Knik Arm Tunnel Feasibility Study

PSA No. 25251013

Program No. HSHWY00029

Geotechnical Data Report and Statistical Summary

Prepared For:

State of Alaska Department of Transportation and Public Facilities, Northern Region

2301 Peger Road

Fairbanks, AK 99709

Prepared By:

Emprise Concepts

P.O. Box 384

Evergreen, CO 80437

August 29, 2025

Table of Contents:

Tables:

Figures:

1 INTRODUCTION

This report provides a statistical summary of available geotechnical data pertaining to the Knik Arm Tunnel Feasibility Study. Available geotechnical data were obtained from previously completed geotechnical investigations and geotechnical laboratory testing programs that were performed in the Knik Arm channel and the surrounding on-shore areas. Data was provided by the Alaska Department of Transportation and Public Facilities (DOT&PF). Detailed descriptions of the previous geotechnical studies that serve as the sources of the data contained in this report can be found in Emprise Concept's (Emprise) Geotechnical Data Summary report dated 15 April 2025.

The purpose of this report is to provide a factual, quantitative summary of the existing geotechnical data that may be used to assess feasibility and advance the design of the proposed Knik Arm Tunnel. Data interpretation in this report has been purposely minimized. A subsequent deliverable will be provided shortly after submitting this Geotechnical Data Report and Statistical Summary which will provide discussion and interpretation of the geological/geotechnical conditions present near the proposed Knik Arm Tunnel alignments, the uncertainty associated with these conditions, and recommendations for further geotechnical investigations and additional next steps necessary to advance the design of the Knik Arm Tunnel project.

1.1 Prior Studies

Prior geotechnical studies, along with existing sources of geotechnical data, related to the Knik Arm Crossing have been discussed in detail in Emprise's Geotechnical Data Summary report dated 15 April 2025. A brief summary of the previous studies performed in support of the Knik Arm Crossing is provided below:

Geotechnical studies related to the Knik Arm Crossing (KAC) have been performed previously, beginning in the early 1970s. The most recent geotechnical studies were conducted between 2004 and 2007. These studies have primarily focused on the feasibility and conceptual design of a bridge crossing. These studies are briefly discussed below:

Prior to the early 2000s, there are four known geotechnical studies performed north of Cairn Point to evaluate various alignment crossings. These studies are Dames & Moore, 1970, Alaska Department of Highways, 1970, Shannon & Wilson, 1971, and Harding Lawson Associates (HLA), 1984. These reports have not been provided or made available by DOT&PF, and are presumed to be limited in extent based on narratives in more recent reports.

In 2003, Parsons Brinckerhoff Construction Services, Inc./HDR Alaska, Inc. published a feasibility study for the Knik Arm Crossing evaluating both bridge and tunnel alternatives. The technological feasibility assessment relied on the existing geotechnical investigation data to-date and revealed broad gaps in geotechnical information. Geologic profiles and estimated ranges of geotechnical parameters for each of the soil units are derived from the previous studies and reported in this feasibility study.

In the early 2000s, a number of additional geotechnical investigations were conducted, focusing on the bridge alternative. In 2003, Shannon & Wilson conducted a field reconnaissance of a proposed new Alaska Railroad Corporation rail corridor extending from Port MacKenzie north to either Wasilla or Houston, Alaska. This study focused on near-surface geotechnical conditions, primarily outside of the study area for this tunnel feasibility study.

In 2004, Golder Associates performed an overwater geophysical survey with the purpose of mapping the thickness and characteristics of unconsolidated sediments overlying bedrock in the corridor being considered for a bridge crossing. Seismic refraction was performed to interpret subsurface features or boundaries, sediment thickness and depth to subsurface reflectors. A bathymetry survey was also conducted to map the seafloor.

A 2004 preliminary geotechnical report developed by Shannon & Wilson incorporates the Golder geophysical survey as well as field explorations and testing, surface reconnaissance and laboratory testing for the preliminary engineering analysis of the bridge pile foundations. The study provides an updated geological section as well as a preliminary ground response analysis of the site, a brief liquefaction evaluation, and a preliminary embankment stability evaluation.

The most recent geotechnical investigations in the Knik Arm Crossing corridor were conducted in 2007. The Geotechnical Data Report, Knik Arm Crossing (Shannon & Wilson 2007a), included an off-shore boring program, supported by cone penetration tests (CPT), shear wave measurements and in situ pressuremeter testing. Two on-shore borings were also completed to characterize the East and West shoreline soils. Site and regional tectonics and seismicity are also discussed in detail.

The Geotechnical Engineering Report, Knik Arm Crossing, Mat-Su Access Route (Shannon & Wilson, 2007b) presents the results of the geotechnical study for a road corridor accessing the west side of KAC. This study characterizes the general near-surface ground conditions along the approximately 13-mile alignment.

The Knik Arm Crossing Geotechnical Memorandum (Shannon & Wilson 2007c) summarizes the regional geology and geologic units present in the channel and on the shorelines. This memorandum also includes historical site investigation data that has not been provided in previous reports.

1.2 Current Scope of Work

As a part of the overall Knik Arm Tunnel Feasibility Study (PSA No. 25251013) scope, DOT&PF has requested an interpretation of the existing geologic/geotechnical conditions at the project site. This interpretation should focus on the feasibility of construction of the proposed Knik Arm Tunnel and should identify data gaps. Recommendations to reduce these data gaps, through further geotechnical site investigations or other methods should be provided. Prior to developing our interpretation of the existing geotechnical data and recommendations, it was necessary to digitize, perform a statistical analysis, and develop Engineering Soil Units (ESUs) for the existing geotechnical data, as summarized in this report. Our interpretations and recommendations will be presented in a forthcoming deliverable.

1.3 Report Organization

This summary report is organized into 7 main sections. Section 1 consists of general information regarding the project, prior studies, current scope of work, and the authorization and limitations of this report. Section 2 describes the site and project. Section 3 provides the regional and site-specific geology of the project area. Section 4 provides a summary of the sources of geotechnical data contained in this report. Section 5 presents the Engineering Soil Units (ESUs) for the project area that were developed using the available geotechnical data. Section 6 presents the geotechnical data summary and statistics for the ESUs. Conclusions are provided in Section 7.

1.4 Authorization

This work was performed in general accordance with our Subconsultant Agreement with Stantec Consulting Services Inc. with subsequent amendments aimed at completing an expanded work scope. Stantec and the project representatives from the DOT&PF approved the general scope of the geotechnical work for this report in the Statement of Services of the Prime contract (PSA No. 25251013).

1.5 Limitations

The available geotechnical site investigation data provided by DOT&PF was collected by others during previous geotechnical site investigations and was provided in PDF format. This available geotechnical data was digitized by Emprise as part of the scope of work of this contract. Where clear errors/erroneous data were observed in the provided geotechnical site investigation data, these errors were corrected if an obvious/unquestionable correction was available. Errors or erroneous data was otherwise omitted from the digitized data set. Aside from a quantitative, rule-based grouping of soils into ESUs, no interpretation of the geotechnical data is provided in this initial report. Any interpretive statements or claims attributed to other parties in this report do not necessarily reflect the views of Emprise Concepts or the project team.

2 SITE AND PROJECT DESCRIPTION

The Knik Arm Crossing aims to connect the west and east shore of Knik Arm, along with and an upland connection to existing roads north of Port MacKenzie. The following sections provide a description of the project and site, along with brief descriptions of the current alignment alternatives being considered.

2.1 Project Description

The purpose of the KAC is to provide an alternative transportation corridor to the Glenn Highway, connecting Anchorage with the Matanuska-Susitna Valley and further locations to the north and east. This report is part of a larger tunnel feasibility study being undertaken to address potential safety, mobility, and economic benefits associated with the proposed tunnel as an alternative to the existing Glenn Highway. The anticipated rise in commuter and freight traffic between Anchorage and the Matanuska-Susitna Borough, as well as the disruptions from seismic activity, bridge impacts, and increasing construction in recent years, underscores the need for alternative transportation corridors to strengthen the overall network in Southcentral Alaska.

2.2 Site Description

The Knik Arm is an extension of the upper Cook Inlet north of Anchorage, Alaska. Anchorage is the largest city in the state and accounts for roughly 40% of the state's population. Major transportation hubs for people and goods include the Port of Anchorage and the Ted Stevens Anchorage International Airport. Knik Arm is an approximately 34 mile long and 1.5- to 5-mile-wide body of water that is oriented approximately northeast-southwest. A vicinity map is provided on Figure 1.

Knik Arm is part of a glacial and tectonically active landscape and is influenced by glacial rivers like the Knik and Matanuska Rivers, which bring large sediment loads into the Knik Arm. It is characterized by strong currents, deep water and large tides. Extreme weather in the form of strong winds, winter storms, and sea ice are common. Tides are large and range between approximately Elevation +34.1 feet (MLLW Datum) at high tide and -6.1 feet at low tide

to a total maximum change of 40.2 feet. Visibility under water is generally limited to a few feet or less due to the presence of glacially derived fine-grained sediment.

A site map showing the proposed alternative alignments of the KAC (as of the date of this report) is provided in Figure 2. Currently, four (4) alternative alignments are proposed and being evaluated, with two potential Anchorage land side portal locations, and 2 potential Pt. MacKenzie land side portal locations.

3 SITE AND REGIONAL GEOLOGY

3.1 Regional Geology and Physiography

The project area exists within the physiographic province of the Cook Inlet-Susitna Lowland, which corresponds roughly with the Cook Inlet basin. The Cook Inlet basin is a major intermontane structural and physiographic basin about 200 miles long by 60 miles wide, of which about 70% is covered by the Cook Inlet (Schmoll, et al., 1999). Geographically, the Knik Arm forms the northern terminus of the Cook Inlet. The Cook Inlet basin is characterized by glaciated lowland containing areas of ground moraine, stagnant ice topography, drumlin fields, eskers, and outwash plains (Wahrhaftig, 1965). The Knik Arm is primarily fed by the Knik River and several other smaller streams and rivers that flow out of the Chugach Mountains to the east.

The Cook Inlet basin has fluctuated between terrestrial and estuarine environments during the Quaternary and has experienced a complex history of glaciation.

The surficial geology of the Cook Inlet basin is dominated by glacial, alluvial, and estuarian soils with minimal bedrock outcropping within the physiographic province. Surficial glacial soils are composed of glacial moraine, glacial outwash, marine, and lake deposits. The bedrock beneath the lowland consists of mainly Tertiary-aged, mildly deformed to flat lying, coal-bearing sedimentary rocks. The Tertiary-aged sedimentary rocks contain mostly fluviatile and alluvial sandstone, siltstone, claystone, and conglomerate (Magoon, et al., 1976; Winkler, 1992). The Cook Inlet basin is bounded by the Chugach and Kenai Mountains to the east-southeast, the Tordrillo Mountains to the west-northwest, and gently sloping uplands leading to the Talkeetna Mountains to the north.

The geologic conditions and existing topography present within the project area are predominately a result of several periods of recent glaciation. Several interpretations of glacial history and shoreline reconstruction within the Cook Inlet basin have evolved throughout the years, but the consensus is that glaciers from a variety of mountain sources, each situated differently with respect to the basin, have advanced into the Cook Inlet Basin throughout the Quaternary. At least 5 separate periods of glaciation have occurred within the upper Cook Inlet basin during the Quaternary, including the Mount Susitna Glaciation, Caribou Hills Glaciation, Eklutna Glaciation, Knik Glaciation, and the most-recent Naptowne Glaciation (most recent maximum advance of approximately 20,000 to 25,000 years ago) (Karlstrom, 1964).

Several major faults are present near the upper Cook Inlet basin/Knik Arm and the area has been subject to a history of large earthquakes. The over 600-mile-long Border Ranges fault roughly parallels the Chugach Mountains to the east of the Knik Arm and Anchorage, separating the Chugach Terrane from the Peninsular Terrane. A thrust fault (which has been referred to as the Knik Fault, the Eagle River Thrust Fault, and the Southern portion of the Border Ranges fault system) located within the Chugach Terrane, marks the boundary between the two most prominent rock

types of the western Chugach Mountains: the older McHugh Complex and the younger Valdez Group. The Castle Mountain Fault, located within the Peninsular Terrane to north of the Knik Arm has been active in recent times. The most prominent source of seismicity within the area is the Aleutian Megathrust, which forms the current subduction plate boundary between the North American and Pacific Plates. The Aleutian Megathrust has been responsible for both the 1964 magnitude 9.2 earthquake and the more recent 2018 magnitude 7.1 earthquake that both caused damage in Anchorage (Schmoll, et al., 1999; Liu, et al., 2019). A generalized geologic map of the Upper Cook Inlet region showing the location of major faults, is shown on Figure 3.

3.2 Site Geology

The geology of the project area is composed entirely of glacial, alluvial, and estuarian soils. Bedrock has been estimated by others to be at least 600 feet deep within the Knik Arm channel and is not anticipated to be encountered during any construction activities related to the Knik Arm Tunnel (Golder, 2004). A surficial geologic map of the project area is provided in Figure 4. Our understanding of the geology of the project site is solely based off review of publicly available geologic reports and maps, and prior site investigations in support of the KAC. In order from youngest to oldest, the most commonly encountered geologic units within the project area are recent (Holocene-aged) deposits, glacial deposits from the Naptowne Glaciation (approximately 4,000 to 45,000 years ago), and glacial deposits from the Knik Glaciation (approximately 45,000 to 85,000 years ago) (Karlstrom, 1964).

Holocene aged deposits include alluvium, estuarine deposits, landslide deposits, and fill. Alluvium is generally constrained to major rivers and adjacent terraces on the Anchorage side of the Knik Arm, such as Ship Creek and Cambell Creek. Estuarine deposits are present both within the Knik Arm tidal flats (modern deposits that are actively reworked daily by tides) and above the present-day zone of tidal activity (ancient deposits). Both types of estuarine deposits are generally composed of stratified silt and fine sand. Landslide deposits are common within the steep bluffs adjacent to the Knik Arm and Ship Creek. Additionally, landslides within the Bootlegger Cover Formation occurred during the 1964 earthquake and were studied extensively by others (Updike and Carpenter, 1986; Updike, et al., 1988; Varnes, 1969). Unmapped artificial fill is widespread on the Anchorage side of the Knik Arm and is also locally present on the Pt. MacKenzie side of the Knik Arm from development. Within the Knik Arm Channel, recent channel marine deposits composed of loose to medium-dense, silty to clean, fine sand have been encountered near the middle of the channel during previous KCA site investigations (Shannon & Wilson, 2007c).

Glacial deposits from the multiple advances of the Naptowne Glaciation make up the majority of the surficial soils deposits present on both the Anchorage and Pt. MacKenzie sides of the Knik Arm. At the maximum extent of the Naptowne Glaciation, the Knik and Matanuska glaciers converged and extended south into the present-day Knik Arm during the Elmendorf glacial advance (approximately 13,500 years ago), depositing a terminal moraine known as the Elmendorf Moraine. This moraine is present on both sides of the Knik Arm, with its southern extent located just south of the narrowest point of the Knik Arm, near Cairn Point (Reger, et al., 1995). Glacial outwash deposits are present to the south-southwest of the Elmendorf Moraine, while localized zones of glacioalluvium occur within the Elmendorf Moraine on the Anchorage side of the Knik Arm. Glacioestuarian deposits of medium to coarse sand are present to the south-southwest of the glacial outwash. The glacioestuarian deposit is commonly overlain by peat (Wilson, et al., 2009).

The Bootleggers Cove Formation (BCF) underlies the Elmendorf glacial advance deposits. The exact origins of the BCF have been disputed historically but are generally understood to be glacioestuarian in origin with possible glaciolacustrine origin near the top of the unit. The BCF is thought to have formed just prior to the Elmendorf glacial advance. The BCF is predominantly silty clay to clayey silt with some interbeds of silt and fine to medium sand. Some zones of the BCF are sensitive and are responsible for multiple landslides during the 1964 earthquake (Wilson, et al., 2009).

Additional soil deposits from the early Naptowne Glaciation and Knik Glaciation are not present as surficial soils within the project area but are understood to occur at depth underlying the younger Naptowne Glaciation deposits previously described. Previous geotechnical site investigations in support of the KAC have encountered the following units within the Knik Arm Channel (Shannon & Wilson, 2007c): glacial till or moraine deposits, glacial lake clays, marine or alluvial sands, and possible knik tills. To assess feasibility of the Knik Arm Tunnel, the geologic units present in the project area have been grouped into Engineering Soil Units (ESU) with similar geotechnical engineering properties. These ESUs are presented in Section 5 of this report.

4 EXISTING GEOTECHNICAL DATA SOURCES

DOT&PF-provided PDF reports and memorandums were reviewed to identify relevant existing geotechnical data. The following section provides a summary of the documents found to contain existing geotechnical data. The summary shows the type and quantity of available geotechnical data. Table 1 summarizes the PDF reports and memorandums containing geotechnical data applicable to the potential site. While additional reports included geotechnical data or information, they were excluded from Table 1 because the data pertained to locations too far from the potential site to be considered useful or were not applicable to assessing tunneling feasibility. For a detailed breakdown of all the geotechnical data available within the DOT&PF provided documents please refer to the Knik Arm Tunnel Feasibility Study Geotechnical Data Summary (2025) by Emprise Concepts.

All geotechnical data present in the documents listed in Table 1, including any appendices of these documents, were digitized and uploaded to a PostgreSQL, KAC database. The database was also exported and re-formatted to a generalized gINT format as an .XLSX file. This database can be provided in either format (PostgreSQL or gINT-formatted .XLSX) upon request.

4.1 Existing Geotechnical Data Limitations

CPT data for a total of seven CPTs were presented in the Preliminary Geotechnical Report – Knik Arm Bridge Project (2004) and the Geotechnical Data Report, Knik Arm Crossing (2007) in graphical PDF format. Tabular data that was able to be digitized was not available and as such the CPT has not been digitized, imported in the KAC geotechnical database, or used in the development of ESUs/discussed in this geotechnical data report. CPTs were performed adjacent to conventional geotechnical borings and appeared to correlate well with the stratigraphy encountered in the geotechnical borings.

Five 1D consolidation tests were performed on samples collected as part of the geotechnical site investigation discussed in the Preliminary Geotechnical Report – Knik Arm Bridge Project (2004). An additional five consolidation tests were performed on samples collected as part of the geotechnical site investigation discussed in the Geotechnical Data Report, Knik Arm Crossing (2007). Graphical plots of load vs displacement or load vs. void ratio were provided

in the geotechnical reports, but calculated consolidation parameters from these tests were not provided. As such, no consolidation parameters were able to be digitized or imported into the KAC geotechnical database.

Table 1: Geotechnical Data Summary of Documents Utilized

Document Title	Geotechnical Data									
	Year	**Boreholes [No.]**	**SPT [No.]**	**Atterberg Limit [No.]**	**Moisture Content [No.]**	**Gradation [No.]**	**Density [No.]**	**Consolidation [No.]**	**Strength Tests [No.]**	**CPT Data [No.]**
Preliminary Geotechnical Report - Knik Arm Bridge Project	**2004**	22	251	76	327	59	52	5	199	2
Geotechnical Data Report, Knik Arm Crossing	**2007**	25	493	65	567	67	37	3	604	5
Knik Arm Crossing Geotechnical Memorandum, 2007 – 01536-003 Knik Arm Crossing	**2005**	4	87	5	90	14	0	0	38	0
Knik Arm Crossing Geotechnical Memorandum, 2007 – 01622 Port MacKenzie Sand & Gravel Assessment	**2003**	3	13	1	7	6	0	0	0	0
Knik Arm Crossing Geotechnical Memorandum, 2007 – 01719 TOFC	**2005**	4	34	4	35	0	0	0	20	0
Knik Arm Crossing Geotechnical Memorandum, 2007 – Y-5693 Defense Fuels Support Point Site Characterization	**1997**	3	22	0	0	0	0	0	0	0
Knik Arm Crossing Geotechnical Memorandum, 2007 – A-517-2 Ingra Street Extension	**1994**	8	32	9	56	0	0	0	8	0
Knik Arm Crossing Geotechnical Memorandum, 2007 – Government Hill Slide	**1964**	6	13	312	386	0	0	0	358	0
Knik Arm Crossing Geotechnical Memorandum, 2007 – 1st Avenue Slide	**1964**	10	12	299	329	0	0	0	467	0

5 ENGINEERING SOIL UNITS (ESU)

Soils in the project vicinity include a diverse suite of soils from glacial, alluvial, and estuarian origins, as discussed in Section 3.2. The distribution of these soil types, combined with the geologic history of repeated glacial advances and retreats, has created a complex stratigraphy that influences both geotechnical conditions and engineering considerations in the project area.

In general, the material beneath and on the sides of the Knik Arm channel can be classified into six basic ESUs identified below:

1. Group 1 (LS – Loose Sand to Silty Sand): Corresponds to recent channel marine deposits and generally consists of loose, fine-grained sand. These deposits are mobile, and exhibit low penetration resistance, making them susceptible to liquefaction during strong seismic shaking.
2. Group 2 (DG – Dense Gravel): Associated with Knik till deposits or marine deposits and composed of dense, coarse-grained gravel. These deposits are interwoven within the other engineering soil units.
3. Group 3 (DS – Dense Sand to Silty Sand): Part of the marine/alluvial sands, typically dense and fine-grained interbeds.
4. Group 4 (F – Stiff to Hard Low-Plasticity Fines): Likely corresponds to glacial lake clays, consisting of low-plasticity silt and clay.
5. Group 5 (FG – Stiff to Hard Gravelly Fines): Related to glacial till or moraine deposits, containing gravelly, fine-grained soils with stiff to hard consistency.
6. Group 6 (PT – Peat): Localized deposits of organic peat material, typically weak and compressible and encountered at low depths.

The ESUs were determined by a rule-based classification scheme that considers the soil relative density or consistency (based upon SPT N1(60)), the USCS (considering primary soil type, particle size distribution, and presence of organic material), and secondary soil type. A summarized version of this classification is presented in Table 2. These ESUs provide a framework for evaluating geotechnical properties of subsurface materials across the project site.

Table 2: Engineering Soil Units (ESUs)

Group	Description	Acronym	SPT Range	SPT Description	USCS	Additional Requirements
1	Loose Sand and Silty Sand	LS	0-30	Very loose, very-loose, loose, medium dense, medium-dense	SM, SC, SP, SP-SM, SP-SC, SW, SW-SM, SW-SC	
2	Dense Gravel	DG	31+	Dense, very dense, very-dense	GM, GP, GP-GM, GW, GW-GM	
3	Dense Sand and Silty Sand	DS	31+	Dense, very dense, very-dense	SM, SC, SP, SP-SM, SP-SC, SW, SW-SM, SW-SC	
4	Stiff to Hard Low-Plasticity Fines	F	8+	Stiff, very stiff, very-stiff, hard	CL, CL-ML, ML	
5	Stiff to Hard Gravelly Fines	FG	8+	Stiff, very stiff, very-stiff, hard	CL, CL-ML, ML	Gravel supported by fines
6	Peat	PT	0+	-	PT	

6 EXISTING GEOTECHNICAL DATA SUMMARY AND STATISTICS

The subsurface geotechnical data was divided into three subgroups based upon location: Port MacKenzie land side, Anchorage land side, and overwater borings. The lithology encountered within the borings at each subgroup were classified into the ESUs described above, and available data was statistically analyzed using measures such as minimum, maximum, mean, median, standard deviation, 10th percentile, and 90th percentile.

This statistical evaluation included the following parameters:

- moisture content (Appendix A),
- bulk density (Appendix B),
- dry density (Appendix C),
- N60 corrected SPT (Appendix D),
- N1(60) corrected SPT (Appendix E),
- Atterberg limits: plasticity index and consistency index (Appendix F-G),
- Grain size analysis (Appendix H), and
- strength parameters: unconfined compressive stress, and undrained strength (Appendix I-J)

Summary results of the statistical evaluation are presented in tabular form in Tables 3 to 5. Detailed, graphical results of the statistical evaluation are provided in the figures in Appendix A through Appendix J. ESU Group 6 (PT) was excluded from these tables because only one data point exists for

this unit, with no associated laboratory testing results. Gradation results are included in the appendix figures but are not included in the summary tables.

6.1 Geotechnical Testing Methods

The geotechnical testing methods that were used to determine the previously listed parameters are discussed below to provide a summary of the testing methods and potential limitations. The geotechnical testing methods discussed below refer to the methods reported in the documents outlined in Table 1. Samples that were used for geotechnical testing were obtained through multiple methods, including: Standard Penetration Testing (SPT), Thin-walled tube sampling (i.e.: "Shelby tube"), grab sampling, soil coring, or direct push soil core.

- *Bulk Density and Dry Density*: Bulk density and dry density were determined as part of the testing process for Unconsolidated-Undrained (UU) Triaxial testing, Unconfined Compressive Strength (UCS) testing, and 1D Consolidation testing. Seven dry-density values were provided on boring logs in the 2004 and 2007 Shannon & Wilson (S&W) geotechnical reports that were determined by unknown methods. Bulk density accounts for both soil solids and moisture, while dry density considers only soil solids.
- *Moisture Content*: Moisture content was primarily determined by moisture content testing. Moisture content testing is generally performed in accordance with ASTM D2216, Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass. This test method determines the natural moisture content of soils by measuring the mass of water lost after oven drying. Additional moisture content values were determined by UU Triaxial testing, UCS testing, and 1D Consolidation testing. Where more than one moisture content value was reported for one soil sample, the value obtained from moisture content testing was selected as the value to use in the KAC geotechnical database. If no moisture content testing was performed on a soil sample, the average of the values determined from UU Triaxial testing, UCS testing, and 1D Consolidation testing were averaged (where available) and the average moisture content was selected as the value to use in the KAC geotechnical database.
- *Atterberg Limits:* Atterberg limits, including the liquid limit, plastic limit, and plasticity index, are generally determined by the testing procedure outlined in ASTM D4318, Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils. The Atterberg limits describe the consistency and behavior of fine-grained soils across moisture ranges. The consistency index, derived from the Atterberg limits and the natural water content, indicates the relative firmness of cohesive soils. These tests are used for soil classification, for determining clogging potential during tunneling, and to assess shrink-swell potential.
- *Standard Penetration Testing (SPT)*: SPT testing is generally performed by the approach provided in ASTM D1586, Standard Test Method for Standard Penetration Test (SPT) and Split-Barrel Sampling of Soils, describes the procedure for driving a split-spoon sampler into the soil using a calibrated hammer and recording the number of blows (N) over one foot of penetration.

SPT sampling provides a relative measure of soil density or consistency, is commonly correlated with soil strength and deformation parameters, and is a common method to obtain disturbed soil samples. SPT sampling generally uses a 140-lb hammer that is dropped from a height of 30-inches to drive a 2-inch diameter OD split-spoon sampler into the soil. A modified version of SPT sampling that can be beneficial in obtaining soil samples in gravelly soils used a 300-lb or 340-lb hammer and 3-inch diameter OD split spoon sampler. Both the standard and modified versions of SPT sampling were used to collect soil samples and geotechnical data reported in the documents in Table 1. The field-obtained "N" value is often corrected for several external factors to obtain two additional parameters: N60 and N1,60.

  - *N60*: SPT N60 corrects the SPT N value for hammer efficiency, which can be estimated by hammer type, or can be measured directly.
  - *N1(60)*: SPT N1(60) further corrects SPT N60 for length of drill rod, borehole diameter, sampler liner, and to a standard overburden pressure of 100 kPa.

- *Gradation:* Soil gradation testing involves determining the particle size distribution of a soil, along with several additional coefficients, and is used for soil classification. The particle size distribution for coarse-grained soils is generally determined in accordance with ASTM D6913, Standard Test Methods for Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis. This method provides the particle size distribution for soil particles larger than 0.075 mm. To determine the particle size distribution for fine-grained soils (smaller than 0.075 mm), a test method that uses a hydrometer is required. Only sieve-based gradations were reported in the documents used to develop the KAC geotechnical database.
- *Soil Strength Tests*: A combination of field and laboratory-based soil strength tests were used to determine the Unconfined Compressive Strength (UCS) and undrained shear strength of generally fine-grained soil samples:
  - *Pocket Penetrometer:* The pocket penetrometer is a simple field device, that does not have an ASTM standard associated with it. It is used to estimate the unconfined compressive strength of cohesive soils. This is done by pressing a calibrated piston into the soil surface. It provides a quick result, making it useful for preliminary evaluations of the in-situ soil conditions. The maximum reading of the pocket penetrometer unconfined compressive strength used in this statistical summary is 4.5 tons per square foot (tsf). The undrained shear strength of a soil can be determined by diving the unconfined compressive strength by two, therefore the maximum undrained shear strength reading that can be obtained with the pocket penetrometer used in this statistical summary is 2.25 tsf. Soils with strength above this range cannot be accurately measured. The pocket penetrometer is sensitive to soil disturbance.
  - *Torvane*: A torvane shear device is a simple field device that does not have an ASTM standard associated with it. It measures the undrained shear strength of cohesive soils by rotating a small vane inserted into the soil surface until failure occurs. It is portable and very easy to use, making it useful for preliminary evaluations of the in-situ soil conditions. The maximum undrained shear strength reading obtained with a torvane

used in this statistical summary is 2.5 tsf. Torvane results included in this report were obtained predominantly on undisturbed (Shelby tube) soil samples and included shear strength data from tests performed along the vertical axis of the sample., along the horizontal axis of the sample, and on remolded specimens.

