	14	13	15	17	18	17	16	14
Cloud coverage																			
Precipitation (mm/3h)	0 -	0 -	0 -	0 -	0 -	0 -	0 -	0 -	0 -	0 -	0 -	0 -	0 -	0 -	0 -	0 -	0 -	0 -	0 -
Waves direction	→	→	→	→	→	→	→	→	↘	↘	↘	↘	↘	↘	↘	↘	↘	↘	→
Waves height (m)	0.8	0.8	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.8	0.8	0.7	0.7
Waves period (s)	7s	7s	7s	7s	7s	6s	6s	6s	6s	6s	6s	6s	6s	6s	6s	6s	6s	6s	6s

Daily Progress Report

Project Name	Winema HDD Cable Landing	Date	7/7/22
Project No.	20230058.001A	DPR No.	003
Location	Winema Beach, Oregon	Time Arrived	0545
Client	RTI	Time Departed	1400
Contractor	Global Geophysics	Travel Time	2 hr
Equipment Observed	Charter Boats	Mileage	
ASN Representative	N/A	Date Reviewed	
Weather	Overcast/Cool		

Observations/Remarks:

Summary:
Last 24 hours: Mobilize to project site
Progress to Date: Attempted ERT test offshore
Next 24 hours: Continue ERT test offsite

Personnel Onsite:

Name	Association	Phone	Hours Worked
Pedro Rivas	Kleinfelder	559.360.0247	8
John Liu	Global Geophysics	425.890.4321	8
Evangeline Johnston	Global Geophysics	-	8
Demar Hagger	Big Bites Charters	503.333.4634	8
David Tindall	Big Bites Charters	-	8
Aaron McCann	Big Bites Charters	-	8
		Total Hours Worked	48

Events Log:
0545: Onsite, charter boat being offloaded at the marina
0600: Tailboard meeting with Global Geophysics and Big Bites Charters crews.
0610: Geophysics equipment is loaded onto boats
0630: Boats depart marina
0930: Crew arrives at project site. Slow travel due to difficulty traversing high waves. Scopes out and verifies alignment.
1000: Begin setting up to perform ERT
1140: Crew mentions having trouble anchoring.
1200: Due to anchoring problem, ERT cable head is pulled into the water and possibly damaged. Unable to continue for the day. Head back to marina
1330: Arrive at marina, offload equipment
1400: Offsite

Notes:
ERT cable was pulled into ocean due to the boat not being anchored properly. Sensitive sensors at the cable head were submerged underwater and deemed unusable until fixed. Work is planning to continue with backup cables. Charter boat plans to acquire heavier anchors by tomorrow to keep the boat stable and continue work.

ASN Representative

Pedro Rivas
Kleinfelder Representative

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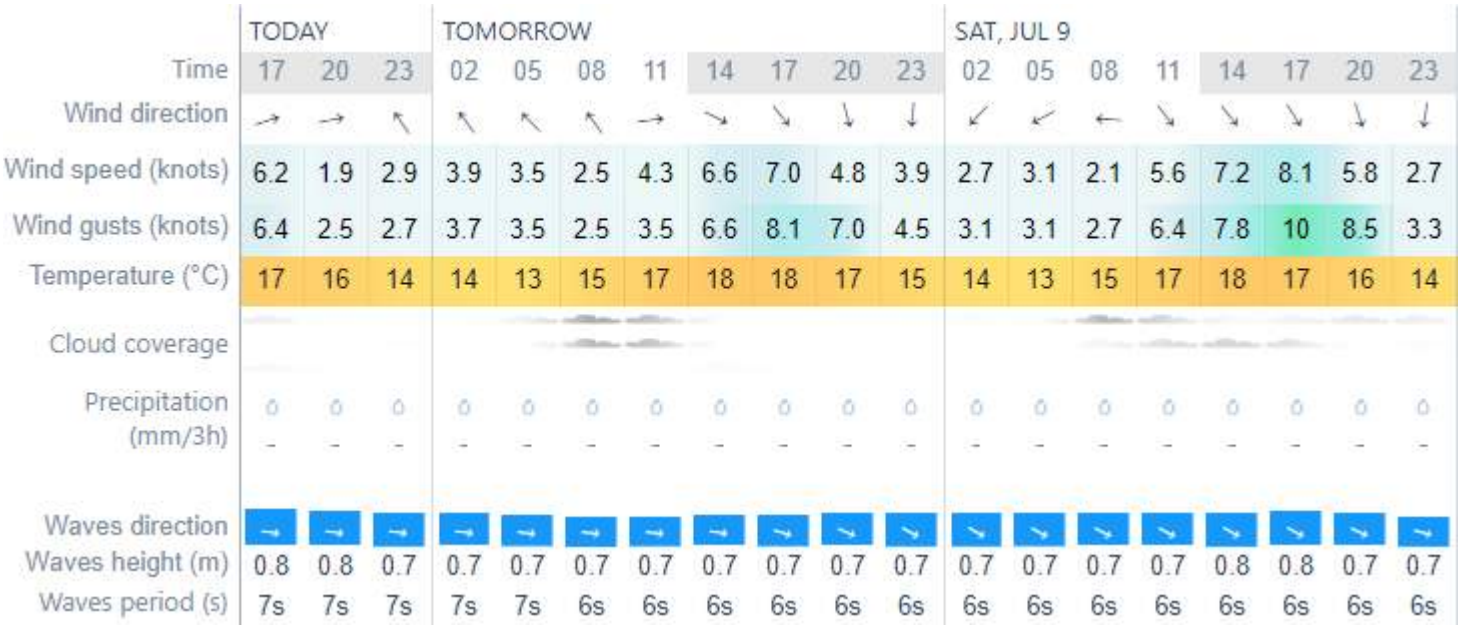
Weather Forecast



	TODAY			TOMORROW								SAT, JUL 9							
Time	17	20	23	02	05	08	11	14	17	20	23	02	05	08	11	14	17	20	23
Wind direction	→	→	↖	↖	↖	↖	→	↘	↘	↓	↓	↙	↙	←	↘	↘	↘	↓	↓
Wind speed (knots)	6.2	1.9	2.9	3.9	3.5	2.5	4.3	6.6	7.0	4.8	3.9	2.7	3.1	2.1	5.6	7.2	8.1	5.8	2.7
Wind gusts (knots)	6.4	2.5	2.7	3.7	3.5	2.5	3.5	6.6	8.1	7.0	4.5	3.1	3.1	2.7	6.4	7.8	10	8.5	3.3
Temperature (°C)	17	16	14	14	13	15	17	18	18	17	15	14	13	15	17	18	17	16	14
Cloud coverage																			
Precipitation (mm/3h)	0 -	0 -	0 -	0 -	0 -	0 -	0 -	0 -	0 -	0 -	0 -	0 -	0 -	0 -	0 -	0 -	0 -	0 -	0 -
Waves direction	→	→	→	→	→	→	→	→	↘	↘	↘	↘	↘	↘	↘	↘	↘	↘	→
Waves height (m)	0.8	0.8	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.8	0.8	0.7	0.7
Waves period (s)	7s	7s	7s	7s	7s	6s	6s	6s	6s	6s	6s	6s	6s	6s	6s	6s	6s	6s	6s

Daily Progress Report

Project Name	Winema HDD Cable Landing	Date	7/8/22
Project No.	20230058.001A	DPR No.	004
Location	Winema Beach, Oregon	Time Arrived	0600
Client	RTI	Time Departed	1400
Contractor	Global Geophysics	Travel Time	2 hr
Equipment Observed	Charter Boats	Mileage	
ASN Representative	N/A	Date Reviewed	
Weather	Clear/Sunny		

Observations/Remarks:

Summary:
Last 24 hours: Attempted ERT test offshore
Progress to Date: Completed ERT test offshore
Next 24 hours: Perform offshore seismic profiling

Personnel Onsite:

Name	Association	Phone	Hours Worked
Pedro Rivas	Kleinfelder	559.360.0247	9.5
John Liu	Global Geophysics	425.890.4321	9.5
Evangeline Johnston	Global Geophysics	-	9.5
Demar Hagger	Big Bites Charters	503.333.4634	9.5
David Tindall	Big Bites Charters	-	9.5
Aaron McCann	Big Bites Charters	-	9.5
		Total Hours Worked	57

Events Log:
0600: Tailboard meeting with Global Geophysics and Big Bites Charters crews and equipment is loaded onto boats.
0610: Boats depart marina
0730: Crew arrives at project site. Begin setting up to perform ERT test
1345: Finish ERT tests. Head back to marina
1500: Arrive at marina, offload equipment
1530: Offsite

Notes:

ASN Representative

Pedro Rivas
Kleinfelder Representative

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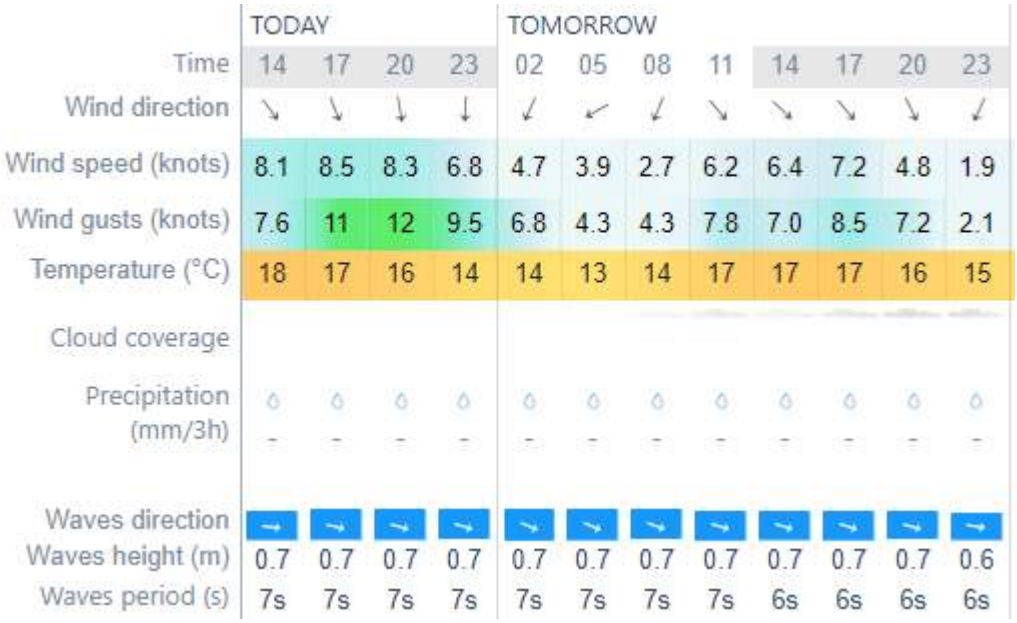
Weather Forecast



	TODAY				TOMORROW							
Time	14	17	20	23	02	05	08	11	14	17	20	23
Wind direction	↘	↘	↓	↓	↙	↙	↙	↘	↘	↘	↘	↙
Wind speed (knots)	8.1	8.5	8.3	6.8	4.7	3.9	2.7	6.2	6.4	7.2	4.8	1.9
Wind gusts (knots)	7.6	11	12	9.5	6.8	4.3	4.3	7.8	7.0	8.5	7.2	2.1
Temperature (°C)	18	17	16	14	14	13	14	17	17	17	16	15
Cloud coverage												
Precipitation (mm/3h)	0 -	0 -	0 -	0 -	0 -	0 -	0 -	0 -	0 -	0 -	0 -	0 -
Waves direction	→	→	→	→	→	→	→	→	→	→	→	→
Waves height (m)	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.6
Waves period (s)	7s	7s	7s	7s	7s	7s	7s	7s	6s	6s	6s	6s

ERT Testing performed along proposed alignment

Daily Progress Report

Project Name	Winema HDD Cable Landing	Date	7/9/22
Project No.	20230058.001A	DPR No.	005
Location	Winema Beach, Oregon	Time Arrived	0600
Client	RTI	Time Departed	1330
Contractor	Global Geophysics	Travel Time	2 hr
Equipment Observed	Charter Boat	Mileage	
ASN Representative	N/A	Date Reviewed	
Weather	Clear/Sunny		

Observations/Remarks:

Summary:
Last 24 hours: Completed ERT test offshore
Progress to Date: Completed offshore seismic profiling
Next 24 hours: N/A

Personnel Onsite:

Name	Association	Phone	Hours Worked
Pedro Rivas	Kleinfelder	559.360.0247	8
John Liu	Global Geophysics	425.890.4321	8
Evangeline Johnston	Global Geophysics	-	8
Demar Hagger	Big Bites Charters	503.333.4634	8
		Total Hours Worked	32

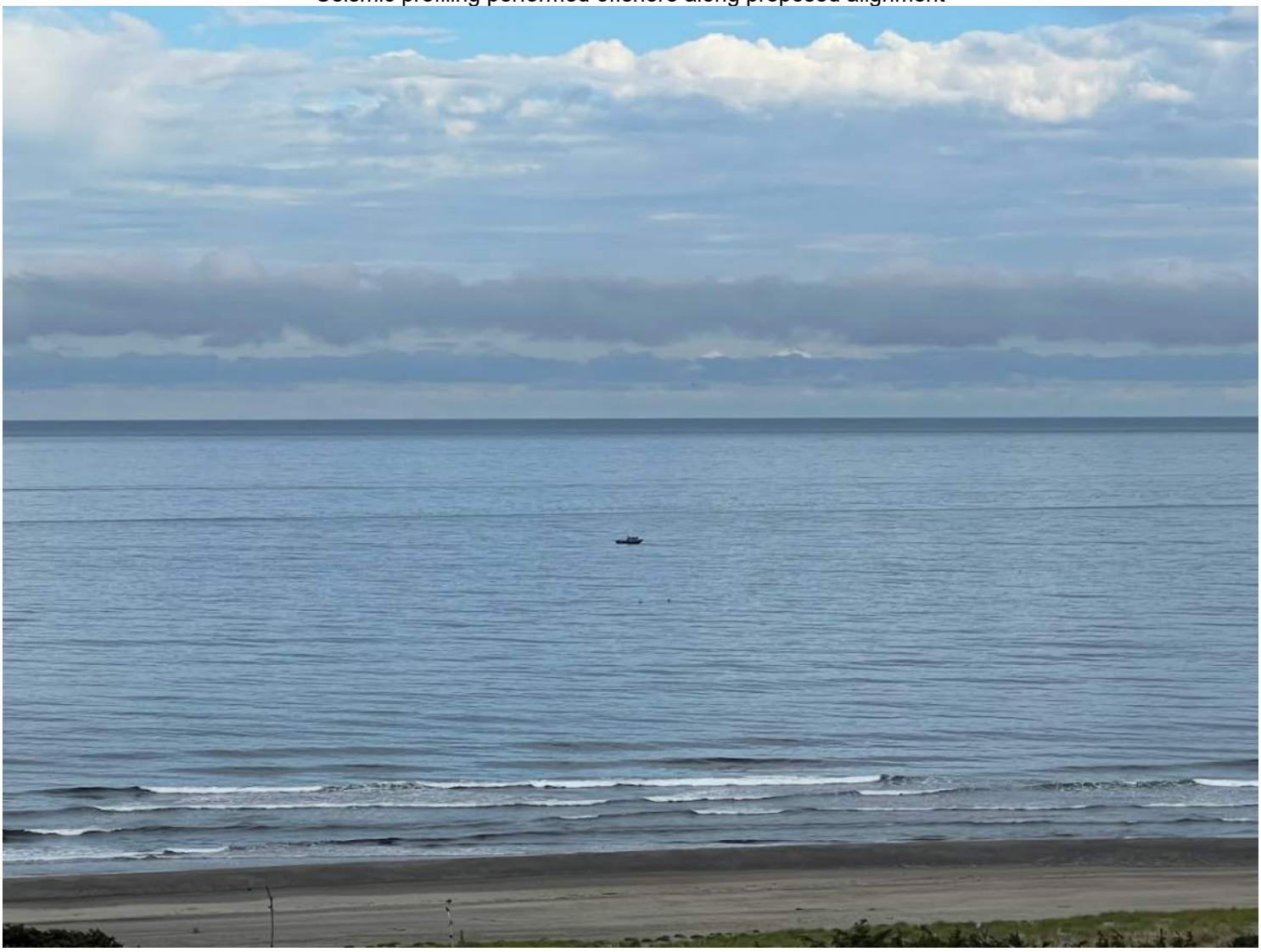
Events Log:
0600: Tailboard meeting with Global Geophysics and Big Bites Charters crews and equipment is loaded onto boat.
0645: Charter boat departs marina
0800: Crew arrives at project site. Begin setting up to perform seismic profiling
1215: Finish test. Head back to marina
1330: Arrive at marina, offload equipment
1400: Offsite

Notes:

ASN Representative

Pedro Rivas
Kleinfelder Representative

Seismic profiling performed offshore along proposed alignment



Daily Progress Report

Project Name	Winema HDD Cable Landing	Date	7/9/22
Project No.	20230058.001A	DPR No.	005
Location	Winema Beach, Oregon	Time Arrived	0600
Client	RTI	Time Departed	1400
Contractor	Global Geophysics	Travel Time	2 hr
Equipment Observed	Charter Boat	Mileage	
ASN Representative	N/A	Date Reviewed	
		Weather	Clear/Sunny

Observations/Remarks:

Summary:
Last 24 hours: Completed ERT test offshore
Progress to Date: Completed offshore seismic profiling
Next 24 hours: N/A

Personnel Onsite:

Name	Association	Phone	Hours Worked
Pedro Rivas	Kleinfelder	559.360.0247	8
John Liu	Global Geophysics	425.890.4321	8
Evangeline Johnston	Global Geophysics	-	8
Demar Hagger	Big Bites Charters	503.333.4634	8
		Total Hours Worked	32

Events Log:
0600: Tailboard meeting with Global Geophysics and Big Bites Charters crews and equipment is loaded onto boat.
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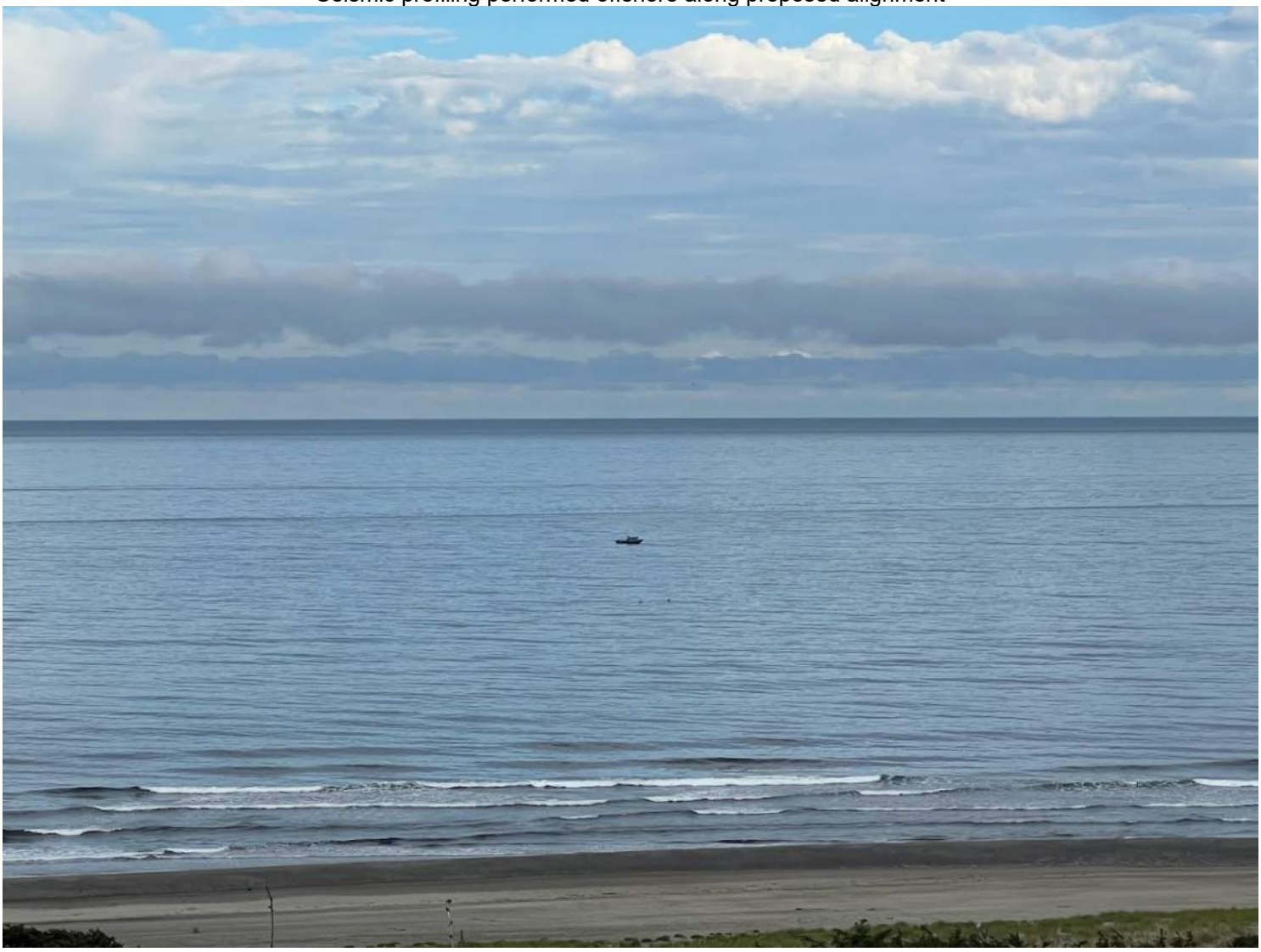
0800: Crew arrives at project site. Begin setting up to perform seismic profiling
1215: Finish test. Head back to marina
1330: Arrive at marina, offload equipment
1400: Offsite

Notes:

ASN Representative

Pedro Rivas
Kleinfelder Representative

Seismic profiling performed offshore along proposed alignment



APPENDIX B

AVAILABLE FIELD EXPLORATION EQUIPMENT DOCUMENTATION

LIST OF ATTACHMENTS

The following sheets are attached and complete this appendix.

Appendix B-1	Drill Rig Specifications
Appendix B-2	Drill Rig Hammer Efficiency Calibration
Appendix B-3	Geophysical Survey Equipment Specifications

APPENDIX B-1

Drill Rig Specifications

CME-75

Versatility...

Available mounted on single or tandem rear axle truck

Performance and Dependability, the CME-75 delivers

Ever wonder why you see so many CME-75 drills out there in the field? It's really quite simple. With over 45 years of field experience, the CME-75 has earned a reputation second to none for outstanding performance and dependability.

Hydraulic feed and retract system provides 30,000 pounds of retract force and 20,000 pounds of down pressure.

The twin 72 inch stroke feed cylinders of the hydraulic vertical drive system are in line with the drill spindle providing precise control of force on the drilling tools.

The split, two piece, feed slide bushings are easily replaced after normal wear intervals. And the standard upright gives you clearance to drill with 12 1/4 inch I.D. hollow augers.

For exceptional drilling efficiency the feed system has two separate controls. One gives you manual control of feed and retract and features both normal and fast retract positions. Retract rates of up to 95 feet per minute let you add or remove drilling tools quickly.

The other is used exclusively for feed and has a detent engaged position. Pressure controls let you dial in specific feed rate and feed pressure. This system is extremely advantageous in core drilling and other operations that require precise control of feed.

And since the two controls are isolated, you can use the manual control for rapid retract without changing pressure settings for the detent feed control.

Control logic - the key to operator productivity

Drilling and set-up controls are logically arranged on a control panel located at the driller's station. The most frequently used controls, such as the feed, hydraulic hoists and sliding base levers, are staggered for easier identification and operation. A lock-out position for the clutch lever helps prevent accidental engagement.

Rugged mechanical rotary drive provides over 10,400 foot pounds of torque, plus high rotation speed when you need it

You get the torque you need for auger drilling, as well as rotation speeds over 745 rpm for rotary or core drilling applications. Other optional rotation speed and torque combinations are also available, including a high-torque rotary drive that gives you 13,200 foot pounds of torque.

With five forward gears and one reverse, there's a rotation speed and torque combination available for just about any situation. The transmission is connected to the drill engine through a heavy duty 13 inch clutch.

Patented spindle brake stops rotation in an instant

Our emergency spindle brake can stop rotation in less than a revolution. This system is activated by two conveniently located push button switches as well as by strategically located, multi-directional wobble switches.

Optional Equipment for even more productivity

Automatic SPT hammer*

Our 140-pound (63.5 kg) automatic hammer gives you extremely consistent and accurate Standard Penetration Test results, meeting all ASTM-D-1586-99 requirements. There are no ropes or cables to impede the free-fall of the weight. A viewing slot allows you to verify the 30 inch (76 cm) fall height.

The hammer swings on a hydraulic cylinder, from the stored position to on-hole position. And the six foot vertical travel also allows you to use the hammer to drive casing or probes. Since raising and lowering is done hydraulically, set-up is quick and almost effortless.

To improve safety, all moving parts are enclosed, including the impact area between weight and anvil.

Other hammers with internationally accepted weight and fall height configurations are available, including a combination 340/140 pound (154/63.5 kg) model.

Hydraulic rod holder and breakout wrench*

The hydraulic rod holder makes your job quicker and safer. It not only pivots from on-hole to off-hole positions, but also hydraulically telescopes in and out. It is especially compatible with the optional in-out and sideways slide bases.

Slide bases make the job easier and quicker

Slide base options are available for both in-out and sideways movement of the drill on the platform.

An 18 inch in-out movement allows you to quickly move the drill off the borehole and align the sheaves for lifting tools with the cathead or any of the hoists.

An 16 inch sideways movement gives you even more versatility. Aligning augers or rods when making connections is easy. Or, if the bit drifts off at an angle when you start a hole, you can quickly straighten it to a vertical position.

If you've ever tried to line up your rig on an existing borehole, you've probably already recognized another benefit of the slide bases.

Quick mast disconnect

This feature allows you to quickly disconnect the optional mast when working inside buildings, underneath bridges or in other low overhead drilling locations. Since the mast is completely separated from the uprights, it doesn't interfere with other drill functions such as the optional slide bases.

With the mast in a horizontal position, you simply clamp it to its storage rack and extend the drill's in-out slide base. This pulls the sockets on the upright drill frame away from the large tapered pins on the mast.

Angle drilling system for special applications*

This unique system is especially effective for drilling underneath ponds, storage tanks or other structures. When used with our patented Continuous Sample Tube System, you can even take soil samples while drilling angle holes.

And, since the kelly drive is directly connected to the right angle drive box, you can raise or lower the mast with the drive-train already connected and ready to go.

Fluted kelly and chuck assembly

If your drilling operations include a substantial amount of core or rotary drilling, the CME fluted kelly and chuck assembly can save you a lot of time. The 5 foot stroke of the kelly, combined with the 6 foot stroke of the feed system, gives you a total stroke of 11 feet. You can use 10 foot drill rods, which means fewer rod connections and less rod handling.

The kelly has two vertical slots and two horizontal slots which are engaged by the chuck to provide rotary torque and thrust. The CME fluted kelly can even be rotated without engaging the thrust plungers. This gives you the option of using the weight of the drill string to provide down pressure on the bit.

The 2 5/8 inch fluted kelly and chuck assembly is available in either manual or hydraulically actuated configurations. Or, for larger diameter holes, a 3 1/2 inch O.D. fluted kelly and hydraulic chuck assembly is available.

Plenty of auger storage available

Above deck auger storage areas are provided with the optional drill platform. The CME-75 is also available with several under body auger rack configurations, including hydraulically operated racks that slide in and out for easy access to augers.

Water tank / tool box combinations

You can choose a 250 gallon or a 500 gallon water tank. Numerous water tank/tool box configurations are available, including models with rod storage capacity underneath and an expanded metal rack on top.

Additional optional equipment

Drill platform
Continuous Sample Tube System
High torque or high speed rotary drive
CPT controls
Mast, 22 ft. or 26 ft.
(from base of frame to sheaves)
Underside sheave
Low clearance sheave
Cathead, 8 in. diameter
8,500 lb. hydraulic hoist
max line speed...72 ft/min. up - 310 ft./min. dwn
7,000 lb. hydraulic hoist
max line speed...85 ft/min. up - 340 ft/min. dwn
3,200 lb. hydraulic hoist
max line speed...100 ft./min.
1,800 lb. hydraulic hoist
max line speed...200 ft./min.
Hydraulic wireline hoist (1800 lb. pull)
max line speed...200 ft./min.
Auger and rod guides for angle drilling
Probe hammer
Spindle Adapter
Water pumps:

Moyno 3L6	36 gpm/225 psi
Moyno 3L8	84 gpm/225 psi
Bean	25 gpm/500 psi
Bean	35 gpm/500 psi
Gardner Denver 4 1/2x5	1.48 gpm/197 psi
Gardner Denver 5x6	200 gpm/310 psi

(Other pumps available)

*patented by CME

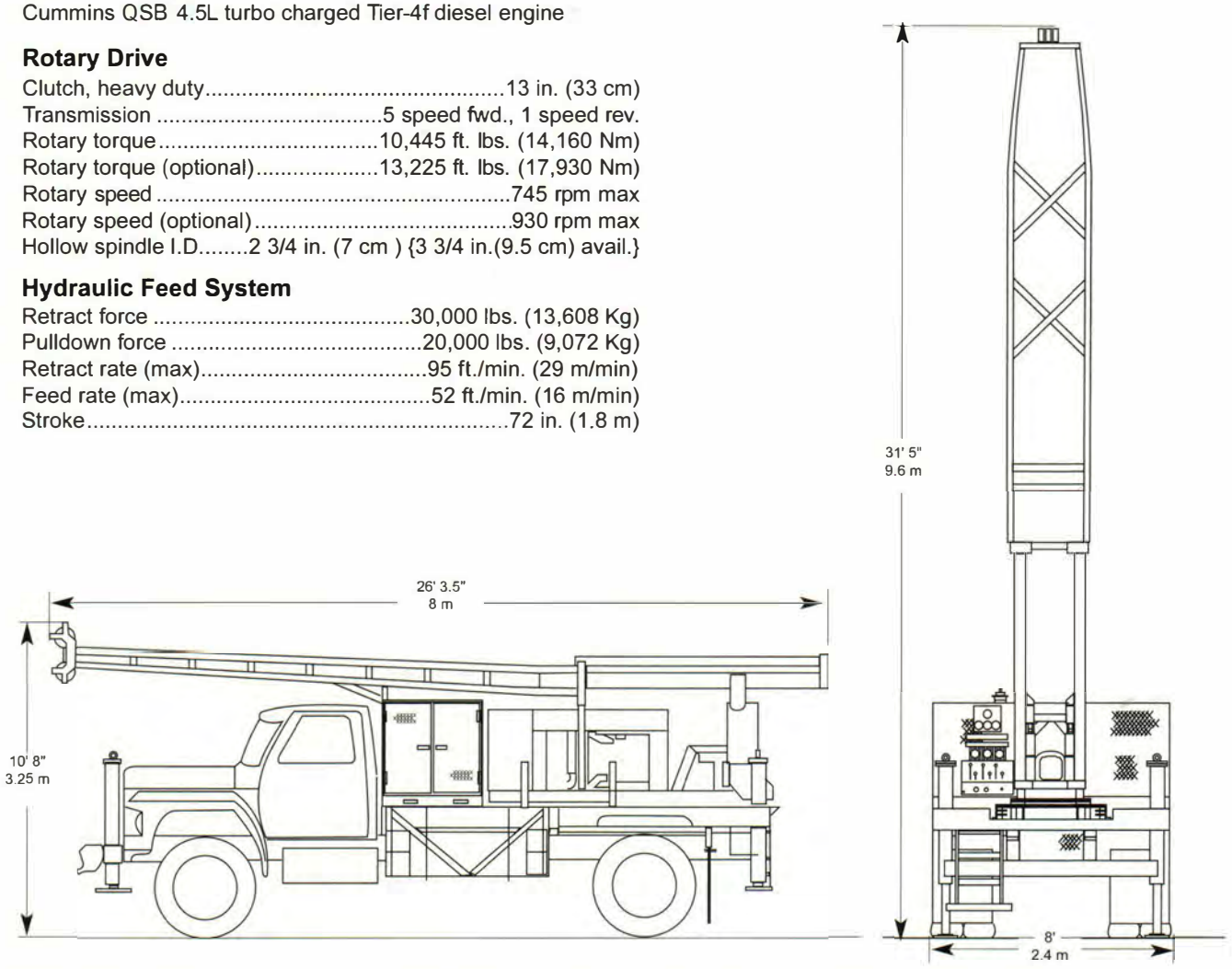
CME-75

Specifications

Power
Cummins QSB 4.5L turbo charged Tier-4f diesel engine

Rotary Drive
Clutch, heavy duty.....13 in. (33 cm)
Transmission .....5 speed fwd., 1 speed rev.
Rotary torque.....10,445 ft. lbs. (14,160 Nm)
Rotary torque (optional).....13,225 ft. lbs. (17,930 Nm)
Rotary speed .....745 rpm max
Rotary speed (optional).....930 rpm max
Hollow spindle I.D.....2 3/4 in. (7 cm) {3 3/4 in.(9.5 cm) avail.}

Hydraulic Feed System
Retract force .....30,000 lbs. (13,608 Kg)
Pulldown force .....20,000 lbs. (9,072 Kg)
Retract rate (max).....95 ft./min. (29 m/min)
Feed rate (max).....52 ft./min. (16 m/min)
Stroke.....72 in. (1.8 m)



Typical single rear axle truck configuration with 26' mast and optional deck platform.
Dimensions will vary, depending on truck wheel base and all-wheel drive or tandem rear axle applications.

Central Mine Equipment Company manufactures a complete line of drilling equipment for the environmental, geotechnical and water well drilling industries of the world. We have been a leader in drilling product quality, innovation and service for over ninety years.

CENTRAL MINE EQUIPMENT COMPANY
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APPENDIX B-2

Drill Rig Hammer Efficiency Calibration

Table 1. Energy Transfer Ratio and Correction Factors

Rig No.	Energy Transfer Ratio	Correction Factor
Track Rig #2	75.1	1.252
Track Rig #3	77.2	1.287
Truck Rig #4	77.5	1.292
Truck Rig #5	85.5	1.425
Track Rig #7	71.6	1.193
Track Rig #8	74.3	1.238
Truck Rig #9	77.7	1.295
Track Rig #10	77.0	1.283
Track Rig #12	81.4	1.357

The transfer energy can vary as a result of changes to rig operating rate and lubrication, rod verticality, rig anvil dimensions, the subassembly, and other varying factors. The dynamic test data and representative wave forms for the SPT hammer systems are presented in Attachment A. ASTM D4633 recommends that the equipment used to perform the calibrations be calibrated every three years or as recommended by the manufacturer. Calibration information for the equipment is presented in Attachment B.

♦ ♦ ♦

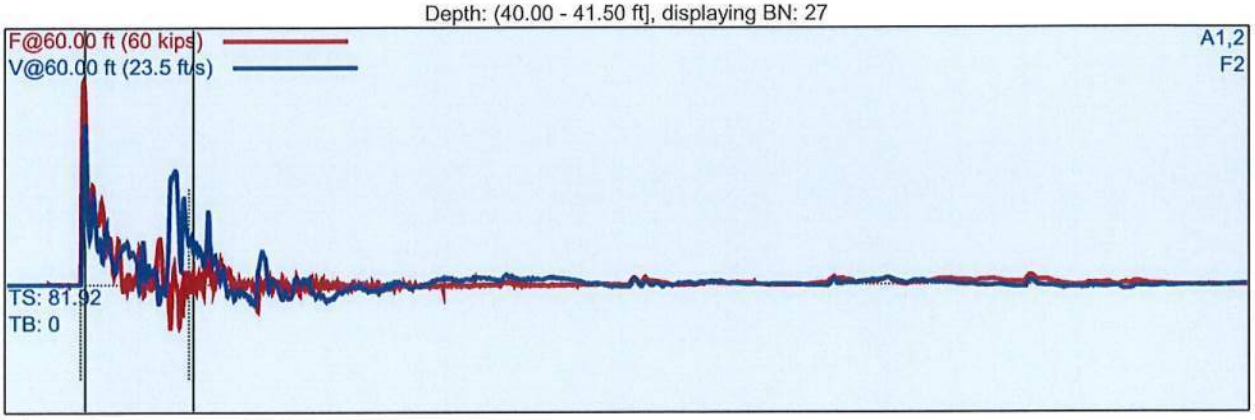
WSSC-8-06
GJS
WSSC

RIG #5
Interval start: 12/23/2021

AR: 1.43 in^2
LE: 60.00 ft
WS: 16807.9 ft/s

SP: 0.492 k/ft3
EM: 30000 ksi

Depth: (40.00 - 41.50 ft], displaying BN: 27



F2 : [SPT B2] 213.8 PDICAL (1) FF1

A1 (PR): [K0035] 295 mv/6.4v/5000g (1) VF1
A2 (PR): [K0232] 318 mv/6.4v/5000g (1) VF1

FMX: Maximum Force
VMX: Maximum Velocity
BPM: Blows/Minute

EFV: Maximum Energy
ETR: Energy Transfer Ratio - Rated

BL#	BC /6"	FMX kips	VMX ft/s	BPM bpm	EFV ft-lb	ETR %
1	4	52	15.0	1.9	303	86.5
2	4	48	14.2	42.9	293	83.6
3	4	50	14.7	44.0	310	88.5
4	4	51	14.7	47.0	311	88.8
5	10	51	14.7	50.7	301	86.0
6	10	49	14.7	51.9	302	86.3
7	10	53	15.0	51.7	314	89.7
8	10	49	14.5	52.4	311	89.0
9	10	54	14.8	52.0	310	88.5
10	10	48	14.4	51.8	306	87.4
11	10	50	14.6	52.2	310	88.6
12	10	47	14.3	51.7	297	84.9
13	10	49	14.4	52.3	309	88.4
14	10	50	14.6	51.9	314	89.7
15	15	50	14.5	51.7	312	89.1
16	15	49	14.4	52.4	311	88.8
17	15	47	14.2	51.9	293	83.8
18	15	50	14.8	52.2	315	89.9
19	15	48	14.6	52.3	307	87.6
20	15	51	14.8	51.5	315	90.1
21	15	50	15.0	52.5	311	88.7
22	15	48	14.7	52.1	303	86.5
23	15	50	14.8	51.6	313	89.3
24	15	54	15.2	52.0	314	89.6
25	15	52	14.9	52.0	314	89.7
26	15	54	15.0	52.0	316	90.4
27	15	48	14.7	52.2	303	86.5
28	15	48	14.8	51.9	308	88.0

29	15	48	14.2	52.1	299	85.4
	Average	50	14.7	52.0	308	88.1
	Std Dev	2	0.2	0.4	6	1.7
	Maximum	54	15.2	52.5	316	90.4
	Minimum	47	14.2	50.7	293	83.8

N-value: 25

Sample Interval Time: 32.87 seconds.

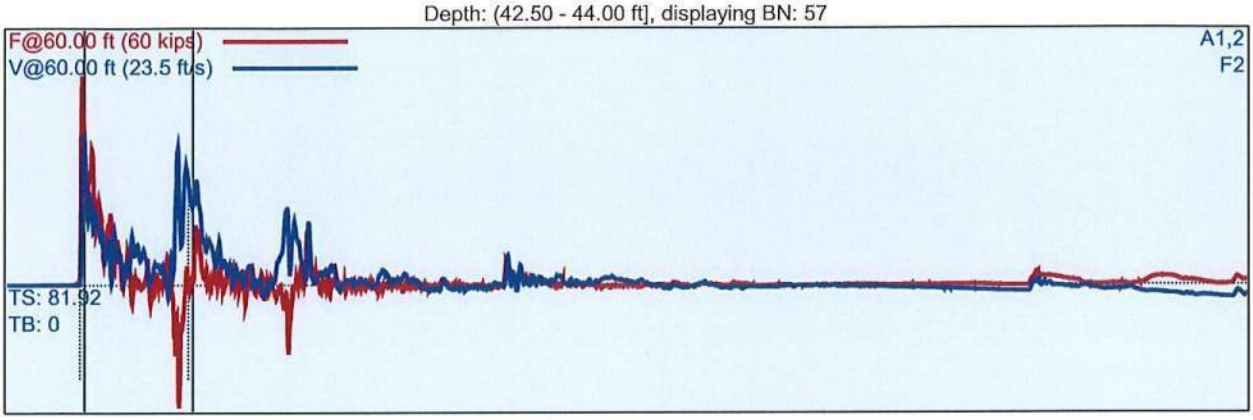
WSSC-8-06
GJS
WSSC

RIG #5
Interval start: 12/23/2021

AR: 1.43 in^2
LE: 60.00 ft
WS: 16807.9 ft/s

SP: 0.492 k/ft3
EM: 30000 ksi

Depth: (42.50 - 44.00 ft], displaying BN: 57



F2 : [SPT B2] 213.8 PDICAL (1) FF1

A1 (PR): [K0035] 295 mv/6.4v/5000g (1) VF1
A2 (PR): [K0232] 318 mv/6.4v/5000g (1) VF1

BL#	BC /6"	FMX kips	VMX ft/s	BPM bpm	EFV ft-lb	ETR %
30	8	47	14.3	1.9	302	86.2
31	8	50	14.7	51.2	305	87.1
32	8	52	14.8	52.0	304	86.8
33	8	49	14.6	51.9	309	88.4
34	8	49	14.3	51.7	309	88.3
35	8	48	14.1	51.9	305	87.0
36	8	47	14.3	52.0	306	87.5
37	8	51	14.3	51.6	307	87.8
38	10	50	14.1	52.1	300	85.8
39	10	49	14.2	52.0	301	85.9
40	10	49	14.2	51.5	302	86.2
41	10	50	14.0	51.8	305	87.2
42	10	51	14.1	52.1	300	85.8
43	10	51	13.8	52.0	298	85.0
44	10	47	14.1	51.8	299	85.5
45	10	47	14.0	52.0	298	85.2
46	10	51	13.8	51.7	298	85.0
47	10	50	13.7	52.4	296	84.5
48	12	48	14.0	51.4	300	85.6
49	12	49	13.8	52.2	299	85.4
50	12	50	14.0	51.9	298	85.2
51	12	48	13.9	52.1	299	85.3
52	12	48	13.8	51.3	304	86.9
53	12	51	13.6	52.5	291	83.3
54	12	48	13.8	51.8	297	84.8
55	12	45	14.0	51.5	296	84.6
56	12	48	14.0	52.2	302	86.3
57	12	49	13.7	52.0	299	85.4
58	12	50	13.5	52.2	292	83.3
59	12	49	13.9	51.8	301	85.9

Average	49	13.9	51.9	299	85.4
Std Dev	1	0.2	0.3	3	0.9
Maximum	51	14.2	52.5	305	87.2
Minimum	45	13.5	51.3	291	83.3

N-value: 22

Sample Interval Time: 33.48 seconds.

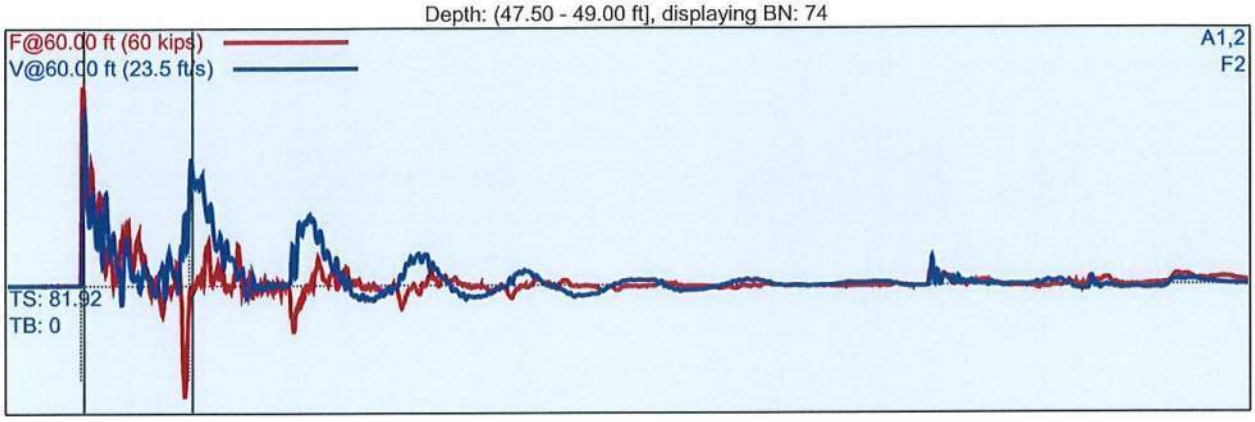
WSSC-8-06
GJS
WSSC

RIG #5
Interval start: 12/23/2021

AR: 1.43 in^2
LE: 60.00 ft
WS: 16807.9 ft/s

SP: 0.492 k/ft3
EM: 30000 ksi

Depth: (47.50 - 49.00 ft], displaying BN: 74



F2 : [SPT B2] 213.8 PDICAL (1) FF1

A1 (PR): [K0035] 295 mv/6.4v/5000g (1) VF1
A2 (PR): [K0232] 318 mv/6.4v/5000g (1) VF1

BL#	BC /6"	FMX kips	VMX ft/s	BPM bpm	EFV ft-lb	ETR %
60	2	46	14.6	1.9	312	89.2
61	2	46	14.4	51.2	306	87.3
62	6	45	14.8	51.9	301	86.1
63	6	49	15.2	51.7	306	87.5
64	6	45	14.8	51.9	296	84.5
65	6	46	15.1	51.8	302	86.4
66	6	46	15.3	51.7	312	89.0
67	6	46	15.4	51.9	310	88.6
68	9	46	15.5	51.9	310	88.5
69	9	45	15.2	51.8	299	85.3
70	9	45	15.2	51.8	301	86.0
71	9	45	15.1	51.8	299	85.4
72	9	45	15.2	51.6	301	86.0
73	9	44	15.3	52.1	300	85.6
74	9	47	15.7	51.7	315	90.0
75	9	46	15.4	52.0	306	87.5
76	9	45	15.3	51.8	301	85.9
	Average	46	15.2	51.8	304	86.8
	Std Dev	1	0.2	0.1	5	1.6
	Maximum	49	15.7	52.1	315	90.0
	Minimum	44	14.8	51.6	296	84.5

N-value: 15

Sample Interval Time: 18.50 seconds.

