Tillamook County

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

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Tillamook, Oregon 97141
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Land of Cheese, Trees and Ocean Breeze

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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.

Written testimony may be submitted to the Tillamook County Department of Community Development, 1510-B Third Street, Tillamook, Oregon, 97141 prior to 4:00 p.m. on the date of the December 8, 2022, Planning Commission hearing. If submitted by 4:00 p.m. on November 30, 2022, the testimony will be included in the packet mailed to the Planning Commission the week prior to the December 8, 2022, hearing. Failure of an issue to be raised in a hearing, in person or by letter, or failure to provide sufficient specificity to afford the decision-maker an opportunity to respond to the issue precludes appeal to the Land Use Board of Appeals on that issue. Please contact Lynn Tone, Office Specialist 2, Tillamook County Department of Community Development, ltone@co.tillamook.or.us as soon as possible if you wish to have your comments included in the staff report that will be presented to the Planning Commission.

The documents and submitted application are also available on the Tillamook County Department of Community Development website (https://www.co.tillamook.or.us/commdev/landuseapps) or at the Department of Community Development office located at 1510-B Third Street, Tillamook, Oregon 97141. A copy of the application and related materials may be purchased from the Department of Community Development at a cost of 25 cents per page. The staff report will be available for public inspection on January 20, 2022. Please contact Lynn Tone for additional information ltone@co.tillamook.or.us or call 1-800-488-8280 x3423.

In addition to the specific applicable review criteria, the Tillamook County Land Use Ordinance, Tillamook County Land Division Ordinance, Tillamook County Comprehensive Plan, and Statewide Planning Goals which may contain additional regulations, policies, zones and standards that may apply to the request are also available for review at the Department of Community Development.

The Tillamook County Courthouse is handicapped accessible. If special accommodations are needed for persons with hearing, visual, or manual impairments who wish to participate in the hearing, please contact 1-800-488-8280 ext. 3303, at least 24 hours prior to the hearing in order that appropriate communications assistance can be arranged.

If you need additional information, please contact Lynn Tone, DCD Office Specialist, at 1-800-488-8280 ext. 3423 or email ltone@co.tillamook.or.us.

Tillamook County Department of Community Development

Sarah Absher, CBO, CFM, Director

REVIEW CRITERIA

SECTION 6.040: REVIEW CRITERIA:

Any CONDITIONAL USE authorized according to this Article shall be subject to the following criteria, where applicable:

(1) The use is listed as a CONDITIONAL USE in the underlying zone, or in an applicable overlying zone.

(2) The use is consistent with the applicable goals and policies of the Comprehensive Plan.

(3) The parcel is suitable for the proposed use considering its size, shape, location, topography, existence of improvements and natural features.

(4) The proposed use will not alter the character of the surrounding area in a manner which substantially limits, impairs or prevents the use of surrounding properties for the permitted uses listed in the underlying zone.

(5) The proposed use will not have detrimental effect on existing solar energy systems, wind energy conversion systems or wind mills.

(6) The proposed use is timely, considering the adequacy of public facilities and services existing or planned for the area affected by the use.

TCLUO SECTION 3.510: FLOOD HAZARD OVERLAY ZONE

(14) DEVELOPMENT PERMIT PROCEDURES

(b) Development Permit Review Criteria

(1) The fill is not within a Coastal High Hazard Area.

(2) Fill placed within the Regulatory Floodway shall not result in any increase in flood levels during the occurrence of the base flood discharge.

(3) The fill is necessary for an approved use on the property.

(4) The fill is the minimum amount necessary to achieve the approved use.

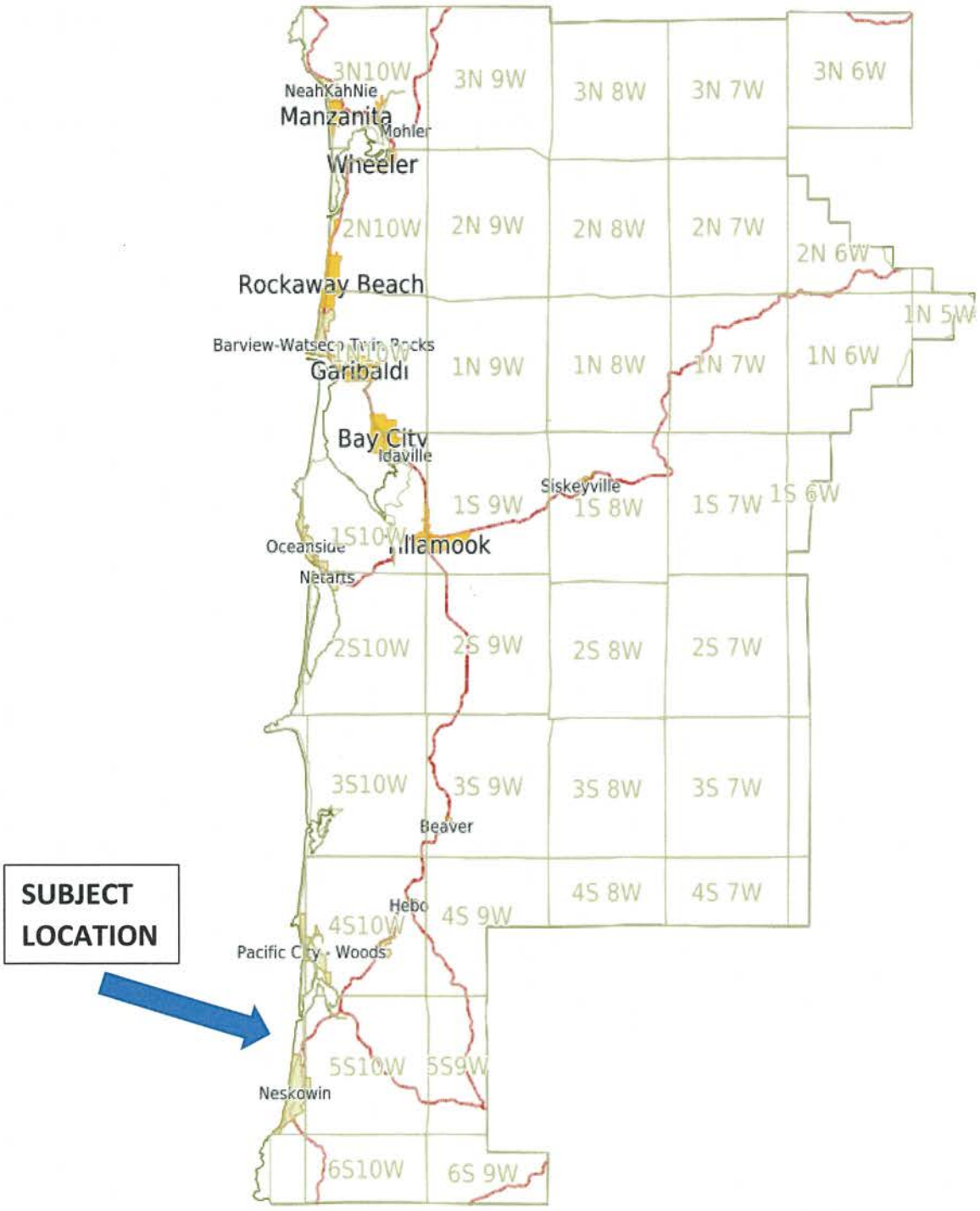
(5) No feasible alternative upland locations exist on the property.

(6) The fill does not impede or alter drainage or the flow of floodwaters.

(7) If the proposal is for a new critical facility, no feasible alternative site is available.

Conditions of approval may require that if the fill is found to not meet criterion (5), the fill shall be removed or, where reasonable and practical, appropriate mitigation measures shall be required of the property owner. Such measures shall be verified by a certified engineer or hydrologist that the mitigation measures will not result in a net rise in floodwaters and be in coordination with applicable state, federal and local agencies, including the Oregon Department of Fish and Wildlife.

VICINITY MAP



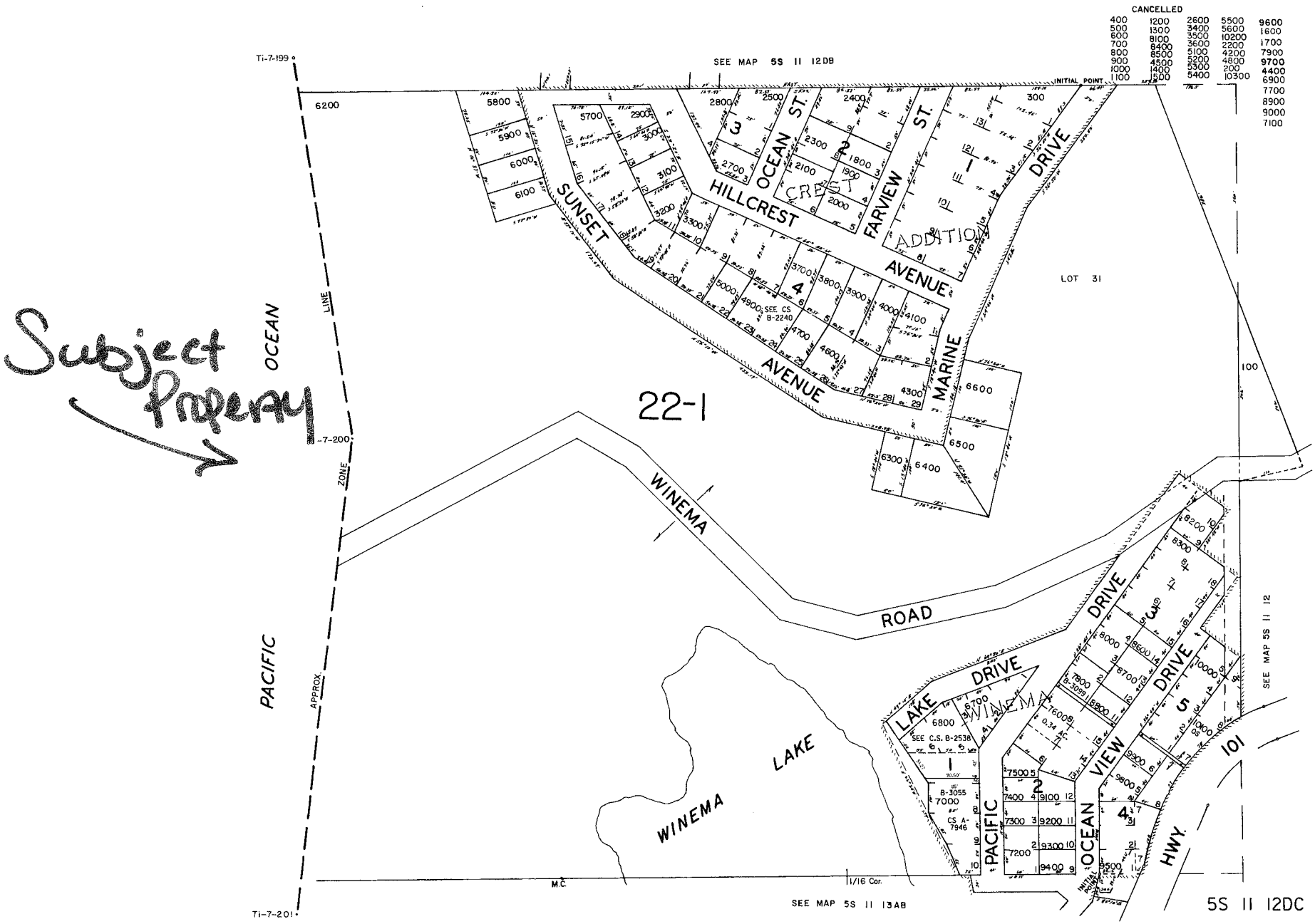
#851-22-000388-PLNG & #851-22-000373-PLNG:
AMCD LLA/Astound/Wi-Ne-Ma Christian Camp

THIS MAP WAS PREPARED FOR ASSESSMENT PURPOSE ONLY

SW1/4 SE1/4 SEC.12 T.5S. R.11W. W.M.
TILLAMOOK COUNTY

1" = 100'

5S 11 12DC
WINEMA



5S 11 12DC

REVISED 12/10/07, WS

Map

Generated with the GeoMOOSE Printing Utilities

CC OTH 00555831 2022 TR

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

PLANNING APPLICATION

OFFICE USE ONLY
Date Stamp
☐Approved ☐Denied
Received by:
Receipt #:
Fees: 1300.-
Permit No: 851-22-000388-PLNG

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

Name: AMCS LLC Phone: (206) 577-6684

Address: 410 Terry Avenue North

City: Seattle State: WA Zip: 98109

Email:subsea-interest@amazon.com; infrastructure-contract-notices@amazon.com

Property Owner

Name: Astound Phone: (541) 760-9822

Address: 151 E. Olive Street

City: Newport State: OR Zip: 97365

Email: matthew.updenkelder@astound.com

Request: **Request a Conditional Use approval to install a utility(submarine fiber optic cable) on a private lot (Lot 6200). Please see attached narrative for more detail.**

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

Location:

Site Address: **5195 Wi Ne Ma Rd, Cloverdale, OR 97112**

Map Number:	05S	11W	12	6200
	Township	Range	Section	Tax Lot(s)

Clerk's Instrument #: _____

Authorization

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

DocuSigned by: Matt Updenkelder 9/22/2022

Property Owner Signature (Required) Date

DocuSigned by: David Selby 27AB44D02DA64E4... September 21, 2022 | 9:

Applicant Signature Date

Permit Narrative

Conditional Use Permit Application

Bifrost Submarine Cable Beach Manhole Installation – Tillamook County, Oregon

Project Description:

AMCS LLC (AMCS), an affiliate of Amazon Web Services (AWS), proposes to install the Bifrost Submarine Cable System (or "Bifrost"), an ultra-high speed fiber optic cable telecommunication cable system providing large capacity direct link between the continental U.S. (Oregon and California) and Asia (Singapore), crossing the Pacific Ocean via Guam. The proposed installation and operation of this utility line has been designed to minimize impacts to air, water, land, public facilities, beaches, dunes, and nearby residential properties. The cable would be trenched in the seafloor where possible, landing via a horizontal directional drill (HDD) bore at 5611 Wi Ne Ma Road in Cloverdale, Oregon (**Figure 1**). Upon landing, the cable would be fed into a newly installed upland beach manhole (BMH), and then from the BMH into a local telecommunications conduit system via a short (235-foot [71.6-meter [m]) terrestrial conduit link (**Appendix 1**).

The single HDD bore would start at the newly installed BMH located on a private lot (Lot 6200; **Figure 2**) and extend to 4,100 feet (1,250 m) offshore. This bore would result in the placement of a 7-inch (18-centimeter [cm]) submarine bore pipe for the Bifrost cable to feed through.

This HDD effort would provide the terrestrial-to-marine interface to minimize possible disturbances to the beach area and nearshore environment. The HDD profiles would be at least 30 feet (9 m) below grade, in accordance with Oregon State requirements, while also providing maximum protection to the cable in the surf zone (**Appendix 2**). It would take approximately 4-5 weeks to complete the BMH installation and HDD activities, however, deviations from standard operating pace, such as equipment breakdowns or delays in shipments, could add to this timeline. Upon completion of the HDD operations, areas surrounding the BMH would be restored to pre-construction conditions.

The project has been sited away from residences to reduce potential construction-related impacts, with the nearest residences being located approximately 500 feet (152 m) from the proposed drilling location (see **Photolog**). Furthermore, any noise associated with the project would be dampened for beach users by the vegetation and dunes located between the HDD equipment and the beach. While HDD does generate noise during operation, AMCS' comprehensive research and planning would ensure the local community experiences minimal impact (if any) during construction activities.

The HDD set up area on Lot 6200 would encompass 0.5 acres of vacant private property dominated by pastural grasses with scrub/shrub along the dunes. Site preparations would include grading to install a new, underground BMH. All proposed construction activities would be at or below grade:

1. For the BMH, approximately 12 feet (length) x 6 feet (width) x 7 feet (depth) (3.7m x 1.8m x 2.1m) would be excavated, removing 20.1 cubic yards (yd^3; 15.3 cubic meters [m^3]) of fill. Any excess excavated material would be disposed of offsite.
2. The temporary excavation for the HDD bore pit would measure approximately 6-feet (length) x 6-feet (width) x 3-feet (depth) (1.8 m x 1.8 m x 0.9 m) requiring the removal of approximately 4 yd^3 (3 m^3) of material. The bore pit would be backfilled with the excavated material upon installation of the BMH.

3. Upon completion of the BMH and conduit installation, the intent is to restore the site to its pre-construction elevations and vegetation.

TILLAMOOK COUNTY LAND USE ORDINANCE ARTICLE VI: CONDITIONAL USE REVIEW PROCEDURES AND CRITERIA:

SECTION 6.040: REVIEW CRITERIA

Any CONDITIONAL USE authorized according to this Article shall be subject to the following criteria, where applicable:

1. The use is listed as a CONDITIONAL USE in the underlying zone, or in an applicable overlying zone.

Response:
Lot 6200 is located seaward of Highway 101 in Cloverdale, Oregon. The parcel is zoned as Recreation Management Zone (RM). As per TCLUO 3.040 (2), the development request contains the following use that is PERMITTED OUTRIGHT:

- TCLUO Section 3.040(2)(d): Utility lines, excluding power transmission lines.

2. The use is consistent with the applicable goals and policies of the Comprehensive Plan.

Response:
The proposed use of the site within the boundaries and applicable setbacks of the existing tax lot is consistent with the applicable *Goals and Policies of the Tillamook County Comprehensive Plan*. The most applicable Goals are:

- Goal 6: Air, Water, Land
- Goal 11: Public Facilities
- Goal 18: Beaches and Dunes

Goal 6: Air, Water, Land
The installation of the BMH and conduit from the BMH to Wi Ne Ma Road would use standard excavating equipment (e.g., excavator), an HDD drill rig, and small diesel generators, that meet both State and Federal air quality standards. As a result, the project would meet all applicable air quality standards.

The applicant has completed a thorough geophysical and geotechnical site investigation, consisting of a combination of marine and terrestrial based surveys (Lot 6200) to improve understanding of the geology within the drill profile. As part of this study, the potential impact to groundwater from the HDD activities was assessed. The report notes that there are no surface waters onsite, and excluding the Pacific Ocean, there are no surface waters immediately adjacent the project area. The findings of this geotechnical investigation are included as **Appendix 3**.

Note, also, that the methodology proposed for this HDD effort is consistent with the methodology outlined in the Oregon Department of Environmental Quality's (DEQ) *Groundwater Monitoring Well Drilling, Construction, and Decommissioning* (OAR 690-240-0035).

Based on the geotechnical study, the potential for the HDD to cause any impacts to the water, land on Lot 6200, or in the adjacent area is low. The geotechnical study specifically concludes that:

- *Inadvertent Return: The proposed plan of a 10-degree pipe installation angle within the site soil conditions would make an inadvertent return highly unlikely. The contractor would*

continually monitor fluid pressures during drilling operations and adjust operations in the event of fluid fluctuations.

- *Ground-Borne Vibration: The risk of vibratory damage to adjacent buildings and infrastructure located 500 feet or more from the HDD drill rig should be considered negligible. We will maintain movable equipment and stationary equipment that generate vibration at least 25 feet from any structure to maintain vibration levels well below the threshold values.*

- *Bentonite Mud: Bentonite is generally considered inert and approved by DEQ and the Oregon Water Resource Department for use in different drilling applications, including as a permanent plug to seal boreholes. An additive mixture will be needed to stabilize the mud in the saltwater conditions.*

- *Bentonite Mud Dispersion: Drilling mud is intended to remain within a narrow annulus of the HDD borehole and will not migrate any significant distance within the surrounding soil media, above or below groundwater.*

- *Surface Soil Stability: The site is not part of the active dune and beach shoreline, and the property is well vegetated with grasses, shrubs, and trees, which significantly reduces the susceptibility to wide-spread erosion across the property (see **Photolog**). Construction, laydown and access areas requiring clearing of vegetation will be planned; the amounts and exposures will be limited to the practical extent possible and protected.*

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. Ground disturbance is confined to the drill entry site and the exit site, avoiding impacts to vegetation or sensitive habitats along the bore path. The bentonite mud used during HDD operations would consist of non-toxic materials, predominantly water (92-94% of the mixture, which would adhere to safe drinking standards) and bentonite (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. Safety data sheets (SDS) can be provided upon request. During typical operations, this bentonite mud would be fully contained; it would only be released in the event of an unpreventable inadvertent return.

In the event of an unavoidable inadvertent return of bentonite mud, it would be addressed as outlined in the Inadvertent Return Contingency Plan (**Appendix 4**). 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.

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**). The applicant has concluded that no adverse environmental, scenic, recreational, or economic impacts would 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. According to the safety data sheets (SDS) for a steel bore pipe, the solid alloy 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 of time, 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.

Although rare, sinkhole formation 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.

If a sinkhole is detected, it would be addressed promptly (**Appendix 5**). Agencies would be notified within 24 hours of 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. A handheld compactor or a skid steer with a vibratory roller would be used to compact the beach sand immediately following high tide while the sand is saturated to directly address closure of any spaces around the bore pipe and eliminate the propagation of voids to the surface. Smaller (less than 3 feet [0.9 m] in diameter) sinkholes may be filled in by hand. 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.

In recognition of the low-impact approach to installation of this utility line, we expect DEQ to issue a Water Quality Certification for the Bifrost Cable System. Furthermore, due to the project's proximity to the beach, no groundwater impacts would likely result from the HDD.

The projected timeline for construction is approximately 4-5 weeks. Activities on the site would include mobilization and setup within the work area, earth excavation for the BMH, and a 1–2-week HDD boring effort. Typical mobilization and demobilization construction traffic would include 5-6 semi-truck loads of equipment and materials, including a water truck (daily), work pickup and utility vehicles (daily), fuel truck (every 2-3 days), and dump truck (every 2-3 days).

AMCS has worked closely with the Wi-Ne-Ma Christian Camp to ensure project activities are conducted at a time and in a manner that minimizes disturbance to camp activities. Construction activities would occur during Tillamook County-approved days and times and have been scheduled to avoid peak activities at the camp. Prior to construction, signs would be posted notifying users of beach activities and scheduled days. Work would be performed quickly and efficiently to minimize potential disturbances.

A traffic impact analysis would be conducted prior to construction activities, and a traffic control plan would be implemented prior to construction. 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. Construction-related noise would be dampened for beach users because of the vegetation and dunes located between the HDD equipment and the beach.

Goal 11: Public Facilities
The installation and operation of the proposed buried utility line would not impact any of the following Public Facilities present in or around the community:

- Sewage Treatment
- Solid Waste Disposal
- Fire Protection
- Public Schools
- Police Protection
- Storm Drainage
- Planning, Zoning, and Subdivision Control
- Community Health
- Energy Utilities
- Community Government

Goal 18: Beaches and Dunes
Regarding Goal 18 (Beaches and Dunes), the County's comprehensive plan indicates that Lot 6200 and the area adjacent to it is classified as "Recently Stabilized Foredunes" (or "FD"). The applicant's geotechnical report confirmed that the site is not part of an active dune or beach shoreline, and that the property is well vegetated with grasses, shrubs, and trees, which significantly reduce the susceptibility to erosion across the site. Construction activities would be subject to an approved temporary erosion and sedimentation control plan (TESC), subject to best management practices (BMPs). As a result, the risk of any impacts to adjacent beaches and dunes would be low and monitored through an approved construction management plan.

Upon completion of the BMH and conduit installation, the proposed use would be non-detrimental and non-invasive to the adjacent established residential uses. The proposed use does not prohibit nor preclude the future use of the parcel. Furthermore, the proposed use is consistent with the designations of the Oregon Territorial Seas Plan, Part 5.

3. The parcel is suitable for the proposed use considering its size, shape, location, topography, existence of improvements and natural features.

Response:
The parcel is fully suitable for the proposed use as per criteria:

- **Size, Shape Location:** The proposed use meets all the regulations of a parcel within the RM Zoning designation.
- **Topography and Natural features:** The parcel is relatively level and covered with vegetative ground, shrub, and tree cover. The proposed area of construction minimizes impacts to trees and vegetation on the lot; the BMH location is sited in a previously disturbed area with scattered pastural grasses (see **Photolog).**

Post construction the site would be restored in grade and vegetated ground cover consistent with surrounding land. Project infrastructure would be entirely contained below grade.

- **Existing Improvements:** The proposed use does not require the expansion of public services such as water, sewer, and power. Construction equipment would utilize the paved Wi Ne Ma Road for access to the site, however, upon completion, no additional demands on public infrastructure would be placed. AMCS and their subcontractors would not need to visit the site regularly.

4. **The proposed use will not alter the character of the surrounding area in a manner which substantially limits, impairs or prevents the use of surrounding properties for the permitted uses listed in the underlying zone.**

Response:
Any (temporary) impacts of the proposed use are limited to the duration of installation of the BMH and the short (approximately 235-foot [71.6-m]) terrestrial conduit link, both of which would be entirely confined within the boundaries of Lot 6200. Entry and egress to the site would be from Wi-Ne-Ma Road and would not infringe on any adjacent land uses. Typical mobilization and demobilization construction traffic would include 5-6 semi-truck loads of equipment and materials, including a water truck (daily), work pickup and utility vehicles (daily), fuel truck (every 2-3 days), and dump truck (every 2-3 days).