- *Laboratory Vane Shear:* This laboratory-based test follows the procedure outlined in ASTM D4648, Standard Test Method for Laboratory Miniature Vane Shear Test for Saturated Fine-Grained Soils, determines the undrained shear strength of soft cohesive soils in the lab using a miniature vane device. Generally, this test should not be used as a standalone measure due to disturbance and sample quality. Typically, vane shear strength should be calibrated against Unconsolidated-Undrained Triaxial data or Unconfined Compression Strength. The maximum undrained shear strength reading obtained with a lab vane used in this statistical summary is 1 tsf.
- *Unconfined Compressive Strength (UCS):* The UCS of a cohesive soil is determined by the procedure provided in ASTM D2166, Standard Test Method for Unconfined Compressive Strength of Cohesive Soil, which measures the axial compressive strength of soils without lateral confinement, providing a simple and cost-effective estimate of the unconfined compressive strength and the undrained shear strength. It is not suitable for granular, or non-cohesive soils.
- *Unconsolidated-Undrained (UU) Triaxial:* The UU triaxial test is a common geotechnical laboratory test used to determine the undrained shear strength of a cohesive soil. This test generally follows the procedure provided in ASTM D2850, Standard Test Method for Unconsolidated-Undrained Triaxial Compression Test on Cohesive Soils. This test determines the undrained shear strength of soils under triaxial loading conditions where drainage is not permitted. This test is used as a tool to evaluate the strength of soil under short-term loading conditions such as during construction or rapid loading. Its main limitation is that it does not represent long-term drained behavior. Results can vary depending on strain rate, and are sensitive to sample disturbance.

Table 3: Geotechnical Data Summary for Port MacKenzie Borings

Parameter / Property	ESU Group / Acronym				
	1 / LS	2 / DG	3 / DS	4 / F	5 / FG
Total Unit Weight (pcf) Lowest Measured / Mean / Highest Measured Standard Deviation / Number of Tests	NA	NA	NA	NA	NA
Dry Unit Weight (pcf) Lowest Measured / Mean / Highest Measured Standard Deviation / Number of Tests	NA	NA	NA	NA	NA
Moisture Content (%) Lowest Measured / Mean / Highest Measured Standard Deviation / Number of Tests	3 / 10.7 / 18 6.5 / 6	2 / 4.1 / 8 2 / 11	3 / 13.9 / 24 7.1 / 39	11 / 20 / 25 3.6 / 18	5 / 12 / 21 3.7 / 59
Liquid Limit (%) Lowest Measured / Mean / Highest Measured Standard Deviation / Number of Tests	NA	NA	NA	32 / 36 / 43 4.7 / 5	34 / 34 / 34 - / 1
Plastic Limit (%) Lowest Measured / Mean / Highest Measured Standard Deviation / Number of Tests	NA	NA	NA	18 / 20 / 21 1.3 / 5	15 / 15 / 15 - / 1
Plasticity Index (%) Lowest Measured / Mean / Highest Measured Standard Deviation / Number of Tests	NA	NA	NA	13 / 16 / 22 4.1 / 5	19 / 19 / 19 - / 1
Unconfined Compressive Stress (tsf) Lowest Measured / Mean / Highest Measured Standard Deviation / Number of Tests	NA	NA	NA	NA	NA
Undrained Strength from Triaxial UU (tsf) Lowest Measured / Mean / Highest Measured Standard Deviation / Number of Tests	NA	NA	NA	NA	NA
Undrained Strength from all test sources (tsf) Lowest Measured / Mean / Highest Measured Standard Deviation / Number of Tests	NA	NA	0.85 / 1.24 / 2 0.3 / 13	2.25 / 2.25 / 2.25 0 / 13	1.25 / 2.08 / 2.25 0.3 / 35
SPT (blow counts) Lowest Measured / Mean / Highest Measured Standard Deviation / Number of Tests	14 / 23 / 38 10 / 7	29 / 85 / 180 43 / 10	2 / 70 / 180 47 / 40	35 / 48 / 57 7 / 18	35 / 65 / 300 48 / 60
SPT Corr N60 (blow counts) Lowest Measured / Mean / Highest Measured Standard Deviation / Number of Tests	14 / 26 / 43 11 / 7	29 / 101 / 240 62 / 10	2 / 91 / 240 62 / 40	47 / 64 / 76 10 / 18	47 / 85 / 400 63 / 60
SPT Corr N1(60) (blow counts) Lowest Measured / Mean / Highest Measured Standard Deviation / Number of Tests	17 / 33 / 56 14 / 7	37 / 97 / 155 38 / 10	4 / 55 / 165 40 / 40	17 / 29 / 51 9 / 18	21 / 57 / 182 35 / 60

Table 4: Geotechnical Data Summary for Anchorage Borings

Parameter / Property	ESU Group / Acronym				
	1 / LS	2 / DG	3 / DS	4 / F	5 / FG
Total Unit Weight (pcf) Lowest Measured / Mean / Highest Measured Standard Deviation / Number of Tests	NA	NA	NA	NA	NA
Dry Unit Weight (pcf) Lowest Measured / Mean / Highest Measured Standard Deviation / Number of Tests	NA	NA	NA	NA	NA
Moisture Content (%) Lowest Measured / Mean / Highest Measured Standard Deviation / Number of Tests	2 / 14 / 29 8.7 / 39	17 / 21.7 / 24 2.7 / 6	10.9 / 21.5 / 30 5.4 / 27	8 / 29.2 / 65 5.2 / 708	8.2 / 16 / 32.2 5.6 / 23
Liquid Limit (%) Lowest Measured / Mean / Highest Measured Standard Deviation / Number of Tests	37 / 37 / 37 - / 1	NA	30 / 37 / 41 6.1 / 3	21 / 37 / 56 7.7 / 604	23 / 28 / 33 4.1 / 6
Plastic Limit (%) Lowest Measured / Mean / Highest Measured Standard Deviation / Number of Tests	20 / 20 / 20 - / 1	NA	19 / 20 / 20 0.6 / 3	14 / 21 / 46 3.3 / 604	13 / 16 / 19 2.0 / 6
Plasticity Index (%) Lowest Measured / Mean / Highest Measured Standard Deviation / Number of Tests	17 / 17 / 17 - / 1	NA	11 / 17 / 21 5.5 / 3	1 / 15 / 30 5.3 / 604	8 / 12 / 16 2.9 / 6
Unconfined Compressive Stress (tsf) Lowest Measured / Mean / Highest Measured Standard Deviation / Number of Tests	NA	NA	NA	NA	NA
Undrained Strength from Triaxial UU (tsf) Lowest Measured / Mean / Highest Measured Standard Deviation / Number of Tests	NA	NA	NA	NA	NA
Undrained Strength from all test sources (tsf) Lowest Measured / Mean / Highest Measured Standard Deviation / Number of Tests	0.25 / 1.3 / 2.25 0.79 / 5	NA	0.55 / 0.77 / 1 0.2 / 8	0.13 / 0.64 / 2.25 0.2 / 802	NA
SPT (blow counts) Lowest Measured / Mean / Highest Measured Standard Deviation / Number of Tests	0 / 13 / 30 8 / 45	8 / 46 / 100 35 / 22	13 / 40 / 89 19 / 19	0 / 23 / 200 35 / 44	9 / 38 / 81 20 / 23
SPT Corr N60 (blow counts) Lowest Measured / Mean / Highest Measured Standard Deviation / Number of Tests	0 / 15 / 38 9 / 45	8 / 41 / 100 32 / 22	13 / 47 / 113 25 / 19	0 / 28 / 253 45 / 44	9 / 45 / 103 26 / 23
SPT Corr N1(60) (blow counts) Lowest Measured / Mean / Highest Measured Standard Deviation / Number of Tests	0 / 18 / 49 11 / 45	6 / 38 / 91 28 / 22	7 / 44 / 103 24 / 19	0 / 24 / 204 34 / 44	12 / 49 / 95 22 / 23

Note: Reported Atterberg limits for cohesionless ESUs (LS, DS) are from minor fine-grained interbeds.

Table 5: Geotechnical Data Summary for Overwater Borings

Parameter / Property	ESU Group / Acronym				
	1 / LS	2 / DG	3 / DS	4 / F	5 / FG
Total Unit Weight (pcf) Lowest Measured / Mean / Highest Measured Standard Deviation / Number of Tests	NA	NA	125 / 128 / 129 2.4 / 3	94 / 129 / 162 10.3 / 52	121 / 131 / 149 6.4 / 28
Dry Unit Weight (pcf) Lowest Measured / Mean / Highest Measured Standard Deviation / Number of Tests	NA	141 / 144 / 150 4.2 / 4	104 / 106 / 107 1.5 / 3	74 / 104 / 132 10.5 / 54	91 / 107 / 124 8.9 / 28
Moisture Content (%) Lowest Measured / Mean / Highest Measured Standard Deviation / Number of Tests	11.4 / 25 / 31.2 4.8 / 30	1.1 / 9.4 / 29 5.2 / 57	6.4 / 22.6 / 46.1 6.5 / 248	11.6 / 23 / 44.5 3.8 / 309	5 / 19.7 / 34 7 / 175
Liquid Limit (%) Lowest Measured / Mean / Highest Measured Standard Deviation / Number of Tests	NA	24 / 24 / 24 - / 1	27 / 36 / 40 6.2 / 6	20 / 37 / 47 5.9 / 71	12 / 30 / 46 8.6 / 56
Plastic Limit (%) Lowest Measured / Mean / Highest Measured Standard Deviation / Number of Tests	NA	16 / 16 / 16 - / 1	14 / 20 / 24 3.4 / 6	13 / 19 / 24 2 / 71	11 / 17 / 23 3 / 56
Plasticity Index (%) Lowest Measured / Mean / Highest Measured Standard Deviation / Number of Tests	NA	8 / 8 / 8 - / 1	3 / 16 / 20 6.5 / 6	3 / 17 / 24 4.5 / 71	0 / 13 / 23 6.2 / 56
Unconfined Compressive Stress (tsf) Lowest Measured / Mean / Highest Measured Standard Deviation / Number of Tests	NA	NA	3.0 / 3.1 / 3.2 - / 2	0.54 / 3.91 / 10.0 2.3 / 37	0.6 / 2.78 / 5.4 1.4 / 17
Undrained Strength from Triaxial UU (tsf) Lowest Measured / Mean / Highest Measured Standard Deviation / Number of Tests	NA	NA	2.1 / 2.1 / 2.1 - / 1	1.15 / 3.05 / 4.75 1.3 / 12	0.75 / 1.71 / 4.15 1.2 / 7
Undrained Strength from all test sources (tsf) Lowest Measured / Mean / Highest Measured Standard Deviation / Number of Tests	1.5 / 1.5 / 1.5 - / 1	NA	0.5 / 1.53 / 2.25 0.5 / 15	0.09 / 1.6 / 5 0.6 / 504	0.2 / 1.42 / 4.15 0.6 / 184
SPT (blow counts) Lowest Measured / Mean / Highest Measured Standard Deviation / Number of Tests	0 / 14 / 36 10 / 36	8 / 119 / 432 73 / 75	0 / 59 / 246 41 / 255	0 / 57 / 300 41 / 197	5 / 76 / 600 84 / 105
SPT Corr N60 (blow counts) Lowest Measured / Mean / Highest Measured Standard Deviation / Number of Tests	0 / 16 / 48 11 / 36	10 / 149 / 432 87 / 75	0 / 77 / 328 54 / 255	0 / 75 / 400 55 / 197	5 / 100 / 800 112 / 105
SPT Corr N1(60) (blow counts) Lowest Measured / Mean / Highest Measured Standard Deviation / Number of Tests	0 / 23 / 66 15 / 36	10 / 109 / 535 83 / 75	0 / 52 / 234 38 / 255	0 / 43 / 222 30 / 197	7 / 55 / 367 48 / 105

Note: Reported Atterberg limits for cohesionless ESUs (LS, DS) are from minor fine-grained interbeds.

7 CONCLUSIONS

This report provides a statistical summary of available geotechnical data pertaining to the Knik Arm Tunnel Feasibility Study. Available geotechnical data were obtained from previously completed geotechnical investigations and geotechnical laboratory testing programs that were performed in the Knik Arm channel and the surrounding onshore areas. Detailed descriptions of the previous geotechnical studies that serve as the sources of the data contained in this report can be found in Emprise Concept's (Emprise) Geotechnical Data Summary report dated 15 April 2025. Geotechnical data from the previous geotechnical studies was digitized and added to a KAC geotechnical database.

Six Engineering Soil Units (ESUs) were determined using a rule-based classification scheme that considers the soil relative density or consistency (based upon SPT N1,60), the USCS (considering primary soil type, particle size distribution, and presence of organic material), and secondary soil type. The geotechnical data was divided into three subgroups based upon location: Port MacKenzie land side, Anchorage land side, and overwater borings. The lithology encountered within the borings at each subgroup were classified as one of the six ESUs and available data was statistically analyzed, tabulated, and plotted.

The purpose of this report is to provide a factual, quantitative summary of the existing geotechnical data that may be used to assess feasibility and advance the design of the proposed Knik Arm Tunnel. Data interpretation in this report has been purposely minimized.

8 REFERENCES

Alaska Department of Highways, 1970, Report of Preliminary Field and Laboratory Soils Data, Knik Arm, Project No. X12750, December.

Dames & Moore, 1970, Report of Seismic Reflection Survey, Proposed Knik Arm Highway Crossing for the State of Alaska Department of Highways, December.

Golder Associates, 2004, Knik Arm Geophysical Investigation, February.

Harding Lawson Associates, 1984, Geologic and Geotechnical Considerations, Knik Arm Crossing, Anchorage, Alaska , HLA Job No. 9620,016.08, November.

Karlstrom, T. N. V., 1964, Quaternary Geology of the Kenai Lowland and Glacial History of the Cook Inlet Region, Alaska, U.S. Geological Survey Professional Paper 443.

Liu, C. & Lay, T. & Xie, Z. & Xiong, X, 2019, Intraslab deformation in the 30 November 2018 Anchorage, Alaska, M_W 7.1 earthquake, Geophysical Research Letters, Volume 46, Issue 5, pgs. 2449–2457.

Magoon, L. B. & Adkison, W. L. & Egbert, R. M., 1976, Map Showing Geology, Wildcat Wells, Tertiary Plant Fossil Localities, K-Ar Age Dates, and Petroleum Operations, Cook Inlet Area, Alaska, U.S. Geological Survey Misc. Investigation Series Map I-1019, Scale 1:250,000.

Parsons Brinckerhoff/HDR Alaska, Inc., 2003, Knik Arm Crossing Engineering Feasibility and Cost Estimate Update, January 31.

Reger, R.D. & Combellick, R.A. & Brigham-Grette, J., 1995, Late-Wisconsin events in the Upper Cook Inlet region, southcentral Alaska, Short Notes on Alaska Geology 1995, State of Alaska Department of Natural Resources, Division of Geological and Geophysical Surveys.

Schmoll, H.R. & Yehle, L.A. & Updike, R.G., 1999, Summary of Quaternary Geology of the Municipality of Anchorage, Alaska, Quaternary International, Volume 60, pgs. 3-36, U.S. Geological Survey.

Shannon & Wilson, Inc., 1971, Geologic and Engineering Reconnaissance, Proposed Knik Arm Crossing, Anchorage, Alaska, August.

Shannon & Wilson, Inc., 2003, Reconnaissance Geotechnical Report, Mat-Su Rail Corridor, Mat-Su Valley, Alaska, June.

Shannon & Wilson, Inc., 2004, Preliminary Geotechnical Report, Knik Arm Bridge Project, February.

Shannon & Wilson, Inc., 2007a, Geotechnical Data Report, Knik Arm Crossing, Knik Arm, Alaska, March.

Shannon & Wilson, Inc., 2007b, Geotechnical Engineering Report, Knik Arm Crossing, Mat-Su Access Route, Point MacKenzie, Alaska, March.

Shannon & Wilson, Inc., 2007c, Knik Arm Crossing Geotechnical Memorandum, March.

Updike, R. G. & Carpenter, B. A., 1986, Engineering Geology of the Government Hill Area, Anchorage, Alaska, U.S. Geological Survey Bulletin 1588.

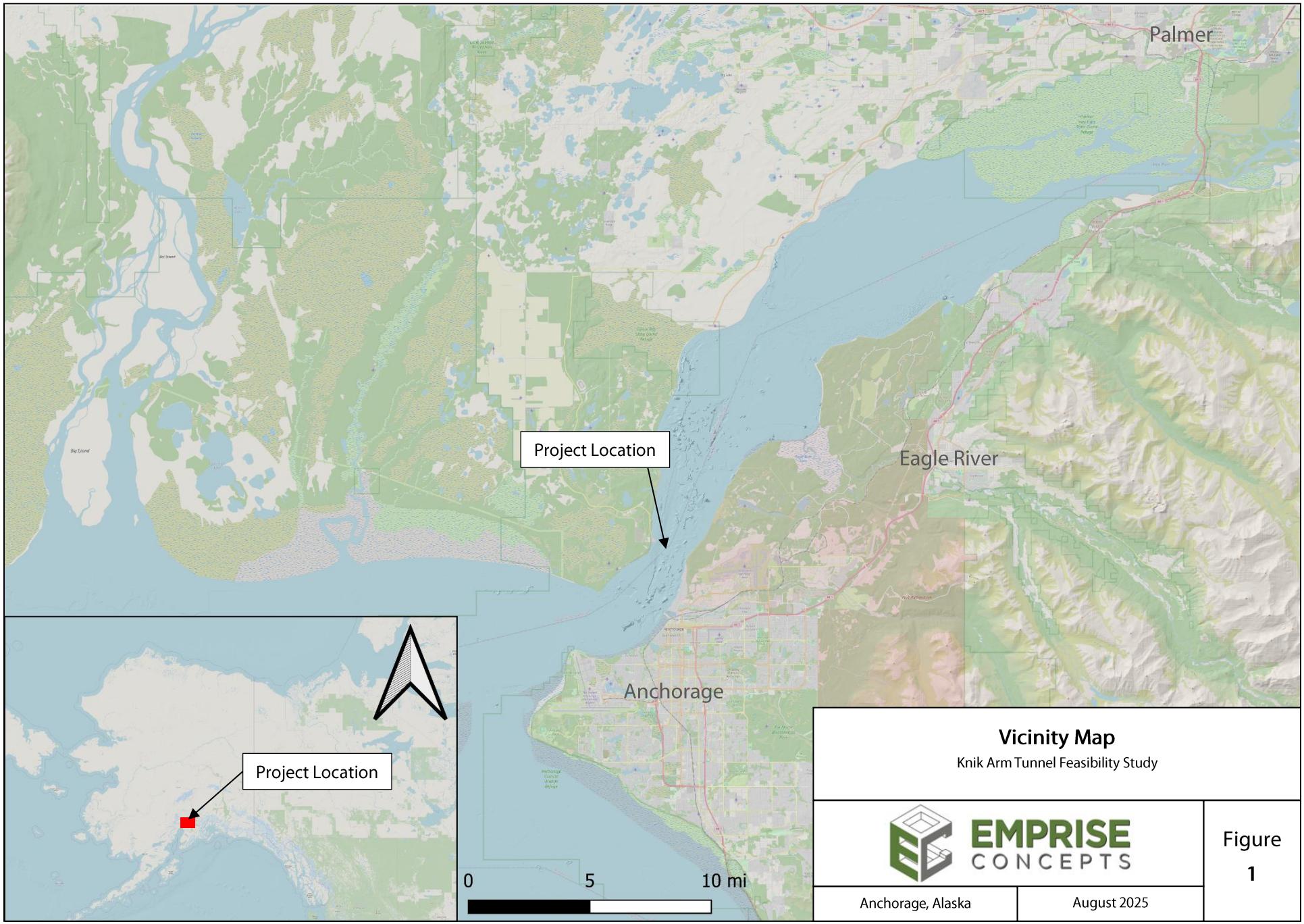
Updike, R. G. & Olsen, H.W. & Schmoll, H. R. & Kharaka, Y. K. & Stokoe II K. H., 1988. Geologic and Geotechnical Conditions Adjacent to the Turnagain Heights Landslide, Anchorage, Alaska, U.S. Geological Survey Bulletin 1817.

Varnes, D. J., 1969, Stability of the west slope of Government Hill port area of Anchorage, Alaska, U.S. Geological Survey Bulletin 1258-D, p. D1-D61.

Wahrhaftig, C., 1965, Physiographic Divisions of Alaska, U.S. Geological Survey Professional Paper 482, Scale 1:2,500,000.

Wilson, F.H & Hults, C.P. & Scholl, H.R. & Haeussler, P.J. & Schmidt, J.M. & Yehle, L.A. & Labay, K.A., 2009, Preliminary Geologic Map of the Cook Inlet Region, Alaska, Including parts of the Talkeetna, Talkeetna Mountains, Tyonek, Anchorage, Lake Clark, Seard, Illiamna, Seldovia, Mount Katmai, and Afognak 1:250,000-scale quadrangles, United States Geological Survey Open-File Report 2009-1108, Scale 1:250,000.

Winkler, G. R, 1992, Geologic Map and Summary Geochronology of the Anchorage Quadrangle, Southern Alaska, U.S. Geological Survey Misc. Investigation Series Map I-2283, Scale 1:250,000.