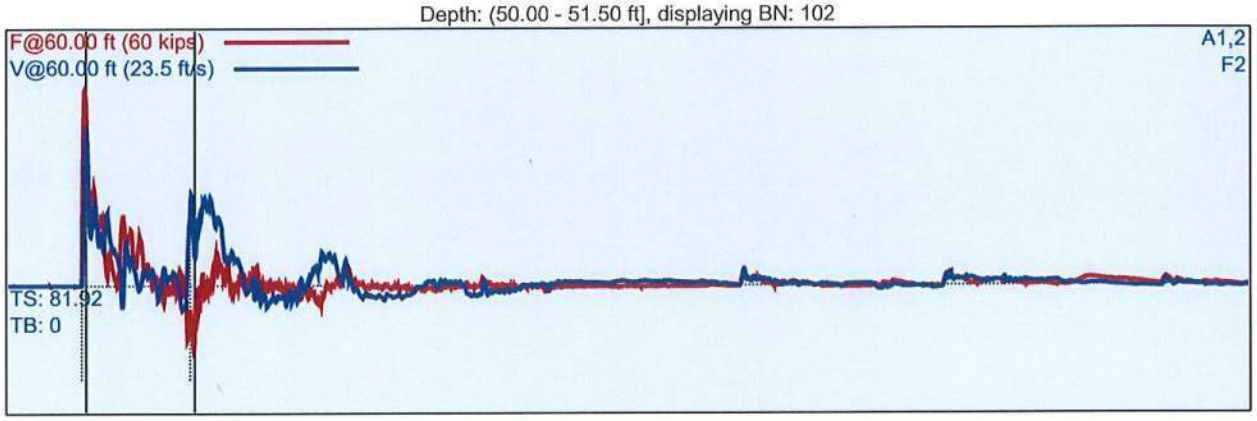
WSSC-8-06
GJS
WSSC

RIG #5
Interval start: 12/23/2021

AR: 1.43 in^2
LE: 60.00 ft
WS: 16807.9 ft/s

SP: 0.492 k/ft3
EM: 30000 ksi

Depth: (50.00 - 51.50 ft], displaying BN: 102



F2 : [SPT B2] 213.8 PDICAL (1) FF1

A1 (PR): [K0035] 295 mv/6.4v/5000g (1) VF1
A2 (PR): [K0232] 318 mv/6.4v/5000g (1) VF1

BL#	BC /6"	FMX kips	VMX ft/s	BPM bpm	EFV ft-lb	ETR %
77	6	0	2.1	1.9	0	0.0
78	6	49	15.5	59.7	296	84.5
79	6	49	15.0	51.2	311	88.9
80	6	46	15.0	51.6	312	89.2
81	6	50	15.3	52.0	306	87.5
82	6	52	15.5	51.7	307	87.7
83	9	50	14.9	51.8	307	87.8
84	9	48	14.8	51.7	309	88.2
85	9	50	15.1	51.5	301	86.1
86	9	50	15.0	52.0	298	85.2
87	9	49	14.9	52.0	300	85.8
88	9	52	15.4	51.4	302	86.4
89	9	50	14.7	51.9	311	89.0
90	9	49	14.4	52.0	307	87.9
91	9	49	14.4	51.9	300	85.7
92	13	50	14.5	51.3	302	86.4
93	13	47	14.2	52.4	293	83.6
94	13	0	1.0	70.0	2	0.6
95	13	49	14.4	41.0	290	82.8
96	13	47	14.2	52.2	300	85.6
97	13	47	14.2	51.5	291	83.1
98	13	46	14.2	51.8	300	85.8
99	13	46	14.2	51.7	304	86.8
100	13	47	14.2	52.2	301	85.9
101	13	47	14.4	51.8	289	82.5
102	13	46	14.2	51.8	287	82.0
103	13	49	14.4	51.9	303	86.5
104	13	46	14.3	51.9	291	83.2

Average	46	13.9	52.2	286	81.7
Std Dev	10	2.8	4.5	62	17.8
Maximum	52	15.4	70.0	311	89.0
Minimum	0	1.0	41.0	2	0.6

N-value: 22

Sample Interval Time: 30.97 seconds.

Summary of SPT Test Results

Project: WSSC-8-06, Test Date: 12/23/2021

FMX: Maximum Force
VMX: Maximum Velocity
BPM: Blows/Minute

EFV: Maximum Energy
ETR: Energy Transfer Ratio - Rated

Instr. Length ft	Blows Applied /6"	N Value	N60 Value	Average FMX kips	Average VMX ft/s	Average BPM bpm	Average EFV ft-lb	Average ETR %
60.00	**4-10-15**	**25**	**35**	50	14.7	52.0	308	88.1
60.00	**8-10-12**	**22**	**31**	49	13.9	51.9	299	85.4
60.00	**2-6-9**	**15**	**21**	46	15.2	51.8	304	86.8
60.00	**6-9-13**	**22**	**31**	46	13.9	52.2	286	81.7
		Overall Average Values:		48	14.4	52.0	299	85.5
		Standard Deviation:		6	1.6	2.3	33	9.5
		Overall Maximum Value:		54	15.7	70.0	316	90.4
		Overall Minimum Value:		0	1.0	41.0	2	0.6

APPENDIX B-3

Geophysical Survey Equipment Specifications

Geostuff

Wall-Lock Borehole Geophones

- **3-component tri-axial sensors**
- **Motor-driven clamp mechanism**
- **Fits in 2-inch (51-mm) boreholes**
- **Automatic orientation of horizontal geophones to any azimuth (Model BHG-3)**
- **Cable disconnects for convenient surface handling and extending depth**
- **Works in wet or dry holes**

Geostuff's BHG series, 3-component borehole geophones are designed for shallow seismic velocity measurements. Both units include a motor-driven clamp to hold the sensor in position in the borehole.

These geophones are applicable to a wide variety of shallow surveys, including shothole logging, downhole shear wave measurements, static corrections for petroleum shear-wave reflection surveys, cross-hole, tomographic, seam wave, and shallow VSP surveys for coal, minerals, and rock mechanics.

Model BHG-3 includes a fluxgate compass and servo mechanism which automatically orients the horizontal geophones to any magnetic azimuth selected by the operator. Thus, the longitudinal sensor can be aligned with the polarization of the shear wave source.

While downhole shear wave surveys have traditionally been done with random orientation, being able to precisely align one of the horizontal geophones with the plank or energy source provides significant advantages. Anisotrophy appears to be much more common than originally thought, and the velocities of horizontally polarized shear waves vary with azimuth. With an orientable geophone, these velocity variations may be measured or simply avoided. By maintaining orientation of the source-receiver combination all the way down the borehole, the user can maintain better control and recognition of shear wave arrivals.

Download a free copy of our tutorial paper "**Borehole Shear-Wave Surveys for Engineering Site Investigations**" at http://www.geostuff.com

The clamping mechanism is a steel leaf spring, compressed by a motor-driven piston. When compressed, the spring expands, forcing the geophone against the borehole wall.

The tool may be used in soft-wall, uncased holes as well as cased holes. In the unlikely event of a failure to release, the tool may be dragged up the hole against the spring friction. The motor-driven spring is faster, more reliable, and less cumbersome than the common alternative using an inflated bladder.

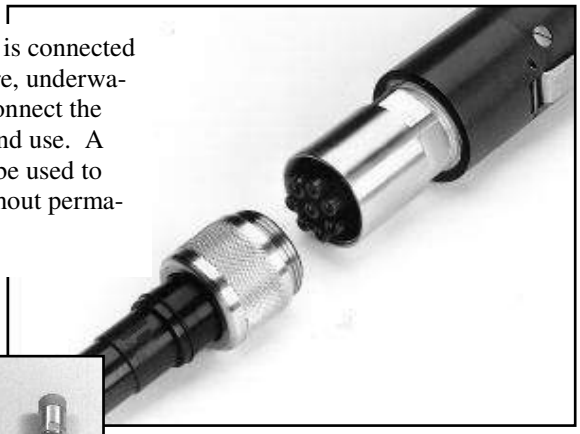
Control Electronics:

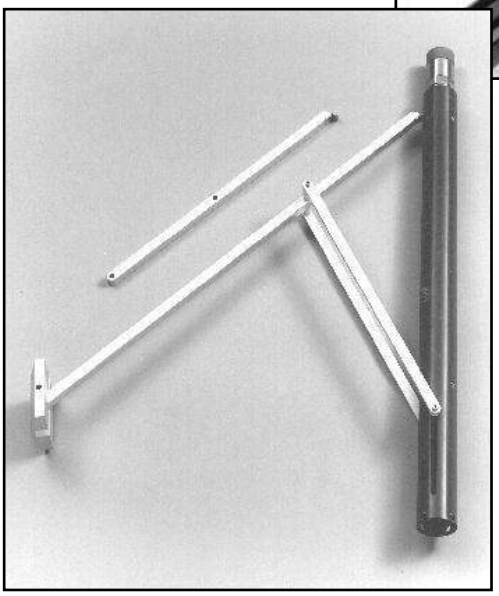
The BHGC-1b controller directs the voltages to control the clamping mechanism and servo mechanism. A meter monitors motor current to indicate the clamping action and force. This unit is usable with either model.

A rechargeable, internal. 24-volt battery is supplied, along with a 110/220 volt charger.

A Model BHGC-4 which can control up to four borehole geophones is also available.

Removable connector: The cable is connected to the geophone by a high-pressure, underwater connector. The ability to disconnect the sensor makes it easier to handle and use. A male-female extension cable can be used to temporarily extend the length without permanently





Big Hole Adaptor: An optional mechanical arm and pressure foot (shown here on the BHG-2) can be substituted for the spring to clamp the tool in large diameter boreholes. Conversion is easily done by the user in minutes. Multiple arms provide for various diameter holes. Largest arm extends diameter up to 480 mm (19 inches). When retracted, will fit inside a 75-mm (3-inch) diameter borehole.

Common Specifications

Number of geophones: 1 vertical and 2 horizontal in an X-Y-Z configuration

Natural Frequency: 15-Hz high-output omnidirectional is standard; 10, 28 and 40 Hz optional

Pressure rating: 300 meters (1000 ft) water depth, consult factory for deeper options

Clamp mechanism: DC motor. Requires 24 volts DC on surface (or more, depending on cable length). Requires ½ amp when moving spring (1 amp peak at clamping)

Expanded diameter: 18 cm (7 in) total diameter including probe body.

BHG-2 Borehole Geophone

Diameter: 48 mm (1.9 in)
Length: 700 mm (27.5 in)
Weight: 2 kg (4 lb)

BHG-3 Borehole Geophone

Diameter: 48 mm (1.9 in)
Length: 1.1 m (44 in)
Weight: 3.4 kg (7 lb)

Compass: fluxgate sensor, powered from same DC voltage as clamp mechanism.

Maximum inclination: +/- 90 degrees from vertical with standard 15-Hz sensors, much less with optional sensors.

Orientation Accuracy: better than 5 degrees

The flux gate compass will not function in steel-cased boreholes.

Cable

7-conductor, with two copper and 5 copperweld conductors, Kevlar-reinforced, polyurethane-jacket cable, with Reed Products SU-8 female connector molded on wet end.

Specifications are subject to change without notice for product improvement or other considerations. For more information, contact:

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Geode
Exploration Seismograph

GEOMETRICS
Innovation • Experience • Results

It is no wonder that over 2,700 Geodes have been sold. It is the most versatile and flexible seismograph available. Small and lightweight enough to pack in your suitcase, it expands easily for full-scale 2D and 3D surveys at a cost your bottom line will love. When you are not using the Geode for reflection, refraction, MASW/MAM, or tomography surveys, use it for monitoring earthquakes and other passive sources. The Geode will even do marine profiling or continuous recording. It is the most popular engineering seismograph in the world, and is widely used throughout the academic and research community.

For light-duty applications, you can use your laptop to view, record and even process your data. In harsh conditions, control your Geodes with Geometrics' StrataVisor NZ/C series computers and seismographs. You can connect Geodes together to build systems of over 1,000 channels. Geodes are shock-proof, dust-proof, submersible and able to withstand extreme temperatures.

Fifteen years on, we can say with confidence that the Geode is the most reliable seismograph we have ever produced. Because of this, we can offer a 3-year warranty backed by Geometrics, now in our 48th year of providing prompt, knowledgeable customer support.

FEATURES & BENEFITS

- **Bulletproof** - Not really, but almost. Survives 1.5m drop onto concrete in 14 orientations. The Geode comes standard with a 3-year warranty.
- **Distributed architecture** - Use standard 24-pair geophone cables, no matter how many channels.
- **Ultra-wide bandwidth** - Useful for everything from crosshole surveys to earthquake monitoring.
- **Geophone and line testing** - No need for time-consuming "tap test".
- **Versatile** - Configure systems ranging from 8 to 1000 channels.*
- **Waterproof and dustproof** - No need to pick up the system in a sudden rain or dust storm.
- **High temperature range** - Use in the Sahara, Amazon or at the North Pole.
- **GPS synchronization** - Sub-sample timing accuracy so you know exactly when an event occurs.

* Systems can be expanded temporarily via Geometrics' rental pool or existing loaner networks.

SPECIFICATIONS | Geode Exploration Seismograph

Configurations: 8, 12, 16, or 24 channels in weatherproof field-deployable Geode module. Geode is operated from either Windows XP/7/10-based laptop or by Geometrics' ruggedized StrataVisor NZ field computer/seismograph. Basic operating software controls one Geode. It can also be optionally expanded to control multiple Geodes, as well as do marine surveying, continuous recording, GPS synchronization, and seismic surveillance.

A/D Conversion: 24-bit result using Crystal Semiconductor sigma-delta converters and Geometrics proprietary over sampling.

Dynamic Range: 144 dB (system), 110 dB (instantaneous, measured) at 2 ms, 24 dB.

Distortion: 0.0005% @ 2 ms, 1.75 to 208 Hz.

Bandwidth: 1.75 Hz to 20 kHz. 0.6 and DC low frequency option available.

Common Mode Rejection: > 100 dB at <= 100 Hz, 36 dB.

Crosstalk: -125 dB at 23.5 Hz, 24 dB, 2 ms.

Noise Floor: 0.20 µV, RFI at 2 ms, 36 dB, 1.75 to 208 Hz.

Stacking Trigger Accuracy: 1/32 of sample interval.

Maximum Input Signal: 2.8 V PP, 0 dB.

Input Impedance: 20 kOhm, 0.02 µf.

Preamplifier Gains: Standard factory configuration is 24 and 36 dB. Optional configurations include 12 and 24 dB or 0 dB.

Anti-alias Filters: -3 dB at 83% of Nyquist frequency.

Acquisition and Display Filters:

- **Low Cut:** OUT, 10, 15, 25, 35, 50, 70, 100, 140, 200, 280, 400 Hz, 24 or 48 dB/octave, Butterworth.
- **Notch:** 50, 60, 150, 180 Hz and OUT, with the 50 dB rejection bandwidth 2% of center frequency.
- **High Cut:** OUT, 32, 64, 125, 250, 500 or 1000 Hz, 24 or 48 dB/octave.

Sample Interval: 0.02, 0.03125, 0.0625, 0.125, 0.25, 0.5, 1.0, 2.0, 4.0, 8.0, 16.0 ms.

Correlation: Optional (with SGOS, standard with MGOS) high-speed hardware correlator available in each Geode for fast cycle time with vibrators and pseudo-random sources. Correlates 16K record, unlimited channels, in under 1 second.

Record Length: 16,384 samples standard, 65,536 samples optional.

Pre-trigger Data: Up to full record length.

Delay: Full record length to +100 sec.

Data Transmission: Uses Ethernet transmission standard over CAT-5 copper or multimode fiber-optic cable. Distance between boxes: CAT 5 cable up to 0.25 km; fiber-optic cable up to 1.5 km.

Event Trigger: Based on seismic event; criteria set by user.

Continuous Recording (optional): Record GPS-synchronized, gapless data in SEG-2 format.

Auxiliary Channels: All Geode channels can be programmed as either AUX or DATA.

Roll-along: Built-in, no external roll box required.

Geophone Testing: Pulse test measures resistance, sensitivity, natural frequency, and damping.

Instrument Tests: Optional analog testing available. Measure noise, crosstalk, CMR, dynamic range, gain similarity and trigger accuracy. Additional built-in oscillator required.

Data Formats: SEG-2 standard. SEG-D and SEG-Y available as options.

System Software: Basic operating software includes full compliment of acquisition, display, plotting, filtering and storage features. Numerous optional features available; see SCS data sheet.

Bundled Applications Software: SeisImager/2D Lite refraction analysis software from OYO.

Data Storage: Stores data locally in SEG-2 on laptop/PC media. Drivers available for tape/disk storage in SEG-2/D/Y.

Plotters: Drives any Windows-compatible plotter or printer.

Triggering: Positive/negative TTL or contact closure, software adjustable threshold. STA/LTA-like algorithm for triggering on seismic waveform.

Power: Requires 12V external battery. Uses 0.5 W/channel during acquisition (0.25 ms sample rate). A single 12 Amp-hour battery is sufficient for a typical day of data acquisition; standby mode reduces power consumption by 70%.

Environmental: Operates from -50ºC to +70ºC (-58ºF to +158ºF). Waterproof and submersible. Withstands a 1m drop onto concrete on 6 sides and 8 corners. Passes MIL810E/F vibration.

Physical: L: 25.4 cm; W: 30.5 cm; H: 17.75 cm; Weight: 3.6 kg (10x12x7 in; 8 lb). Uses waterproof Bendix 61-pin connector for geophone input.

Operating System: Windows XP/7/10.

Warranty: Three years standard, extended warranty available.

Optional Built-In Test Functions

Instrument:

- Noise
- DC Offset
- Gain Accuracy
- Gain and Phase Similarity
- Distortion
- Crossfeed
- CMR
- Bandwidth
- Timing Accuracy

Geophone:

- Natural Frequency
- Resistance
- Damping
- Sensitivity

Specifications subject to change without notice. GeodeDS_v1 (0518)

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APPENDIX C

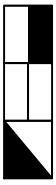
BORING LOGS

LIST OF ATTACHMENTS

The following figures are attached and complete this appendix.

Figure C-1	Graphics Key
Figure C-2	Soil Description Key
Figure C-3	Rock Description Key
Figure C-4	Boring Log B-1
Figure C-5 to C-19	Sample Photos

SAMPLE/SAMPLER TYPE GRAPHICS



CALIFORNIA SAMPLER
(3 in. (76.2 mm.) outer diameter)

CORE SAMPLER

STANDARD PENETRATION SPLIT SPOON SAMPLER
(2 in. (50.8 mm.) outer diameter and 1-3/8 in. (34.9 mm.) inner diameter)

ROCK LITHOLOGY GRAPHICS

SANDSTONE

GROUND WATER GRAPHICS

WATER LEVEL (level where first observed)

WATER LEVEL (level after exploration completion)

WATER LEVEL (additional levels after exploration)

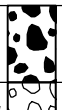
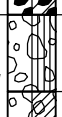
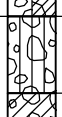
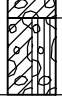
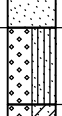
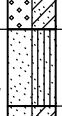
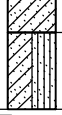
OBSERVED SEEPAGE

NOTES

- The report and graphics key are an integral part of these logs. All data and interpretations in this log are subject to the explanations and limitations stated in the report.
- Lines separating strata on the logs represent approximate boundaries only. Actual transitions may be gradual or differ from those shown.
- No warranty is provided as to the continuity of soil or rock conditions between individual sample locations.
- Logs represent general soil or rock conditions observed at the point of exploration on the date indicated.
- In general, Unified Soil Classification System designations presented on the logs were based on visual classification in the field and were modified where appropriate based on gradation and index property testing.
- Fine grained soils that plot within the hatched area on the Plasticity Chart, and coarse grained soils with between 5% and 12% passing the No. 200 sieve require dual USCS symbols, ie., GW-GM, GP-GM, GW-GC, GP-GC, GC-GM, SW-SM, SP-SM, SW-SC, SP-SC, SC-SM.
- If sampler is not able to be driven at least 6 inches then 50/X indicates number of blows required to drive the identified sampler X inches with a 140 pound hammer falling 30 inches.

ABBREVIATIONS
WOH - Weight of Hammer
WOR - Weight of Rod

UNIFIED SOIL CLASSIFICATION SYSTEM (ASTM D 2487)

COARSE GRAINED SOILS (More than half of material is larger than the #200 sieve)	**GRAVELS** (More than half of coarse fraction is larger than the #4 sieve)	CLEAN GRAVEL WITH <5% FINES	Cu≥4 and 1≤Cc≤3		**GW**	WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE OR NO FINES
			Cu<4 and/ or 1>Cc>3		**GP**	POORLY GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE OR NO FINES
		GRAVELS WITH 5% TO 12% FINES	Cu≥4 and 1≤Cc≤3		**GW-GM**	WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE FINES
					**GW-GC**	WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE CLAY FINES
			Cu<4 and/ or 1>Cc>3		**GP-GM**	POORLY GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE FINES
					**GP-GC**	POORLY GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE CLAY FINES
		GRAVELS WITH > 12% FINES			**GM**	SILTY GRAVELS, GRAVEL-SILT-SAND MIXTURES
					**GC**	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES
					**GC-GM**	CLAYEY GRAVELS, GRAVEL-SAND-CLAY-SILT MIXTURES
	SANDS (Half or more of coarse fraction is smaller than the #4 sieve)	CLEAN SANDS WITH <5% FINES	Cu≥6 and 1≤Cc≤3		**SW**	WELL-GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE OR NO FINES
			Cu<6 and/ or 1>Cc>3		**SP**	POORLY GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE OR NO FINES
		SANDS WITH 5% TO 12% FINES	Cu≥6 and 1≤Cc≤3		**SW-SM**	WELL-GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE FINES
					**SW-SC**	WELL-GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE CLAY FINES
			Cu<6 and/ or 1>Cc>3		**SP-SM**	POORLY GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE FINES
					**SP-SC**	POORLY GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE CLAY FINES
		SANDS WITH > 12% FINES			**SM**	SILTY SANDS, SAND-GRAVEL-SILT MIXTURES
					**SC**	CLAYEY SANDS, SAND-GRAVEL-CLAY MIXTURES
					**SC-SM**	CLAYEY SANDS, SAND-SILT-CLAY MIXTURES
FINE GRAINED SOILS (Half or more of material is smaller than the #200 sieve)	SILTS AND CLAYS (Liquid Limit less than 50)				**ML**	INORGANIC SILTS AND VERY FINE SANDS, SILTY OR CLAYEY FINE SANDS, SILTS WITH SLIGHT PLASTICITY
					**CL**	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
					**CL-ML**	INORGANIC CLAYS-SILTS OF LOW PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
					**OL**	ORGANIC SILTS & ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS (Liquid Limit 50 or greater)				**MH**	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILT
					**CH**	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
					**OH**	ORGANIC CLAYS & ORGANIC SILTS OF MEDIUM-TO-HIGH PLASTICITY

NOTE: USE MATERIAL DESCRIPTION ON THE LOG TO DEFINE A GRAPHIC THAT MAY NOT BE PROVIDED ON THIS LEGEND.

KLEINFELDER
Bright People. Right Solutions.

PROJECT NO.: 20230058.001A

DRAWN BY:

CHECKED BY:

DATE:

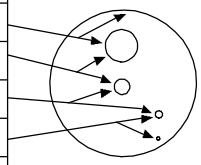
GRAPHICS KEY

OFFSHORE CABLE LANDING
HORIZONTAL DIRECTIONAL DRILL INSTALLATIONS
WINEMA BEACH, CLOVERDALE, OREGON

C-1

GRAIN SIZE

DESCRIPTION		SIEVE SIZE	GRAIN SIZE	APPROXIMATE SIZE
Boulders		>12 in. (304.8 mm.)	>12 in. (304.8 mm.)	Larger than basketball-sized
Cobbles		3 - 12 in. (76.2 - 304.8 mm.)	3 - 12 in. (76.2 - 304.8 mm.)	Fist-sized to basketball-sized
Gravel	coarse	3/4 -3 in. (19 - 76.2 mm.)	3/4 -3 in. (19 - 76.2 mm.)	Thumb-sized to fist-sized
	fine	#4 - 3/4 in. (#4 - 19 mm.)	0.19 - 0.75 in. (4.8 - 19 mm.)	Pea-sized to thumb-sized
Sand	coarse	#10 - #4	0.079 - 0.19 in. (2 - 4.9 mm.)	Rock salt-sized to pea-sized
	medium	#40 - #10	0.017 - 0.079 in. (0.43 - 2 mm.)	Sugar-sized to rock salt-sized
	fine	#200 - #40	0.0029 - 0.017 in. (0.07 - 0.43 mm.)	Flour-sized to sugar-sized
Fines		Passing #200	<0.0029 in. (<0.07 mm.)	Flour-sized and smaller



SECONDARY CONSTITUENT

	AMOUNT	
Term of Use	Secondary Constituent is Fine Grained	Secondary Constituent is Coarse Grained
Trace	<5%	<15%
With	≥5 to <15%	≥15 to <30%
Modifier	≥15%	≥30%

MOISTURE CONTENT

DESCRIPTION	FIELD TEST
Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water, usually soil is below water table

CEMENTATION

DESCRIPTION	FIELD TEST
Weakly	Crumbles or breaks with handling or slight finger pressure
Moderately	Crumbles or breaks with considerable finger pressure
Strongly	Will not crumble or break with finger pressure

CONSISTENCY - FINE-GRAINED SOIL

CONSISTENCY	SPT - N_{60} (# blows / ft)	Pocket Pen (tsf)	UNCONFINED COMPRESSIVE STRENGTH (Q_u)(psf)	VISUAL / MANUAL CRITERIA
Very Soft	<2	PP < 0.25	<500	Thumb will penetrate more than 1 inch (25 mm). Extrudes between fingers when squeezed.
Soft	2 - 4	0.25 ≤ PP <0.5	500 - 1000	Thumb will penetrate soil about 1 inch (25 mm). Remolded by light finger pressure.
Medium Stiff	4 - 8	0.5 ≤ PP <1	1000 - 2000	Thumb will penetrate soil about 1/4 inch (6 mm). Remolded by strong finger pressure.
Stiff	8 - 15	1 ≤ PP <2	2000 - 4000	Can be imprinted with considerable pressure from thumb.
Very Stiff	15 - 30	2 ≤ PP <4	4000 - 8000	Thumb will not indent soil but readily indented with thumbnail.
Hard	>30	4 ≤ PP	>8000	Thumbnail will not indent soil.

REACTION WITH HYDROCHLORIC ACID

DESCRIPTION	FIELD TEST
None	No visible reaction
Weak	Some reaction, with bubbles forming slowly
Strong	Violent reaction, with bubbles forming immediately

APPARENT / RELATIVE DENSITY - COARSE-GRAINED SOIL

APPARENT DENSITY	SPT-N_{60} (# blows/ft)	MODIFIED CA SAMPLER (# blows/ft)	CALIFORNIA SAMPLER (# blows/ft)	RELATIVE DENSITY (%)
Very Loose	<4	<4	<5	0 - 15
Loose	4 - 10	5 - 12	5 - 15	15 - 35
Medium Dense	10 - 30	12 - 35	15 - 40	35 - 65
Dense	30 - 50	35 - 60	40 - 70	65 - 85
Very Dense	>50	>60	>70	85 - 100

FROM TERZAGHI AND PECK, 1948

PLASTICITY

DESCRIPTION	LL	Either the LL or the PI (or both) may be used to describe the soil plasticity. The ranges of numbers shown here do not imply that the LL ranges correlate with the PI ranges for all soils.	PI
Non-Plastic	NP		NP
Low	< 30		< 15
Medium	30 - 50		15 - 25
High	> 50		> 25

LL is from Casagrande, 1948. PI is from Holtz , 1959.

STRUCTURE

DESCRIPTION	CRITERIA
Stratified	Alternating layers of varying material or color with layers at least 1/4-in. thick, note thickness.
Laminated	Alternating layers of varying material or color with the layer less than 1/4-in. thick, note thickness.
Fissured	Breaks along definite planes of fracture with little resistance to fracturing.
Slickensided	Fracture planes appear polished or glossy, sometimes striated.
Blocky	Cohesive soil that can be broken down into small angular lumps which resist further breakdown.
Lensed	Inclusion of small pockets of different soils, such as small lenses of sand scattered through a mass of clay; note thickness.

ANGULARITY

DESCRIPTION	CRITERIA
Angular	Particles have sharp edges and relatively plane sides with unpolished surfaces.
Subangular	Particles are similar to angular description but have rounded edges.
Subrounded	Particles have nearly plane sides but have well-rounded corners and edges.
Rounded	Particles have smoothly curved sides and no edges.

KLEINFELDER
Bright People. Right Solutions.

PROJECT NO.: 20230058.001A

DRAWN BY:

CHECKED BY:

DATE:

SOIL DESCRIPTION KEY

OFFSHORE CABLE LANDING
HORIZONTAL DIRECTIONAL DRILL INSTALLATIONS
WINEMA BEACH, CLOVERDALE, OREGON

C-2

INFILLING TYPE

NAME	ABBR	NAME	ABBR
Albite	Al	Muscovite	Mus
Apatite	Ap	None	No
Biotite	Bi	Pyrite	Py
Clay	Cl	Quartz	Qz
Calcite	Ca	Sand	Sd
Chlorite	Ch	Sericite	Ser
Epidote	Ep	Silt	Si
Iron Oxide	Fe	Talc	Ta
Manganese	Mn	Unknown	Uk

BEDDING CHARACTERISTICS

TERM	Thickness (in.)	Thickness (mm.)
Very Thick Bedded	> 36	> 915
Thick Bedded	12 - 36	305 - 915
Moderately Bedded	4 - 12	102 - 305
Thin Bedded	1 - 4	25 - 102
Very Thin Bedded	0.4 - 1	10 - 25
Laminated	0.1 - 0.4	2.5 - 10
Thinly Laminated	< 0.1	< 2.5

Bedding Planes — Planes dividing the individual layers, beds, or stratigraphy of rocks.
Joint — Fracture in rock, generally more or less vertical or traverse to bedding.
Seam — Applies to bedding plane with unspecified degree of weather.

DENSITY/SPACING OF DISCONTINUITIES

DESCRIPTION	SPACING CRITERIA
Unfractured	> 6 ft. (> 1.83 meters)
Slightly Fractured	2 - 6 ft. (.061 - 1.83 meters)
Moderately Fractured	8 in - 2 ft. (203.20 - 609.60 mm.)
Highly Fractured	2 - 8 in. (50.80 - 203.30 mm.)
Intensely Fractured	< 2 in. (< 50.80 mm.)

APERTURE

DESCRIPTION	CRITERIA [in.(mm.)]
Tight	< 0.04 (< 1)
Open	0.04 - 0.20 (1 - 5)
Wide	> 0.20 (> 5)

ADDITIONAL TEXTURAL ADJECTIVES

DESCRIPTION	RECOGNITION
Pit (Pitted)	Pinhole to 0.03 ft. (3/8 in.) (>1 to 10 mm.) openings
Vug (Vuggy)	Small openings (usually lined with crystals) ranging in diameter from 0.03 ft. (3/8 in.) to 0.33 ft. (4 in.) (10 to 100 mm.)
Cavity	An opening larger than 0.33 ft. (4 in.) (100 mm.), size descriptions are required, and adjectives such as small, large, etc., may be used
Honeycombed	If numerous enough that only thin walls separate individual pits or vugs, this term further describes the preceding nomenclature to indicate cell-like form
Vesicle (Vesicular)	Small openings in volcanic rocks of variable shape and size formed by entrapped gas bubbles during solidification

DISCONTINUITY TYPE

DESCRIPTION
Fault
Joint
Shear
Foliation
Vein
Bedding

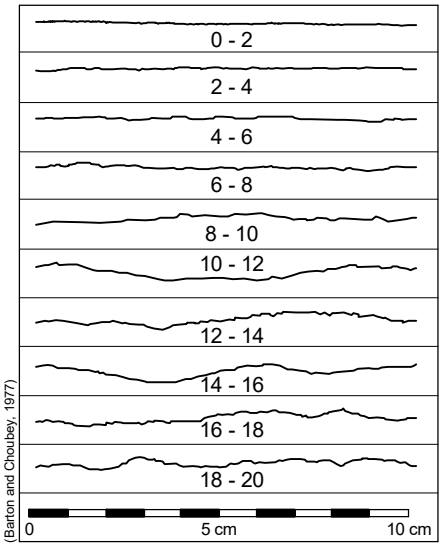
INFILLING AMOUNT

DESCRIPTION
Surface Stain
Spotty
Partially Filled
Filled
None

ROCK QUALITY DESIGNATION (RQD)

DESCRIPTION	RQD (%)
Very Poor	0 - 25
Poor	25 - 50
Fair	50 - 75
Good	75 - 90
Excellent	90 - 100

JOINT ROUGHNESS COEFFICIENT (JRC)



RQD — Rock-quality designation (RQD) Rough measure of the degree of jointing or fracture in a rock mass, measured as a percentage of the drill core in lengths of 10 cm. or more.

DEGREES OF WEATHERING

DESCRIPTION	CRITERIA
Unweathered	No evidence of chemical/mechanical alternation; rings with hammer blow.
Slightly Weathered	Slight discoloration on surface; slight alteration along discontinuities; <10% rock volume altered.
Moderately Weathered	Discoloring evident; surface pitted and alteration penetration well below surface; Weathering "halos" evident; 10-50% rock altered.
Highly Weathered	Entire mass discolored; Alteration pervading most rock, some slight weathering pockets; some minerals may be leached out.
Decomposed	Rock reduced to soil with relic rock texture/structure; Generally molded and crumbled by hand.

RELATIVE HARDNESS / STRENGTH DESCRIPTIONS - FOR WEAKER SEDIMENTARY ROCKS IN COLORADO

SPT N_{60}	HARDNESS
< 20	Very Weak to Weathered
20 - 39	Weak
40 - 49	Moderately Strong
50 - 50/6"	Strong
> 50/6"	Very Strong

This table was developed by Kleinfelder based on project experience in Colorado for shale, claystone, siltstone, poorly cemented sandstone, and other weaker sedimentary rocks.

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PROJECT NO.: 20230058.001A
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DATE:

ROCK DESCRIPTION KEY

OFFSHORE CABLE LANDING
HORIZONTAL DIRECTIONAL DRILL INSTALLATIONS
WINEMA BEACH, CLOVERDALE, OREGON

C-3

INFILLING TYPE[3]

NAME	ABBR	NAME	ABBR
Albite	Al	Muscovite	Mus
Apatite	Ap	None	No
Biotite	Bi	Pyrite	Py
Clay	Cl	Quartz	Qz
Calcite	Ca	Sand	Sd
Chlorite	Ch	Sericite	Ser
Epidote	Ep	Silt	Si
Gypsum	Gy	Talc	Ta
Iron Oxide	Fe	Unknown	Uk
Manganese	Mn		

DENSITY/SPACING OF DISCONTINUITIES[5]

DESCRIPTION	SPACING CRITERIA
Unfractured	>6 ft. (>1.83 meters)
Slightly Fractured	2 - 6 ft. (0.061 - 1.83 meters)
Moderately Fractured	8 in - 2 ft. (203.20 - 609.60 mm)
Highly Fractured	2 - 8 in (50.80 - 203.30 mm)
Intensely Fractured	<2 in (<50.80 mm)

ADDITIONAL TEXTURAL ADJECTIVES[5]

DESCRIPTION	RECOGNITION
Pit (Pitted)	Pinhole to 0.03 ft. (3/8 in.) (>1 to 10 mm.) openings
Vug (Vuggy)	Small openings (usually lined with crystals) ranging in diameter from 0.03 ft. (3/8 in.) to 0.33 ft. (4 in.) (10 to 100 mm.)
Cavity	An opening larger than 0.33 ft. (4 in.) (100 mm.), size descriptions are required, and adjectives such as small, large, etc., may be used
Honeycombed	If numerous enough that only thin walls separate individual pits or vugs, this term further describes the preceding nomenclature to indicate cell-like form.
Vesicle (Vesicular)	Small openings in volcanic rocks of variable shape and size formed by entrapped gas bubbles during solidification.

WEATHERING[5]

DESCRIPTION	CRITERIA
Unweathered	No evidence of chemical / mechanical alternation; rings with hammer blow.
Slightly Weathered	Slight discoloration on surface; slight alteration along discontinuities; <10% rock volume altered.
Moderately Weathered	Discoloring evident; surface pitted and alteration penetration well below surface; Weathering "halos" evident; 10-50% rock altered.
Highly Weathered	Entire mass discolored; Alteration pervading most rock, some slight weathering pockets; some minerals may be leached out.
Decomposed	Rock reduced to soil with relic rock texture/structure; Generally molded and crumbled by hand.

RELATIVE HARDNESS / STRENGTH DESCRIPTIONS[4]

GRADE		UCS	FIELD TEST
R0	Extremely Weak	0.25 - 1.0	Indented by thumbnail
R1	Very Weak	1.0 - 5.0	Crumbles under firm blows of geological hammer, can be peeled by a pocket knife.
R2	Weak	5.0 - 25	Can be peeled by a pocket knife with difficulty, shallow indentations made by firm blow with point of geological hammer.
R3	Medium Strong	25 - 50	Cannot be scraped or peeled with a pocket knife, specimen can be fractured with a single firm blow of a geological hammer.
R4	Strong	50 - 100	Specimen requires more than one blow of geological hammer to fracture it.
R5	Very Strong	100 - 250	Specimen requires many blows of geological hammer to fracture it.
R6	Extremely Strong	> 250	Specimen can only be chipped with a geological hammer.

ROCK QUALITY DESIGNATION (RQD)[2]

DESCRIPTION	RQD (%)
Very Poor	0 - 25
Poor	25 - 50
Fair	50 - 75
Good	75 - 90
Excellent	90 - 100

APERTURE[1]

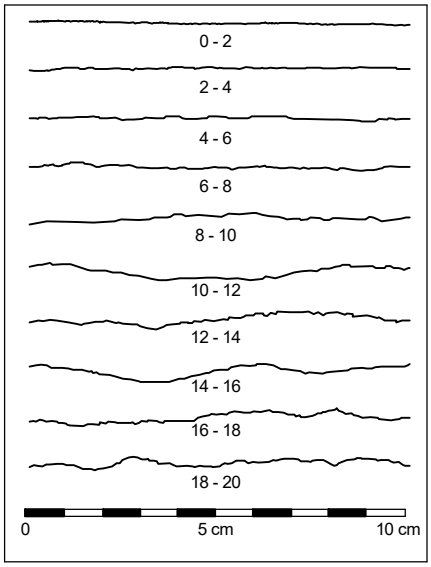
DESCRIPTION	CRITERIA [in (mm)]
Tight	<0.04 (<1)
Open	0.04 - 0.20 (1 - 5)
Wide	>0.20 (>5)

BEDDING CHARACTERISTICS[6]

DESCRIPTION	Thickness [in (mm)]
Very Thick Bedded	>36 (>915)
Thick Bedded	12 - 36 (305 - 915)
Moderately Bedded	4 - 12 (102 - 305)
Thin Bedded	1 - 4 (25 - 102)
Very Thin Bedded	0.4 - 1 (10 - 25)
Laminated	0.1 - 0.4 (2.5 - 10)
Thinly Laminated	<0.1 (<2.5)

Bedding Planes	Planes dividing the individual layers, beds, or stratigraphy of rocks.
Joint	Fracture in rock, generally more or less vertical or traverse to bedding.
Seam	Applies to bedding plane with unspecified degree of weather.

JOINT ROUGHNESS COEFFICIENT (JRC)[4]



RQD Rock-quality designation (RQD) Rough measure of the degree of jointing or fracture in a rock mass, measured as a percentage of the drill core in lengths of 4 in. (10 cm.) or more.

REFERENCES

1. Bieniawski, Z.T., 1989, Engineering Rock Mass Classifications. John Wiley & Sons, New York. (Mod. by Kleinfelder).
2. Deere, D.U., and Deere, D.W., 1989, Rock Quality Designation (RQD) After Twenty Years, USACE Contract Report GL-89-1.
3. Federal Highway Administration (FHWA), 2002, Subsurface Investigations, FHWA-NHI-01-031. (Mod. by Kleinfelder).
4. International Society for Rock Mechanics (ISRM), 1978, "Suggested Methods for the Quantitative Description of Discontinuities in Rock Masses," International Joint Rock Mechanics and Mining Sciences & Geomechanics Abstracts, Vol. 15.
5. United States Army Corps of Engineers (USACE), 1994, Rock Foundations, EM 1110-1-2908, November 30, 1994.
6. United States Department of the Interior Bureau of Reclamation (USBR), 1998, Engineering Geology Field Manual, Volume 1.

CORE SAMPLER TYPE GRAPHICS

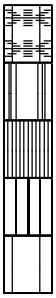
CORE SAMPLER

AQ CORE BARREL
(1.067 in. (27.1 mm.) core diameter)

AX CORE BARREL
(1.185 in. (30.1 mm.) core diameter)

BQ CORE BARREL
(1.433 in. (36.4 mm.) core diameter)

CONTINUOUS CORE SAMPLE
(2.000 in. (50.8 mm.) core diameter)



EX CORE BARREL
(0.846 in. (21.5 mm.) core diameter)

HQ CORE SAMPLE
(2.500 in. (63.5 mm.) core diameter)

NQ CORE SAMPLE
(1.874 in. (47.6 mm.) core diameter)

NO RECOVERY CORE SAMPLE

NX CORE SAMPLE
(2.154 in. (54.7 mm.) core diameter)

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PROJECT NO.: 20230058.001A

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CHECKED BY:

DATE:

ROCK DESCRIPTION KEY

OFFSHORE CABLE LANDING
HORIZONTAL DIRECTIONAL DRILL
WINEMA BEACH, CLOVERDALE, OREGON

C-3

Date Begin - End:	5/16/2022 - 5/18/2022	**Drilling Company:**	Western States	**ROCK CORING LOG B-1**	
Logged By:	P. Rivas	**Drill Crew:**	Adonis, Collin		
Hor.-Vert. Datum:	WGS 1984	**Drilling Equipment:**	CME-75	**Hammer Type - Drop:**	140 lb. Auto - 30 in.
Plunge:	-90 degrees	**Drilling Method:**	Mud Rotary	**Hammer Efficiency:**	85.5%
Weather:	Cloudy	**Exploration Diameter:**	4 in. O.D.	**Hammer Cal. Date:**	12/23/2021

FIELD EXPLORATION

Latitude: 45.14690° N
Longitude: -123.97376° E
Approximate Ground Surface Elevation (ft.): 21.00
Surface Condition: Bare Earth

Approximate Elevation (feet)	Depth (feet)	Graphical Log	Lithologic Description	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in. Pocket Pen(PP)= tsf RQD=%	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
20			**Alluvial Beach and Dune Deposits** **Silty SAND with Gravel (SM)**: fine to coarse sand, brown, moist											
			Poorly Graded SAND (SP): fine sand, gray, moist, medium dense											
15	5				BC=9 12 16			11.1	111.0		0.9			
10					BC=2 1 1									
10 ▽			**Clayey SAND (SC)**: fine sand, low plasticity, dark brown, organic odor, wet, very loose											
			Poorly Graded SAND (SP): fine sand, gray, wet, dense											
15					BC=13 23 29			20.3	107.4		4.0			
5														
20			**Poorly Graded GRAVEL with Silt and Sand (GP-GM)**: fine to coarse gravel, gray, wet, very dense, fine to coarse sand, cobbles and boulders up to 18 in.		BC=15 27 22		GP-GM			47	8.6			
0														
25			dense		BC=27 18 22		GP-GM			33	5.9			
-5														
30			no boulders		BC=31 50/6"									
-10														

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DATE: 5/24/2022

ROCK CORING LOG B-1

OFFSHORE CABLE LANDING
HORIZONTAL DIRECTIONAL DRILL
WINEMA BEACH, CLOVERDALE, OREGON

FIGURE
C-3

Date Begin - End:	5/16/2022 - 5/18/2022	**Drilling Company:**	Western States	**ROCK CORING LOG B-1**	
Logged By:	P. Rivas	**Drill Crew:**	Adonis, Collin		
Hor.-Vert. Datum:	WGS 1984	**Drilling Equipment:**	CME-75	**Hammer Type - Drop:**	140 lb. Auto - 30 in.
Plunge:	-90 degrees	**Drilling Method:**	Mud Rotary	**Hammer Efficiency:**	85.5%
Weather:	Cloudy	**Exploration Diameter:**	4 in. O.D.	**Hammer Cal. Date:**	12/23/2021

FIELD EXPLORATION

Latitude: 45.14690° N
Longitude: -123.97376° E
Approximate Ground Surface Elevation (ft.): 21.00
Surface Condition: Bare Earth

Approximate Elevation (feet)	Depth (feet)	Graphical Log	Lithologic Description	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in. Pocket Pen(PP)= tsf RQD=%	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
-15			**Poorly Graded SAND with Silt (SP)**: fine to coarse sand, brown, wet, very dense, fine to coarse gravel, seashells present		BC=32 26 20									
			Clayey SAND (SC): fine sand, medium plasticity, dark gray, wet, medium dense, trace fine gravel											
-20	40				BC=3 3 4		SC				17	53	26	
			Poorly Graded SAND (SP): fine to medium sand, dark brown, wet, very dense, trace fine gravel											
-25	45				BC=25 50/4"			15.2	122.9		3.6			
-30	50		yellowish brown, no gravel		BC=30 39 41						5.4			
-35	55				BC=24 35 38									
-40	60		**ALSEA FORMATION** **SANDSTONE**: brown, fine-grained sand, highly weathered, R0, intensely fractured		BC=41 41 50/6"									
-45	65		Brown to dark brown		BC=50/6"									

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ROCK CORING LOG B-1

OFFSHORE CABLE LANDING
HORIZONTAL DIRECTIONAL DRILL
WINEMA BEACH, CLOVERDALE, OREGON

FIGURE
C-3

Date Begin - End:	5/16/2022 - 5/18/2022	**Drilling Company:**	Western States
Logged By:	P. Rivas	**Drill Crew:**	Adonis/Collin
Hor.-Vert. Datum:	WGS 1984	**Drilling Equipment:**	CME-75
Plunge:	-90 degrees	**Coring Method:**	Coring
Weather:	Cloudy	**Core Bit Type:**	NQ Core

ROCK CORING LOG B-1

ROCK CORING INFORMATION

Latitude: 45.14690° N
Longitude: -123.97376° E
Approximate Ground Surface Elevation (ft.): 21.00