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.

As the proposed use is entirely contained below grade, the character of the parcel would not be altered by the proposed project. During construction, crews would be mindful of noise, sightlines, property line boundaries, and any applicable vegetative buffers. Upon completion of the BMH installation, the site would be restored to pre-construction conditions. Overall, the proposed project would not alter, limit, impair, or prevent the use of surrounding properties for the permitted uses.

5. **The proposed use will not have detrimental effect on existing solar energy systems, wind energy conversion systems or windmills.**

Response:
No solar energy or wind energy conversion systems exist in proximity to the site; therefore, none would be affected by the proposed use.

6. **The proposed use is timely, considering the adequacy of public facilities and services existing or planned for the area affected by the use.**

Response:
The proposed use is in response to the large demand for high-speed internet services worldwide. Bifrost 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 two regions by providing seamless direct connectivity. The project 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.

The proposed subsea cable would not impinge on existing internet services in the area. Onward connectivity from Wi Ne Ma Road to the Hillsboro area would be via an existing terrestrial fiber optic cable route. In the future, Astound intends to construct a new terrestrial route using a mix of new and existing conduits within established ODOT ROW, which would enable route enhancement for Bifrost between the landing and Hillsboro. There would be multiple potential customers to this new route, which would include providing and facilitating 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.

Figures

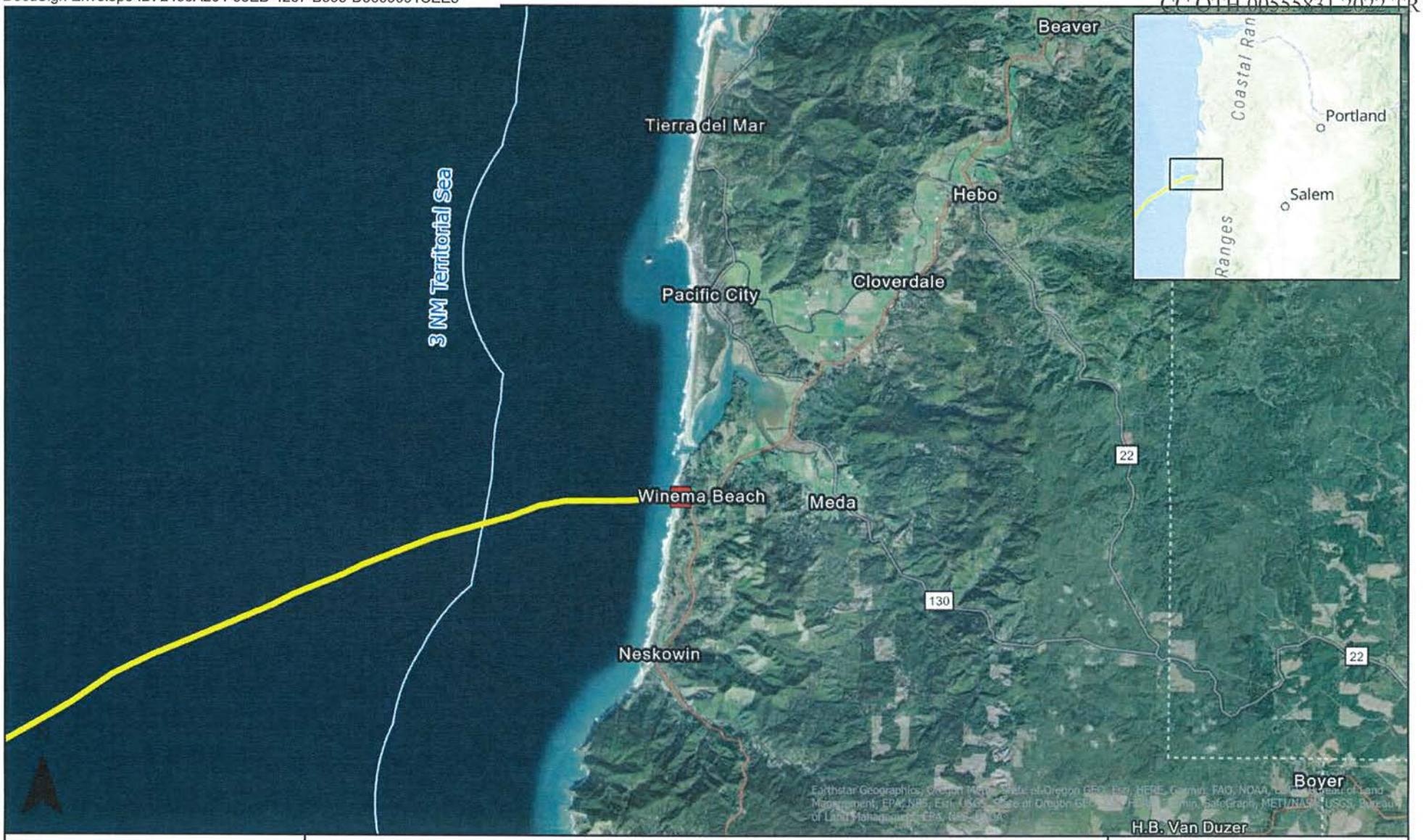


Fig. No. 1
Vicinity Map

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.

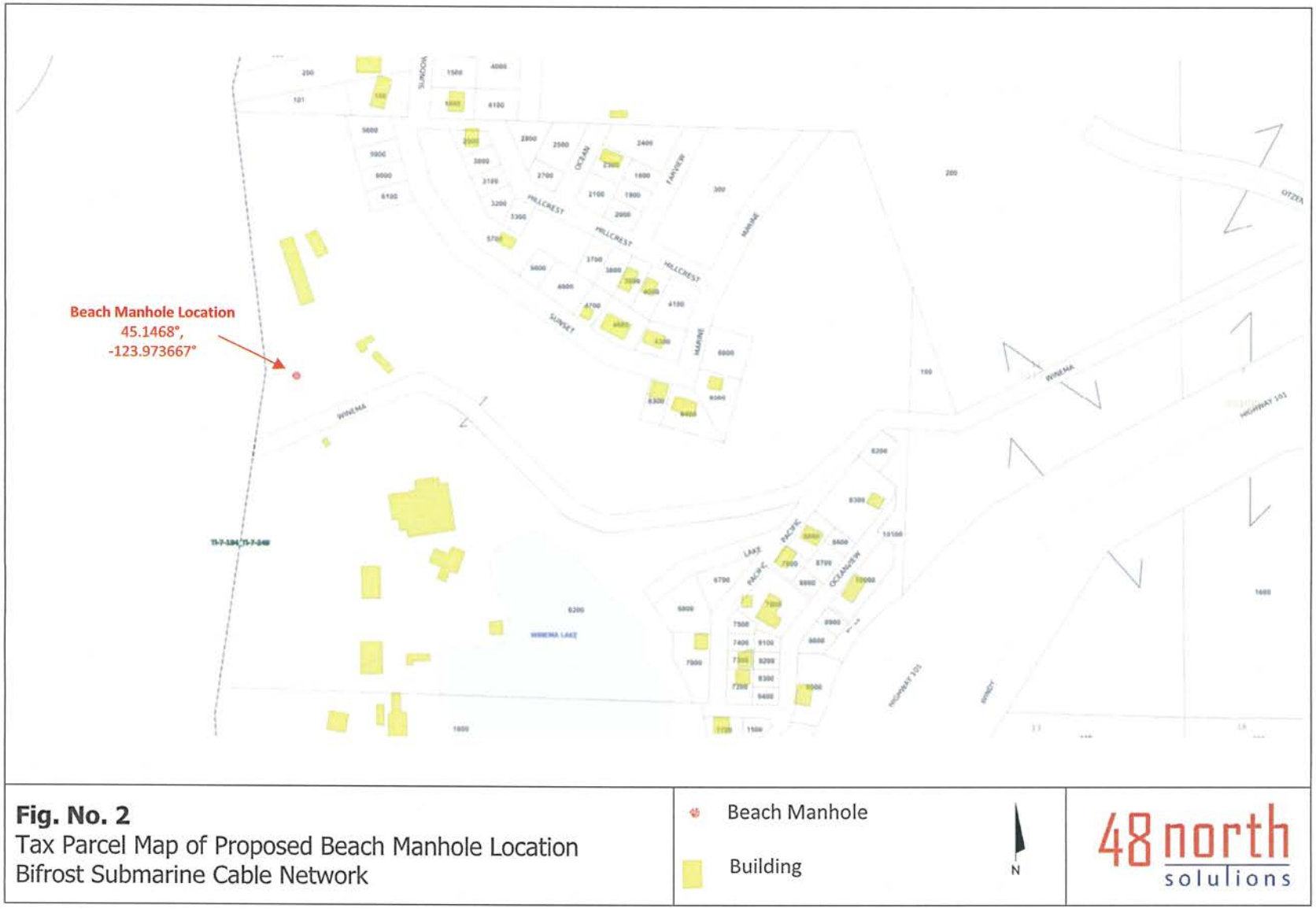


Fig. No. 2
Tax Parcel Map of Proposed Beach Manhole Location
Bifrost Submarine Cable Network

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.		

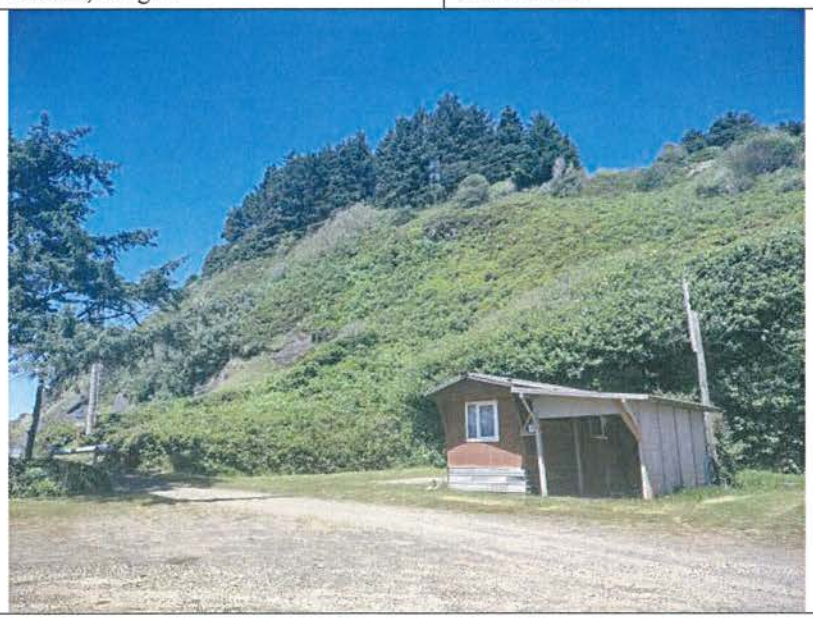
PHOTOGRAPHIC LOG: 2

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		

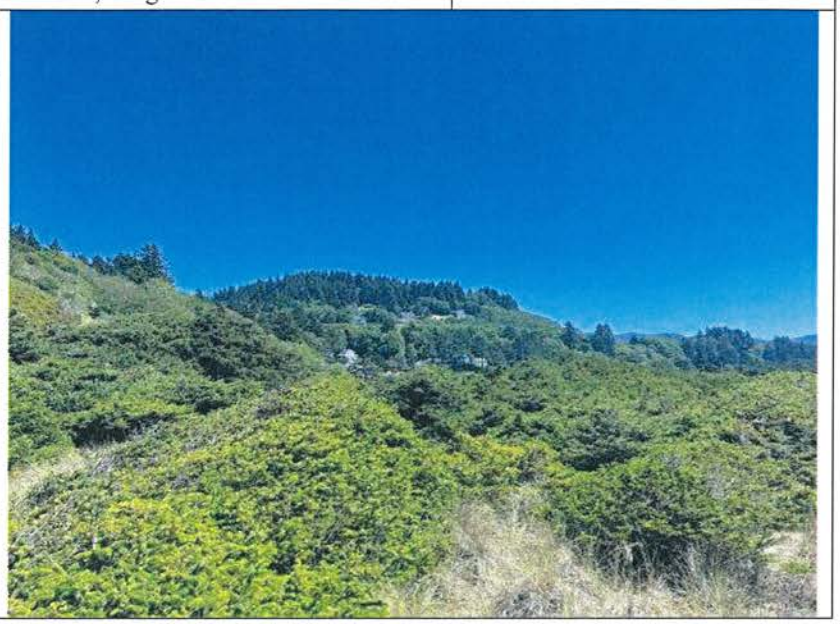
PHOTOGRAPHIC LOG: 3

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
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 6 to 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 30 feet, 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.
- Cable Landing Station. A CLS is needed to support the submarine fiber optic cable. The CLS will be located approximately one-half miles from the BMH, near the intersection of Winema Road and Highway 101. The CLS will house power generation, telecommunications and ancillary equipment needed to operate the marine cable. From here, the telecommunications traffic will be connected into the broader telecommunications network with onward connectivity to major metropolitan areas such as 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 2
Engineering Designs

BIFROST SUBSEA CABLE PROJECT

LANDING PIPE, BHM, AND OGB DRAWINGS

SHEET INDEX

WINEMA, OREGON

RTI—I

PERMIT ISSUE
JUNE 14 2022

BHC
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	Chd	App
0	xx-xx-xx	TBD	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:
GENERAL NOTES AND SYMNOLOGY

Project No.:

Date Drawn:

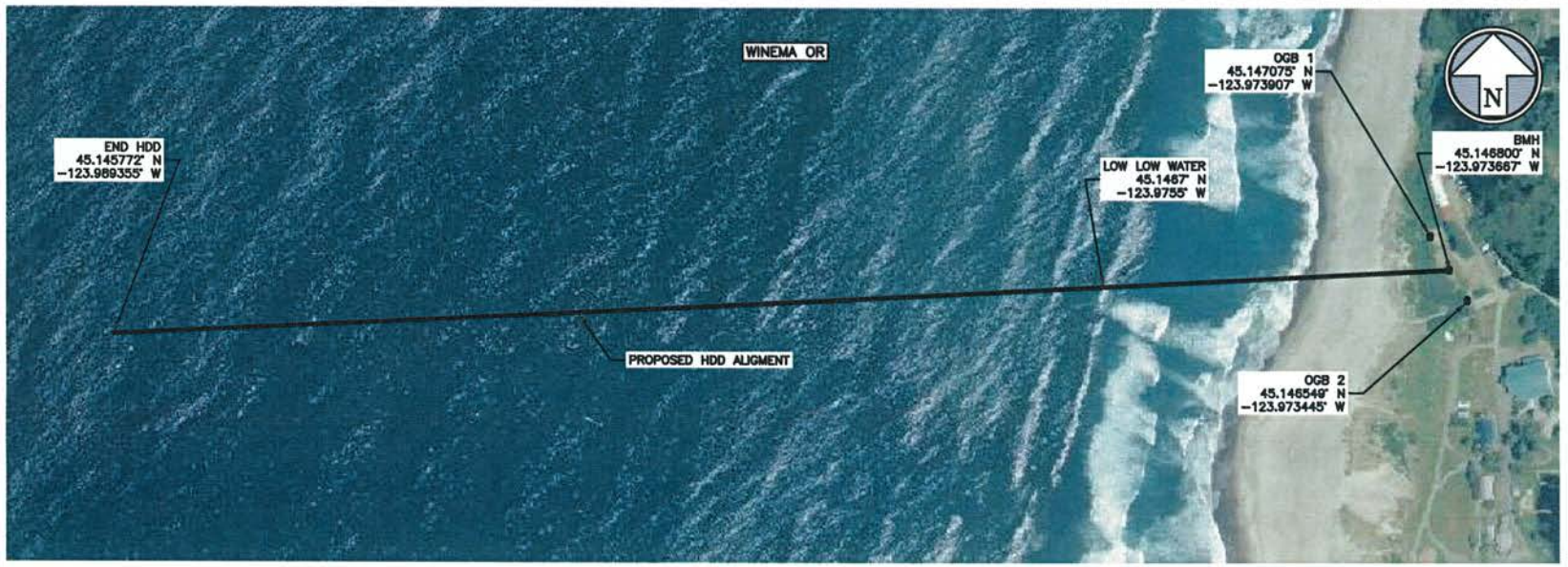
Drawn:

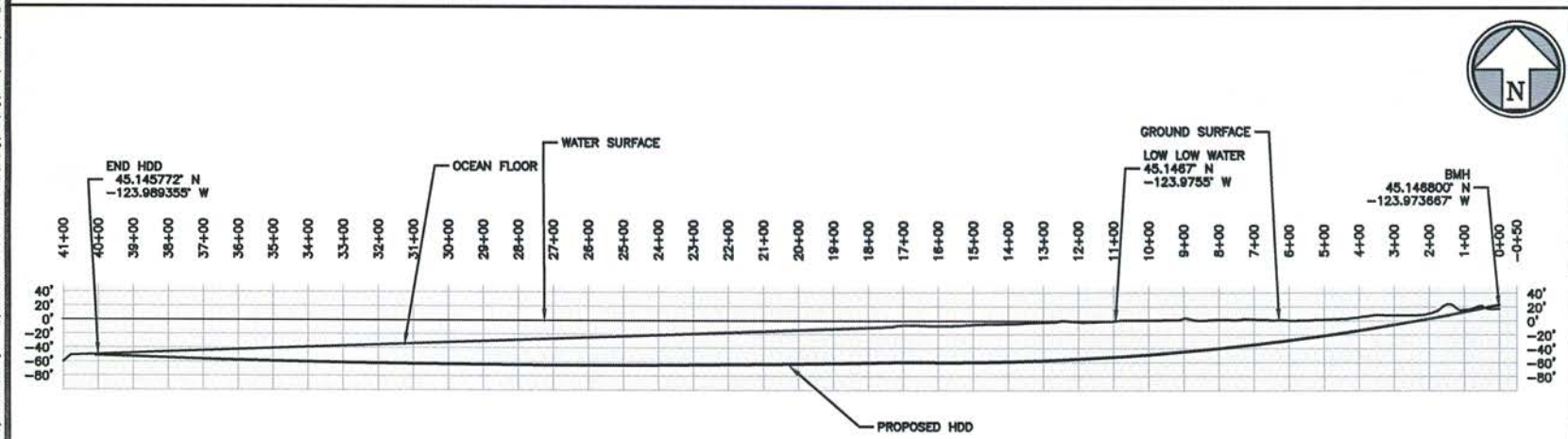
Checked:

Approved:

Scale:

Sheet:
2
2 of 7





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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:

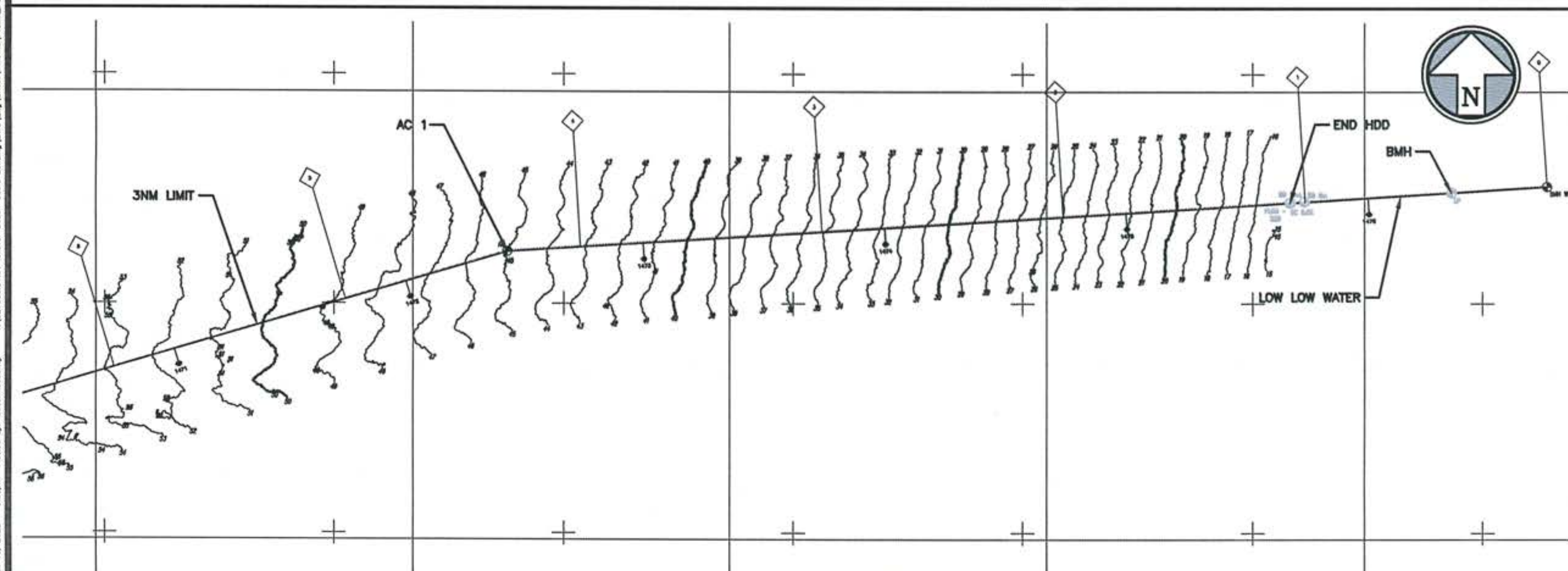
Scale:

Sheet:
3
3 of 7

Jun 15, 2022 – 4:02pm Plotted By: lucas.mobberley P:\027030.01.01–Gower Beach Cable Landing\DWG\Dwg\Sheet\Winema\Prelim_For_Permit.dwg Layout: HDD AND LANDING SITE

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



Jun 16, 2022 – 3:58pm Plotted By: lucas.mobberley T:\027030.01.01–Grover Beach Cable Landing\DWG\Eng\Sheet\Winema\Prelim_For_Permit.dwg Layout: 3NM

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: SHORE TO 3NM

Project No.:

Date Drawn:

Drawn:

Checked:

Approved:

Scale:

Sheet: 4

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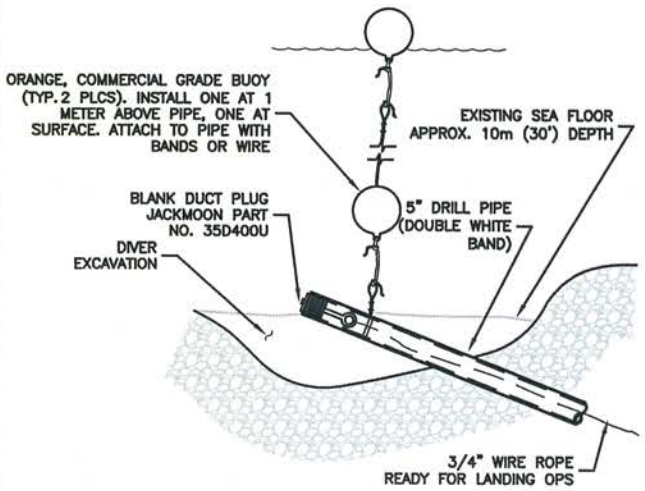
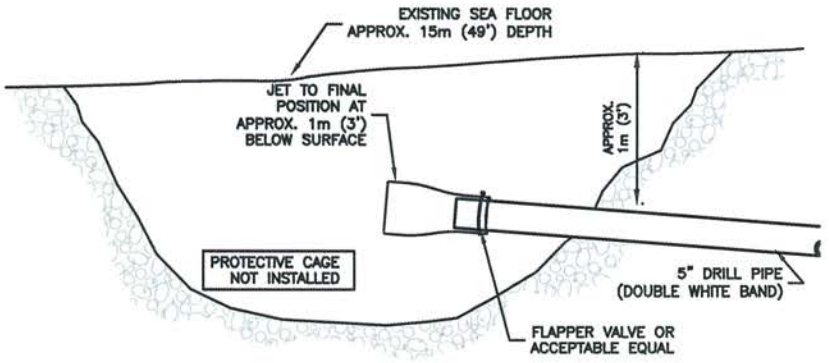


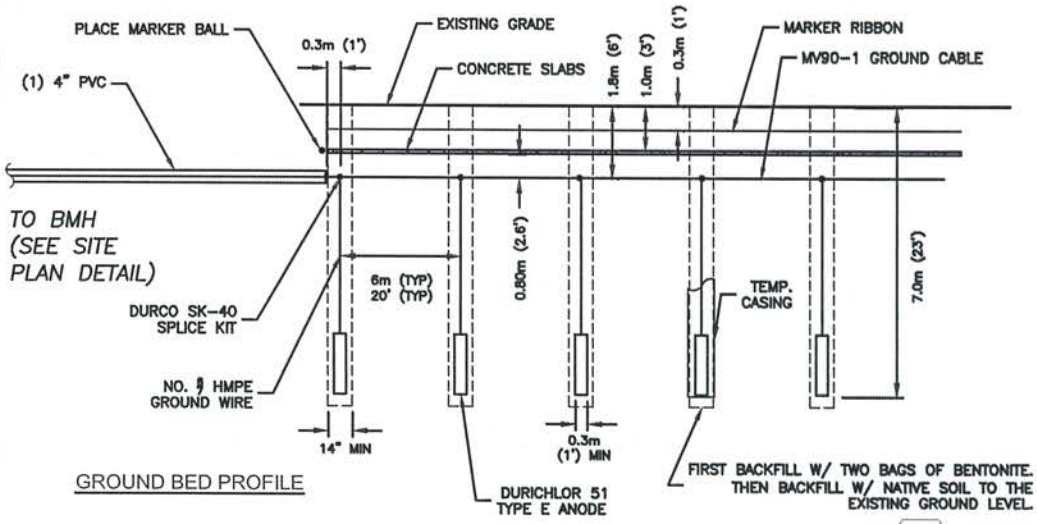
END OF BORE PIPE - NO 1.
PREPARED FOR LANDING
CONDITION



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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RTI–I