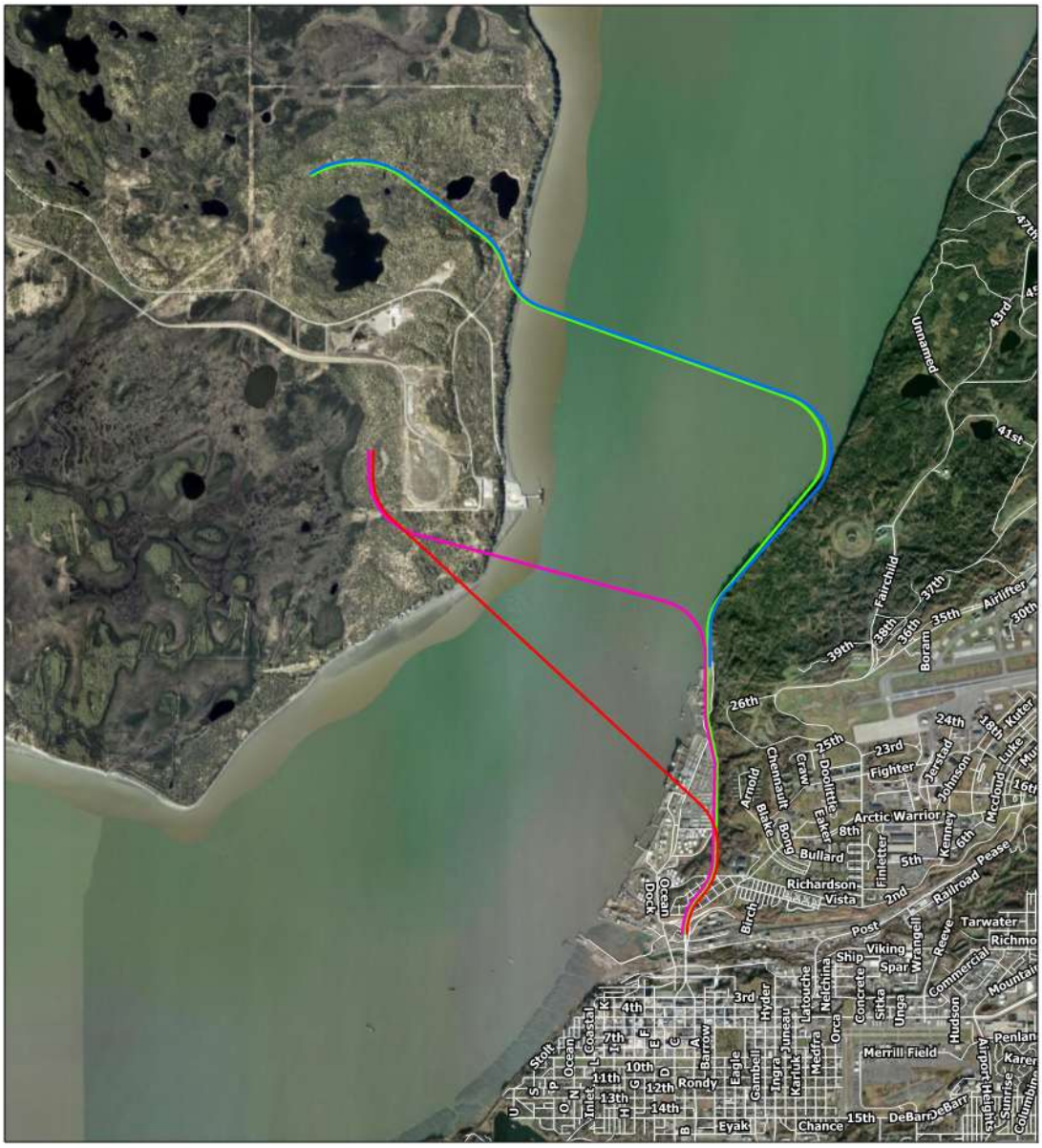
Vicinity Map

Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure 1



Source: Stantec, 08/2025

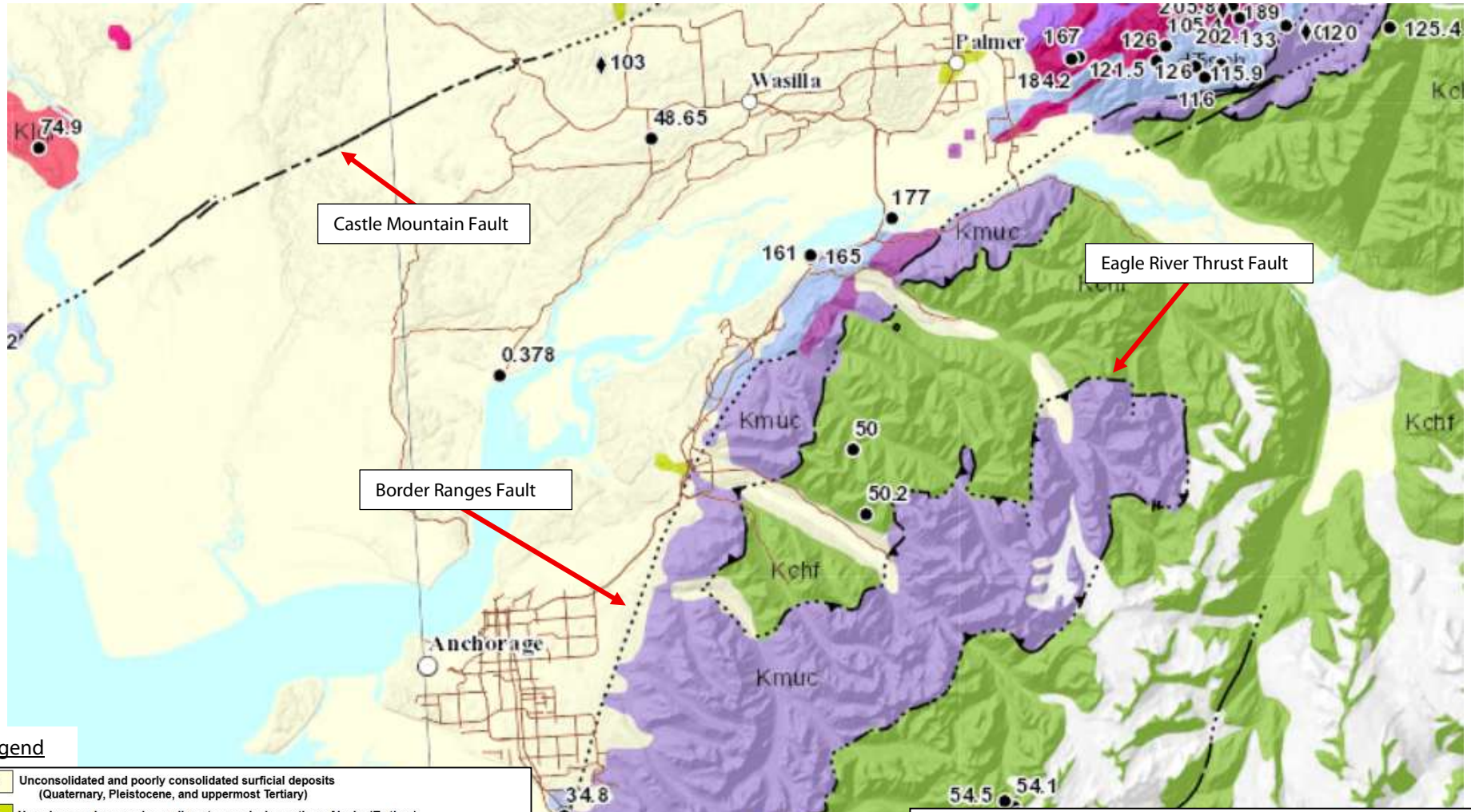
Site Map

Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure 2



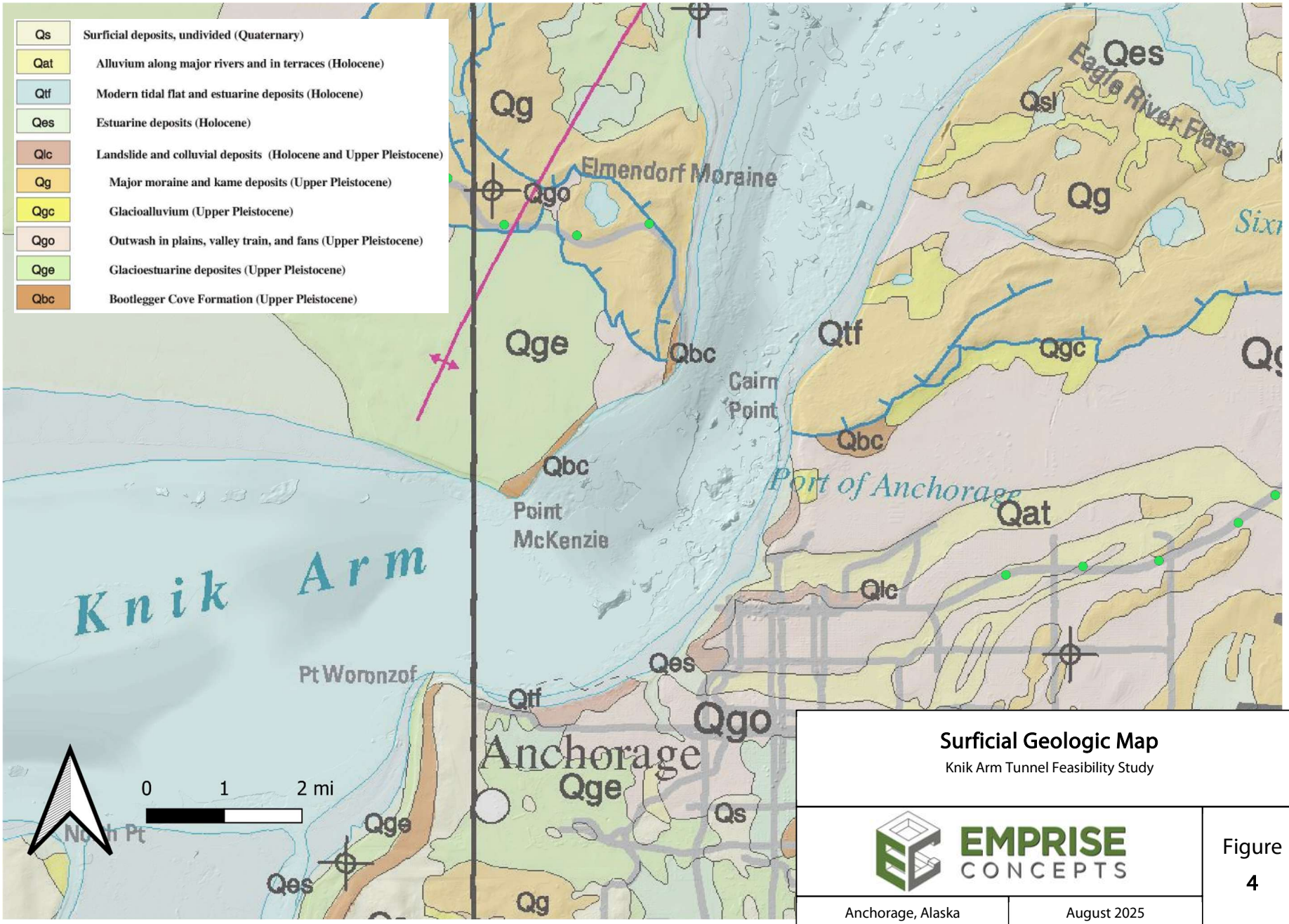
Regional Geologic and Fault Map

Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure 3



Surficial Geologic Map

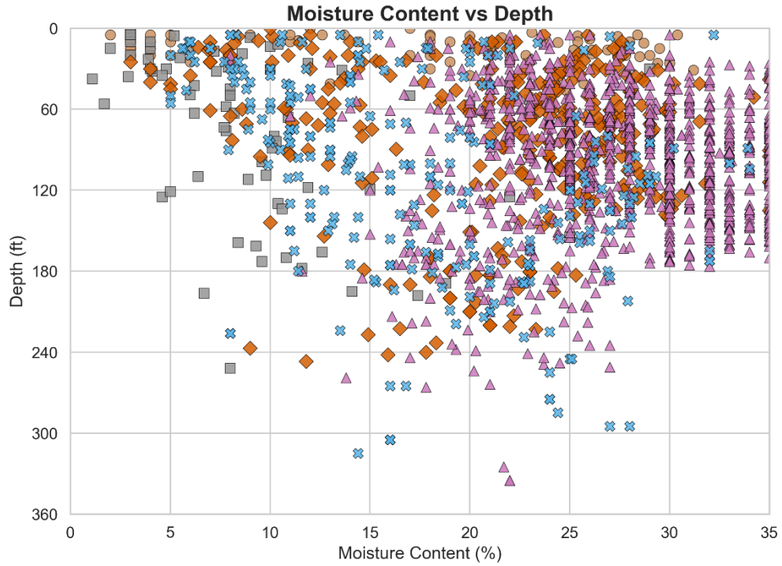
Knik Arm Tunnel Feasibility Study

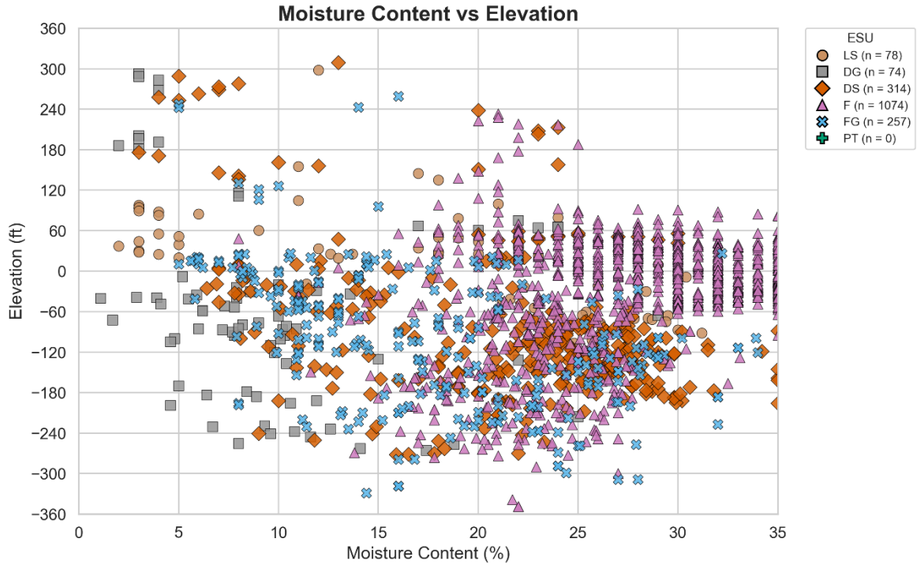
EMPRISE CONCEPTS

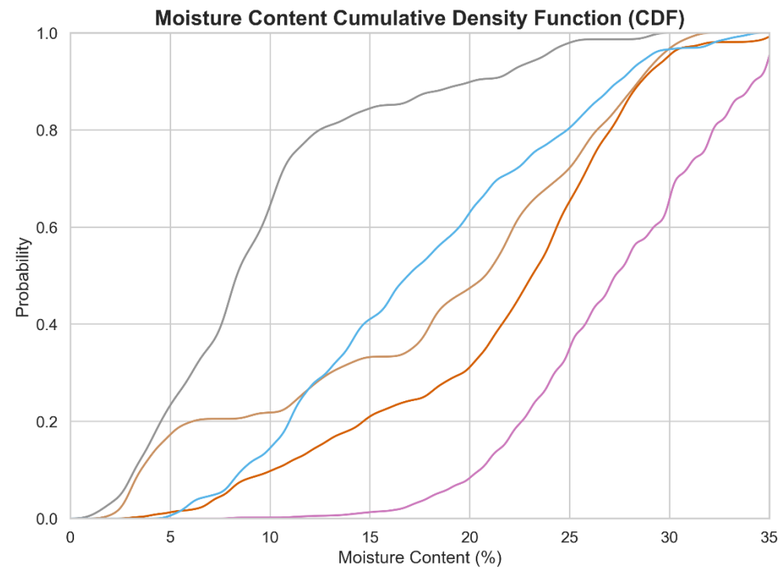
Anchorage, Alaska | August 2025

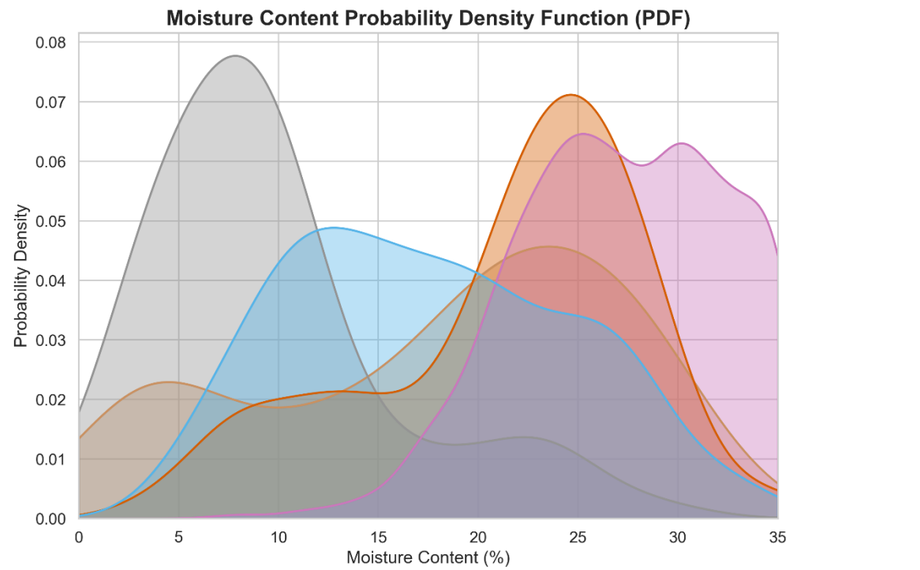
Figure 4

All Borings









Moisture Content – All Borings, All ESUs

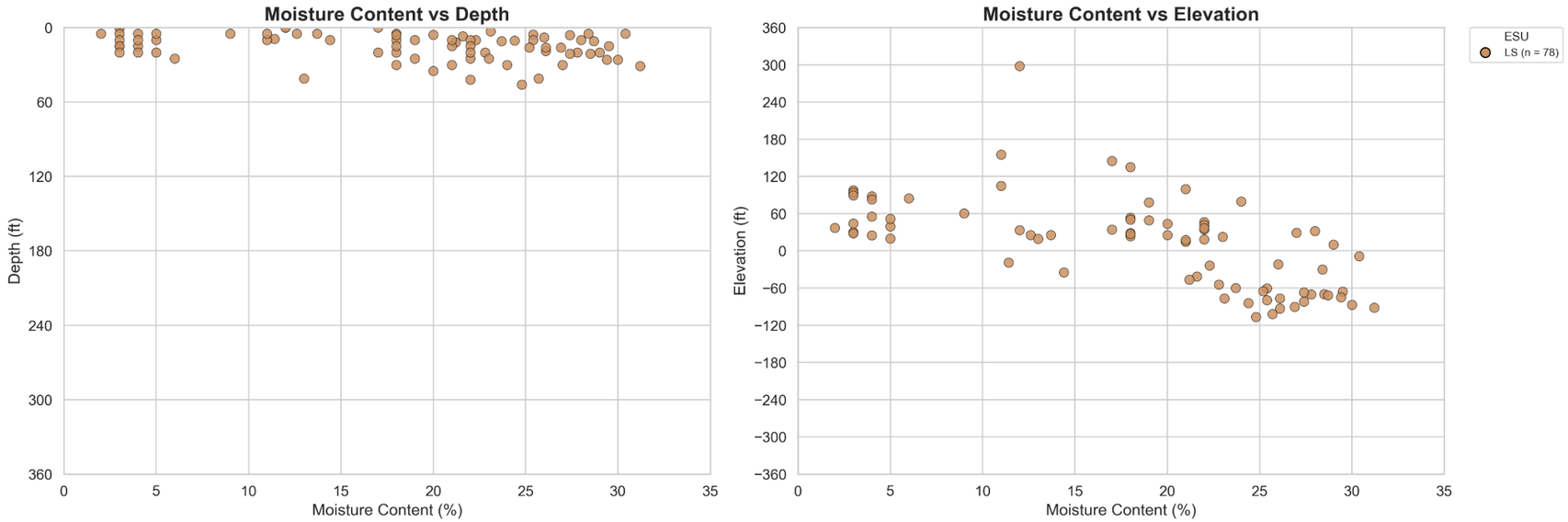
Knik Arm Tunnel Feasibility Study

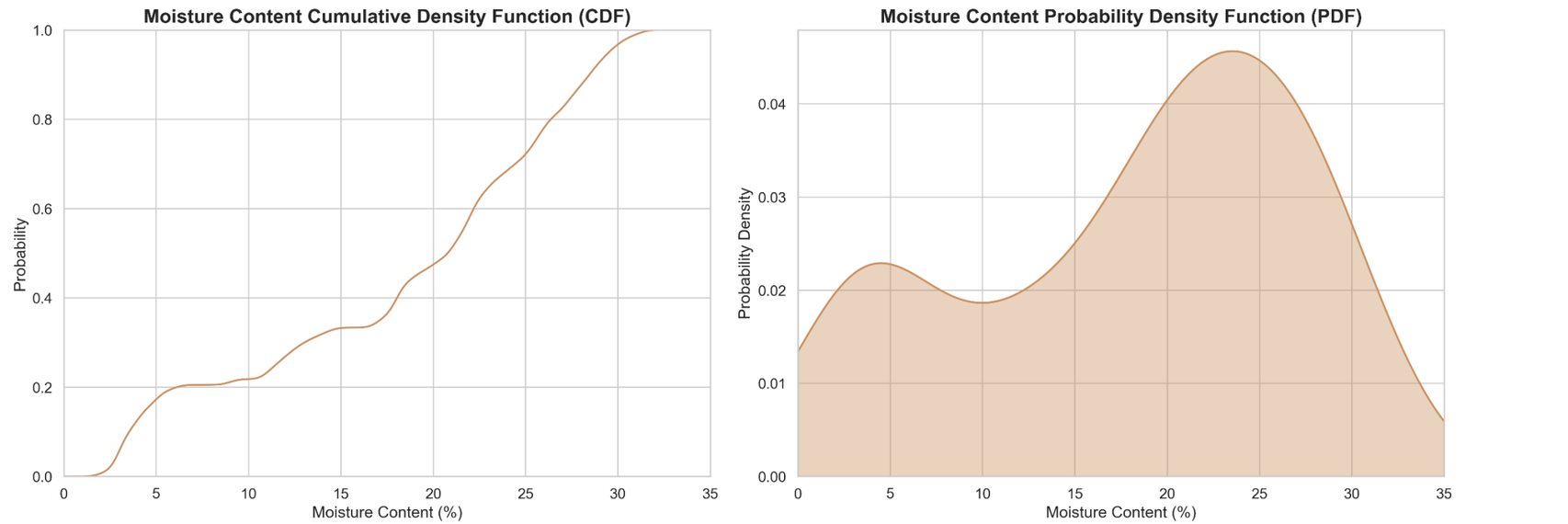
EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure A-1

LS (n = 78) - All Borings





Moisture Content – All Borings, ESU LS

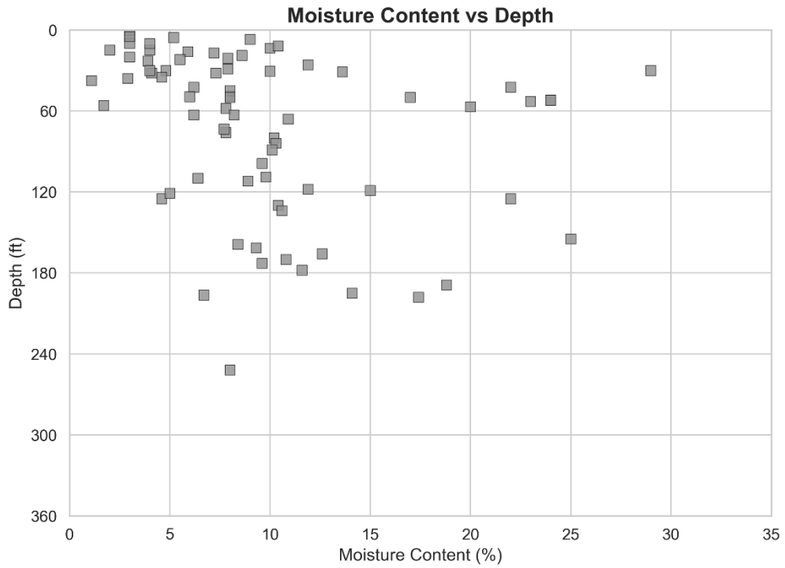
Knik Arm Tunnel Feasibility Study

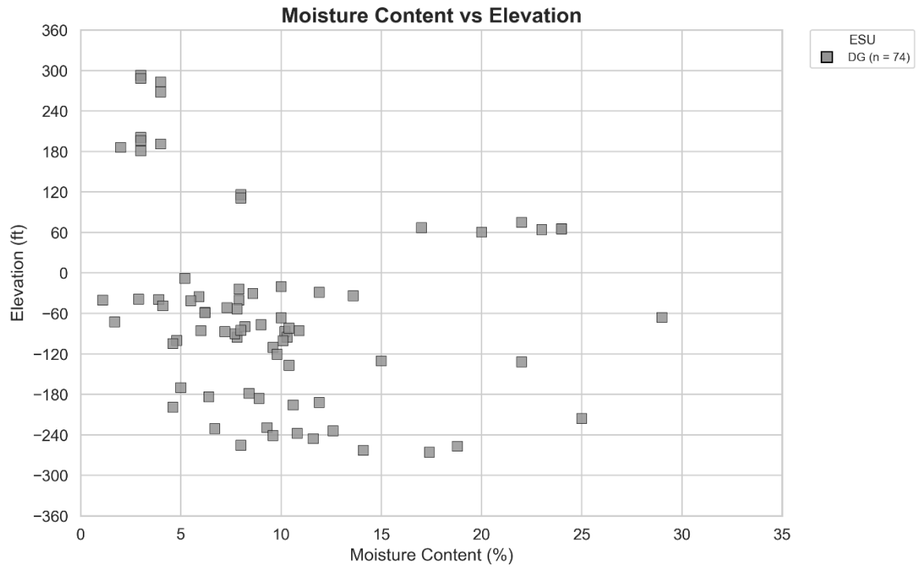
EMPRISE CONCEPTS

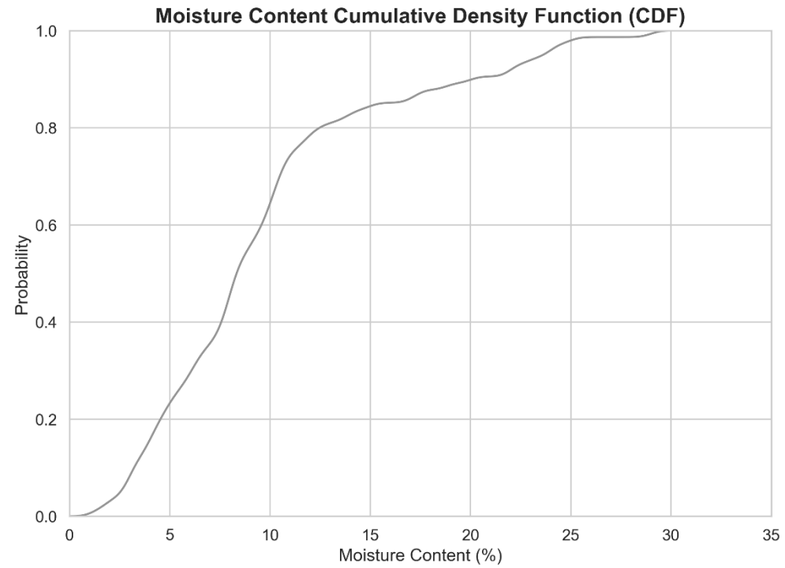
Anchorage, Alaska | August 2025

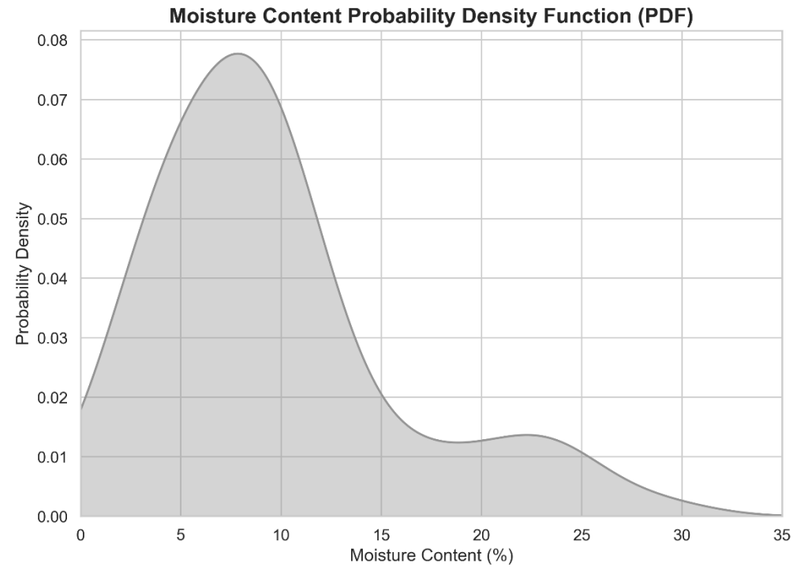
Figure **A-2**

DG (n = 74) - All Borings









Moisture Content – All Borings, ESU DG

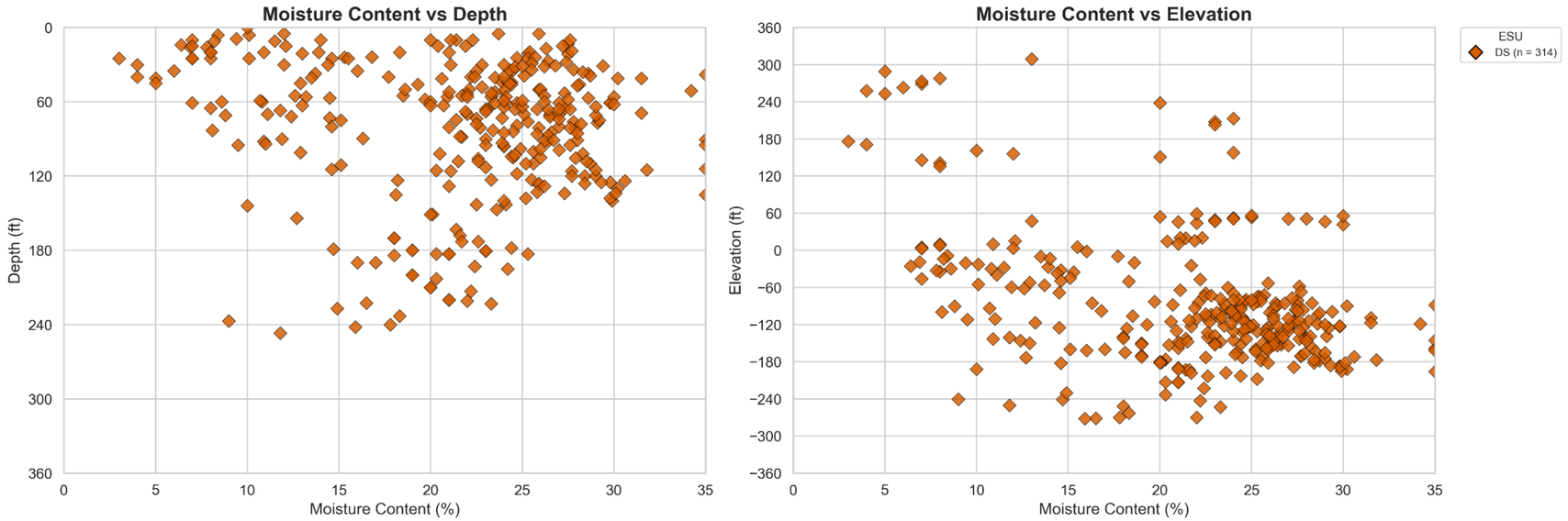
Knik Arm Tunnel Feasibility Study

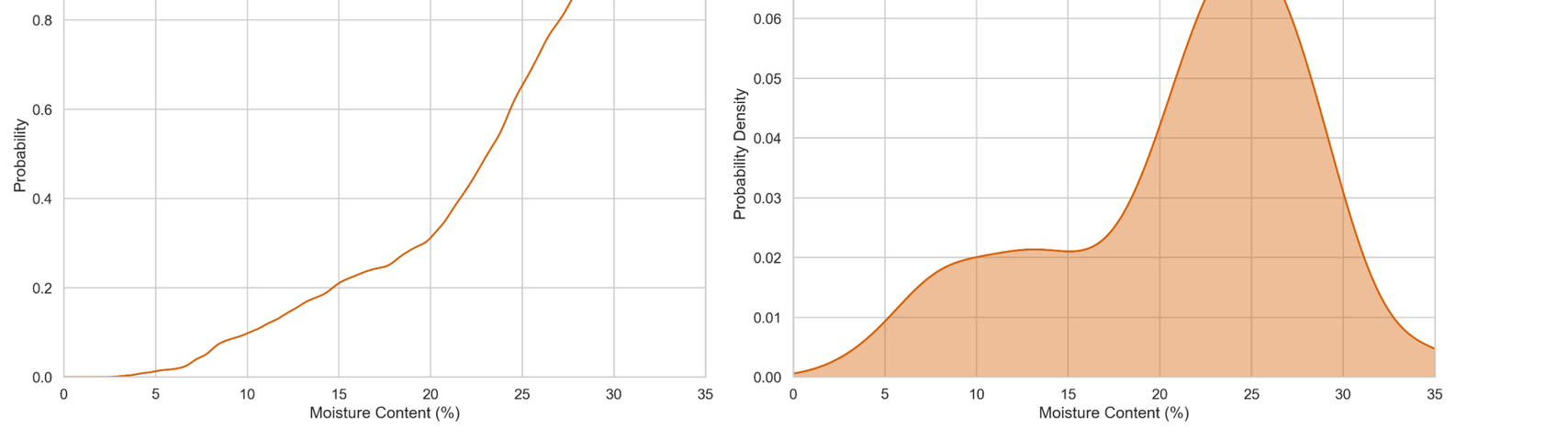
EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure **A-3**