Approximate Elevation (feet) / Depth (feet)	Graphical Log	Formation and Rock Type, Color, Grain/Particle Size, Weathering, Bedding, Density or Spacing	Box Number	Run Number	Sample Type	Recovery (NR=No Recovery)	Drill Rate (min/ft)	RQD (%)	Relative Strength	Discontinuity Description Fracture#: (Depth), Type, Relative Dip, Density or Spacing. Degree of Infilling, Infilling Type, Aperture, Surface Weathering, JRC
-50		**SANDSTONE**: dark gray, fine-grained sand, moderately weathered, moderately bedded, intensely fractured, contains small shell fragments, silt matrix prevalent	1	1		12"	N/A	0	R2	
		Slightly weathered, moderately fractured	1	2		56"	N/A	75		(71.6'), joint, 55°, moderately fractured, none, No, tight, JRC=16-18
										(73.2'), joint, 3°, highly fractured, none, No, slightly open, JRC=10-12
75		4 in. layer of intensely fractured to brecciated								(73.4'), joint, 0°, moderately fractured, none, No, slightly open, JRC=10-12
-55		5 in. layer of intensely fractured and rehealed Thickly bedded	2	3		59"	N/A	85		(76.5'), joint, 50°, none, No, slightly open, JRC=8-10
										(76.9'), joint, 40°, none, No, slightly open, JRC=6-8
		Highly fractured Moderately fractured								(77.7'), joint, 55°, none, No, tight, JRC=4-6
80		Convolute siltsone rip-up clasts, bed remnants								(78.7'), joint, 55°, none, No, slightly open, JRC=10-12
-60										(79'), joint, 40°, highly fractured, none, No, slightly open, JRC=8-10
		UCS = 5610 psi	2	4		60"	N/A	91		(79.3'), joint, 65°, moderately fractured, none, No, slightly open, JRC=12-14
										(80'), joint, 45°, none, No, slightly open, JRC=8-10
85		Moderately fractured								(84.4'), joint, 45°, slightly fractured, none, No, slightly open, JRC=4-6
-65										(85.1'), joint, 60°, moderately fractured, none, No, slightly open, JRC=4-6
		Gray to dark gray, moderately fractured	2/3	5		60"	N/A	96		(85.8'), joint, 30°, none, No, slightly open, JRC=2-4
										(86.1'), joint, 70°, highly fractured, none, No, slightly open, JRC=10-12
90		Localized calcareous mineralization within joints								(88'), joint, 30°, none, No, slightly open, JRC=2-4
-70										(88.2'), joint, 50°, none, No, slightly open, JRC=10-12
		UCS = 5050 psi	3	6		60"	N/A	75		(88.8'), joint, 50°, none, No, slightly open, JRC=4-6
										(89.3'), joint, 65°, moderately fractured, none, No, slightly open, JRC=14-16
95		Localized mass highly fractured and partially rehealed								(90.5'), joint, 25°, slightly fractured, none, No, slightly open, JRC=2-4
-75										(93'), joint, 30°, moderately fractured, none, No, slightly open, JRC=4-6
			3/4	7		60"	N/A	93		(93.5'), joint, 80°, none, No, slightly open, JRC=14-16
										(94'), joint, 30°, highly fractured, none, No, slightly open, JRC=4-6
100										(94.2'), joint, 60°, none, No, slightly open, JRC=8-10
-80										(94.5'), joint, 60°, none, No, slightly open, JRC=8-10
			4	8		60"	N/A	86		(95.1'), joint, 50°, moderately fractured, none, No, slightly open, JRC=14-16
										(98'), slightly fractured
										(100.6'), joint, 45°, none, No, slightly open, JRC=8-10

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DATE: 5/24/2022

ROCK CORING LOG B-1

OFFSHORE CABLE LANDING
HORIZONTAL DIRECTIONAL DRILL
WINEMA BEACH, CLOVERDALE, OREGON

FIGURE
C-3

Date Begin - End:	5/16/2022 - 5/18/2022	**Drilling Company:**	Western States
Logged By:	P. Rivas	**Drill Crew:**	Adonis/Collin
Hor.-Vert. Datum:	WGS 1984	**Drilling Equipment:**	CME-75
Plunge:	-90 degrees	**Coring Method:**	Coring
Weather:	Cloudy	**Core Bit Type:**	NQ Core

ROCK CORING LOG B-1

ROCK CORING INFORMATION

Latitude: 45.14690° N
Longitude: -123.97376° E
Approximate Ground Surface Elevation (ft.): 21.00

Approximate Elevation (feet) / Depth (feet)	Graphical Log	Formation and Rock Type, Color, Grain/Particle Size, Weathering, Bedding, Density or Spacing	Box Number	Run Number	Sample Type	Recovery (NR=No Recovery)	Drill Rate (min/ft)	RQD (%)	Relative Strength	Discontinuity Description Fracture#: (Depth), Type, Relative Dip, Density or Spacing. Degree of Infilling, Infilling Type, Aperture, Surface Weathering, JRC
-85		**SANDSTONE**: gray to dark gray, fine-grained sand, slightly weathered, moderately bedded, moderately fractured, containes fine calcareous shell fragments, silt matrix prevalent Decrease in shell fragments present	4	8		60" *(cont.)*	N/A	86 *(cont.)*	R2	(100.9'), joint, 70°, spotty, Ca, slightly open, JRC=4-6
			5	9		60"	N/A	75		(104.1'), joint, 35°, none, No, slightly open, JRC=12-14 (105.1'), joint, 80°, spotty, Ca, slightly open, JRC=10-12 (106.1'), joint, 25°, highly fractured, none, No, slightly open, JRC=8-10
110										(106.5'), joint, 15°, none, No, slightly open, JRC=6-8
-90			5	10		60"	N/A	100		(107.5'), joint, 85°, moderately fractured, none, No, slightly open, JRC=0-2
		UCS = 4210 psi								(107.9'), joint, 20°, none, No, slightly open, JRC=2-4 (109.1'), joint, 30°, none, No, slightly open, JRC=2-4
115										(109.8'), joint, 10°, none, No, slightly open, JRC=2-4
-95			6	11		60"	N/A	93		(110.5'), joint, 20°, moderately fractured, spotty, Ca, slightly open, JRC=4-6
		Slightly fractured, abundant fine calcareous shell fragments								(111.7'), joint, 55°, highly fractured, none, No, slightly open, JRC=4-6 (112.2'), joint, 70°, slightly fractured, none, No, slightly open, JRC=4-6
120										(115.2'), joint, 40°, highly fractured, none, No, slightly open, JRC=2-4
-100			6	12		58"	N/A	96		(115.4'), joint, 40°, moderately fractured, none, No, slightly open, JRC=2-4 (116.5'), joint, 60°, slightly fractured, none, No, slightly open, JRC=6-8 (120.5'), bedding, 5°, moderately fractured, none, No, tight, JRC=2-4
125										(121.5'), bedding, 5°, slightly fractured, none, No, tight, JRC=0-2
-105			7	13		60"	N/A	100		(123.3'), bedding, 5°, none, No, tight, JRC=2-4 (127'), joint, 40°, moderately fractured, spotty, Ca, slightly open, JRC=6-8 (127.8'), joint, 10°, none, No, slightly open, JRC=2-4
130										(129.5'), joint, 20°, none, No, slightly open, JRC=6-8
-110		Shell fragments to 0.75 in. present	7/8	14		60"	N/A	98		(131.1'), joint, 15°, highly fractured, partially filled, Cl, slightly open, JRC=4-6
		UCS = 4990 psi								(131.5'), joint, 15°, none, No, slightly open, JRC=6-8 (131.8'), bedding, 5°, slightly fractured, none, No, slightly open, JRC=6-8
135										
-115			8	15		60"	N/A	31		(136.5'), joint, 80°, none, No, slightly open, JRC=14-16
		Intensely fractured zone with sand and clay fracture infill								(136.8'), joint, 45°, partially filled, Ca, slightly open, JRC=2-4

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DATE: 5/24/2022

ROCK CORING LOG B-1

OFFSHORE CABLE LANDING
HORIZONTAL DIRECTIONAL DRILL
WINEMA BEACH, CLOVERDALE, OREGON

FIGURE
C-3

Date Begin - End: 5/16/2022 - 5/18/2022 **Drilling Company:** Western States

Logged By: P. Rivas **Drill Crew:** Adonis/Collin

Hor.-Vert. Datum: WGS 1984 **Drilling Equipment:** CME-75

Plunge: -90 degrees **Coring Method:** Coring

Weather: Cloudy **Core Bit Type:** NQ Core

ROCK CORING LOG B-1

ROCK CORING INFORMATION

Latitude: 45.14690° N
Longitude: -123.97376° E
Approximate Ground Surface Elevation (ft.): 21.00

Approximate Elevation (feet) / Depth (feet)	Graphical Log	Formation and Rock Type, Color, Grain/Particle Size, Weathering, Bedding, Density or Spacing	Box Number	Run Number	Sample Type	Recovery (NR=No Recovery)	Drill Rate (min/ft)	RQD (%)	Relative Strength	Discontinuity Description Fracture#: (Depth), Type, Relative Dip, Density or Spacing. Degree of Infilling, Infilling Type, Aperture, Surface Weathering, JRC
-120		**SANDSTONE**: gray to dark gray, fine-grained sand, slightly weathered, thickly to very thickly bedded, moderately fractured, contains fine calcareous shell fragments, silt matrix prevalent, locally aligned with bedding and crossbedding	8	15		60" *(cont.)*	N/A	31 *(cont.)*	R2	(136.9'), joint, 20°, highly fractured, partially filled, Ca, slightly open, JRC=2-4
			8	16		59"	N/A	71		(137.6'), joint, 80°, intensely fractured, partially filled, Cl, slightly open, JRC=10-12 (139.8'), joint, 70°, moderately fractured, partially filled, Cl, slightly open, JRC=2-4 (142.2'), joint, 50°, slightly fractured, none, No, slightly open, JRC=8-10
145 -125		Intensely fractured and partially rehealed layer								(145.6'), joint, 60°, moderately fractured, none, No, slightly open, JRC=16-18
			9	17		59"	N/A	71		(146.5'), joint, 55°, none, No, slightly open, JRC=6-8 (148.3'), joint, 60°, highly fractured, partially filled, Ca, slightly open, JRC=6-8 (148.6'), joint, 60°, slightly fractured, none, No, slightly open, JRC=4-6
150 -130										(151.3'), joint, 80°, none, No, slightly open, JRC=10-12
155 -135										
160 -140										
165 -145										
170 -150										

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PROJECT NO.: 20230058.001A	ROCK CORING LOG B-1	FIGURE
DRAWN BY: PR	OFFSHORE CABLE LANDING HORIZONTAL DIRECTIONAL DRILL WINEMA BEACH, CLOVERDALE, OREGON	C-3
CHECKED BY: TD		
DATE: 5/24/2022		PAGE: 5 of 5

PHOTO 1: BORING B-1, 5 FT SAMPLE

PHOTO 2: BORING B-1, 10 FT SAMPLE

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□HOTO S□ MM□ R□

OFFSHORE CABLE LANDING
HORIZONTAL DIRECTIONAL DRILL INSTALLATIONS
WINEMA BEACH, CLOVERDALE, OREGON

FIGURE:

C-□

PHOTO 3: BORING B-1, 15 FT SAMPLE

PHOTO 4: BORING B-1, 20 FT SAMPLE

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PHOTO SUMMARY

OFFSHORE CABLE LANDING
HORIZONTAL DIRECTIONAL DRILL INSTALLATIONS
WINEMA BEACH, CLOVERDALE, OREGON

FIGURE:

C-6

PHOTO 5: BORING B-1, 25 FT SAMPLE

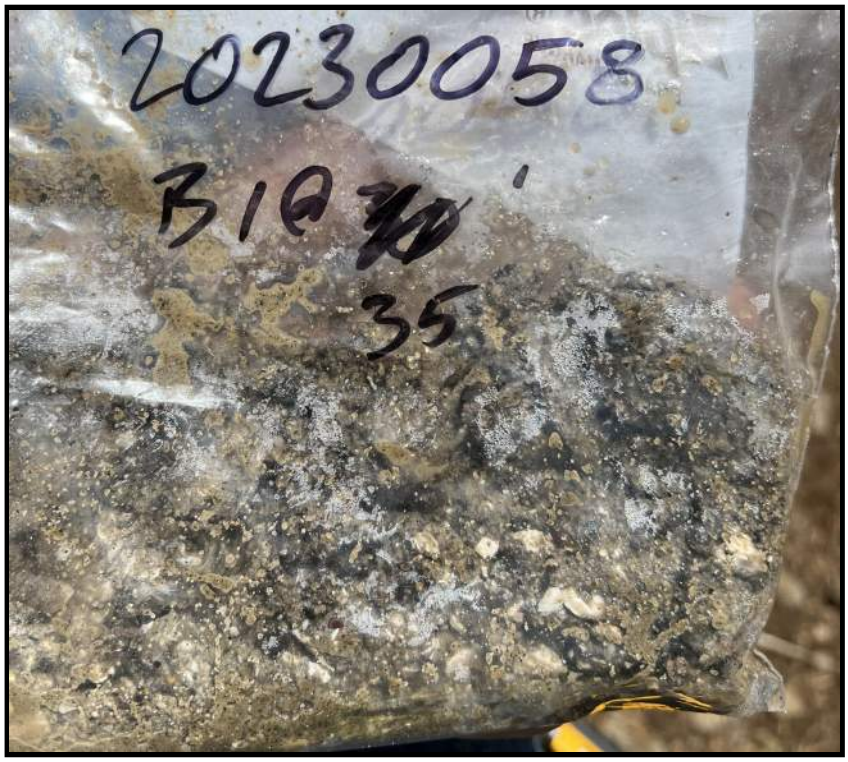

PHOTO 6: BORING B-1, 35 FT SAMPLE

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PHOTO SUMMARY

OFFSHORE CABLE LANDING
HORIZONTAL DIRECTIONAL DRILL INSTALLATIONS
WINEMA BEACH, CLOVERDALE, OREGON

FIGURE:

C-

PHOTO 7: BORING B-1, 40 FT SAMPLE

PHOTO 8: BORING B-1, 45 FT SAMPLE

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	DRAWN: 06/2022		
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	FILE NAME: PHOTO SUMMARY		

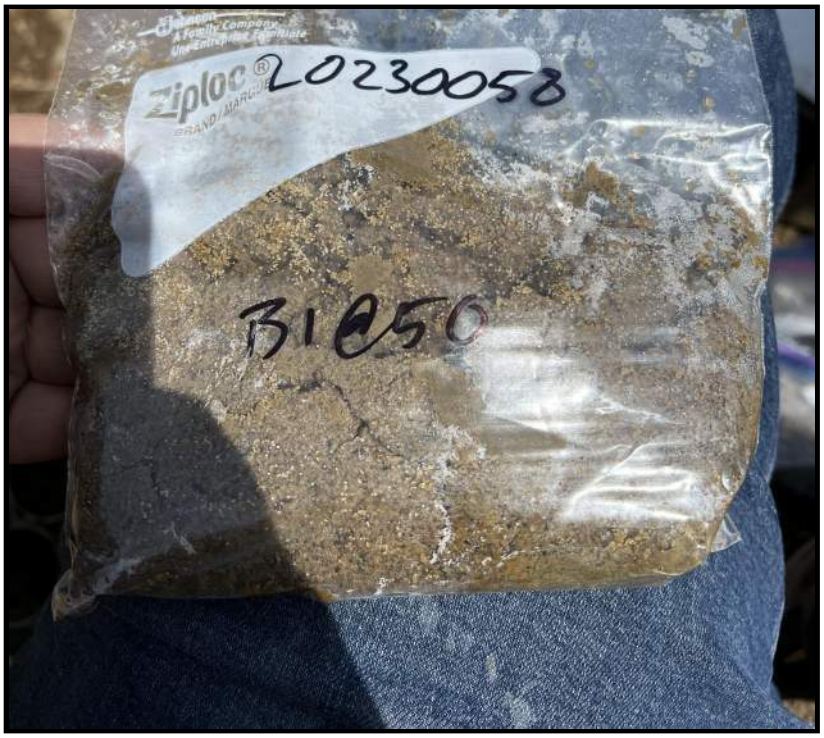

PHOTO 9: BORING B-1, 50 FT SAMPLE

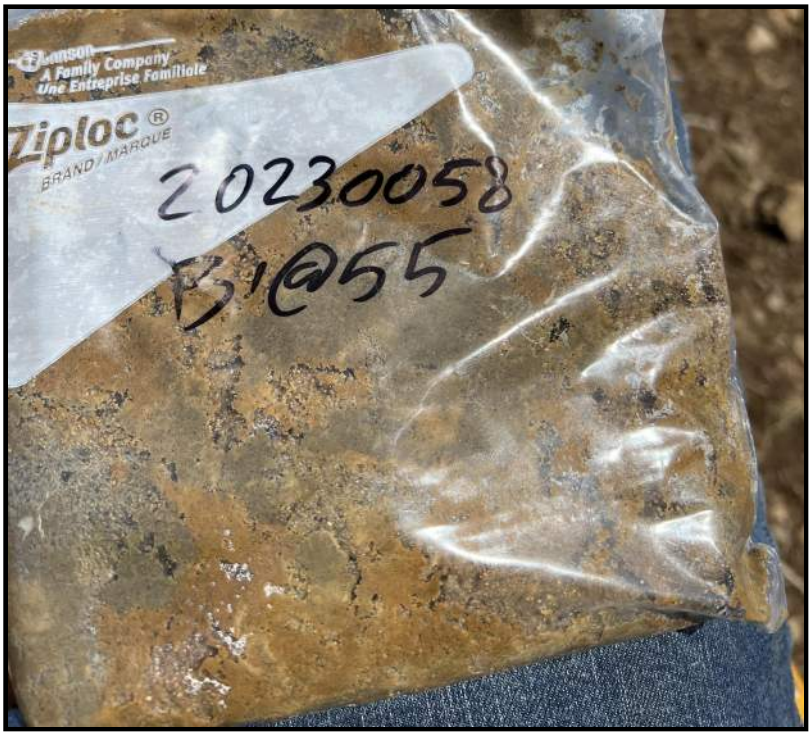

PHOTO 10: BORING B-1, 55 FT SAMPLE

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	FILE NAME: PHOTO SUMMARY		

PHOTO 11: BORING B-1, 60 FT SAMPLE

PHOTO 12: BORING B-1, 65FT SAMPLE

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	DRAWN: 06/2022		
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	FILE NAME: PHOTO SUMMARY		

PHOTO 13: BORING B-1, CORE RUNE 1: 70 FT -71.5 FT

PHOTO 14: BORING B-1, CORE RUN 2: 71.5 FT - 76.5 FT

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	CHECKED BY: KS/SC	OFFSHORE CABLE LANDING HORIZONTAL DIRECTIONAL DRILL INSTALLATIONS WINEMA BEACH, CLOVERDALE, OREGON	
	FILE NAME: PHOTO SUMMARY		

PHOTO 15: BORING B-1, CORE RUNE 3: 76.5 FT -81.5 FT

PHOTO 16: BORING B-1, CORE RUN 4: 81.5 FT - 86.5 FT

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	FILE NAME: PHOTO SUMMARY		

PHOTO 17: BORING B-1, CORE RUNE 5: 86.5 FT -91.5 FT

PHOTO 18: BORING B-1, CORE RUN 6: 91.5 FT - 96.5 FT

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	DRAWN: 06/2022		
	DRAWN BY: TD		
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	FILE NAME: PHOTO SUMMARY		

PHOTO 19: BORING B-1, CORE RUNE 7: 96.5 FT -101.5 FT

PHOTO 20: BORING B-1, CORE RUN 8: 101.5 FT - 106.5 FT

KLEINFELDER *Bright People. Right Solutions.* www.kleinfelder.com	PROJECT NO. 20230058.001A	PHOTO SUMMARY	FIGURE: C-4
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	FILE NAME: PHOTO SUMMARY		

PHOTO 21: BORING B-1, CORE RUNE 9: 106.5 FT -111.5 FT

PHOTO 22: BORING B-1, CORE RUN 10: 111.5 FT - 116.5 FT

PHOTO 23: BORING B-1, CORE RUNE 11: 116.5 FT -121.5 FT

PHOTO 24: BORING B-1, CORE RUN 12: 121.5 FT - 126.5 FT

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	DRAWN: 06/2022		
	DRAWN BY: TD		
	CHECKED BY: KS/SC	OFFSHORE CABLE LANDING HORIZONTAL DIRECTIONAL DRILL INSTALLATIONS WINEMA BEACH, CLOVERDALE, OREGON	
	FILE NAME: PHOTO SUMMARY		

PHOTO 25: BORING B-1, CORE RUNE 13: 126.5 FT -131.5 FT

PHOTO 26: BORING B-1, CORE RUN 14: 131.5 FT - 136.5 FT

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	DRAWN: 06/2022		
	DRAWN BY: TD		
	CHECKED BY: KS/SC	OFFSHORE CABLE LANDING HORIZONTAL DIRECTIONAL DRILL INSTALLATIONS WINEMA BEACH, CLOVERDALE, OREGON	
	FILE NAME: PHOTO SUMMARY		

PHOTO 27: BORING B-1, CORE RUNE 15: 136.5 FT -141.5 FT

PHOTO 28: BORING B-1, CORE RUN 16: 141.5 FT - 146.5 FT

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	DRAWN: 06/2022		
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	FILE NAME: PHOTO SUMMARY		

PHOTO 29: BORING B-1, CORE RUNE 17: 146.5 FT -151.5 FT

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	DRAWN: 06/2022		
	DRAWN BY: TD		
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	FILE NAME: PHOTO SUMMARY		

APPENDIX D

LABORATORY TEST RESULTS

LIST OF ATTACHMENTS

The following figures are attached and complete this appendix.

Figure D-1 – Laboratory Test Result Summary
Figure D-2 – Rock Laboratory Test Result Summary
Figure D-3 – Atterberg Limits Test Results
Figure D-4 – Sieve Analysis Test Results
Figures D-5 to D-8 – Uniaxial Compressive Strength Results

Exploration ID	Depth (ft.)	Sample Description	Water Content (%)	Dry Unit Wt. (pcf)	Sieve Analysis (%)			Atterberg Limits			Additional Tests
					Passing 3/4"	Passing #4	Passing #200	Liquid Limit	Plastic Limit	Plasticity Index	
B-1	5.0	POORLY GRADED SAND (SP)	11.1	111.0			0.9				
B-1	15.0	POORLY GRADED SAND (SP)	20.3	107.4			4.0				
B-1	20.0	POORLY GRADED GRAVEL WITH SILT AND SAND (GP-GM)			91	47	8.6				
B-1	25.0	POORLY GRADED GRAVEL WITH SILT AND SAND (GP-GM)			73	33	5.9				
B-1	40.0	CLAYEY SAND (SC)					17	53	27	26	
B-1	45.0	POORLY GRADED SAND (SP)	15.2	122.9			3.6				
B-1	50.0	POORLY GRADED SAND (SP)					5.4				

Refer to the Geotechnical Evaluation Report or the supplemental plates for the method used for the testing performed above.
NP = NonPlastic

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LABORATORY TEST RESULT SUMMARY

OFFSHORE CABLE LANDING
HORIZONTAL DIRECTIONAL DRILL
WINEMA BEACH, CLOVERDALE, OREGON

FIGURE
D-1

Exploration ID	Depth (ft.)	Sample Description	Unconfined Compressive Strength (psi)	UCS with Young's Modulus (tsf)	Triaxial Compressive Strength (tsf)	Triaxial with Young's Modulus (tsf)	Triaxial with Poisson's Ratio	Point Load Index (MPa)	Direct Shear Strength on Saw-Cut Surface (tsf)	Direct Shear Strength on Fracture Surface (tsf)	Direct Shear Strength Apparent Friction	Brazilian Splitting Tensile Strength (MPa)	Dry Unit Weight (pcf)	Specific Gravity	Moh's Hardness	Slake Durability	Cerhar Abrasivity Index
B-1	82.0	SANDSTONE	5610										146.0				
B-1	91.5	SANDSTONE	5050										157.0				
B-1	112.4	SANDSTONE	4210										153.0				
B-1	132.5	SANDSTONE	4990										152.0				

Refer to the Geotechnical Investigation Report or the supplemental plates for the method used for the testing performed above.
NA = Not Available

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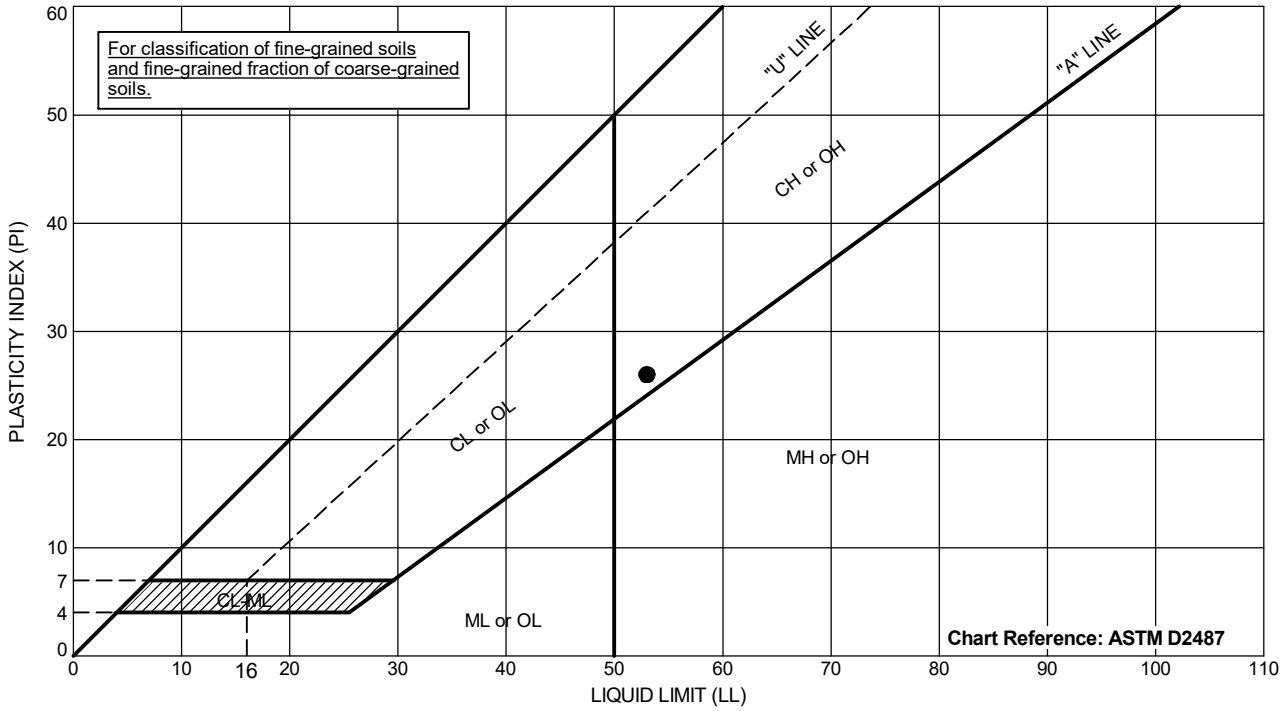
ROCK LABORATORY TEST RESULT SUMMARY

OFFSHORE CABLE LANDING
HORIZONTAL DIRECTIONAL DRILL
WINEMA BEACH, CLOVERDALE, OREGON

FIGURE
D-2



Exploration ID	Depth (ft.)	Sample Description	Passing #200	LL	PL	PI
● B-1	40	CLAYEY SAND (SC)	17	53	27	26

Testing performed in general accordance with ASTM D4318.
NP = Nonplastic
NM = Not Measured

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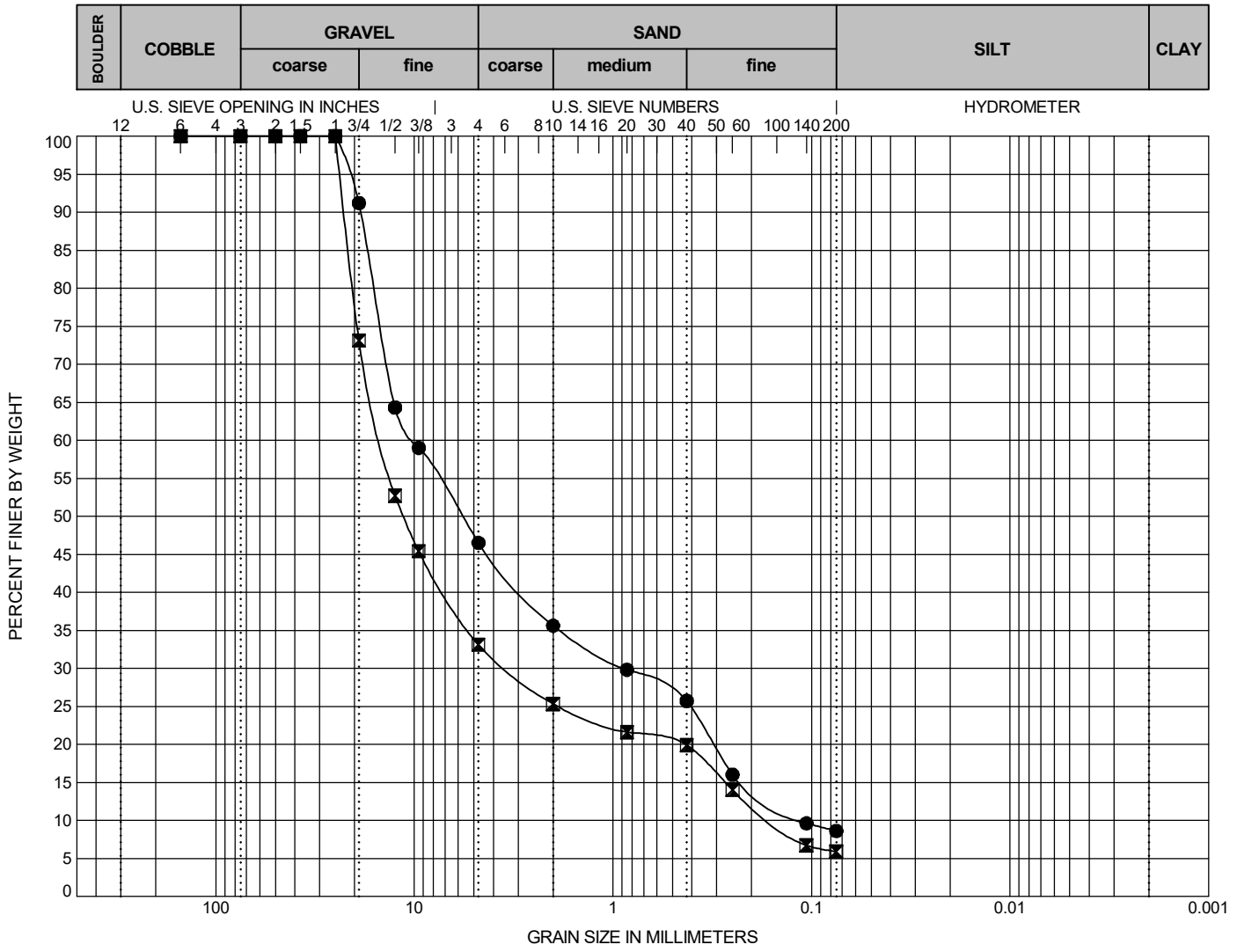
DATE:

ATTERBERG LIMITS

OFFSHORE CABLE LANDING
HORIZONTAL DIRECTIONAL DRILL
WINEMA BEACH, CLOVERDALE, OREGON

FIGURE
D-3



Exploration ID		Depth (ft.)	Sample Description	LL	PL	PI
●	B-1	20	POORLY GRADED GRAVEL WITH SILT AND SAND (GP-GM)	NM	NM	NM
⊠	B-1	25	POORLY GRADED GRAVEL WITH SILT AND SAND (GP-GM)	NM	NM	NM

Exploration ID		Depth (ft.)	D_{100}	D_{60}	D_{30}	D_{10}	Cc	Cu	Passing 3/4"	Passing #4	Passing #200	%Silt*	%Clay*
●	B-1	20	150	10.005	0.875	0.112	0.68	89.46	91	47	8.6	NM	NM
⊠	B-1	25	150	14.52	3.368	0.156	5.00	92.94	73	33	5.9	NM	NM

*These numbers represent silt-sized and clay-sized content but may not indicate the percentage of the material with the engineering properties of silt or clay. Sieve Analysis and Hydrometer Analysis testing performed in general accordance with ASTM D6913(Sieve Analysis) and ASTM D7928 (Hydrometer Analysis).
NP = Nonplastic
NM = Not Measured

Coefficients of Uniformity - $C_u = D_{60} / D_{10}$
Coefficients of Curvature - $C_C = (D_{30})^2 / D_{60} D_{10}$
D_{60} = Grain diameter at 60% passing
D_{30} = Grain diameter at 30% passing
D_{10} = Grain diameter at 10% passing

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DATE:

SIEVE ANALYSIS

OFFSHORE CABLE LANDING
HORIZONTAL DIRECTIONAL DRILL
WINEMA BEACH, CLOVERDALE, OREGON

FIGURE
D-4

Specimen Preparation in accordance with ASTM D4543	Diameter, in	D_O	2.39
Remarks:	Height, in	H_O	5.42
	Moisture Condition		As Received
	Unit Weight, pcf	ρ_d	146
	Uniaxial Compressive Strength (psi)	σ_u	5,610
	Time to Failure, mm:ss		2:18

Description of Specimen: --

Test Method: ASTM D7012, Method C

Boring:	B-1
Run:	4
Depth, ft:	82
Test Date:	6/9/22

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PROJECT NO.: 20230058
ENTRY BY: S. Winn
CHECKED BY: C. Pollack
DATE: 6/14/2022

UNIAXIAL COMPRESSION TEST

OFFSHOR□ C□BL□ L□□DI□G HORI□O□T□L DIR□CTIO□□L DRILL □ I□□M□ B□□CH□CLO□□RD□L□□OR□GO□

FIGURE

D□□

Specimen Preparation in accordance with ASTM D4543	Diameter, in	D_O	2.39
Remarks:	Height, in	H_O	5.04
	Moisture Condition		As Received
	Unit Weight, pcf	ρ_d	157
	Uniaxial Compressive Strength (psi)	σ_u	5,050
	Time to Failure, mm:ss		3:12

Description of Specimen: --

Test Method: ASTM D7012, Method C

Boring:	B-1
Run:	6
Depth, ft:	91.5
Test Date:	6/9/2022

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PROJECT NO.: 20230058
ENTRY BY: A. Auvinen
CHECKED BY: C. Pollack
DATE: 6/14/2022

UNIAXIAL COMPRESSION TEST

OFFSHOR□ C□BL□ L□□DI□G HORI□O□T□L DIR□CTIO□□L DRILL □ I□□M□ B□□CH□CLO□□RD□L□□OR□GO□

FIGURE

D□□

Specimen Preparation in accordance with ASTM D4543	Diameter, in	D_O	2.39
Remarks:	Height, in	H_O	5.17
	Moisture Condition		As Received
	Unit Weight, pcf	ρ_d	153
	Uniaxial Compressive Strength (psi)	σ_u	4,210
	Time to Failure, mm:ss		2:16

Description of Specimen: --

Test Method: ASTM D7012, Method C

Boring:	B-1
Run:	10
Depth, ft:	112.4
Test Date:	6/9/2022

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PROJECT NO.: 20230058
ENTRY BY: S. Winn
CHECKED BY: C. Pollack
DATE: 6/14/2022

UNIAXIAL COMPRESSION TEST

OFFSHOR□ C□BL□ L□□DI□G HORI□O□T□L DIR□CTIO□□L DRILL □ I□□M□ B□□CH□CLO□□RD□L□□OR□GO□

FIGURE

D□□

Specimen Preparation in accordance with ASTM D4543	Diameter, in	D_O	2.40
Remarks:	Height, in	H_O	5.03
	Moisture Condition		As Received
	Unit Weight, pcf	ρ_d	152
	Uniaxial Compressive Strength (psi)	σ_u	4,990
	Time to Failure, mm:ss		5:49

Description of Specimen: --

Test Method: ASTM D7012, Method C

Boring:	B-1
Run:	14
Depth, ft:	132.5-133.8
Test Date:	6/9/2022

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PROJECT NO.: 20230058
ENTRY BY: S. Winn
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DATE: 6/14/2022

UNIAXIAL COMPRESSION TEST

OFFSHOR□ C□BL□ L□□DI□G HORI□O□T□L DIR□CTIO□□L DRILL □ I□□M□ B□□CH□CLO□□RD□L□□OR□GO□

FIGURE

D□□

APPENDIX E

GEOPHYSICAL INVESTIGATION RESULTS

Global Geophysics

P. O. Box 2229
Redmond, WA 98053

Tel: 425-890-4321
Fax: 206-582-0838

July 14, 2022 Our ref: 112-0228.000

Kleinfelder
3731 W. Ashcroft Ave,
Fresno, CA 93722

Attention: Mr. Pedro Rivas

RE: REPORT FOR THE GEOPHYSICAL SURVEYS FOR WINEMA HDD, OREGON

Dear Mr. Rivas:

Global Geophysics LLC. conducted downhole seismic, multi-channel analysis of surface wave (MASW), electrical resistivity tomography (ERT), and overwater seismic profiling surveys near Winema, OR in May, June and July, 2022. The objective of the studies is to the stratigraphy along the proposed HDD alignment.

1. GEOPHYSICAL METHODS, INSTRUMENTATION AND FIELD PROCEDRUES

The following paragraphs describe the methods and procedures.

1.1. Downhole Seismic Survey

The seismic downhole method provides a designer with information pertinent to the seismic wave velocities of the materials in question. The P-wave and S-wave velocities are directly related to the important geotechnical elastic constants of Poisson's ratio, shear modulus, bulk modulus, and Young's modulus. Accurate in-situ P-wave and S-wave velocity profiles are essential in geotechnical foundation designs. These parameters are used in both analyses of soil behavior under both static and dynamic loads where the elastic constants are input variables into the models defining the different states of deformations such as elastic, elasto-plastic, and failure. Another important use of estimated shear wave velocities in geotechnical design is in the liquefaction assessment of soils.

The downhole seismic survey was carried out using a Geometrics 32-bit Geode, a 24-channel seismograph. The receiver package employed was a Geostuff BHG-2 tri-axial package containing one vertical geophone for recording compressional wave (P-wave) and the two horizontal geophones for recording shear waves (S-wave). A lumber secured under vehicle

front wheels was used for S-wave source. The lumber was impacted by a 20 lb sledge hammer horizontally on both sides of the lumber to generate S-wave with opposite polarities. The receiver was lowered in the borehole at 3-foot interval, and data was collected and stored for further interpretation.

1.2. Multichannel Analysis of Surface Wave (MASW)

The MASW method determines variations in surface wave velocities with increasing distances and wavelengths. The data from these measurements are used to model the shear wave velocities of the subsurface. This information can then be used to infer rock/soil types, stratigraphy and soil conditions.

The MASW survey requires a seismic source, to generate surface-waves, and at least 24 geophones, to measure the ground response at increasing distances from the source. Surface waves are a special type of seismic wave whose propagation is confined to the near surface medium. The depth of subsurface penetration of a surface-wave is directly proportional to its wavelength. In a non-homogeneous medium, surface-waves are dispersive, i.e. each wavelength has a characteristic velocity stemming from subsurface heterogeneities. The relationship between surface-wave velocity and wavelength is used to calculate the shear-wave velocity of the medium with increasing depth.

The seismic source will be an excavator. Examples of passive sources are drill rigs, road traffic, micro-tremors, and water-wave action (in near-shore environments). Geophone measures the arrival time of the various components of the surface wave-train traveling from the seismic source.

The surface-wave velocity with respect to frequency (called the ‘dispersion curve’) is determined by measuring the delay time in wave propagation between the geophones. The dispersion curve is then matched to a theoretical dispersion curve using an iterative forward-modeling procedure. The result is a profile of shear-wave velocity versus depth. This shear wave profile can be with used other parameters such as density, to estimate the dynamic shear modulus of the medium as a function of depth.

The MASW survey was conducted using 24 geophone spaced at 10 ft.

1.3. Electrical Resistivity Tomography

The electrical resistivity tomography (ERT) technique maps differences in the electrical properties of geologic materials. These differences can result from variations in lithology, water content, pore-water chemistry, or voids. The method involves transmitting an electric current into the ground between two electrodes and measuring the voltage between two other electrodes. The direct measurement is the apparent resistivity of the area beneath the electrodes. The measurements include deeper layers as the electrode spacing is increased. Recent advances in technology permit rapid collection of multiple soundings, using up to 56 electrodes for each spread. The data are modeled to create a 2-D geo-electric cross-section that is useful for mapping both vertical and horizontal variations of the subsurface strata.

The data wasacquired with an AGI SuperSting R8 system using up to 56 electrodes space at a 10-20 feet interval on the ground surface/sea floor along the proposed HDD alignment. Once the electrode array was installed in the ground, multiple soundings were automatically carried out by the control unit. The data was downloaded on site into a computer and processed using specialized inversion software to determine if all of the objectives had been met.

1.4. Overwater Profiling

Overwater profiling provides a continuous subsurface image of the seabed, the underlying stratigraphy and major structural features in the bedrock. The subsurface acoustic image are produced in real-time on a computer screen which displays the data as a profile or cross-section view along the transect. Subsurface reflection data is acquired every 1 to 2 meters and the location of each data point is determined with the global position satellite system. Preliminary interpretation of the data can be done in the field without the need for additional processing.

The reflection survey used a low frequency seismic reflection system, with a frequency band-pass of 450 to 1500 Hz to obtain maximum subsurface penetration in fined-grained to coarse-grained sediment. The acoustic energy source was mounted on the side of the vessel and a 20 ft long hydrophone is towed approximately 10 ft astern of the acoustic transducer.

A DGPS system will be used to navigate along proposed HDD alignment. The reflection data is processed and stored on a digital acquisition system.

2. RESULTS

The line locations are shown in Figure 1. The s-wave profile MASW 1 (on land) is presented in Figure 2 together with resistivity profile ERT 2 (on land). The borehole B1 is approximately 65 north of the transect. The interpreted top of the sandstone is shown in dashed magenta line. MASW and ERT measure different soil properties with different electrode/geophone/shot spacings, their contour lines may not match.

In addition, the measured soil resistivity values are in very different ranges when collected on land and in sea water. The resistivity range is much lower in sea water due to large current output. The ERT 1 profile is shown in Figure 3. The interpreted overburden and basal layer (assuming sandstone) is highlighted with the dashed magenta line. The overburden thickness varies between 35 ft to 50 ft. However, there is a big data gap between ERT1 and ERT2, and different materials have similar resistivity ranges, the interpreted geological units can be different from ground truthing.

The overwater seismic profiling data were collected back and forth between (45°8.750’N, -123°59.366’) and (45°8.783’, -123°58.816’) as close to the shore as possible (approximately 15 ft water depth). The track lines and profiles are shown in Figure 4. The interpreted basal layer based on the resistivity profile is shown in dashed purple line.

The shear velocities measured at borehole B1 is listed in the table below:

Table 1: Calculated shear wave velocity at B1

Depth (ft)	Arrival (ms)	S-wave Velocity (ft/s)
3	21.72	
6	24.96	610
9	28.21	766
12	31.45	834
15	34.70	867
18	37.94	885
21	41.18	896
24	44.43	903
27	47.67	908
30	49.81	1378
33	51.96	1382
36	54.10	1385
39	56.25	1387
42	58.39	1389
45	60.54	1390
48	62.68	1391
51	64.82	1392
54	66.97	1393
57	69.11	1393
60	71.26	1394
63	73.40	1395
66	74.94	1942
69	76.48	1943
72	78.02	1943
75	79.56	1944
78	81.10	1944
81	82.64	1944
84	83.85	2466
87	85.07	2466
90	86.28	2466
93	87.50	2466
96	88.71	2467
99	89.93	2467
102	91.14	2467
105	92.36	2467
108	93.57	2467

111	94.79	2467
114	96.00	2468
117	97.18	2536
120	98.36	2536
123	99.55	2536
126	100.73	2536
129	101.91	2537
132	103.09	2537
135	104.27	2537
138	105.45	2537
141	106.64	2537
144	107.82	2537
147	109.00	2537

S-wave source to borehole distance = 5 ft

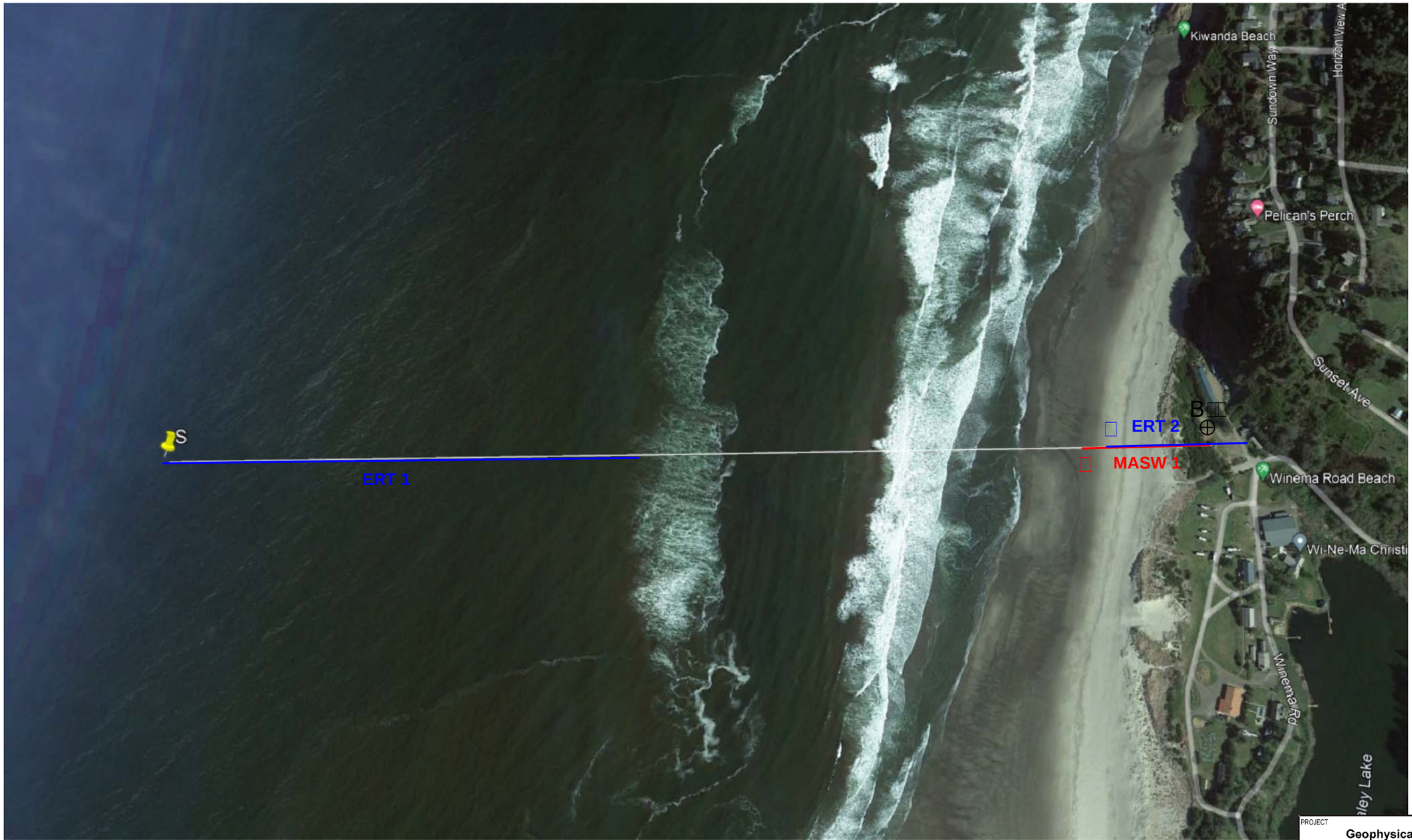
LIMITATION OF GEOPHYSICAL METHODS

Global geophysics services are conducted in a manner consistent with the level of care and skill ordinarily exercised by other members of the geophysical community currently practicing under similar conditions subject to the time limits and financial and physical constraints applicable to the services. MASW, ERT, seismic profiling are remote sensing geophysical methods that may not detect all subsurface conditions due to the limitations of the methods, soil conditions, size of the features and their depths. Different soil/rock types have wide overlapping velocity and resistivity ranges, the interpreted geological units may be proven to be different by ground truthing.