CIVIL ENGINEERING / SURVEYING / UTILITIES

Project:
BIFROST
SUBSEA CABLES
WINEMA OREGON

Site Address:
45.146800° N
-123.973667° W

Sheet Title:
OGB AND HDD END

Project No.:

Date Drawn:

Drawn:

Checked:

Approved:

Scale:

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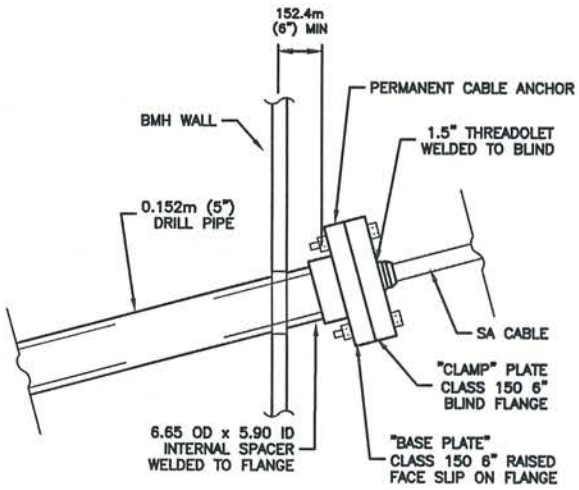
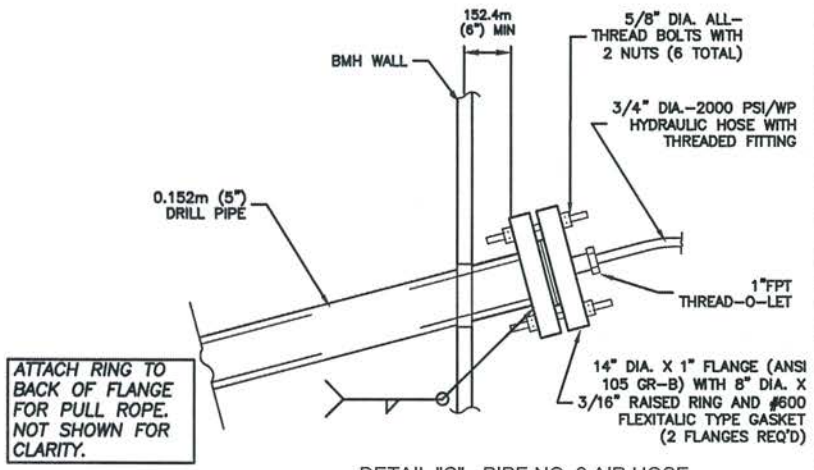
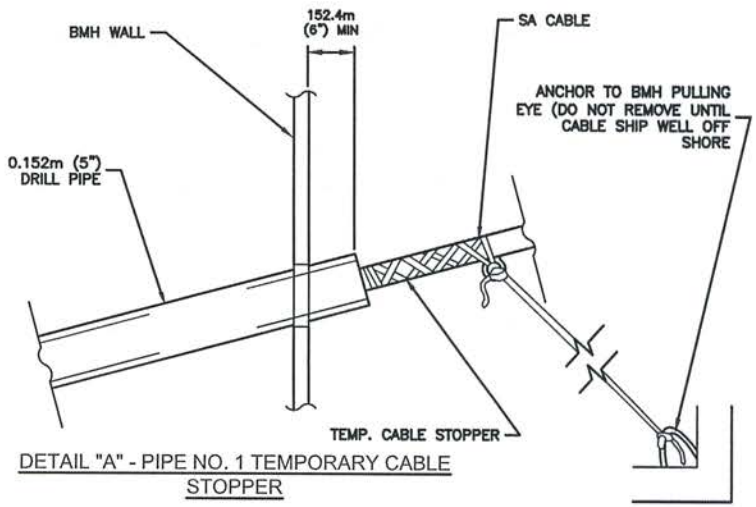


DETAIL "B" - PIPE NO. 1 PERMANENT CABLE ANCHOR



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:

Sheet:
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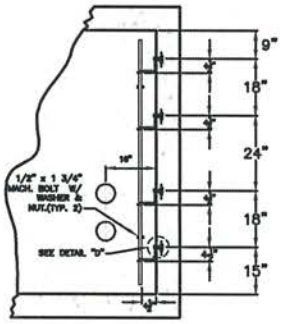
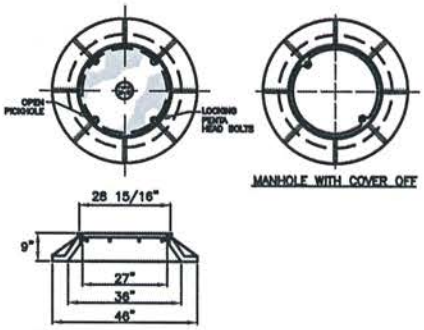
Jun 16, 2022 - 8:38am Plotted By: lucas.mabberley I:\0270300.01.01-Grover Beach Cable Landing\DWG\Eng\Sheet\Winema\Prelim_For_Permit.dwg Layout: AIR HOSE PIPE AND CABLE ANCHOR

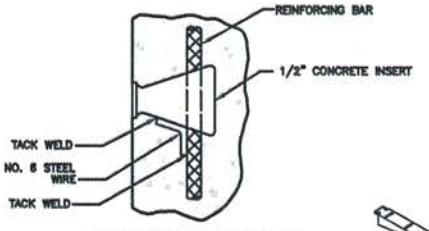


CABLE RACK MOUNTING DETAIL "C"

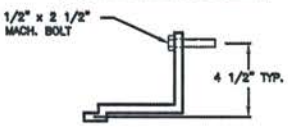
NOTE: TYP. ALL CABLE RACKS



MANHOLE COVER DETAIL "A"



CONCRETE INSERT DETAIL "D"



S CABLE RACK SUPPORT DETAIL "E"

GALVANIZED CUT RACKING
SCALE: N.T.S.

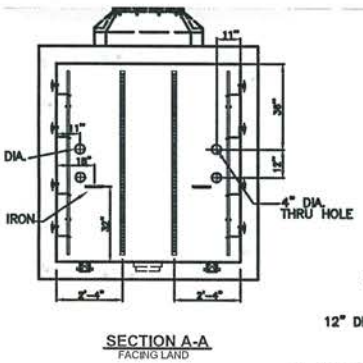
MANHOLE:
46 HOLE – 1,981.20mm (6'-6")

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)



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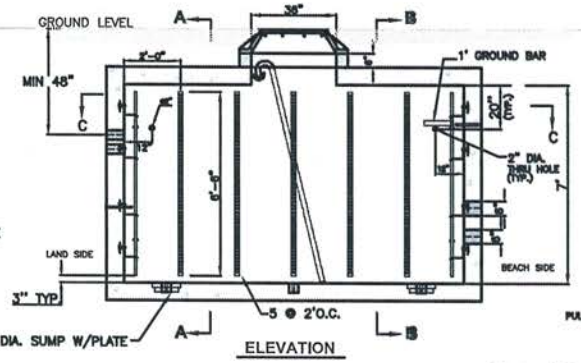
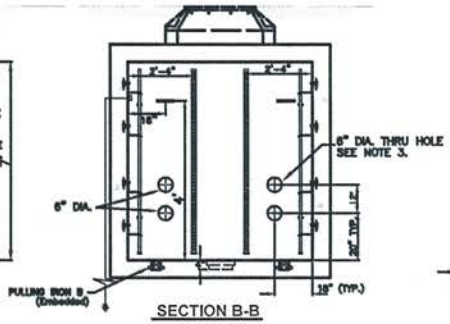
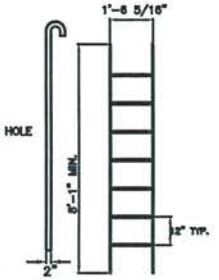
FACING LAND



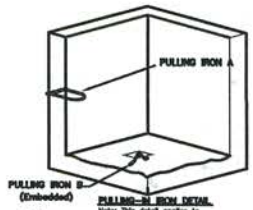
ELEVATION



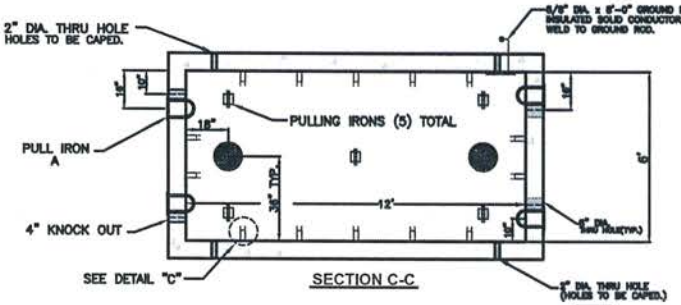
SECTION B-B
FACING SEA



LADDER DETAIL



PULLING IRON DETAIL
Note: 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-xxx	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:
BEACH MANHOLE

Project No.:

Date Drawn:

Drawn:

Checked:

Approved:

Scale:

Sheet:
7
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Appendix 3
Site Specific Geotechnical Report

KLEINFELDER
Bright People. Right Solutions.

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

KLEINFELDER
Bright People. Right Solutions.

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.

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.

Pedro Rivas
Staff Engineer II

Tyler S. DeSouza
Project Engineer / Project Manager

Kenneth G. Sorensen
Sr. Principal Geotechnical Engineer

Samuel R. Christie, PE, GE
Principal Geotechnical Engineer

REGISTERED PROFESSIONAL ENGINEER
69409PE
OREGON
NOVEMBER 12, 2008
SAMUEL R. CHRISTIE

KLEINFELDER
Bright People. Right Solutions.

TABLE OF CONTENTS

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

TABLE OF CONTENTS (Continued)

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.

- 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.

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.

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

Bennett, D., Ariaratnam, S., et al. (2017), "Horizontal Directional Drilling Good Practices Guidelines," Fourth Edition, North American Society for Trenchless Technologies.

Boulanger, R.W. and Idriss, I. M., 2006, "Liquefaction susceptibility criteria for silts and clays." J. Geotechnical and Geoenvironmental Eng., ASCE 132(11), 1413-426.

Coastal Oregon Fault Map, Cascadia Fold Fault Zone Map, accessed June 6, 2022, https://www.cccarto.com/faults/orfaults/#7/44.406/-124.746

Cetin, K. O., Seed R. B., Der Kiureghian, A., Tokimatsu, K., Harder, L. F., Kayen, R. E., and Moss, R. E. S., 2004, "Standard penetration test-based probabilistic and deterministic assessment of seismic soil liquefaction potential." J. Geotechnical and Geoenvironmental Eng., ASCE 130(12), 1314-340.

Idriss, I.M., and Boulanger, R.W., 2008, Soil Liquefaction During Earthquakes. Monograph MNO-12, Earthquake Engineering Institute, Oakland, CA 261 pp.

Oregon Department of Geology and Mineral Industries, Oregon HazVu: Statewide Geohazards Viewer, accessed June 6, 2022, https://gis.dogami.oregon.gov/maps/hazvu/

PRCI (1998), "Installation of Pipelines Beneath Levees Using Horizontal Directional Drilling", Contract CPAR-GL-98-1, Pipeline Research Council International, Inc., April 1998.

Puckett, J.S. (2003), "Analysis of Theoretical versus Actual HDD Pulling Loads," ASCE International Conference of Pipeline Engineering and Construction, Baltimore, MD.

Snavely Jr, P. D., Niem, A., Wong, F. L., MacLeod, N. S., Calhoun, T. K., Minasian, D. L., & Niem, W. (1996), "Geologic Map of the Cascade Head Area, Northwestern Oregon Coast Range (Neskiwin, Nestucca Bay, Hebo, and Dolph 7.5 minute Quadrangles)", (No. 96-534). US Geological Survey.

Youd et al., 2001, "Liquefaction Resistance of Soils: Summary Report from the 1996 NCEER and 1998 NCEER/NSF Workshops on Evaluation of Liquefaction Resistance of Soils," J. Geotechnical and Geoenvironmental Eng., ASCE 127(10), 817-33.

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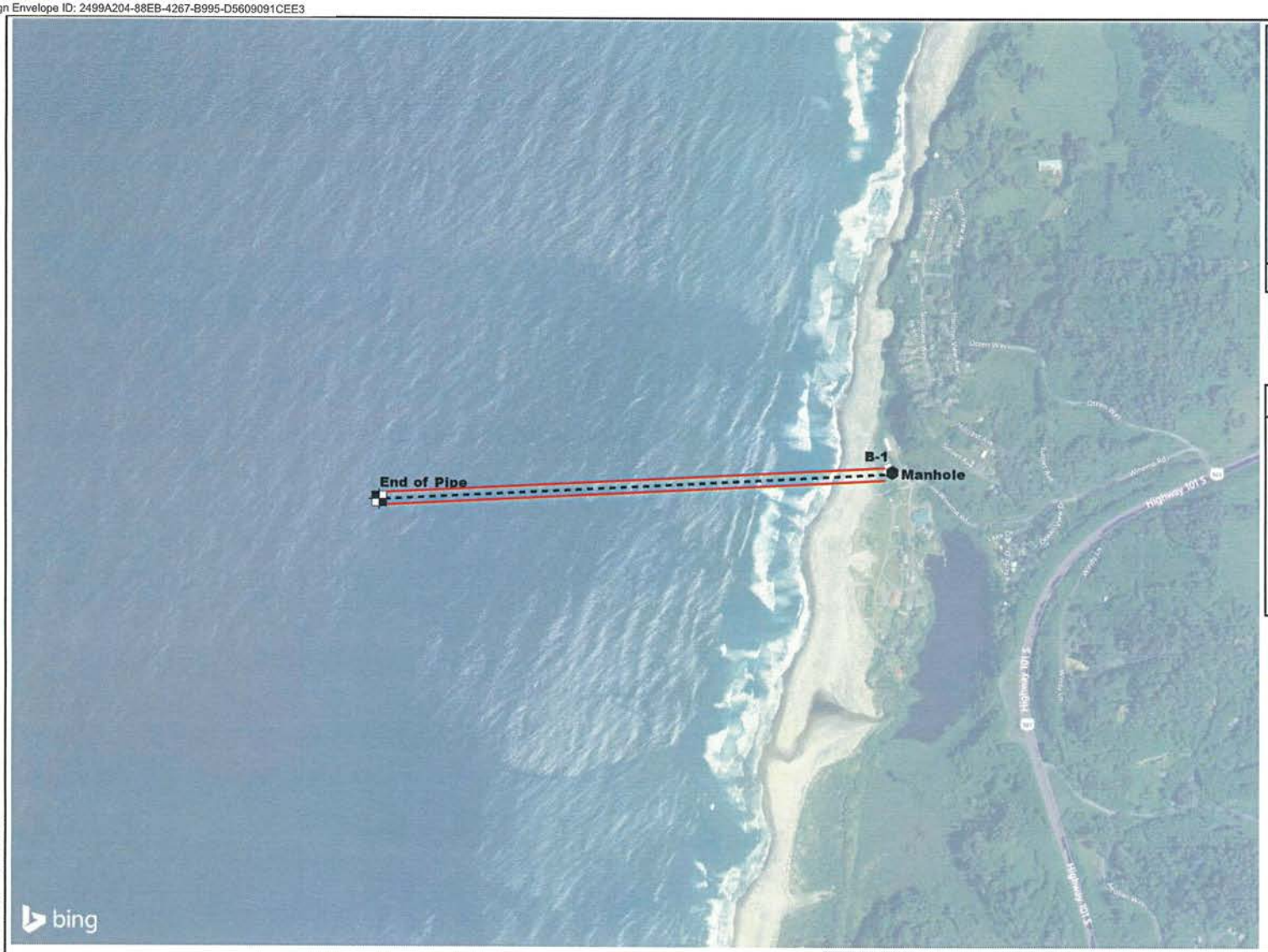
FIGURES

LIST OF ATTACHMENTS

The following figures are attached and complete this appendix.

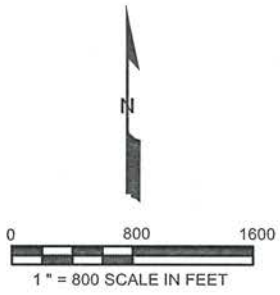
CC OTH 00555831 2022 TR



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

LEGEND

- MANHOLE LOCATION
- EXPLORATORY BORING
- END OF PIPE
- CABLE LANDING HDD ALIGNMENT



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

SITE VICINITY MAP

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

FIGURE 1

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

LEGEND

- MANHOLE LOCATION
- EXPLORATORY BORING
- TERRESTRIAL GEOPHYSICAL SURVEY AREA
- CABLE LANDING HDD ALIGNMENT

N

0 100 200
1 " = 100 SCALE IN FEET

legal

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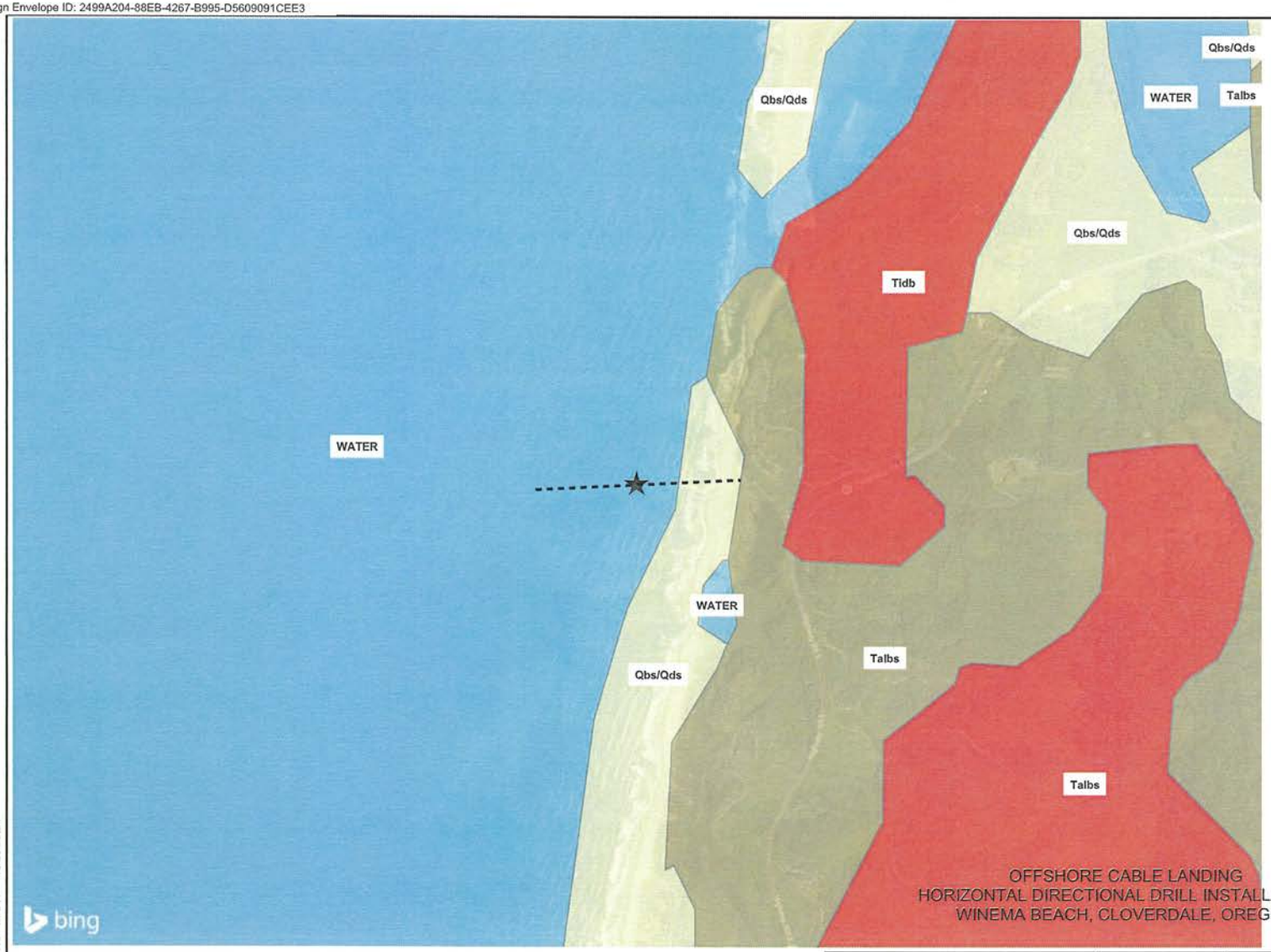
PROJECT NO. 20230058.001A		EXPLORATION LOCATION MAP	FIGURE
DRAWN BY:	tdesouza	OFFSHORE CABLE LANDING HORIZONTAL DIRECTIONAL DRILL INSTALLATIONS WINEMA BEACH, CLOVERDALE, OREGON	2
CHECKED BY: T. DeSouza			
DATE:	06-06-2022		



LEGEND

- Cable Landing HDD Alignment
- Tidb — Depoe Bay Basalt
- Talbs — Basaltic Sandstone (Alsea Formation)
- Qbs/Qds — Alluvial Beach and Dune Sands
- 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
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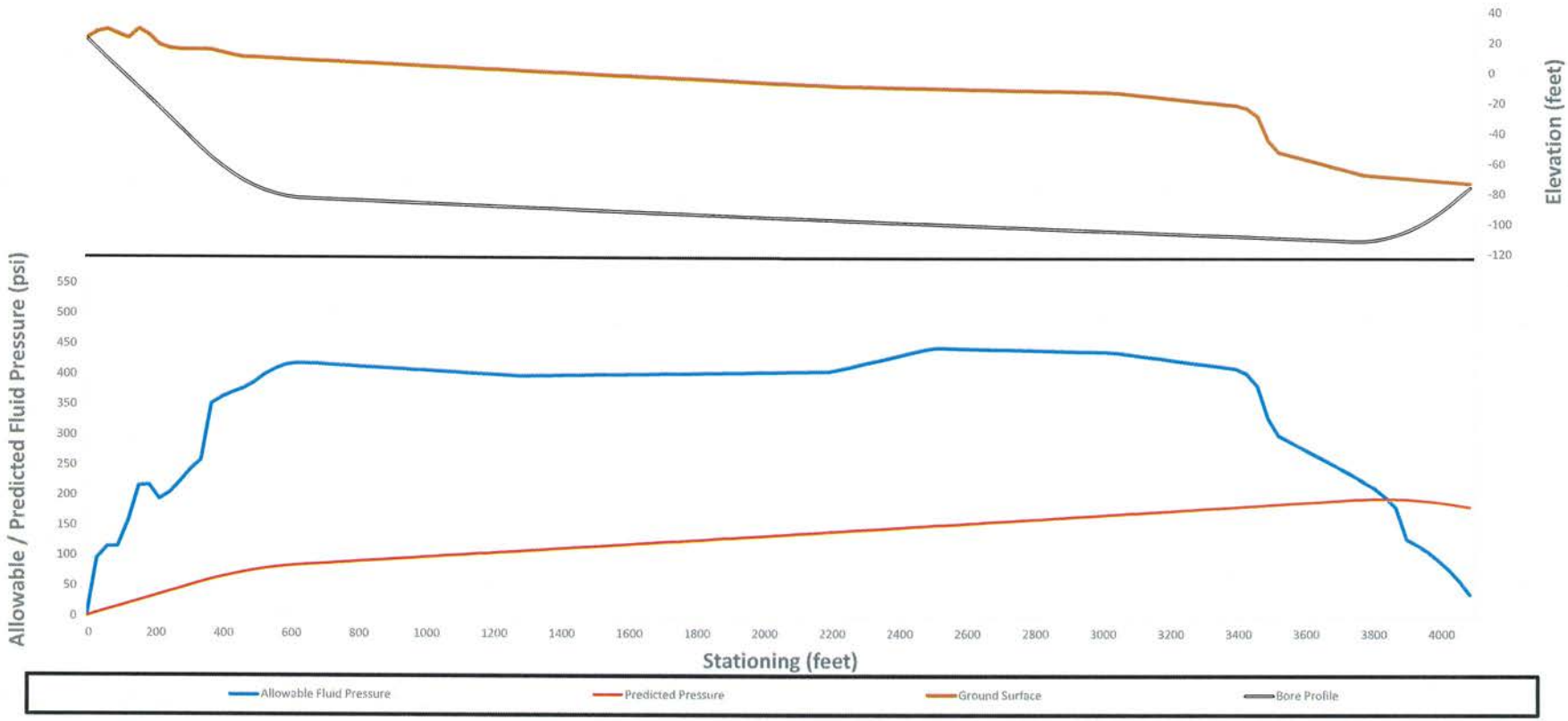
PROJECT NO.	20230058.001A
DRAWN BY:	tdesouza
CHECKED BY:	T. DeSouza
DATE:	06-06-2022

GEOLOGY MAP

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

FIGURE 3

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.