DS (n = 314) - All Borings





Moisture Content – All Borings, ESU DS

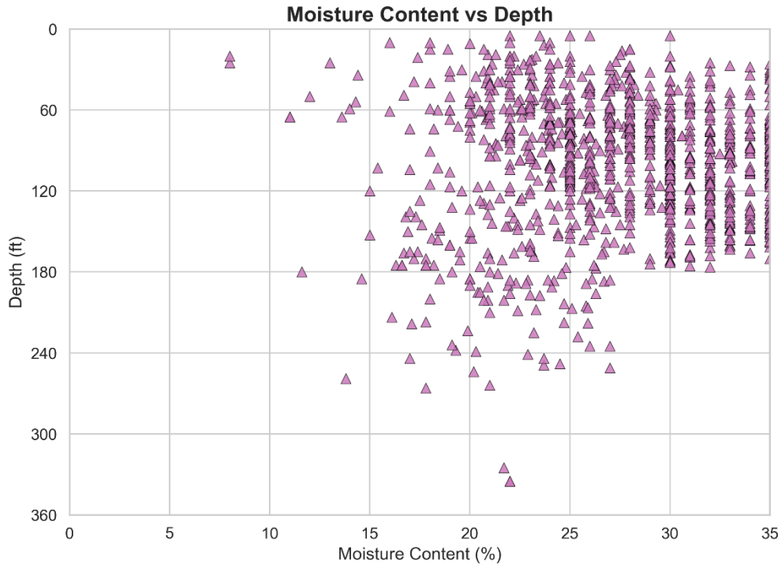
Knik Arm Tunnel Feasibility Study

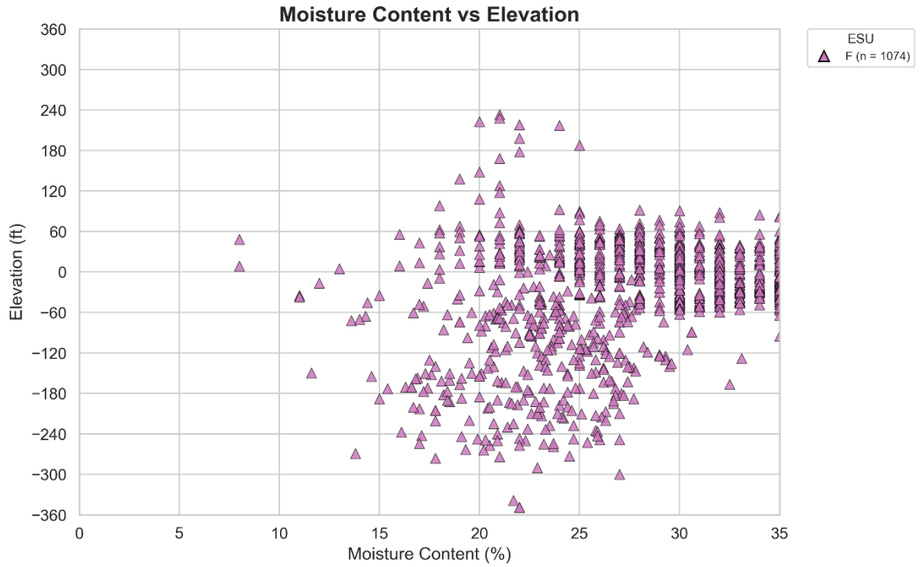
EMPRISE CONCEPTS

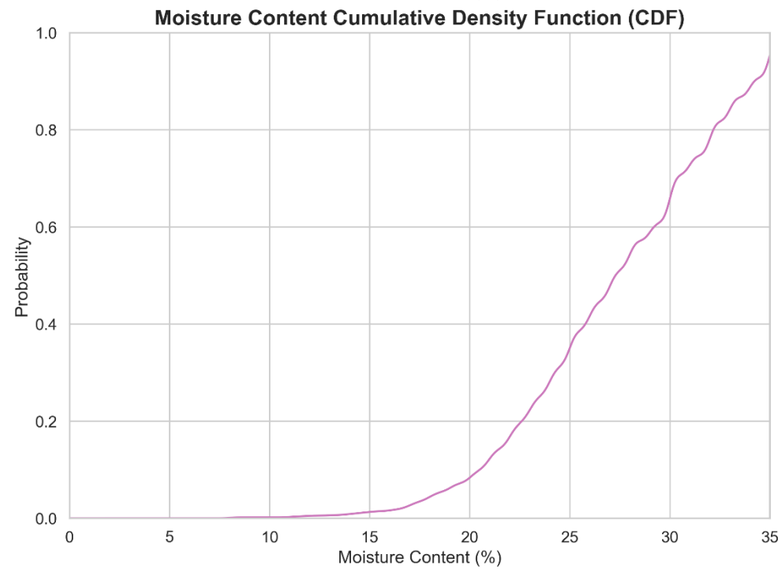
Anchorage, Alaska | August 2025

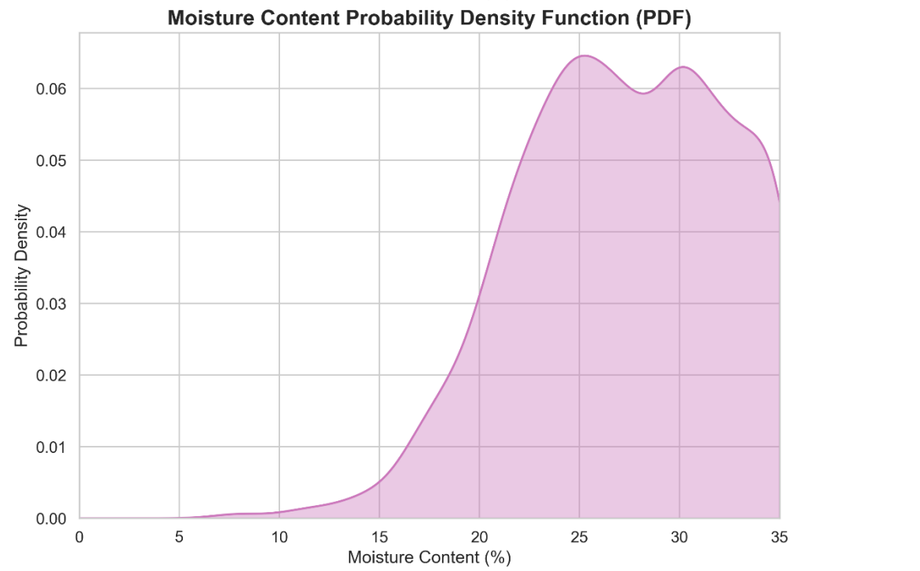
Figure **A-4**

F (n = 1074) - All Borings









Moisture Content – All Borings, ESU F

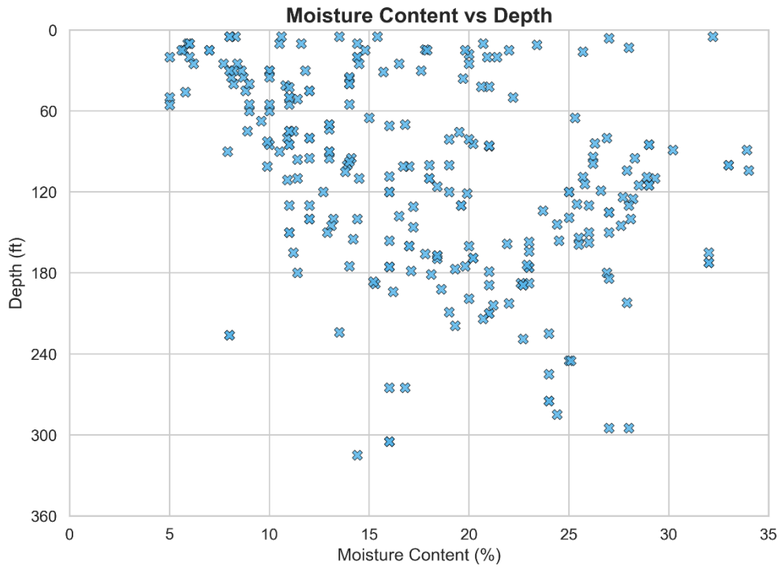
Knik Arm Tunnel Feasibility Study

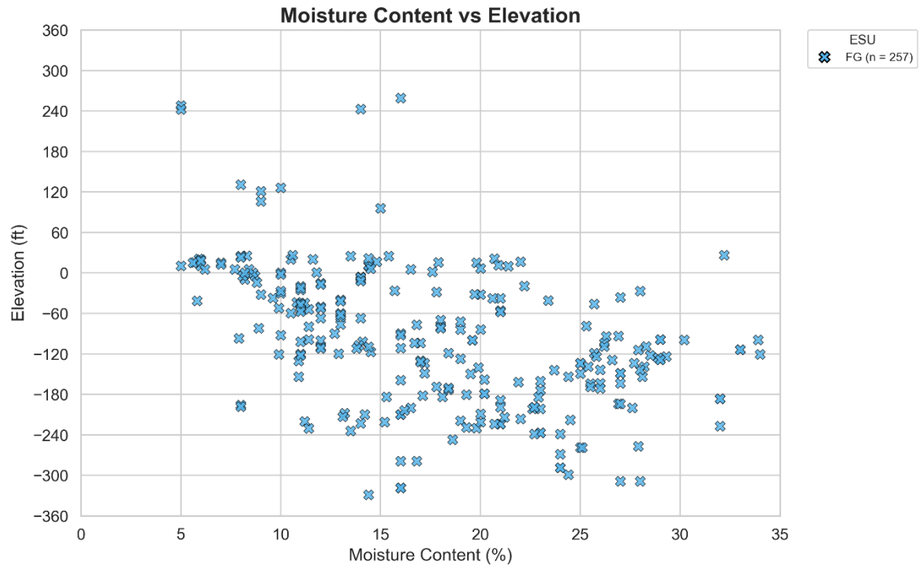
EMPRISE CONCEPTS

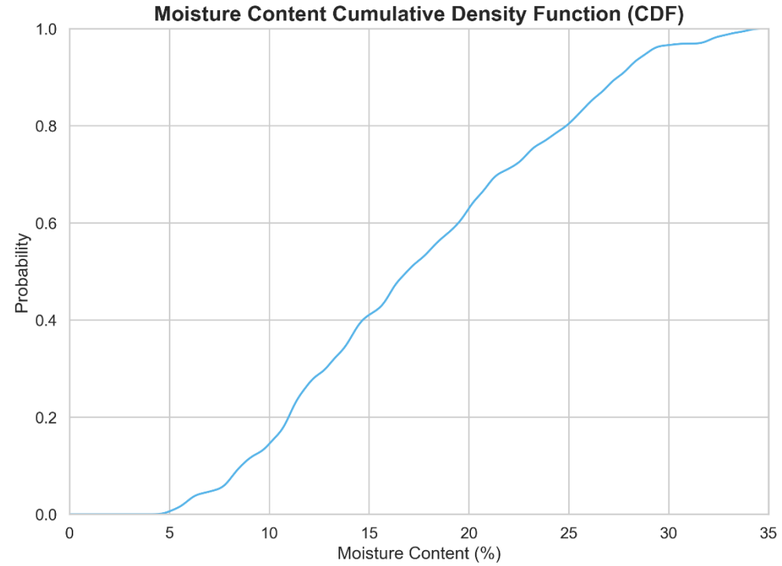
Anchorage, Alaska | August 2025

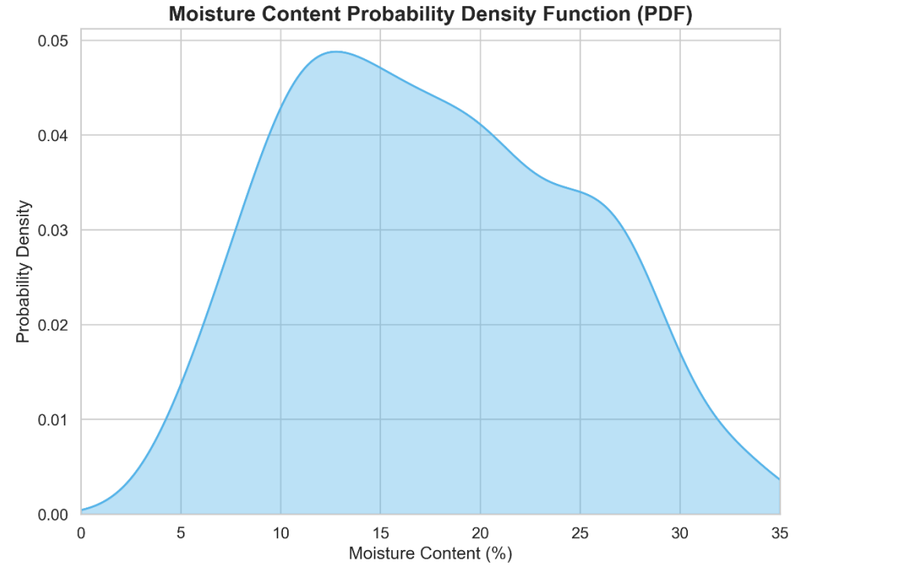
Figure **A-5**

FG (n = 257) - All Borings









Moisture Content – All Borings, ESU FG

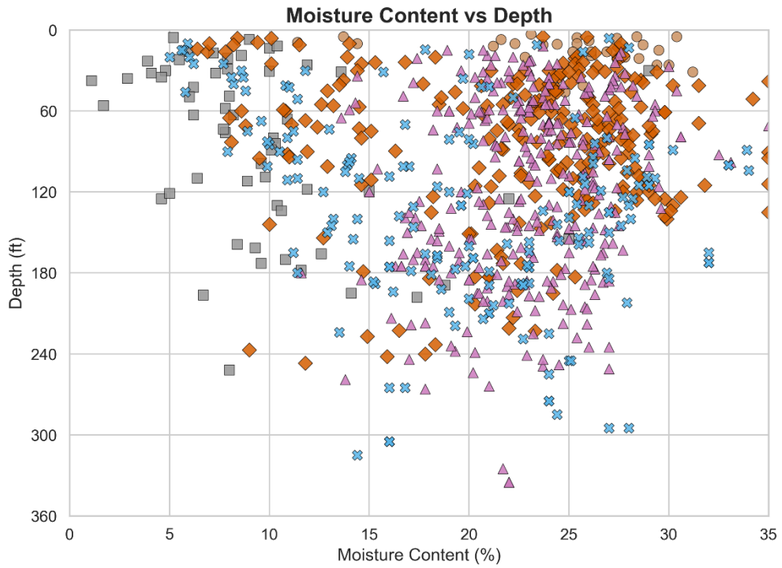
Knik Arm Tunnel Feasibility Study

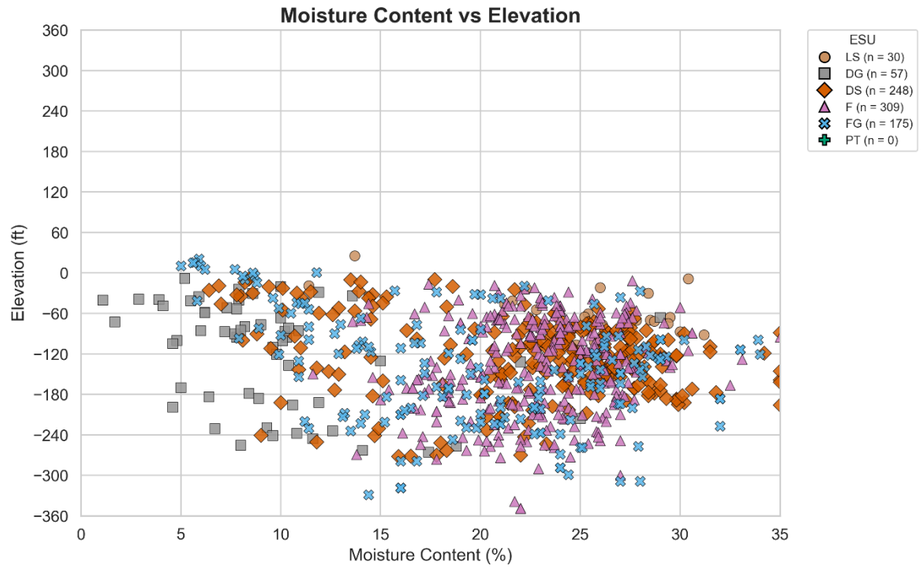
EMPRISE CONCEPTS

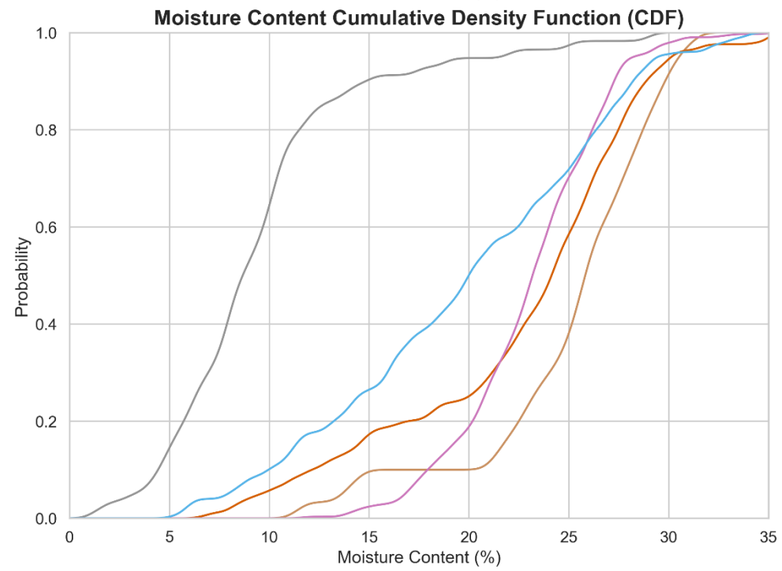
Anchorage, Alaska | August 2025

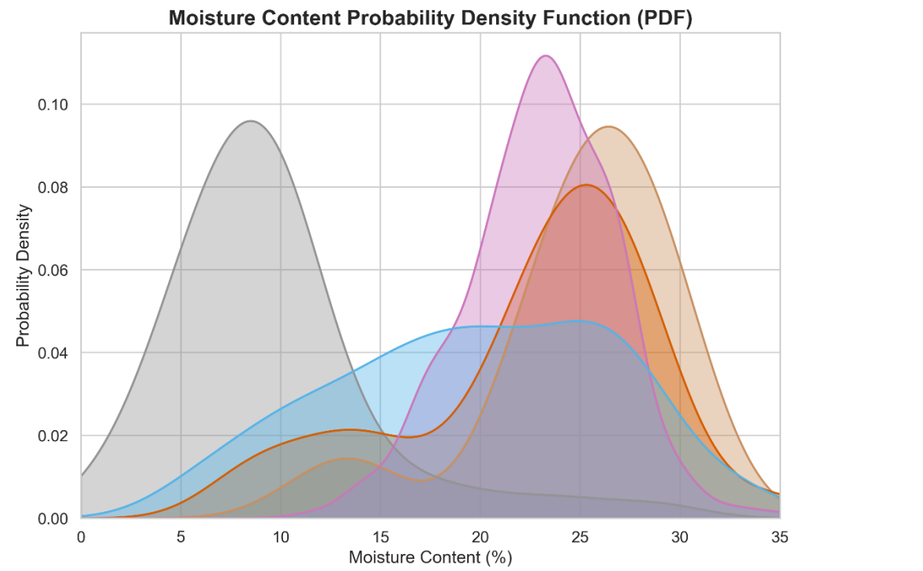
Figure **A-6**

Overwater Borings









Moisture Content – Overwater Borings, All ESUs

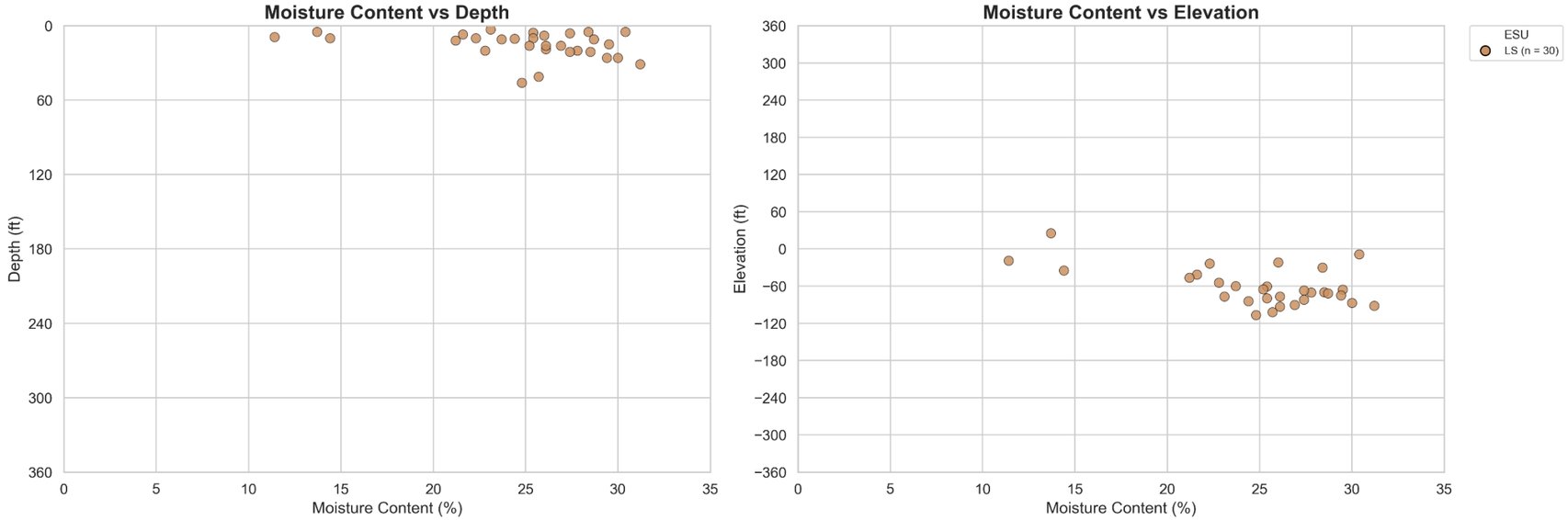
Knik Arm Tunnel Feasibility Study

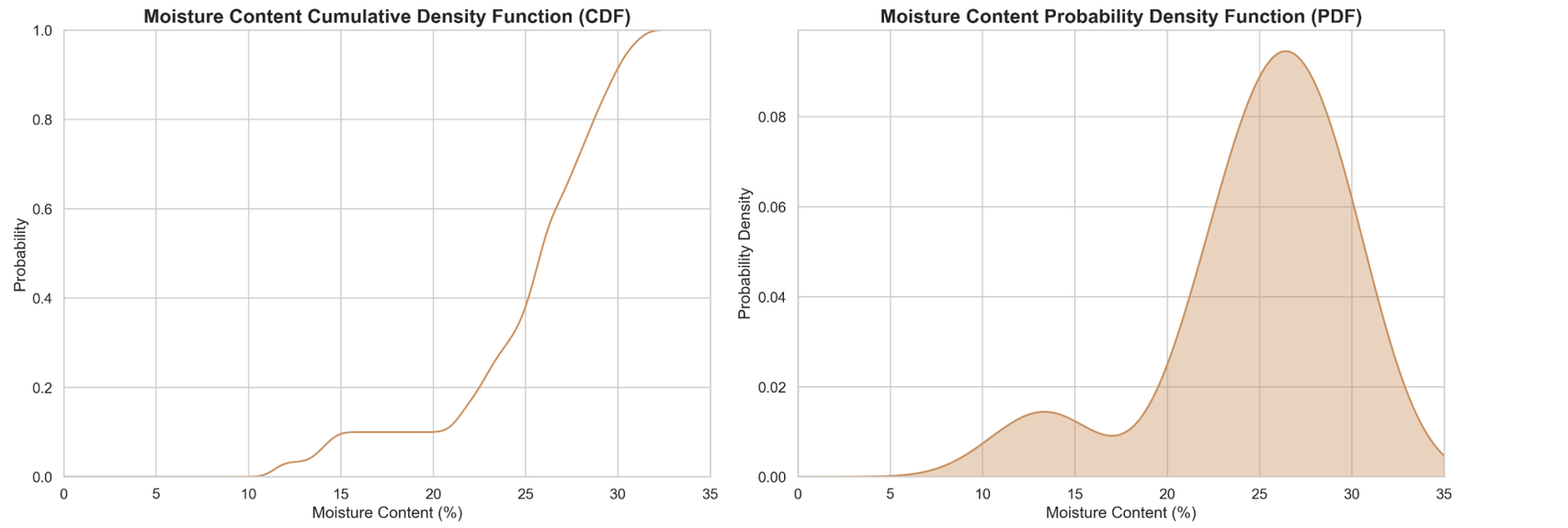
EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure **A-7**

LS (n = 30) - Overwater Borings





Moisture Content – Overwater Borings, ESU LS

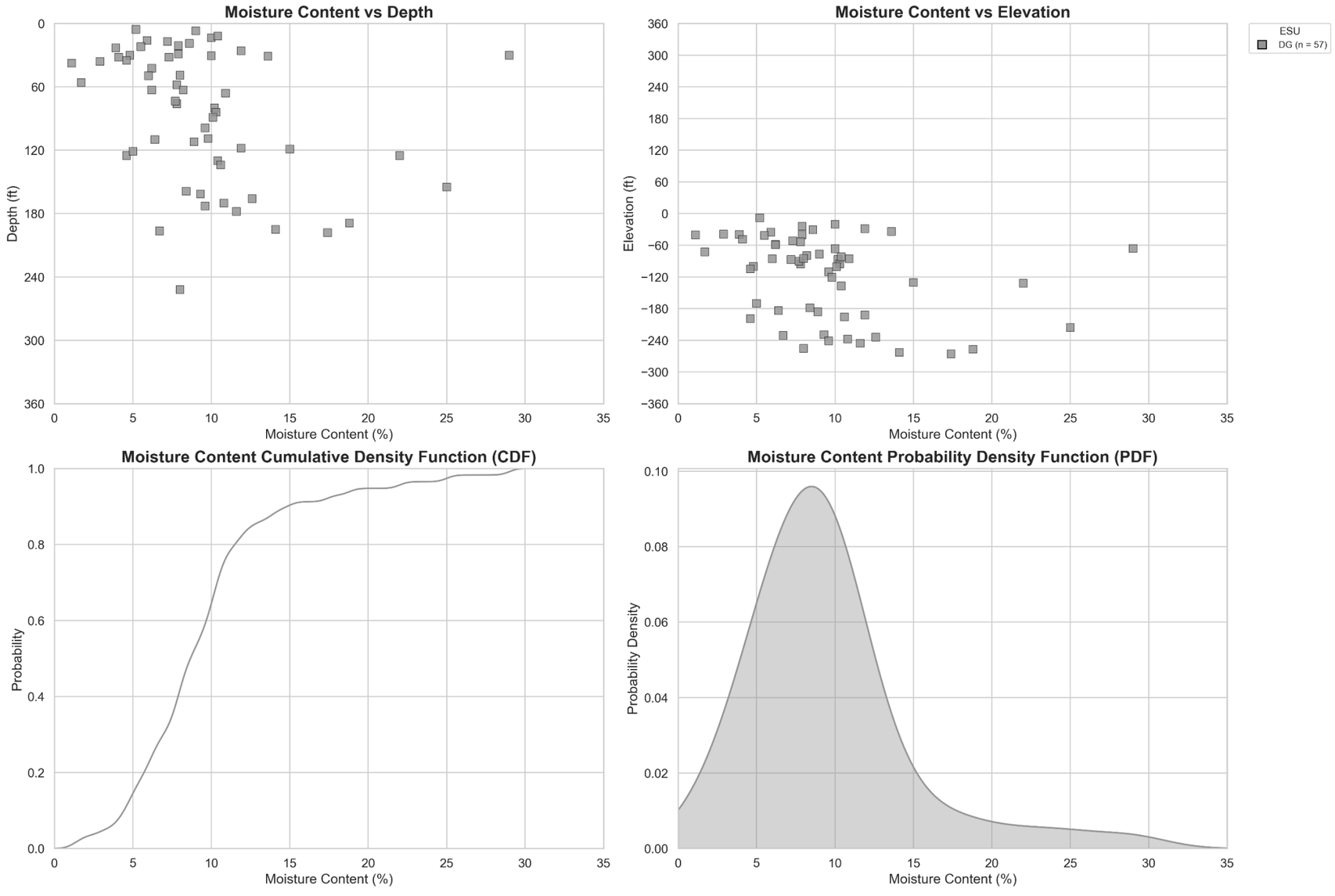
Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure **A-8**