Sincerely,

Global Geophysics

John Liu, Ph.D., R.G.
Principal Geophysicist



N

□ ft □□□ ft □□□□ ft

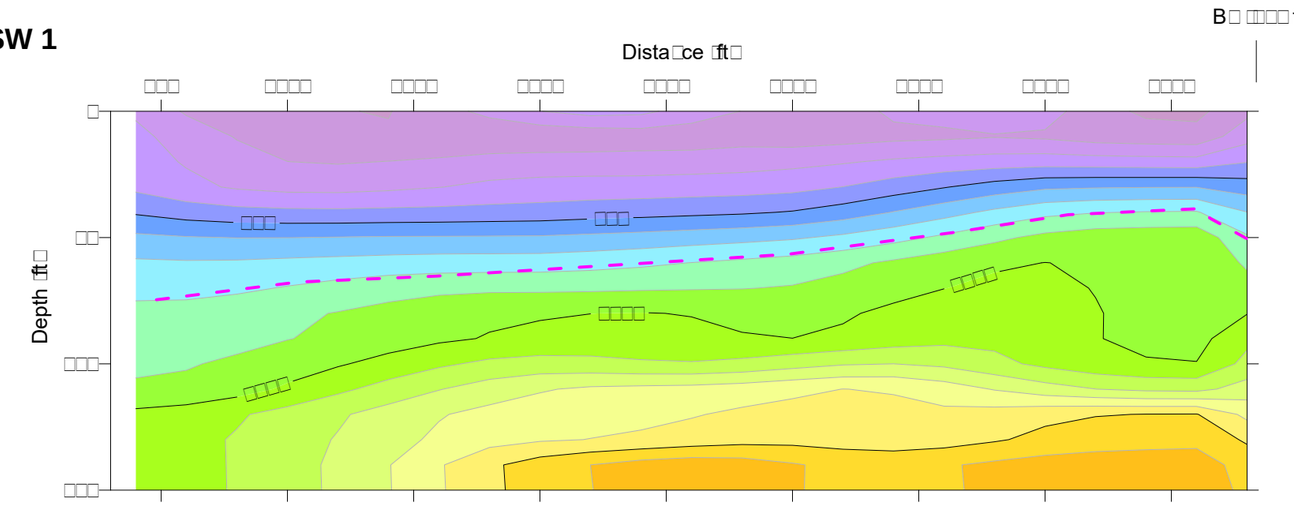
PROJECT
Geophysical Survey Along Winema HDD
Winema, OR

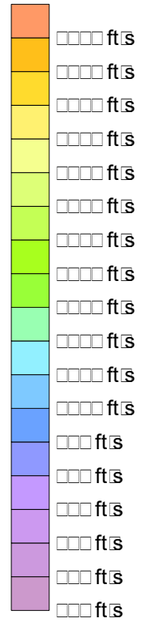
TITLE
Site Map

Global Geophysics
P.O. Box 2229
Redmond, WA 98073-2229
Tel: 425-890-4321

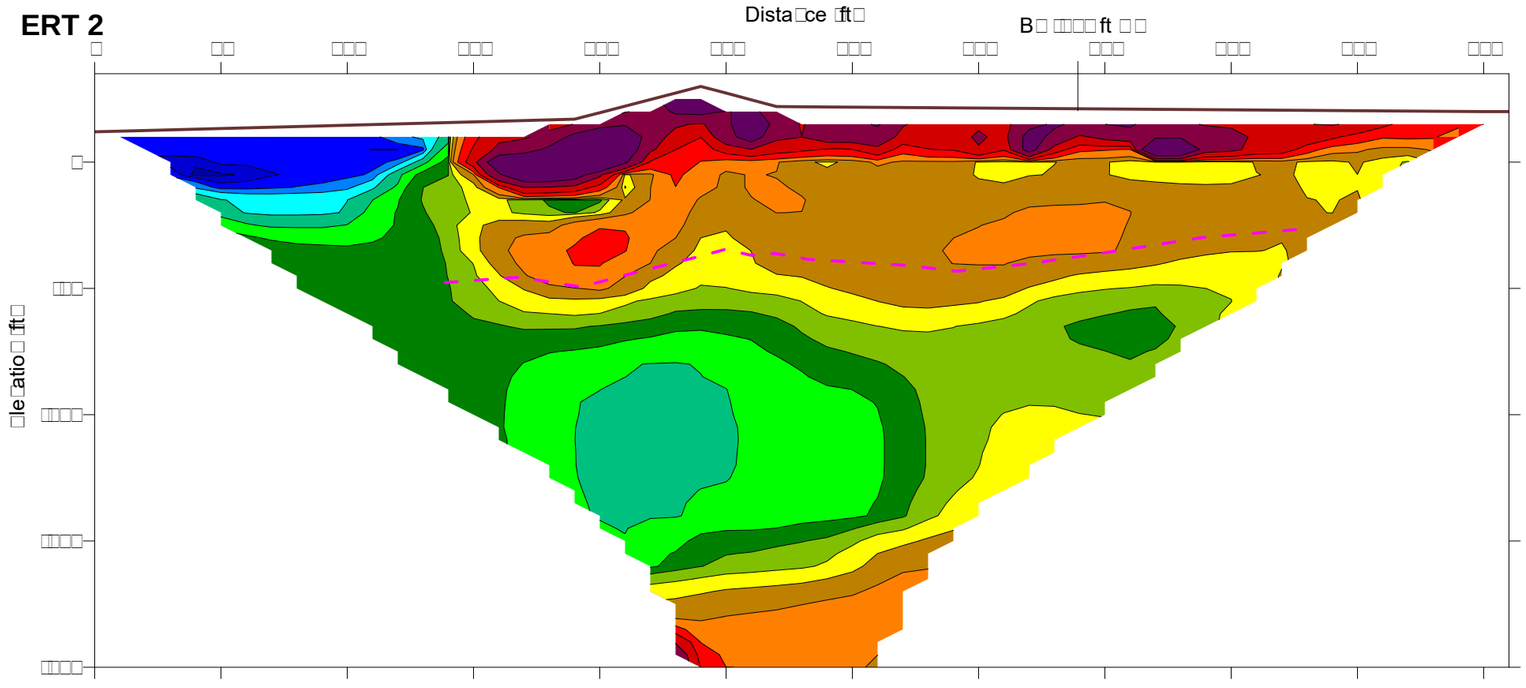
Project #: 112-0228.000			FILE No.
DESIGN	--		SCALE AS SHOWN REV.
CADD	EJ		**FIGURE 1**
CHECK	JL		
REVIEW	--		

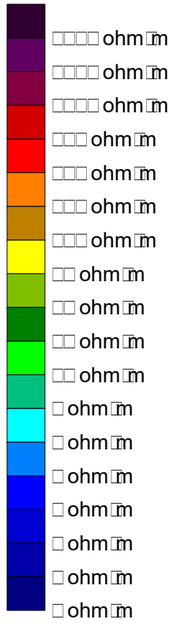
MASW 1





ERT 2





ft ft ft

Legend:

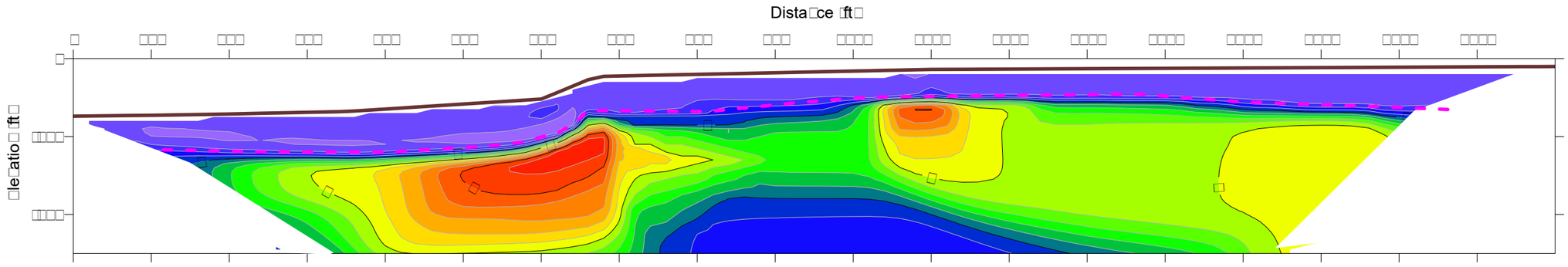
Interpreted top of the sandstone

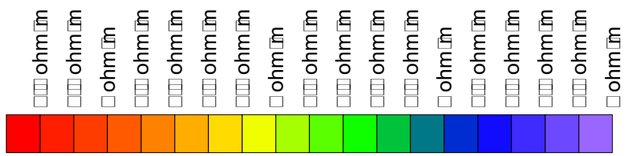
PROJECT
Geophysical Survey Along Winema HDD
Winema, OR

TITLE
S-wave Velocity and Resistivity Profiles

Global Geophysics
P.O. Box 2229
Redmond, WA 98073-2229
Tel: 425-890-4321

Project #: 112-0228.000			FILE No.
DESIGN	--		SCALE AS SHOWN REV.
CADD	EJ		**FIGURE 2**
CHECK	JL		
REVIEW	--		



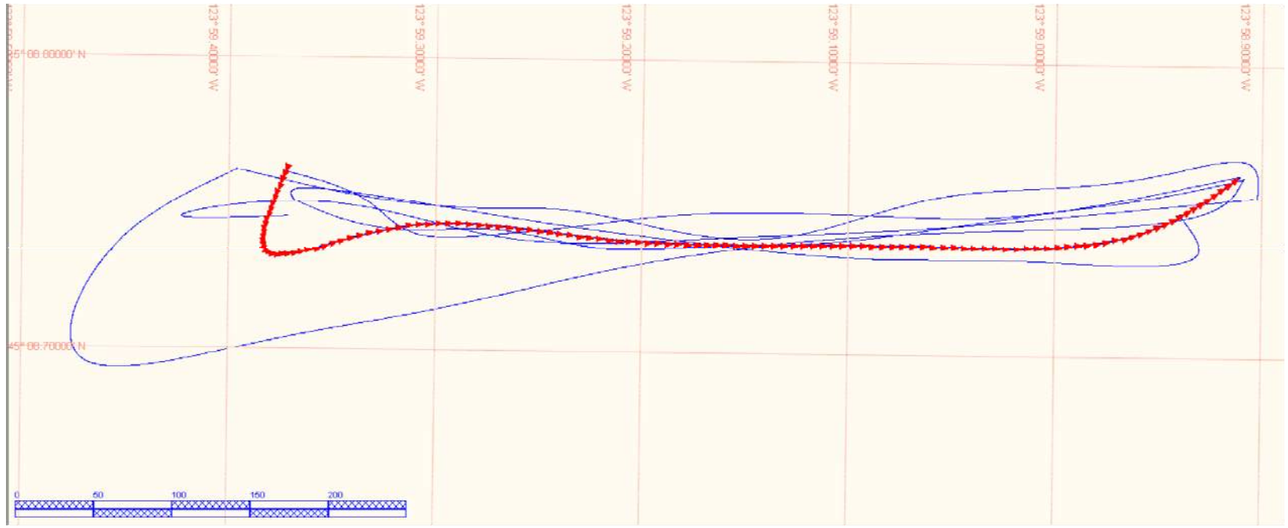


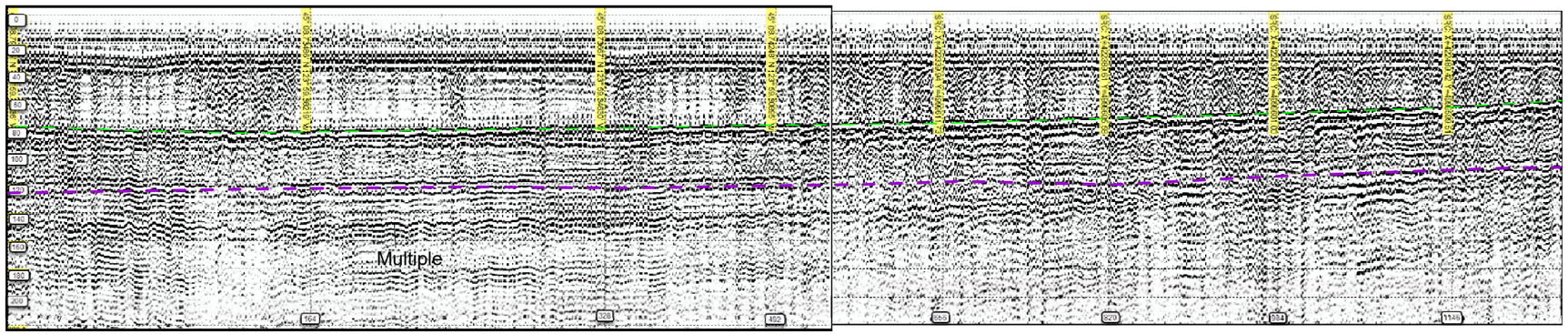
Legend:

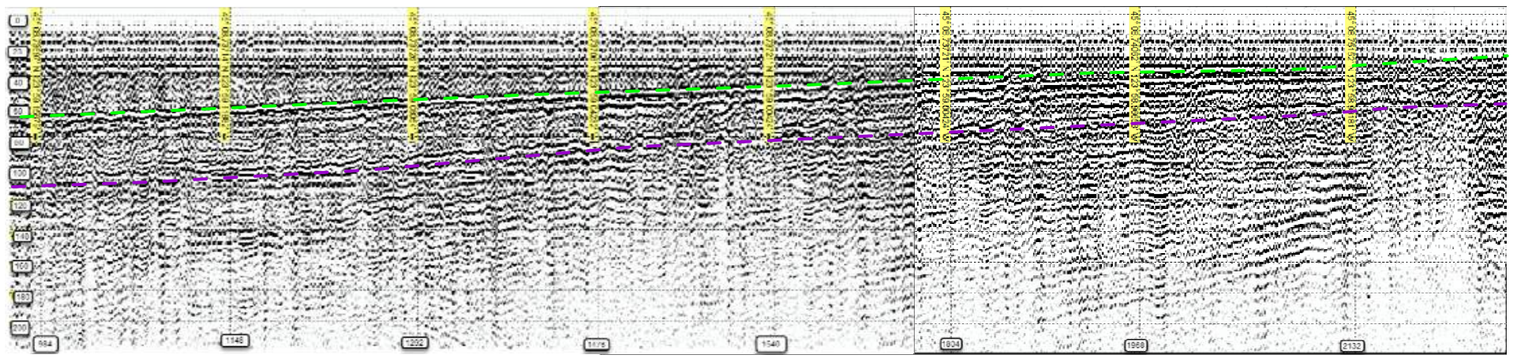
Interpreted top of the sandstone

PROJECT	Geophysical Survey Along Winema HDD Winema, OR		
TITLE	ERT 1 Resistivity Profile		
Global Geophysics P.O. Box 2229 Redmond, WA 98073-2229 Tel: 425-890-4321	Project #: 112-0228.000	FILE No.	
	DESIGN --	SCALE AS SHOWN	REV.
	CADD EJ	FIGURE 3	
	CHECK JL		
	REVIEW --		

Track Lines







Seismic record images are not scaled

Legend

Sea floor

Interpreted basal layer

PROJECT

Geophysical Survey Along Winema HDD
Winema, OR

TITLE

Seismic Profile

Global Geophysics
P.O. Box 2229
Redmond, WA 98073-2229
Tel: 425-890-4321

Project #: 112-0228.000			FILE No.
DESIGN	--		SCALE AS SHOWN REV.
CADD	EJ		
CHECK	JL		**FIGURE 4**
REVIEW	--		

APPENDIX F

GBA INFORMATION SHEET

Important Information about This

Geotechnical-Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

The Geoprofessional Business Association (GBA) has prepared this advisory to help you – assumedly a client representative – interpret and apply this geotechnical-engineering report as effectively as possible. In that way, you can benefit from a lowered exposure to problems associated with subsurface conditions at project sites and development of them that, for decades, have been a principal cause of construction delays, cost overruns, claims, and disputes. If you have questions or want more information about any of the issues discussed herein, contact your GBA-member geotechnical engineer. Active engagement in GBA exposes geotechnical engineers to a wide array of risk-confrontation techniques that can be of genuine benefit for everyone involved with a construction project.

Understand the Geotechnical-Engineering Services Provided for this Report

Geotechnical-engineering services typically include the planning, collection, interpretation, and analysis of exploratory data from widely spaced borings and/or test pits. Field data are combined with results from laboratory tests of soil and rock samples obtained from field exploration (if applicable), observations made during site reconnaissance, and historical information to form one or more models of the expected subsurface conditions beneath the site. Local geology and alterations of the site surface and subsurface by previous and proposed construction are also important considerations. Geotechnical engineers apply their engineering training, experience, and judgment to adapt the requirements of the prospective project to the subsurface model(s). Estimates are made of the subsurface conditions that will likely be exposed during construction as well as the expected performance of foundations and other structures being planned and/or affected by construction activities.

The culmination of these geotechnical-engineering services is typically a geotechnical-engineering report providing the data obtained, a discussion of the subsurface model(s), the engineering and geologic engineering assessments and analyses made, and the recommendations developed to satisfy the given requirements of the project. These reports may be titled investigations, explorations, studies, assessments, or evaluations. Regardless of the title used, the geotechnical-engineering report is an engineering interpretation of the subsurface conditions within the context of the project and does not represent a close examination, systematic inquiry, or thorough investigation of all site and subsurface conditions.

Geotechnical-Engineering Services are Performed for Specific Purposes, Persons, and Projects, and At Specific Times

Geotechnical engineers structure their services to meet the specific needs, goals, and risk management preferences of their clients. A geotechnical-engineering study conducted for a given civil engineer will not likely meet the needs of a civil-works constructor or even a different civil engineer. Because each geotechnical-engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client.

Likewise, geotechnical-engineering services are performed for a specific project and purpose. For example, it is unlikely that a geotechnical-engineering study for a refrigerated warehouse will be the same as one prepared for a parking garage; and a few borings drilled during a preliminary study to evaluate site feasibility will not be adequate to develop geotechnical design recommendations for the project.

Do not rely on this report if your geotechnical engineer prepared it:

- for a different client;
- for a different project or purpose;
- for a different site (that may or may not include all or a portion of the original site); or
- before important events occurred at the site or adjacent to it; e.g., man-made events like construction or environmental remediation, or natural events like floods, droughts, earthquakes, or groundwater fluctuations.

Note, too, the reliability of a geotechnical-engineering report can be affected by the passage of time, because of factors like changed subsurface conditions; new or modified codes, standards, or regulations; or new techniques or tools. *If you are the least bit uncertain* about the continued reliability of this report, contact your geotechnical engineer before applying the recommendations in it. A minor amount of additional testing or analysis after the passage of time – if any is required at all – could prevent major problems.

Read this Report in Full

Costly problems have occurred because those relying on a geotechnical-engineering report did not read the report in its entirety. Do not rely on an executive summary. Do not read selective elements only. *Read and refer to the report in full.*

You Need to Inform Your Geotechnical Engineer About Change

Your geotechnical engineer considered unique, project-specific factors when developing the scope of study behind this report and developing the confirmation-dependent recommendations the report conveys. Typical changes that could erode the reliability of this report include those that affect:

- the site's size or shape;
- the elevation, configuration, location, orientation, function or weight of the proposed structure and the desired performance criteria;
- the composition of the design team; or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project or site changes – even minor ones – and request an assessment of their impact. *The geotechnical engineer who prepared this report cannot accept*

responsibility or liability for problems that arise because the geotechnical engineer was not informed about developments the engineer otherwise would have considered.

Most of the "Findings" Related in This Report Are Professional Opinions

Before construction begins, geotechnical engineers explore a site's subsurface using various sampling and testing procedures. *Geotechnical engineers can observe actual subsurface conditions only at those specific locations where sampling and testing is performed.* The data derived from that sampling and testing were reviewed by your geotechnical engineer, who then applied professional judgement to form opinions about subsurface conditions throughout the site. Actual sitewide-subsurface conditions may differ – maybe significantly – from those indicated in this report. Confront that risk by retaining your geotechnical engineer to serve on the design team through project completion to obtain informed guidance quickly, whenever needed.

This Report's Recommendations Are Confirmation-Dependent

The recommendations included in this report – including any options or alternatives – are confirmation-dependent. In other words, they are not final, because the geotechnical engineer who developed them relied heavily on judgement and opinion to do so. Your geotechnical engineer can finalize the recommendations *only after observing actual subsurface conditions* exposed during construction. If through observation your geotechnical engineer confirms that the conditions assumed to exist actually do exist, the recommendations can be relied upon, assuming no other changes have occurred. *The geotechnical engineer who prepared this report cannot assume responsibility or liability for confirmation-dependent recommendations if you fail to retain that engineer to perform construction observation.*

This Report Could Be Misinterpreted

Other design professionals' misinterpretation of geotechnical-engineering reports has resulted in costly problems. Confront that risk by having your geotechnical engineer serve as a continuing member of the design team, to:

- confer with other design-team members;
- help develop specifications;
- review pertinent elements of other design professionals' plans and specifications; and
- be available whenever geotechnical-engineering guidance is needed.

You should also confront the risk of constructors misinterpreting this report. Do so by retaining your geotechnical engineer to participate in prebid and preconstruction conferences and to perform construction-phase observations.

Give Constructors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can shift unanticipated-subsurface-conditions liability to constructors by limiting the information they provide for bid preparation. To help prevent the costly, contentious problems this practice has caused, include the complete geotechnical-engineering report, along with any attachments or appendices, with your contract documents, *but be certain to note conspicuously that you've included the material for information purposes only.* To avoid misunderstanding, you may also want to note that "informational purposes" means constructors have no right to rely on the interpretations, opinions, conclusions, or recommendations in the report. Be certain that constructors know they may learn about specific project requirements, including options selected from the report, *only* from the design drawings and specifications. Remind constructors that they may perform their own studies if they want to, and *be sure to allow enough time* to permit them to do so. Only then might you be in a position to give constructors the information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions. Conducting prebid and preconstruction conferences can also be valuable in this respect.

Read Responsibility Provisions Closely

Some client representatives, design professionals, and constructors do not realize that geotechnical engineering is far less exact than other engineering disciplines. This happens in part because soil and rock on project sites are typically heterogeneous and not manufactured materials with well-defined engineering properties like steel and concrete. That lack of understanding has nurtured unrealistic expectations that have resulted in disappointments, delays, cost overruns, claims, and disputes. To confront that risk, geotechnical engineers commonly include explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are Not Covered

The personnel, equipment, and techniques used to perform an environmental study – e.g., a "phase-one" or "phase-two" environmental site assessment – differ significantly from those used to perform a geotechnical-engineering study. For that reason, a geotechnical-engineering report does not usually provide environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated subsurface environmental problems have led to project failures.* If you have not obtained your own environmental information about the project site, ask your geotechnical consultant for a recommendation on how to find environmental risk-management guidance.

Obtain Professional Assistance to Deal with Moisture Infiltration and Mold

While your geotechnical engineer may have addressed groundwater, water infiltration, or similar issues in this report, the engineer's services were not designed, conducted, or intended to prevent migration of moisture – including water vapor – from the soil through building slabs and walls and into the building interior, where it can cause mold growth and material-performance deficiencies. Accordingly, ***proper implementation of the geotechnical engineer's recommendations will not of itself be sufficient to prevent moisture infiltration. Confront the risk of moisture infiltration*** by including building-envelope or mold specialists on the design team. ***Geotechnical engineers are not building-envelope or mold specialists.***

GEOPROFESSIONAL BUSINESS ASSOCIATION

Telephone: 301/565-2733
e-mail: info@geoprofessional.org www.geoprofessional.org

Appendix 5
Inadvertent Return Contingency Plan
Drill Break Avoidence and Response Plan
Beach Void Monitoring and Response Plan

BIFROST CABLE
Inadvertent Return Contingency Plan For Horizontal Directional Drilling

Prepared for

Bifrost Subsea Fiber Optic Cable Project

Winema, Oregon Operations

February 10, 2023

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List of Tables

Appendices

1. Introduction

This Inadvertent Return Contingency Plan has been developed for the Bifrost Subsea Fiber Optic Cable Project (Project) in Winema, Oregon. The primary construction component of the project is the installation of a single steel landing pipe (LP) that will extend from on shore to a specified point in the ocean. This LP will be installed by use of horizontal directional drill (HDD) construction methods. Further detailed descriptions on this process and the LP are included below.

RTI Solutions, Inc. (RTI-S) has adapted and modified this plan based on the plan previously developed by AMCS LLC That plan was previously submitted and approved for use in a previous similar project. This plan is submitted in compliance with applicable environmental regulations, rules, and policies for federal and state authorities, including but not limited to the U.S. Army Corps of Engineers (USACE), National Marine Fisheries Service (NMFS), Oregon Parks and Recreation Department (OPRD), and the Oregon Department of State Lands (DSL).

Pursuant to the OPRD Beach Construction/Alteration Standards (Chapter 736, Division 20), Rules 736-020-0005 (Factors Evaluated), 736-020-0010 (General Standards), 736-020-0015 (Scenic Standards), 736-020-0020 (Recreational Use Standards), 736-020-0025 (Safety Standards), and 736-020-0030 (Natural and Cultural Resource Standards), the inadvertent return contingency plan, beach void monitoring and response plan, and drill break avoidance and response plan are collectively intended to meet OPRD's standards for avoiding and minimizing potential impacts to the following public and natural resources: Physical Environment; Aesthetics; Public Access; Public Recreation; Public Safety; and Water Quality. Based on field surveys and publicly available literature, implementation of the Project would result in no impacts to the following additional resources under the purview of OPRD, pursuant to 736-020-0015 (Scenic Standards) and 736-020-0030 (Natural and Cultural Resource Standards): Key Natural Features; Shoreline Vegetation; Fish and Wildlife Resources; Historic, Cultural, and Archeological Sites; Navigation; and Areas of Geologic Interest.

Horizontal Directional Drill (HDD) operations, also known as directional bores, have the potential to release drilling fluids, a mixture of fine clay and water described later, to the ground surface or onto the ocean floor. The release is known as an inadvertent return (IR). An IR can occur where the drill bit is particularly close to the ground surface or where the drilling mud migrates to the surface through a fracture or fisher in the ground. Because drilling muds consist largely of a bentonite clay-water mixture (approximately 92% water 7% bentonite clay and 1% nontoxic additives), they are not classified as toxic or hazardous substances. However, if it is released into low flow aquatic environments in large quantities, the mud has the potential to settle onto the bottom and, acting as a silt, adversely impact fish and invertebrate species.

While drilling mud seepage associated with an IR is most likely to occur near the bore entry and exit points where the drill head is shallow, IRs can occur in any location along a directional bore path. This Inadvertent Return Contingency Plan (IRCP) establishes operational procedures and responsibilities for the prevention, containment, and clean-up of IRs associated with the proposed directional drilling utility project. All onsite personnel, including subcontractors, responsible for the work must adhere to this plan during the directional drilling process.

The specific objectives of this IRCP are to:

1. Minimize the potential for an IR associated with directional drilling activities.
2. Provide for the timely detection of IRs.
3. Protect the environmentally sensitive habitats that may occur in the vicinity of the work.
4. Provide for an organized, timely, and "minimum-impact" response in the event of an IR.
5. Provide for all appropriate notifications are made immediately to the management and safety personnel, as well as the applicable regulatory agencies.

2. Site Conditions

The possibility of having an IR is heavily influenced by the specific characteristics of each site. For this Project, there are a number of site characteristics that are advantageous to the drilling process and will help reduce the probability of an IR, lessen the potential severity of an IR and increase the ability to respond to an IR. Some of these site characteristics include:

1. There are no sensitive habitats, such as streams or wetlands in proximity to the site. Therefore, there is no potential for an IR to reach a stream, wetland or other sensitive aquatic habitat.
2. The Site elevation of twenty feet (20') is close to sea level. This is important in that it will reduce the residual head pressure in the bore pipe once the HDD pump is shut down. Should an IR be identified, shutting down the drill operation is the first step. A bore site that is substantially above sea level would have a higher volume of drilling mud in the pipe remaining above sea level. Gravity could allow this mud to flow down the pipe thereby increasing the volume of the IR. With a bore site elevation of twenty feet, potential for additional mud to escape once the pumps are shut down is minimal.
3. The bore site is located a sufficient distance from the ocean (~500 feet) and set back quite a distance from the beach (~200 feet). This will allow the bore pipe to achieve a depth of approximately thirty-five feet (35') as it begins to pass under the beach and approximately eighty feet (80') as it reaches the ocean edge. The deeper the bore the less likely an IR is.
4. The initial stages of the bore will be under the dune area. The presence of the dunes increases the overburden over the drill head thereby reducing the possibility of an IR.
5. The bore site is surrounded by higher ground.

3. Responsibilities

The Site Supervisor has overall responsibility for implementing this IRCP. The Site Supervisor will ensure that all employees are trained prior to the commencement of the HDD installation. The Site Supervisor shall be notified immediately when an IR is detected. The Site Supervisor will be responsible for ensuring that the safety department is aware of the IR, coordinating personnel, response, cleanup, regulatory agency notification and coordination to ensure proper clean-up, disposal of recovered material, and timely reporting of the incident. The Site Supervisor shall also ensure all waste materials are properly containerized, labeled, and removed from the site to an approved disposal facility by personnel experienced in the removal, transport, and disposal of drilling mud.

The Site Supervisor shall be familiar with all aspects of the drilling activity, the contents of this IRCP and the conditions of approval under which the activity is permitted to take place. The Site Supervisor shall have the authority to stop work and commit the resources (personnel and equipment) necessary to implement this plan. The Site Supervisor shall assure that a copy of this plan is available (onsite) and accessible to all construction personnel during all HDD construction. The Site Supervisor shall ensure that all workers are properly trained and familiar with the necessary procedures for response to an IR, prior to commencement of drilling operations.

The Site Supervisor shall ensure that:

- All equipment and vehicles are be checked and maintained daily to prevent leaks of hazardous materials.
- Spill kits and spill containment materials are always available on-site and that the equipment is in good working order.
- Equipment required to contain and clean up an IR will either be available at the work site or readily available at an offsite location within 15 minutes of the bore site.
- If equipment is required to be operated near an identified sensitive aquatic habitat, absorbent pads, and plastic sheeting for placement beneath motorized equipment shall be used to protect the riverbed from engine fluids.

Prior to the start of construction, the Site Supervisor shall ensure that the crew members receive training in the following:

- The provisions of the IRCP, equipment maintenance, and site-specific permit and monitoring requirements.
- Inspection procedures for release prevention and containment equipment and materials.
- Contractor/crew obligation to immediately stop the drilling operation upon first evidence of the occurrence of an IR and to immediately report any releases.
- Contractor/crew member responsibilities in the event of a release.
- Operation of release prevention and control equipment and the location of release control materials, as necessary and appropriate.
- Protocols for communication with agency representatives who might be on-site during the clean-up effort.
- As part of the Site Supervisors daily safety meeting, they will ensure the workers understand the appropriate procedures to be followed in case of an IR

4. HDD Design and Operations

4.1 HDD Design Elements

The Project has been designed to minimize the potential of an IR. Figure 1 below shows the general site design.

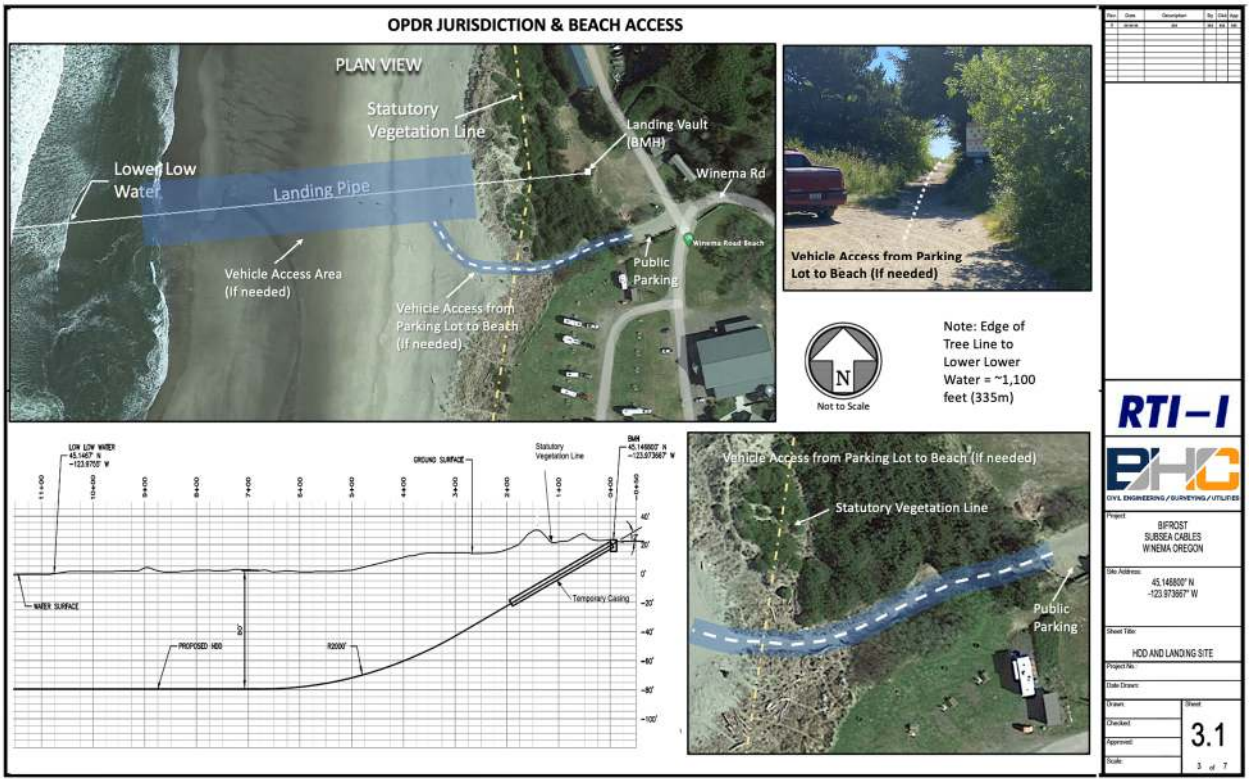

Figure 1: General Site Design

Some of the design elements that have been incorporated include:

- Geotechnical Analysis and Guidance. The Geotechnical Report prepared for the project identifies the subsurface soil characteristics to be expected along the drill path and makes recommendations to help inform the HDD contractor relative to mud mixture and formation penetration rates.
- Temporary Surface Casing. A temporary casing approximately 17 to 20-inches in diameter will be installed for approximately the first 200 linear feet of the HDD at which point the casing will be approximately 20 feet deep. It will enter cross the Statutory Vegetation Line approximately 110 feet westerly of the entry point and

will be at a depth of approximately 20 feet. The temporary casing will terminate just westerly of the dunes at which point it will be 35 feet deep. The purpose of this casing is to ensure the integrity of the bore hole as the remainder of the bore operation is completed. The casing will ensure the bore hole does not collapse during the drilling process. Further it protects from scour that would increase the diameter of the bore hole. As the drill head reaches deeper depths (beyond about 20' deep) the subsurface materials are denser and well packed and there is limited risk of collapse.

- HDD Entry Angle. The entry angle of the bore pipe will be approximately 12 degrees from horizontal. This angle is steep enough to allow the bore head to gain depth quickly, thereby reducing the potential of an IR, and horizontal enough to allow for a larger bend radius on the bore pipe.
- Large Bend Radius. The bend radius used for the bore pipe is 2,000 feet. This very large radius will allow for minimum pressure to be exerted on the bore pipe when leveling it off at the desired elevation and as it is guided to its design end point.

4.2 The HDD Bore Machine

The HDD bore machine, also known as the HDD rig, will be placed in position and prepared for bore pipe installation. The individual segments of bore pipe will be placed on the HDD rig by either a small crane, forklift or excavator stationed next to the drill rig.

Figure 2: Example of an HDD Rig, Bore Pipes and Forklift

4.3 Fluid Mixing & Recycling Unit

A mixing & recycling unit will be used to mix the drilling mud, remove the drill cuttings for disposal and recycle the drilling mud for reuse in the drilling process. The drilling mud is made up of a natural clay called bentonite and water which are mixed in the large tank for use in the drilling process. The mud is mixed at a ratio of approximately 95% water and 7% bentonite clay and up to 1% of non-toxic additives. The drilling mud is pumped down the drill pipe to turn the cutting head as it penetrates the formation. The drilling mud exits the cutting head, which is larger than the bore pipe, and returns to the bore site in the annular space between the sides of the bore hole and the bore pipe. In the process the drilling mud suspends and carries the cuttings from the drilling process (sand, rock, soil, clay) back to

the bore site for disposal. In the process, the drilling mud coats the bore hole helping keep it from collapsing, seals it and serves to lubricate the hole allowing the bore pipe to slide along the hole more easily. As the drilling mud and cuttings are returned to the bore site they are pumped back to the mixing/recycling unit where the cuttings are separated from the drilling fluid. The cuttings are stockpiled for removal to an approved landfill and the drilling fluid reused as the bore process continues. This recycling process will minimize the use of freshwater for the mixing and reduce the risk of drilling fluid leak in the surrounding area.

The recycling unit chosen for these operations typically has a 280 m^3 / hour clean mud recycling capacity and utilizes three stages of recycling: a preliminary shaker, a de-sander, and a de-silter. The de-silter employs two sets of meshes and hydro cyclones to clean the fluid from solids up to 20 µm. An example of this unit is illustrated in 3.

Figure 3: Example of a Drilling Fluid Mixing & Recycling Unit

4.4 On-site Response Equipment

Certain equipment will be on site and available for immediate deployment to contain and remove an IR should one occur. Some of this equipment is included in standard HDD operations and some are specific to particular response. On-site or staged within a 10-minute drive from the site will be:

- Pumps and hoses to pump drilling mud back to the bore site from a near-by IR.
- Sandbags or straw bales and coir waddles to use to surround and contain an IR.
- Vacuum trailer or truck to respond to IR's that lie beyond the length of available hoses
- Spill Kit for potential machinery leaks or spills. Though not part of an IR, it is worth noting that a standard hazardous materials spill kit will be on site to respond to potential spills from hydraulic leaks, fuels or other materials used in the equipment.

4.5 Drilling Mud

4.5.1 Drilling Mud Mixing and Preparation

The mud to be used typically consists of approximately 92% water, 7% bentonite clay and less than 1% other non-toxic additives. The drilling mud is prepared by mixing the water, bentonite clay and additives in the mixing unit. The dust that would be produced when pouring the bentonite in the mixing unit poses an inhalation hazard for the worker that does the mixing. Appropriate Personal Protection Equipment, including dust masks and eye protection, will be worn by personnel near the mixing process.

There are various components that may be added to the drilling mud that enhance borehole stabilization, fluid carrying capacity, and water characteristics. A polymer additive would be available on-site to be employed in the drilling fluid in negligible concentration (0.5 kg per m^3 of drilling fluid) as (and only if) required to enhance the bore hole stability by strengthening the filter-cake being formed on the bore walls during the drilling operation. Filter-cake refers to the layers (caking) of the drilling mud that form on the bore hole walls as the drilling mud penetrates the formation as is circulated throughout the bore hole. This caking affect serves to help hold the hole open and provide a more lubricated surface for the bore pipe and the returning drilling mud and cuttings.

All components are biodegradable and non-toxic/environmentally friendly. MSDS of the drilling fluid powder and the polymer additive are included in Appendices A-C of this plan.

The drilling mud to be used for each day's work will be prepared in the beginning of the day with adequate time provided for thorough mixing and adjustment of the mud's properties according to the previous day's findings and the manufacturer's specification. Typically, approximately 30 minutes is needed for proper hydration of the mud components and homogenization of the mix.

4.5.2 Rheological Adjustments

Assigned personnel will monitor the return fluids from the borehole to determine percentage of hole cleaning and drilling mud carrying capacities. Modifications in the drilling mud composition or rheological characteristics may be required as the drill passes through different substrates to ensure proper borehole stabilization and filter-cake formation and returns.

4.5.3 Cuttings Removal

As the drilling mud and cuttings return to the bore entry pit, they are pumped directly to the mixer for recycling. Solids can be optically assessed with accuracy after the fluid turbidity clears and the volume of fluids can be calculated so that comparisons can take place between the calculated volume accruing from the borehole length / drilled cross-sectional area, and the actual recycled quantity. The cuttings that cannot be recycled further are spoils and will be transported off-site by a vacuum truck and disposed of at an approved facility.

4.5.4 Drilling Mud Containment

The drilling mud does not constitute harmful substance to the environment and the surrounding area as bentonite is a naturally occurred substance whilst all the additives employed for saltwater tolerance are biodegradable. However, the employment of the recycling unit will ensure that the drilling mud be of a minimum amount and, therefore, the risk of non-containment is minimized.

Additionally, the last 30 to 40 meters of the pilot bore will be bored using fresh water being fed in the bore, flushing out the drilling fluid so that there will be minimal mud escaping the bore at the punch out position. The exact length of flushing shall be decided on site, depending on the drilling findings and the actual drilled material at the end of the pilot bore. Having assessed the above, a calculation of the drilling rate combined with the drilling fluid volume in the pipeline will be made to start pumping water in the system to displace the entire amount of mud from the drill-string by the time that punch out occurs.

5. Inadvertent Return Contingency Plan

5.1 Bore Status Monitoring and Site Preparation

Prevention of IRs begins at the bore site and with the bore machinery and site preparation. During the bore process, the drilling operator will closely monitor the drilling fluid volumes and pressures, the bore thrust force, the volume of fluids returning to the site (returns) and other variables. The drill operator will balance these variables to achieve the most efficient formation penetration rate. Pressure levels will be set at a minimum level necessary to advance the bore while reducing the probability of IRs most efficiently. During the bore process, the drilling operator will work to

keep the annular space between the bore pipe and the drill hole open to allow for the drilling fluids to return to the bore site for reuse. However, this is not always possible given the bore conditions and lengths of the bore.

A pit at the bore entry point is excavated to collect the drilling mud and cuttings as they return to the drill site. A pump is placed in the bore entry pit to pump the returns to the recycling unit. Typically, sandbags are used around the top edge of the pit to provide additional containment. The vacuum trailer and portable suction pumps will be on-site during all drilling operations. Containment materials (e.g., straw, silt fencing, sandbags, spill kits) will be staged on-site, readily available, and easily mobilized for immediate use in the event of an accidental release of drilling mud.

Water containing mud, silt, bentonite, or other pollutants from equipment washing or other activities will not be allowed to enter the water (sea). The bentonite used in the drilling process will be either disposed of at an approved disposal facility or recycled in an appropriate manner. Other construction materials and wastes shall be recycled or disposed of, as appropriate.

5.2 Inadvertent Return Detection

An IR appears as aa visible pooling of drilling mud on the ground surface or discoloration of the water in the ocean. Drilling indicators that can act as an early warning that an IR may be imminent are, sudden decrease in mud volume returns during drilling operations, or loss in drilling mud pump pressure. While these indicators are not uncommon and usually don't lead to an IR, they are indicators that the Site Supervisor and on-site representatives need to remain vigilant in their visual inspections along the drill path on land and in the ocean. Drilling personnel will observe the volume of drilling fluid return and immediately report reductions to the Site Supervisor. The mud system operator will monitor actual drilling fluid volumes from the pumps and the return flow from the borehole. The operator will alert the on-site personnel if there is a significant variance. In the event of partial circulation loss, pumping of drilling fluid may be reduced to lessen pressure applied to native formation materials.

Visual inspections will occur along the bore path at regular intervals while during drilling of the pilot hole. The Site Supervisor will ensure the bore path is inspected every one to two hours. These will be increased as necessary should the drilling conditions described above warrant more frequent inspections.

Should an IR be identified, its location will be recorded, notes made concerning the extent of the drilling mud on the surface and the Corrective Actions described in the following section will be implemented.

5.3 Corrective Actions

The response of the field crew to an IR will be immediate and in accordance with procedures outlined in this IRCP. It is important for the reader to understand certain site conditions specific to the Project that will influence the measures that may or may be necessary. Those site characteristics are described in Section 2 above.

The actions to be taken will vary greatly depending on the location of the IR, for example on land or in the ocean, and the size of the IR and perhaps most importantly, the ability to contain and control the IR. To better focus the response measures, IRs on land will be addressed separately in this plan for those in the ocean.

5.4 Inadvertent Returns on Land (Terrestrial)

Should an IR be identified on land, whether wet or dry but not within the ocean water the following actions will be taken:

1. Direction boring and mud circulation will cease immediately.
2. The bore stem will be pulled back to relieve pressure on the IR.
3. The Site Supervisor will notify the project team of the response actions to be taken and notifications to agencies will be made (see Section 5).
4. Containment measures will be immediately implemented upon discovery of the IR. These measures may differ depending on the severity of the IR as described below.

- If the IR is small, that is it can easily be contained and controlled using the equipment on site and is not threatening sensitive resources the following actions will be taken:
    - All drilling and mud circulation will stop until it the IR can be contained and controlled.
    - Containment measures will be implemented and may include placing a physical barrier such as sandbags, silt fence, straw bales, coir waddles or an earth berm around the release point of the IR. It may also be beneficial to dig a small pit to accommodate a pump or to implement other reasonable containment measures. Once contained, the drilling mud will be removed, either by hand tools, a pump or vacuum and returned to the back to the bore site for recycling.
    - In some cases, the IR is so small, and the drilling mud is so thick that it simply piles up and can be removed by shovels without the need to install containment devices. In these cases, it will be treated like any other stockpiled materials until it can be removed from the site.
    - In some cases, the IR is so small and temporary that containment measures are not warranted. In such cases it is likely that removal of the drilling mud may cause damage to the area. In these cases, the mud will be allowed to dry naturally.
- If the IR is large, that is it cannot be it cannot be controlled or removed using the on-site pumps and vacuum trailer and/or it threatens sensitive resources the following actions will be taken:
    - All drilling and mud circulation will stop until it the IR can be contained and controlled.
    - Containment measures will be implemented by the Site Supervisor. Containment will require the deployment of the larger vacuum truck, additional mechanical equipment and additional sandbags and other containment materials described above. The vacuum truck will be positioned as close to the IR location as possible and will remove the drilling mud from the area and return it to the drill site for recycling.

5. **Drilling of the landing pipe can only continue if the IR is controlled.** Once the IR is contained and controlled, it is likely that the best course of action will be to advance the bore pipe past the fracture point, until the drilling mud ceases to come to the surface. Leak stopping materials, such as pelletized bentonite or nut shells, may be added to the drilling mud to help seal off the fracture. As long as the drilling mud coming to the surface can be contained and controlled, the bore operation may continue. In some cases, it may be necessary to pull the bore head back and redirect to a different bore path or depth.
    - For small IRs, the Site Supervisor will have the authority to continue drilling, as long as the IR is fully contained and controlled.
    - For large IRs, the bore process will remain shut down until after consultation with the regulatory agencies.
6. Reporting requirements will be different for a small IR versus a large IR.
    - Small IRs, by definition, did not impact sensitive resources. The incidents will be noted in the Site Supervisor's daily logs and discussed in the daily safety meetings. The daily log will include pictures of the site before and after cleanup.
    - Large IRs will require the preparation of a specific incident report documenting the event including pictures before and after containment/clean-up and details such as location, activity in progress, drilling fluid and pumping parameters, personnel involved, and mitigating actions to be taken shall be prepared.