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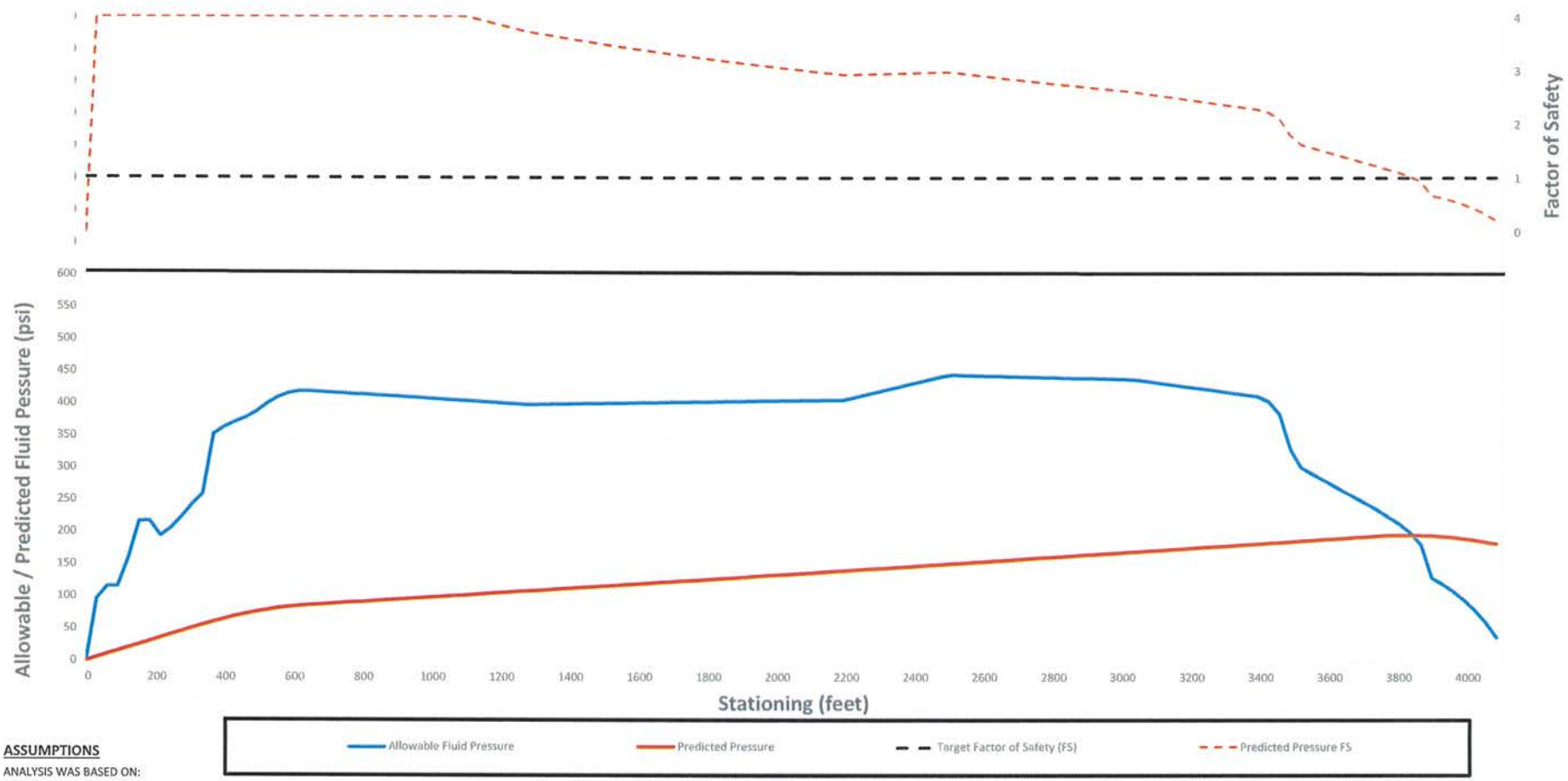
Proj. No. 20230058.001A	HYDROFRACTURE RISK ANALYSIS OF THE PILOT BORE	FIGURE
Drawn By PR		4a
Check By KS	OFFSHORE CABLE LANDING HORIZONTAL DIRECTIONAL DRILL WINEMA BEACH, OREGON	
Date 7/29/2022		

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



ASSUMPTIONS

ANALYSIS WAS BASED ON:

A. ENTRY ANGLE OF 12 DEGREES.
B. EXIT ANGLE OF 11 DEGREES.
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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.

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Proj. No. 20230058.001A		HYDROFRACTURE RISK ANALYSIS OF THE PILOT BORE	FIGURE
Drawn By	PR		
Check By	KS	OFFSHORE CABLE LANDING HORIZONTAL DIRECTIONAL DRILL WINEMA BEACH, OREGON	4b
Date	7/29/2022		

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APPENDIX A

FIELD INVESTIGATION DAILY FIELD REPORTS

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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

	Pedro Rivas
ASN Representative	**Kleinfelder Representative**

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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

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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

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ERT test set up on the beach

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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

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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 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. 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

KLEINFELDER
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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

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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)	-	-	-	-	-	-	-	-	-	-	-	-
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

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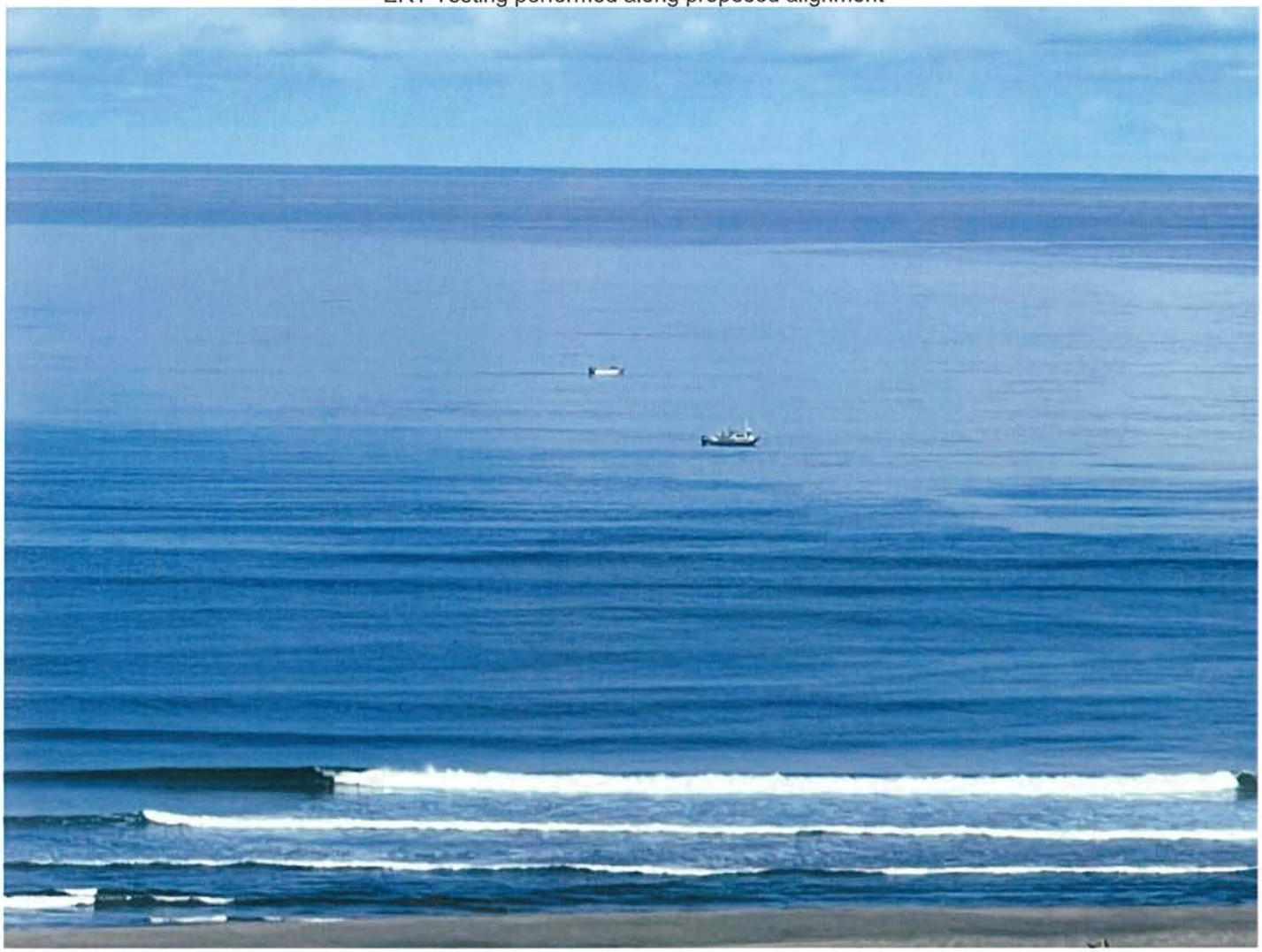
ERT Testing performed along proposed alignment



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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

KLEINFELDER
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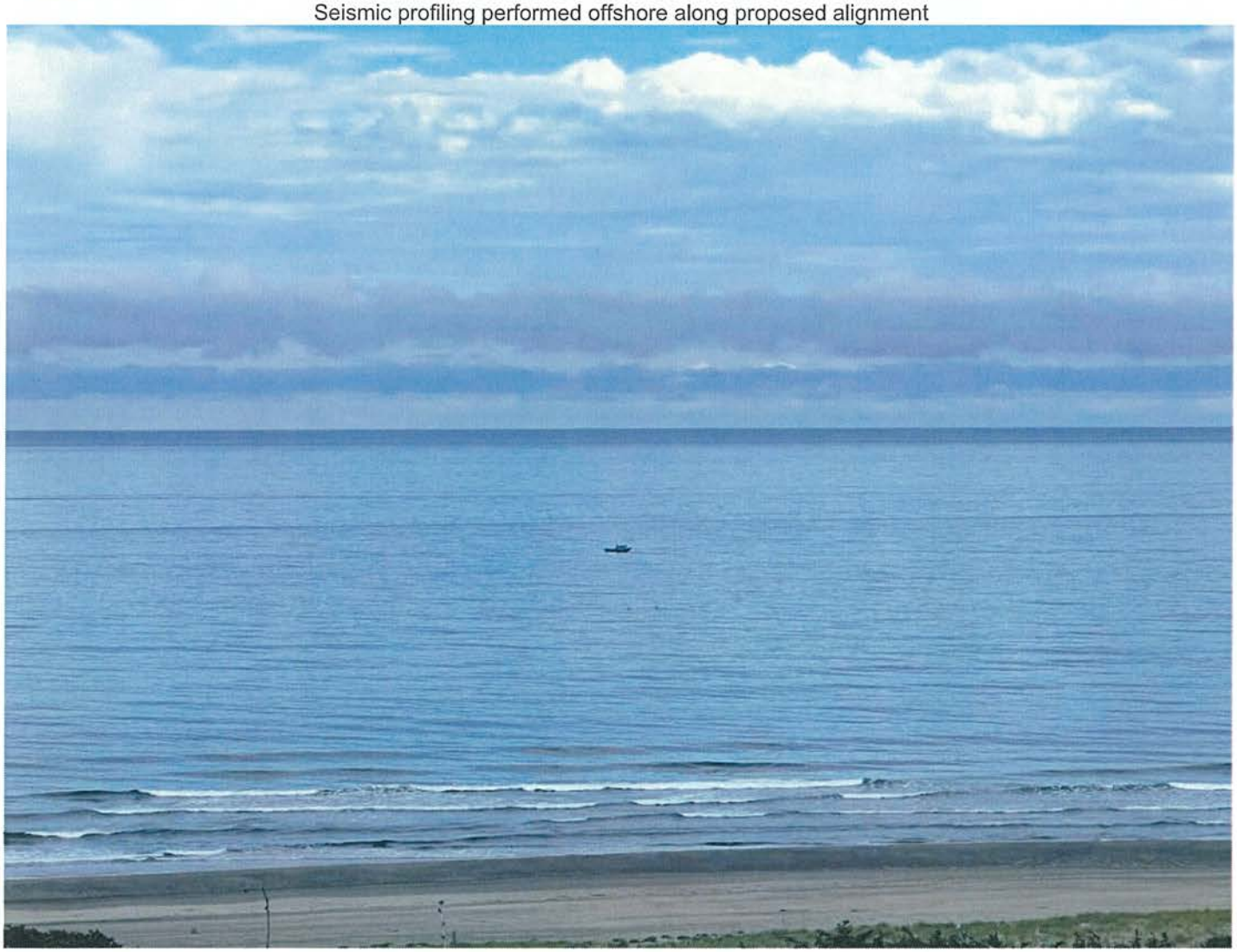
Seismic profiling performed offshore along proposed alignment



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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.
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

KLEINFELDER
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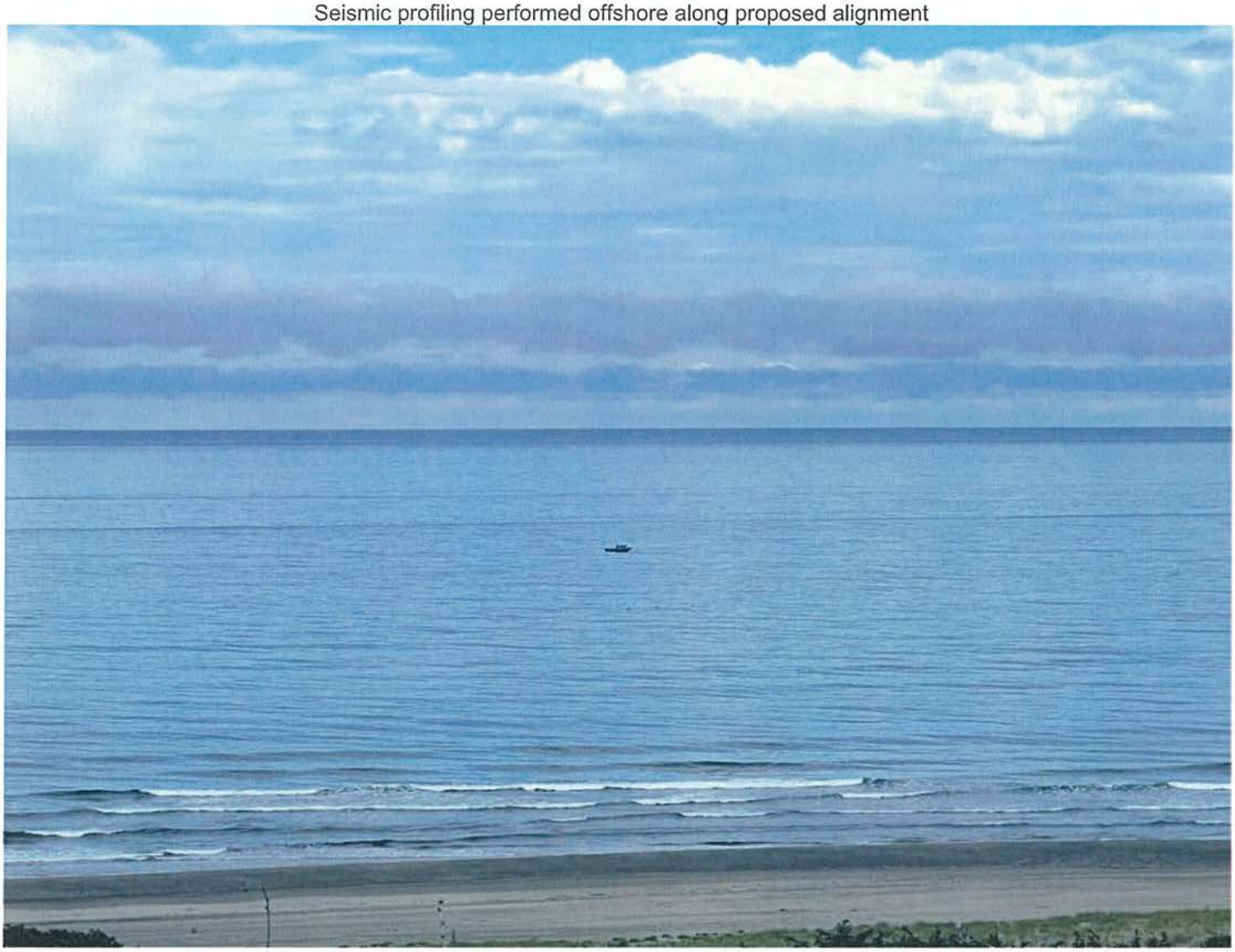
Seismic profiling performed offshore along proposed alignment



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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

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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.

Safety...
it's a habit you can live with.

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.

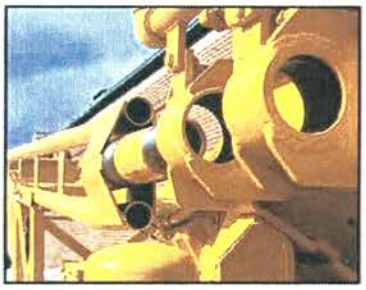
An 18 inch in-out movement allows you to quickly move the drill off the borehole and align the sheaves for lifting tools with the cathead or any of the hoists.

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.

*patented by CME

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)

CME-75

Specifications

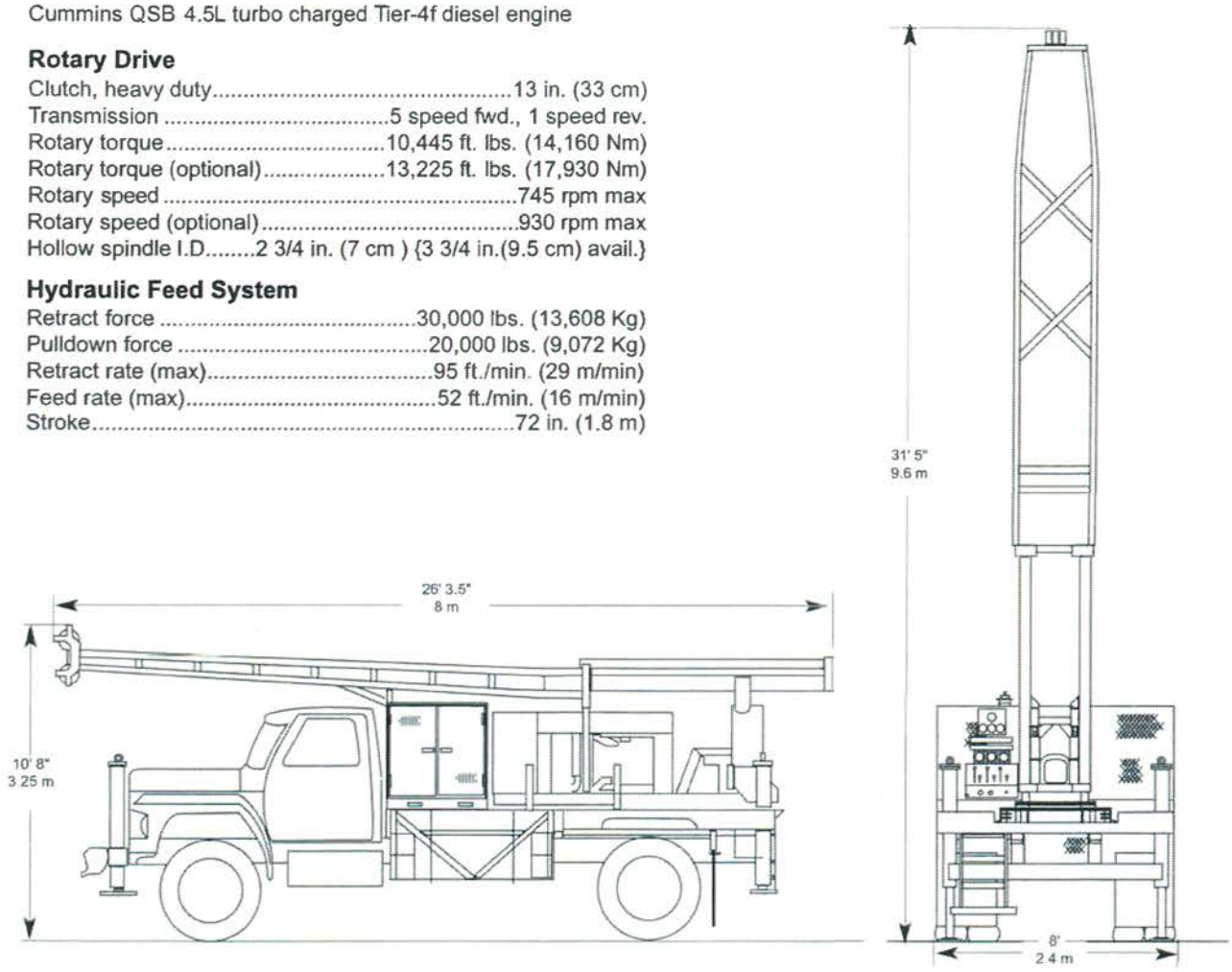
Power
Cummins QSB 4.5L turbo charged Tier-4f diesel engine

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
4215 Rider Trail North, Earth City (St. Louis), Missouri, 63045 USA
Phone: 314-291-7700 • 1-800-325-8827 • FAX: 314-291-4880
E-mail:info@cmeco.com • Website:www.cmeco.com

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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.

♦ ♦ ♦

Pile Dynamics, Inc.
SPT Analyzer Results

PDA-S Ver. 2021.34 - Printed: 12/27/2021

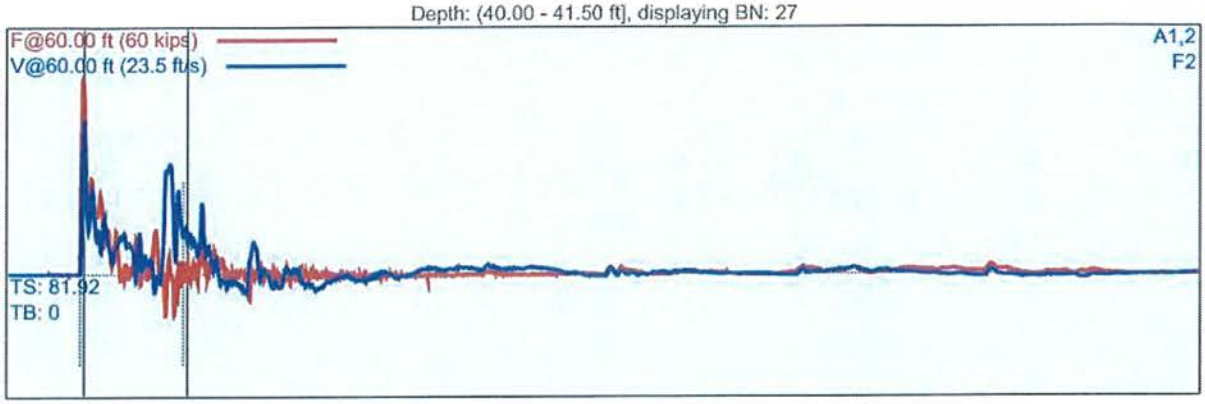
WSSC-8-06
GJS
WSSC

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.

Pile Dynamics, Inc.
SPT Analyzer Results

PDA-S Ver. 2021.34 - Printed: 12/27/2021

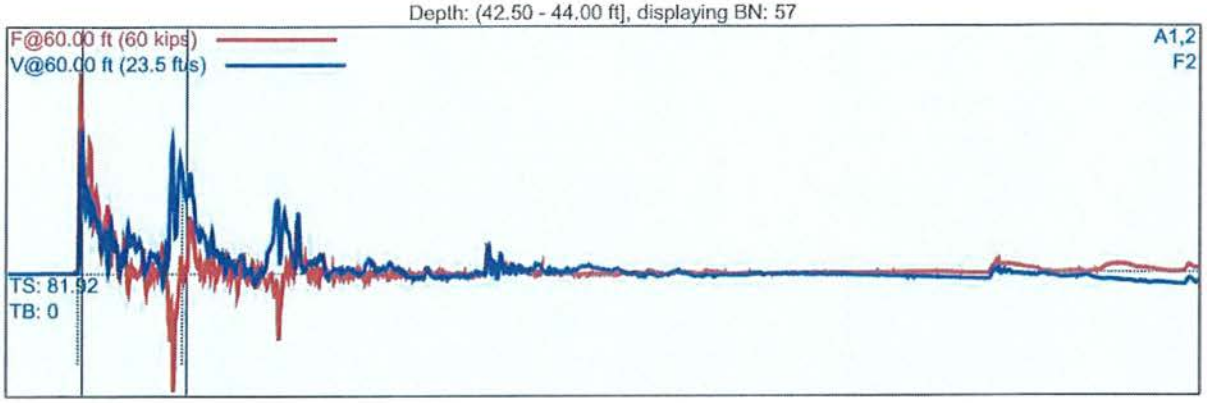
WSSC-8-06
GJS
WSSC

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.