DG (n = 57) - Overwater Borings



Moisture Content – Overwater Borings, ESU DG

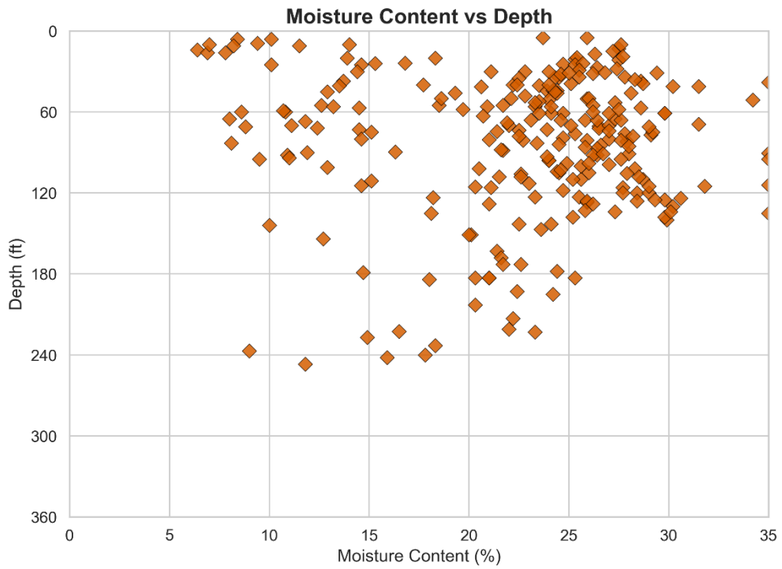
Knik Arm Tunnel Feasibility Study

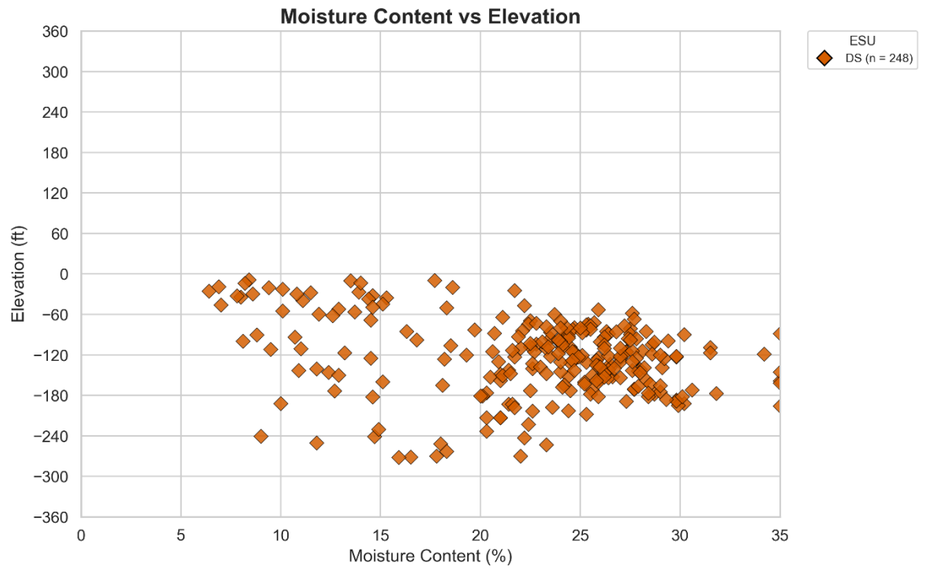
EMPRISE CONCEPTS

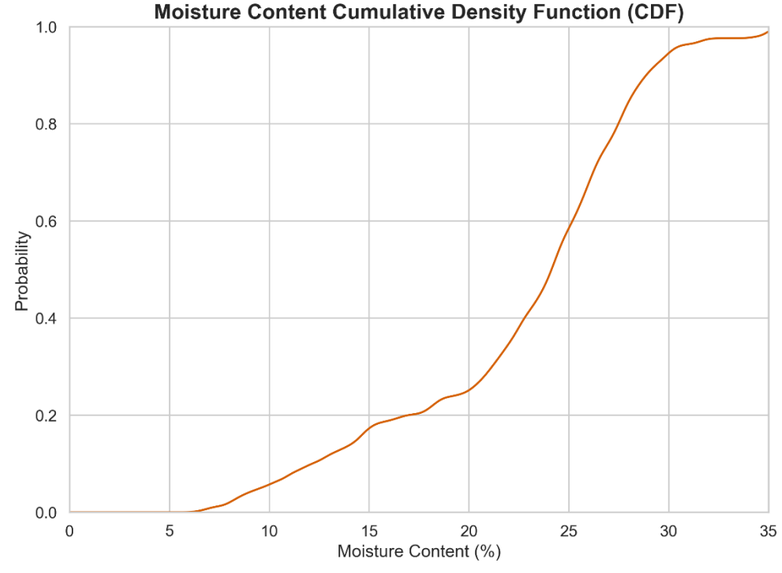
Anchorage, Alaska | August 2025

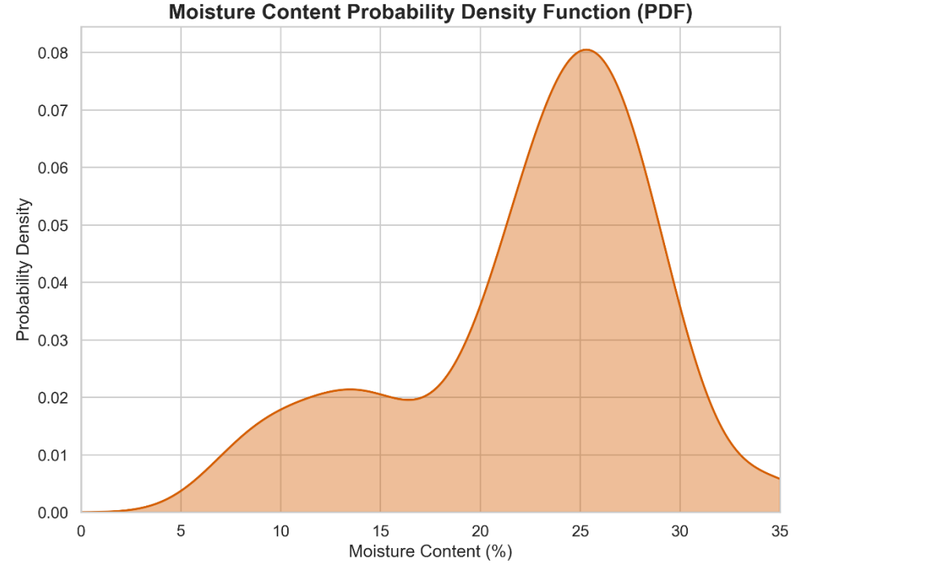
Figure **A-9**

DS (n = 248) - Overwater Borings









Moisture Content – Overwater Borings, ESU DS

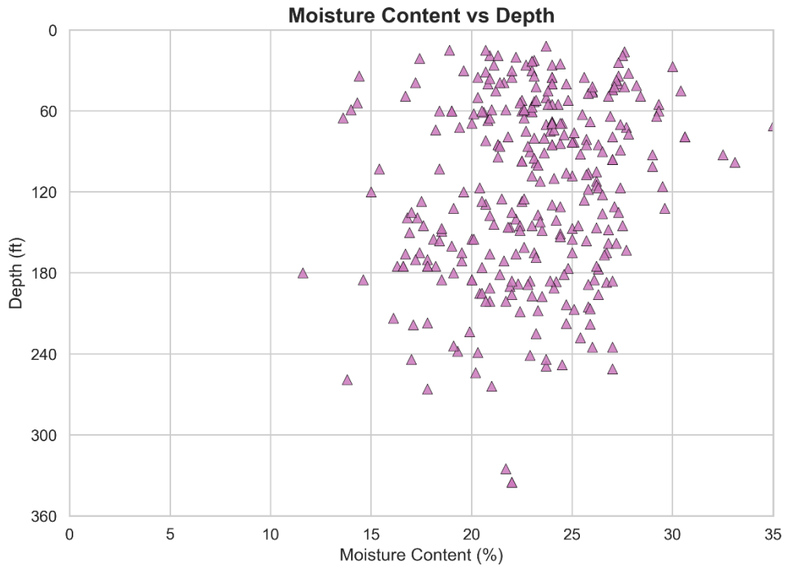
Knik Arm Tunnel Feasibility Study

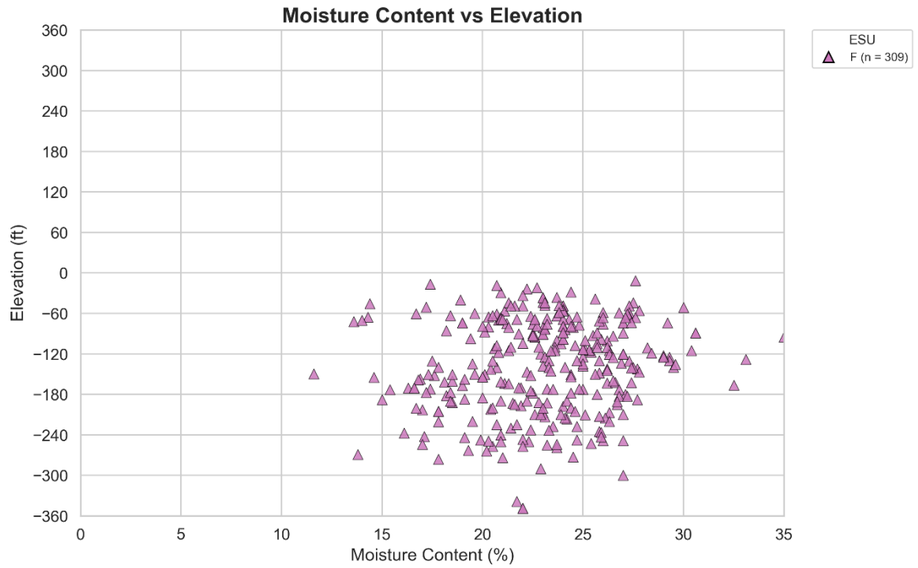
EMPRISE CONCEPTS

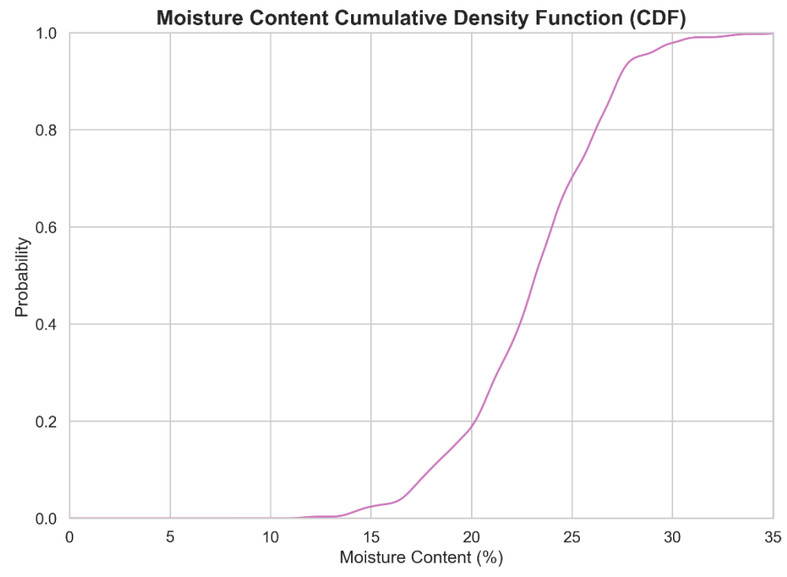
Anchorage, Alaska | August 2025

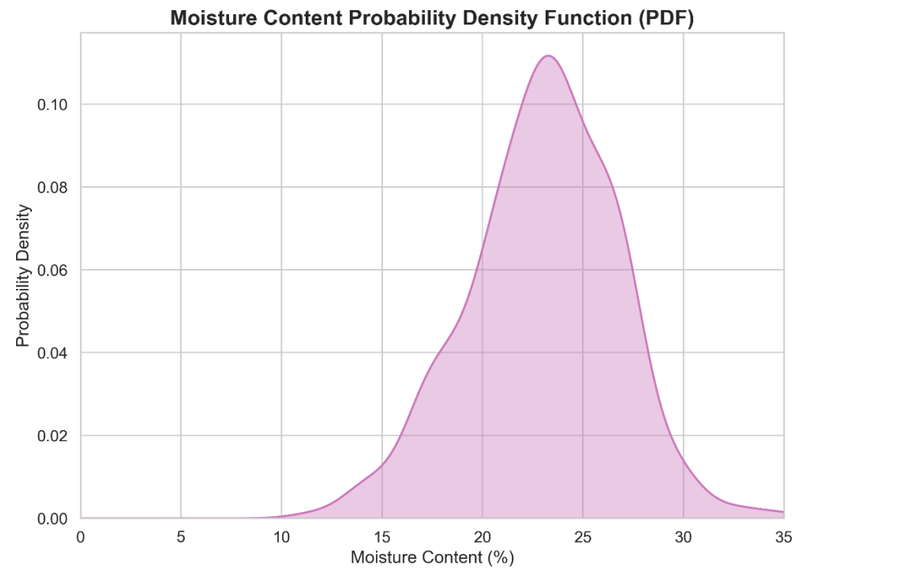
Figure **A-10**

F (n = 309) - Overwater Borings









Moisture Content – Overwater Borings, ESU F

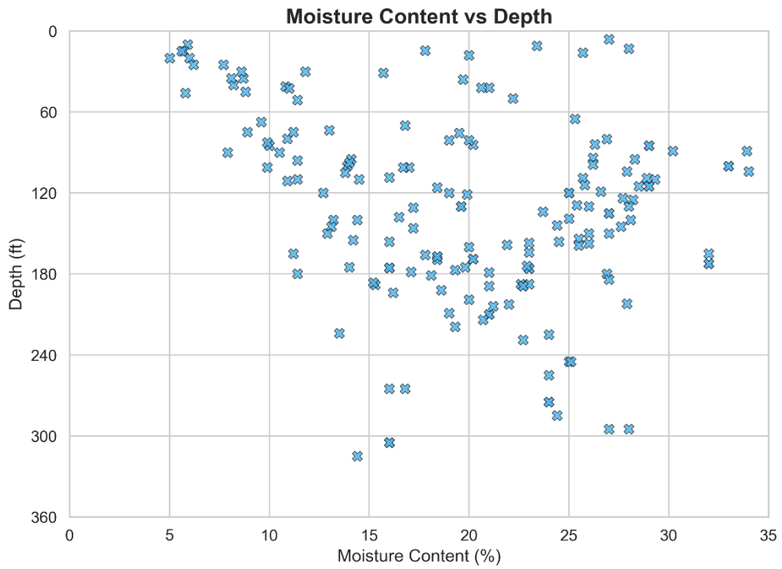
Knik Arm Tunnel Feasibility Study

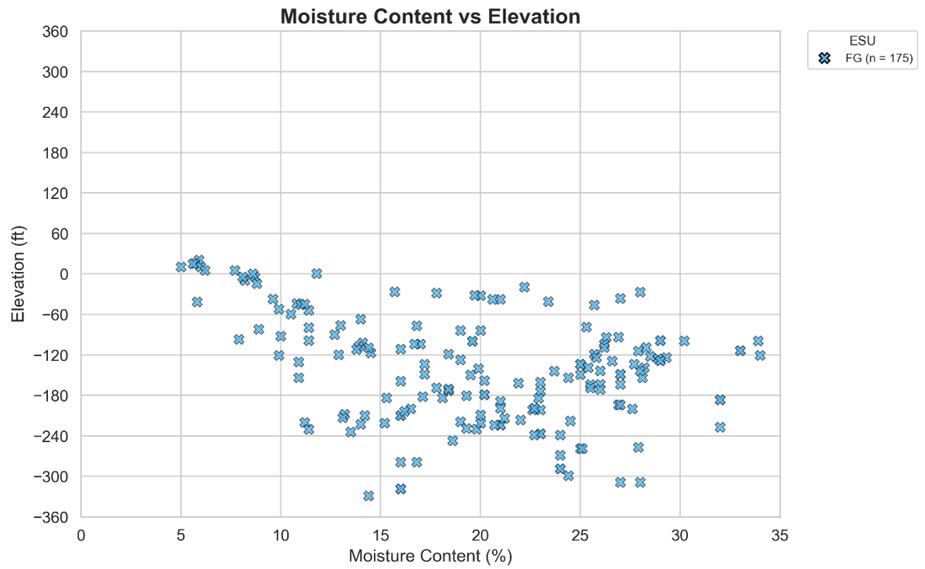
EMPRISE CONCEPTS

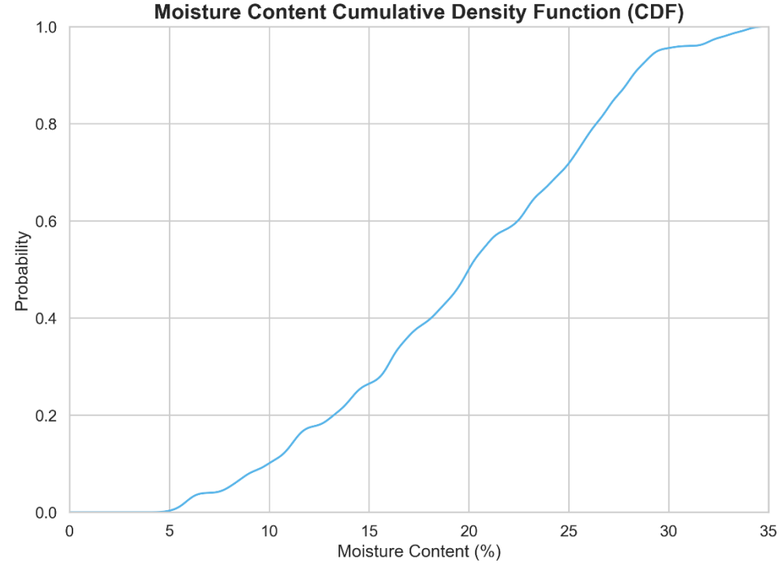
Anchorage, Alaska | August 2025

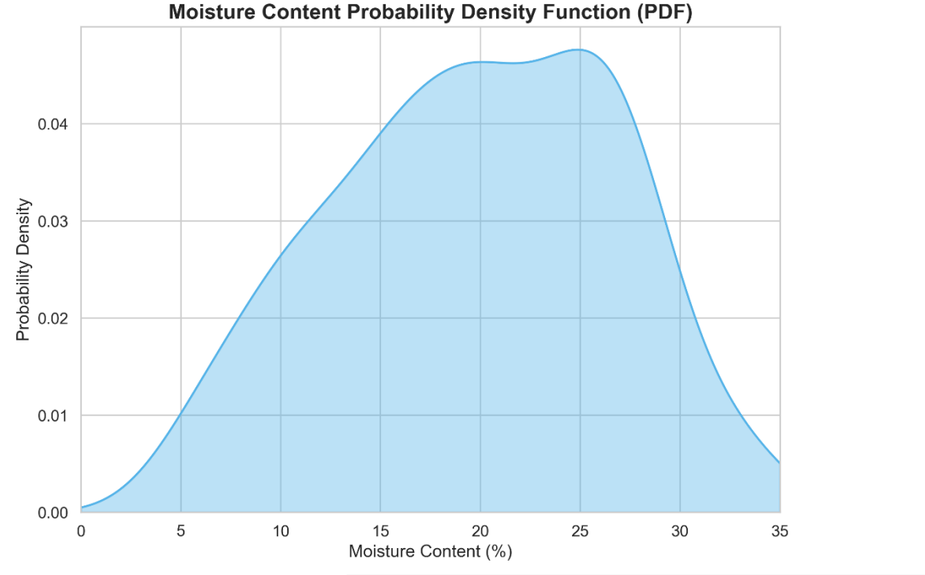
Figure **A-11**

FG (n = 175) - Overwater Borings









Moisture Content – Overwater Borings, ESU FG

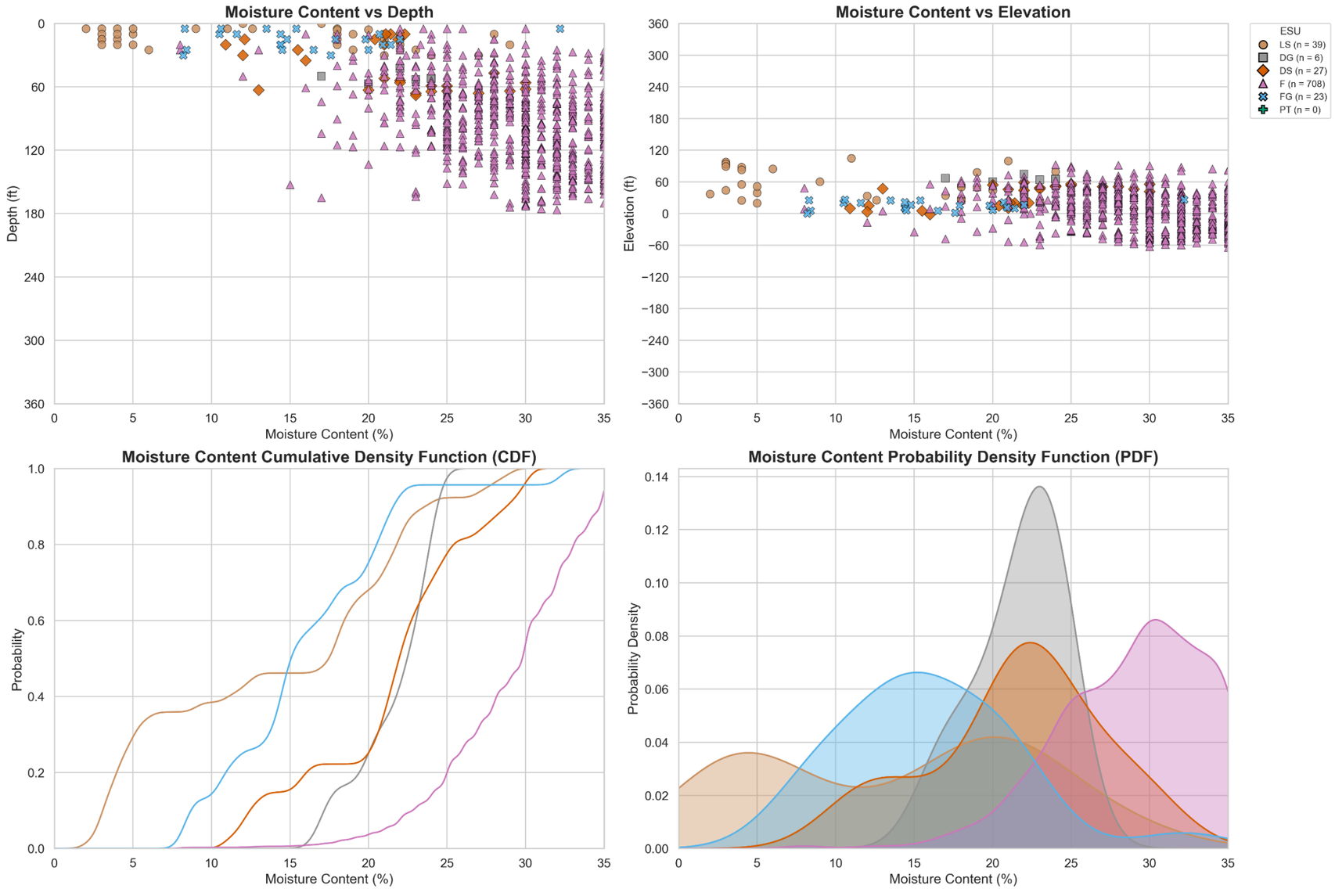
Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure **A-12**