5.5 Inadvertent Returns in the Ocean

While the drill head is under the ocean, workers will perform visually inspections a minimum of 4 times per day of the ocean from the shore to for possible IRs in the ocean. If detected, the following measures will be taken to allow for the drilling fluid to dissipate.

1. Direction boring and mud circulation would cease immediately as practical.
2. The bore stem will be pulled back to relieve pressure on the IR.
3. The Site Supervisor will notify the project team of the response actions to be taken and notifications to agencies will be made.
4. The Site Supervisor, drill rig operator, will determine if adding leak stopping materials, such as pelletized bentonite or pecan shells is likely to reduce or eliminate the IR.
5. Allow for sediment dissipation and dilution. There is no feasible way to contain an inadvertent release in the ocean. The proper course of action will be to control the release volume and time allowing for the drilling mud to dissipate as the bore head is advanced beyond the facture point and the IR ceases. It is important to understand that the bore will be passing under the surf zone. The drilling mud will quickly dissipate in this high energy zone of the ocean. The following steps will be implemented once the bore is allowed to continue.
    - Drilling activities will cease until the inadvertent release has dissipated as determined by visual inspection.
    - Once the IR has dissipated, drilling activities will continue for a period no longer than 10 minutes after the inadvertent release is once again observed at which point drilling activities will cease until the IR dissipates.
    - The drilling process will continue in this manner until the IR ceases, or the bore is completed.

5.6 Final Clean-up of Releases

The clean-up will commence after the release is contained as described above. The final clean-up will include removal of all visible drilling mud located in accessible areas. Removal methods will vary based on the volume of the release and the site-specific conditions. Removal equipment may include vacuum trucks, loader and track hoe buckets, small pumps, shovels and buckets. After removal of the drilling mud, all containment measures (e.g., fiber rolls, straw bale) will be removed (unless otherwise specified by the Site Supervisor) and the release area will be returned as close to the original condition as possible. If the removal of the drilling mud leaves a depression, clean sand from the immediate surrounding area will be used to restore the grade. If clean sand is not available from the immediate surrounding area, clean sand from a commercial source will be brought in.

5.7 Beach Access

Vehicles that may be necessary to drive onto the beach include a pickup truck, utility work truck and trailer, vacuum truck and/or front-end loader. Access to the beach would be from the existing public parking lot located at the end of Winema Road as shown in Figure 1 above and along the previously improved access route. It may be necessary to prune some of the overhanging branches from the trees along the access route to allow for access of larger vehicles should they be needed. The sand is expected to be compact enough for Project contractors to operate on the beach safely, however, if the beach sand is super loose and not compacted, they may have to mat a pathway to the site with standard 6-foot by 12-foot timber or plastic mats to allow for equipment access.

6. Documentation

The Site Supervisor will record the IR event in their daily log. The log would include the following:

- Details on the release event, including:

    - an estimate of the amount of drilling fluid released,
    - the location and date/time of release,
    - the size of the area impacted, and
    - the success of the clean-up action.
- Name and telephone number of person reporting.
- How the release occurred.
- The type of activity that was occurring around the area of the IR.
- Description of any sensitive areas, and their location in relation to the IR.
- Description of the methods used to clean up or secure the site.
- A listing of the current permits obtained for the project.

7. Communication with Regulatory Agencies

All employees and subcontractors will adhere to the following protocols when permitting Regulatory Agency Personnel to arrive on site. Regulatory Agency Personnel will be required to comply with appropriate safety rules. Only the Site Supervisor will coordinate communication with Regulatory Agency Personnel.

Small IRs, which, by definition, are immediately controlled and not in a sensitive environment, will be reported to the regulatory agencies no later than the day following the IR event.

For large IRs as described in Section 5.4, notification to the regulatory agencies listed below will be immediate according to the location of the IR:

If an inadvertent return on the beach or in the ocean occurs, the Oregon Department of Environmental Quality (DEQ) Emergency Spill Response will be notified immediately:

The Oregon Emergency Response: 1-800-452-0311

- Within the ocean: US Army Corps of Engineers and Oregon Department of State Lands
- On the Beach (between Statutory Vegetation Line and Low Lower Water Line: Oregon Department of Parks and Recreation, Tillamook County

Easterly of the Beach: Tillamook County.

Table 1. List of Agency Contacts

Agency	Point of Contact	Contact Information
US Army Corps of Engineers	Kinsey Friesen	Kinsey.M.Friesen@usace.army.mil Cell: 503-577-8298
Oregon Dept. of State Lands	Dario Frisone	Dario.Frisone@dsl.oregon.gov Cell: (503) 302-6094
Oregon Parks and Recreation Dept.	Kevin Herkamp and Tyler Blanchette	Kevin.A.Herkamp@oprd.oregon.gov Cell: (971) 376-1509 and Tyler.blanchette@oprd.oregon.gov Cell: (503) 510-6741
Oregon Dept. of Environmental Quality	Haley Teach	Haley.teach@deq.state.or.us Cell: (503) 702-9753
Tillamook County	Sarah Absher	sabsher@co.tillamook.or.us Office: (503) 842-3408 x3317

Appendix A. Example of Drilling Fluids

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Geology

SAND, CLAY, SILT and MARL

Drilling Fluid System

MAX GEL

MAX GEL viscosifier is a premium Wyoming bentonite blended with special extenders, producing a product that will yield more than twice as much viscosity as API Wyoming bentonite. MAX GEL is an easily mixed bentonite for freshwater and extended bentonite systems. It is used to rapidly build mud viscosity and provide superior hole cleaning, as well as to help control lost circulation, formation sloughing and promote hole stability in unconsolidated formations. It is typically used between 15 and 35 lbs./gal as required.

Yields much faster than API-standard bentonite
Non-toxic and proven suitable for use in all drilling applications
Transportation and storage costs are reduced due to lower treatment requirements as compared to API bentonite

SODA ASH

SODA ASH is used to condition and soften make-up water and raise pH, allowing drilling fluid additives to mix more efficiently. SODA ASH treats out hardness due to calcium in make-up water and raises pH.

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HYDRO FORCE

HYDRO FORCE liquid is designed for use as a permanent clay/shale stabilizer. The product provides excellent shale and clay control and greatly reduces bit balling and mud rings. HYDRO FORCE is compatible with all drilling fluids and bentonite, synthetic polymers, and biopolymers. Concentration will vary depending on the reactivity of the clay or shale encountered.

Excellent shale and clay inhibition when used as directed
Soluble in all water-based mud systems
Mixes easily and immediately controls clay/shale swelling

LUBE FORCE

LUBE FORCE is an ecologically friendly drilling fluid lubricant and shale control additive for water-based mud systems. It is based on oleo chemicals, which are derived from natural oils and fats, and is 100% biodegradable. LUBE FORCE Improves lubricity resulting in torque and drag reduction allowing faster, deeper, and highly deviated drilling.

Improves Lubricity
Easily disperses in WBM
Does not affect mud rheology
Improves API filtration properties
Compatible in artic drilling conditions and is thermally stable to +300 F

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SAND FORCE

SAND FORCE is a biopolymer used for increasing viscosity in water-base systems. Small additions provide viscosity and weight-material suspension for all water-base mud systems.

SAND FORCE has the unique ability to produce a fluid that is highly shear-thinning (LSRV).

SAND FORCE effectively increases viscosity for cuttings transport and suspension in all water-base fluids, from highly weighted to low-solids systems, and including freshwater, seawater, salt and heavy-brine systems.

Highly effective low shear rate viscosifier for improved hydraulics and power at the bit for maximum penetration rates

TROL FORCE

TROL FORCE is an anionic fluid loss control agent aimed at HDD. TROL FORCE produces a thin, resilient filter cake which minimizes differential sticking potential. TROL FORCE also provides excellent carrying capacity for cuttings and hole cleaning.

NSF/ANSI 60 approved
Reduces differential sticking
More economical alternative to PAC or CMC
Excellent fluid loss control agent

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Lost Circulation

HDD Defense

HDD Defense is a blend of environmentally safe sealants and swellable materials designed to remediate inadvertent return events in HDD applications. Designed to be applied at the onset of inadvertent returns, HDD Defense should be spotted as a pill on bottom (in the inadvertent return zone), with typical concentrations varying from 1 – 1.5 lbs./gallon.

Effectively bridges across loss zones
Can be pumped through mud motors
Environmentally safe and non-toxic

APPLICATION

At the onset of inadvertent returns, pumping should be stopped while mixing the HDD Defense pill. Isolate a mixing tank suitable of holding the desired finished volume, and fill with fresh mud. Add the required HDD Defense through the mixing hopper. Once the pill is mixed, the entire pill should be picked up and pumped down the drill pipe. Chase the pill with active mud until the tail of the pill is outside of the bit. Stop pumping and pull pipe out of the hole to position the bit behind the tail of the pill. Begin circulating at a slow rate while monitoring returns. Stage the pumps up slowly and circulate behind the pill for 1-2 hours to allow the material to create a seal. Wash and ream to bottom pumping sweeps with Drill-Seal as needed to prevent further inadvertent returns.

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DRILL-SEAL

DRILL-SEAL is a blend of natural plant fibers. These deformable and compressible particles conform to the shape of pores and fractures to provide a bridge and a primary seal against loss of drilling mud. DRILL-SEAL can be used as a standalone product or in conjunction with HDD Defense lost circulation materials to combat lost circulation / inadvertent returns.

Sealing various types of unconsolidated and fragile soil

Stopping major losses of mud and fluids in fractured formation

Deformable and compressible particles conform to the shape of pores and fractures

APPLICATION

Pills may be used in sweep fashion or spotted downhole to create a lasting seal. Typical concentrations range from 1 – 2 sacks per 50 gallons.

SEAL FORCE

SEAL FORCE is a swelling copolymer for lost circulation that expands over 200 times its volume in freshwater. SEAL FORCE is a lost circulation material used to seal fractures. It can also be spotted in caving zones to consolidate loose formations. After placing SEAL FORCE pills, pull up above the problem zone to prevent stuck pipe. Hydration occurs in 20 to 30 minutes. Circulate with mud and LCM to fill the voids between the spotted pill.

Can be hydrated prior to spotting

Will accumulate in a variety of fracture sizes due to its swelling capacity and particle size distribution

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Loss of Circulation Materials (LCM)

LCM pills and sweeps incorporate fibrous and granular products to effectively block the paths of the seepage or whole loss. Magma Fiber will mesh across loss zones and provide a foundation for the blockage where sawdust will further incorporate itself into the structure. High viscosity base bentonite/Drill Plex fluid will further slow the migration of drilling fluid into loss zones and form extremely high gel strengths around the loss zone. SEAL FORCE/POLY SWELL, an insoluble and flexible LCM, can swell up to 200 times its volume in fresh water. SEAL FORCE/POLY SWELL can be added at connections, dry or pre-hydrated for seepage losses, or incorporated in the LCM pill at various points of mixing to improve the blocking potential.

Recommended properties and maintenance

As mud engineering is not confirmed for this project, drilling fluids monitoring and maintenance will depend on the experience of the drilling foreman, driller and tank hands, as well as available testing equipment on location. Wherever possible, API RP 13B-1 should be followed when monitoring drilling fluid parameters. An application guide is provided for field personnel with additions for each section of the bore. All drilling fluid additive concentrations must be maintained for fresh water added, including make-up volume for disposed fluids.

Viscosity

The funnel viscosity of the drilling fluid will depend on the diameter of the section of hole being drilled or reamed and the nature of the drilled cuttings being removed. It is a simple measurement that indicates how much thicker the fluid is in relation to water (26 seconds/quart). Crews can monitor the funnel viscosity of the fluid to maintain recommended mud properties and determine if the formation being drilled is contributing to an increase in viscosity. As a result, clay control additives can be adjusted to further improve clay and shale stability.

Similarly, in unconsolidated formations like sand, silt and gravel, viscosity increases will improve cuttings transport and suspension. Continuous monitoring of the funnel viscosity in these formations will ensure the drilling fluid maintains optimum performance.

Sand Content

Sand content is normally maintained below 1 %. Excessive sand in the drilling fluid can cause premature wear on circulating pumps, piping and mud motors. Periodic sand content tests by crews can effectively determine formation (geology) changes as well as deficiencies in the cleaning system. Holes in shaker screens and plugged hydrocyclones can cause rapid increases in the sand content and should be repaired immediately.

Density (mud weight)

The mud density should be maintained as low as possible. Continuous mud density monitoring by tank hands can expose deficiencies in the circulating system such as holes in shaker screens, plugged hydrocyclones and poor centrifuge performance. Excess density will increase hydrostatic pressure and could cause inadvertent losses into weak formations. Excess solids due to higher mud weight can also affect the rate of penetration.

Fluid Loss (API Filtrate)

High yield bentonite on its own does provide some fluid loss control but often additives are required for unconsolidated formations or reactive clay formations demonstrating a higher dispersion potential. TROL FORCE/PAC L FORCE/PLATINUM PAC provides fluid loss control and crews can monitor fluid loss if there is a filter press on location. Maintaining acceptable parameters for fluid loss can prevent hole collapse and clay/shale hydration.

pH, Hardness & Chlorides

Testing the make-up water before mixing drilling fluid products will determine compatibility and

potential contamination. Recommended drilling fluid additives are designed to mix efficiently in any make-up water but there are exceptions. Very high hardness levels can restrict bentonite and additive hydration and salt content over 5000 ppm can reduce the hydration potential of bentonite products. Soda ash or sodium bicarbonate is normally to treat contaminated hard water sources. Higher salt content may require the use of specialty additives if the source water cannot be replaced. Resulting pH and hardness following mixing can also be determined by the filtrate from the fluid loss test (API filtrate).

Rheology

Crews are often trained on the use of electric and hand crank viscometers and additional fluid properties can be checked during the shift. Increases in plastic viscosity are often an indication of increases in mud weight due to excess solids and low gravity solids dissolution. Maintaining the mud weight as low as possible will result in a lower plastic viscosity. Slight changes in additive concentrations may better consolidate cuttings and reduce sloughing and swelling in HDD bores.

Yield point and low-end rheology (6/3 RPM) properties determine the ability of the fluid to efficiently clean cuttings from the borehole by maintaining the appropriate flow regime for HDD bore path lengths and angles. Elevated properties may provide solutions to reduce torque, drag, annular pressures, and seepage losses.

Gel strengths (10 sec/10 min) indicate the ability of the drilling fluid to “stiffen” and provide a matrix for effective cuttings suspension. Gel strengths should be higher and flatter in HDD fluids to provide immediate suspension and reduce the tendency of cuttings to form beds. These cuttings beds may accumulate as annular blockages that can affect fluid flow and annular pressures.

These tests are normally performed by mud engineers. We recommend mud engineering on all crossings.

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Crossing Specifications and Mud Volumes

Length:	**6100 ft**
Pilot:	12-1/4 inches
Casing:	NA
Product:	36" STEEL
Reaming Stages:	30-inch, 40-inch, 48-inch, Swab Pass
Formation:	CLAY – SAND – SILT – MARL
Mud Motor:	JET
Rig:	440 K +
Tank Volume:	8000 gal.
Total Fluid:	668,816 gal.

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Mud Volume Calculations for Each Pass

12-1/4" Pilot Bore	
Hole Volume per Foot:	6 gallons/foot
Recommended Pump Rate: (ROP = 10 - 15 mins/joint)	125 GPM
Hole Volume:	37,363 gallons
Mud to Pump:	363,095 gallons
Mud Lost (2%):	7,262 gallons
Total Mud to Pump (losses, tanks, hole vol.):	370,357 gallons

Ream Pass 1: 30" Diameter	
Hole Volume per Foot:	37 gallons/foot
Recommended Pump Rate: (ROP = 20 - 25 mins/joint)	400 GPM
Hole Volume:	224,082 gallons
Mud to Pump:	1,549,206 gallons
Mud Lost (1%):	15,492 gallons
Total Mud to Pump (losses + increases in hole vol.):	1,564,698 gallons

Ream Pass 2: 40" Diameter	
Hole Volume per Foot:	65 gallons/foot
Recommended Pump Rate: (ROP = 15 - 20 mins/joint)	500 GPM
Hole Volume:	398,367 gallons
Mud to Pump:	1,936,508 gallons
Mud Lost (1%):	19,365 gallons
Total Mud to Pump (losses + increases in hole vol.):	1,955,873 gallons

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Right Turn Supply, LLC.

P.O. Box 132016
Spring, TX 77393

P.O. Box 840
Pella, IA 50219

Ream Pass 3: 48" Diameter	
Hole Volume per Foot:	94 gallons/foot
Recommended Pump Rate: (ROP = 15 - 20 mins/joint)	600 GPM
Hole Volume:	573,649 gallons
Mud to Pump:	1,742,857 gallons
Mud Lost (1%):	17,429 gallons
Total Mud to Pump (losses + increases in hole vol.):	1,760,286 gallons

Swab Pass: 48" Diameter	
Hole Volume per Foot:	94 gallons/foot
Recommended Pump Rate:	600 GPM
Hole Volume:	573,649 gallons
Mud to Pump:	1,161,905 gallons
Mud Lost (1%):	11,619 gallons
Total Mud to Pump (losses + increases in hole vol.):	1,173,524 gallons

Additive Concentrations

Batch Mixing per 3000 Gallons

MAX GEL	SAND FORCE	TROL FORCE	SODA ASH	HYDRO FORCE	LUBE FORCE
12 – 18 **BAGS**	**6 – 12 lbs. (3 – 6 VIS CUPS)**	**12 – 18 lbs. (6 – 9 VIS CUPS)**	**8 – 15 lbs. (4 – 8 VIS CUPS)**	**3 – 6 GAL.**	**3 – 6 GAL.**

NOTE: Adjust water pH first with SODA ASH. pH level needs to be 8.5 – 10
NOTE: Mix MAX GEL 2nd and let hydrate for 5 minutes
NOTE: Add SAND FORCE and TROL FORCE through the hopper
NOTE: Lastly add HYDRO FORCE and LUBE FORCE directly into the clean tank

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Properties

Stage	Stage Funnel Viscosity (sec/qt)	Mud Weight (lb/gal)	Sand Content (%)	Plastic Viscosity (CP)	Yield Point (lb/100 ft2)	Fluid Loss (mL)	Hardness (ppm)	pH
Pilot	**60 - 80**	**8.8 - 10**	**<1 %**	**9 - 15**	**18 -32**	**<15**	**< 100**	**8.5 - 10**
Ream	**80 - 100**	**8.8 - 10**	**<1 %**	**9 - 15**	**35+**	**<15**	**< 100**	**8.5 - 10**
Swab Pass	**80 - 100**	**8.8 - 10**	**<1 %**	**9 - 15**	**35+**	**<15**	**< 100**	**8.5 - 10**

Additive Concentrations

Product Name	Quantity	Units	Pallets
MAX GEL	**133,763 – 200,645 LBS.**	**2,675 – 4,013 bags**	**39 – 58 (70/PALLET)**
SODA ASH	**1672 – 3344 LBS.**	**67 – 134 buckets**	**2 – 4 (32/PALLET)**
SAND FORCE	**1338 - 2675 LBS.**	**54 – 107 buckets**	**2 – 4 (32/PALLET)**
TROL FORCE	**2675 - 4013 LBS.**	**107 – 161 buckets**	**4 – 5 (32/PALLET)**
HYDRO FORCE	**669 - 1338 GAL.**	**134 – 268 buckets**	**4 - 9 (32 PALLET)**
LUBE FORCE	**669 - 1338 GAL.**	**134 – 268 buckets**	**4 - 9 (32 PALLET)**

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Safety Data Sheet
MAX GEL*

1. Identification of the substance/preparation and of the Company/undertaking

1.1 Product identifier

Product name MAX GEL*
Product code PID1046

1.2 Relevant identified uses of the substance or mixture and uses advised against

Recommended Use Viscosifier.

Uses advised against Consumer use

1.3 Details of the supplier of the safety data sheet

Supplier
M-I Drilling Fluids UK Limited
C/O Schlumberger
Enterprise Drive
Westhill Industrial Estate
Westhill, AB32 6TQ
Scotland UK
+47 51577424

MISDS@slb.com

1.4 Emergency Telephone Number

Emergency telephone - (24 Hour) Australia +61 2801 44558, Asia Pacific +65 3158 1074, China +86 10 5100 3039, Europe +44 (0) 1235 239 670, Middle East and Africa +44 (0) 1235 239 671, New Zealand +64 9929 1483, USA 001 281 561 1600

Norway	Poison information centre: +47 22 59 13 00

2. Hazards identification

2.1 Classification of the substance or mixture

Regulation (EC) No. 1272/2008

Health hazards Not classified

Environmental hazards Not classified

Physical Hazards Not classified

2.2 Label elements

Signal word
None

Hazard statements

This product is not classified as hazardous therefore no (H) hazard statements assigned.

Precautionary Statements - EU (§28, 1272/2008)
This product is not classified as hazardous therefore has no (P) precautionary statements assigned.

-

-

Contains
Crystalline silica (impurity)

Silica - crystalline, tridymite

2.3 Other data

Not classified as PBT/vPvB by current EU criteria

Australian statement of hazardous/dangerous nature
Classified as Non-Hazardous according to the criteria of NOHSC.
NON-HAZARDOUS SUBSTANCE. NON-DANGEROUS GOODS.

3. Composition/information on ingredients

3.1 Substances

Component	EC-No.	CAS-No	Weight % - range	Classification (67/548)	Classification (Reg. 1272/2008)	REACH registration number
Crystalline silica (impurity)	238-878-4	14808-60-7	1-5	Xn; R48/20	STOT Rep. 2 - H373	Exempt
Silica - crystalline, tridymite	239-487-1	15468-32-3	0-1	Xn; R48/20	STOT RE 2 (H373)	No data available

3.2 Mixtures

Not Applicable

Comments
Naturally occuring mineral.

The product contains other ingredients which do not contribute to the overall classification.

This product contains a small quantity of quartz, crystalline silica. Prolonged and repeated exposure to concentrations of crystalline silica exceeding the workplace exposure limit (WEL) may lead to chronic lung disease such as silicosis. IARC Monographs, Vol. 68, 1997, concludes that there is sufficient evidence that inhaled crystalline silica in the form of quartz or cristobalite from occupational sources causes cancer in humans. IARC Classification Group I.

4. First aid measures

4.1 First Aid

Inhalation If inhaled, remove from area to fresh air. Get medical attention if respiratory irritation develops or if breathing becomes difficult.

Ingestion Rinse mouth. Do not induce vomiting without medical advice. Never give anything by mouth to an unconscious person. Get medical attention if symptoms occur.

Skin contact Wash skin thoroughly with soap and water. Get medical attention if irritation persists.

Eye contact Promptly wash eyes with lots of water while lifting eye lids. Remove contact lenses. Get medical attention if any discomfort continues.

4.2 Most important symptoms and effects, both acute and delayed

General advice The severity of the symptoms described will vary dependant of the concentration and the length of exposure. If adverse symptoms develop, the casualty should be transferred to hospital as soon as possible.

Main symptoms

Inhalation Please see Section 11. Toxicological Information for further information.

Ingestion Please see Section 11. Toxicological Information for further information.

Skin contact Please see Section 11. Toxicological Information for further information.

Eye contact Please see Section 11. Toxicological Information for further information.

4.3 Indication of any immediate medical attention and special treatment needed

Notes to physician Treat symptomatically.

5. Fire-fighting measures

5.1 Extinguishing media

Suitable extinguishing media
Use extinguishing media appropriate for surrounding material.

Extinguishing media which shall not be used for safety reasons
None known.

5.2 Special hazards arising from the substance or mixture

Unusual fire and explosion hazards
None known.

Hazardous combustion products
Thermal decomposition can lead to release of irritating gases and vapours

5.3 Advice for firefighters

Special protective equipment for fire-fighters

As in any fire, wear self-contained breathing apparatus and full protective gear.

Special Fire-Fighting Procedures
Containers close to fire should be removed immediately or cooled with water.

6. Accidental release measures

6.1 Personal precautions, protective equipment and emergency procedures

Use personal protective equipment. See also section 8.

6.2 Environmental precautions

Disposal should be in accordance with applicable regional, national and local laws and regulations. Large spills released to the environment may disturb the natural chemical balance of soil/fresh water.

Environmental exposure controls
Avoid release to the environment. Local authorities should be advised if significant spillages cannot be contained.

6.3 Methods and materials for containment and cleaning up

Methods for containment
Prevent further leakage or spillage if safe to do so. Cover powder spill with plastic sheet or tarp to minimise spreading.

Methods for cleaning up
Sweep up and shovel into suitable containers for disposal. After cleaning, flush away traces with water.

6.4 Reference to other sections

See section 13 for more information.

7. Handling and storage

7.1 Precautions for safe handling

Handling
Handle in accordance with good industrial hygiene and safety practice. Avoid contact with skin and eyes. Avoid dust formation.

Hygiene measures
Use good work and personal hygiene practices to avoid exposure When using do not smoke, eat or drink. Wash hands and face before breaks and immediately after handling the product Remove contaminated clothing

7.2 Conditions for safe storage, including any incompatibilities

Technical measures/precautions	Ensure adequate ventilation. Keep airborne concentrations below exposure limits.
Storage precautions	Keep containers tightly closed in a dry, cool and well-ventilated place Protect from moisture
Storage class	Chemical storage.
Packaging material	Use specially constructed containers only

7.3 Specific end uses

See Section 1.2.

8. Exposure controls/personal protection

8.1 Control parameters

Exposure Limits No biological limit allocated

Component	EU OEL - Third List	Austria	Australia	Denmark
Crystalline silica (impurity)	Not determined	0.15 mg/m³ TWA alveolar dust, respirable fraction	0.1mg/m³TWArespirable dust	0.1mg/m³
Silica - crystalline, tridymite	Not determined	0.15 mg/m³ TWA alveolar dust, respirable fraction	0.1mg/m³TWArespirable dust	0.15 mg/m³ TWA 0.05 mg/m³ TWA K
Component	**Malaysia**	**France**	**Germany**	**Hungary**
Crystalline silica (impurity)	0.1 mg/m³ TWA	0.1 mg/m³TWA	Not determined	0.15mg/m³TWA
Silica - crystalline, tridymite	0.05 mg/m³ TWA	0.05 mg/m³TWA	Not determined	0.15mg/m³TWA
Component	**New Zealand**	**Italy**	**Netherlands**	**Norway**
Crystalline silica (impurity)	0.2 mg/m³ TWA Known or presumed human carcinogen	Not determined	0.075 mg/m³	0.3 mg/m³ TWA total dust 0.1 mg/m³ TWA respirable dust 0.3 mg/m³ STEL total dust 0.1 mg/m³ STEL respirable dust Carcinogen
Silica - crystalline, tridymite	0.1 mg/m³ TWA Known or presumed human carcinogen	Not determined	0.075 mg/m³	0.15 mg/m³ TWA total dust 0.05 mg/m³ TWA respirable dust 0.45 mg/m³ STEL total dust 0.15 mg/m³ STEL respirable dust Carcinogen
Component	**Poland**	**Portugal**	**Romania**	**Russia**
Crystalline silica (impurity)	2 mg/m³ TWA NDS >50% free crystalline silica 0.3 mg/m³ TWA NDS >50% free crystalline silica 4.0 mg/m³ TWA NDS 2% to 50% free crystalline silica 1.0 mg/m³ TWA NDS 2% to 50% free crystalline silica	0.025 mg/m³ TWA respirable fraction	0.1mg/m³TWArespirable fraction, dust	3 mg/m³ STEL 1123 disintegration aerosol, total mass of aerosols 3 mg/m³ STEL 1124 total mass of aerosols 1 mg/m³ TWA 1123 1 mg/m³ TWA 1124 Fibrogenic substance glass;regulated under Quartz 1123, 1124
Silica - crystalline, tridymite	2 mg/m³ TWA NDS >50% free crystalline silica 0.3 mg/m³ TWA NDS >50% free crystalline silica 4.0 mg/m³ TWA NDS 2% to 50% free crystalline silica 1.0 mg/m³ TWA NDS 2% to 50% free crystalline silica	Not determined	0.05mg/m³TWArespirable fraction, dust	3 mg/m³ STEL 1124 total mass of aerosols 1 mg/m³ TWA 1124 Fibrogenic substance 1124
Component	**Spain**	**Switzerland**	**Turkey**	**UK**

Crystalline silica (impurity)	0.05 mg/m³ TWA VLA-ED	0.15 mg/m³ TWA MAK	Not determined	Not determined
Silica - crystalline, tridymite	Not determined	0.15 mg/m³ TWA MAK	Not determined	Not determined

8.2 Exposure controls

All chemical Personal Protective Equipment (PPE) should be selected based on an assessment of both the chemical hazard present and the risk of exposure to those hazards. The PPE recommendations below are based on an assessment of the chemical hazards associated with this product. Where this product is used in a mixture with other products or fluids, additional hazards may be created and as such further assessment of risk may be required. The risk of exposure and need of respiratory protection will vary from workplace to workplace and should be assessed by the user in each situation.

Engineering measures to reduce exposure
Ensure adequate ventilation. Mechanical ventilation or local exhaust ventilation is required.

Personal protective equipment

Eye protection	Safety glasses with side-shields. Tightly fitting safety goggles.
Hand protection	Repeated or prolonged contact:, Use protective gloves made of:, Neoprene, Nitrile, Frequent change is advisable.
Respiratory protection	No personal respiratory protective equipment normally required, In case of insufficient ventilation wear suitable respiratory equipment, Suitable mask with particle filter P3 (European Norm 143), At work in confined or poorly ventilated spaces, respiratory protection with air supply must be used.
Skin and body protection	Wear suitable protective clothing, Eye wash and emergency shower must be available at the work place.

Hygiene measures Wash hands before eating, drinking or smoking, Remove and wash contaminated clothing before re-use.

9. Physical and chemical properties

9.1 Information on basic physical and chemical properties

Physical state	Solid
Appearance	Powder
Odour	Odourless
Colour	Tan - Grey
Odour threshold	Not applicable

Property	Values	Remarks
pH	No information available	
pH @ dilution		
Melting/freezing point	No information available	
Boiling point/range	No information available	
Flash point	No information available	
Evaporation rate	No information available	

Flammability (solid, gas)	Not Applicable	
Flammability Limits in Air		Not applicable
Upper flammability limit	Not applicable	
Lower flammability limit	Not applicable	
Vapour pressure	No information available	
Vapour density	No information available	
Specific gravity	No information available	
Bulk density	No information available	
Relative density	2.3 - 2.5 sg	@ 20 °C.
Water solubility	Insoluble in water	
Solubility in other solvents	No information available	
Autoignition temperature	No information available	
Decomposition temperature	No information available	
Kinematic viscosity	No information available	
Dynamic viscosity	No information available	
Log Pow	No information available	

Explosive properties	Not Applicable
Oxidising properties	None known

9.2 Other information

Pour point	No information available
Molecular weight	No information available
VOC content(%)	None
Density	No information available

10. Stability and reactivity

10.1 Reactivity

No specific reactivity hazards associated with this product.

10.2 Chemical stability

Stable under normal temperature conditions and recommended use.

10.3 Possibility of Hazardous Reactions

Hazardous polymerisation
Hazardous polymerisation does not occur.

10.4 Conditions to avoid

Avoid dust formation. Protect from moisture.

10.5 Incompatible materials

No materials to be especially mentioned.

10.6 Hazardous decomposition products

See Section 5.

11. Toxicological information

11.1 Information on toxicological effects

Acute toxicity

Product information This product contains a small quantity of quartz, crystalline silica. Prolonged and repeated exposure to concentrations of crystalline silica exceeding the workplace exposure limit (WEL) may lead to chronic lung disease such as silicosis.

Inhalation Inhalation of dust in high concentration may cause irritation of respiratory system.

Eye contact Dust may cause mechanical irritation.

Skin contact Prolonged contact may cause redness and irritation.

Ingestion Ingestion may cause stomach discomfort.

Unknown acute toxicity Not Applicable.

Component	LD50 Oral	LD50 Dermal	LC50 Inhalation
Crystalline silica (impurity)	= 500 mg/kg (Rat)	No data available	No data available
Silica - crystalline, tridymite	No data available	No data available	No data available

Sensitisation This product does not contain any components suspected to be sensitizing.

Mutagenic effects This product does not contain any known or suspected mutagens.

Carcinogenicity Crystalline silica dust is listed by IARC in Group 1 as known to cause lung cancer in humans, if inhaled.

Reproductive toxicity This product does not contain any known or suspected reproductive hazards.

Routes of exposure Inhalation.

Routes of entry Inhalation.

Specific target organ toxicity (single exposure) Not classified

Specific target organ toxicity (repeated exposure) Not classified.

Aspiration hazard Not Applicable.

12. Ecological information

12.1 Toxicity

The product component(s) are not classified as environmentally hazardous. However, this does not exclude the possibility that large or frequent spills can have a harmful or damaging effect on the environment. Listed on PLONOR list of OSPAR

Toxicity to algae
This product is not considered toxic to algae.

Toxicity to fish
This product is not considered toxic to fish.

Toxicity to daphnia and other aquatic invertebrates
This product is not considered toxic to invertebrates.

Component	Toxicity to fish	Toxicity to algae	Toxicity to daphnia and other aquatic invertebrates
Crystalline silica (impurity)	No information available	No information available	No information available
Silica - crystalline, tridymite	No information available	No information available	No information available

12.2 Persistence and degradability

Not Applicable - Inorganic chemical.

12.3 Bioaccumulative potential

Not Applicable - Inorganic chemical.

12.4 Mobility in soil

Mobility
Insoluble in water.

12.5 Results of PBT and vPvB assessment

Not classified as PBT/vPvB by current EU criteria.

12.6 Other adverse effects.

None known.

13. Disposal considerations

13.1 Waste treatment methods

Waste from residues / unused products	Dispose of in accordance with local regulations.
Contaminated packaging	Empty containers should be transported/delivered using a registered waste carrier for local recycling or waste disposal.
EWC waste disposal No.	According to the European Waste Catalogue, Waste Codes are not product specific, but application specific. Waste codes should be assigned by the user based on the application for which the product was used The following Waste Codes are only suggestions: EWC waste disposal No: 01 05 99 - wastes not otherwise specified

14. Transport information

14.1 UN number
Not regulated

14.2 Proper shipping name
The product is not covered by international regulation on the transport of dangerous goods

14.3. Hazard class(es)

ADR/RID/ADN/ADG Hazard class	Not regulated
IMDG Hazard class	Not regulated
ICAO Hazard class/division	Not regulated

14.4 Packing group

ADR/RID/ADN/ADG Packing Group	Not regulated
IMDG Packing group	Not regulated
ICAO Packing group	Not regulated

14.5 Environmental hazard
No

14.6 Special precautions
Not Applicable

14.7 Transport in bulk according to Annex I/II of MARPOL 73/78 and the IBC Code
Please contact MISDS@slb.com for info regarding transport in Bulk.

15. Regulatory information

15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture

Germany, Water Endangering Classes (VwVwS)	Water endangering class = 1

Australian Standard for the Uniform Scheduling of Drugs and Poisons
No Poisons Schedule number allocated

New Zealand hazard classification Not classified.

HSNO approval no. Not required.

Group number Not required.

Commission Regulation (EU) No 453/2010 of 20 May 2010 amending Regulation (EC) No 1907/2006 of the European Parliament and of the Council on the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH). Regulation (EC) No 1907/2006 of the European Parliament and of the Council of 18 December 2006 concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH), establishing a European Chemicals Agency, amending Directive 1999/EC and repealing Council Regulation (EEC) No 793/93 and Commission Regulation (EC) No 1488/94 as well as Council Directive 76/769/EEC and Commission Directives 91/155/EEC, 93/67/EEC, 93/105/EC and 2000/21/EC, including amendments.

This safety data sheet complies with the requirements of Regulation (EC) No. 1272/2008.

National Code of Practice for the Preparation of Material Safety Data Sheets 2nd Edition [NOHSC: 2011 (2003)].

National Occupational Health and Safety Commission's Approved Criteria for Classifying Hazardous Substances [NOHSC:1008 (2004) 3rd Edition].

National Occupational Health and Safety Commission's Exposure Standards for Atmospheric Contaminants in the occupational Environment [NOHSC:1003 (1995)].

Safe Work Australia.

Standard for the Uniform Scheduling of Drugs and Poisons (SUSDP).

Not classified as Dangerous Goods by the criteria of the Australian Dangerous Goods Code (ADG Code) for transport by road or rail.

International inventories

USA, Toxic Substances Control Act inventory (TSCA)	Complies
European Union - EINECS and ELINCS	Complies
Canada (DSL)	Complies.
Philippines (PICCS)	Complies
Inventory - Japan - Existing and New Chemicals list	Complies
China (IECSC)	Complies
Australia (AICS)	Complies
Korea (KECL)	Complies
Inventory - New Zealand - Inventory of Chemicals (NZIoC)	Complies

Contact REACH@miswaco.slb.com for REACH information.

15.2 Chemical Safety Report

No information available

16. Other information

Prepared by	Global Regulatory Compliance - Chemicals (GRC - Chemicals) , Anne Karin (Anka) Fosse
Supercedes date	14/Feb/2016
Revision date	28/Oct/2016
Version	4
The following sections have been revised:	3,, 5,, 6,, 7,, 9,, 10,, 11,, 16, No changes with regard to classification have been made.

Text of R phrases mentioned in Section 3
R48/20 - Harmful: danger of serious damage to health by prolonged exposure through inhalation

Full text of H-Statements referred to under sections 2 and 3

This product is not classified as hazardous therefore no (H) hazard statements assigned.

H373 - May cause damage to organs through prolonged or repeated exposure if inhaled

*A mark of M-I L.L.C., a Schlumberger Company

Disclaimer
The information contained herein is considered in good faith as reliable of the date issued and is based upon on measurements, tests or data derived from supplier's own study or furnished by others. In providing this SDS information, Supplier makes no express or implied warranties as to the information or product; merchantability or fitness of purpose; any express or implied warranty; or non-infringement of intellectual property rights; and supplier assumes no responsibility for any direct, special or consequential damages, results obtained, or the activities of others. To the maximum extent permitted by law, supplier's warranty obligations and buyer's sole remedies are as stated in separate agreement between the parties.

Safety Data Sheet
Sodium Carbonate, Anhydrous

Date Reviewed: January 2021 Supersedes: February 2015

This document has been prepared to meet the requirements of the U.S. OSHA Hazard Communication Standard, 29 CFR 1910.1200; the Canada's Workplace Hazards Materials Information System (WHMIS) and, the EC Directive, 2001/58/EC.

SECTION 1: Product and Company Identification

Product Name	Sodium Carbonate, Anhydrous
Alternate Product Name(s)	Soda Ash, Disodium Carbonate Also: Dense Soda Ash, Soda Ash Light, Synthetic Light Soda Ash, Soda Ash Liquid, Natural Light Soda Ash, Natural Light HA Soda Ash
Chemical Formula	Na_2CO_3
Product Use	Oil well drilling fluid additive. Calcium precipitation.

This chemical is certified to ANSI/NSF Standard 60, Drinking Water Chemicals – Health Effects (as packaged in the original, unopened container). Concentration not to exceed 100 ppm when used for corrosion control or scale control pH adjustment.

Supplier	Drillchem Drilling Solutions PO Box 132107 Spring, TX 77393
Telephone No. **Emergency No.**	Ph: (281) 713-8941 (24 Hours) 800-424-9300 CHEMTREC

SECTION 2: Hazards Identification

***Emergency Overview*:**
White, odorless, granular solid. Product is non-combustible. Reacts with acids to release carbon dioxide gas and heat. May irritate skin and eyes. Dusts may irritate respiratory tract. Not expected to be toxic to the environment, nor to aquatic organisms. Avoid simultaneous exposure to soda ash and lime dust. In the presence of moisture (i.e. perspiration) the two materials combine to form caustic soda (NaOH), which may cause burns.

Hazard Classification:

Class	Category	Hazard Statement
Eye Irritant	Category 2	H319 Causes serious eye irritation

EC Labelling:

Name of Substance to appear on label	Sodium Carbonate
Symbol(s)	Xi- irritating 
Label Phrases	R36: Irritating to eyes. S26: In case of contact with eyes, rinse immediately with plenty of water and seek medical advice. S2: Keep out of reach of children S22: Do not breath dust

Potential Health Effects:

Skin	Prolonged contact may cause skin irritation (red, dry, cracked skin).
Eyes	Irritating to the eyes.
Ingestions	Although low in toxicity, ingestion may cause nausea, vomiting, stomach ache, and diarrhea.
Inhalation	Prolonged inhalation of product dusts may irritate nose, throat, and lungs.
Chronic Effects	Excessive, long term contact may produce “soda ulcers” on hands and perforation of the nasal septum. Sensitivity reactions may occur from prolonged and repeated exposure. This product does not contain any ingredient designated by IARC, NTP, ACGIH or OSHA as probable or suspected human carcinogens.

SECTION 3: Composition/Information on Ingredients

Chemical Name	CAS #	Wt%	EC No.	EC Class
Sodium Carbonate	497-19-8	99.8	207-838-8	Xi, R36

SECTION 4: First Aid Measures

Skin	Wash with plenty of soap and water. Get medical attention if irritation occurs and persists. Remove and wash contaminated clothing before re-use.
Eyes	Immediately flush with water for at least 15 minutes lifting the upper and lower eyelids intermittently. See a medical doctor or ophthalmologist as necessary.
Ingestions	Rinse mouth with water. Dilute by giving 1 or 2 glasses of water. Do not induce vomiting. Never give anything by mouth to an unconscious person. If symptoms persist, contact a doctor or poison control center
Inhalation	Remove to fresh air. If breathing difficulty or discomfort occurs and persists, obtain medical attention.
Advice to Physician	While internal toxicity is low, irritant effects of high concentrations may produce corneal opacities, and vesicular skin reactions in humans with abraded skin only. Treatment is symptomatic and supportive.

SECTION 5: Firefighting measures

Extinguishing Media	Not combustible, use extinguishing method suitable for surrounding fire.
Fire/Explosion Hazards	Not applicable.
Fire Fighting Procedures	Wear full protective clothing and self-contained breathing apparatus
Flammable Limits	Not applicable
Auto-Ignition Temperature	Not applicable
Hazardous Combustion Products	Carbon dioxide.
Sensitivity to Impact	None
Sensitivity to Static Discharge	None

SECTION 6: Accidental Release Measures

Personal Precautions	Refer to Section 8 “Exposure Controls / Personal Protection”
Containment	Prevent large quantities of this product from contacting vegetation or waterways; large spills could kill vegetation and fish.
Clean Up	This product, if spilled, can be recovered and re-used if contamination does not present a problem. Vacuum or sweep up the material and collect in a suitable container for disposal. If the spilled product is unusable due to contamination, consult state or federal environmental agencies for acceptable disposal procedures and locations. See Section 13 “Disposal Considerations”.
Notification Requirements	Federal regulations do not require notification for spills of this product. State and local regulations may contain different requirements; consult local authorities.

SECTION 7: Handling and Storage

Handling	Use air conveying / mechanical systems for bulk transfer to storage. For manual handling of bulk transfer use mechanical ventilation to remove airborne dust from railcar, ship or truck. Use approved respiratory protection when ventilation systems are not available. Selection of respirators is based on the dust cloud generation. Keep material out of lakes, streams, ponds and sewer drains. Avoid eye contact or prolonged skin contact. Avoid breathing dusts. When dissolving, add to water cautiously and with stirring; solutions can get hot. Use good personal hygiene and housekeeping.
Storage	Store in a cool dry area, away from incompatible products (acids). Prolonged storage may cause product to cake from atmospheric moisture.

SECTION 8: Exposure Controls/ Personal Protection

Engineering Controls	Where possible, provide general mechanical and/or local exhaust ventilation to prevent release of airborne dust into the work environment. Eye wash facility should be provided in storage and general work area.

Personal Protective Equipment:

Eyes and Face	For dusty or misty conditions, or when handling solutions where there is reasonable probability of eye contact, wear chemical safety goggles and hardhat. Under these conditions do not wear contact lenses. Otherwise, appropriate eye and face protection equipment (ANSI Z87 approved) should be selected for the particular use intended for this material. Safety glasses with side shields are recommended.
Respiratory	Whenever dust in the worker's breathing zone cannot be controlled with ventilation or other engineering means, workers should wear respirators or dust masks approved by NIOSH/MSHA, EU CEN or comparable certification organization to protect them against airborne dust.
Hands, Body, and Arms	Wear long-sleeve shirt and trousers, and impervious gloves for routine product use. Cotton gloves are sufficient for dry product; wear impervious (e.g., rubber, neoprene, etc.) gloves when handling solutions. Protective shoes or boots.

Exposure Guidelines:
Federal guidelines treat the ingredient(s) in this product as a nuisance dust, as no product-specific guidelines have been issued for exposure. As with all nuisance dusts, worker breathing zone concentrations should be measured by validated sampling and analytical methods. The following limits (OSHA and MSHA) apply to this material:

Particulates Not Otherwise Regulated:
OSHA (PEL / TWA): 15 mg/m^3 (total dust); 5 mg/m^3 (rasp fraction) MSHA (PEL / TWA): 10 mg/m^3 (total dust)

SECTION 9: Physical and Chemical Properties

Appearance	White, granular solid
Odor	Odorless
Odor Threshold	Not applicable
Formula	Na_2CO_3
Molecular Weight	105.99
pH	11.3
Melting point/freezing point	854°C (1569°F)
Initial boiling point/boiling range	Decomposes
Flash point	None
Evaporation rate	Not Applicable
Flammability (solid, gas)	Not combustible
Flammability in Air	
Upper flammability limit	No information available
Lower flammability limit	No information available
Vapor Pressure	Not applicable
Vapor Density	Not applicable
Bulk Density (g/l)	Dense grades: 0.9 – 1.1 Natural light grade: 0.7 – 0.9 Synthetic light grade: 0.5 – 0.7
Specific Gravity	2.533 (vs. Water)
Water Solubility(ies)	212.5 g/l @ 20°C
Partition coefficient	No information available
Auto-ignition temperature	No information available
Decomposition temperature	400°C
Viscosity	
Viscosity, dynamic	No information available
Viscosity, cinematic	No information available
Percent Volatile	0%

SECTION 10: Stability and Reactivity

Stability	Stable
Conditions to Avoid	Contract with acids will release carbon dioxide, heat. Contract with lime dust in the presence of moisture can produce corrosive sodium hydroxide.
Materials to Avoid	May react with aluminum, acids, fluorine, lithium, and 2,4,6- Trinitrotoluene.
Polymerization	Will not occur.
Hazardous Decomposition	When heated to decomposition, carbon dioxide is released.
Other Precautions	When dissolving, add to water cautiously and with stirring; solutions can get hot.