Pile Dynamics, Inc.
SPT Analyzer Results

PDA-S Ver. 2021.34 - Printed: 12/27/2021

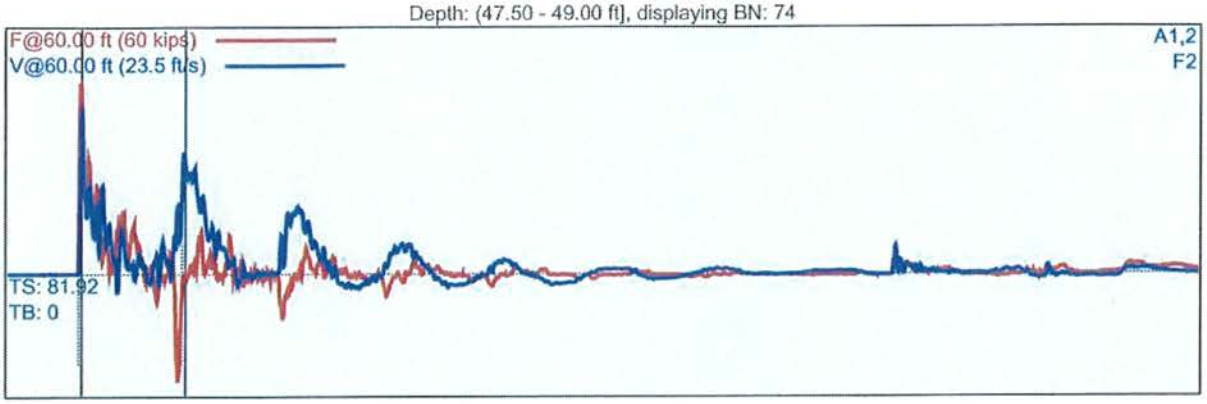
WSSC-8-06
GJS
WSSC

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.

Pile Dynamics, Inc.
SPT Analyzer Results

PDA-S Ver. 2021.34 - Printed: 12/27/2021

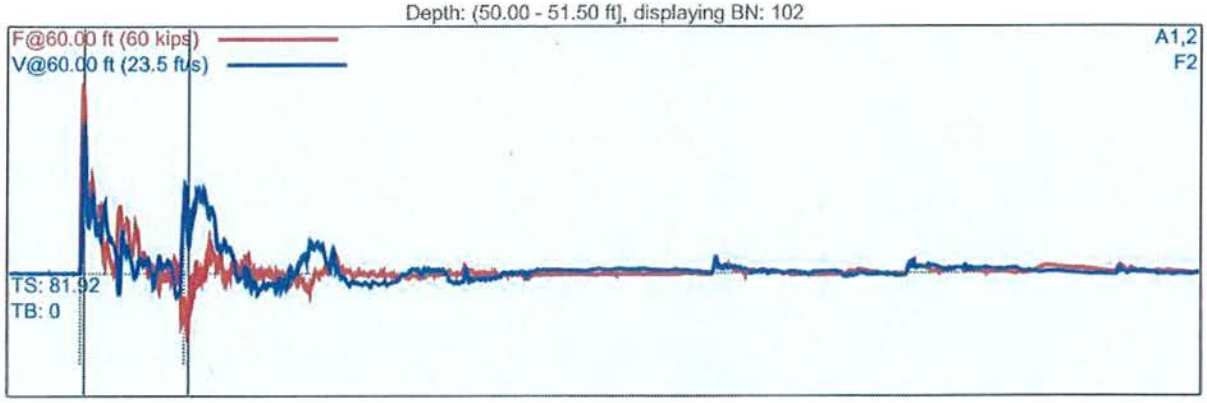
WSSC-8-06
GJS
WSSC

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.

Pile Dynamics, Inc.
SPT Analyzer Results

PDA-S Ver. 2021.34 - Printed: 12/27/2021

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

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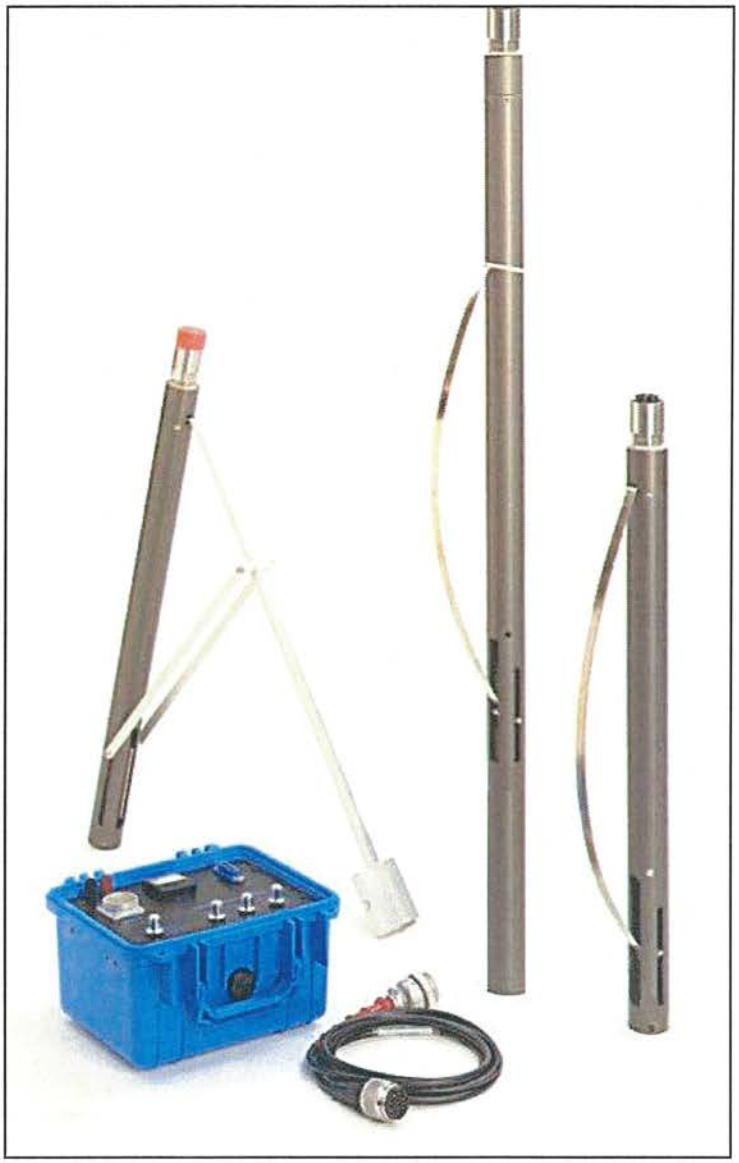
APPENDIX B-3

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.

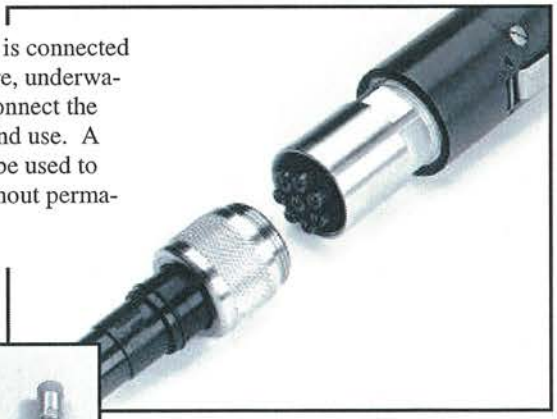
Control Electronics:

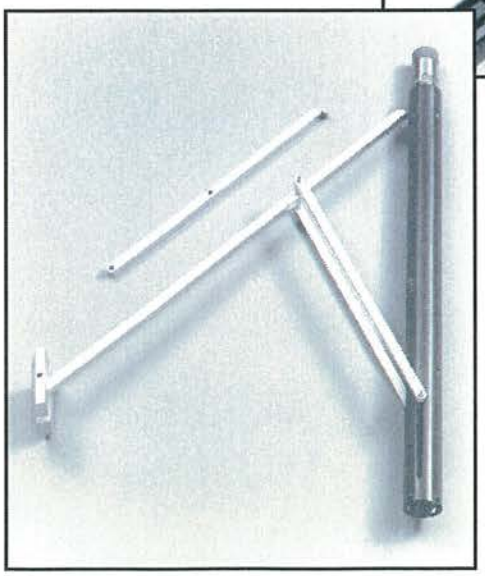
The BHGC-1b controller directs the voltages to control the clamping mechanism and servo mechanism. A meter monitors motor current to indicate the clamping action and force. This unit is usable with either model.

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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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 -50°C to +70°C (-58°F to +158°F). 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:		Geophone:
• Noise	• Distortion	• Natural Frequency
• DC Offset	• Crossfeed	• Resistance
• Gain Accuracy	• CMR	• Damping
• Gain and Phase Similarity	• Bandwidth	• Sensitivity
	• Timing Accuracy	

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

CC OTH 00555831 2022 TR

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.

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PROJECT NO.: 20230058.001A
DRAWN BY:
CHECKED BY:
DATE:

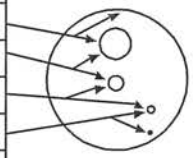
GRAPHICS KEY

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.

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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

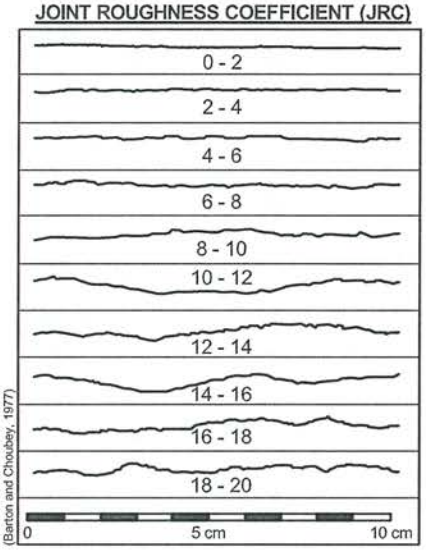
INFILLING AMOUNT

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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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 alteration; 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]

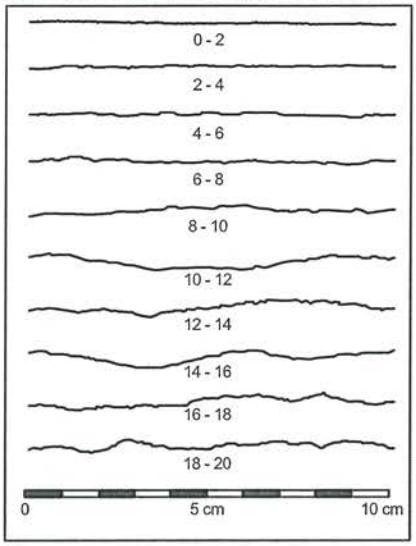
DESCRIPTION	CRITERIA [in (mm)]
Tight	<0.04 (<1)
Open	0.04 - 0.20 (1 - 5)
Wide	>0.20 (>5)

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]

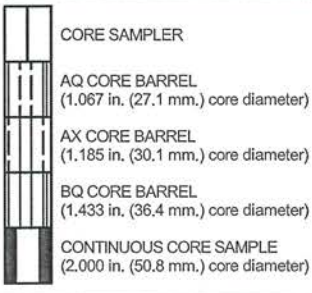


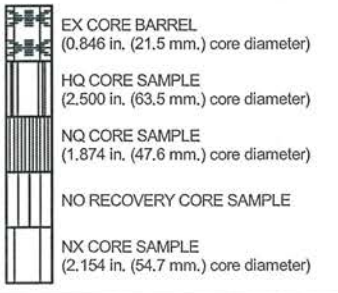
RQD Rock-quality designation (RQD) Rough measure of the degree of jointing or fracture in a rock mass, measured as a percentage of the drill core in lengths of 4 in. (10 cm.) or more.

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





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ROCK DESCRIPTION KEY

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

C-3

CC OTH 00555831 2022 TR

ROCK CORING LOG B-1

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	**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

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											
	5		**Poorly Graded SAND (SP)**: fine sand, gray, moist, medium dense		BC=9 12 16			11.1	111.0		0.9			
15														
	10				BC=2 1 1									
10 ▽			**Clayey SAND (SC)**: fine sand, low plasticity, dark brown, organic odor, wet, very loose											
	15		**Poorly Graded SAND (SP)**: fine sand, gray, wet, dense		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

ROCK CORING LOG B-1

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	**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)
-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	
			Poorly Graded SAND (SP): fine to medium sand, dark brown, wet, very dense, trace fine gravel			
-25	45				BC=25 50/4"	
-30	50		yellowish brown, no gravel		BC=30 39 41	
-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"	

LABORATORY RESULTS

USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
SC				17	53	26	
	15.2	122.9		3.6			
				5.4			

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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

ROCK CORING LOG B-1

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

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

ROCK CORING LOG B-1

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

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

ROCK CORING INFORMATION

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											(110.5'), joint, 20°, moderately fractured, spotty, Ca, slightly open, JRC=4-6
			Slightly fractured, abundant fine calcareous shell fragments	6	11		60"	N/A	93		(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											(115.4'), joint, 40°, moderately fractured, none, No, slightly open, JRC=2-4
				6	12		58"	N/A	96		(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											(123.3'), bedding, 5°, none, No, tight, JRC=2-4
				7	13		60"	N/A	100		(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											(131.1'), joint, 15°, highly fractured, partially filled, Cl, slightly open, JRC=4-6
			Shell fragments to 0.75 in. present UCS = 4990 psi	7/8	14		60"	N/A	98		(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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PROJECT NO.:	20230058.001A
DRAWN BY:	PR
CHECKED BY:	TD
DATE:	5/24/2022

ROCK CORING LOG B-1

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

FIGURE
C-3

ROCK CORING LOG B-1

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 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 (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			8	16		59"	N/A	71		
-125		Intensely fractured and partially rehealed layer								(145.6'), joint, 60°, moderately fractured, none, No, slightly open, JRC=16-18 (146.5'), joint, 55°, none, No, slightly open, JRC=6-8
			9	17		59"	N/A	71		(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
DRAWN BY:	PR
CHECKED BY:	TD
DATE:	5/24/2022

ROCK CORING LOG B-1

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

FIGURE
C-3

PHOTO 1: BORING B-1, 5 FT SAMPLE

PHOTO 2: BORING B-1, 10 FT SAMPLE

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PROJECT NO.	20230058.001A
DRAWN:	06/2022
DRAWN BY:	TD
CHECKED BY:	KS/SC
FILE NAME:	PHOTO SUMMARY

PHOTO SUMMARY

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

FIGURE:

C-5

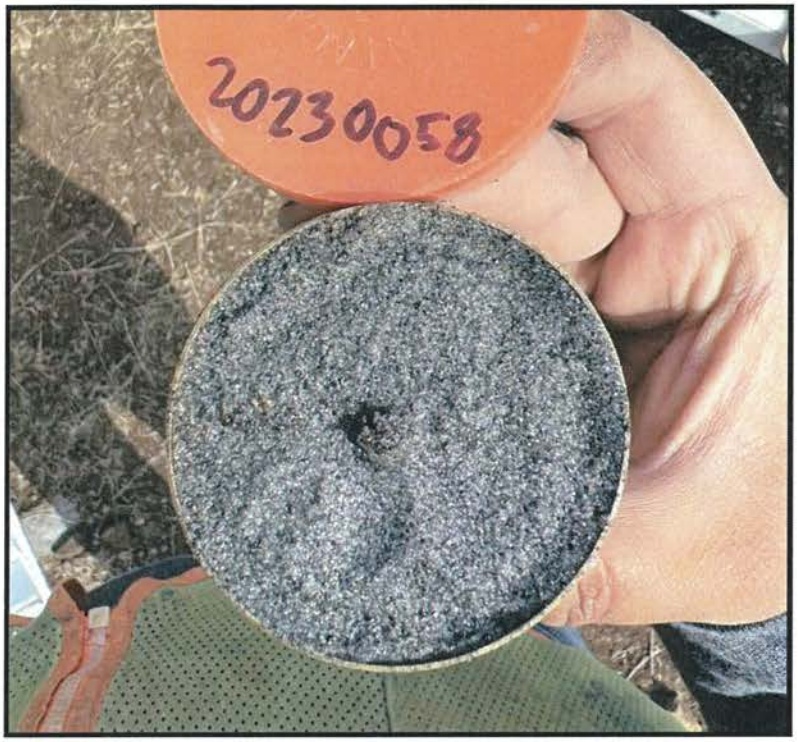

PHOTO 3: BORING B-1, 15 FT SAMPLE

PHOTO 4: BORING B-1, 20 FT SAMPLE

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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 5: BORING B-1, 25 FT SAMPLE

PHOTO 6: BORING B-1, 35 FT SAMPLE

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PROJECT NO.	20230058.001A
DRAWN:	06/2022
DRAWN BY:	TD
CHECKED BY:	KS/SC
FILE NAME:	PHOTO SUMMARY

PHOTO SUMMARY

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

FIGURE:
C-7

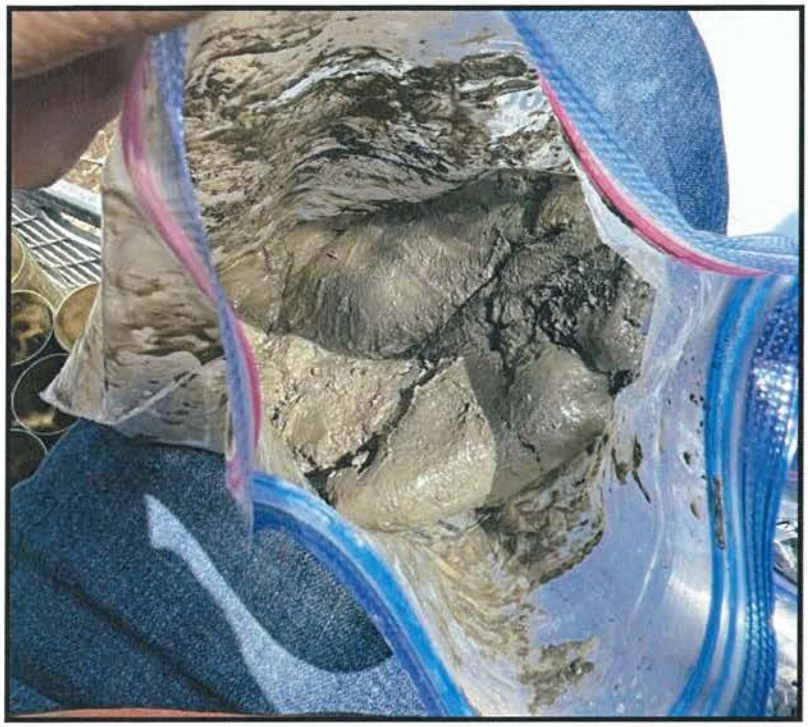

PHOTO 7: BORING B-1, 40 FT SAMPLE

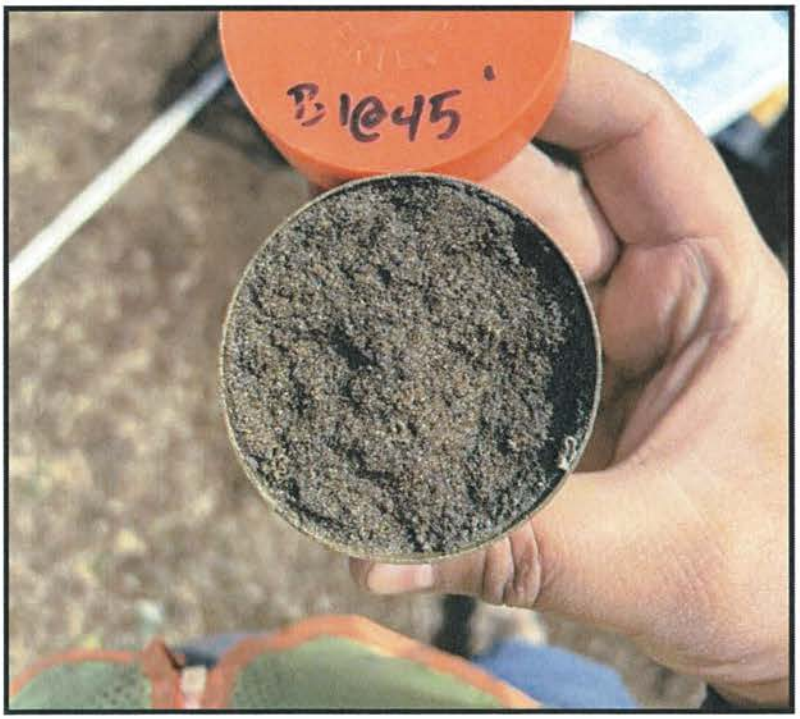

PHOTO 8: BORING B-1, 45 FT SAMPLE

KLEINFELDER *Bright People. Right Solutions.* www.kleinfelder.com	PROJECT NO. 20230058.001A	**PHOTO SUMMARY**	FIGURE: **C-8**
	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		

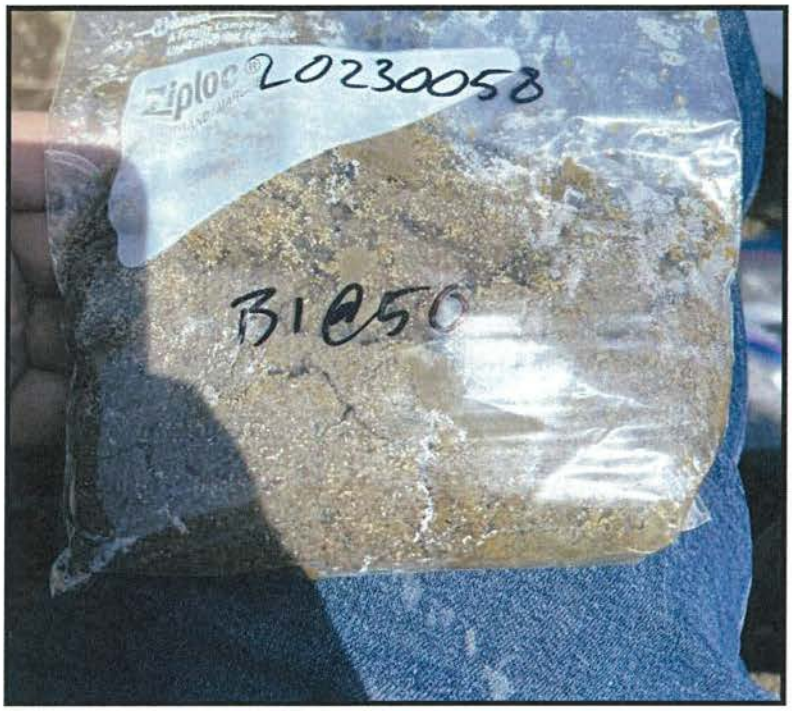

PHOTO 9: BORING B-1, 50 FT SAMPLE

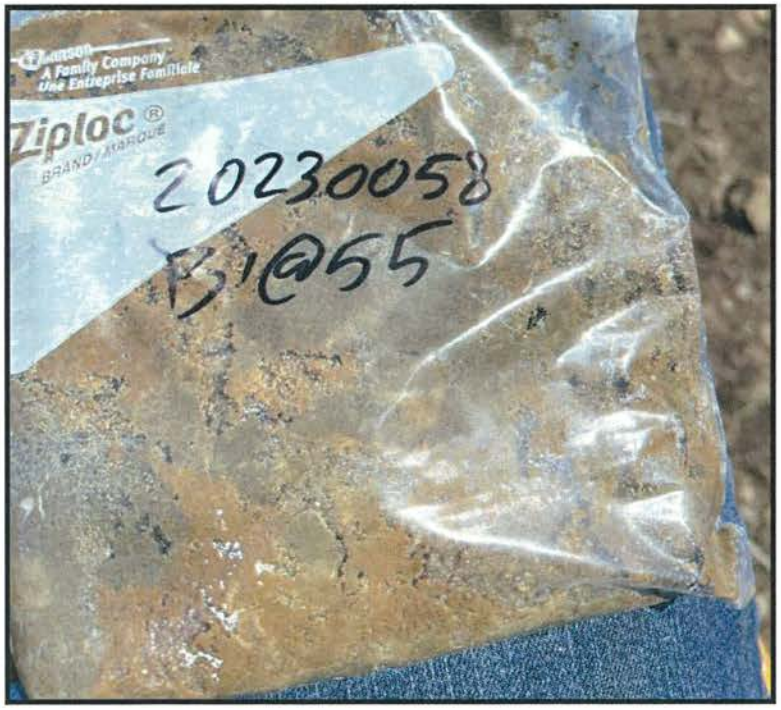

PHOTO 10: BORING B-1, 55 FT SAMPLE

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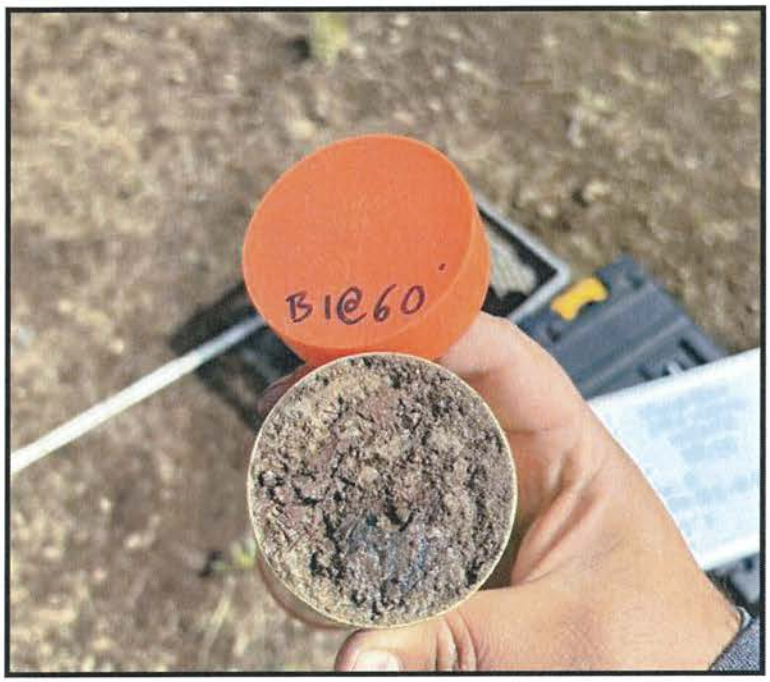