Anchorage Landside Borings



Moisture Content – Anchorage Landside Borings, All ESUs

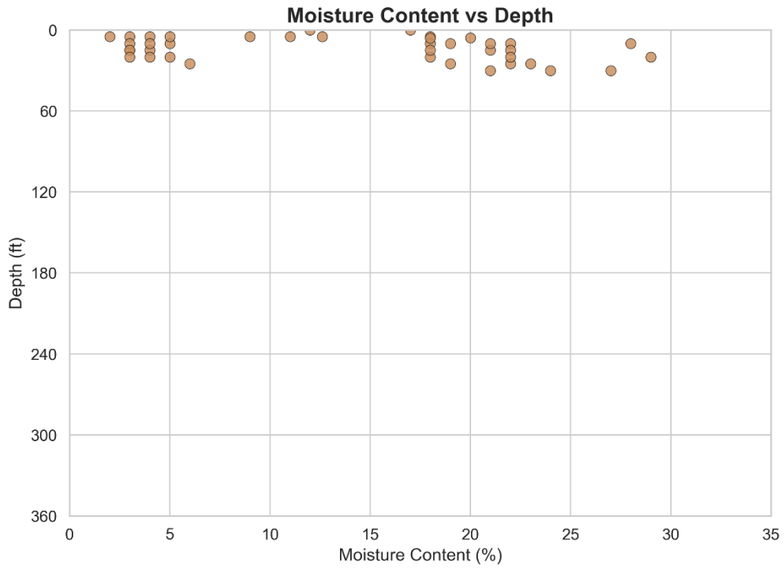
Knik Arm Tunnel Feasibility Study

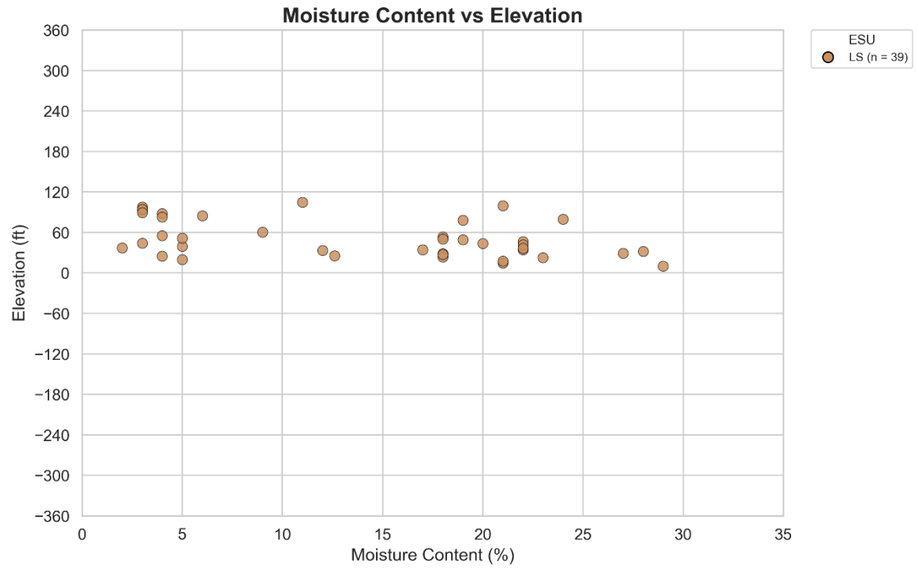
EMPRISE CONCEPTS

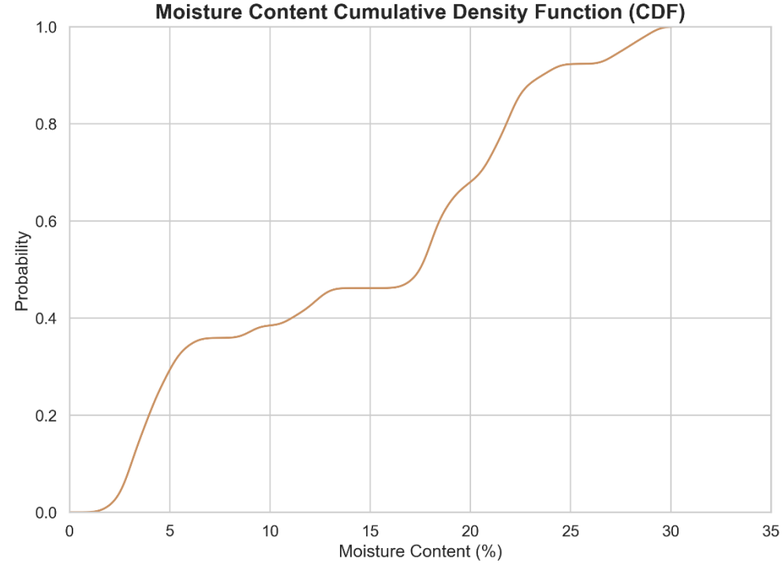
Anchorage, Alaska | August 2025

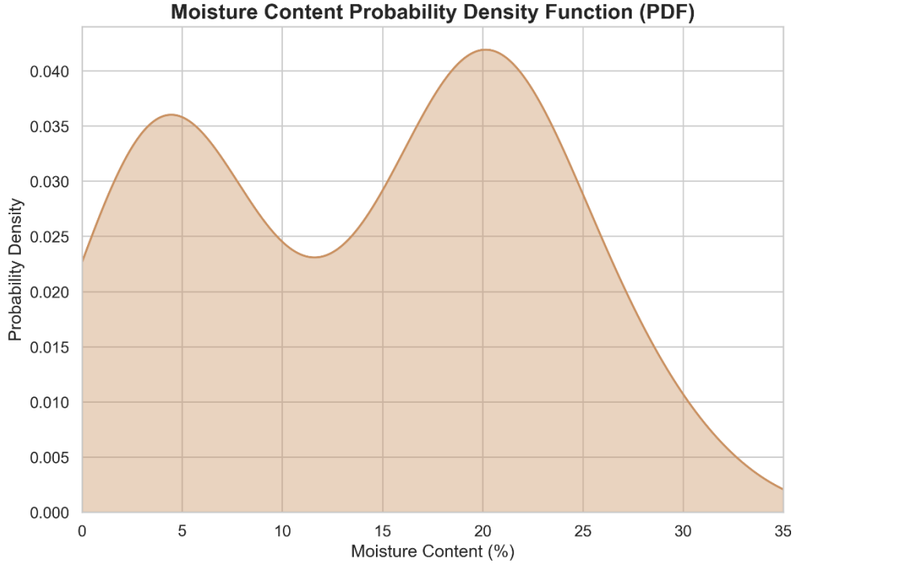
Figure **A-13**

LS (n = 39) - Anchorage Landside Borings









Moisture Content – Anchorage Landside Borings, ESU LS

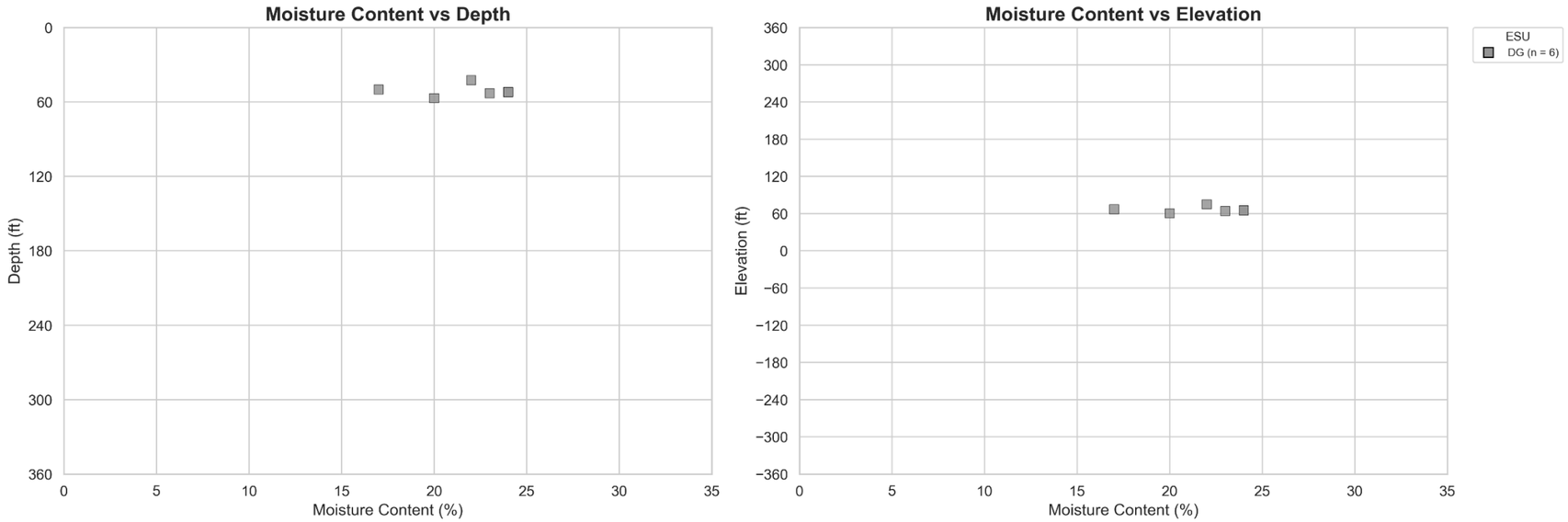
Knik Arm Tunnel Feasibility Study

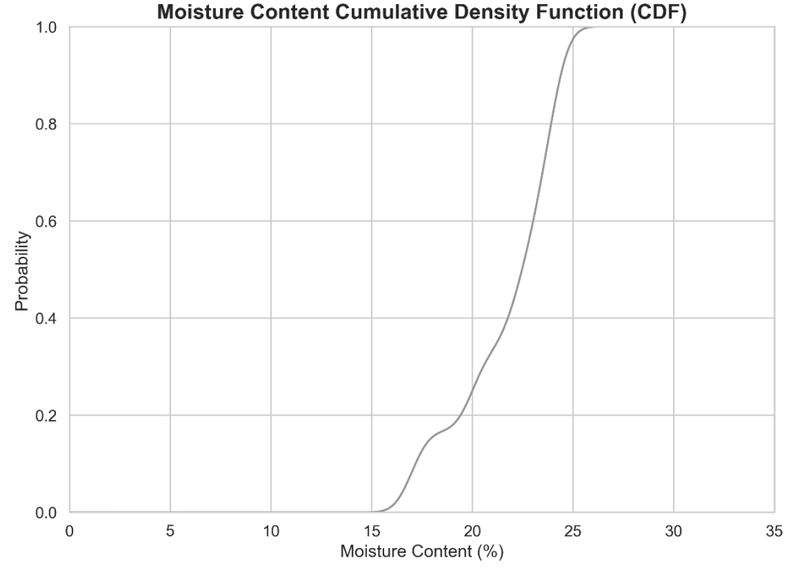
EMPRISE CONCEPTS

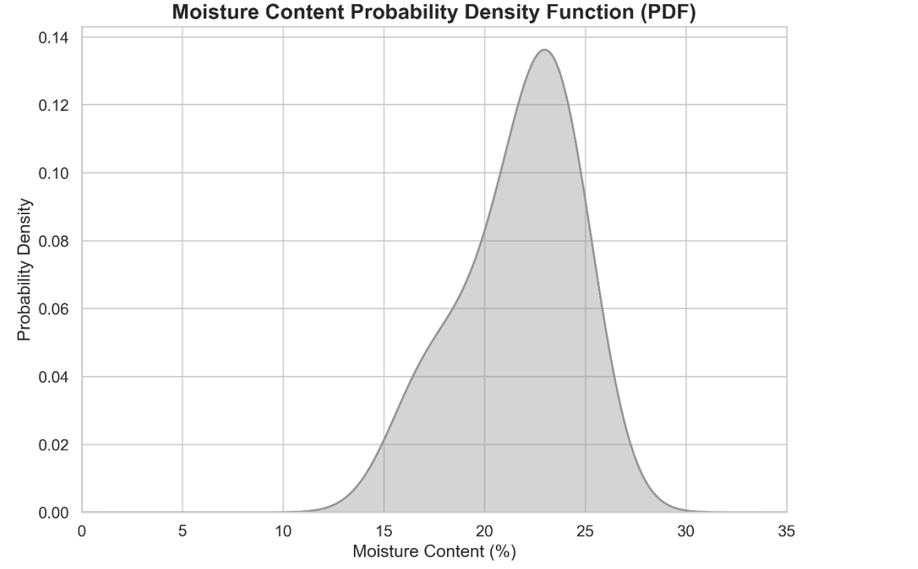
Anchorage, Alaska | August 2025

Figure **A-14**

DG (n = 6) - Anchorage Landside Borings







Moisture Content – Anchorage Landside Borings, ESU DG

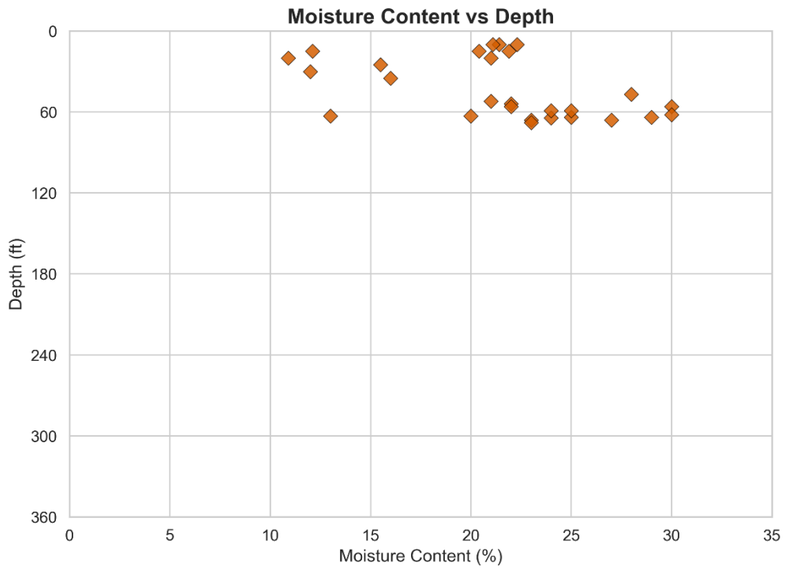
Knik Arm Tunnel Feasibility Study

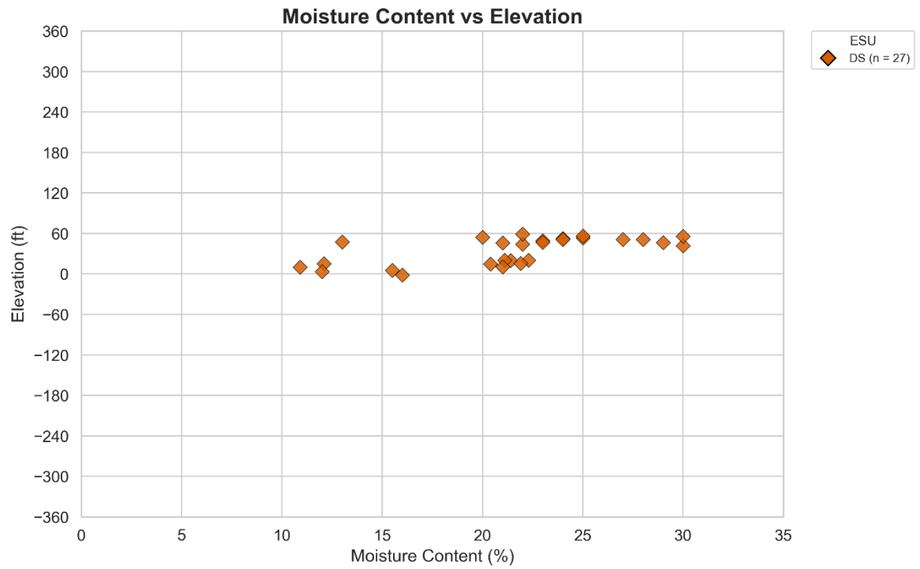
EMPRISE CONCEPTS

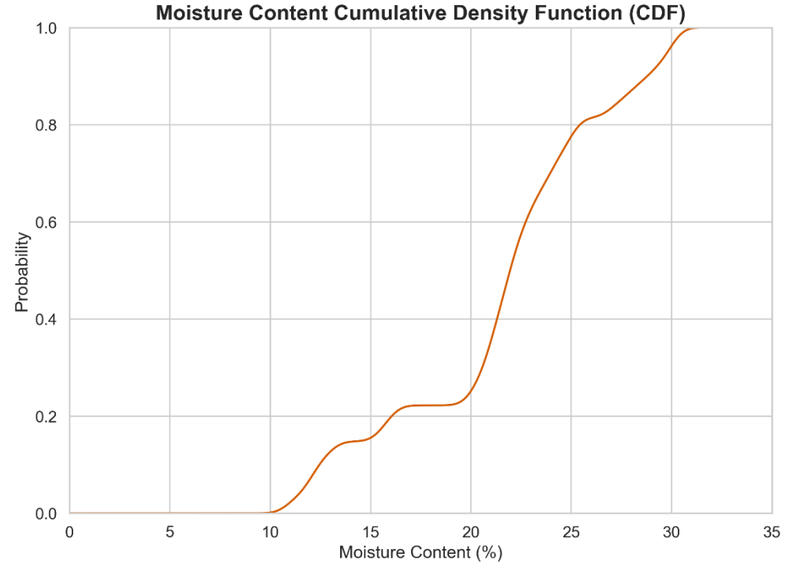
Anchorage, Alaska | August 2025

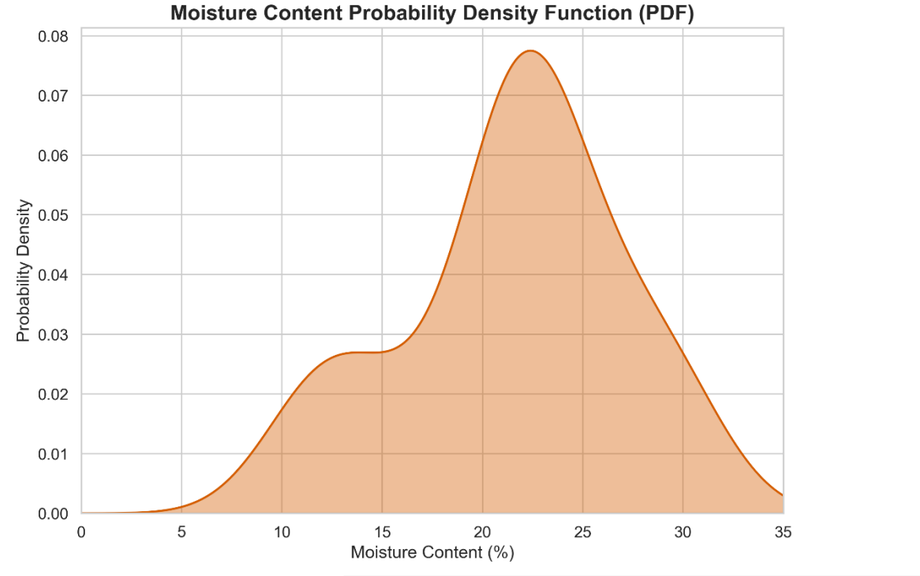
Figure **A-15**

DS (n = 27) - Anchorage Landside Borings









Moisture Content – Anchorage Landside Borings, ESU DS

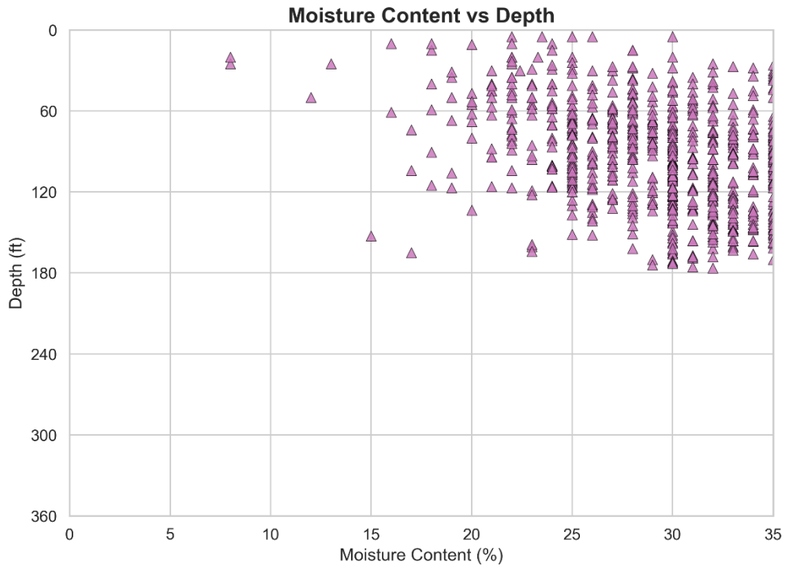
Knik Arm Tunnel Feasibility Study

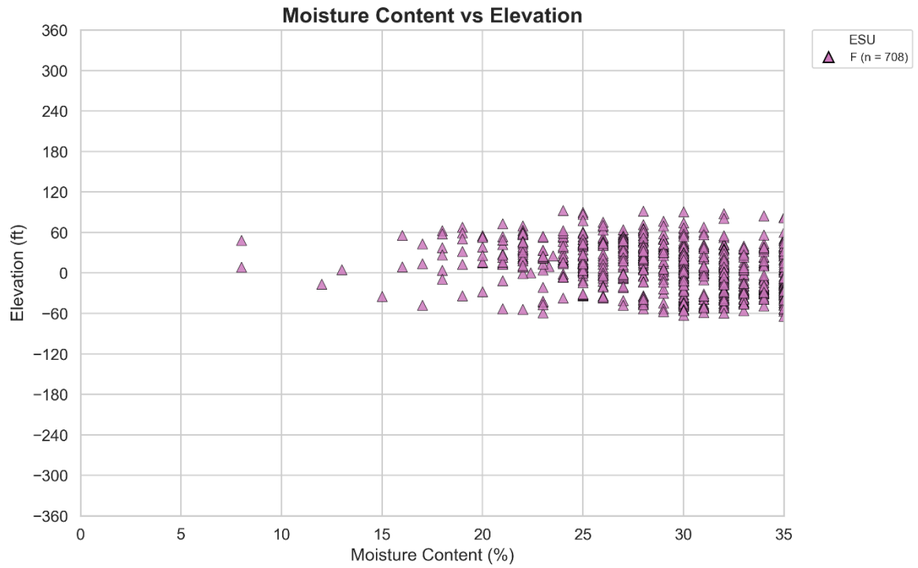
EMPRISE CONCEPTS

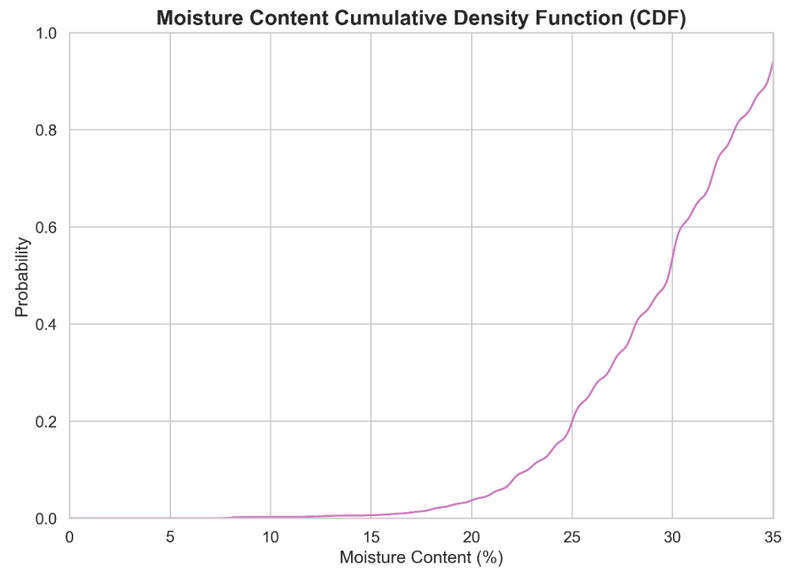
Anchorage, Alaska | August 2025

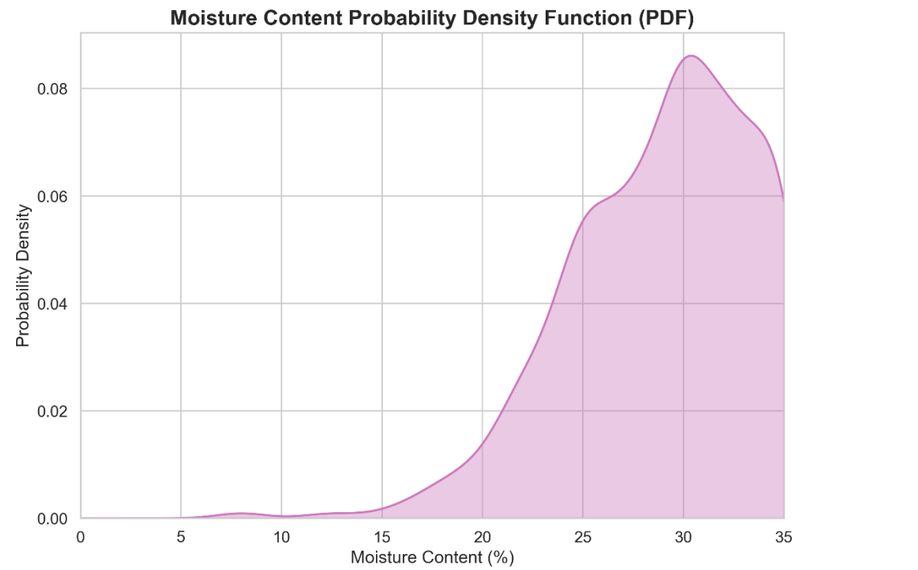
Figure **A-16**

F (n = 708) - Anchorage Landside Borings









Moisture Content – Anchorage Landside Borings, ESU F

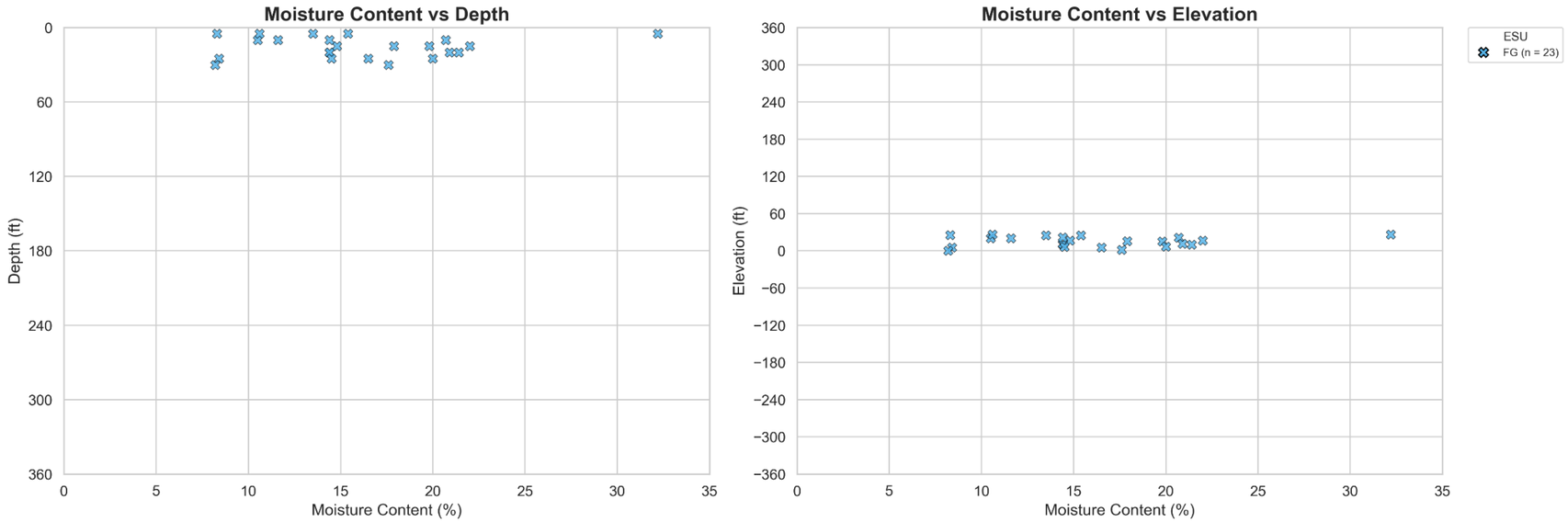
Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure **A-17**

FG (n = 23) - Anchorage Landside Borings



Moisture Content – Anchorage Landside Borings, ESU FG

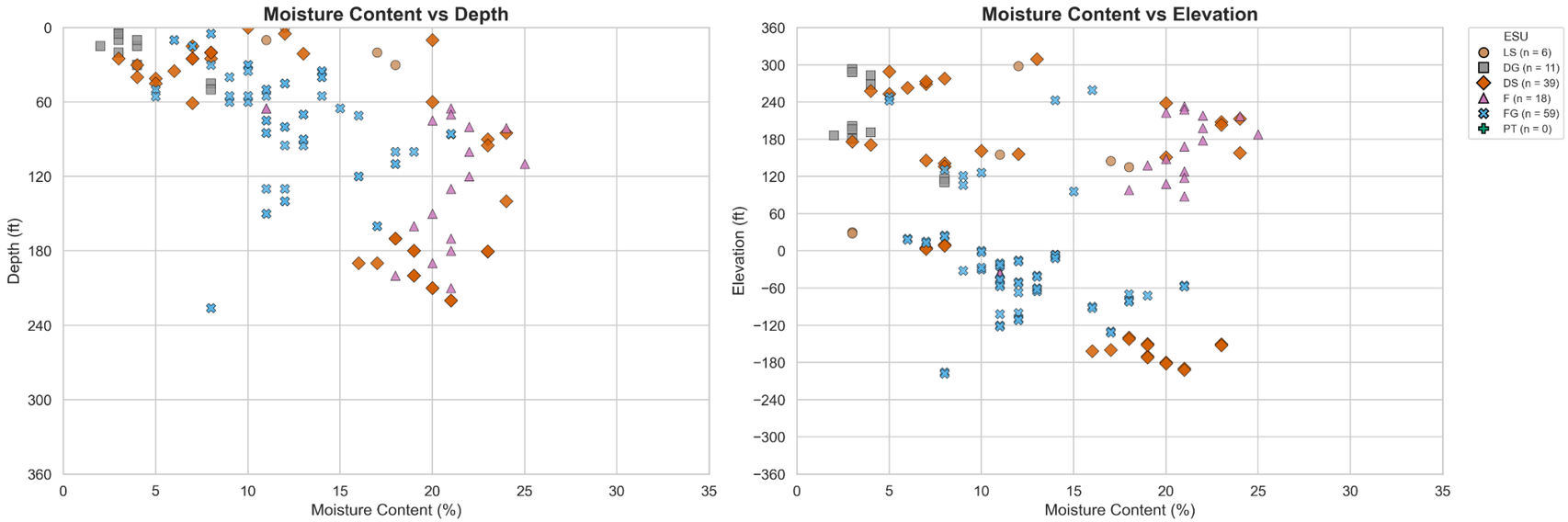
Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure **A-18**