SECTION 11: Toxicological Information

Eye	Severe irritant (50 mg, rabbit).
Skin	Mild irritant (500 mg/24hr, rabbit). Minor irritation may occur on abraded skin. Not a sensitizer (tested at 0.25% solution).
Oral	LD_{50}, rat: 4,090 mg/kg
Inhalation	LC_{50}, rat, 2hr 2.3 mg/l 24 – hour LC_{50}: 800 mg/m^3, 20 h exposure (guinea pig) (moderate toxicity)
Chronic	Excessive, long term contact may produce “soda ulcers” on hands and perforation of the nasal septum. Sensitivity reactions may occur from prolonged and repeated exposure.
Carcinogenicity	Not designated by IARC, NTP, ACGIH or OSHA as probable or suspected human carcinogens.

SECTION 12: Ecological Information

Acute Ecotoxicity	96 – hour LC_{50}: 265 – 565 mg/l (daphnia magnia) (low toxicity) 300 – 320 mg/l (blue gill sunfish) (low toxicity) 96 – hour TL_m: 1200 mg/l (mosquito-fish) 48 – hour TL_m: 840 mg/l (mosquito-fish) 48 – hour EC_{50}: 265 mg/l (daphnia magnia) 5 Day EC_{50}: 242 mg/l (Nitszcheria linearis)
Chronic Ecotoxicity	7 Day EC, biomass:14 mg/l (phytoplankton)
Mobility	Air: Not Applicable Water: Considerable solubility and mobility. Soil / sediments: Non-significant adsorption
Abiotic Degradation	Water (hydrolysis): degradation's products: carbonate (pH>10) / carbonic acid / carbon dioxide (pH<6). Soil**:** Hydrolysis as a function of pH.
Biotic Degradation	Aerobic / anaerobic: Not applicable (inorganic compound)
Potential for Bioaccumulation	Not applicable (ionizable inorganic compound)

Observed effects are related to alkaline properties of the product. Product is not significantly hazardous for the environment

SECTION 13: Disposal Considerations

Disposal Method	When this product is discarded or disposed of, as purchased, it is neither a characteristic nor a listed hazardous waste according to US Federal RCRA regulations (40 CFR 261). As a non-hazardous waste the material may be disposed of in a landfill in accordance with government regulations; check local or state regulations for applicable requirements prior to disposal. Any processing, usage, alteration, chemical additions to, or contamination of, the product may atler the disposal requirements. Under Federal Regulations, it is the generator's responsibility to determine if a waste is a hazardous waste.

SECTION 14: Transport Information

Proper Shipping Name	Not regulated
Primary Hazard Class/Division	Not regulated
UN/NA Number	Not applicable
Label(s), Placard(s), Marking(s)	Not applicable
Reportable Quantity (RQ)	None
49 STCC Number	Not Applicable
ADR (EU), TDG (Canada)	Not regulated
IMDG (sea), ICAO (air), IATA (air)	Not regulated

SECTION 15: Regulatory Information

SARA Title III (Superfund Amendments and Reauthorization Act)

Section 302 Extremely Hazardous Substances: 40CFR355, Appendix A	Not listed
Section 311 Hazard Class 40CFR370	Immediate (acute)
Section 312 Threshold Planning Quantity (TPQ) 40CFR370	No TPQ listed for sodium carbonate
Section 313 Reportable Ingredients 40CFR372	Not listed

CERCLA (Comprehensive Environmental Response Compensation and Liability Act):
40CFR302.4 – There is no listed RQ (reportable quantity) for this product.

TSCA (Toxic Substance Control Act)
This product is listed on the TSCA Inventory of Chemical Substances. No other TSCA rules affect this product

State Regulations:
This product does not contain any components that are regulated under California Proposition 65.

Other:
Clean Water Act (CWA) – Section 301/ 311: Not listed
Clean Air Act (CAA) – Section 112: Not regulated

CANADA:

WHMIS Classification	D2B Toxic Class E Corrosive Symbol:  This product has been classified in accordance with hazard criteria of the Controlled Products Regulations and the MSDS contains all the information required by the Controlled Products Regulations.
WHMIS Ingredient Disclosure List	Listed
DSL Status (Domestic Substances List)	Listed on DSL

EUROPEAN UNION:

EINECS Inventory	Listed: 207-838-8
Annex I (Substances Directive)	Listed: 011-005-00-2 Xi, R-36 (See label details in Section 16)
German Water Classification	Hazard class 1, low hazard to waters
EU – Food Additives Directive (95/2/EC) – Annex I – Generally Permitted for Use in Food	E500

INTERNATIONAL:

This product is also found in the chemical inventories of Australia, China, Korea, Japan and the Philippines.

SECTION 16: Other Information

HMIS (Hazardous Material Identification System)

Health	2
Flammability	0
Physical Hazard	0
Personal Protection (PPE)	B

Protection = B (Safety glasses and gloves)

4 = Severe, 3 = Serious, 2 = Moderate, 1 = Slight, 0 = Minimal

NFPA (National Fire Protection Association System)

Health	2
Flammability	0
Reactivity	0
Special	None

4 = Extreme, 3 = High, 2 = Moderate, 1 = Slight, 0 = Insignificant

Other Information:

Soda ash is produced in three principal grades: Dense, natural light and synthetic light soda ash. When these products are mixed in water they may be known as liquid soda ash. These grades differ only in physical characteristics such as bulk density and size and shape of particles, which influence flow characteristics and angle of repose. Other physical properties, as well as chemical as chemical properties of solutions, are common to each grade of soda ash.

Certified to ANSI / NSF 60

Concentration not to exceed 100 ppm when used for corrosion control or scale control pH adjustment.

SAFETY DATA SHEET

Sand Force

Section: 1. PRODUCT AND COMPANY IDENTIFICATION

Product name	:	Sand Force
Other means of identification	:	N/A
Recommended use	:	Viscosifier
Restrictions on use	:	None known
Company	:	Right Turn Supply LLC P.O. Box 132016 Spring, TX 77393
Emergency telephone number	:	(800) 424-9300 (24 Hours) CHEMTREC
Issuing date	:	08/01/2018
Reissue date	:	01/01/2021

Section: 2. HAZARDS IDENTIFICATION

GHS Classification

Flammable liquids	:	Not classified
Skin irritation	:	Not classified
Eye irritation	:	Not classified
Carcinogenicity	:	Not classified
Reproductive toxicity	:	Not classified
Specific target organ toxicity - single exposure	:	Not classified
Aspiration hazard	:	Not classified

GHS Label element

Hazard pictograms :

Signal Word	:	Warning
Hazard Statements	:	May form combustible dust concentrations in air.

Precautionary Statements :

Prevention:
P201 – Obtain special instructions before use.
P264 – Wash face, hands and any exposed skin thoroughly after handling.
P280 – Wear protective gloves/protective clothing/eye protection/face protection.

Response:
P308 + P313 – If exposed or concerned: Get medical advice/attention.
P302 + P352 – IF ON SKIN: Wash with plenty of soap and water.
P332 + P313 – If skin irritation occurs: Get medical advice/attention.
P363 – Wash contaminated clothing before reuse.
P305 + P351 + P338 – IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses if present and easy to do. Continue rinsing.
P337 + P313 – If eye irritation persists: Get medical attention/advice.

Storage:
P403 + P235: Store in a well-ventilated place. Keep cool
P404 – Store in a closed container
P405 – Store locked up.

Disposal:
P501 – Dispose of contents/container in accordance with local/regional/national regulations.

Other hazards : None Known

Section: 3. COMPOSITION/INFORMATION ON INGREDIENTS

Substances	CAS Number	Percent	GHS Classification – US
Xanthan Gum	11138-66-22	60 – 100%	Expl. Dust (Combustible Dust)

The exact percentage (concentration) of the composition has been withheld as proprietary

Section: 4. FIRST AID MEASURES

In case of eye contact : Flush eyes with water for at least 15 minutes, holding eyelids open. Remove Any contact lenses. If irritation persists, seek medical attention.

In case of skin contact : Wash with soap and water. Get medical attention if irritation persists.

If swallowed : Under normal conditions, first aid procedures are not required.

If inhaled	:	If inhaled, remove from area to fresh air. Get medical attention if respiratory irritation develops or if breathing becomes difficult.
Protection of first-aiders	:	Move to fresh air. Call a physician if symptoms develop or persist.
Notes to physician	:	Treat symptomatically.
Most important symptoms and effects, both acute and delayed	:	No significant hazards expected.

Section: 5. FIREFIGHTING MEASURES

Suitable extinguishing media	:	Water, fog, carbon dioxide, foam, dry chemical.
Unsuitable extinguishing media	:	None known
Specific hazards during firefighting	:	Full protective clothing and approved self-contained breathing apparatus required for firefighting personnel.
Hazardous combustion products	:	Decomposition in fire may produce toxic gases. Organic dust in the presence of an ignition source can be explosive in high concentrations. Good housekeeping practices are required to minimize this potential
Special protective equipment for firefighters	:	Self-contained breathing apparatus and full protective clothing must be worn in case of fire.
Specific extinguishing methods	:	Use standard firefighting procedures and consider the hazards of other involved materials.

Section: 6. ACCIDENTAL RELEASE MEASURES

Personal precautions, protective equipment and emergency procedures	:	Avoid contact with skin, eyes and clothing. Ventilate area. Avoid creating and breathing dust. Wear appropriate personal protective equipment.
Environmental precautions	:	None known.
Methods and materials for containment and cleaning up	:	Collect using dustless method and hold for appropriate disposal. Consider possible toxic or fire hazards associated with contaminating substances and use appropriate methods for collection, storage and disposal. In the event of spill or accidental release, notify relevant authorities in accordance with all applicable regulations. For waste disposal, see section 13 of the SDS.

Section: 7. HANDLING AND STORAGE

Advice on safe handling : Wear personal protective equipment. Avoid contact with eyes, skin or clothing. Wash hands after use. Do not eat, drink or smoke in work area. Wash contaminated clothing before reuse. Wear a NIOSH-approved, European Standard En 149, or equivalent when using this product. Material slippery when wet. Avoid creating or inhaling dust.

Conditions for safe storage : Store in a cool dry place. Keep away from oxidizers. Protect from physical damage.

Section: 8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Components with workplace control parameters

8(a): OCCUPATIONAL EXPOSURE LIMITS:

Substances	CAS Number	OSHA PEL-TWA	ACGIH-TLV-TWA
Xanthan Gum	11138-66-2	15 mg/m³	10 mg/m³

Engineering measures : Use in a well-ventilated area. Use approved industrial ventilation and local exhaust. As required to maintain exposures below applicable exposure limits.

Personal protective equipment

Eye protection : Wear safety glasses with side shields or splash proof goggles.

Hand protection : Wear normal work gloves.

Skin protection : Wear suitable protective clothing.

Respiratory protection : Wear NIOSH-approved, European Standard EN 149 (FFP2/FFP3), AS/NZS 1715, or equivalent respirator when using this product. Handle only in a well-ventilated area.

Hygiene measures : Always observe good personal hygiene measures, such as washing after handling the material and before eating, drinking, and/or smoking. Routinely wash work clothing and protective equipment to remove contaminants.

Section: 9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance : Powder

Colour	:	Off white to tan
Odour	:	Slight
Flash point	:	200.0 °F (93.3 °C) estimated
pH	:	7 (1%)
Odour Threshold	:	no data available
Melting point/freezing point	:	no data available
Initial boiling point and boiling range	:	no data available
Evaporation rate	:	no data available
Flammability (solid, gas)	:	no data available
Upper explosion limit	:	no data available
Lower explosion limit	:	no data available
Vapour pressure	:	no data available
Relative vapour density	:	no data available
Relative density	:	1.6
Density	:	42.5 lbs/ft³
Water solubility	:	Soluble in water
Solubility in other solvents	:	no data available
Partition coefficient: n-octanol/water	:	no data available
Auto-ignition temperature	:	no data available
Thermal decomposition temperature	:	no data available
Viscosity, dynamic	:	no data available
Viscosity, kinematic	:	no data available
Molecular weight	:	1,000,000

Section: 10. STABILITY AND REACTIVITY

Chemical stability	:	Material is stable under normal conditions.
Possibility of hazardous reactions	:	Hazardous polymerization will not occur
Conditions to avoid	:	Avoid creation of dust when handling and avoid all possible sources of ignition (spark or flame. Take precautionary measures against electrostatic discharges. To avoid fire or explosion, dissipate static electricity by grounding and bonding containers and equipment before transferring material. Prevent dust accumulation.
Incompatible materials	:	Strong oxidizing agents.

Hazardous decomposition products	:	Carbon monoxide and carbon dioxide.

Section: 11. TOXICOLOGICAL INFORMATION

Information on likely routes of exposure	:	Eye, skin contact, inhalation

Potential Health Effects

Eyes	:	May cause mild irritation to the eye.
Skin	:	None known.
Ingestion	:	None known
Inhalation	:	May impede respiration
Acute oral toxicity	:	No data available
Acute inhalation toxicity	:	No data available
Acute dermal toxicity	:	No data available
Skin corrosion/irritation	:	No data available
Serious eye damage/eye irritation	:	May cause mild irritation to the eye.
Respiratory or skin sensitization	:	No data available
Carcinogenicity	:	No data available to indicate product or components present at greater than 0.1% are chronic health hazards

Section: 12. ECOLOGICAL INFORMATION

Ecotoxicity

Ecotoxicity for the component:

Substances	CAS Number	LD50 Oral	LD50 Dermal	LC50 Inhalation
Xanthan Gum	11138-66-2	>45,000 mg/kg (Rat)	No data available	>21 mg/L (Rat) 1h >4.25 mg/L (Rat) 4h

Substances	CAS Number	Skin corrosion/irritation
Xanthan Gum	11138-66-2	Non-irritating to the skin in rabbits

Substances	CAS Number	Eye damage/irritation
Xanthan Gum	11138-66-2	Mechanical irritation of the eyes is possible.

Substances	CAS Number	Skin Sensitization
Xanthan Gum	11138-66-2	No information available.

Substances	CAS Number	Respiratory Sensitization
Xanthan Gum	11138-66-2	No sensitation responses were observed

Substances	CAS Number	Mutagenic Effects
Xanthan Gum	11138-66-2	No information available

Substances	CAS Number	Carcinogenic Effects
Xanthan Gum	11138-66-2	Did not show carcinogenic effects in animal experiments

Substances	CAS Number	Reproductive toxicity
Xanthan Gum	11138-66-2	Animal testing did not show any effects on fertility

Substances	CAS Number	STOT - single exposure
Xanthan Gum	11138-66-2	No significant toxicity observed in animal studies at concentration requiring classification.

Substances	CAS Number	STOT - repeated exposure
Xanthan Gum	11138-66-2	No significant toxicity observed in animal studies at concentration requiring classification.

Substances	CAS Number	Aspiration hazard
Xanthan Gum	11138-66-2	Not applicalbe

Substances	CAS Number	Toxicity to Algae	Toxicity to Fish	Toxicity to Microorganisms	Toxicity to Invertebrates
Xanthan Gum	11138-66-2	No information available	TLM96 320-560 ppm (Oncorhynchus mykiss) LC50 (96h) 490 mg/L (Oncorhynchus mykiss)	No information available	TLM96 >75,000 ppm (Mysidopsis bahia) LC50 (48h) 980 mg/L (Daphnia magna)

Environmental Effects : The product is not classified as environmentally hazardous. However, this does not exclude the possibility that large or frequent spills can have a harmful or damaging effect on the environment.

Persistence and degradability: no data available

Mobility: no data available

Bioaccumulative potential: no data available

Other information

No other adverse environmental effects (e.g. ozone depletion, photochemical ozone creation potential, endocrine disruption, global warming potential) are expected from this component.

Section: 13. DISPOSAL CONSIDERATIONS

Disposal methods : Bury in a licensed landfill according to federal, state and local regulations. Follow all applicable national and local regulations.

Contaminated packaging	:	Since emptied containers may retain product residue, follow label warnings even after container is emptied. Empty containers should be taken to an approved waste handling site for recycling or disposal.

Section: 14. TRANSPORT INFORMATION

US D.O.T Non-bulk (packages less than 119 gallons).:

Land transport (DOT):

Not regulated as dangerous goods.

Air transport (IATA)

Not regulated as dangerous goods

Sea transport (IMDG/IMO)

Not regulated as dangerous goods

Section: 15. REGULATORY INFORMATION

This product is not known to be a "Hazardous Chemical" as defined by the OSHA Hazard Communication Standard, 29 CFR 1910.1200.

TSCA list	:	All components listed on inventory or are exempt

EPA SARA Title III Extremely hazardous substances: Not applicable.

EPA SARA (311, 312) Hazard Class: None

EPA SARA (313) Chemicals: This product does not contain a toxic chemical for routine annual “Toxic Chemical Release Reporting” under Section 313 (10 CFR 372)

EPA CERCLA/Superfund Reportable Spill Quantity: Not applicable

EPA RCRA Hazardous waste classification: If product becomes a waste, it does NOT meet the criteria of a hazardous waste as defined by the US EPA.

US STATE REGULATION:

US. California Controlled Substances. CA Department of Justice (California Health and Safety Code Section 11100): All components listed do not apply to the California Proposition 65 Regulation.

US. Massachusetts RTK - Substance List: Does not apply

US. New Jersey Worker and Community Right-to-Know Act: Does not apply

US. Pennsylvania Worker and Community Right-to-Know Law: Does not apply

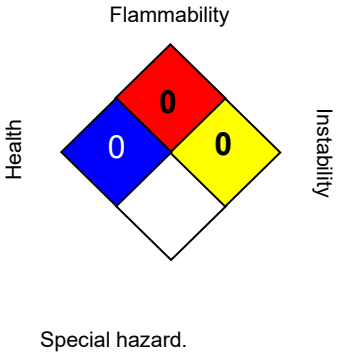
INTERNATIONAL CHEMICAL CONTROL LAWS:

United States TSCA Inventory: On TSCA Inventory

Canadian Domestic Substances List (DSL): On DSL Inventory

Section: 16. OTHER INFORMATION

NFPA:



HMIS III:

HEALTH	0
FLAMMABILITY	0
PHYSICAL HAZARD	0

0 = not significant, 1 =Slight,
2 = Moderate, 3 = High
4 = Extreme, * = Chronic

Revision Date	:	08/01/2018
Version Number	:	1.0

The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text.

SAFETY DATA SHEET

SDS DATE: 1-1-2022

SECTION 1: PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NAME: **TROL FORCE NSF**

CAS: Proprietary

MANUFACTURER: Right Turn Supply
ADDRESS: 2265 Graceland Cemetery Road, Pella, IA 50219

EMERGENCY PHONE: 281-413-1939
E mail: Info@rightturnsupply.com

CHEMICAL FAMILY: Polysaccharides

RECOMMENDED USE: Fluid Loss Control/Rheology Modfifciation

SECTION 2: HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW:

IMMEDIATE CONCERNS: May cause eye and respiratory irritation.

POTENTIAL HEALTH EFFECTS

EYES: Contact may cause eye irritation

SKIN: This product is unlikely to cause skin irritation

INGESTION: This product is unlikely to cause harmful effects from ingestion

INHALATION: May cause irritation to the respiratory tract if inhaled. May cause coughing, sneezing or nasal irritation.

ACUTE HEALTH HAZARDS: None.

CHRONIC HEALTH HAZARDS: Excessive inhalation or eye exposure over long periods may cause harmful irritation

SLIP HAZARD: If the material becomes wet, it could produce a slip hazard.

MEDICAL CONDITIONS GENERALLY AGGRAVATED BY EXPOSURE: Particulate inhalation may lead to pulmonary problems.

SECTION 3: COMPOSITION/INFORMATION ON INGREDIENTS

COMPONENTS:

	CAS NO.	% WT
Proprietary		

SECTION 4: FIRST AID MEASURES

EYES: Immediately flush with large amounts of cold water, holding eye-lids open. Flush for 15 minutes if possible. Remove contact lenses if present.

SKIN: Rinse contact area with cold water. Remove contaminated clothing, and wash with soap and water. If irritation develops, seek medical attention.

INGESTION: Do not induce vomiting. Have exposed individual rinse mouth thoroughly with water. Never give anything by mouth to an unconscious person. Consult physician if symptoms persist.

INHALATION: Move exposed person to fresh air and call 911. Give artificial respiration if not breathing and administer oxygen if breathing is difficult.

NOTES TO PHYSICIANS OR FIRST AID PROVIDERS: Treat Symptomatically. Ensure that medical personnel are aware of the materials involved and take precautions to protect themselves. First aid responders are advised to wear protective equipment as found in section 8 of this SDS.

SECTION 5: FIRE-FIGHTING MEASURES

FLASH POINT: No data available

AUTOIGNITION TEMPERATURE: No data available

EXTINGUISHING MEDIA: Use alcohol foam, CO2, water fog, or dry chemicals when fighting fires involving this material. Do not use a direct stream if dust is if formed. Dust dispersed by a direct stream in the presence of an ignition source could ignite.

SPECIAL FIRE FIGHTING PROCEDURES: Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal; do not scatter the material. Persons involved in fire-fighting response involving this product and its containers/packaging should refer to Section 8 of this SDS for the proper selection of exposure controls and personal protective equipment.

UNUSUAL FIRE AND EXPLOSION HAZARDS: Dust-air mixtures may be explosive. Avoid open flames, sparks etc.

HAZARDOUS DECOMPOSITION PRODUCTS: Carbon oxides (COx).

SECTION 6: ACCIDENTAL RELEASE MEASURES

SPILLS: Wet material is slippery! Avoid generating and spreading of dust. Shovel into dry containers. Cover and move the containers. Wash away with water or vacuum with a high efficiency filter to recover and reuse the material. If product is contaminated, collect in suitable containers for disposal. Do not contaminate drainage or waterways. Repackage or recycle if possible.

ENVIRONMENTAL PRECAUTIONS: Prevent entry into waterways, sewers, basements or confined areas. Inform the relevant authorities if the product has caused environmental pollution (sewers, waterways, soil or air). Avoid allowing water runoff to contact spilled material. If sweeping of a contaminated area is necessary, use a dust suppressant agent that does not react with the product. Contaminated surfaces will be extremely slippery.

SPECIAL PROTECTIVE EQUIPMENT: In case of dust generation, wear goggles and ensure adequate ventilation and/or use breathing apparatus. Dust in high concentrations may form explosive mixtures with air. Review Sections 5 and 7 of this SDS with personnel before starting any cleanup operations.

SECTION 7: HANDLING AND STORAGE

HANDLING: Avoid dust generation. Ensure adequate ventilation or breathing apparatus before handling material. Gloves should be worn.

STORAGE: Store in dry conditions, do not let product get wet, wet material could produce a slip hazard. Store in original packaging, or appropriate alternative. If repackaged, label new packaging. Store at ambient temperature and pressure.

OTHER PRECAUTIONS: Keep away from ignition source.

SECTION 8: EXPOSURE CONTROLS/PERSONAL PROTECTION

ENGINEERING CONTROLS: Provide adequate general and local exhaust ventilation. Provide readily accessible eye wash stations and emergency showers. Where explosive mixtures may be present, electrical systems safe for such locations must be used.

VENTILATION: Ensure area of use is well ventilated.

RESPIRATORY PROTECTION: Depending on airborne concentration, wear an OSHA approved N95 half-face dust respirator.

EYE PROTECTION: Employees should be provided with and required to use safety goggles where there is any possibility of product coming in contact with eyes. Contact lenses are not eye protective devices. Appropriate eye protection must be worn instead of contact lenses. Ensure that an eye wash station is operable and nearby.

SKIN PROTECTION: Depending on the conditions of use, protective gloves, apron, boots, head and face protection should be worn. Remove contaminated clothing immediately, wash skin with soap and water, and launder clothing before reuse.

WORK HYGIENIC PRACTICES: Use good personal hygiene practices. Avoid repeated and/or prolonged skin exposure. Wash hands before eating, drinking, smoking, or using toilet facilities. Promptly remove contaminated clothing and launder before reuse. Shower after work using plenty of soap and water.

SECTION 9: PHYSICAL AND CHEMICAL PROPERTIES

FORM: solid powder.

APPEARANCE: white to off white.

ODOR: odorless or no characteristic odor.

pH (2% solution): 8-11

BOILING POINT: No data available

MELTING POINT: No data available

FREEZING POINT: No data available

SPECIFIC GRAVITY: 1.5 typical

EVAPORATION RATE: No data available

FLAMABILITY LIMITS: No data available

AUTOIGNITION TEMPERATURE: No data available

FLASH POINT: No data available

SOLUBILITY IN WATER: 100%

SECTION 10: STABILITY AND REACTIVITY

STABILITY: Stable. Hazardous polymerization does not occur.

CONDITIONS TO AVOID: Ignition sources may cause exothermic reaction. Wet material can be a slip hazard.

MATERIALS TO AVOID: Oxidizing agents

HAZARDOUS DECOMPOSITION OR BY-PRODUCTS: Carbon oxides (COx)

SECTION 11: TOXICOLOGICAL INFORMATION

TOXICOLOGICAL INFORMATION:

ORAL LD50 (RAT); No data available

DERMAL LD50 (RABBIT): No data available

INHALATION LC50 (RAT): No data available

CARCINOGENICITY:

NTP	Not listed
IARC	Not listed
OSHA	Not listed

SENSITIZATION: No data available

NEUROTOXICITY: No data available

GENETIC EFFECTS: No data available

REPRODUCTIVE EFFECTS: No data available

TERATOGENIC EFFECTS: No data available

MUTAGENICITY: No data available

SECTION 12: ECOLOGICAL INFORMATION

ENVIRONMENTAL DATA: MOBILITY IN SOIL POTENTIAL - No data available

ECOTOXICOLOGICAL INFORMATION: TERRESTRIAL/MICROORGANISM TOXICITY –
ACUTE: No data available
CHRONIC: No data available

BIOACCUMULATION/ACCUMULATION: No data available
AQUATIC TOXICITY: No data available

CHEMICAL FATE INFORMATION: PERSISTENCE & DEGRADABILITY – Material breaks down naturally.

GENERAL COMMENTS: Any other adverse environmental effects, such as environmental fate (exposure), ozone depletion potential, photochemical ozone creation potential, endocrine disrupting potential, and global warming potential are indicated in this section if data exists. Otherwise, this data has not been established.

SECTION 13: DISPOSAL CONSIDERATIONS

DISPOSAL METHOD: This product does not meet the criteria of a hazardous waste if discarded in its purchased form. Under RCRA, it is the responsibility of the user of the product to determine at the time of disposal, whether the product meets RCRA criteria for hazardous waste. This is because product uses, transformations, mixtures, processes, etc. may render the resulting materials hazardous.

PRODUCT DISPOSAL: Recover and reclaim or recycle, if practical. Should this product become a waste, dispose of in a permitted industrial landfill. Ensure that containers are empty by RCRA criteria prior to disposal in a permitted industrial landfill.

EMPTY CONTAINER: Empty containers may retain residues. All label precautions must be observed.

COMMENTS: Dispose of material in accordance with national, state, regional, and local regulations. Never discharge directly into sewers or surface water. Consult with environmental regulatory agencies for guidance on acceptable disposal practices for the product, in any form, and its containers/packaging.

SECTION 14: TRANSPORT INFORMATION

DOT (DEPARTMENT OF TRANSPORTATION)
PROPER SHIPPING NAME: Not regulated as a dangerous good.

ROAD AND RAIL (ADR/RID)
SHIPPING NAME: Not regulated as a dangerous good.
AIR (ICAO/IATA)
SHIPPING NAME: Not regulated as a dangerous good.

VESSEL (IMO/IMDG)
SHIPPING NAME: Not regulated as a dangerous good.

SECTION 15: REGULATORY INFORMATION

UNITED STATES:

SARA TITLE III (SUPERFUND AMENDMENTS AND REAUTHORIZATION ACT)
311/312 HAZARD CATEGORIES: None of the components are listed.
313 REPORTABLE INGREDIENTS: None of the components are listed.

CERCLA (COMPREHENSIVE ENVIRONMENTAL RESPONSE, COMPENSATION, AND LIABILITY ACT)
CERCLA REGULATORY: None of the components are listed.

TSCA (TOXIC SUBSTANCE CONTROL ACT)
TSCA REGULATORY: All components are listed and registered.

CALIFORNIA PROPOSITION 65: This product does not contain any chemicals that are known to the State of California to cause cancer, birth defects or other reproductive harm at concentrations that trigger the warning requirements of California Proposition 65.

CARCINOGEN: This product is not listed as a carcinogen under NTP, IARC, or OSHA.
CANADA
WHMIS (WORKPLACE HAZARDOUS MATERIALS INFORMATION SYSTEM): Not a controlled product.

SECTION 16: OTHER INFORMATION

REVISION SUMMARY: This SDS replaces the 06/16/2014 SDS.

NFPA

Health Hazard:	1
Fire Hazard:	1
Reactivity Hazard:	0

HMIS

Health Hazard:	1
Flammability:	1
Physical Hazard:	0

HMIS RATINGS NOTES: Please refer to Section 8 of this SDS for recommended personal protective equipment.

GENERAL STATEMENTS: Other information not included anywhere else in this SDS is included in this section if, in fact, such data exists.
MANUFACTURER DISCLAIMER: This information relates to the specific material designated and may not be valid for such material used in combination with any other materials or in any process. Such information is to the best of our knowledge and belief, accurate and reliable as of the date compiled. However, no representation, warranty or guarantee is made as to its accuracy, reliability or completeness. NO WARRANTY OF MERCANTABILITY, FITNESS FOR ANY PARTICULAR PURPOSE, OR ANY OTHER WARRANTY, EXPRESSED OR IMPLIED, IS MADE CONCERNING THE INFORMATION HEREIN PROVIDED. It is the user's responsibility to satisfy himself as to the suitability and completeness of such information for his own particular use. We do not accept liability for any loss or damage that may occur from the use of this information nor do we offer warranty against patent infringement.

1. IDENTIFICATION

Product Name	**Hydroforce HDD**
Product Use	HDD/Boring/Tunneling Applications
Supplier	Drillchem Drilling Solutions PO Box 132107, Spring, TX 77393
Contact Numbers	281-713-8941
E-mail Contact for SDS	**info@drillchem.com**
Emergency Telephone Number	CHEMTREC: 800-424-9300 (24 Hours)

2. HAZARDS IDENTIFICATION

Hazard Classification

This material is not classified as hazardous according to 29CFR 1910.1200.

Precautionary Statements:

None applicable.

3. COMPOSITION / INFORMATION ON INGREDIENTS

Description: Mixture

Component	CAS No.	Concentration (%)
Proprietary Blend	*	95

(*) Our company is withholding the specific chemical composition under provision of the OSHA Hazard Communication Rule Trade Secrets. The specific composition will be made available to health professionals in accordance with 29 CFR 1910.1200(i)(1-4).

4. FIRST AID MEASURES

Inhalation	Remove to fresh air. If not breathing, if breathing is irregular, or if respiratory arrest occurs, provide artificial respiration or oxygen by trained personnel. Loosen tight clothing that may restrict breathing. Obtain medical attention if discomfort persists.
Skin	Remove contaminated clothing. Immediately wash off with mild detergent for at least 20-60 minutes. Wash clothing before reuse. Clean shoes thoroughly before reuse. Obtain medical attention if irritation persists.
Eye	Obtain immediate medical attention. Immediately flush eye with plenty of water for at least 20-60 minutes while holding eyelids open.

Ingestion	Do not induce vomiting unless directed to do so my medical personnel. Obtain medical attention if you feel unwell.

5. FIRE FIGHTING MEASURES

Extinguishing media	CO_2, Dry Chemical. Foam, Water Fog
Unsuitable extinguishing media	Do not use a direct stream of water. Water may cause splattering.
Fire fighting procedures	Do not enter any enclosed or confined fire space without proper protective equipment including self contained breathing apparatus and full bunker gear.
Combustion products	Oxides of carbon and hydrogen chloride.

6. ACCIDENTAL RELEASE MEASURES

Personal Precautions	Avoid contact with skin and eyes. Evacuate the area of all non-essential personnel. Shut off leaks, if possible without personal risk.
Personal Protection	Wear protective clothing specified for normal operations (see section 8).
Environmental Protection	None Known.
Clean up methods - small spillage	Absorb or contain liquid with sand, earth, or spill control material. Shovel up and place in labelled, sealable container for subsequent safe disposal.
Clean up methods - large spillage	Transfer to a salvage tank for recovery or safe disposal. Do not flush away residues with water. Treat residues as for small spillages.

7. HANDLING AND STORAGE

Handling	Avoid breathing vapors and/or mists. Avoid contact with skin, eyes and clothing.
Storage	Store in a cool, well ventilated area.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Occupational Exposure Standards	None established.
Engineering Control	Use only in well-ventilated areas.

Measures	
Respiratory Protection	Use NIOSH/MSHA approved air-purifying or air-fed respirator if recommended exposure limit is exceeded. Use self contained breathing apparatus for entry into confined space, for other poorly ventilated areas and for large spill clean-up sites.
Hand Protection	Chemical resistant gloves: Nitrile, Neoprene or PVC.
Eye Protection	Chemical splash goggles (chemical monogoggles). Wear face-shield in addition when transferring material.
Body Protection	Use protective clothing, which is chemical resistant to this material. Safety shoes or boots should be chemical resistant.

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance & Physical state: light colorless to slightly hazy, light amber liquid

Odor: none

Odor Threshold: Not applicable

pH-value: 6 - 8

Melting/Freezing Point: < 25 °C

Initial Boiling Point & **Range:** Not available

Flash Point: > 200 °F

Evaporation Rate: Not available

Upper/Lower Explosion Limits: Not applicable

Vapor Pressure: Not available

Flammability: Not applicable

Vapor Density: Not available

Relative density: 1.11 - 1.19 (15.6°C)

Density: 9.26 - 9.93 lbs/gallon

Solubility: Dispersible in water

Partial coefficient (n-octanol/water): Not available

Auto-ignition Temperature: Not available

Decomposition Temperature: Not available

Viscosity: 2.6 cP at 40 °C

10. STABILITY AND REACTIVITY

Stability	Stable under normal conditions of use.
Conditions To Avoid	Excessive heat, sparks and open flames.

Incompatible Materials	Strong oxidizing materials. Strong Lewis or mineral acids, Strong alkalis.
Thermal Decomposition Products	Oxides of carbon, carbon dioxide and water vapor.

11. TOXICOLOGICAL INFORMATION

Basis for assessment	Information given is based on the toxicology of components in the mixture.
Skin irritation:	Expected to cause irritation
Eye irritation	Expected to cause irritation
Acute toxicity - Dermal	ND
Acute toxicity - Inhalation	Expected to cause irritation
Acute toxicity - Oral	ND
Repeated dose toxicity	ND.
Mutagenicity	ND.
Developmental toxicity	ND.

12. ECOLOGICAL INFORMATION

Basis for Assessment	Ecotoxicological data have not been determined specifically for this product. The information given below is based on knowledge of the components.
Mobility	Soluble in water
Persistence/degradability	ND
Bioaccumulation	ND
Freshwater Fish Toxicity	ND
Freshwater Invertebrates Toxicity	ND
Acute toxicity - algae	ND
Acute toxicity - bacteria	ND

13. DISPOSAL CONSIDERATIONS

Waste disposal	Dispose to licensed disposal contractor. Responsibility for proper waste disposal rests with the generator of the waste.
Container disposal	Dispose to licensed disposal contractor.
Local Legislation	The recommendations given are considered appropriate for safe disposal. However, local regulations may be more stringent and these must be complied with.

14. TRANSPORT INFORMATION

DOT Classification	Not DOT regulated.

15. REGULATORY INFORMATION

INTERNATIONAL REGISTRATION:

TSCA (USA)	All components listed or exempted.
SARA Title III	No components listed.

16. OTHER INFORMATION

Abbreviations:	ND: No data available
Revisions:	1/21/2012: Original version 9/22/2015: Updated SDS format 3/31/2018: Updated Formatting
Prepared by:	HSE Coordinator

The information is based on the data of which we are aware and is believed to be correct as of the data hereof. Since the information contained herein may be applied under conditions beyond our control and with which we may be unfamiliar and since data made available subsequent to the date hereof may suggest modification of the information, we do not assume any responsibility for the result of its use. This information is furnished upon condition that the person receiving it shall make his own determination of the suitability of the material for his particular purpose.

Safety Data Sheet
Lube Force

SDS Revision Date: 02/21/2020

1. Identification of the substance/mixture and of the company/undertaking

1.1. Product identifier

Product Identity	Lube Force
Alternate Names	BioDegradable Drilling Lubricant

1.2. Relevant identified uses of the substance or mixture and uses advised against

Intended use	Downhole Drilling Lubricant.
Application Method	See Technical Data Sheet.

1.3. Details of the supplier of the safety data sheet

Company Name	Right Turn Supply P.O. Box 840 Pella, IA 50219, USA
Emergency	
CHEMTREC (USA)	(800) 424-9300
24 hour Emergency Telephone No.	International +1-703-527-3887
Customer Service: Right Turn Supply	(641-780-1953)

2. Hazard identification of the product

2.1. Classification of the substance or mixture

No applicable GHS categories.

2.2. Label elements

Using the Toxicity Data listed in section 11 and 12 the product is labeled as follows.

No applicable GHS categories.

[Prevention]:
No GHS prevention statements
[Response]:
No GHS response statements
[Storage]:
No GHS storage statements
[Disposal]:
No GHS disposal statements

3. Composition/information on ingredients

This product contains the following substances that present a hazard within the meaning of the relevant State and Federal Hazardous Substances regulations.

Ingredient/Chemical Designations	Weight %	GHS Classification	Notes
Fatty acid **CAS Number: 0061790-12-3**	**40-60%**	**Not Classified**	**[1]**
Proprietary-Trade Secret **CAS Number: 0090622-46-1**	**30-60%**	**Asp. Tox. 1;H304**	**[1]**

[1] Substance classified with a health or environmental hazard.
[2] Substance with a workplace exposure limit.
[3] PBT-substance or vPvB-substance.
*The full texts of the phrases are shown in Section 16.

4. First aid measures

4.1. Description of first aid measures

General In all cases of doubt, or when symptoms persist, seek medical attention.
Never give anything by mouth to an unconscious person.

Inhalation Remove to fresh air, keep patient warm and at rest. If breathing is irregular or stopped, give artificial respiration. If unconscious place in the recovery position and obtain immediate medical attention. Give nothing by mouth.

Eyes Irrigate copiously with clean water for at least 15 minutes, holding the eyelids apart and seek medical attention.

Skin Remove contaminated clothing. Wash skin thoroughly with soap and water or use a recognized skin cleanser.

Ingestion Get Medical attention immediately. If swallowed, do not induce vomiting. If person is fully conscious, give water to drink. Never give anything by mouth to an unconscious person. If vomiting occurs, keep head lower than hips to help prevent aspiration.

4.2. Most important symptoms and effects, both acute and delayed

Overview Inhalation: Liquid, no dust is generated in normal use.
Skin: May be irritating to the skin with prolonged contact.
Eye: May cause irritation to the eyes and could cause prolonged impairment of vision.
Ingestion: Not anticipated route of exposure. If ingested may be irritating to mouth, throat and stomach. Exposure to solvent vapor concentrations from the component solvents in excess of the stated occupational exposure limits may result in adverse health effects such as mucous membrane and respiratory system irritation and adverse effects on the kidneys, liver and central nervous system. Symptoms include headache, nausea, dizziness, fatigue, muscular weakness, drowsiness and in extreme cases, loss of consciousness.

Repeated or prolonged contact with the preparation may cause removal of natural fat from the skin resulting in dryness, irritation and possible non-allergic contact dermatitis. Solvents may also be absorbed through the skin. Splashes of liquid in the eyes may cause irritation and soreness with possible reversible damage. See section 2 for further details.

5. Fire-fighting measures

5.1. Extinguishing media

Dry chemical, foam, carbon dioxide and water fog.

5.2. Special hazards arising from the substance or mixture

Hazardous decomposition: High temperatures and fires may produce such toxic substances as carbon monoxide and carbon dioxide.

5.3. Advice for fire-fighters

Cool closed containers exposed to fire by spraying them with water. Do not allow run off water and contaminants from fire fighting to enter drains or water ways.

ERG Guide No. ----

6. Accidental release measures

6.1. Personal precautions, protective equipment and emergency procedures

Use good personal hygiene practices. Wash hands before eating, drinking, smoking or using toilet. Promptly remove soiled clothing and wash thoroughly before reuse.

6.2. Environmental precautions

None known.

6.3. Methods and material for containment and cleaning up

Collect and place in suitable container for reuse or disposal.

7. Handling and storage

7.1. Precautions for safe handling

See section 2 for further details. - [Prevention]:

7.2. Conditions for safe storage, including any incompatibilities

Keep from freezing, store in a cool dry place.
Handle containers carefully to prevent damage and spillage or accumulation of dust.

Incompatible materials: Strong oxidizing agents and acids.

See section 2 for further details. - [Storage]:

7.3. Specific end use(s)

No data available.

8. Exposure controls and personal protection

8.1. Control parameters

Exposure

CAS No.	Ingredient	Source	Value
0061790-12-3	Fatty acid	OSHA	No Established Limit
		ACGIH	No Established Limit
		NIOSH	No Established Limit
		Supplier	No Established Limit
0090622-46-1	Proprietary Trade Secret	OSHA	No Established Limit
ACGIH			No Established Limit
NIOSH			No Established Limit
Supplier			No Established Limit

Carcinogen Data

CAS No.	Ingredient	Source	Value
0061790-12-3	Fatty acid	OSHA	Select Carcinogen: No
		NTP	Known: No; Suspected: No
		IARC	Group 1: No; Group 2a: No; Group 2b: No; Group 3: No; Group 4: No;
0090622-46-1	Proprietary Trade Secret	OSHA	Select Carcinogen: No
		NTP	Known: No; Suspected: No
		IARC	Group 1: No; Group 2a: No; Group 2b: No; Group 3: No; Group 4: No;

8.2. Exposure controls

Respiratory If workers are exposed to concentrations above the exposure limit they must use the appropriate, certified respirators.

Eyes Wear safety glasses or googles with side shields. Maintain eye wash station in work area.

Skin Overalls which cover the body, arms and legs should be worn. Skin should not be exposed. All parts of the body should be washed after contact.

Engineering Controls Provide adequate ventilation. Where reasonably practicable this should be achieved by the use of local exhaust ventilation and good general extraction. If these are not sufficient to maintain concentrations of particulates and any vapor below occupational exposure limits suitable respiratory protection must be worn.

Other Work Practices Use good personal hygiene practices. Wash hands before eating, drinking, smoking or using toilet. Promptly remove soiled clothing and wash thoroughly before reuse.

See section 2 for further details. - [Prevention]:

9. Physical and chemical properties

Appearance	Brown/Black Liquid
Odor	None
Odor threshold	Not Measured

pH	6.7
Melting point / freezing point	Not Measured
Initial boiling point and boiling range	> 212F
Flash Point	> 600F
Evaporation rate (Ether = 1)	Not Applicable
Flammability (solid, gas)	Not Applicable
Upper/lower flammability or explosive limits	**Lower Explosive Limit:** Not Measured **Upper Explosive Limit:** Not Measured
Vapor pressure (Pa)	Not Measured
Vapor Density	Not Applicable
Specific Gravity	0.9005-0.9305 g/cm3
Solubility in Water	Appreciable
Partition coefficient n-octanol/water (Log Kow)	Not Measured
Auto-ignition temperature	Not Measured
Decomposition temperature	Not Measured
Viscosity (cSt)	Not Measured

9.2. Other information

No other relevant information.

10. Stability and reactivity

10.1. Reactivity

Hazardous Polymerization will not occur.

10.2. Chemical stability

Stable under normal circumstances.

10.3. Possibility of hazardous reactions

No data available.

10.4. Conditions to avoid

Excessive heat and open flame.

10.5. Incompatible materials

Strong oxidizing agents and acids.

10.6. Hazardous decomposition products

High temperatures and fires may produce such toxic substances as carbon monoxide and carbon dioxide.

11. Toxicological information

Acute toxicity

Exposure to solvent vapor concentrations from the component solvents in excess of the stated occupational exposure limits may result in adverse health effects such as mucous membrane and respiratory system irritation and adverse

effects on the kidneys, liver and central nervous system. Symptoms include headache, nausea, dizziness, fatigue, muscular weakness, drowsiness and in extreme cases, loss of consciousness.

Repeated or prolonged contact with the preparation may cause removal of natural fat from the skin resulting in dryness, irritation and possible non-allergic contact dermatitis. Solvents may also be absorbed through the skin. Splashes of liquid in the eyes may cause irritation and soreness with possible reversible damage.

Ingredient	Oral LD50, mg/kg	Skin LD50, mg/kg	Inhalation Vapor LD50, mg/L/4hr	Inhalation Dust/Mist LD50, mg/L/4hr	Inhalation Gas LD50, ppm
Fatty acid - (61790-12-3)	3,200.00, Rat - Category: 5	No data available	No data available	No data available	No data available
Proprietary (90622-46-1) Trade Secret	No data available	No data available	No data available	No data available	No data available

Note: When no route specific LD50 data is available for an acute toxin, the converted acute toxicity point estimate was used in the calculation of the product's ATE (Acute Toxicity Estimate).

Classification	Category	Hazard Description
Acute toxicity (oral)	---	Not Applicable
Acute toxicity (dermal)	---	Not Applicable
Acute toxicity (inhalation)	---	Not Applicable
Skin corrosion/irritation	---	Not Applicable
Serious eye damage/irritation	---	Not Applicable
Respiratory sensitization	---	Not Applicable
Skin sensitization	---	Not Applicable
Germ cell mutagenicity	---	Not Applicable
Carcinogenicity	---	Not Applicable
Reproductive toxicity	---	Not Applicable
STOT-single exposure	---	Not Applicable
STOT-repeated exposure	---	Not Applicable
Aspiration hazard	---	Not Applicable

12. Ecological information

12.1. Toxicity

No additional information provided for this product. See Section 3 for chemical specific data.

Aquatic Ecotoxicity

Ingredient	Americamysis bahia (Mycid Shrimp)	Microtox Threshold Level	ErC50 algae, mg/l
Fatty acid - (61790-12-3)	894,200 ppm	.Not Available	Not Available

Proprietary (90622-46-1) Trade Secret	Not Available	Not Available	Not Available

12.2.Persistence and degradability

This product is readily BioDegradable. 81% in 28 days

12.3. Bioaccumulative potential

Not Measured

12.4. Mobility in soil

No data available.

12.5. Results of PBT and vPvB assessment

This product contains no PBT/vPvB chemicals.

12.6. Other adverse effects

No data available.

13. Disposal considerations

13.1. Waste treatment methods

Observe all federal, state and local regulations when disposing of this substance.

14. Transport information

	DOT (Domestic Surface Transportation)	IMO / IMDG (Ocean Transportation)	ICAO/IATA
14.1. UN number	Not Applicable	Not Regulated	Not Regulated
14.2. UN proper shipping name	Not Regulated	Not Regulated	Not Regulated
14.3. Transport hazard class(es)	**DOT Hazard Class:** Not Applicable **DOT Label:** ---	**IMDG:** Not Applicable **Sub Class:** Not Applicable	**Air Class:** Not Applicable
14.4. Packing group	Not Applicable	Not Applicable	Not Applicable

14.5. Environmental hazards

IMDG Marine Pollutant: No

14.6. Special precautions for user

No further information

15. Regulatory information

Regulatory Overview	The regulatory data in Section 15 is not intended to be all-inclusive, only selected regulations are represented.
Toxic Substance Control Act (TSCA)	All components of this material are either listed or exempt from listing on the TSCA Inventory.
WHMIS Classification	Not Regulated

US EPA Tier II Hazards

Fire: No
Sudden Release of Pressure: No
Reactive: No
Immediate (Acute): No
Delayed (Chronic): No

EPCRA 311/312 Chemicals and RQs:
To the best of our knowledge, there are no chemicals at levels which require reporting under this statute.