PHOTO 11: BORING B-1, 60 FT SAMPLE

PHOTO 12: BORING B-1, 65FT SAMPLE

KLEINFELDER *Bright People. Right Solutions.* www.kleinfelder.com	PROJECT NO. 20230058.001A	**PHOTO SUMMARY**	FIGURE: **C-10**
	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 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

KLEINFELDER Bright People. Right Solutions. www.kleinfelder.com	PROJECT NO. 20230058.001A	PHOTO SUMMARY	FIGURE: C-11
	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 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

KLEINFELDER Bright People. Right Solutions. www.kleinfelder.com	PROJECT NO. 20230058.001A	PHOTO SUMMARY	FIGURE: C-12
	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		

Regal

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

KLEINFELDER Bright People. Right Solutions. www.kleinfelder.com	PROJECT NO. 20230058.001A	**PHOTO SUMMARY**	FIGURE: **C-13**
	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 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-14**
	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 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

KLEINFELDER Bright People. Right Solutions. www.kleinfelder.com	PROJECT NO. 20230058.001A DRAWN: 06/2022 DRAWN BY: TD CHECKED BY: KS/SC FILE NAME: PHOTO SUMMARY	**PHOTO SUMMARY** OFFSHORE CABLE LANDING HORIZONTAL DIRECTIONAL DRILL INSTALLATIONS WINEMA BEACH, CLOVERDALE, OREGON	FIGURE: **C-15**

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

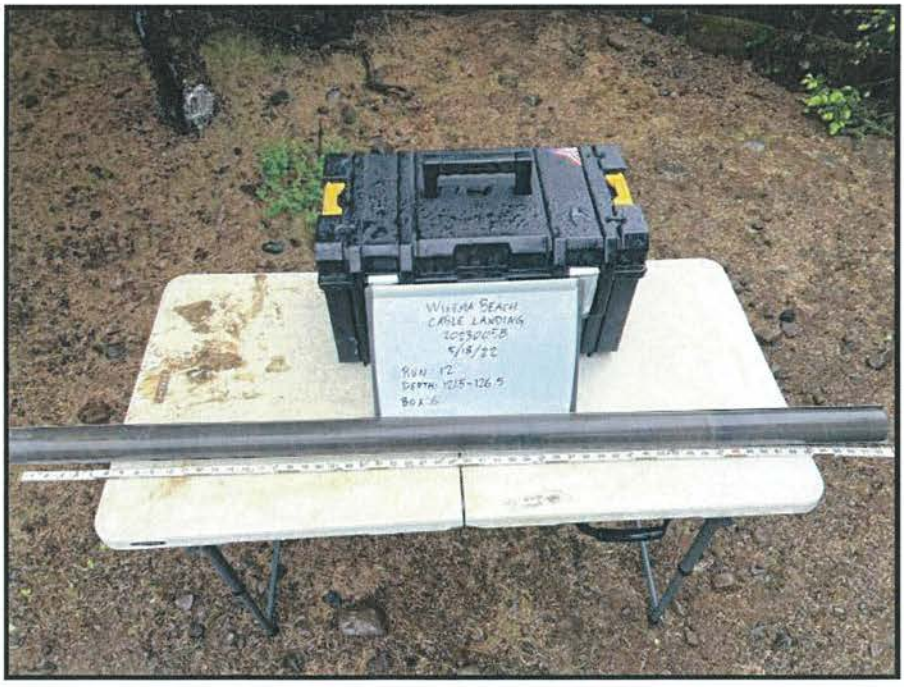

PHOTO 24: BORING B-1, CORE RUN 12: 121.5 FT - 126.5 FT

KLEINFELDER Bright People. Right Solutions. www.kleinfelder.com	PROJECT NO. 20230058.001A	**PHOTO SUMMARY**	FIGURE: **C-16**
	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

KLEINFELDER Bright People. Right Solutions. www.kleinfelder.com	PROJECT NO. 20230058.001A	**PHOTO SUMMARY**	FIGURE: **C-17**
	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

KLEINFELDER Bright People. Right Solutions. www.kleinfelder.com	PROJECT NO. 20230058.001A	PHOTO SUMMARY	FIGURE: C-18
	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 29: BORING B-1, CORE RUNE 17: 146.5 FT -151.5 FT

KLEINFELDER *Bright People. Right Solutions.* www.kleinfelder.com	PROJECT NO. 20230058.001A	**PHOTO SUMMARY**	FIGURE: **C-19**
	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		

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APPENDIX D

LABORATORY TEST RESULTS

LIST OF ATTACHMENTS

The following figures are attached and complete this appendix.

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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PROJECT NO.: 20230058.001A
DRAWN BY:
CHECKED BY:
DATE:

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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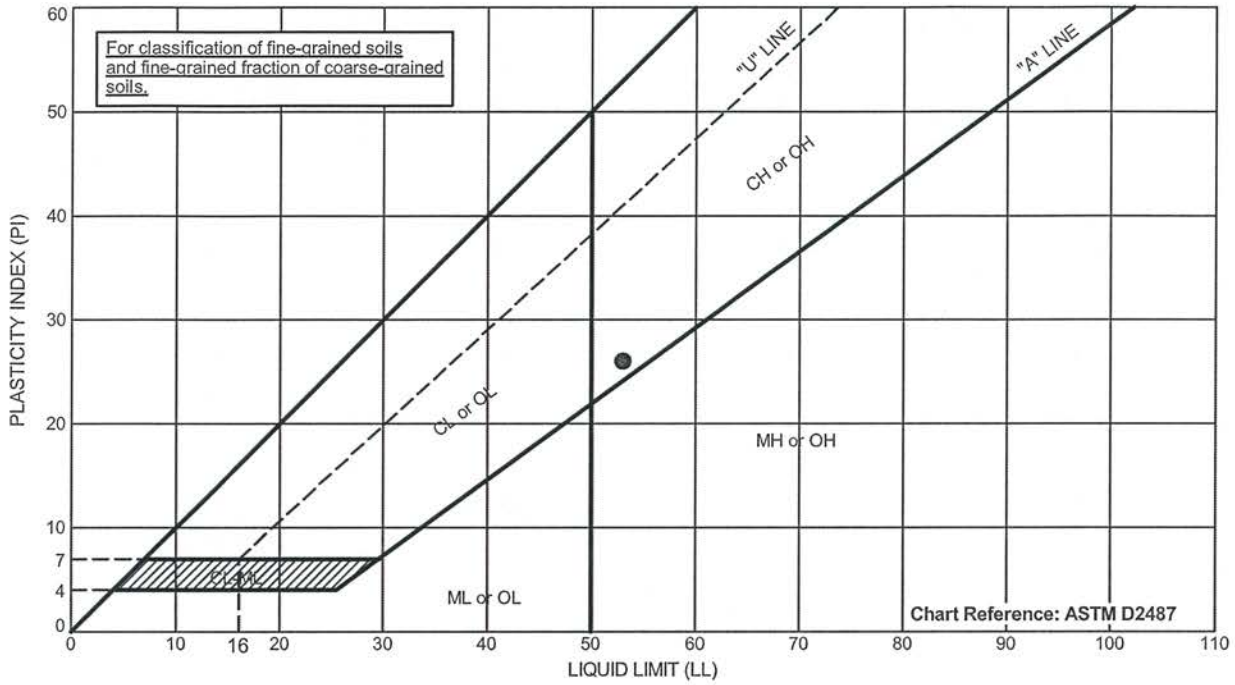
DATE:

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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PROJECT NO.: 20230058.001A

DRAWN BY:

CHECKED BY:

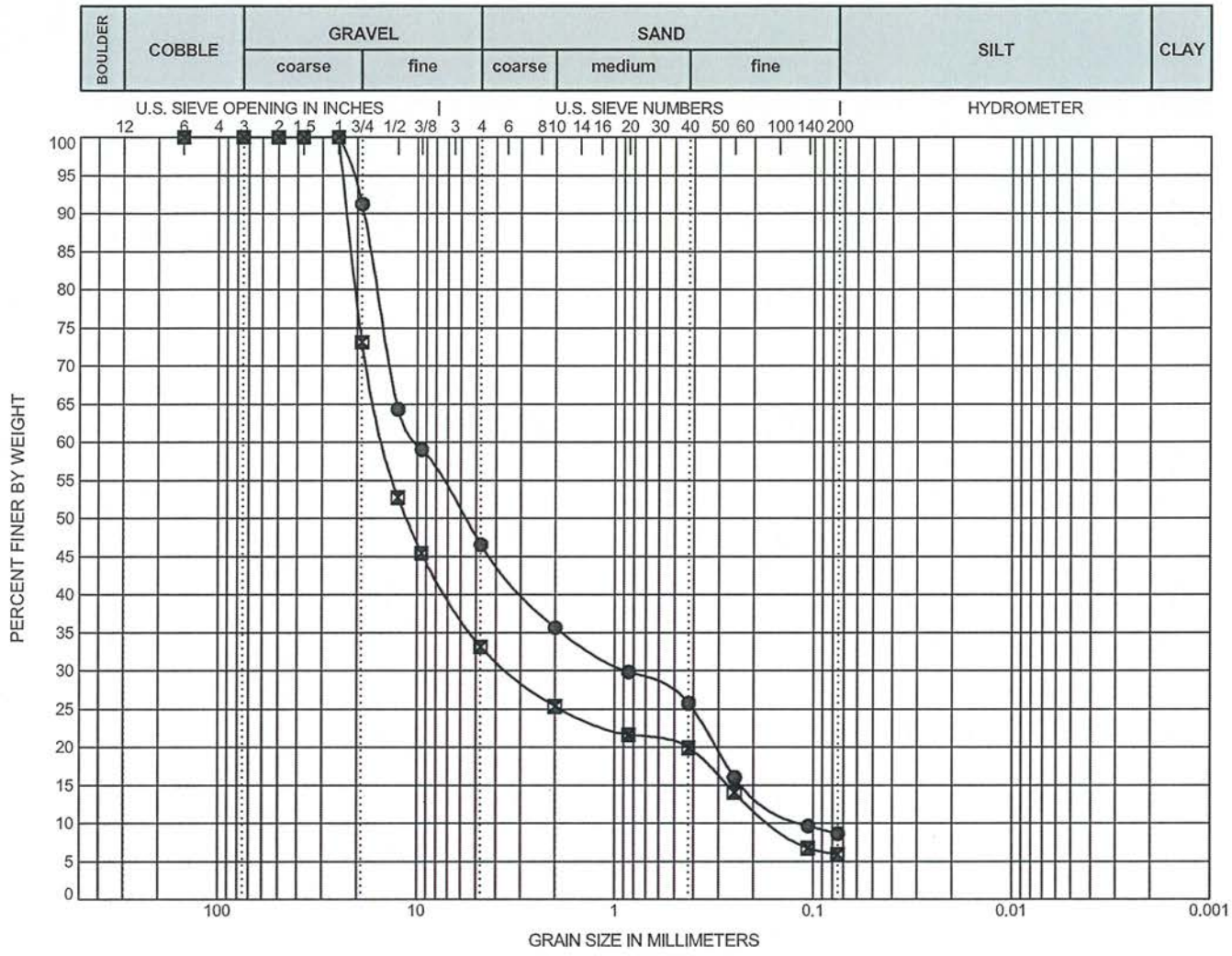
DATE:

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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PROJECT NO.: 20230058.001A
DRAWN BY:
CHECKED BY:
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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9969 Horn Rd., Sacramento, CA 95827

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

UNIAXIAL COMPRESSION TEST

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

FIGURE

D-5

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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9969 Horn Rd., Sacramento, CA 95827

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

UNIAXIAL COMPRESSION TEST

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

FIGURE
D-6

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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9969 Horn Rd., Sacramento, CA 95827

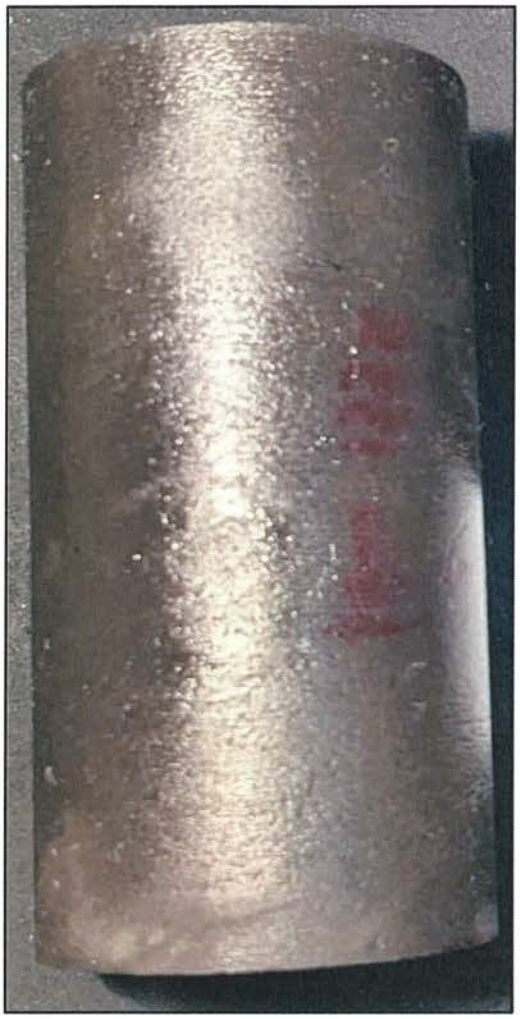
PROJECT NO.:	20230058
ENTRY BY:	S. Winn
CHECKED BY:	C. Pollack
DATE:	6/14/2022

UNIAXIAL COMPRESSION TEST

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

FIGURE

D-7



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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HORIZONTAL DIRECTIONAL DRILL
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FIGURE

D-8

KLEINFELDER
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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

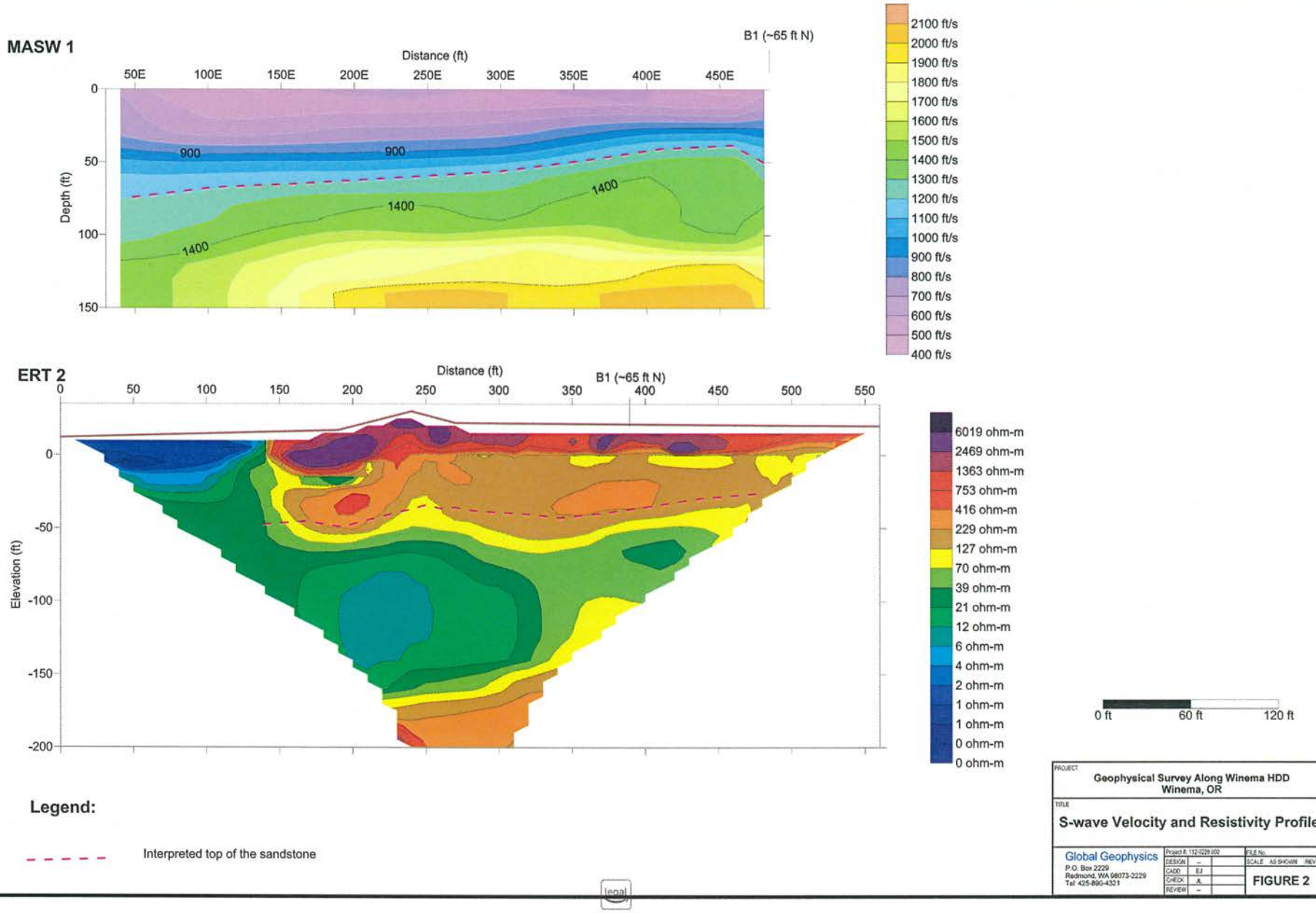
John Liu, Ph.D., R.G.
Principal Geophysicist

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 # 112-0226100			FILE No
DESIGN	--		SCALE AS SHOWN REV.
CADD	EJ		**FIGURE 1**
CHECK	JL		
REVIEW	--		



Legend:

Interpreted top of the sandstone

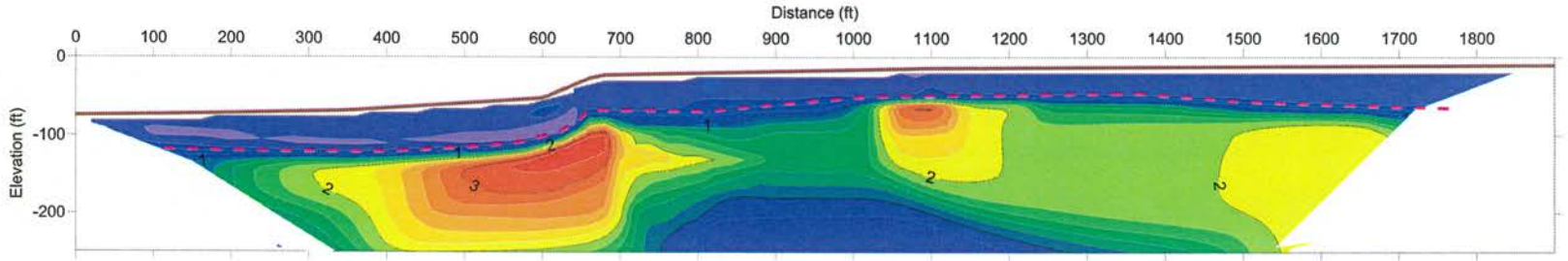
PROJECT
Geophysical Survey Along Winema HDD
Winema, OR

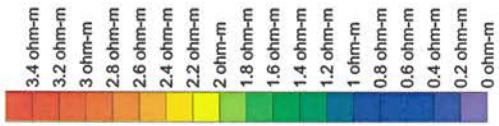
TITLE
S-wave Velocity and Resistivity Profiles

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

Project # 112-0228.002
DESIGN --
CADD EJ
CHECK JL
REVIEW --
FILE No.
SCALE AS SHOWN REV.

FIGURE 2





Legend:

- - - - - Interpreted top of the sandstone

PROJECT
Geophysical Survey Along Winema HDD
Winema, OR

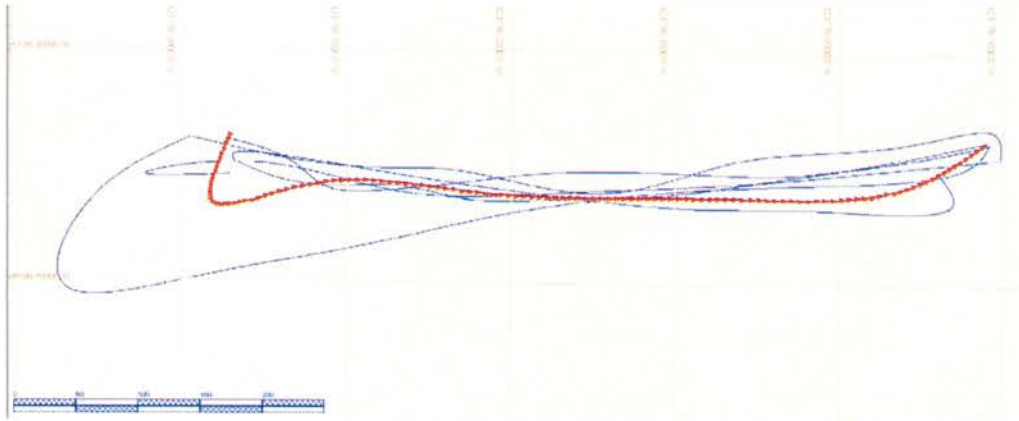
TITLE
ERT 1 Resistivity Profile

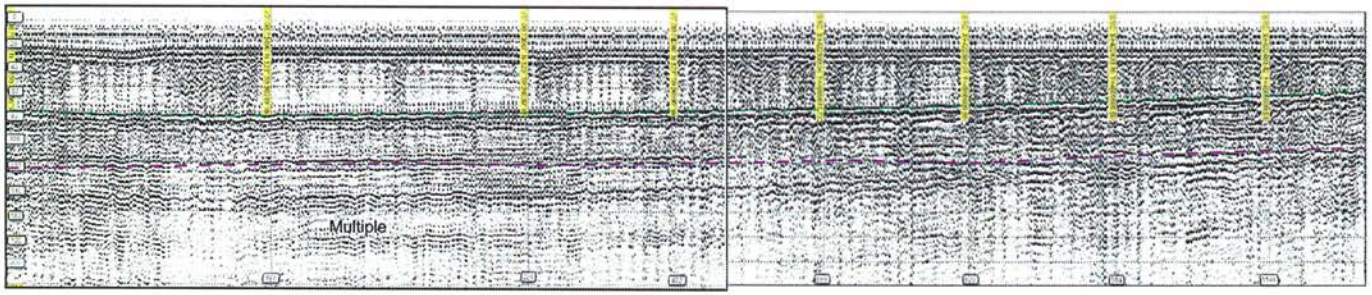
Global Geophysics
P.O. Box 2229
Redmond, WA 98073-2229
Tel: 425-890-4321

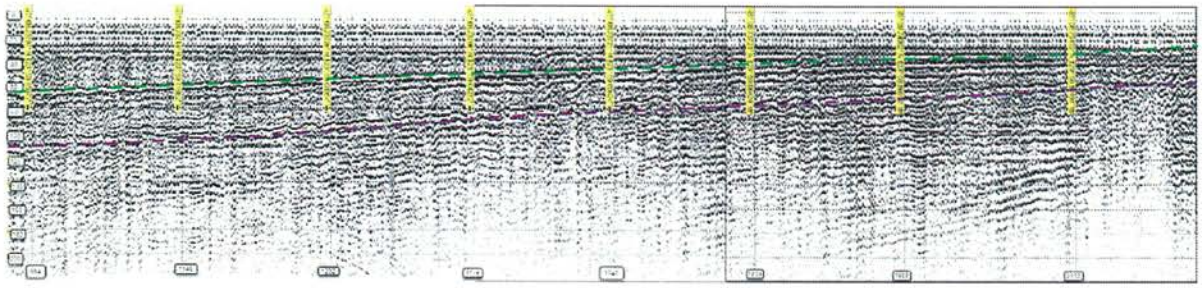
Project # 112-0228.000			FILE No.
DESIGN	--		SCALE AS SHOWN REV.
CADD	EJ		
CHECK	JL		FIGURE 3
REVIEW	--		

legal

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 # 112-0220.000			FILE No.
DESIGN	--		SCALE AS SHOWN REV.
CADD	EJ		
CHECK	JL		FIGURE 4
REVIEW	--		

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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 4
Inadvertent Return Contingency Plan

Inadvertent Return Contingency Plan For Horizontal Directional Drilling

Table of Contents

Table of Figures

Appendices

1. Introduction

Horizontal Directional Drill (HDD) operations, also known as directional bores, have the potential to release drilling fluids into the surface environment through inadvertent returns, or the condition where drilling mud is released through fractured bedrock into the surrounding rock and sand and travels toward the surface. Because drilling muds consist largely of a bentonite clay-water mixture, they are not classified as toxic or hazardous substances. However, if it is released into restricted water bodies in large quantities, bentonite has the potential to adversely impact fish and invertebrate species.