Point MacKenzie Landside Borings



Moisture Content–Point MacKenzie Landside Borings, All ESUs

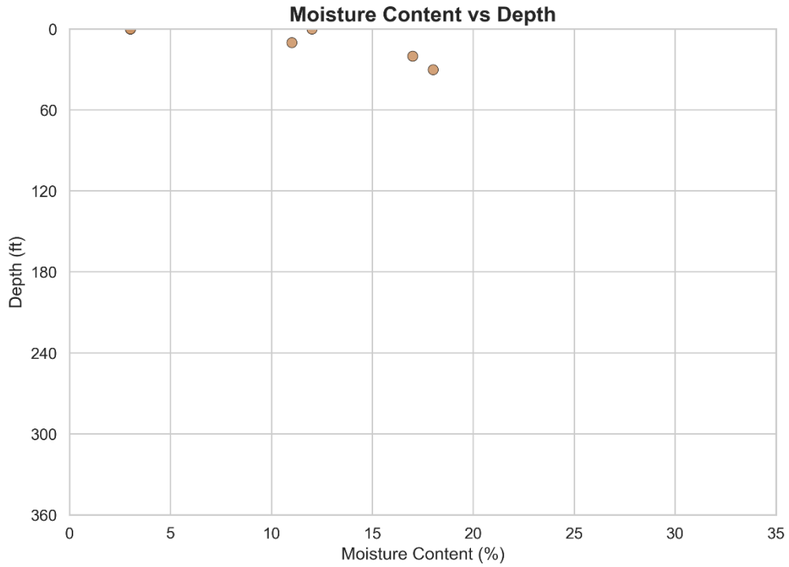
Knik Arm Tunnel Feasibility Study

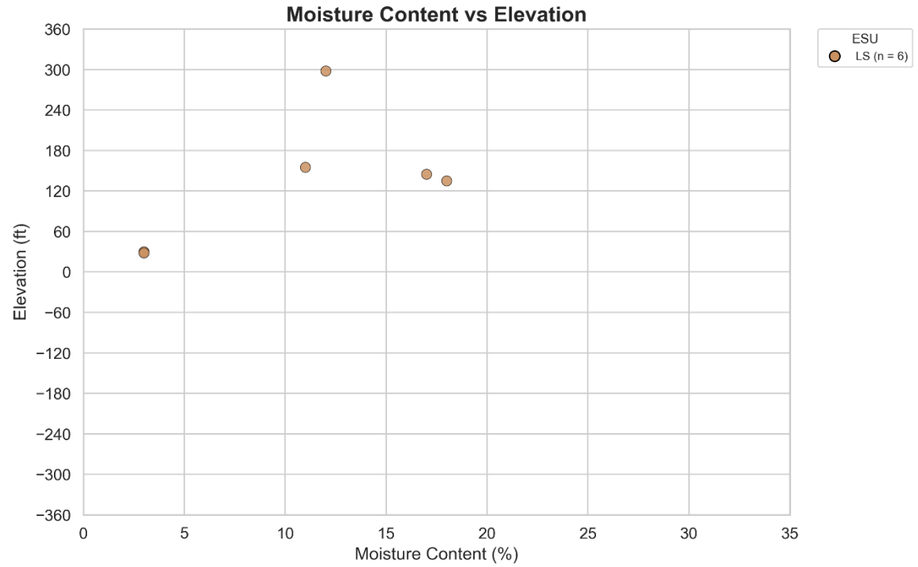
EMPRISE CONCEPTS

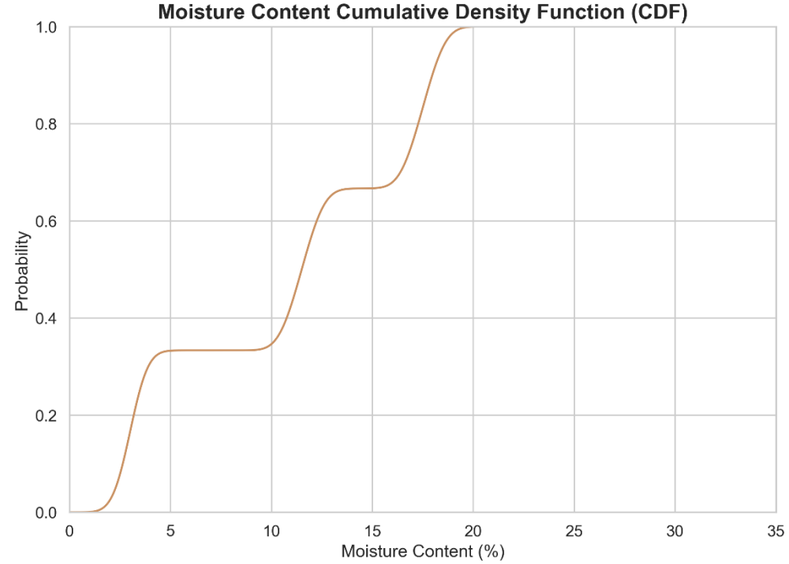
Anchorage, Alaska | August 2025

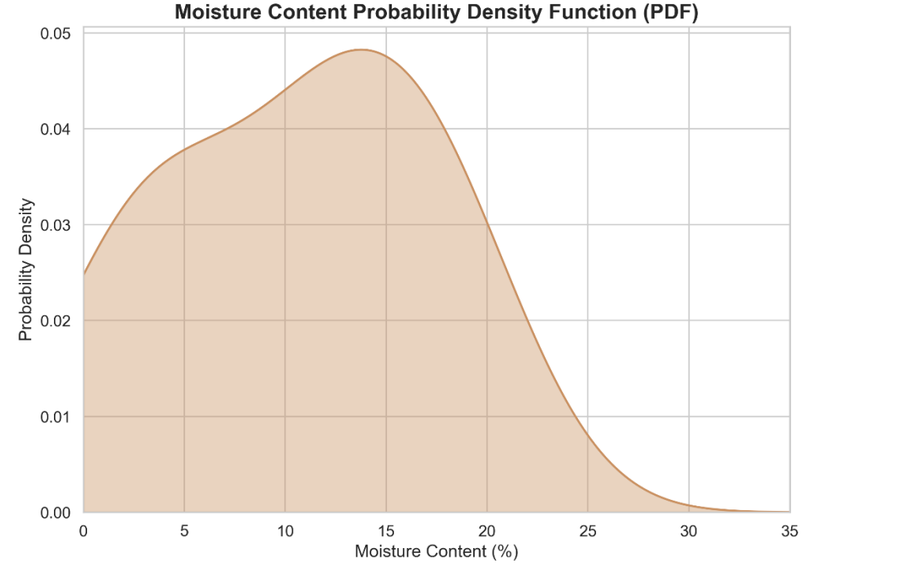
Figure **A-19**

LS (n = 6) - Point MacKenzie Landside Borings









Moisture Content – Point MacKenzie Landside Borings, ESU LS

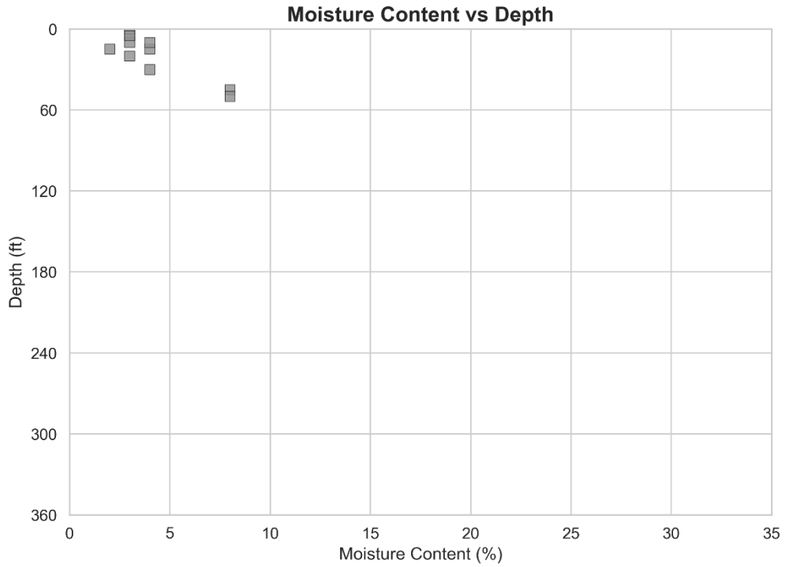
Knik Arm Tunnel Feasibility Study

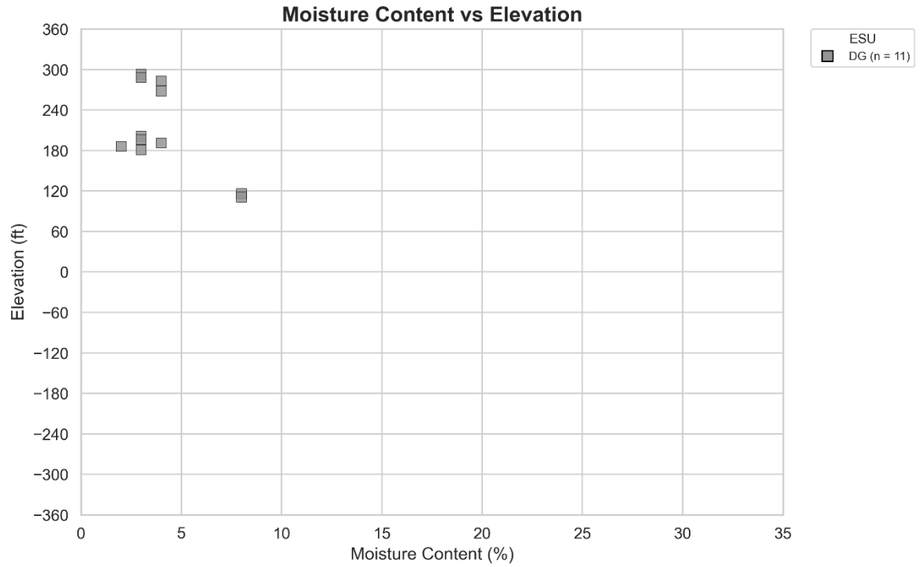
EMPRISE CONCEPTS

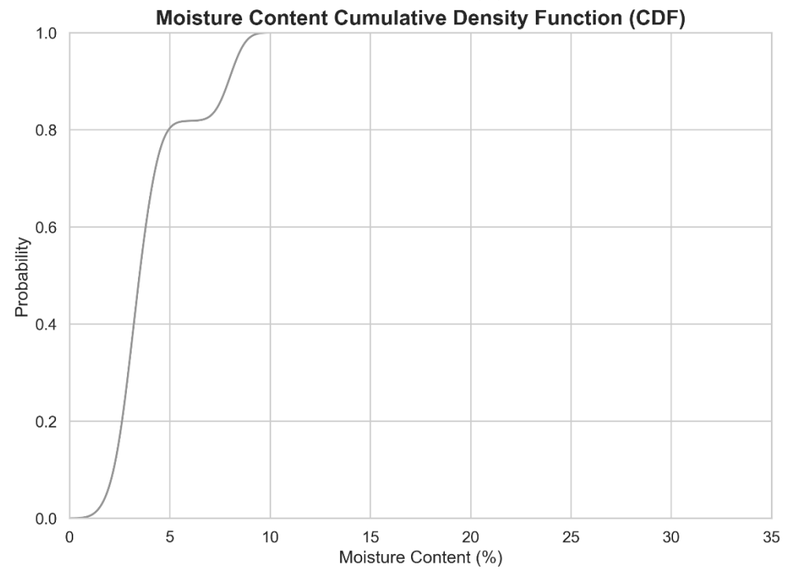
Anchorage, Alaska | August 2025

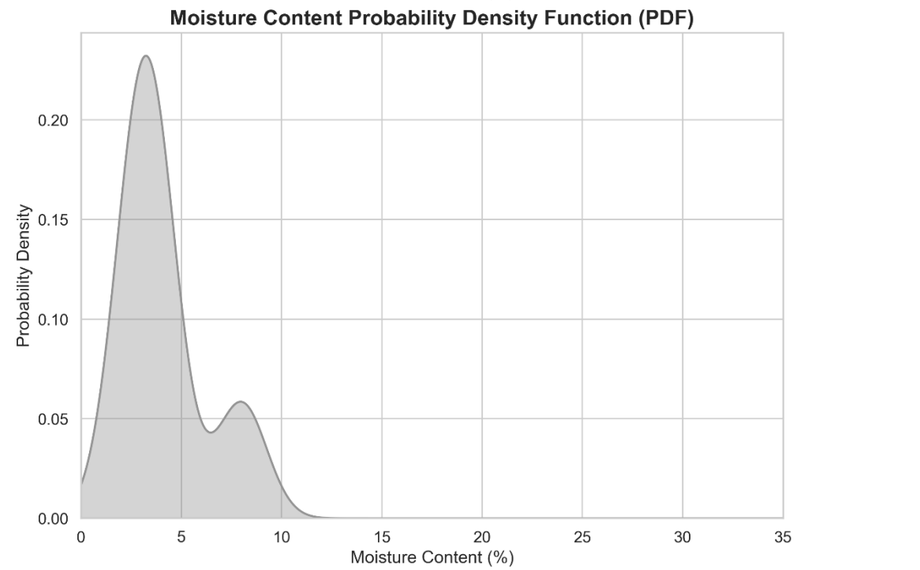
Figure **A-20**

DG (n = 11) - Point MacKenzie Landside Borings









Moisture Content – Point MacKenzie Landside Borings, ESU DG

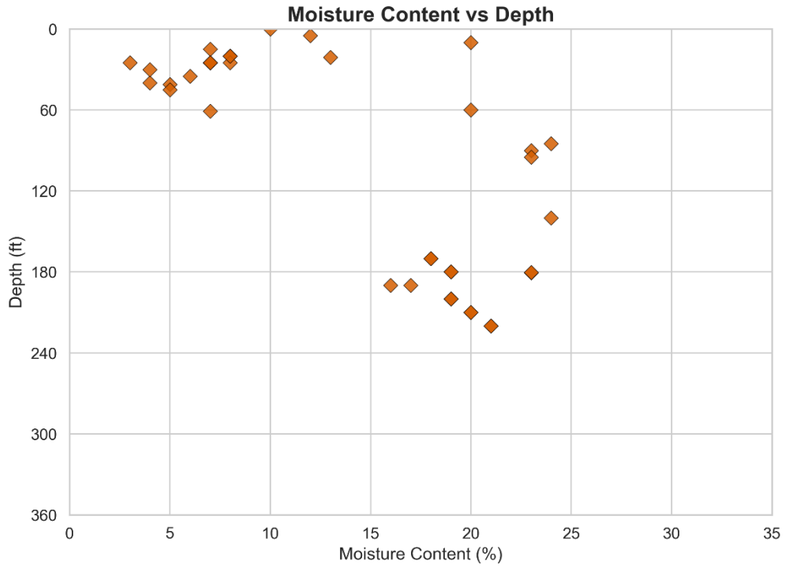
Knik Arm Tunnel Feasibility Study

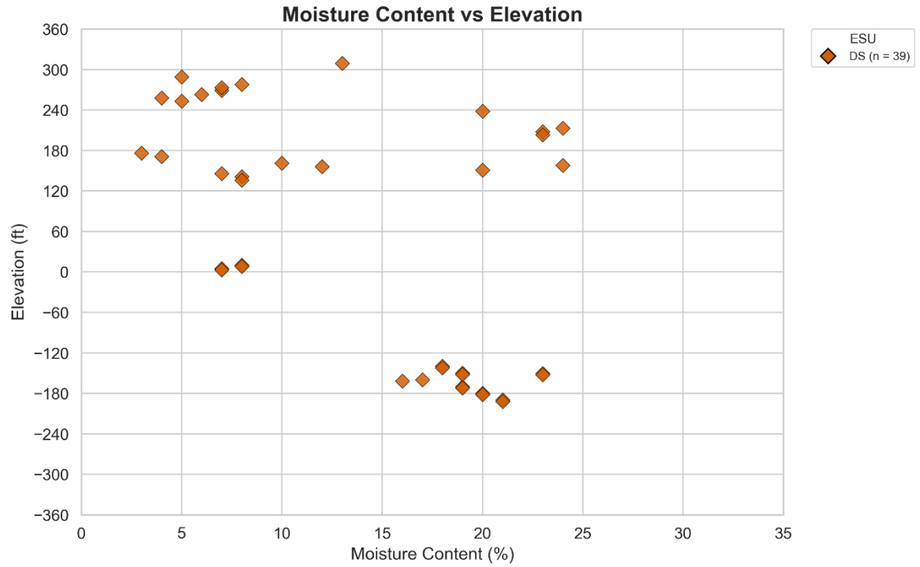
EMPRISE CONCEPTS

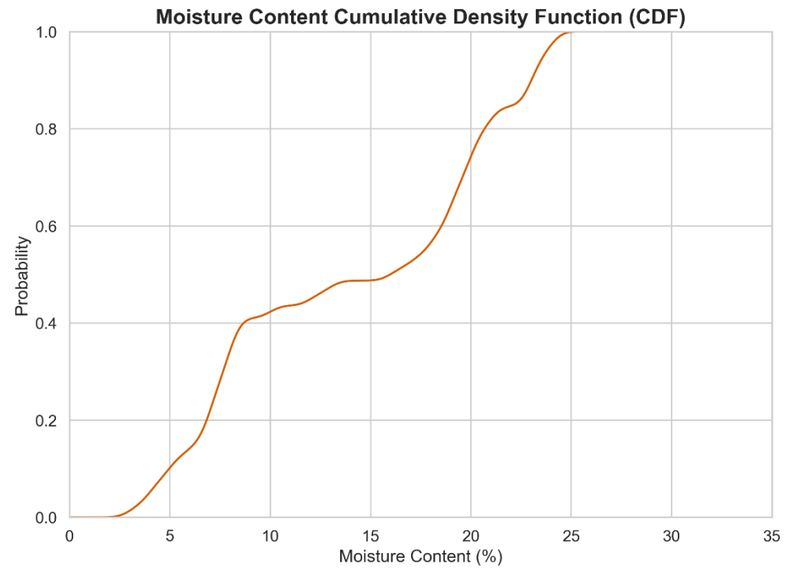
Anchorage, Alaska | August 2025

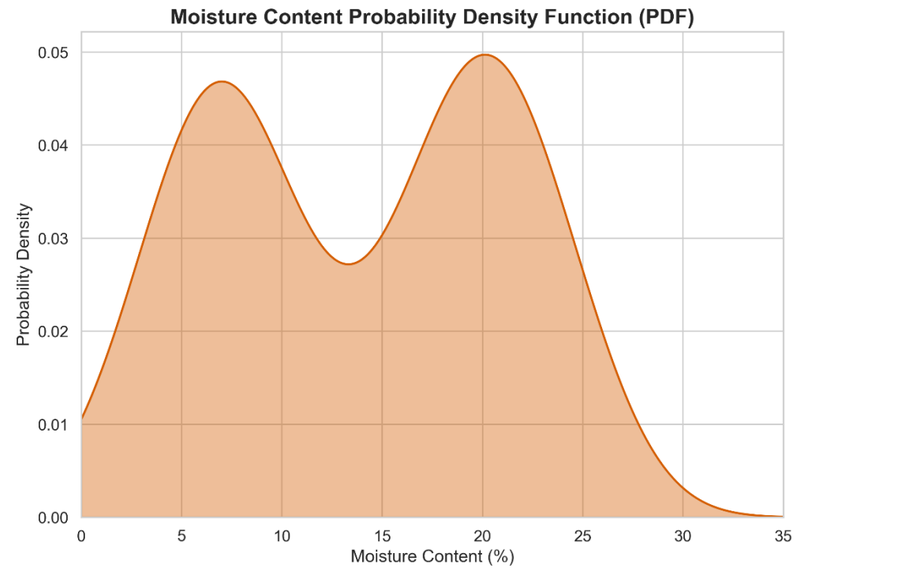
Figure **A-21**

DS (n = 39) - Point MacKenzie Landside Borings









Moisture Content – Point MacKenzie Landside Borings, ESU DS

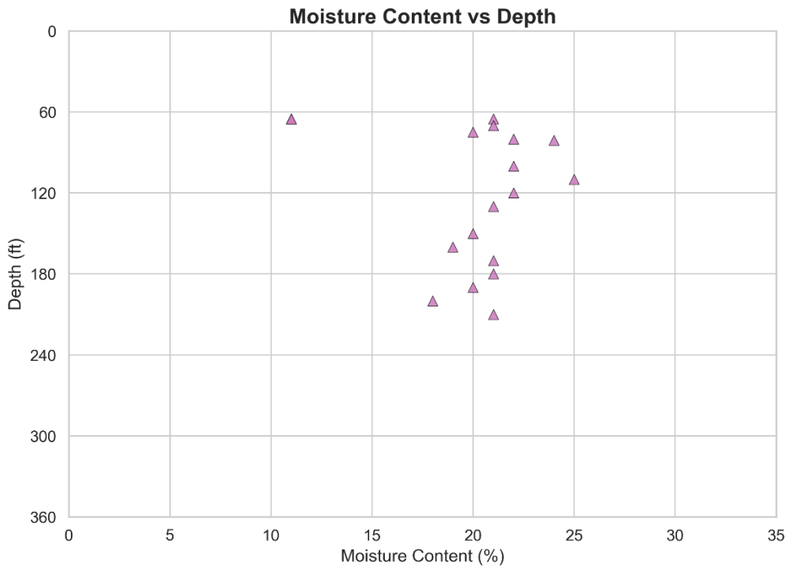
Knik Arm Tunnel Feasibility Study

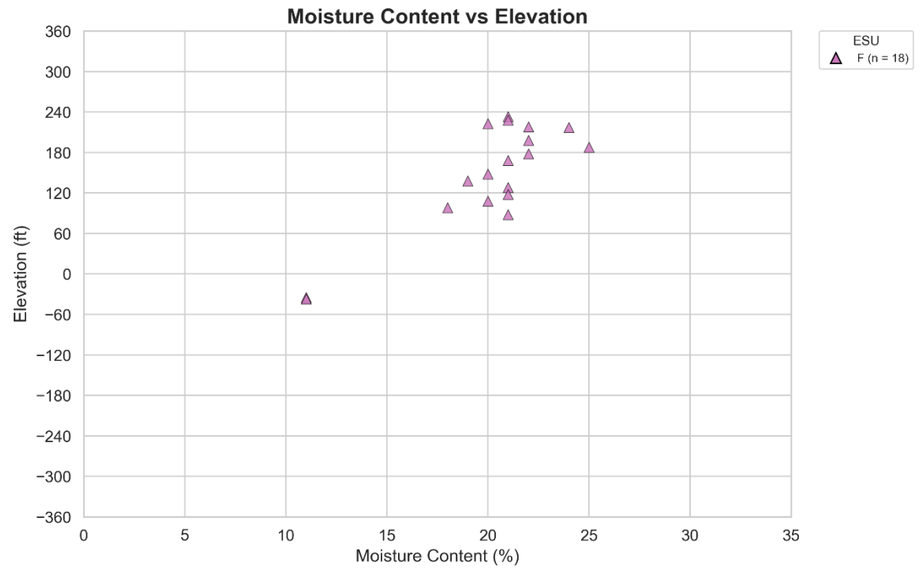
EMPRISE CONCEPTS

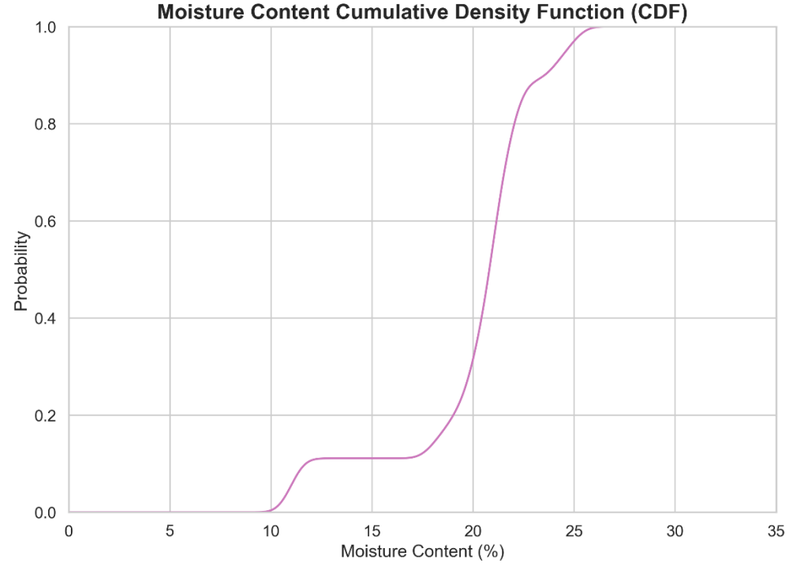
Anchorage, Alaska | August 2025

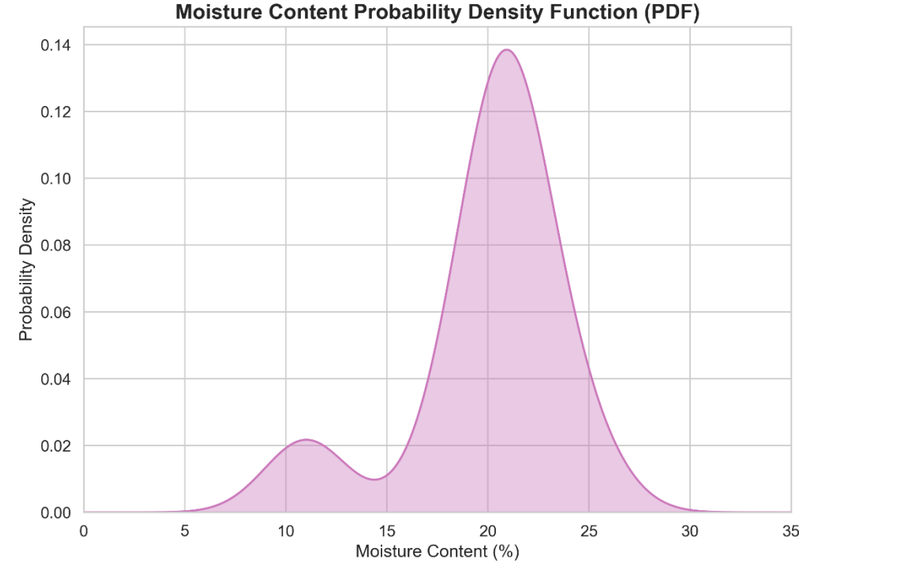
Figure **A-22**

F (n = 18) - Point MacKenzie Landside Borings









Moisture Content – Point MacKenzie Landside Borings, ESU F

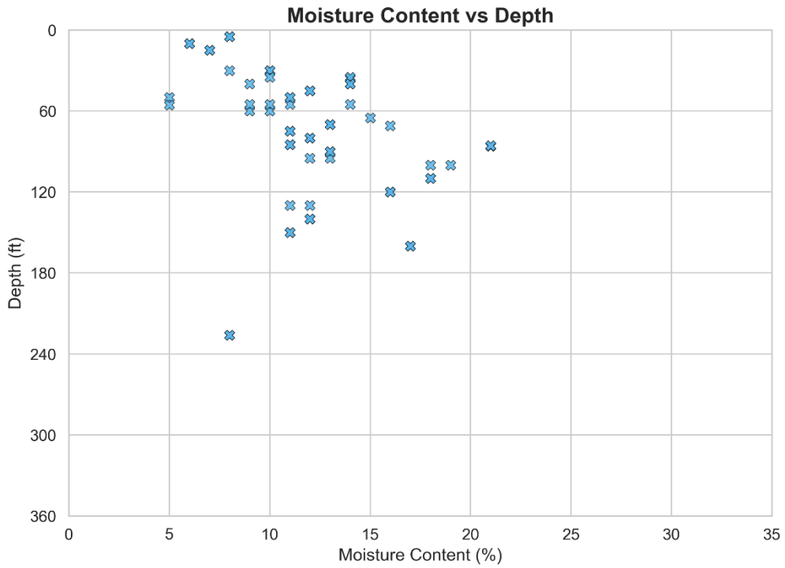
Knik Arm Tunnel Feasibility Study

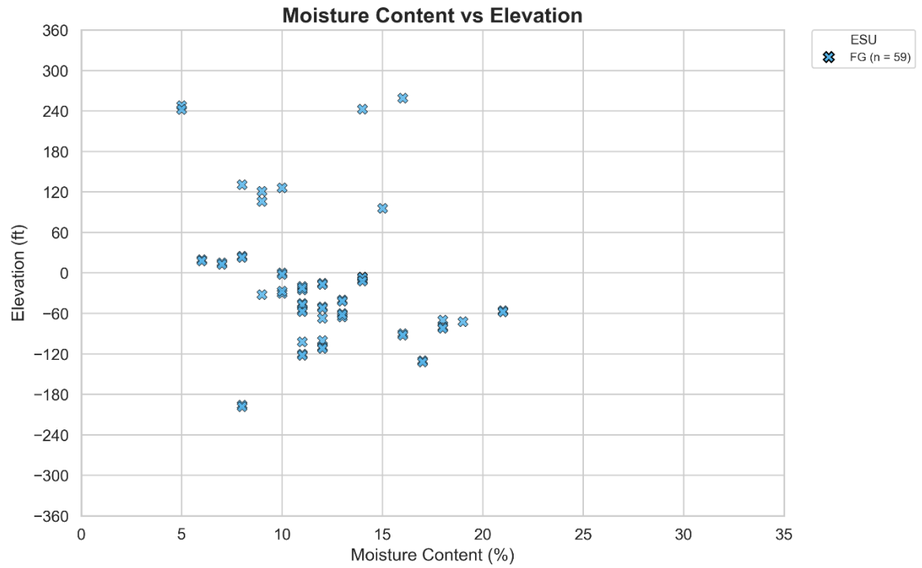
EMPRISE CONCEPTS

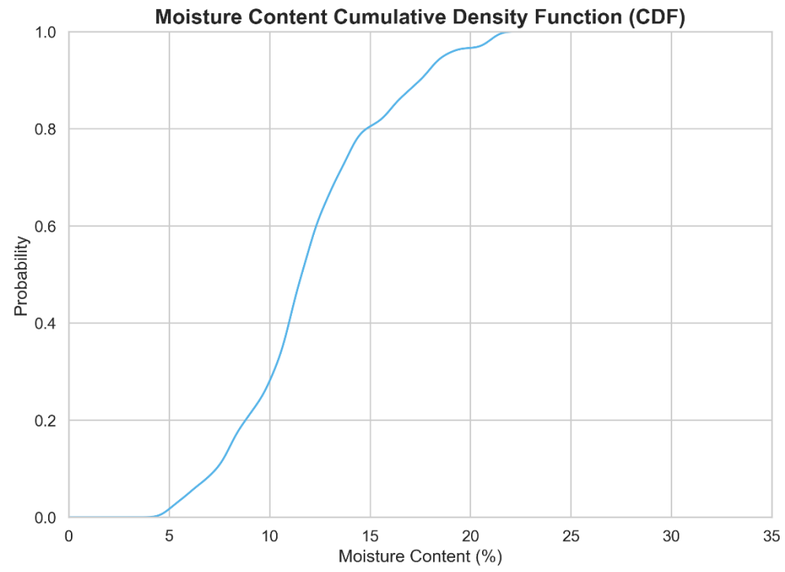
Anchorage, Alaska | August 2025

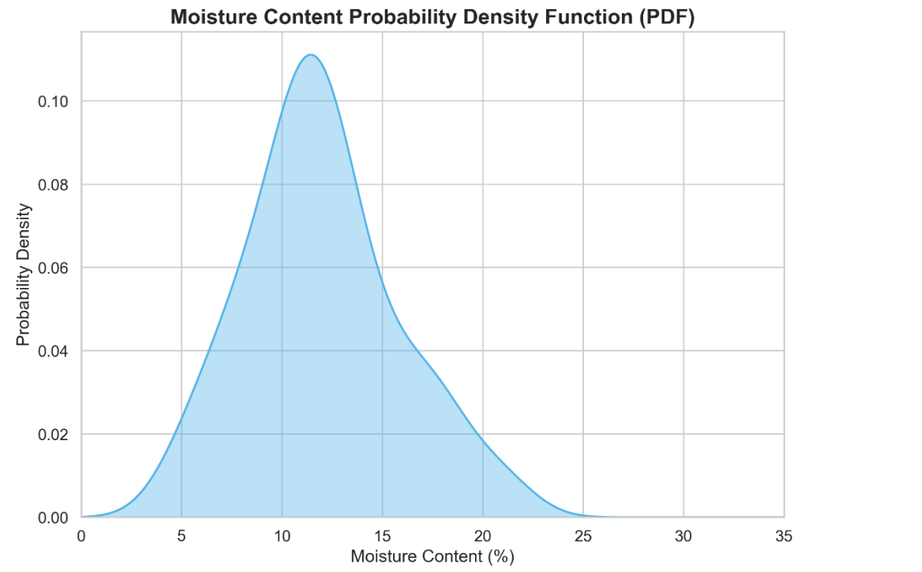
Figure **A-23**

FG (n = 59) - Point MacKenzie Landside Borings









Moisture Content – Point MacKenzie Landside Borings, ESU FG

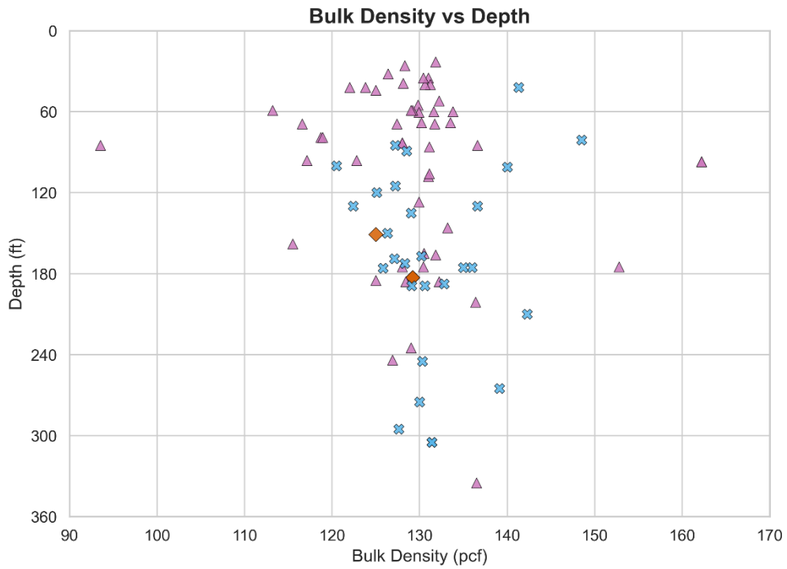
Knik Arm Tunnel Feasibility Study

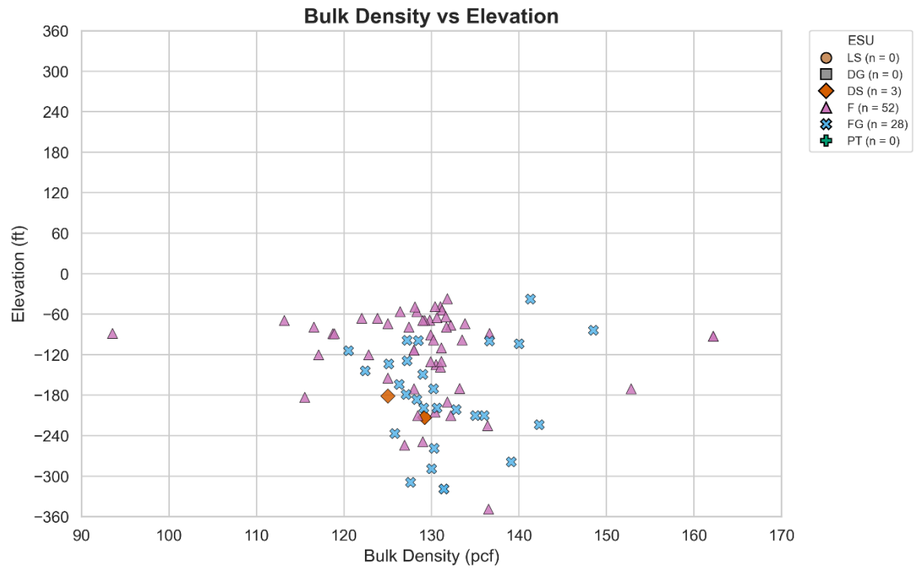
EMPRISE CONCEPTS