EPCRA 302 Extremely Hazardous :
To the best of our knowledge, there are no chemicals at levels which require reporting under this statute.

EPCRA 313 Toxic Chemicals:
To the best of our knowledge, there are no chemicals at levels which require reporting under this statute.

Proposition 65 - Carcinogens (>0.0%):
To the best of our knowledge, there are no chemicals at levels which require reporting under this statute.

Proposition 65 - Developmental Toxins (>0.0%):
To the best of our knowledge, there are no chemicals at levels which require reporting under this statute.

Proposition 65 - Female Repro Toxins (>0.0%):
To the best of our knowledge, there are no chemicals at levels which require reporting under this statute.

Proposition 65 - Male Repro Toxins (>0.0%):
To the best of our knowledge, there are no chemicals at levels which require reporting under this statute.

N.J. RTK Substances (>1%) :
To the best of our knowledge, there are no chemicals at levels which require reporting under this statute.

Penn RTK Substances (>1%):

Edible oil

16. Other information

The information and recommendations contained herein are based upon data believed to be correct. However, no guarantee or warranty of any kind, expressed or implied, is made with respect to the information contained herein. We accept no responsibility and disclaim all liability for any harmful effects which may be caused by exposure to our products. Customers/users of this product must comply with all applicable health and safety laws, regulations, and orders.

The full text of the phrases appearing in section 3 is:

H304 May be harmful if swallowed and enters airways.

This is the first version in the GHS SDS format. Listings of changes from previous versions in other formats are not applicable.

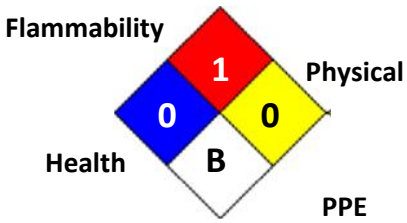
The information and data herein are believed to be accurate and have been compiled from sources believed to be reliable. It is offered for your consideration, investigation and verification. Buyer assumes all risk of use, storage and

handling of the product in compliance with applicable Federal, State and local law and regulations. Right Turn Supply makes no warranty of any kind, express or implied, concerning the accuracy of completeness of the information and data herein. The implied warranties of merchantability and fitness for a particular purpose are specifically excluded. Right Turn Supply will not be liable for claims relating to any use of this product.

Emergency Overview:

Risk Classification System:

HEALTH	**0**
FLAMMABILITY	**1**
PHYSICAL	**0**
PPE	**B**



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BIFROST CABLE
DRILL BREAK AVOIDANCE & RESPONSE PLAN

Prepared for
Bifrost Subsea Fiber Optic Cable Project
Winema, Oregon Operations

February 10, 2023

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1. INTRODUCTION

The construction of the Bifrost Subsea Fiber Optic Cable Project (Project) includes the installation of a single steel landing pipe (LP) that will extend from on shore to a point in the ocean (**Figure 1**). This LP will be installed by use of horizontal directional drill (HDD) construction methods. Further detailed descriptions on this process and the LP are included in Ocean Shores Alteration Permit application.

While exceedingly rare, it is possible that during the HDD process, the LP can become jammed or break. This Drill Break Avoidance & Response Plan (Plan) details the measures that will be taken to help prevent the LP becoming stuck, broken, or unrecoverable. The Plan also includes those measures that will take place to attempt to recover a stuck or broken pipe as well as an abandonment plan should the pipe be unrecoverable. This Plan may be revised periodically.

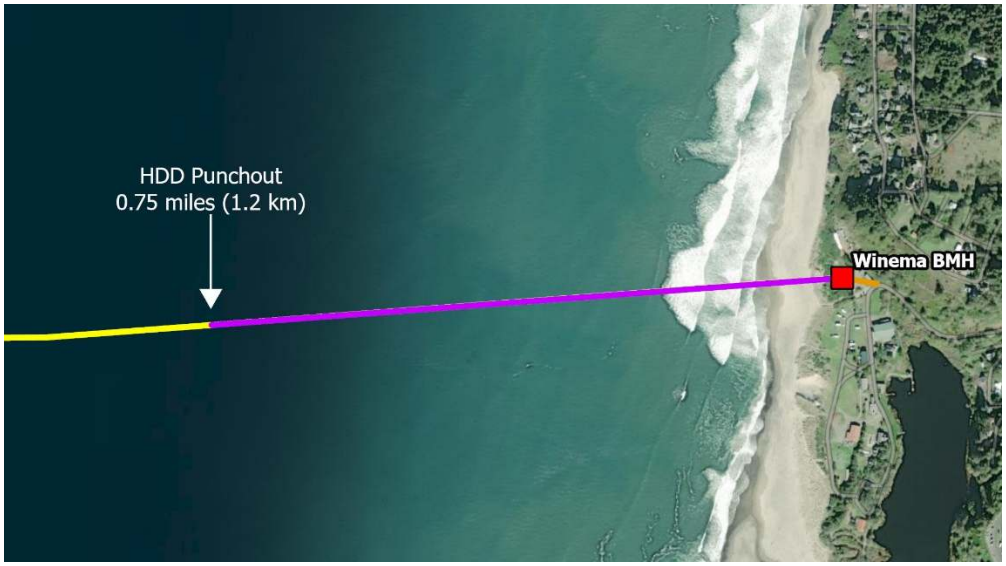

Figure 1: Bore extent from BMH to Exit Hole.

AMCS LLC (AMCS) prepared this Plan for the proposed Project in compliance with applicable environmental regulations, rules, and policies for federal and state authorities, including but not limited to the U.S. Army Corps of Engineers (USACE), National Marine Fisheries Service (NMFS), Oregon Parks and Recreation Department (OPRD), and the Oregon Department of State Lands (DSL).

Pursuant to the OPRD Beach Construction/Alteration Standards (Chapter 736, Division 20), Rules 736-020-0005 (Factors Evaluated), 736-020-0010 (General Standards), 736-020-0015 (Scenic Standards), 736-020-0020 (Recreational Use Standards), 736-020-0025 (Safety Standards), and 736-020-0030 (Natural and Cultural Resource Standards), the inadvertent return contingency plan, beach void monitoring and response plan, and drill break avoidance and response plan are collectively intended to meet OPRD's standards for avoiding and minimizing potential impacts to the following public and natural resources: Physical Environment; Aesthetics; Public Access; Public Recreation; Public Safety; and Water Quality. Based on field surveys and publicly available literature, implementation of the Project would result in no impacts to the following additional resources under the purview of OPRD, pursuant to 736-020-0015 (Scenic Standards) and 736-020-0030 (Natural and Cultural Resource Standards): Key Natural Features; Shoreline Vegetation; Fish and Wildlife Resources; Historic, Cultural, and Archeological Sites; Navigation; and Areas of Geologic Interest.

2. BASELINE CONDITIONS AND DESIGN CONSIDERATIONS

To inform the engineering design and the HDD implementation, a detailed geophysical and geotechnical investigative surveys has been conducted to identify the sub-terrain along the proposed LP alignment. These surveys included both marine and terrestrial surveys:

1. Marine Surveys: The marine surveys included utilization of a seismic subbottom profiler to determine the seafloor conditions and Electronic Resistivity Tomography (ERT) to better understand the subsurface geomorphology. These data were collected in the ocean where the vessels can operate safely.
2. Terrestrial Survey: The terrestrial geotechnical surveys included the use of ERT, multichannel analysis of surface waves (MASW), sonar, and geophysical drill exploration. The ERT and MASW were conducted along the proposed LP alignment. The vertical drill was conducted near the planned entry point for the LP. The sonar was utilized down the horizontal drilled hole.

These data was compiled into a comprehensive geotechnical report that provides recommendations concerning LP specifications and HDD parameters. Based on the data collected, the following specification and design parameters have been incorporated into the project design:

1) Landing Pipe Specifications:
    a) Pipe grade: E-75 or greater.
    b) Size: Approximately 6- to 7-inch outside diameter at the joint.
    c) Wall size (thickness): 0.3-inch or greater.
    d) Torsional Strength: 60,000 feet below land surface or greater (35,000 or greater at the joint).
    e) Tensile Strength: 500,000 pounds or greater.

2) Surface Casing.
    a) Due to the changing nature of the geology confirmed via the geotechnical survey, it is expected that an additional temporary casing, called a “surface casing” (or “conductor casing”) will be likely be installed for the first portion of the bore. The casing will be approximately 18-20-inches in diameter and will be approximately 180 to 200-feet in length. It will enter cross the Statutory Vegetation Line approximately 110 feet westerly of the entry point and will be at a depth of approximately 20 feet. The temporary casing will terminate just westerly of the dunes at which point it will be 35 feet deep. The purpose of the casing is to provide a stable path for the LP as it is being installed beneath the softer, looser surface materials. The casing will keep the bore hole from collapsing in the softer earth materials and will keep a clear path for the drilling mud to be returned to the bore site.
    b) Upon completion of the HDD operations and installation of the LP, the surface casing will be removed creating a void space around the LP. The void space is typically naturally filled in by the loose materials around the bore hole. Where the bore hole is relatively shallow and close to the surface and the overburden is loose, it is possible that the void space can migrate to the surface as a result of sand collapsing into the void. This potential void space will be monitored and mitigated as described in the accompanying Beach Void Monitoring and Response Plan prepared for the Project.

3. DRILL BREAK AVOIDANCE MEASURES

The results from the geophysical survey was used to inform HDD engineering to prepare for drilling through interchanging formations of soft and hard materials expected to be encountered. The geotechnical report provides information allowing the driller to:

- Adjust penetration rates according to the identified formations.
- Slow down prior to approaching hard formations.

- Stop the drill upon encountering hard formations and if necessary, switch out tooling to drill account for the harder or softer formation.
- Adjust drilling fluid properties according to the formations.
- Determine what additional rock drill bits, mud-motor or other equipment to have on-site.
- Pre-stage drill break response materials and equipment to have on site (see Section 4).

4. Drill Break Response Measures

This section describes the measures that will be implemented in the unlikely event that the drill string or drill head is broken (i.e., "drill break") during the HDD process. A drill break can occur in conditions where the bore head becomes stuck or wedged against the down-hole formation and the efforts to free the pipe cause the bore pipe or bore head to break.

4.1 Immediate Notification

In the event of a drill break during HDD operations, a designated Project representative (e.g., contractor or subcontractor) will notify the individuals listed in **Table 1** by phone and/or e-mail within twenty-four (24) hours of the occurrence of the break (the "Initial Notification").

Following the Initial Notification, the designated Project representative will submit a written report regarding the incident (the "Preliminary Report") to the same individuals within three (3) business days following the occurrence of the break. The Preliminary Report will provide the following:

- Description of the break, including the date, time, location of drill head relative to the punch in location, and other material details regarding the break.
- Description of the suspected root cause of the break.
- Description of the immediate responsive action taken on-site.
- Description of the corrective actions taken to preclude recurrence of the break and to prevent similar occurrences involving similar components or systems.
- A copy of the Daily Progress Report from the date of the incident.
- Summary of all the third parties/agencies notified and preliminary responses from those parties.

Table 1: List of Agency Contacts

Agency	Point of Contact	Contact Information
US Army Corps of Engineers	Kinsey Friesen	Kinsey.M.Friesen@usace.army.mil Cell: 503-577-8298
Oregon Dept. of State Lands	Dario Frisone	Dario.Frisone@dsl.oregon.gov Cell: (503) 302-6094
Oregon Parks and Recreation Dept.	Kevin Herkamp and Tyler Blanchette	Kevin.A.Herkamp@oprd.oregon.gov Cell: (971) 376-1509 and Tyler.blanchette@oprd.oregon.gov Cell: (503) 510-6741
Oregon Dept. of Environmental Quality	Haley Teach	Haley.teach@deq.state.or.us Cell: (503) 702-9753
Tillamook County	Sarah Absher	sabsher@co.tillamook.or.us Office: (503) 842-3408 x3317

4.2 Corrective Actions

In the event of a drill break, the following corrective actions will be taken:

- All HDD operations will stop immediately.
- The HDD operator will recover the remaining drilling assembly attached to the HDD machine back to the drill site. The length of recovered drill pipe will be recorded.
- The drill pipe will be fitted with a tool, known as a "fishing tool" (**Figure 2**), that is designed to follow the bore hole to the down-hole break location. Fishing tools use the principle of one-way grip designed to slide over the broken drill string and latch on to the broken drill pipe.
- The HDD operator will guide the fishing tool back down the hole to the severed end of the drill pipe and attempt to attach it to the pipe.
- If the fish tool can be successfully attached to the pipe the HDD operator will attempt to recover the remainder of the drill broken drill string.
- If the broken drill string is successfully recovered, the HDD operator will determine if the existing bore hole is fully reusable, partially reusable, or not reusable.
    - Fully Reusable: This means the HDD operator will continue the HDD operation using the same bore hole in its entirety.
    - Partially Reusable: This means a portion of, or majority of, the existing bore hole can be reused but at some point, the HDD operator will divert the bore head to start cutting a new bore hole.
    - Not Reusable: This means the entire bore hole would be abandoned (See abandonment plan below) and a new bore hole will be commenced.
- If the broken drill string is not successfully recovered, the bore hole will be abandoned and a new bore hole started.
- The HDD operator will contain any released drilling mud (see Section 6).
- The HDD operator will create an incident report that documents the break and that includes photographs of the break and details regarding the break, such as location, activity in progress, drilling parameters, personnel involved, and mitigating actions to be taken. This incident report will be created and provided to agencies listed in **Table 1** within 7 days of the incident.

Figure 2: Examples of Fishing Tools

5. Bore Hole Abandonment Plan

If the bore hole must be abandoned, the bore hole will be filled with grout in accordance with the Oregon of Water Resources Department Chapter 690, Division 210, Section 310 https://secure.sos.state.or.us/oard/viewSingleRule.action?ruleVrsnRsn=178819.

The HDD operator will:

- Prepare the appropriate grout mixture in accordance with 690-210-0131 as sited above.
- Mobilize a grout pump and mixer truck to the site.
- Pump grout downhole until it is seen coming back to the surface at the bore hole entrance.
- Remove and clean up any excess grout leaving the grout line approximately 1-foot below natural grade.
- Fill the remaining 1-foot with topsoil.

6. Drilling Mud Release

Terrestrial Inadvertent Return

The drill operator will be equipped with a tracked hydraulic excavator, straw or hay bales, stakes to secure bails, silt fence, sandbags, shovels, pumps, and any other materials or equipment necessary to contain and clean up inadvertent releases of drilling mud caused by a drill break. Drill operator will position barriers to keep any inadvertent release on Lot 6200 or the beach from reaching to the ocean shore. **For additional information on inadvertent returns and responses please see the accompanying *Inadvertent Return Contingency Plan*.**

7. Equipment Needed & Beach Access

It is highly unlikely that vehicle access on the beach would be necessary due to the designed depth of the bore pipe as it crosses under the beach. However, it is possible that certain survey or locational equipment and vehicles may need to access the beach.

Vehicles that may be necessary to drive onto the beach include a pickup truck, utility work truck and front-end loader. Access to the beach would be from the existing public parking lot located at the end of Winema Road as shown in **Figure 3**. The sand is expected to be compact enough for Project contractors to operate on the beach safely, however, if the beach sand is super loose and not compacted, they may have to mat a pathway to the site with standard 6-foot by 12-foot timber mats to allow the equipment to access it.

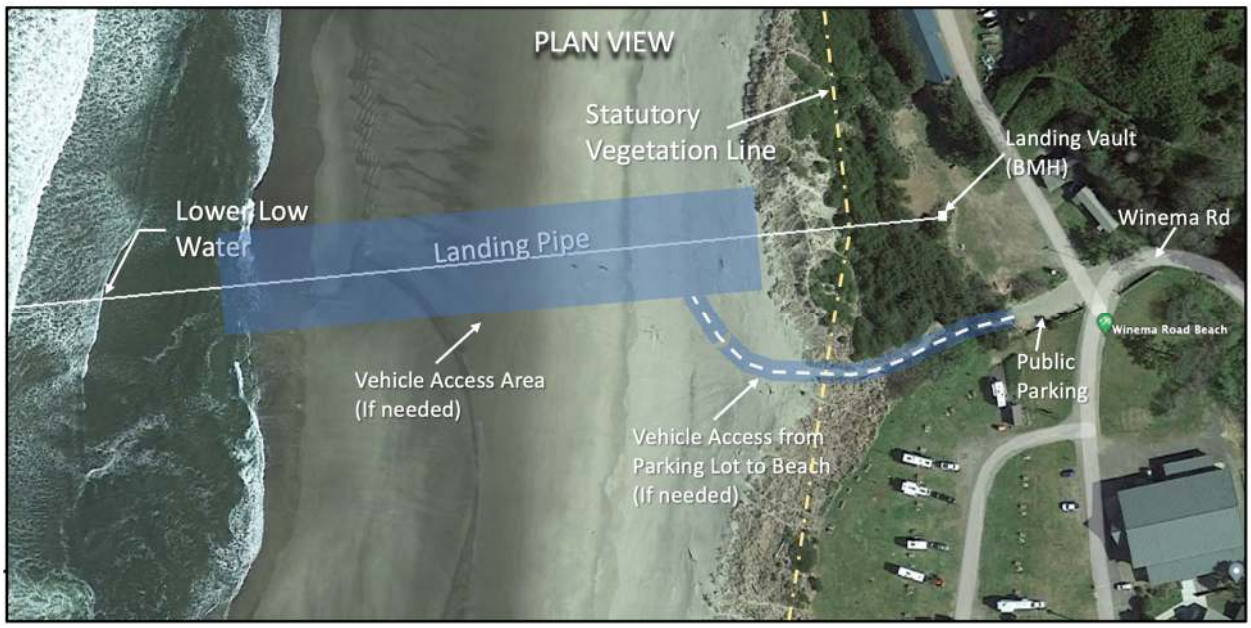

Figure 3: Vehicle Access to Beach (If needed)

BIFROST CABLE
BEACH VOID MONITORING & RESPONSE PLAN

Prepared for
Bifrost Subsea Fiber Optic Cable Project
Winema, Oregon Operations

February 10, 2023

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1. INTRODUCTION

The construction of the Bifrost Subsea Fiber Optic Cable Project (Project) includes the installation of a single steel landing pipe (LP) that will extend from on shore to a point in the ocean (**Figure 1**). This LP will be installed by use of horizontal directional drill (HDD) construction methods. Further detailed descriptions on this process and the LP are included in Ocean Shores Alteration Permit application.

While exceedingly rare, it is possible that beach voids (or "sinkholes") may occur after HDD construction is conducted. Beach voids may be the result of sand collapsing into the space created by the removal of the casing that would be used during the installation of the permanent bore pipe that would house the Bifrost cable. This Beach Void Monitoring and Response Plan (Plan) details the measures that will be taken to monitor for beach voids and address them as necessary.

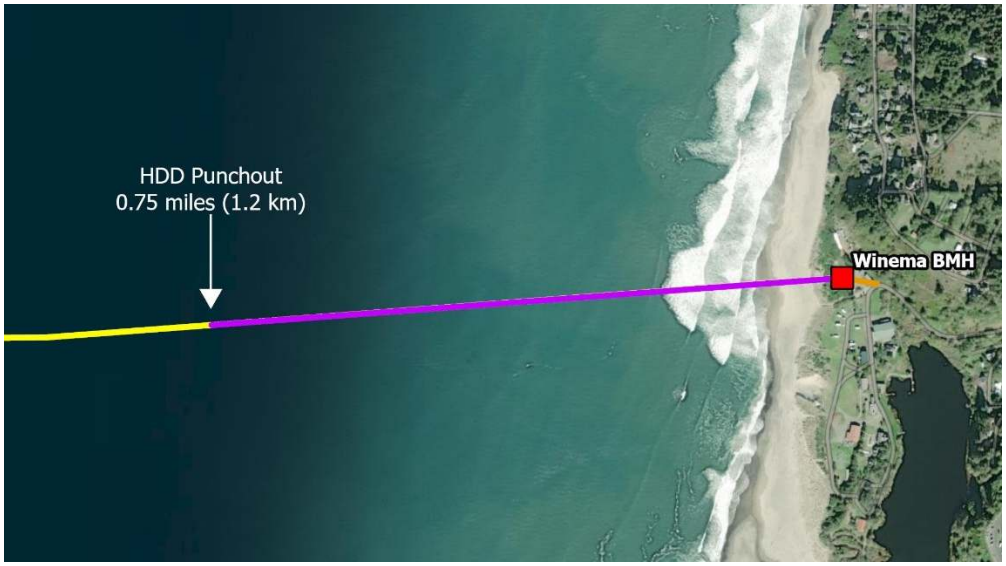

Figure 1: Bore Extent from BMH to Exit Hole.

This plan was prepared for the proposed Project in compliance with applicable environmental regulations, rules, and policies for federal and state authorities, including but not limited to the U.S. Army Corps of Engineers (USACE), National Marine Fisheries Service (NMFS), OPRD, and the Oregon Department of State Lands (DSL).

Pursuant to the OPRD Beach Construction/Alteration Standards (Chapter 736, Division 20), Rules 736-020-0005 (Factors Evaluated), 736-020-0010 (General Standards), 736-020-0015 (Scenic Standards), 736-020-0020 (Recreational Use Standards), 736-020-0025 (Safety Standards), and 736-020-0030 (Natural and Cultural Resource Standards), the inadvertent return contingency plan, beach void monitoring and response plan, and drill break avoidance and response plan are collectively intended to meet OPRD's standards for avoiding and minimizing potential impacts to the following public and natural resources: Physical Environment; Aesthetics; Public Access; Public Recreation; Public Safety; and Water Quality. Based on field surveys and publicly available literature, implementation of the Project would result in no impacts to the following additional resources under the purview of OPRD, pursuant to 736-020-0015 (Scenic Standards) and 736-020-0030 (Natural and Cultural Resource Standards): Key Natural Features; Shoreline Vegetation; Fish and Wildlife Resources; Historic, Cultural, and Archeological Sites; Navigation; and Areas of Geologic Interest.

2. Construction Elements – Surface Casing

Due to the changing nature of the geology confirmed via the geotechnical survey, it is expected that an additional temporary casing, called a "surface casing" (or "conductor casing") will be likely be installed for the first portion of the bore. The casing will be approximately 18-20 inches in diameter and will be between 180 and 200 feet in length. It will enter cross the Statutory Vegetation Line approximately 110 feet westerly of the entry point and will be at a depth of approximately 20 feet. The temporary casing will terminate just westerly of the dunes at which point it will be 35 feet deep. The purpose of the casing is to provide a stable path for the LP as it is being installed beneath the softer, looser surface materials. The casing will keep the bore hole from collapsing in the softer earth materials and will keep a clear path for the drilling mud to be returned to the bore site.

Upon completion of the HDD operations and installation of the LP, the surface casing will be removed, as described in the Drill Break Avoidance and Response Plan, creating a void space around the LP. The void space is typically naturally filled in by the loose materials around the bore hole. The materials above the hole will naturally bridge and thus there is no visual evidence at the surface. However, where the bore hole is relatively shallow and the overburden is loose, it is possible that the void space can migrate to the surface because of sand collapsing into the void.

Further, during high tides, seawater can saturate the sand and cause the sand to flow into any spaces created during removal of the 18–20-inch guide casing. This saturation could lead to the collapse of the sand above the former casing location and potentially create surface voids. The material is sand so if a sinkhole should occur the sand may naturally settle in around the void. Project contractors would add additional sand by shovel from the adjacent beach as needed. The geophysical survey of the beach area west of Lot 6200 conducted in May-June 2022 did not detect any voids along the proposed bore pipe route.

3. Monitoring and Response

Upon completion of the HDD operations (~September-October 2023), removal of the temporary casing, and prior to landing the Bifrost cable (~April 2024), the beach area along the LP path will be visually inspected by foot for the presence of Project-related sink holes. Inspections will occur daily for the first seven (7) days after the surface casing is removed, then weekly for a total of four (4) weeks then monthly for a total of six (6) months from then the temporary casing was removed. The monitor will record the date and time of the monitoring event and any findings.

4. Notifications and Response

4.1 Notification

In the event of the identification of a sink hole, the Project representative will immediately notify the ODPR representative by email and/or phone call. A written report or email to OPRD will be provided within three (3) business days of the discovery. The report will provide at least the following information:

- Description of observed sink hole including size, diameter, and location on the beach,
- Photo(s) of the observed sinkhole,
- Immediate responsive action taken onsite, and
- Any further corrective action to be undertaken.

If additional corrective actions are necessary, a final report or email describing the actions taken will be submitted upon completion of the repair.

4.2 Repair or Corrective Actions

If a report is received detailing that voids have formed in the sand, a designated Project representative, contractor, or subcontractor will take immediate action to repair the void by backfilling with sand from the immediate area. The area will be secured with cones, signage, temporary fencing, or warning tape as necessary to protect the public from entering the area ("Safety Warning"). These actions will be communicated to OPRD (Kevin Herkamp; [971 376-1509 / Kevin.A.Herkamp@oprd.oregon.gov] and Tyler Blanchette [503 510-6741; tyler.blnchette@oprd.oregon.gov]).

A project team contact list including the Applicant (AMCS), HDD Contractor (the HDD Company), and the General Contractor (Alcatel Submarine Networks [ASN]) is provided in **Table 1**, below.

Table 1. Project Team Representative Contact List

Company Name	Point of Contact	Project Role	Contact Information
AMCS (Applicant)	TBD	Representative	TBD
HDD Company	TBD	Project Superintendent	TBD
ASN (General Contractor)	TBD	On-site Representative	TBD

After installation of the "Safety Warning" and initial notifications are made, the on-site crew will take the appropriate corrective action. The corrective action will depend on the size and nature of the observed sink hole(s).

If a void is less than three (3) feet in diameter at its widest point and less than three (3) feet deep, the void will be filled by hand/shovel upon discovery using beach sand material immediately adjacent to the void. If a void is three (3) or more feet in diameter at its widest point and more than three (3) feet deep, the Project team will immediately fill in the void by hand and then follow up with additional sand compaction in the beach area west of Lot 6200. Sand material used to fill the void space will be collected from the surrounding beach area by scraping thin layers of the surface sand so as not to leave a depression.

Following completion of any corrective action, the Project team will submit a written report ("Response Report") to OPRD within three (3) days describing the results of the corrective action and any modification to the resumed monitoring.

5. Equipment Needed

It is expected that sink holes, if found will be able to be repaired using hand tools such as shovels and rakes. For sink holes larger than three (3) feet in diameter at its widest point or more than three (3) feet deep at its deepest point, a mechanical compactor will need to be used. This will be a self-powered tamper that is operated by one (1) person. It would be brought to the site by a standard pickup/work truck.

Though it is extremely unlikely, it is possible that additional clean (i.e., inert and free of pollutants) sand would need to be brought into the site to address sinkhole(s). If so, it will be necessary to use a small front-end loader (i.e., a bobcat) to deliver the sand to the sinkhole. The sand would be supplied by a small dump truck to the HDD site. From there the front-end loader would deliver the sand to the sink hole and compact it. Note, however, that on-site sources on the beach would be utilized to the greatest extent possible.

Vehicles that may be necessary to drive onto the beach include a pickup truck, utility work truck and/or front-end loader. Access to the beach would be from the existing public parking lot located at the end of Winema Road as shown in **Figure 2** below.

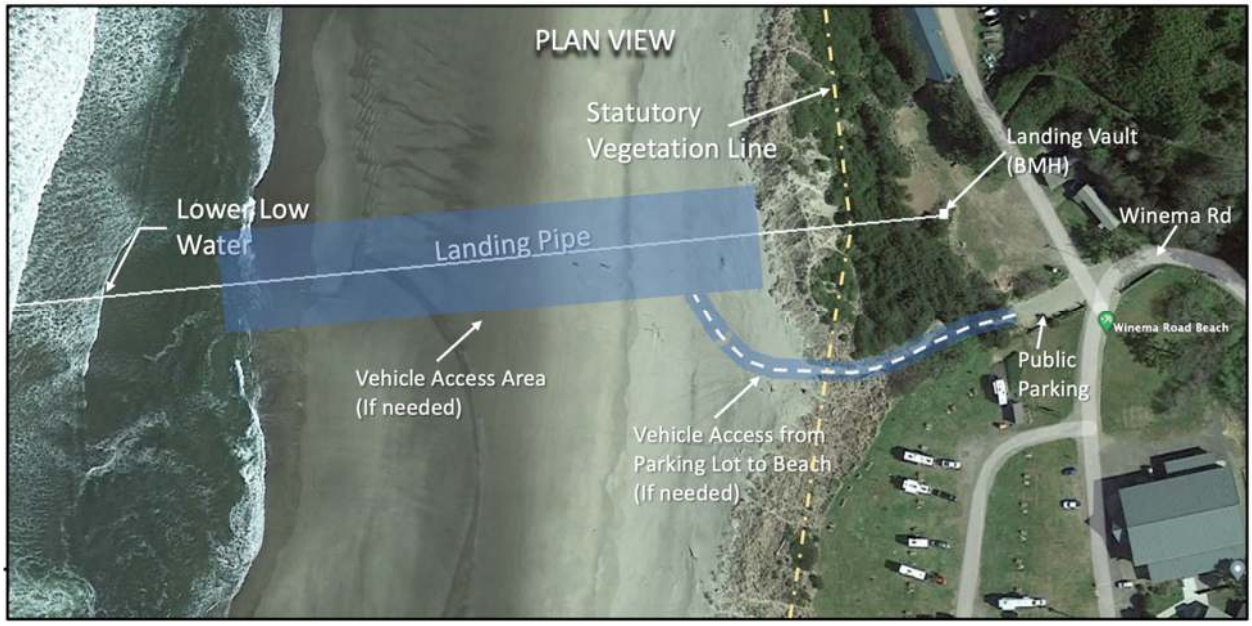

Figure 2: Vehicle Access to Beach (If needed)

Appendix 6
Wetland Delineation Report

WETLAND DELINEATION / DETERMINATION REPORT COVER FORM

A complete report and signed report cover form, along with applicable review fee, are required before a report review timeline can be initiated by the Department of State Lands. All applicants will receive an emailed confirmation that includes the report's unique file number and other information.

Ways to submit report:

- **Under 50MB** - A single unlocked PDF can be emailed to: wetland.delineation@dsl.oregon.gov.
- **50MB or larger** - A single unlocked PDF can be uploaded to DSL's Box.com website. After upload notify DSL by email at: wetland.delineation@dsl.oregon.gov.
- OR a hard copy of the unbound report and signed cover form can be mailed to: Oregon Department of State Lands, 775 Summer Street NE, Suite 100, Salem, OR 97301-1279.

Ways to pay review fee:

- By credit card on DSL's epayment portal after receiving the unique file number from DSL's emailed confirmation.
- By check payable to the Oregon Department of State Lands attached to the unbound mailed hardcopy OR attached to the complete signed cover form if report submitted electronically.

Contact and Authorization Information

☒ Applicant ☐ Owner Name, Firm and Address:
Wave Astound
3700 Monte Villa PKWY
Bothell,WA 98021
MATTHEW UPPENKELDER, SR DIRECTOR CONSTRUCTION

Business phone # (541) 760-9822
Mobile phone # (optional)
E-mail: matthew.upendenkelder@astound.com

☐ Authorized Legal Agent, Name and Address (if different):

Business phone #
Mobile phone # (optional)
E-mail:

I either own the property described below or I have legal authority to allow access to the property. I authorize the Department to access the property for the purpose of confirming the information in the report, after prior notification to the primary contact.

Typed/Printed Name: MATTHEW UPPENKELDER **Signature:** [redacted]
Date: 2/10/23 Special instructions regarding site access: ____

Project and Site Information

Project Name: Winema Beach Landing Site

Latitude: 45 08 48N Longitude: 123 58 24W
decimal degree - centroid of site or start & end points of linear project

Proposed Use:
Cable landing site with buried conduit

Tax Map # Tillamook County map 55
Tax Lot(s) 30

Tax Map #
Tax Lot(s)

Project Street Address (or other descriptive location):
5195 Winema Road

Township 05 Range 11W Section 12 QQ
Use separate sheet for additional tax and location information

City: Cloverdale County: Tillamook

Waterway: River Mile:

Wetland Delineation Information

Wetland Consultant Name, Firm and Address:
Northwest Watershed Solutions LLC
820 Borsberry Ln SE
Salem, OR 97306

Phone # (541) 217-0051
Mobile phone # (if applicable)
E-mail: jandtrumreich@gmail.com

Digitally signed by Tom Rumreich
DN: cn=Tom Rumreich, o=Northwest watershed solutions, ou, email=jandtrumreich@gmail.com, c=US
Date: 2023.02.08 07:52:44 -08'00'

The information and conclusions on this form and in the attached report are true and correct to the best of my knowledge.
Consultant Signature: Date:

Primary Contact for report review and site access is ☐ Consultant ☐ Applicant/Owner ☐ Authorized Agent

Wetland/Waters Present? ☐ Yes ☒ No Study Area size: Total Wetland Acreage:

Check Applicable Boxes Below

☐ R-F permit application submitted
☐ Mitigation bank site
☐ EFSC/ODOE Proj. Mgr: ____
☐ Wetland restoration/enhancement project (not mitigation)
☐ Previous delineation/application on parcel
If known, previous DSL # ____

☐ Fee payment submitted $ ____
☐ Resubmittal of rejected report ($100)
☐ Request for Reissuance. See eligibility criteria. (no fee)
DSL # ____ Expiration date____
☐ LWI shows wetlands or waters on parcel
Wetland ID code ____

For Office Use Only

DSL Reviewer: ____ Fee Paid Date: ____/____/____ DSL WD # ____

Date Delineation Received: ___/___/___ DSL App.# ____

Wetland Determination for the Winema Beach Cable Landing in Cloverdale Oregon

Prepared for: Wave Astound

Prepared By: Northwest Watershed Solutions LLC

Date: February 4, 2023

Project summary

The Wave Astound Company from Bothell Washington is proposing to construct an ocean cable landing facility at Winema Beach near Cloverdale, Oregon. This wetland determination report examines the site of proposed cable landing project near the fore dune close to the Pacific Ocean. This project is a handheld vault with ground rods. The area of potential impact at this site is 183.7 feet by 62.3 feet. The conduit package will be installed by boring. This purpose of this report is to determine if wetlands are present at the site.

Description of Study Area and Landscape Setting

The proposed cable beach landing site is located just east of the fore dune of the Pacific Ocean. To the west of the site are buildings and a gravel roadway. North of the site are some small dunes covered with various grasses and small trees. To the south of the project area is a small berm and the beach access road. The land east of the study site is a series of hills that slope to the study site. The church buildings and the roadway are at the toe of the hillslope and are buffers to the study area. The study area is nearly level except for the southern boundary that has a very slight slope to the beach access road berm.

Current and Past Land Use

The study site appears to be currently used by the adjacent church camp as an overflow parking area and a recreational area. The site is routinely mowed. The site might have been periodically used by campers.

Site Alterations

This particular site appears to have been leveled many years ago and some crushed road rock has been placed to provide a better surface for parking in a small portion of the study area.

Methods for the Wetland Determination

Wetland determination of the project area was conducted on June 6, 2022. The entire area was traversed on foot and a visual assessment of hydrophytic vegetation, unusual topographic features, and wetland hydrology indicators was conducted by Northwest Watershed Solutions LLC professionals. Sample plots were dug to a depth of at least 18 inches. Absolute aerial cover was reported for tree, shrub, and herb layers utilizing 30, 15, and 5 foot radius plots respectively. This was a three-step system to delineate wetland areas in accordance with federal, state and local guidance and regulations. This three-step approach is detailed in the *Corps of Engineers Wetlands Delineation Manual* (Environmental Laboratory, 1987) and the *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Western Mountains, Valleys, and Coast Region* (USACE, 2010). In this process, data is collected using USACE methodology on hydrology, vegetation and soils of upland and wetland plots. This data is recorded for both wetland and upland plots and recorded

on U.S. Army Corps of Engineers Wetland Determination Data Forms. Data forms, photographs and maps are provided for reference in the appendix.

Two field investigators review every observation and concur on the documentation of plants, hydrology, and soil characteristics.

Deviations from LWI or NWI

Potential wetlands and water resources were identified prior to the field determination by reviewing the following resources:

1). US Fish and Wildlife Service (USFWS), National Wetland Inventory (NWI) data (USFWS2016; figures 1a – 1f, Appendix A)

2). Local Wetlands inventory (LWI) for Tillamook County

3). Natural resource Conservation Service GIS Soils Data (NCRS 2016)

4) This determination report was completed in accordance with implementation regulation for Section 404 of the Federal Clean Water Act and the Oregon Removal-Fill Law.

The above resources indicated that there were no wetlands documented in the study area. Wetlands were identified in the area around the southern border of Winema Lake. The wetlands that were identified on the southern boundary of the lake are "Freshwater Forest/ Shrub Wetland." Soil maps indicated that there were no documented hydric soils in the study area as well.

Field Determination

Northwest Watershed Solutions LLC wetland professionals performed the field determination on June 7, 2022. The methodology used for determining the presence of wetlands was strictly adhered to using the *Corps of Engineer Wetland Delineation Manual* (Environmental Laboratory 1987) and the *Regional Supplement to the Corps of Engineers Wetland Delineation Manual*: *Western Mountains, Valleys, and Coastal Region Version 2.0* (Regional Supplement) (USACE 2010). The National Wetland Plant list 2014 (Lichvar et al. 2016) was used to assign wetland indicator statuses for plants, and the NRCS *Guide for Identifying and Delineating Hydric Soils Version 7.0* (Vasilas et al. 2010) Appendix was used to verify hydric soil indicators in the field. All soil colors referenced Appendix C are based on the Munsell color system (Munsell 2019)

After an extensive examination of the study site, no primary or secondary indicators of hydrology were observed. Several test pits were dug to determine if subsurface hydrology indicators were present in the form of a high water table or saturation. Geomorphic position was considered and determined not to be an indicator.

After an extensive survey of the study area, the only suspected wetland area was near the southern boundary of the study area. Hooker's willow (*Salix hookeriana*) was documented at this location. Since this species is identified as being FACW, this area was suspected as a wetland. Sample point 4

was selected near the willows. The vegetation analysis documented that this area did not contain hydrophytic vegetation. Vegetation at this site failed the Fact Neutral Test, Dominance Test, and Prevalence test. Subsequently, the area was determined not to have hydrophytic vegetation.

At sample plot 4, the soil sample pit revealed that the soils were not hydric and there were no indicators of hydrology. The soils exhibited no redox, depleted matrix, or gleyed matrix. A second sample point (sample point 5) for this study area was selected approximately 10 feet south of sample point 4. This sample point was in close proximity to a sand berm that was adjacent to the beach access road and may have been the lowest elevation of the study area. The soil sampling at this location did not document hydric soils or hydrology. No hydric soil indicators were observed in any soil pits dug at this study site.

Photo points C and E depict the study area. Photo point C was taken from the southern boundary of the API looking north. Photo point E was taken from the northern API looking south. Photo point D was not used**.**

Our conclusion for the Winema Beach cable landing site is that this area does not contain wetlands. Most of the area at this study site was routinely mowed, however it is our opinion that this activity did not confound our abilities to identify hydrophytic vegetation at this site.

Results and Conclusion

On June 6, 2022 an extensive field survey was conducted on the entire study area at the Winema Beach Cable Landing Site. Strict adherence to the standard sampling protocols was used based on the methodology outlined in the Corps of Engineers Wetland Delineation Manual. The three criteria for ascertaining whether wetlands are present at the site were based on hydrology, vegetation, and soil studies. After our investigation of the area proposed to be impacted by the cable landing and associated structures, no wetlands were identified.

Disclaimer OAR 141 -090-0035(12)(J)(I)

This report documents the investigation, best professional judgement, and conclusions of the investigators. It is correct and complete to the best of Northwest Watershed Solutions LLC knowledge. It should be considered a preliminary jurisdictional determination of wetlands and other waters and used at the readers own risk until it has been reviewed and approved in writing by DSL in accordance with OARs 141-090-0005 through 141-090-0055 and by the USACE, Portland District.

Jurisdictional determinations, including the applicability of exemptions, are made on a case-by case basis by the DSL and USACE . Those agencies are the authority in these determinations.

APPENDIX A

Figure 1 - Location Map

Figure 2 - Tax Lot Map

Figure 3 – Recent aerial photo

Figure 4 - Wetland determination map

Figure 5 – Ground level photos

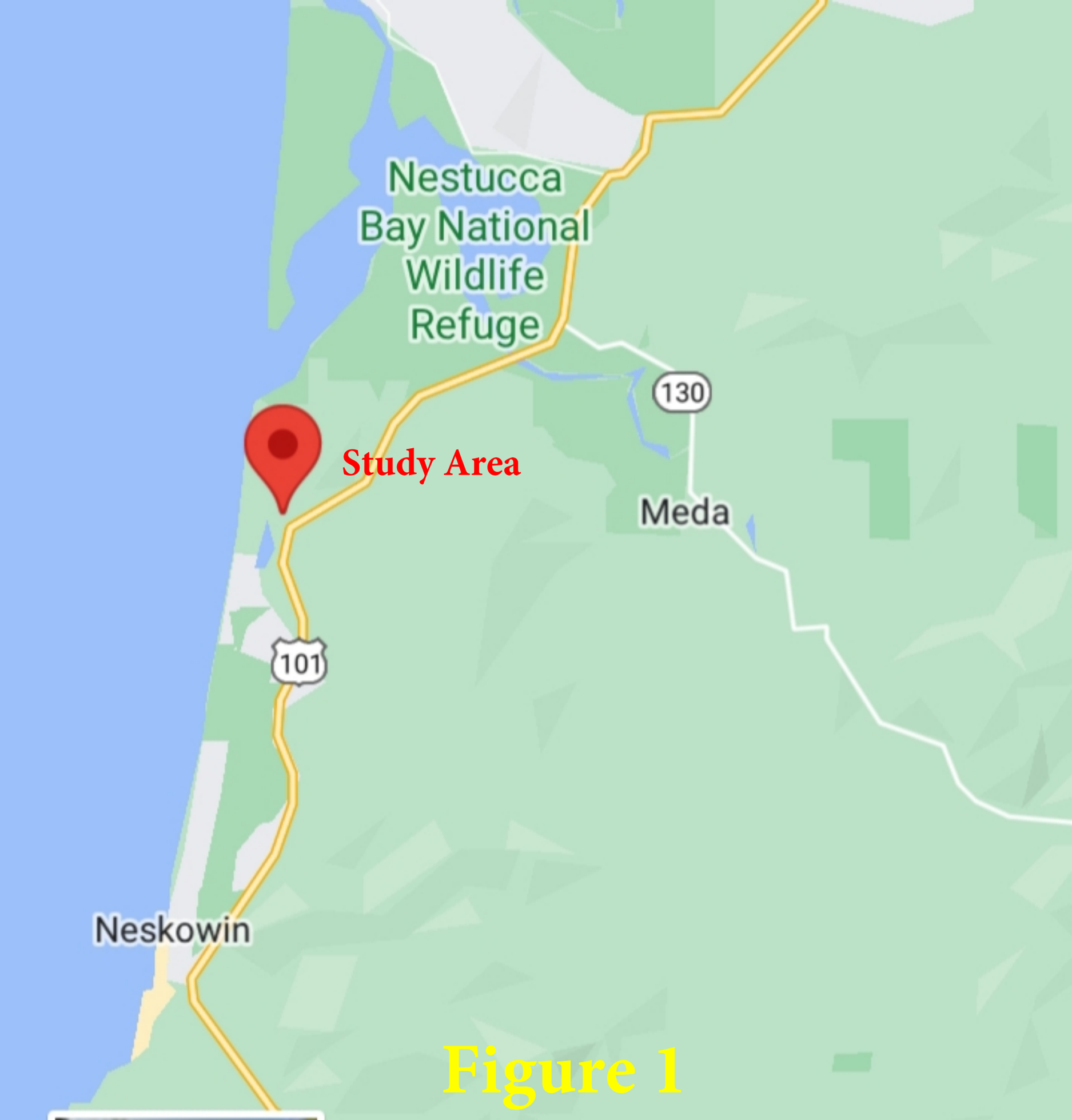
Nestucca
Bay National
Wildlife
Refuge
130
Study Area
Meda
101
Neskowin

Figure 1

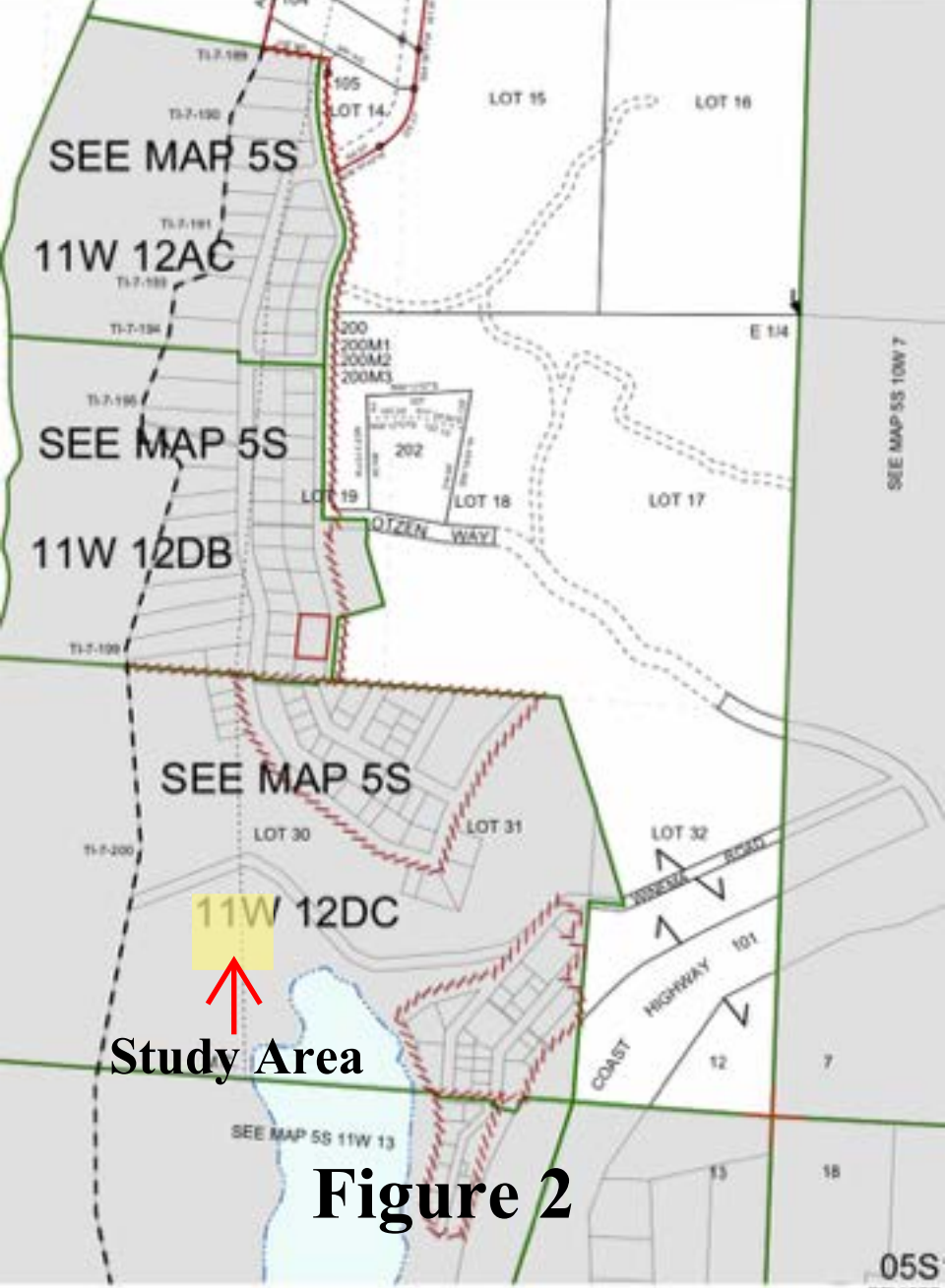
SEE MAP 5S
11W 12AC
SEE MAP 5S
11W 12DB
SEE MAP 5S
11W 12DC
Study Area
LOT 14
LOT 15
LOT 16
LOT 17
LOT 18
LOT 19
LOT 30
LOT 31
LOT 32
105
200
200M1
200M2
200M3
202
E 1/4
OTZEN WAY
SEE MAP 5S 10W 7
SEE MAP 5S 11W 13
COAST HIGHWAY 101
12
13
18
7
REVISED

Figure 2


Photo Point D
Sample Point 4
Sample Point 5
Photo Point C
WINEMA R

Figure 3 & 4

Figure # 5 c - Photo Point C (Facing North)

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APPENDIX B: Citations

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WETLAND DETERMINATION DATA FORM – Western Mountains, Valleys, and Coast Region

Project/Site: Winema Landing City/County: Tillamook Sampling Date: 6/07/22

Applicant/Owner: Wave State: OR Sampling Point: 4

Investigator(s): Northwest Watershed Solutions LLC Section, Township, Range: Sect 7 T5S R 10 W

Landform (hillslope, terrace, etc.): Terrace Local relief (concave, convex, none): Flat Slope (%): 0

Subregion (LRR): A2 Lat: 45deg 08' 48"N Long: -123deg 58' 23"W Datum: N/A

Soil Map Unit Name: Waldport fine sand, thin surface 3-12 percent slopes NWI classification: Upland

Are climatic / hydrologic conditions on the site typical for this time of year? Yes _____ No X (If no, explain in Remarks.)