While drilling fluid seepage associated with an inadvertent return is most likely to occur near the bore entry and exit points where the drill head is shallow, inadvertent returns can occur in any location along a directional bore. This Inadvertent Return Contingency Plan (IRCP) establishes operational procedures and responsibilities for the prevention, containment, and clean-up of inadvertent returns 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 plan are to:

1. Minimize the potential for an inadvertent return associated with directional drilling activities.
2. Provide for the timely detection of inadvertent returns.
3. Protect the environmentally sensitive seabed/riverbed and associated riparian vegetation.
4. Provide for an organized, timely, and "minimum-impact" response in the event of an inadvertent return.
5. Provide for all appropriate notifications are made immediately to the management and safety personnel, as well as the applicable regulatory agencies.

2. Responsibilities

The Site Supervisor has overall responsibility for implementing this IRCP. The Site Supervisor will ensure that all employees are trained prior to all drilling. The Site Supervisor shall be notified immediately when an inadvertent return is detected. The Site Supervisor will be responsible for ensuring that the safety department is aware of the inadvertent return, 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** construction. The Site Supervisor shall ensure that all workers are properly trained and familiar with the necessary procedures for response to an inadvertent return, 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 inadvertent return 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 a riverbed, 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 inadvertent return 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.

The Site Supervisor shall ensure that a Job Briefing meeting is held at the start of each day of drilling to review the appropriate procedures to be followed in case of an inadvertent return. Questions shall be answered, and clarification given on any point over which the drilling crew or other project staff has concerns.

3. HDD Operations

3.1 HDD Rig

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 a back-hoe stationed next to the drill rig.

Figure 1: Example of HDD Rig

3.2 Fluid Mixing & Recycling Unit

A mixing & recycling unit will be used to mix the drilling fluid and to remove the drill cuttings and recycle the drilling fluid during the drilling process. The bentonite clay and water are mixed in the large tank for use in the drilling process. As the drilling fluids are returned to the bore site through the annular space between the drill pipe and the bore hole, it is pumped back to the mixing/recycling unit where the cuttings (soil and rock) from the drill hole 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 Figure 2.

Figure 2. Example of a Drilling Fluid Mixing & Recycling Unit

3.3 Vac-Truck

A vacuum truck shall be staged at the site, allowing it to be mobilized and relocated at any place along the (terrestrial) drill shot within 10 minutes of an inadvertent return detection.

3.4 Drilling Fluid

3.4.1 Drilling Mud Mixing and Preparation

The drilling fluid, called drilling 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 addatives 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 stability by strengthening the filter-cake being formed on the bore walls during the drilling operation.

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.

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.

3.4.2 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.

3.4.3 Sludge Removal

The volume of fluids and cuttings produced will be removed from the drilling pit during regular intervals, or continuously if required, and be prepared for recycling when possible. 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. Solid and liquid sludge that cannot be recycled further will be transported off-site by a vacuum truck and disposed of at an approved facility.

3.4.4 Drilling Fluid Containment

The produced sediment 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 fluid be of a minimum amount and, therefore, the risk of non-containment is minimized.

Additionally, due to the "Drill and Leave" nature of the installation, the last 30 to 40 meters of the pilot bore will be mud-free, with fresh water being fed in the bore, flushing out the drilling fluid so that there will be no 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.

4. Inadvertent Return Contingency Plan

4.1 Bore Status Monitoring and Site Preparation

Prevention of inadvertent returns 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 inadvertent returns most efficiently. During the bore process, the drilling operator will work to keep the anular 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.

Terrestrial exit and entry pits will be enclosed to contain the drilling fluid. Typically, sandbags are used but effective containment can also be achieved by straw bales or silt fences. A spill kit will be maintained on-site and used if an inadvertent return occurs. A vacuum truck, trailer or 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. If necessary, barriers (e.g., straw bales, sandbags, sedimentation fences) between the bore site and the edge of the water will be

constructed prior to drilling to prevent released bentonite material from reaching the water. Other ancillary items readily available during drilling operations include a light tower in case clean-up operations are needed after dark.

Water containing mud, silt, bentonite, or other pollutants from equipment washing or other activities will not be allowed to enter the water (sea, lake, or stream/river). 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.

4.2 Fracture Detection

Most obvious signs of an inadvertent return are the visible pooling of drilling mud on the ground surface or discoloration in the water, sudden decrease in mud volume returns during drilling operations, or loss in drilling mud pump pressure. 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.

The Site Supervisor and the drill rig operator(s) will work to coordinate the likely location of the inadvertent return. The location of the inadvertent return will be recorded, notes made on the location, and measures taken to address the concern.

If required by local authorities and/or project site morphology and conditions, a dye shall be employed and added to the drilling fluid to enhance its detectability, especially when such event takes place underwater. This would ensure that the release can be spotted/assessed easier and therefore much faster by the observers dispatched around the site in case that such release is suspected by the parameters' monitoring.

4.3 Corrective Actions

The response of the field crew to an inadvertent return will be immediate and in accordance with procedures outlined in this IRCP. All appropriate emergency actions that do not pose additional threats to sensitive resources will be taken, as follows:

4.3.1 Terrestrial Inadvertent Returns

1. Direction boring and mud circulation will cease immediately as practical.
2. The bore stem will be pulled back to relieve pressure on the inadvertent return.
3. The Site Supervisor will notify the project team of the response actions to be taken and notifications to agencies will be made.
4. If inadvertent return is minor, easily contained, has not reached the surface, and is not threatening sensitive resources, a leak stopping compound will be used to block it. If the use of leak stopping compound is not fully successful, the bore stem will be redirected to a new location along the desired drill path where an inadvertent return has not occurred.
5. If the inadvertent return of drilling fluid has reached the ground surface, it will be recovered back to the bore site by pumping or by physical removal. A dike or berm may be constructed around the inadvertent return to entrap released drilling fluid, if necessary. Clean sand will be added to the area and smoothed to pre-project contours.
6. If the inadvertent return reaches the surface and becomes widespread, the Site Supervisor will authorize a readily accessible vacuum truck and mechanical equipment to the site. The vacuum truck may be either

positioned at either end of the line of the drill so that the inadvertent return can be reached by crews on foot, or may be pulled by a bulldozer, so that contaminated soils can be vacuumed up.

7. An 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.

4.3.2 Ocean Inadvertent Returns

While the drill head is under the ocean, workers will periodically perform visually inspections of the ocean from the shore to for possible inadvertent returns 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 inadvertent return.
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, and project team will determine if inadvertent return is minor, easily contained, has not reached the surface, and is not threatening sensitive resources.
5. Continuous visual observation of the inadvertent release will commence.
6. Drilling activities will cease until the inadvertent release has dissipated as determined by visual inspection.
7. Drilling activities will commence no sooner than 10 minutes after the inadvertent release has dissipated and will continue for a period no longer than 10 minutes after the inadvertent release is once again observed at which point steps 1 through 5 will be implemented. This cycle will continue until the release is determined to be stopped.

4.4 Containment of Drilling Fluid Release

Immediately following the detection of the inadvertent drilling fluid release on land, containment, and clean-up operations will commence. The Contractor may use straw bales, silt fences, sandbags, and/or earth berms to prevent fluid from migrating or flowing from the immediate area of the discharge. If the volume released is too small for containment measures or, if the release occurs in an environmentally sensitive area where release of containments can cause additional damage, the receiving area will be allowed to dry naturally. If there is a threat to a sensitive resource or a threat to public safety, HDD activities will cease immediately until a plan to proceed is discussed.

Other containment measures include the following:

- Additional berms may be constructed around the release area as directed by the Site Supervisor to prevent release of materials into the adjacent water body.
- If the amount of fluid released is large enough to prevent practical collection, the affected area would be diluted with fresh water and allowed to dry. Measures would be implemented (e.g., berm, silt fence, hay bale installation) to prevent silt laden water from flowing into the water body.
- If hand tools cannot contain a small on-land release, small collection sumps may be constructed to pump the released material into the mud processing system.
- In cases of inadvertent releases to open water, it may be impractical to contain the release. Removal by vacuum truck may be attempted if deemed appropriate.

- The decision to proceed with the drilling operation would be made mutually between the Site Supervisor and the on-site Client Representatives after all practical methods to seal off the location of the discharge have been attempted.
- Underwater releases are typically allowed to dissipate since, by design, the HDD contractor would seek to avoid placing equipment within the water body. Water sampling equipment would be available for use by site inspectors to evaluate turbidity levels.

4.5 Clean-up of Releases

The clean-up will commence after the release is contained. Clean-up will include removal of all visible drilling fluid 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 released drilling fluid, 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.

4.6 Documentation

The Site Supervisor will record the inadvertent return 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 inadvertent return.
- Description of any sensitive areas, and their location in relation to the inadvertent return.
- Description of the methods used to clean up or secure the site.
- A listing of the current permits obtained for the project.

5. 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.

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

In addition, the following regulatory leads will also be notified immediately:

- US Army Corps of Engineer Project Manager.
- DEQ's Section 401 Project Manager.
- Oregon Department of State Lands Removal-Fill Manager.
- Oregon Parks and Recreation Department's Ocean Shores Coordinator.

Appendix A. Example of Bentonite Powder MSDS

HALLIBURTON

MATERIAL SAFETY DATA SHEET

Product Trade Name: **BORE-GEL®**

Revision Date: 20-Mar-2015

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Product Trade Name: BORE-GEL®
Synonyms: None
Chemical Family: Mineral
Application: Viscosifier

Manufacturer/Supplier
Baroid Fluid Services
Product Service Line of Halliburton
P.O. Box 1675
Houston, TX 77251
Telephone: (281) 871-4000
Emergency Telephone: (281) 575-5000

Prepared By
Chemical Stewardship
Telephone: 1-580-251-4335
e-mail: fdunexchem@halliburton.com

2. COMPOSITION/INFORMATION ON INGREDIENTS

Substances	CAS Number	PERCENT (w/w)	ACGIH TLV-TWA	OSHA PEL-TWA
Bentonite	1302-78-9	80 - 100%	TWA: 1 mg/m³	Not applicable
Crystalline silica, quartz	14808-60-7	1 - 5%	TWA: 0.025 mg/m³	$\frac{10\ mg/m^3}{\%SiO2 + 2}$
Crystalline silica, cristobalite	14464-46-1	0.1 - 1%	TWA: 0.025 mg/m³	$1/2 \times \frac{10\ mg/m^3}{\%SiO2 + 2}$
Crystalline silica, tridymite	15468-32-3	0.1 - 1%	0.05 mg/m³	$1/2 \times \frac{10\ mg/m^3}{\%SiO2 + 2}$

3. HAZARDS IDENTIFICATION

Hazard Overview	CAUTION! - ACUTE HEALTH HAZARD May cause eye and respiratory irritation. DANGER! - CHRONIC HEALTH HAZARD Breathing crystalline silica can cause lung disease, including silicosis and lung cancer. Crystalline silica has also been associated with scleroderma and kidney disease. This product contains quartz, cristobalite, and/or tridymite which may become airborne without a visible cloud. Avoid breathing dust. Avoid creating dusty conditions. Use only with adequate ventilation to keep exposures below recommended exposure limits. Wear a NIOSH certified, European Standard EN 149, AS/NZS 1715, or equivalent respirator when using this product. Review the Safety Data Sheet (SDS) for this product, which has been provided to your employer.

4. FIRST AID MEASURES

Inhalation	If inhaled, remove from area to fresh air. Get medical attention if respiratory irritation develops or if breathing becomes difficult.
Skin	Wash with soap and water. Get medical attention if irritation persists.
Eyes	In case of contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention if irritation persists.
Ingestion	Under normal conditions, first aid procedures are not required.
Notes to Physician	Treat symptomatically.

5. FIRE FIGHTING MEASURES

Flash Point/Range (F):	Not Determined
Flash Point/Range (C):	Not Determined
Flash Point Method:	Not Determined
Autoignition Temperature (F):	Not Determined
Autoignition Temperature (C):	Not Determined
Flammability Limits in Air - Lower (%):	Not Determined
Flammability Limits in Air - Upper (%):	Not Determined

Fire Extinguishing Media	All standard firefighting media.
Special Exposure Hazards	Not applicable.
Special Protective Equipment for Fire-Fighters	Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.
NFPA Ratings: HMIS Ratings:	Health 0, Flammability 0, Reactivity 0 Health 0*, Flammability 0, Physical Hazard 0 , PPE: At

6. ACCIDENTAL RELEASE MEASURES

Personal Precautionary Measures	Use appropriate protective equipment. Avoid creating and breathing dust.
Environmental Precautionary Measures	Prevent from entering sewers, waterways, or low areas.

Procedure for Cleaning / Absorption	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.

7. HANDLING AND STORAGE

Handling Precautions	This product contains quartz, cristobalite, and/or tridymite which may become airborne without a visible cloud. Avoid breathing dust. Avoid creating dusty conditions. Use only with adequate ventilation to keep exposure below recommended exposure limits. Wear a NIOSH certified, European Standard En 149, or equivalent respirator when using this product. Material is slippery when wet.
Storage Information	Use good housekeeping in storage and work areas to prevent accumulation of dust. Close container when not in use. Do not reuse empty container. Product has a shelf life of 12 months.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering Controls	Use approved industrial ventilation and local exhaust as required to maintain exposures below applicable exposure limits.
Personal Protective Equipment	If engineering controls and work practices cannot prevent excessive exposures, the selection and proper use of personal protective equipment should be determined by an industrial hygienist or other qualified professional based on the specific application of this product.
Respiratory Protection	Not normally needed. But if significant exposures are possible then the following respirator is recommended: Dust/mist respirator. (N95, P2/P3)
Hand Protection	Normal work gloves.
Skin Protection	Wear clothing appropriate for the work environment. Dusty clothing should be laundered before reuse. Use precautionary measures to avoid creating dust when removing or laundering clothing.
Eye Protection	Wear safety glasses or goggles to protect against exposure.
Other Precautions	None known.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State:	Powder
Color:	Light brown or Gray
Odor:	Mild earthy
pH:	8-10
Specific Gravity @ 20 C (Water=1):	2.5
Density @ 20 C (lbs./gallon):	Not Determined
Bulk Density @ 20 C (lbs/ft3):	53 - 80
Boiling Point/Range (F):	Not Determined
Boiling Point/Range (C):	Not Determined
Freezing Point/Range (F):	Not Determined
Freezing Point/Range (C):	Not Determined
Vapor Pressure @ 20 C (mmHg):	Not Determined
Vapor Density (Air=1):	Not Determined

Percent Volatiles:	Not Determined
Evaporation Rate (Butyl Acetate=1):	Not Determined
Solubility in Water (g/100ml):	Slightly soluble
Solubility in Solvents (g/100ml):	Not Determined
VOCs (lbs./gallon):	Not Determined
Viscosity, Dynamic @ 20 C (centipoise):	Not Determined
Viscosity, Kinematic @ 20 C (centistokes):	Not Determined
Partition Coefficient/n-Octanol/Water:	Not Determined
Molecular Weight (g/mole):	Not Determined

10. STABILITY AND REACTIVITY

Stability Data:	Stable
Hazardous Polymerization:	Will Not Occur
Conditions to Avoid	None anticipated
Incompatibility (Materials to Avoid)	Hydrofluoric acid.
Hazardous Decomposition Products	Amorphous silica may transform at elevated temperatures to tridymite (870 C) or cristobalite (1470 C).
Additional Guidelines	Not Applicable

11. TOXICOLOGICAL INFORMATION

Principle Route of Exposure Eye or skin contact, inhalation.

Sympotoms related to exposure

Acute Toxicity

Inhalation

Inhaled crystalline silica in the form of quartz or cristobalite from occupational sources is carcinogenic to humans (IARC, Group 1). There is sufficient evidence in experimental animals for the carcinogenicity of tridymite (IARC, Group 2A).

Breathing silica dust may cause irritation of the nose, throat, and respiratory passages. Breathing silica dust may not cause noticeable injury or illness even though permanent lung damage may be occurring. Inhalation of dust may also have serious chronic health effects (See "Chronic Effects/Carcinogenicity" subsection below).

Eye Contact May cause eye irritation.

Skin Contact May cause mechanical skin irritation.

Ingestion None known

Chronic Effects/Carcinogenicity

Silicosis: Excessive inhalation of respirable crystalline silica dust may cause a progressive, disabling, and sometimes-fatal lung disease called silicosis. Symptoms include cough, shortness of breath, wheezing, non-specific chest illness, and reduced pulmonary function. This disease is exacerbated by smoking. Individuals with silicosis are predisposed to develop tuberculosis.

Cancer Status: The International Agency for Research on Cancer (IARC) has determined that crystalline silica inhaled in the form of quartz or cristobalite from occupational sources can cause lung cancer in humans (Group 1 - carcinogenic to humans) and has determined that there is sufficient evidence in experimental animals for the carcinogenicity of tridymite (Group 2A - possible carcinogen to humans). Refer to IARC Monograph 68, Silica, Some Silicates and Organic Fibres (June 1997) in conjunction with the use of these minerals. The National Toxicology Program classifies respirable crystalline silica as "Known to be a human carcinogen". Refer to the 9th Report on Carcinogens (2000). The American Conference of Governmental Industrial Hygienists (ACGIH) classifies crystalline silica, quartz, as a suspected human carcinogen (A2).

There is some evidence that breathing respirable crystalline silica or the disease silicosis is associated with an increased incidence of significant disease endpoints such as scleroderma (an immune system disorder manifested by scarring of the lungs, skin, and other internal organs) and kidney disease.

Toxicology data for the components

Substances	CAS Number	LD50 Oral	LD50 Dermal	LC50 Inhalation
Bentonite	1302-78-9	> 5000 mg/kg (Rat) > 2000 mg/kg (Rat)	No data available	> 5.27 mg/L (Rat)
Crystalline silica, quartz	14808-60-7	500 mg/kg (Rat) >15,000 mg/kg (Human)	No data available	No data available
Crystalline silica, cristobalite	14464-46-1	> 5000 mg/kg (Rat)	No data available	No data available
Crystalline silica, tridymite	15468-32-3	> 5000 mg/kg (Rat)	No data available	No data available

12. ECOLOGICAL INFORMATION

Ecotoxicological Information

Ecotoxicity Product

Acute Fish Toxicity: TLM96: 10000 ppm (Oncorhynchus mykiss)
Acute Crustaceans Toxicity: Not determined
Acute Algae Toxicity: Not determined

Ecotoxicity Substance

Substances	CAS Number	Toxicity to Algae	Toxicity to Fish	Toxicity to Microorganisms	Toxicity to Invertebrates
Bentonite	1302-78-9	EC50(72h): > 100 mg/L (freshwater algae)	TLM96 10,000 ppm (Oncorhynchus mykiss) LC50 (96h) 16,000 - 19,000 mg/L (Oncorhynchus mykiss) LC50 (24h) 2800 – 3200 mg/L (black bass, warmouth bass, blue gill and sunfish)	No information available	EC50 (96h) 81.6 mg/L (Metacarcinus magister) EC50 (96h) 24.8 mg/L (Pandalus danae) EC50 (48h) > 100 mg/L (Daphnia magna)
Crystalline silica, quartz	14808-60-7	No information available	LL0 (96h) 10,000 mg/L (Danio rerio) (similar substance)	No information available	LL50 (24h) > 10,000 mg/L (Daphnia magna) (similar substance)
Crystalline silica, cristobalite	14464-46-1	No information available	LL0 (96h) 10,000 mg/L (Danio rerio) (similar substance)	No information available	LL50 (24h) > 10,000 mg/L (Daphnia magna) (similar substance)

Crystalline silica, tridymite	15468-32-3	No information available	LL0 (96h) 10,000 mg/L(Danio rerio) (similar substance)	No information available	LL50 (24h) > 10,000 mg/L (Daphnia magna) (similar substance)

12.2. Persistence and degradability

Substances	CAS Number	Persistence and Degradability
Bentonite	1302-78-9	The methods for determining biodegradability are not applicable to inorganic substances.
Crystalline silica, quartz	14808-60-7	The methods for determining biodegradability are not applicable to inorganic substances.
Crystalline silica, cristobalite	14464-46-1	The methods for determining biodegradability are not applicable to inorganic substances.
Crystalline silica, tridymite	15468-32-3	The methods for determining biodegradability are not applicable to inorganic substances.

12.3. Bioaccumulative potential

Substances	CAS Number	Log Pow
Bentonite	1302-78-9	No information available
Crystalline silica, quartz	14808-60-7	No information available
Crystalline silica, cristobalite	14464-46-1	No information available
Crystalline silica, tridymite	15468-32-3	No information available

12.4. Mobility in soil
No information available

12.5. Results of PBT and vPvB assessment
No information available.

Substances	PBT and vPvB assessment
Bentonite	No data available
Crystalline silica, quartz	Not PBT/vPvB
Crystalline silica, cristobalite	No data available
Crystalline silica, tridymite	No data available

12.6. Other adverse effects
No information available

13. DISPOSAL CONSIDERATIONS

Disposal Method — If practical, recover and reclaim, recycle, or reuse by the guidelines of an approved local reuse program. Should contaminated product become a waste, dispose of in a licensed industrial landfill according to federal, state, and local regulations.

Contaminated Packaging — Follow all applicable national or local regulations.

14. TRANSPORT INFORMATION

US DOT

UN Number:	Not restricted
UN Proper Shipping Name:	Not restricted
Transport Hazard Class(es):	Not applicable
Packing Group:	Not applicable

US DOT Bulk

DOT (Bulk)	Not applicable

Canadian TDG

UN Number:	Not restricted
UN Proper Shipping Name:	Not restricted
Transport Hazard Class(es):	Not applicable
Packing Group:	Not applicable

IMDG/IMO

UN Number:	Not restricted
UN Proper Shipping Name:	Not restricted
Transport Hazard Class(es):	Not applicable
Packing Group:	Not applicable

IATA/ICAO

UN Number:	Not restricted
UN Proper Shipping Name:	Not restricted
Transport Hazard Class(es):	Not applicable
Packing Group:	Not applicable

Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code: Not applicable
Special Precautions for User: None

15. REGULATORY INFORMATION

US Regulations

US TSCA Inventory	All components listed on inventory or are exempt.
EPA SARA Title III Extremely Hazardous Substances	Not applicable
EPA SARA (311,312) Hazard Class	Acute Health Hazard Chronic Health Hazard
EPA SARA (313) Chemicals	This product does not contain a toxic chemical for routine annual "Toxic Chemical Release Reporting" under Section 313 (40 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.
California Proposition 65	The California Proposition 65 regulations apply to this product.
MA Right-to-Know Law	One or more components listed.
NJ Right-to-Know Law	One or more components listed.
PA Right-to-Know Law	One or more components listed.

Canadian Regulations

Canadian DSL Inventory	All components listed on inventory or are exempt.
WHMIS Hazard Class	D2A Very Toxic Materials Crystalline silica

16. OTHER INFORMATION

The following sections have been revised since the last issue of this SDS
Not applicable

Additional information	For additional information on the use of this product, contact your local Halliburton representative. For questions about the Safety Data Sheet for this or other Halliburton products, contact Chemical Stewardship at 1-580-251-4335.
Disclaimer Statement	This information is furnished without warranty, expressed or implied, as to accuracy or completeness. The information is obtained from various sources including the manufacturer and other third party sources. The information may not be valid under all conditions nor if this material is used in combination with other materials or in any process. Final determination of suitability of any material is the sole responsibility of the user.

*****END OF MSDS*****

Appendix B. Example of Biodegradable Polymer Additive MSDS (for Bore Stabilization)

HALLIBURTON

MATERIAL SAFETY DATA SHEET

Product Trade Name: **QUIK-BORE**

Revision Date: 20-Mar-2013

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Product Trade Name: QUIK-BORE
Synonyms: None
Chemical Family: Mineral
Application: Additive

Manufacturer/Supplier
Baroid Industrial Drilling Products
Product Service Line of Halliburton
P.O. Box 1675
Houston, TX 77251
Telephone: (281) 871-4613 or 1-877-379-7412
Emergency Telephone: (281) 575-5000

Prepared By
Chemical Compliance
Telephone: 1-580-251-4335
e-mail: fdunexchem@halliburton.com

2. COMPOSITION/INFORMATION ON INGREDIENTS

Substances	CAS Number	PERCENT	ACGIH TLV-TWA	OSHA PEL-TWA
Bentonite	1302-78-9	60 - 100%	Not applicable	Not applicable
Crystalline silica, cristobalite	14464-46-1	0 - 1%	0.025 mg/m^3	$\frac{1/2 \times 10 \text{ mg/m}^3}{\%SiO2 + 2}$
Crystalline silica, tridymite	15468-32-3	0 - 1%	0.05 mg/m^3	$\frac{1/2 \times 10 \text{ mg/m}^3}{\%SiO2 + 2}$
Crystalline silica, quartz	14808-60-7	1 - 5%	0.025 mg/m^3	$\frac{10 \text{ mg/m}^3}{\%SiO2 + 2}$

More restrictive exposure limits may be enforced by some states, agencies, or other authorities.

3. HAZARDS IDENTIFICATION

Hazard Overview

CAUTION! - ACUTE HEALTH HAZARD
May cause eye and respiratory irritation.

DANGER! - CHRONIC HEALTH HAZARD
Breathing crystalline silica can cause lung disease, including silicosis and lung cancer. Crystalline silica has also been associated with scleroderma and kidney disease.

This product contains quartz, cristobalite, and/or tridymite which may become airborne without a visible cloud. Avoid breathing dust. Avoid creating dusty conditions. Use only with adequate ventilation to keep exposures below recommended exposure limits. Wear a NIOSH certified, European Standard EN 149, or equivalent respirator when using this product. Review the Material Safety Data Sheet (MSDS) for this product, which has been provided to your employer.

4. FIRST AID MEASURES

Inhalation	If inhaled, remove from area to fresh air. Get medical attention if respiratory irritation develops or if breathing becomes difficult.
Skin	Wash with soap and water. Get medical attention if irritation persists.
Eyes	In case of contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention if irritation persists.
Ingestion	Under normal conditions, first aid procedures are not required.
Notes to Physician	Treat symptomatically.

5. FIRE FIGHTING MEASURES

Flash Point/Range (F):	Not Determined
Flash Point/Range (C):	Not Determined
Flash Point Method:	Not Determined
Autoignition Temperature (F):	Not Determined
Autoignition Temperature (C):	Not Determined
Flammability Limits in Air - Lower (%):	Not Determined
Flammability Limits in Air - Upper (%):	Not Determined

Fire Extinguishing Media	All standard firefighting media.
Special Exposure Hazards	Not applicable.
Special Protective Equipment for Fire-Fighters	Not applicable.
NFPA Ratings:	Health 0, Flammability 0, Reactivity 0
HMIS Ratings:	Health 0*, Flammability 0, Reactivity 0

6. ACCIDENTAL RELEASE MEASURES

Personal Precautionary Measures	Use appropriate protective equipment. Avoid creating and breathing dust.
Environmental Precautionary Measures	None known.

Procedure for Cleaning / Absorption	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.

7. HANDLING AND STORAGE

Handling Precautions	This product contains quartz, cristobalite, and/or tridymite which may become airborne without a visible cloud. Avoid breathing dust. Avoid creating dusty conditions. Use only with adequate ventilation to keep exposure below recommended exposure limits. Wear a NIOSH certified, European Standard En 149, or equivalent respirator when using this product. Material is slippery when wet.
Storage Information	Use good housekeeping in storage and work areas to prevent accumulation of dust. Close container when not in use. Do not reuse empty container. Product has a shelf life of 12 months.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering Controls	Use approved industrial ventilation and local exhaust as required to maintain exposures below applicable exposure limits.
Personal Protective Equipment	If engineering controls and work practices cannot prevent excessive exposures, the selection and proper use of personal protective equipment should be determined by an industrial hygienist or other qualified professional based on the specific application of this product.
Respiratory Protection	Not normally needed. But if significant exposures are possible then the following respirator is recommended: Dust/mist respirator. (N95, P2/P3)
Hand Protection	Normal work gloves.
Skin Protection	Wear clothing appropriate for the work environment. Dusty clothing should be laundered before reuse. Use precautionary measures to avoid creating dust when removing or laundering clothing.
Eye Protection	Wear safety glasses or goggles to protect against exposure.
Other Precautions	None known.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State:	Powder
Color:	Gray
Odor:	Mild earthy
pH:	8-10
Specific Gravity @ 20 C (Water=1):	2.60
Density @ 20 C (lbs./gallon):	Not Determined
Bulk Density @ 20 C (lbs/ft3):	50-73
Boiling Point/Range (F):	Not Determined
Boiling Point/Range (C):	Not Determined
Freezing Point/Range (F):	Not Determined
Freezing Point/Range (C):	Not Determined
Vapor Pressure @ 20 C (mmHg):	Not Determined
Vapor Density (Air=1):	Not Determined
Percent Volatiles:	Not Determined
Evaporation Rate (Butyl Acetate=1):	Not Determined
Solubility in Water (g/100ml):	Insoluble

9. PHYSICAL AND CHEMICAL PROPERTIES

Solubility in Solvents (g/100ml):	Not Determined
VOCs (lbs./gallon):	Not Determined
Viscosity, Dynamic @ 20 C (centipoise):	Not Determined
Viscosity, Kinematic @ 20 C (centistokes):	Not Determined
Partition Coefficient/n-Octanol/Water:	Not Determined
Molecular Weight (g/mole):	Not Determined

10. STABILITY AND REACTIVITY

Stability Data:	Stable
Hazardous Polymerization:	Will Not Occur
Conditions to Avoid	None anticipated
Incompatibility (Materials to Avoid)	Hydrofluoric acid
Hazardous Decomposition Products	Amorphous silica may transform at elevated temperatures to tridymite (870 C) or cristobalite (1470 C).
Additional Guidelines	Not Applicable

11. TOXICOLOGICAL INFORMATION

Principle Route of Exposure	Eye or skin contact, inhalation.
Inhalation	Inhaled crystalline silica in the form of quartz or cristobalite from occupational sources is carcinogenic to humans (IARC, Group 1). There is sufficient evidence in experimental animals for the carcinogenicity of tridymite (IARC, Group 2A). Breathing silica dust may cause irritation of the nose, throat, and respiratory passages. Breathing silica dust may not cause noticeable injury or illness even though permanent lung damage may be occurring. Inhalation of dust may also have serious chronic health effects (See "Chronic Effects/Carcinogenicity" subsection below).
Skin Contact	May cause mechanical skin irritation.
Eye Contact	May cause eye irritation.
Ingestion	None known
Aggravated Medical Conditions	Individuals with respiratory disease, including but not limited to asthma and bronchitis, or subject to eye irritation, should not be exposed to quartz dust.

Chronic Effects/Carcinogenicity	Silicosis: Excessive inhalation of respirable crystalline silica dust may cause a progressive, disabling, and sometimes-fatal lung disease called silicosis. Symptoms include cough, shortness of breath, wheezing, non-specific chest illness, and reduced pulmonary function. This disease is exacerbated by smoking. Individuals with silicosis are predisposed to develop tuberculosis. Cancer Status: The International Agency for Research on Cancer (IARC) has determined that crystalline silica inhaled in the form of quartz or cristobalite from occupational sources can cause lung cancer in humans (Group 1 - carcinogenic to humans) and has determined that there is sufficient evidence in experimental animals for the carcinogenicity of tridymite (Group 2A - possible carcinogen to humans). Refer to IARC Monograph 68, Silica, Some Silicates and Organic Fibres (June 1997) in conjunction with the use of these minerals. The National Toxicology Program classifies respirable crystalline silica as "Known to be a human carcinogen". Refer to the 9th Report on Carcinogens (2000). The American Conference of Governmental Industrial Hygienists (ACGIH) classifies crystalline silica, quartz, as a suspected human carcinogen (A2). There is some evidence that breathing respirable crystalline silica or the disease silicosis is associated with an increased incidence of significant disease endpoints such as scleroderma (an immune system disorder manifested by scarring of the lungs, skin, and other internal organs) and kidney disease.
Other Information	For further information consult "Adverse Effects of Crystalline Silica Exposure" published by the American Thoracic Society Medical Section of the American Lung Association, American Journal of Respiratory and Critical Care Medicine, Volume 155, pages 761-768 (1997).

Toxicity Tests

Oral Toxicity:	Not determined
Dermal Toxicity:	Not determined
Inhalation Toxicity:	Not determined
Primary Irritation Effect:	Not determined
Carcinogenicity	Refer to IARC Monograph 68, Silica, Some Silicates and Organic Fibres (June 1997).
Genotoxicity:	Not determined
Reproductive / Developmental Toxicity:	Not determined

12. ECOLOGICAL INFORMATION

Mobility (Water/Soil/Air)	Not determined
Persistence/Degradability	Not determined
Bio-accumulation	Not determined

Ecotoxicological Information

Acute Fish Toxicity:	TLM96: 10000 ppm (Oncorhynchus mykiss)
Acute Crustaceans Toxicity:	Not determined

Acute Algae Toxicity:	Not determined
Chemical Fate Information	Not determined
Other Information	Not applicable

13. DISPOSAL CONSIDERATIONS

Disposal Method	Bury in a licensed landfill according to federal, state, and local regulations.
Contaminated Packaging	Follow all applicable national or local regulations.

14. TRANSPORT INFORMATION

Land Transportation

DOT
Not restricted

Canadian TDG
Not restricted

ADR
Not restricted

Air Transportation

ICAO/IATA
Not restricted

Sea Transportation

IMDG
Not restricted

Other Transportation Information

Labels:	None

15. REGULATORY INFORMATION

US Regulations

US TSCA Inventory	All components listed on inventory or are exempt.
EPA SARA Title III Extremely Hazardous Substances	Not applicable
EPA SARA (311,312) Hazard Class	Acute Health Hazard Chronic Health Hazard
EPA SARA (313) Chemicals	This product does not contain a toxic chemical for routine annual "Toxic Chemical Release Reporting" under Section 313 (40 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.
California Proposition 65	The California Proposition 65 regulations apply to this product.
MA Right-to-Know Law	One or more components listed.
NJ Right-to-Know Law	One or more components listed.
PA Right-to-Know Law	One or more components listed.

Canadian Regulations

Canadian DSL Inventory	All components listed on inventory or are exempt.
WHMIS Hazard Class	Crystalline silica

16. OTHER INFORMATION

The following sections have been revised since the last issue of this SDS
Not applicable

Additional Information	For additional information on the use of this product, contact your local Halliburton representative. For questions about the Safety Data Sheet for this or other Halliburton products, contact Chemical Compliance at 1-580-251-4335.
Disclaimer Statement	This information is furnished without warranty, expressed or implied, as to accuracy or completeness. The information is obtained from various sources including the manufacturer and other third party sources. The information may not be valid under all conditions nor if this material is used in combination with other materials or in any process. Final determination of suitability of any material is the sole responsibility of the user.

END OF MSDS

Appendix C. Example of Biodegradable Polymer Additive MSDS (for Fluid Circulation Loss)

HALLIBURTON

SAFETY DATA SHEET

according to Regulation (EC) No. 453/2010

PAC™-LE

Revision Date: 25-Oct-2012 **Revision Number:** 6

1. IDENTIFICATION OF THE SUBSTANCE/MIXTURE AND OF THE COMPANY/UNDERTAKING

Product identifier

Product Name PAC™-LE

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

Recommended Use Fluid Loss Additive

Sector of use SU2 - Mining, (including offshore industries)

Product category PC20 - Products such as pH-regulators, flocculants, precipitants, neutralization agents, other unspecific

Process categories PROC4 - Use in batch and other process (synthesis) where opportunity for exposure arises

Uses Advised Against No information available

Details of the supplier of the safety data sheet

Halliburton Manufacturing Services, Ltd.
Halliburton House, Howemoss Crescent
Kirkhill Industrial Estate
Dyce
Aberdeen, AB21 0GN
United Kingdom

Emergency Phone Number: +44 1224 795277 or +1 281 575 5000

www.halliburton.com

For further information, please contact

E-Mail address: fdunexchem@halliburton.com

Emergency telephone number

+44 1224 795277 or +1 281 575 5000

Emergency telephone §45 - (EC)1272/2008	
Europe	112
Denmark	Poison Control Hotline (DK): +45 82 12 12 12
France	ORFILA (FR): + 01 45 42 59 59
Germany	Poison Center Berlin (DE): +49 030 30686 790
Italy	Poison Center, Milan (IT): +39 02 6610 1029
Netherlands	National Poisons Information Center (NL): +31 30 274 88 88 (NB: this service is only available to health professionals)
Norway	Poisons Information (NO):+ 47 22 591300
Poland	Poison Control and Information Centre, Warsaw (PL): +48 22 619 66 54; +48 22 619 08 97
Spain	Poison Information Service (ES): +34 91 562 04 20
United Kingdom	NHS Direct (UK): +44 0845 46 47

2. HAZARDS IDENTIFICATION

Classification of the substance or mixture

REGULATION (EC) No 1272/2008

Not classified

2. HAZARDS IDENTIFICATION

Classification according to EU Directives 67/548/EEC or 1999/45/EC
For the full text of the R-phrases mentioned in this Section, see Section 16

Classification Not Classified
Risk Phrases None

Label Elements
Not classified

Hazard Pictograms

Signal Word None

Contains

Substances Contains no hazardous substances
CAS Number Mixture

Other Hazards
Dust can form an explosive mixture in air

3. COMPOSITION/INFORMATION ON INGREDIENTS

Substances	EINECS	CAS Number	PERCENT	EEC Classification	EU - CLP Substance Classification	REACH No.
Contains no hazardous substances	Not applicable	Mixture	60 - 100%	Not applicable	Not applicable	No data available

For the full text of the R-phrases mentioned in this Section, see Section 16

4. FIRST AID MEASURES

Description of first aid measures

Inhalation If inhaled, remove from area to fresh air. Get medical attention if respiratory irritation develops or if breathing becomes difficult.
Eyes In case of contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention if irritation persists.
Skin Wash with soap and water. Get medical attention if irritation persists.
Ingestion Under normal conditions, first aid procedures are not required.

Most important symptoms and effects, both acute and delayed
No significant hazards expected.

Indication of any immediate medical attention and special treatment needed
Notes to Physician Treat symptomatically

5. FIREFIGHTING MEASURES

Extinguishing media
Suitable Extinguishing Media
Water fog, carbon dioxide, foam, dry chemical.

5. FIREFIGHTING MEASURES

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

Special hazards arising from the substance of mixture
Special Exposure Hazards
Organic dust in the presence of an ignition source can be explosive in high concentrations. Good housekeeping practices are required to minimize this potential.

Advice for firefighters
Special Protective Equipment for Fire-Fighters
Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.

6. ACCIDENTAL RELEASE MEASURES

Personal precautions, protective equipment and emergency procedures
Avoid creating and breathing dust.
See Section 12 for additional information

Environmental precautions
None known.

Methods and material for containment and cleaning up
Scoop up and remove.

Reference to other sections
See Section 12 for additional information.

7. HANDLING AND STORAGE

Precautions for Safe Handling
Avoid creating or inhaling dust. Avoid dust accumulations. Slippery when wet.
Hygiene Measures
Handle in accordance with good industrial hygiene and safety practice

Conditions for safe storage, including any incompatibilities
Store away from oxidizers. Store in a dry location. Product has a shelf life of 36 months.

Specific End Use(s)
Exposure Scenario No information available
Other Guidelines No information available

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Control parameters

Substances	EU	UK OEL	Netherlands	France OEL	Germany MAK/TRK
Contains no hazardous substances	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable

Substances	Italy	Poland	Hungary	Czech Republic	Denmark
Contains no hazardous substances	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable

Derived No Effect Level (DNEL) No information available.
Predicted No Effect Concentration (PNEC) No information available.

Exposure controls
Engineering Controls A well ventilated area to control dust levels. Local exhaust ventilation should be used in areas without good cross ventilation.

Personal protective equipment
Respiratory Protection Not normally needed. But if significant exposures are possible then the following respirator is recommended:
Dust/mist respirator. (N95, P2/P3)

Hand Protection	Normal work gloves.
Skin Protection	Normal work coveralls.
Eye Protection	Wear safety glasses or goggles to protect against exposure.
Other Precautions	None known.
Environmental Exposure Controls	No information available

9. PHYSICAL AND CHEMICAL PROPERTIES

Information on basic physical and chemical properties

Physical State:	Solid	**Color:**	White to off white
Odor:	Odorless	**Odor Threshold:**	No information available

Property Remarks/ Method	Values
pH:	6.5-9 (1%)
Melting Point/Range	No data available
Freezing Point/Range (C):	No data available
Boiling Point/Range	No data available
Flash Point	No data available
Evaporation rate	No data available
Vapor Pressure	No data available
Vapor Density	No data available
Specific Gravity	1.6
Water Solubility	Soluble in water
Solubility in other solvents	No data available
Partition coefficient: n-octanol/water	No data available
Autoignition Temperature	No data available
Decomposition Temperature	No data available
Viscosity	No data available
Explosive Properties	No information available
Oxidizing Properties	No information available

Other Information

VOC Content (%)	No data available

10. STABILITY AND REACTIVITY

Reactivity
Not applicable
Chemical Stability
Stable
Possibility of Hazardous Reactions
Will Not Occur
Conditions to Avoid
None anticipated
Incompatible Materials
Strong oxidizers.
Hazardous Decomposition Products
Carbon monoxide and carbon dioxide.

11. TOXICOLOGICAL INFORMATION

Information on Toxicological Effects
Acute Toxicity

Inhalation	May cause mild respiratory irritation.
Eye Contact	May cause mild eye irritation.
Skin Contact	May cause mild skin irritation.
Ingestion	None known

Chronic Effects/Carcinogenicity No data available to indicate product or components present at greater than 1% are chronic health hazards.

11. TOXICOLOGICAL INFORMATION

Substances	LD50 Oral	LD50 Dermal	LC50 Inhalation
Contains no hazardous substances	No data available	No data available	No data available

12. ECOLOGICAL INFORMATION

Toxicity
Ecotoxicity Effects

Substances	Toxicity to Algae	Toxicity to Fish	Toxicity to Microorganisms	Daphnia Magna (Water Flea)
Contains no hazardous substances	No information available	No information available	No information available	No information available

Persistence and degradability
Readily biodegradable

Bioaccumulative potential
No information available

Mobility in soil
No information available

Results of PBT and vPvB assessment
No information available.

Other adverse effects
Endocrine Disruptor Information
This product does not contain any known or suspected endocrine disruptors

13. DISPOSAL CONSIDERATIONS

Waste treatment methods
Disposal Method Bury in a licensed landfill according to federal, state, and local regulations.
Contaminated Packaging Follow all applicable national or local regulations.

14. TRANSPORT INFORMATION

IMDG/IMO
UN Number: Not restricted.
UN Proper Shipping Name: Not restricted
Transport Hazard Class(es): Not applicable

RID
UN Number: Not restricted.
UN Proper Shipping Name: Not restricted
Transport Hazard Class(es): Not applicable

ADR
UN Number: Not restricted.
UN Proper Shipping Name: Not restricted
Transport Hazard Class(es): Not applicable

Appendix 5
Drill Break Avoidance and Response Plan

BIFROST CABLE
DRILL BREAK AVOIDANCE & RESPONSE PLAN

Prepared for
Bifrost Subsea Fiber Optic Cable Project
Winema, Oregon Operations

August 19, 2022

Table of Contents

1. Introduction

The construction of the Bifrost Subsea Fiber Optic Cable Project (Project) includes the installation of a 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 try and avoid the LP becoming stuck, broken, or unrecoverable. The Plan also includes those measures that will take place to try and recover a stuck or broken pipe as sell as an abandonment plan should the pipe be unrecoverable. This Plan may be revised periodically.

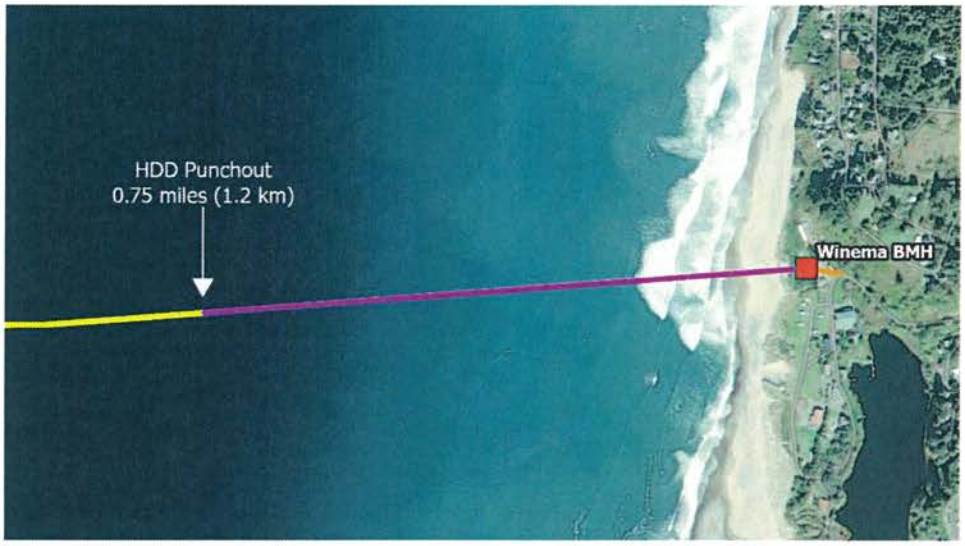

Figure 1: Bore extent from BMH to Exit Hole.

2. Baseline Conditions and Design Considerations

To inform the engineering design and the HDD implementation, a detailed geophysical and geotechnical investigative surveys will be conducted to identify the sub-terrain along the proposed LP alignment. These surveys will include both marine and terrestrial surveys:

1. Marine Surveys: The marine surveys will include utilization of a seismic subbottom profiler to determine the seafloor conditions and Electronic Resistivity Tomography (ERT) to better understand the subsurface geomorphology. These data will be collected in the ocean where the vessels can operate safely.
2. Terrestrial Survey: The terrestrial geotechnical surveys will include the use of ERT, multichannel analysis of surface waves (MASW), sonar, and geophysical drill exploration. The ERT and MASW will be conducted along the proposed LP alignment. The vertical drill will be conducted near the planned entry point for the LP. The sonar will be utilized down the horizontal drilled hole.

These data will be compiled into a comprehensive geotechnical report that will provide 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. 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" will be likely be installed for the first portion of the bore. The casing will be approximately 14-inches in diameter and will be up to 500 feet in length. The purpose of the casing it so provides 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.

3. Drill Break Avoidance Measures

The results from the geophysical survey will be used to finalize the 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 "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 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	Kevin.A.Herkamp@oprd.oregon.gov Cell: (971) 376-1509
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 head 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 local water well drilling requirements. The HDD operator will:

- Recommend the appropriate ground mixture to be used and submit it to the County for approval.
- Upon approval of the mixture, 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' 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 from reaching to the ocean shore.

Clean-up of Releases

The drill operator will promptly remove 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 released drilling fluid, the release area will be returned to its original condition to the greatest extent possible. If any removal equipment is to be located on the beach, the drill operator must contact Kevin Herkamp (OPRD) at (971) 376-1509 immediately for an emergency drive-on-beach permit.

7. Beach Void Monitoring and Response

Upon completion of the HDD operations, the potential for the presence of beach void holes will monitored for in the beach area west of Tax Lot 6200. Voids may be the result of sand collapsing into the space created by the removal of a 16-inch diameter guide casing that would used during the installation of the permanent bore pipe that would house the Bifrost cable.

During high tides, seawater can saturate the sand causing the sand to flow into any spaces created during removal of the 16-inch guide casing. This saturation could lead to the collapse of the sand above the former casing location and potentially create surface voids. 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.

Monitoring and Response

Upon completion of the HDD operations (~May 2023) and prior to landing the Bifrost cable (~September 2023), the beach area adjacent Tax Lot 6200 will be visually inspected by foot for the presence of voids.

If the Project team or a member of the public reports that any voids have formed in the sand, a designated Project representative, contractor, or subcontractor will immediately secure the area with cones, signage, temporary fencing, or tape to protect the public from entering the area ("Safety Warning"). These actions will be coordinated with OPRD (Kevin Herkamp; (971) 376-1509 as listed in **Table 1**).

Upon the void discovery, the Project team will submit a written report regarding the discovery to OPRD within three (3) business days of the discovery (a "Preliminary Report"). The Preliminary Report will provide at least the following information: (i) description of observed sink hole including size, diameter, and location on the beach; (ii) immediate responsive action taken onsite; and (iii) any further corrective action to be undertaken.

After installation of the "Safety Warning" and Preliminary Report, the Project team (or its designated representative, contractor, or subcontractor) in coordination with OPRD will decide on 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, the void will be filled by hand upon discovery. If a void is three (3) or more feet in diameter at its widest point, the Project team will fill in the void by hand and then follow up with additional sand compaction in the beach area west of Lot 6200.

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.

This plan expires seven (7) days after the landing of the Bifrost cable if no discoveries or events occur. If there are continued discoveries or events, the Project team and OPRD will coordinate on an appropriate extension of this plan.

DocuSign

Certificate Of Completion

Envelope Id: 2499A20488EB4267B995D5609091CEE3
Subject: Please DocuSign: Permit Application #1 - Tillamook County CUP
Source Envelope:
Document Pages: 190
Certificate Pages: 5
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Envelope Sent	Hashed/Encrypted	9/22/2022 8:54:56 AM
Certified Delivered	Security Checked	9/22/2022 11:29:33 AM
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