Are Vegetation _____, Soil _____, or Hydrology _____ significantly disturbed? Are "Normal Circumstances" present? Yes X No _____

Are Vegetation _____, Soil _____, or Hydrology _____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes _____ No X	**Is the Sampled Area within a Wetland?** Yes _____ No X
Hydric Soil Present?	Yes _____ No X	
Wetland Hydrology Present?	Yes _____ No X	

Remarks:

Above average rainfall

VEGETATION – Use scientific names of plants.

	Absolute % Cover	Dominant Species?	Indicator Status
Tree Stratum (Plot size: 30)			
1. Salix hookeriana	30	X	FACW
2.			
3.			
4.			
	30 = Total Cover		
Sapling/Shrub Stratum (Plot size: 15)			
1.			
2.			
3.			
4.			
5.			
	_____ = Total Cover		
Herb Stratum (Plot size: 5)			
1. Gaultheria shallon	20	X	FACU
2. Fragaria chiloensis	5		FACU
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
	25 = Total Cover		
Woody Vine Stratum (Plot size: 5)			
1. Rubus ursinus	5		FACU
2.			
	60 = Total Cover		

% Bare Ground in Herb Stratum 10

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 1 (A)

Total Number of Dominant Species Across All Strata: 2 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 50 (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:
OBL species _____	x 1 = _____
FACW species 1	x 2 = 2
FAC species _____	x 3 = _____
FACU species 3	x 4 = 12
UPL species _____	x 5 = _____
Column Totals: 4 (A)	14 (B)

Prevalence Index = B/A = 3.5

Hydrophytic Vegetation Indicators:

___ 1 - Rapid Test for Hydrophytic Vegetation

___ 2 - Dominance Test is >50%

___ 3 - Prevalence Index is ≤3.0[1]

___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ 5 - Wetland Non-Vascular Plants[1]

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes _____ No X

Remarks:

Unknown grass in herb stratum

WETLAND DETERMINATION DATA FORM – Western Mountains, Valleys, and Coast Region

Project/Site: Winema Landing City/County: Tillamook Sampling Date: 6/07/22

Applicant/Owner: Wave State: OR Sampling Point: 5

Investigator(s): Northwest Watershed Solutions LLC Section, Township, Range: Sect 7 T5S R 10 W

Landform (hillslope, terrace, etc.): Terrace Local relief (concave, convex, none): Flat Slope (%): 0

Subregion (LRR): A2 Lat: 45deg 08' 48"N Long: -123deg 58' 24"W Datum: N/A

Soil Map Unit Name: Waldport fine sand, thin surface 3-12 percent slopes NWI classification: Upland

Are climatic / hydrologic conditions on the site typical for this time of year? Yes _____ No X (If no, explain in Remarks.)

Are Vegetation _____, Soil _____, or Hydrology _____ significantly disturbed? Are "Normal Circumstances" present? Yes X No _____

Are Vegetation _____, Soil _____, or Hydrology _____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes _____	No X	**Is the Sampled Area within a Wetland?** Yes _____ No X
Hydric Soil Present?	Yes _____	No X	
Wetland Hydrology Present?	Yes _____	No X	

Remarks:

Above average rainfall

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: 30)	Absolute % Cover	Dominant Species?	Indicator Status
1. Salix hookeriana	60	X	FACW
2.			
3.			
4.			
	60	= Total Cover	
Sapling/Shrub Stratum (Plot size: 15)			
1.			
2.			
3.			
4.			
5.			
	_____	= Total Cover	
Herb Stratum (Plot size: 5)			
1. Gaultheria shallon	20	X	FACU
2. Fragaria chiloensis	5		FACU
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
	25	= Total Cover	
Woody Vine Stratum (Plot size: _____)			
1.			
2.			
	85	= Total Cover	

% Bare Ground in Herb Stratum 10

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 1 (A)

Total Number of Dominant Species Across All Strata: 2 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 50 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	_____	x 1 =	_____
FACW species	1	x 2 =	2
FAC species	_____	x 3 =	_____
FACU species	2	x 4 =	8
UPL species	3	x 5 =	10
Column Totals:	_____ (A)		_____ (B)

Prevalence Index = B/A = 3.3

Hydrophytic Vegetation Indicators:

___ 1 - Rapid Test for Hydrophytic Vegetation

___ 2 - Dominance Test is >50%

___ 3 - Prevalence Index is ≤3.0[1]

___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ 5 - Wetland Non-Vascular Plants[1]

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes _____ No X

Remarks:

Some unknown grass in the plot

SOIL

Sampling Point: 5

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth	Matrix		Redox Features					
(inches)	Color (moist)	%	Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-6	10YR 3/2	100					SL	Sandy Soil
6-14	10YR 5/2	100					SL	Sandy Soil
14-20	7.5 YR 4/2	100					SL	Sandy Soil

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Loamy Mucky Mineral (F1) (**except MLRA 1**)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10)
- ___ Red Parent Material (TF2)
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: _____

Depth (inches): _____

Hydric Soil Present? **Yes** _____ **No** X

Remarks:

This pit was dug under the willow as close to a burm as possible.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Surface Soil Cracks (B6)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Water-Stained Leaves (B9) (**except MLRA 1, 2, 4A, and 4B**)
- ___ Salt Crust (B11)
- ___ Aquatic Invertebrates (B13)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres along Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Stunted or Stressed Plants (D1) (**LRR A**)
- ___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ___ Water-Stained Leaves (B9) (**MLRA 1, 2, 4A, and 4B**)
- ___ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)
- ___ Raised Ant Mounds (D6) (**LRR A**)
- ___ Frost-Heave Hummocks (D7)

Field Observations:

Surface Water Present? Yes _____ No X Depth (inches): _____

Water Table Present? Yes _____ No X Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No X Depth (inches): _____

Wetland Hydrology Present? **Yes** _____ **No** X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

No evidence of hydrology

SOIL

Sampling Point: 4

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Type[1]	Loc[2]	Texture	Remarks
0-5	10YR 3/2	100					SL	
5-10	10YR 5/2	100					SL	
10-20	7.5 YR 4/2	100					SL	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Loamy Mucky Mineral (F1) (**except MLRA 1**)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10)
- ___ Red Parent Material (TF2)
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: _____

Depth (inches): _____

Hydric Soil Present? **Yes** _____ **No** X

Remarks:

No Hydric soil indicators

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Surface Soil Cracks (B6)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Water-Stained Leaves (B9) (**except MLRA 1, 2, 4A, and 4B**)
- ___ Salt Crust (B11)
- ___ Aquatic Invertebrates (B13)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres along Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Stunted or Stressed Plants (D1) (**LRR A**)
- ___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ___ Water-Stained Leaves (B9) (**MLRA 1, 2, 4A, and 4B**)
- ___ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)
- ___ Raised Ant Mounds (D6) (**LRR A**)
- ___ Frost-Heave Hummocks (D7)

Field Observations:

Surface Water Present? Yes _____ No X Depth (inches): _____

Water Table Present? Yes _____ No X Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No X Depth (inches): _____

Wetland Hydrology Present? **Yes** _____ **No** X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

No hydrology indicators presents

Appendix 7
Archeological Survey

Report #

SHPO Use

Year: 2022

State Historic Preservation Office Report Cover Page

Title: Results of a Cultural Resources Study of Amazon Web Services' Winema Road Fiber Optic Cable Installation Project, Tillamook County, Oregon
Results of a Cultural Resources Study of Astound Broadband's Winema Road Fiber Optic Cable Installation

REPORT

Author(s): Bill R. Roulette

Agency/Client: Astound Broadband

District/Contractor: Applied Archaeological Research, Inc.

Agency/Client Report#: 2576 Project Acres: ca. 3.73 Survey Acres: 3.73

LOCATION

County(ies): Tillamook

Township:		Range:		Section(s):	Township:		Range:		Section(s):
5	S	10	W	12					
5	S	11	W	7					

TESTING

Archaeological Permit Number(s): Accession Number:

Reports submitted to: Tribes: ☐ UOMNCH: ☐ LCIS: ☐ Curation:

Report Addresses Testing: ☐

CONSULTATION

Have tribes been contacted or consulted? Yes

List tribes: Confederated Tribes of Coos, Lower Umpqua, and Siuslaw; Confederated Tribes of Grand Ronde; Confederated Tribes of Siletz Coquille Indian Tribe; Cow Creek Band/Umpqua Tribe of Indians

List any other groups contacted or consulted:

PA/ MOA

Report is associated with: PA ☐ MOA ☐

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RESULTS OF A CULTURAL RESOURCES STUDY OF AMAZON WEB SERVICES' WINEMA ROAD FIBER OPTIC CABLE INSTALLATION PROJECT, TILLAMOOK COUNTY, OREGON

By

Bill R. Roulette, M.A., RPA

Prepared for
Astound Broadband
Newport, Oregon

June 29, 2022

APPLIED ARCHAEOLOGICAL RESEARCH, INC. REPORT NO. 2576

APPLIED
ARCHAEOLOGICAL
RESEARCH, INC.
Cultural Resource Management and Historic Preservation

4001 NE Halsey Street, Suite 3
Portland, OR 97232
Phone (503) 281-9451

INTRODUCTION

Project Description

AMCS LLC, an affiliate of Amazon Web Services (AWS) proposes to land a submarine cable on the Oregon coast in Tillamook County (Figure 1). Once on shore, the cable will be installed underground along an approximately 0.4-mile section of Winema Road. A short length of cable would diverge from the main installation and extend to a church camp near the where the cable comes ashore. Establishing the onshore connection and extending the cable to the cable landing station (CLS) will involve excavations that have potential to impact cultural resources if they are present. A beach manhole (BMH) and two ocean ground beds (OGBs) will be installed where the cable comes ashore (Figure 2). To install the BMH will require the excavation of a small pit measuring approximately 4-x-4-feet (ft). The installation of OGBs will require excavation of narrow trenches from the BMH to the beds and where the anodes are to be buried. The trenches would be about 2 ft wide and up to 5 ft deep.

From where it comes ashore to the CLS the cable will be installed underground via directional boring. Installation will require the excavation of five pits for vaults to be placed into the public right of way on the north side of Winema Road. Vault pits typically will measure approximately 6 by 8 ft and would be about 4 ft deep. They will be 5 ft or less from the edge of pavement. A sixth vault will be installed at the CLS that is to be located on the south side of Winema Road at its intersection with Otzen Road. The CLS will contain a paved driveway/parking area, additional grounding beds, and infrastructure required to operate the system.

Project Compliance and Staffing

The landing of the cable on the Oregon coast requires a joint permit application (JPA) between the project proponent, the Oregon Department of State Lands, and the United States Army Corp of Engineers (ACOE). In addition, the construction and operation of the cable requires a license from the Federal Communications Commission. The need for federal permits makes the part of the project an undertaking of the federal government and as such subject to the requirements of Section 106 of the National Historic Preservation Act, as amended, and its implementing regulations, 36 CFR 800 (Section 106), which requires the lead federal agency, assumed to be the ACOE, to make a good faith effort to locate historic properties in the project area of potential effects (APE). Astound Broadband, the contractor for the project, contracted with Applied Archaeological Research, Inc. (AAR) to conduct a study that would assist the lead agency at such time the project comes under its jurisdiction, in fulfilling its Section 106 obligations related to the terrestrial part of the project in Oregon. This report describes the results of AAR's study. It has been prepared by Bill R. Roulette, M.A., RPA 11132. Julie Wilt, M.S., assisted with background research, and Laura De Simone, M.S., assisted with the fieldwork.

Tribal Consultation

Official consultation with affected tribes will be done by the lead federal agency. For AAR's project, an informational email was prepared that described the project and which included a request for information regarding tribal concerns related to it. A map accompanied the email that showed the APE. The email was sent on June 13, 2022, to the Confederated Tribes of Coos, Lower Umpqua, and Siuslaw; Confederated Tribes of Grand Ronde; Confederated Tribes of Siletz; Coquille Indian Tribe; and the Cow Creek Band of the Umpqua Tribe of Indians. Kassandra Rippee, the Tribal Historic Preservation Officer of the Coquille Indian Tribe, responded and stated that she would defer to other tribes. The email was sent to an obsolete address for the Cow Creek Band of the Umpqua Tribe of Indians. Kassandra Rippee forwarded the email to the correct person at the tribe, Jennifer Bryant, Cultural Resources Program Manager. Jennifer Bryant responded that she would review the information provided by AAR. No other comments were received.

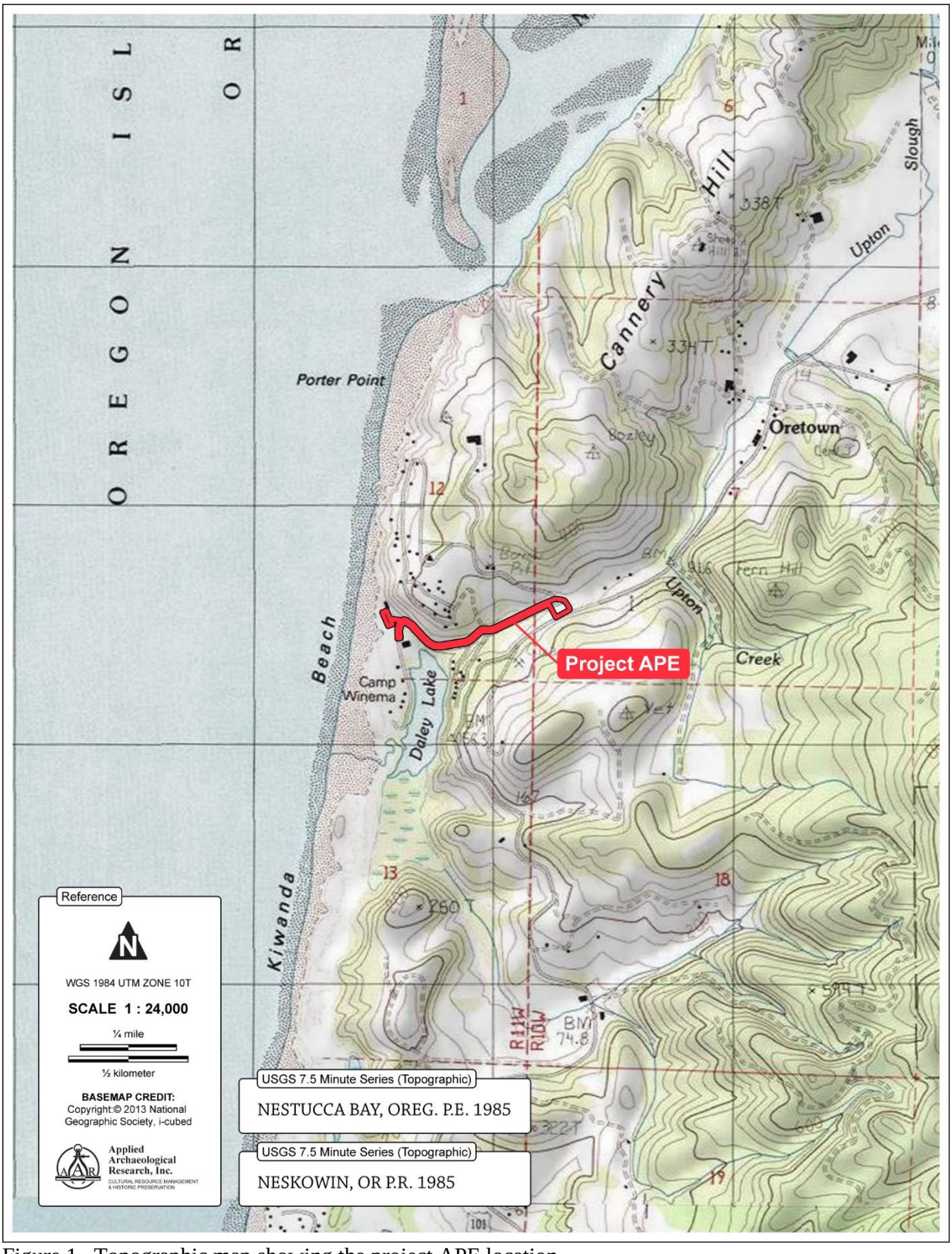

Figure 1. Topographic map showing the project APE location.

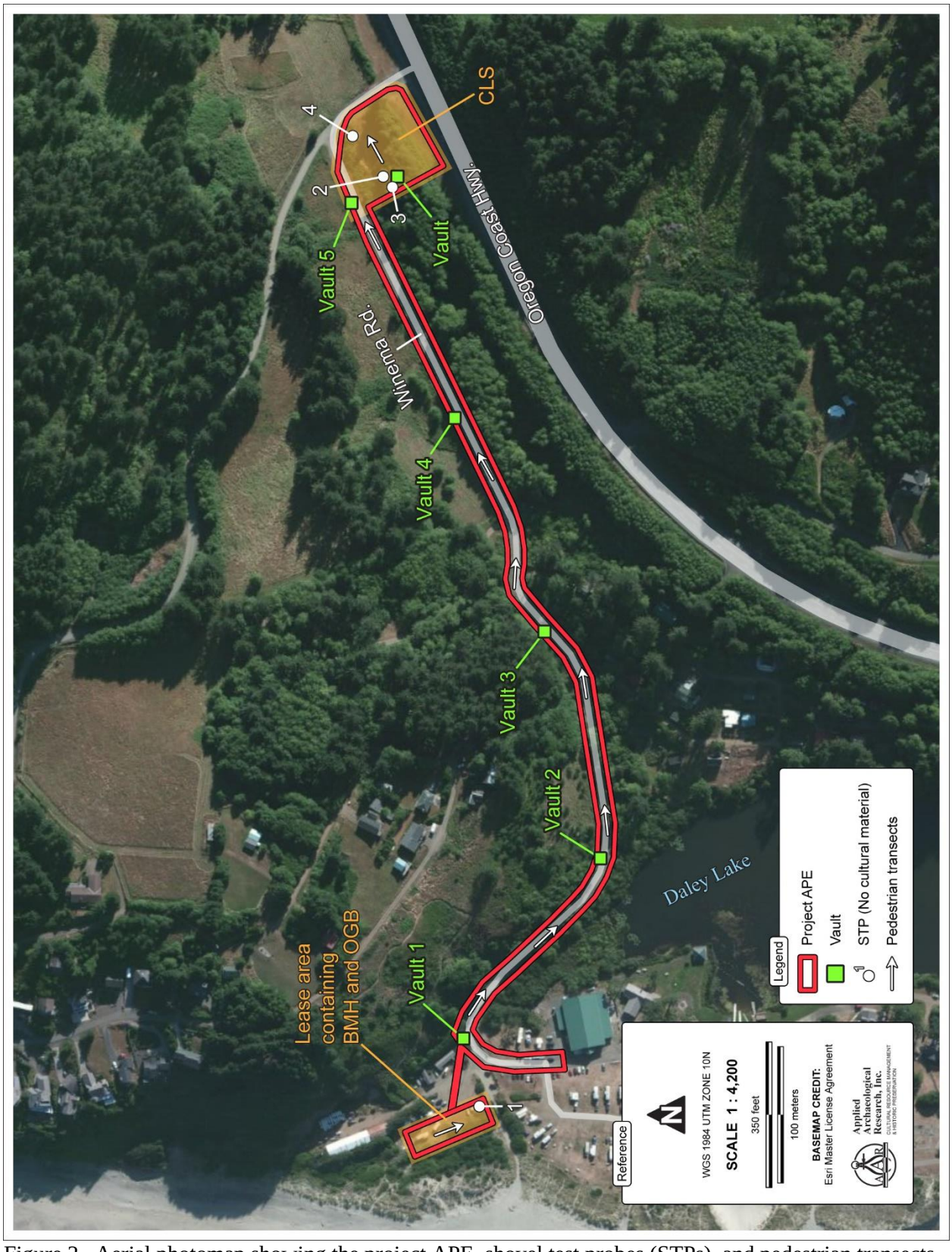

Figure 2. Aerial photomap showing the project APE, shovel test probes (STPs), and pedestrian transects.

APE Description

The APE defined for the project is in Section 12, Township 5 South, Range 11 West, Willamette Meridian (WM) and Section 7, Township 5 South, Range 10 West, WM. It begins in a privately owned rectangular lease area that measures around 200 by 60 ft and encompasses 0.27 acre. The lease area is improved to facilitate recreational vehicle camping. The BMH and the OGBs will be installed in the lease area. From there the installation route extends a short distance eastward along Winema Road and splits with one branch extending southward about 230 ft to a church camp built around Winema Lake. Another branch follows Winema Road generally eastward for approximately 0.4 mile to the CLS. Along roads, the APE is defined as the width of the roadbed plus 10 ft on either side. The CLS is privately owned. It is largely rectangular in shape that measures 154 by 292 ft and encompasses 1.03 acres. In all, the APE includes 3.73 acres. Elevations in the APE range from about 20 ft above mean sea level (amsl) at the lease area to ca. 120 ft amsl at the CLS.

Conventions

Measurements used in this report to express common distances, elevations, and areas are in United States customary units. Measurements related to archaeological techniques are in metric units. Numbers in the thousands used to express ages and distances feature commas to denote thousands. Calendar dates and dates used to express years before present (B.P.) do not use commas to denote the thousands place but do use commas to denote ages of 10,000 B.P. and greater. Modern, common names without taxonomic equivalents are used when listing plants and animals.

ENVIRONMENTAL, ARCHAEOLOGICAL, AND CULTURAL OVERVIEW

Environmental Overview

The cable would come ashore on the coastal plain just east of Winema Beach. In Oregon, the coastal plain consists of a long, narrow zone between the open ocean and the Coast Range (Franklin and Dyrness 1973). It is particularly narrow in the APE vicinity. Winema Lake, just to the south of the landing site, sits in a swale in a stable sand dune field. It is fed by an unnamed stream that slows from the west face of the Coast Range. The old dune field is backed by a steep riser that ascends to the range.

The shape and configuration of the coastal plain has been influenced to an unknown extent by tectonic activity. At least 11 earthquakes during the Holocene along the Oregon coast have resulted in differential subsidence, uplift, sedimentation, and erosion along the coast (Charland and Reckendorf 1998:5-14). The last large quake occurred approximately 300 years ago (Atwater et al. 2005).

Beyond the plain, the remainder of the installation route traverses south-facing slopes on Cannery Hill in the Coast Range. The hill is a spur that is separated from the main mass of the Coast Range by a shallow saddle that likely marks the course of a former drainage. The Coast Range is a narrow belt of moderately high mountains and coastal headlands extending from the Columbia River on the north to the Middle Fork of the Coquille River on the south. The range has been described as "simply a big slab of sea floor raised high and dry, tilted ever so gently eastward, and broken up a bit by a few faults" (Alt and Hyndman 1992:71). Uplift of the sea floor began during the Miocene, a period of prolific volcanism that produced the lava flows of eastern Oregon as the ocean retreated to the west (Orr et al. 1992:169). During the subsequent Pliocene and Pleistocene epochs erosion shaped the mountains and rivers and streams cut drainages that give the range its characteristic dissected appearance.

Overall, the installation route is within the Sitka spruce forest zone that is found on the coastal plain and areas inland to an elevation of 500 ft amsl. Intermixed into this zone are unique habitats that

include sand dune and strand communities and herb-and-shrub-dominated communities (Franklin and Dyrness 1973:291). Major tree species of the Sitka spruce forest zone include Sitka spruce, western hemlock, Douglas-fir, western redcedar, and red alder, although closer to the coast, lodgepole, or shore pine, may dominate. Understory vegetation is dense and includes a variety of shrubs, herbs, and ferns including sword fern, wood sorrel, red and evergreen huckleberry, salal, red elderberry, and western rhododendron. Sand dune and strand communities are dominated by colonizing species including a variety of herbaceous species, such as beach peavine and beach silvertop, sedges and grasses, including bighead sedge and seashore bluegrass, and trailing coast morning glory. A common species in this community is European beachgrass, which was introduced to help stabilize dunes fields in the late 1800s, but which now is a naturalized species (Franklin and Dyrness 1973:291). Shrub communities can contain tightly packed and extremely dense vegetation often dominated by salal, evergreen huckleberry, wax myrtle, rhododendron, and kinnikinnick.

Terrestrial mammals found or formerly found in the APE include deer and elk, coyote, black bear, mountain lion, bobcat, beaver, snowshoe hare, raccoon, weasels, minks, martens, and skunks. Bird species found in the area are numerous and include varieties of blue and ruffed grouse, mountain quail, and owls such as the great horned and long-eared owls (Bailey 1936).

Surficial sediments mapped at the landing site and along the section of the installation route to the church camp are described as Active Dunes (Bowlsby and Swanson 1964, sheet 33). This type of deposit consists of wind-drifted sand in the form of dunes, ridges, or hummocks. The section of the route along Winema Road to the CLS begins with a short steep slope as the road climbs the toeslope of Cannery Hill. The soil mapped in that section of the route is Neskowin silty clay loam, 40 to 60 percent slopes. It is found on moderately to very steep uplands near Oretown and Neskowin. It formed in residuum weathered from igneous rocks (Bowlsby and Swanson 1964:48). The soil mapped along the section of route on the sideslope of Cannery Hill and at the CLS is Hembre silt loam, 3 to 12 percent slopes. It also is limited to upland settings and formed in basic igneous rocks (Bowlsby and Swanson 1964:44).

Archaeological Context

For the current study it is necessary only to describe the prehistory of the Pacific Coast in general outline. Based on changes in human-to-land relations, technology, and human organization, among other factors, four main periods can be defined. They are described below.

Archaic (11,000-5500 B.P.)

People have made the Oregon coast their home for thousands of years, but the dynamic nature of the coast has hindered the discovery of older archaeological sites in the region. Isostatic rebound from glacial melting, erosion, and tectonic events have all led to the destruction or burial of many of the earliest sites (Aikens et al. 2011:218-219). Nevertheless, some older sites have been documented that date to the Terminal Pleistocene/Early Holocene, such as 35CS9, south of the APE in Coos County. The site has been dated to ca. 11,000 B.P. and excavations there suggests use of the locale for several millennia (Hall et al. 2005). A slightly younger site, the Tahkenitch Landing site (35DO130), in Douglas County, contains three cultural components one of which, Component I is dated to between 8000 and 5200 B.P. Subsequent components are dated to ca. 5200-3000 B.P., and to around 3000 B.P. Use of the site appears to have peaked during the second component and to have dwindled over time. It continued at least intermittently into the historic period when it functioned as a canoe landing (Minor and Toepel 1986).

On the northern Oregon coast, Archaic sites are assigned to the Youngs River Complex and contain shouldered and leaf shaped points. They are found on high terraces near the mouth of the

Columbia River. Human groups from this era were mobile and had a broad-spectrum foraging lifeway (Ames and Maschner 1999:67; Minor 1983, 1984).

Early Pacific (5500-3500 B.P.)

The beginning of the Early Pacific period coincides roughly with cooler and wetter environmental conditions (Ames and Maschner 1999:83) and sea level stabilization along the Oregon coast (Lyman 1991:80). Archaeological sites from this period typically contain lanceolate projectile points and scrapers. Bone tools increase in frequency and diversity of forms compared to preceding period assemblages, but this may be in part a function of preservation (Lyman 1991:80). While a diverse suite of resources was used during this period, suggesting a continuation of the broad-spectrum foraging adaptation seen in the Archaic period, resources captured or harvested in the intertidal and coastal zones, including sea mammals, increased in importance. Lyman (1991:80) calls this period the early Littoral to emphasize the apparent increase in exploitation of coastal resources concomitant with sea level stabilization. Increased biological diversity and productivity related to sea level stabilization and the development of estuaries was followed by increased sedentism by prehistoric populations and some increased logistical organization.

Middle Pacific (3500-1500 B.P.)

On the Oregon coast, the first village appears during this period and shell middens become much larger than in the preceding period indicating a greater degree of residential sedentism or site reuse (Ames and Maschner 1999). At the same time, a variety of site types are recognized, suggesting increasing logistical organization of economic activities. More use of storage technology is evident, as is intensification of salmon in some areas (Ames and Maschner 1999:108). More types of bone and antler tools appear in assemblages, including unilaterally barbed harpoons and multipart tools such as the composite toggling harpoon (Ross 1990:555).

Late Pacific (1500-200 B.P.)

Modern climatic conditions were in place by 2000 B.P. On the Northwest Coast generally, the Native American lifeways seen at the time of European and American contact were fully in place by the beginning of this period. Settlement patterns seen archaeologically suggest a developed system of logistical movements with winter villages located around estuaries and a variety of field camps where economic resources were procured and processed in bulk. Faunal remains are highly variable in Late Pacific sites and a wide array of bone and flaked stone tools is found.

Ethnographic Overview

At the time of Euroamerican contact, the APE was within the homeland of the Nestucca Indians, a Salish-speaking people. The Nestucca occupied the region between Cape Lookout and Cascade Head, primarily living around Sand Lake, Nestucca Bay, and Neskowin. The Nestucca were a subdivision of the Tillamook Indians, who occupied the river valleys along the coast from Tillamook Head south to the Siletz River.

Like other Tillamook groups, the Nestucca lived in permanent, mostly politically autonomous winter villages, dispersing in the spring, summer, and fall to more distant locations to gather and process resources for storage and later consumption (Seaburg and Miller 1990). Winter villages were usually located at the mouths or confluences of major rivers, but also along the shores of estuaries and bays (Jacobs 2003:2; Seaburg and Miller 1990:561). Houses were rectangular, made of upright cedar plank walls and gabled roofs, and included both semi-subterranean and aboveground styles (Jacobs 2003:2; Seaburg and Miller 1990:561). House interiors usually featured a central fire pit and raised sleeping

platforms along the sides (Seaburg and Miller 1990:561). Floors were covered with mats and goods were stored in baskets under the platforms or hung from the house rafters for smoking and drying. Besides houses, villages had sweat lodges, menstrual huts, and cemeteries.

Subsidiary residential sites were occupied seasonally from late spring to late autumn at fishing, hunting, and plant gathering sites. Structures were sometimes constructed at these locations but were not as substantial as winter houses (Jacobs 2003:2-3). These secondary sites were the centers of resource procurement and processing and likely featured hearths, ovens, drying racks, and associated artifacts, depending on the specific resources and range of activities. Fish weirs and traps were often constructed to trap fish in areas of shallow water where they were easier to catch (Sauter and Johnson 1974:54). However, such subsidiary sites were open to the community, as well as to outsiders (Jacobs 2003, Sauter and Johnson 1974).

The historical Nestucca villages nearest the APE were to the north. One was on the east side of the Nestucca River in Pacific City. The other was on bay side of North Spit (Sauter and Johnson 1974). Other Nestucca villages and campsites are reported to have been located around Nestucca Bay, on the western edge of Sand Lake, at Tierra del Mar, along the Nestucca River near the present town of Woods, and near Neskowin, where Hawk and Slab creeks meet (Sauter and Johnson 1974:175-177). Stella Falls, located on the Little Nestucca River, was an especially productive fishing site due to the narrowing river and height of the falls (Sauter and Johnson 1974:175).

Fish, roots, berries, terrestrial and sea mammals, and shellfish formed the basis of the Nestucca subsistence (Jacobs 2003:75, 80-81; Seaburg and Miller 1990:562). Resources were taken when available and either consumed directly or processed and stored for future use. In the spring salmonberry sprouts were gathered and camas, huckleberries, and salalberries were collected and processed for storage during the early summer. Some roots such as fern, lily, and wild carrots were collected in the winter months (Jacobs 2003:80-81). Men hunted alone year-round, and groups of men hunted together during the fall elk season. Bow and arrow, spear, traps, and pitfalls were used to capture and kill elk, deer, bear, beaver, muskrat, and other small mammals (Jacobs 2003:75). Sea mammals such as sea lion and seals were hunted, and shellfish were gathered and dried. Fresh and saltwater fish were widely used, and salmon was an important staple. Salmon were taken from August through December (Seaburg and Miller 1990:564).

Like other Tillamook peoples, Nestucca society had free and slave classes with a fluid ranking in the free class based on acquisition of spirit powers (Jacobs 2003:96). Each village had a headman, but leadership was often a looser, task-related responsibility (Seaburg and Miller 1990:565) with knowledgeable individuals taking the lead in specific tasks.

Infectious diseases against which they had no resistance spread among the Nestucca and other Tillamook groups and other Indian communities along the Oregon coast, in the lower Columbia River Valley, and in the Willamette Valley beginning in the late eighteenth century. A smallpox outbreak occurred around 1775 and probably affected the entire coastal region (Boyd 1990:137). All groups lost at least a third of their members in this epidemic, which may have spread from a Spanish expedition ship (Boyd 1990:138). A second epidemic followed in 1801, spread from the Great Plains through the Columbia Plateau. Various other epidemics of measles or smallpox or other infectious diseases occurred periodically between the 1820s and the 1860s. The cumulative effect of the epidemics was to reduce the population of the Tillamook from an estimated 4,320 in the early 1800s to 193 in 1854 (Boyd 1990:136, 146).

Treaties negotiated in 1851, but never ratified, led to the Tillamook ceding their traditional lands. However, no concerted effort was made by white settlers or the military to remove the Tillamook to either the Siletz Reservation, established in 1855 or to the Grand Ronde Reservation, established in 1858. The

United States Congress disposed of land claim cases raised by the Tillamook in 1897 and 1912 and the courts dismissed a lands claim case in 1945. The Tillamook received awards from the Indian Claims Commission in 1958 and 1962 (Seaburg and Miller 1990:561).

Regional Historical Background

The first Euroamericans on the northern Oregon coast may have been Spanish explorers (Ruby and Brown 1976:26-31). American Captain Robert Gray, aboard his ship *Columbia Rediviva,* was the first non-native person to cross the bar at the mouth of Tillamook Bay in 1788. George Vancouver arrived later that same year, exploring the Columbia River to upstream of the Willamette River (Silverstein 1990:535). In 1805, Lewis and Clark reached the mouth of the Columbia, over wintering at Fort Clatsop, and traveling as far south as Seaside, Oregon. These initial visits helped to open the region to further exploration and to trade.

Most early Euroamericans on the northern Oregon coast were engaged in the fur trade. Traders exchanged guns, powder, shot, items of Euroamerican clothing, knives, beads, and tobacco, as well as metal implements such as copper and brass kettles for furs provided by native groups (Silverstein 1990:535). The coastal fur trade focused on sea otters and resulted in the near annihilation of those animals by the early 1830s. Thereafter, the focus shifted to inland mammals such as beaver (Cole and Darling 1990:131). With production of sea otter furs declining, ship-based coastal trading moved to land-based posts at Astoria, Fort Vancouver, and in the Columbia Basin of eastern Oregon and Washington.

As more Euroamericans settled the Willamette Valley in the mid-1800s, many settlers came overland to the coast, following the Yamhill River drainage over the Coast Range into the Salmon River or Nestucca River drainages, and then north up the coast to Tillamook. The beaches were used as travel ways. Indians that lived in a village on the Nestucca River near where Pacific City is now located used their canoes to ferry travelers across the river. Eventually a trail was established on the north side of the river that led upriver to Hebo and could be used to bypass Cape Kiwanda for those heading north (Dicken 1971:35). In 1854, the Nestucca Bay area was bypassed completely when settlers cleared a trail from Tillamook to Hebo, and from Hebo over the coast range to Grand Ronde (Dicken 1971:33).

The largest community near the APE is Pacific City. It was platted as Ocean Park in 1893 by Thomas Malaney but was re-platted in 1910 as Pacific City to avoid confusion with another Ocean Park in Washington. Beginning in the 1910s, Pacific City became a popular resort destination for people from the Willamette Valley. In fact, so many people from McMinnville owned second homes in Pacific City, that a section of the hill above town was known as McMinnville Heights (Boge 1979:135). Nearby communities of Oretown and Neskowin were settled about the same time as Pacific City, or a bit earlier. Both has post offices but neither had the kind of growth as Pacific City (McArthur 1982, 539, 564).

RESULTS OF SITE-SPECIFIC BACKGROUND RESEARCH

Previous Archaeology in the Project Vicinity

A review of site record forms and site distribution maps on file at the Oregon State Historic Preservation Office (SHPO) indicates that the APE has not previously been surveyed and contains no recorded archaeological sites. Little previous archaeological research has been done in the immediate vicinity of the APE. A surface survey conducted in 1977 that included lands along Bozley Creek near Oretown. No cultural resources were identified during the project (Cole and Pettigrew 1977).

Most recorded sites in the general vicinity of the APE are to the north on the Nestucca River. They include 35TI25, 35TI26, and 35TI27, located in the town of Woods on the north bank of the

Nestucca River and which were recorded more than 60 years ago during a survey of the Oregon coast (Collins 1951a, 1951b, 1951c, 1953). Also in the Pacific City area, local artifact collectors report having found artifacts in the dunes around Cape Kiwanda and on the North Spit (Swanson 1976:6). Avocational archaeologists John Sauter and Bruce Johnson were quite active in digging into sites throughout Tillamook County and published a book to describe their findings (Sauter and Johnson 1974). In it they state: "Sand spits such as Netarts, Nestucca, Bay Ocean, and Nehalem all contain pockets of camp midden which reflect temporary encampments" (Sauter and Johnson 1974:142).

Cartographic Research

Historical maps dating from between 1872 and 1955 were examined to determine if any unrecorded historical developments, other than roadways, are within the APE. The earliest maps, prepared by the General land Office (GLO) show no historical features in or near the APE (GLO 1872a, 1872b).

Winema and Ozten Roads are shown on a map published in 1941 by the Army Map Service (AMS 1941). The map shows a few structures at the north end of Winema Lake but no developments other than roadways in the APE. It shows a stream or other type of drainage feature coursing westward following Winema Road and to drain into the lake. No developments except roadways are depicted in the APE on a map published by the United States Geological Survey (USGS) in 1955. The map shows increased developments around the lake. It does not show the drainage feature seen on the 1941 map (USGS 1955).

A real estate atlas published in 1930 shows J.M. Card as the owner of the lands bordering the APE (Metsker 1930). When Card obtained the land is unknown, but it was least by the late 1920s. In 1927, he and his wife Effie, platted the community of Wi-ne-ma on the east side of Winema Lake between it and U.S. 101. Card did not live on the property and instead owned and operated a dairy farm in the Little Nestucca valley (Ancestry.com 2022; Coastview 2021).

A few lots sold but no community ever developed at Wi-ne-ma. By 1941, Edna Flemming owned the townsite and surrounding property. In that year, a group from the Amity Church of Christ was at the looking for a place to camp. They were directed to the Win-ne-ma townsite as a possible camping spot but were told they would need to get permission from the landowner. They were allowed to camp around Winema Lake and so enjoyed the setting that the church made an offer to purchase the property. By 1945 fund for the purchase had been raised and in December of that year, Wi-ne-ma Christian Camp, Inc. became the owner. The purchase included all remaining unsold lots in Wi-ne-ma and the lands west of Winema Lake to the ocean beach. The property has been developed for retreats and other events and recreational vehicle camping (Coastview 2021; Wi-ne-ma Christian Camp 2022).

FIELD METHODS AND RESULTS

Methods

Fieldwork for the project was conducted June 20, 2022, by Bill R. Roulette, M.A., RPA, and Laura L. De Simone, M.S. The lease area where the cable would come ashore and the CLS were surveyed using transects spaced no more than 5 meters apart. Each of the five vault locations along Winema Road were located and examined. Four shovel test probes (STPs) were excavated, one in the lease area and three in the CLS (Figure 2). They were cylindrical holes 45-60 centimeters (cm) in diameter. They were excavated to 12 and 50 cm below surface (cmbs) in levels that were 10 cm thick. Soil removed from them was processed through one-eight-inch gauge hardware mesh.

Results

During the survey of the lease area where the cable will come ashore it was observed that it was artificially flat. It consists of a platform cut into the toeslope of Cannery Hill (Figure 3). A scarp just beyond the west edge of the lease area marked the limits of the cut and fill. There was a 45 cm elevation difference between the surface of the platform and the native landsurface at the base of the scarp. The north half of the lease area has been improved for recreational vehicle camping and contains water spigots and electrical boxes. The water and electrical lines are buried.

The surface of the southern and central parts of the lease area had 50 percent or better surface visibility. However, the exposed surface was not the native ground surface. The surface in its northern part was grassy and had less than 50 percent visibility.

No artifacts were observed at the surface in the lease area. One STP was excavated in the lease area. It was placed where a OGB will be installed at its southern end. It contained 13 cm of moist, dark brown (7.5YR 3/3) clay loam with abundant rock over decaying bedrock. It did not contain artifacts.

The roadside fault locations were marked with flagging tape. Vaults are to be installed on the north side of Winema Road in areas created by cutting and filling (Figures 4 and 5). Vegetation in all their locations was thick resulting in zero percent surface visibility. No artifacts were observed. At the same, because of their locations, the spots had essentially no potential to contain archaeological resources.

The CLS was readily identifiable in the field using project design sheets. Its northern and southern parts were thickly vegetated, its center part less so. A 30- to 35-foot-wide area of vegetation will be preserved along its southern edge to serve as a sight buffer between it and U.S. 101. Excluding the buffer zone, the development footprint in the CLS encompasses roughly 0.8 acre.

Viewed in cross section the CLS has a shallow “U” profile (Figure 6). Its interior part forms a trough framed on its north and south sides by rising ground. The higher ground may be related to road construction as Winema Road borders it to the north and U.S. 101 is a short distance to its south.

Surface visibility was less than 50 percent throughout the CLS and no artifacts were found on the ground surface.

Three STPs were excavated to search for buried archaeological deposits. They were placed in an approximate east-west line toward the center of the CLS. STP 2 was placed at its western end. It contained a layer of moist, dark brown (7.5YR 3/3) to very dark brown (7.5YR 2.5/3) loamy clay. The layer extended to 45 cmbs. It capped a layer of moist, gray (7.5YR 5/1) to brown (7.5YR 5/2) clay. Excavations extended 5 cm into the clay which was determined to most likely be decayed rock (Figure 7).

Despite being located only about 30 m east of STP 2, the soil profile in STP 3 was completely different. It consisted of a 37-cm-thick layer of moist, light brown (7.5 YR 6/3) to brown (7.5YR 5/3) medium sand. The sand layer sat atop decaying bedrock in a matrix of moist dark brown (7.5YR 3/4) loamy clay (Figure 8).

STP 4 was about 30 m east of STP 3. Its soil profile was a truncated version of the one seen in STP 3 and included a 12-cm-thick layer of moist, light brown (7.5 YR 6/3) to brown (7.5YR 5/3) medium sand over decaying bedrock.

STPs excavated in the CLS did not contain artifacts.

Figure 3. Lease area where cable will come ashore with Cannery Hill visible to frame right. Note spigot to left and electrical boxes to right. Truncated scarp in background is edge of push pile. View is north.

Figure 4. Location of Vault 1 along Winema Road. Vault is to be installed to frame left a short distance beyond the "No Parking" sign. View is generally east.

Figure 5. View generally west of location of Vault 5 to be installed on north side of Winema Road (frame right) in center foreground.

Figure 6. Overview looking north of the CLS with Winema Road to frame left and U.S. 101 to frame right.

Figure 7. *Left:* Soil profile exposed in STP 2 excavated at the CLS. *Right:* Soil profile exposed in STP 3 excavated at the CLS. In the photographs, the scale is divided into 10-cm sections and the trowel points north.

SUMMARY AND RECOMMENDATIONS

No cultural resources are recorded in the APE. The lease area where the cable will come ashore has been cut so that the native soil has been removed and decaying bedrock is present just below the surface. Vault pits along Winema Road will be excavated into fill cut from the adjoining hillside. Part of the CLS has been graded to near bedrock and archaeological investigations elsewhere in it did not identify cultural resources.

It is AAR's opinion that its study represents a good faith effort to locate historic properties in the APE and would have done so if they were present. Based on the available evidence, the APE does not contain historic properties and a finding of no effect to historic properties is appropriate for the undertaking. AAR recommends that no additional archaeological investigations are warranted in the APE as described in this report.

AAR's recommendations is made based on the study described in this report. It is always possible that cultural deposits may be encountered during project implementation. If archaeological material is exposed in the APE during project implementation, all work in the vicinity of the finds shall cease immediately and the ACOE, Oregon SHPO, and the affected tribes should be promptly notified to assure compliance with the relevant state and federal laws and regulations. Project-related work in the APE shall not resume until mitigation measures have been agreed upon by all parties.

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