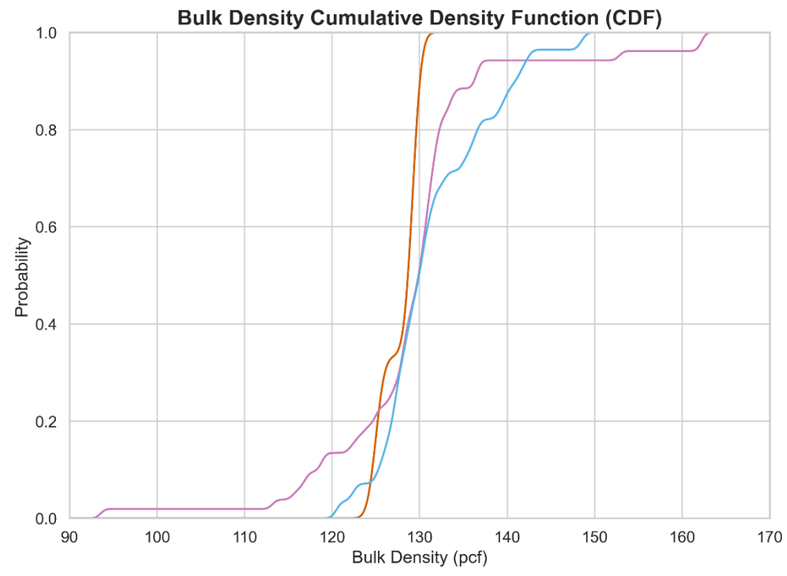
Anchorage, Alaska | August 2025

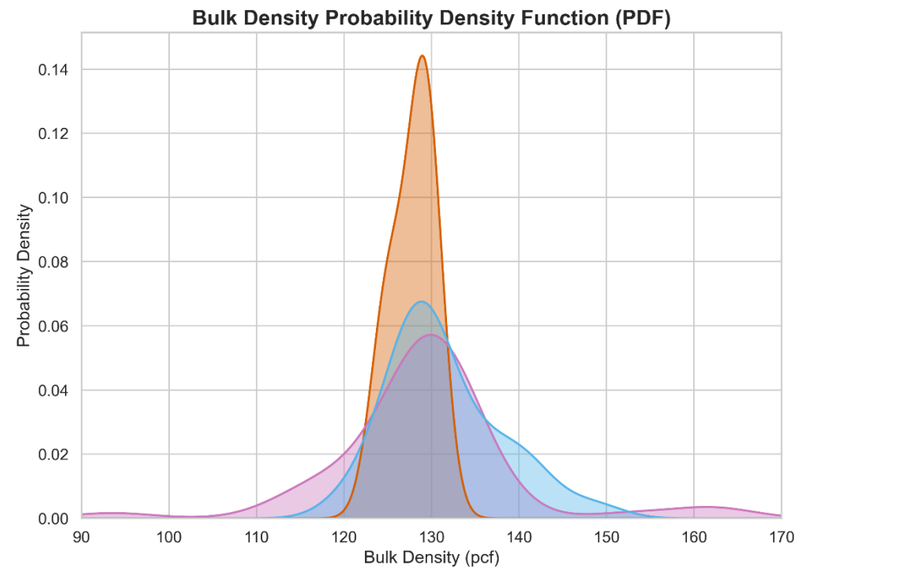
Figure **A-24**

All Borings









Bulk Density – All Borings, All ESUs

Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure **B-1**

NO DATA

Bulk Density – All Borings, ESU LS

Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure

B-2

NO DATA

Bulk Density – All Borings, ESU DG

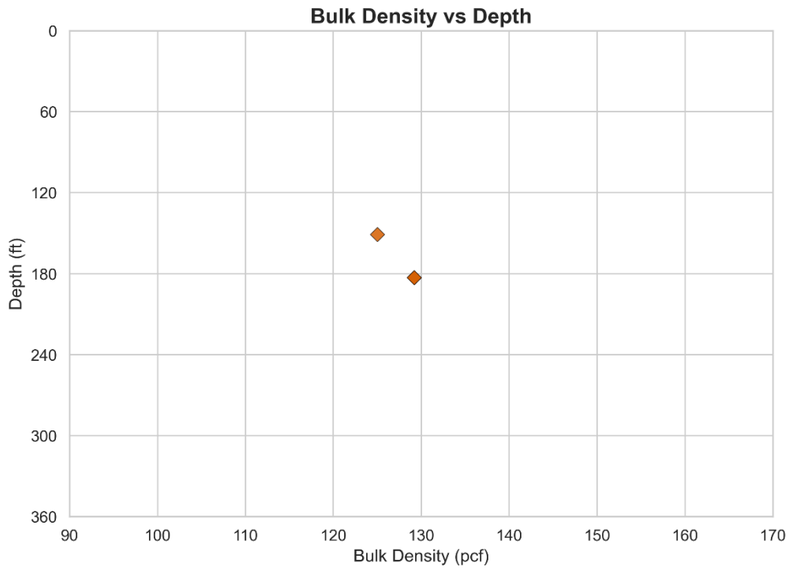
Knik Arm Tunnel Feasibility Study

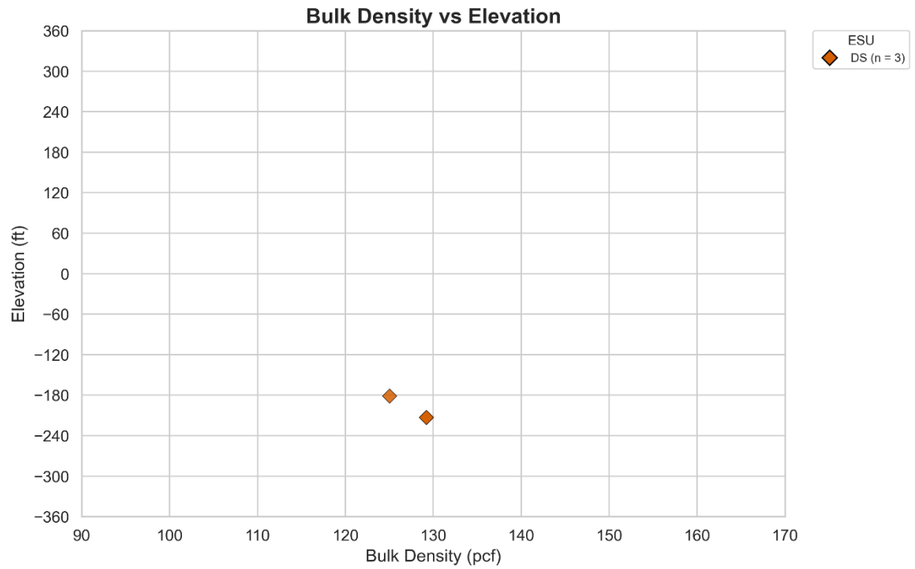
EMPRISE CONCEPTS

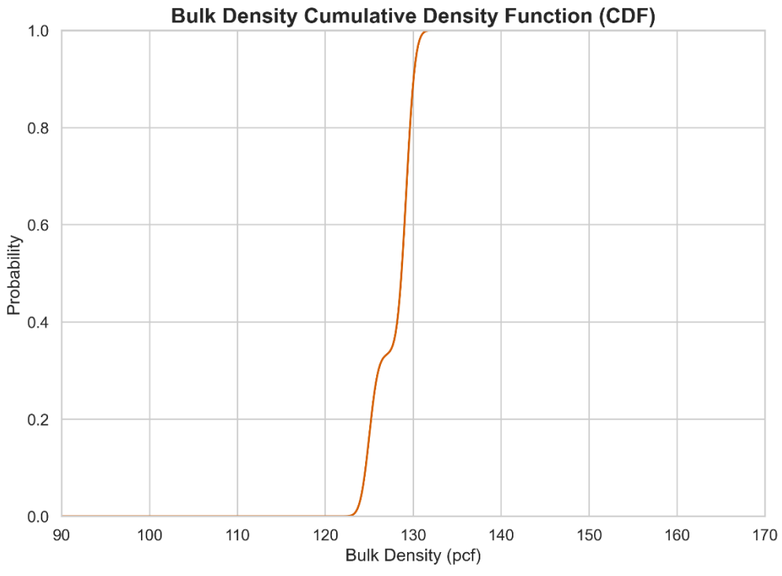
Anchorage, Alaska | August 2025

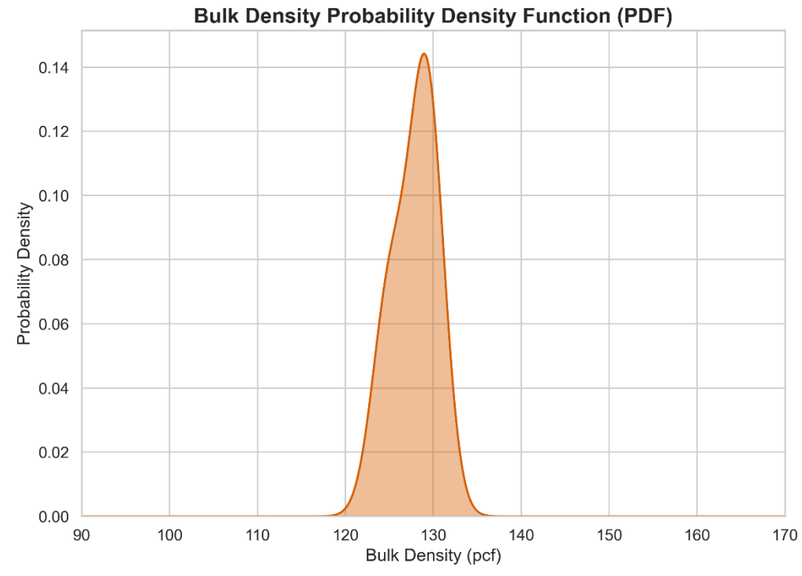
Figure **B-3**

DS (n = 3) - All Borings









Bulk Density – All Borings, ESU DS

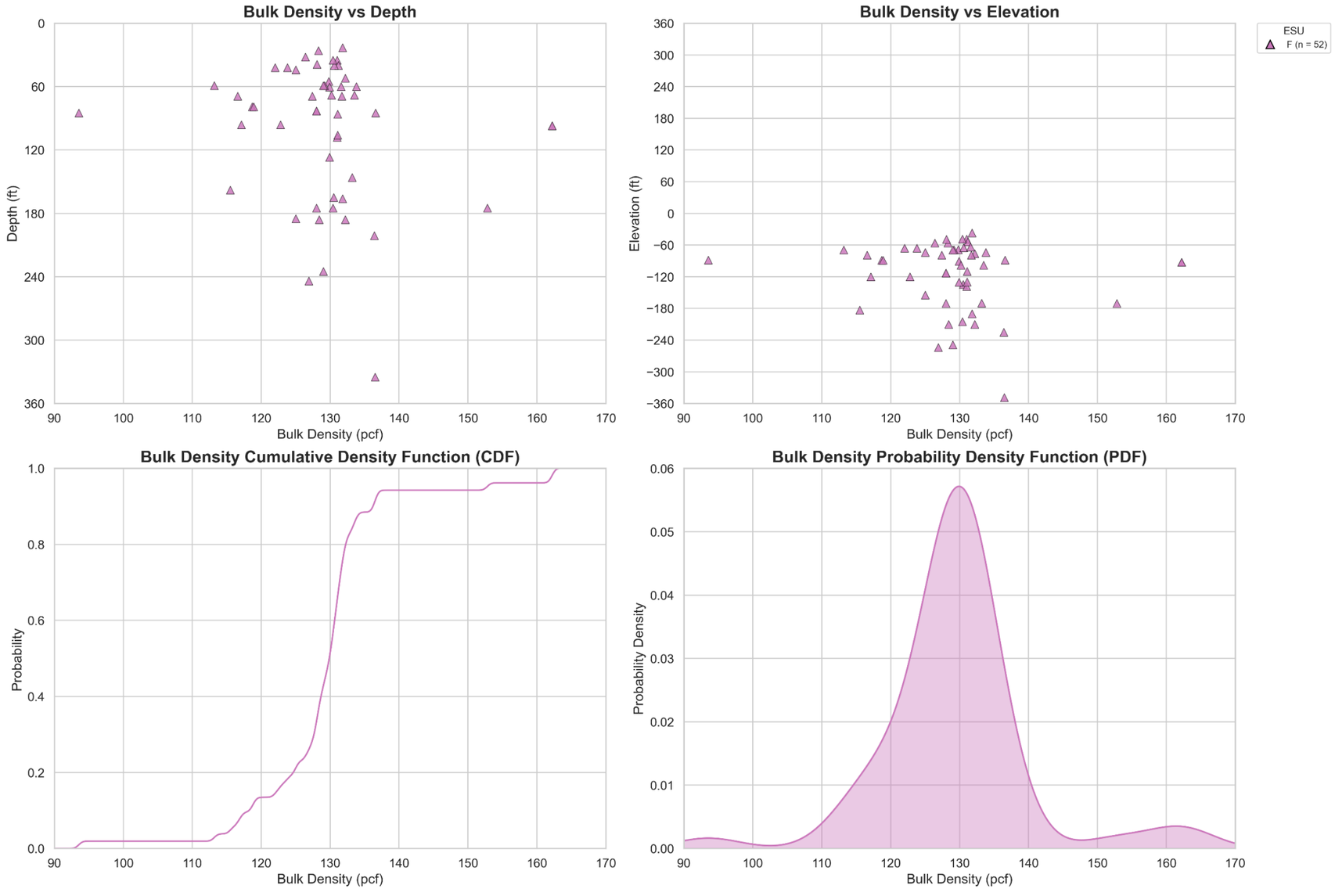
Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure **B-4**

F (n = 52) - All Borings



Bulk Density – All Borings, ESU F

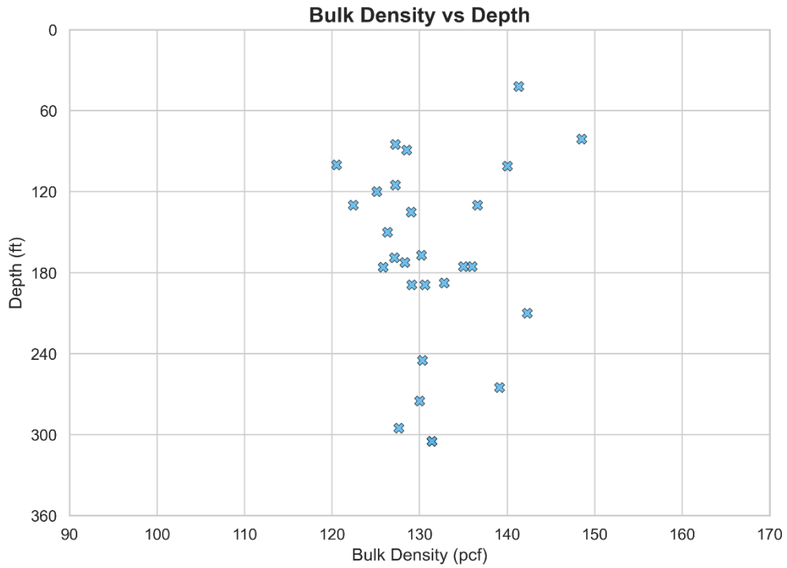
Knik Arm Tunnel Feasibility Study

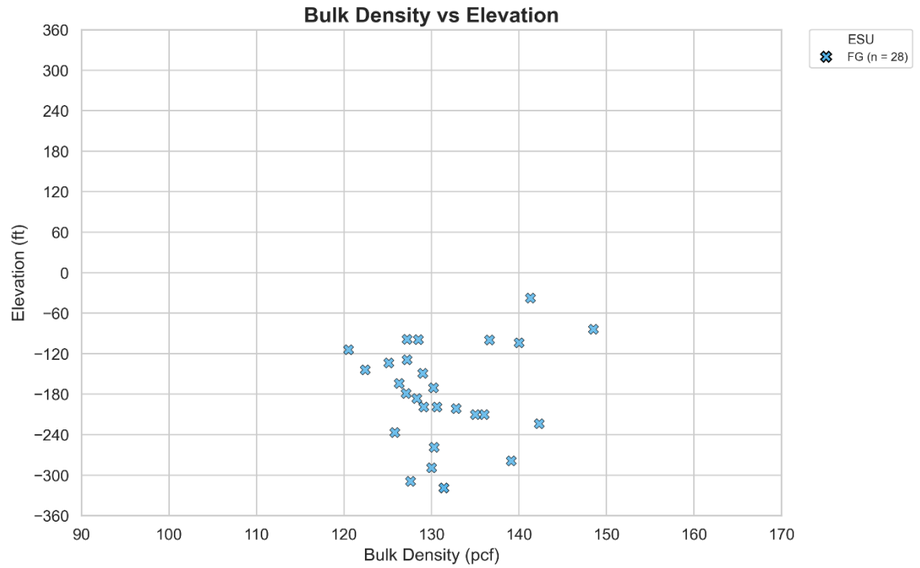
EMPRISE CONCEPTS

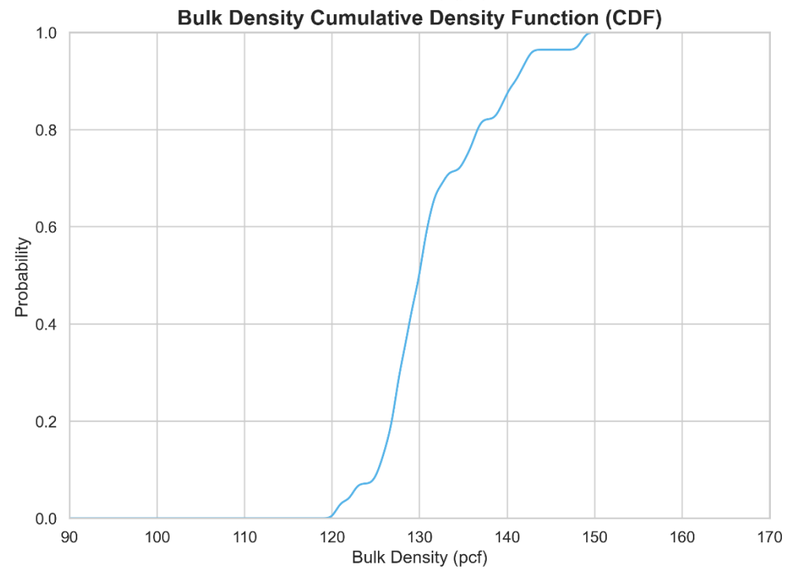
Anchorage, Alaska | August 2025

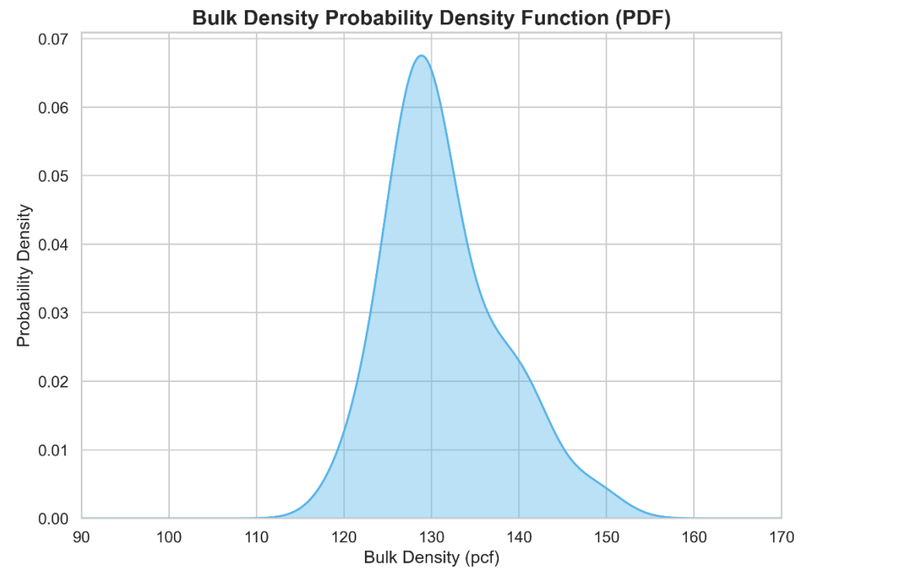
Figure **B-5**

FG (n = 28) - All Borings









Bulk Density – All Borings, ESU FG

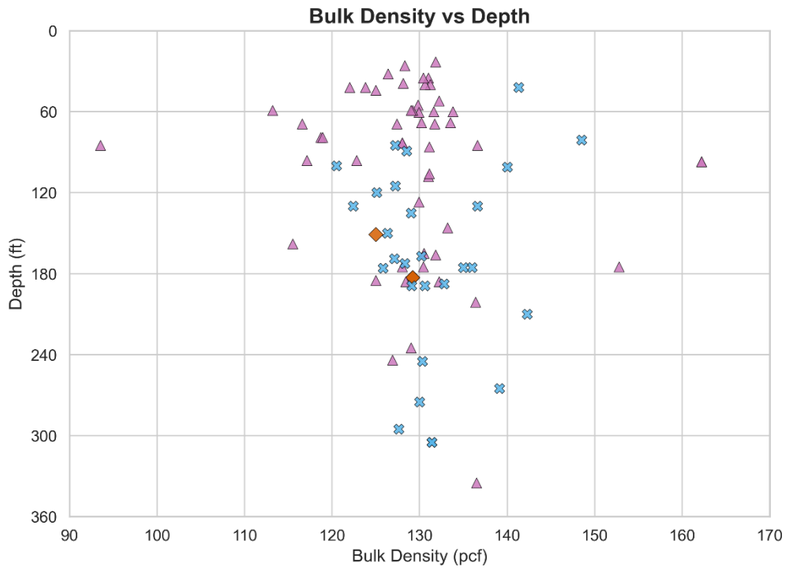
Knik Arm Tunnel Feasibility Study

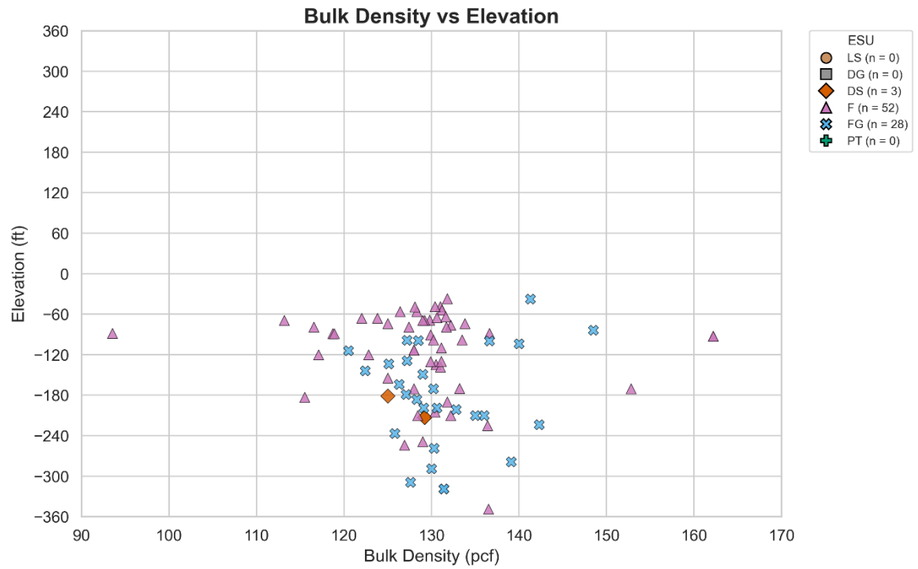
EMPRISE CONCEPTS

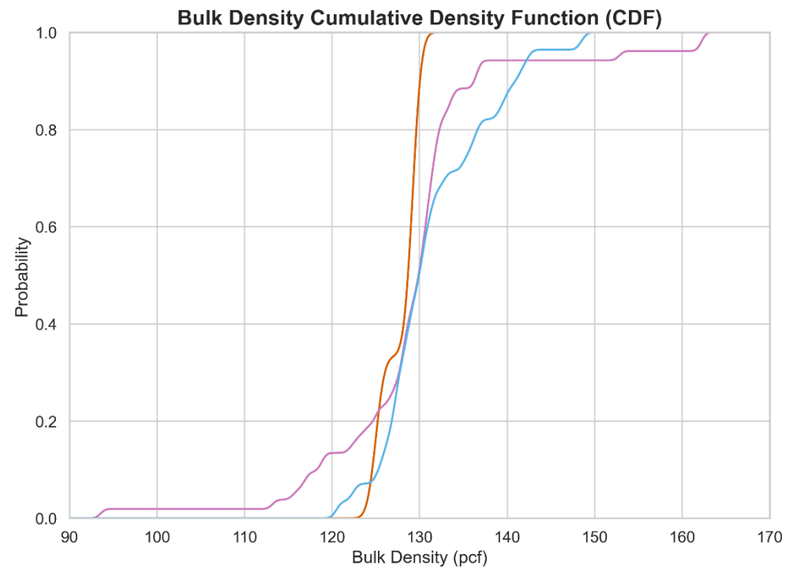
Anchorage, Alaska | August 2025

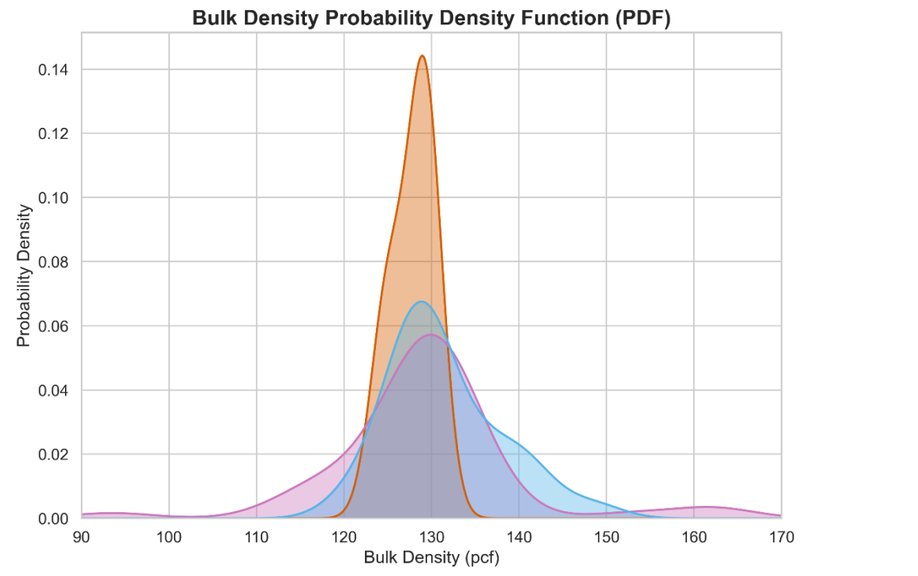
Figure **B-6**

Overwater Borings









Bulk Density – Overwater Borings, All ESUs

Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure **B-7**

NO DATA

Bulk Density – Overwater Borings, ESU LS

Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure **B-8**

NO DATA

Bulk Density – Overwater Borings, ESU DG

Knik Arm Tunnel Feasibility Study

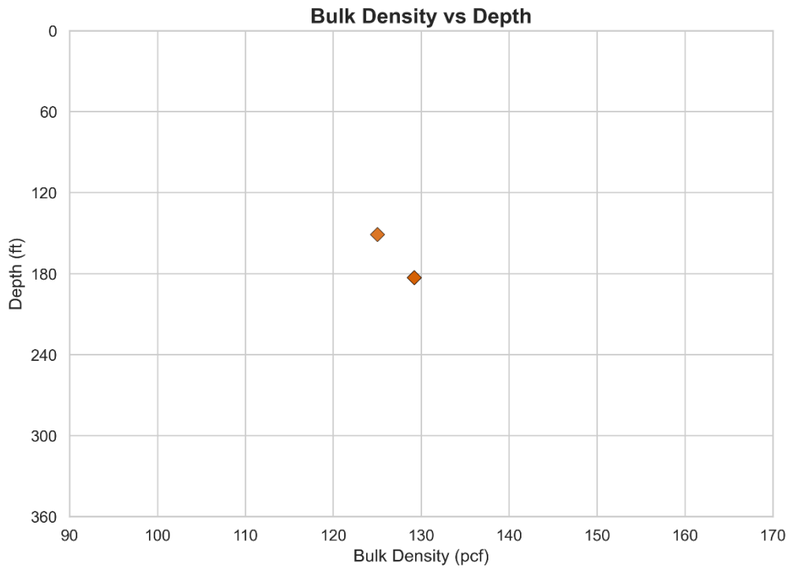
EMPRISE CONCEPTS

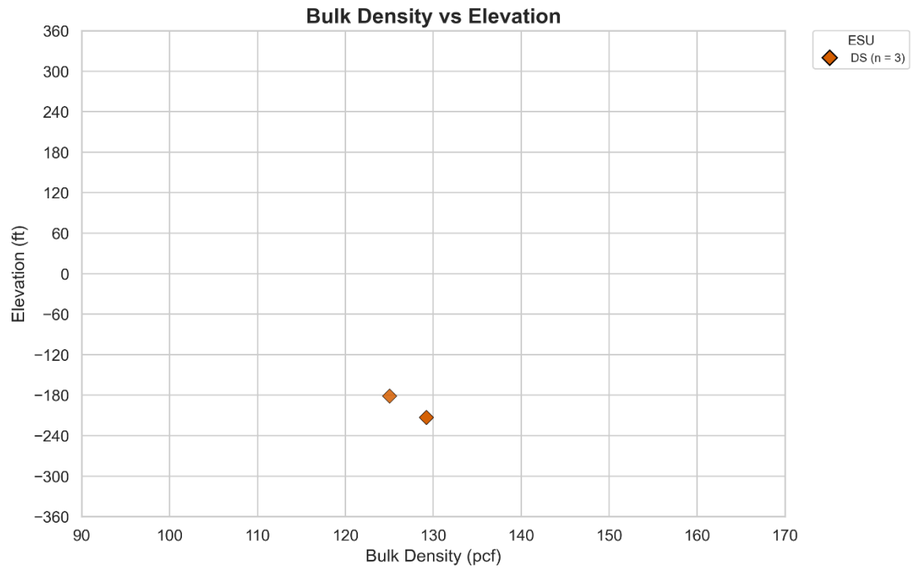
Anchorage, Alaska | August 2025

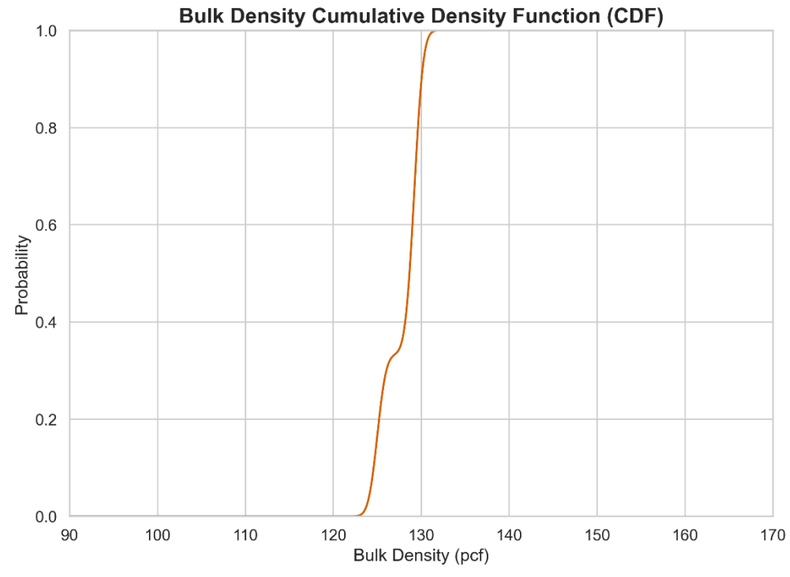
Figure

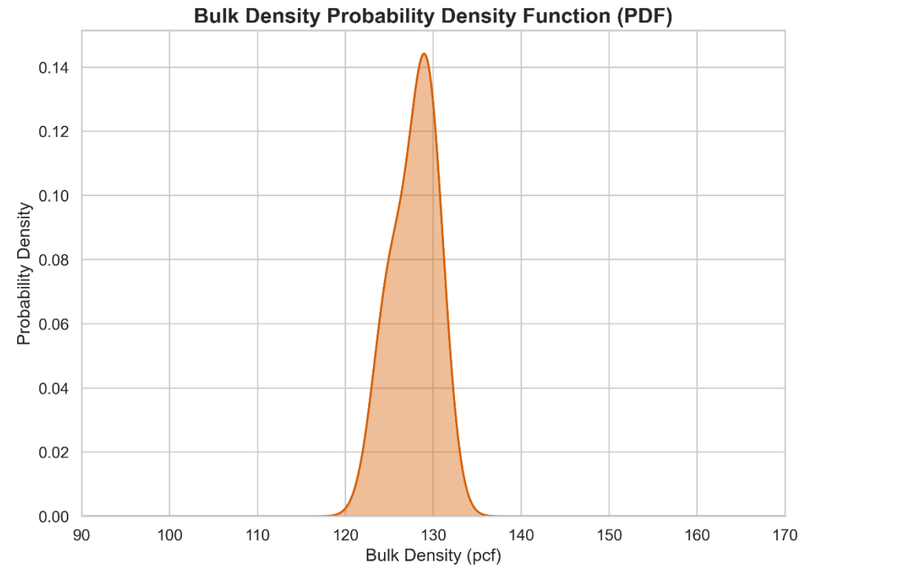
B-9

DS (n = 3) - Overwater Borings









Bulk Density – Overwater Borings, ESU DS

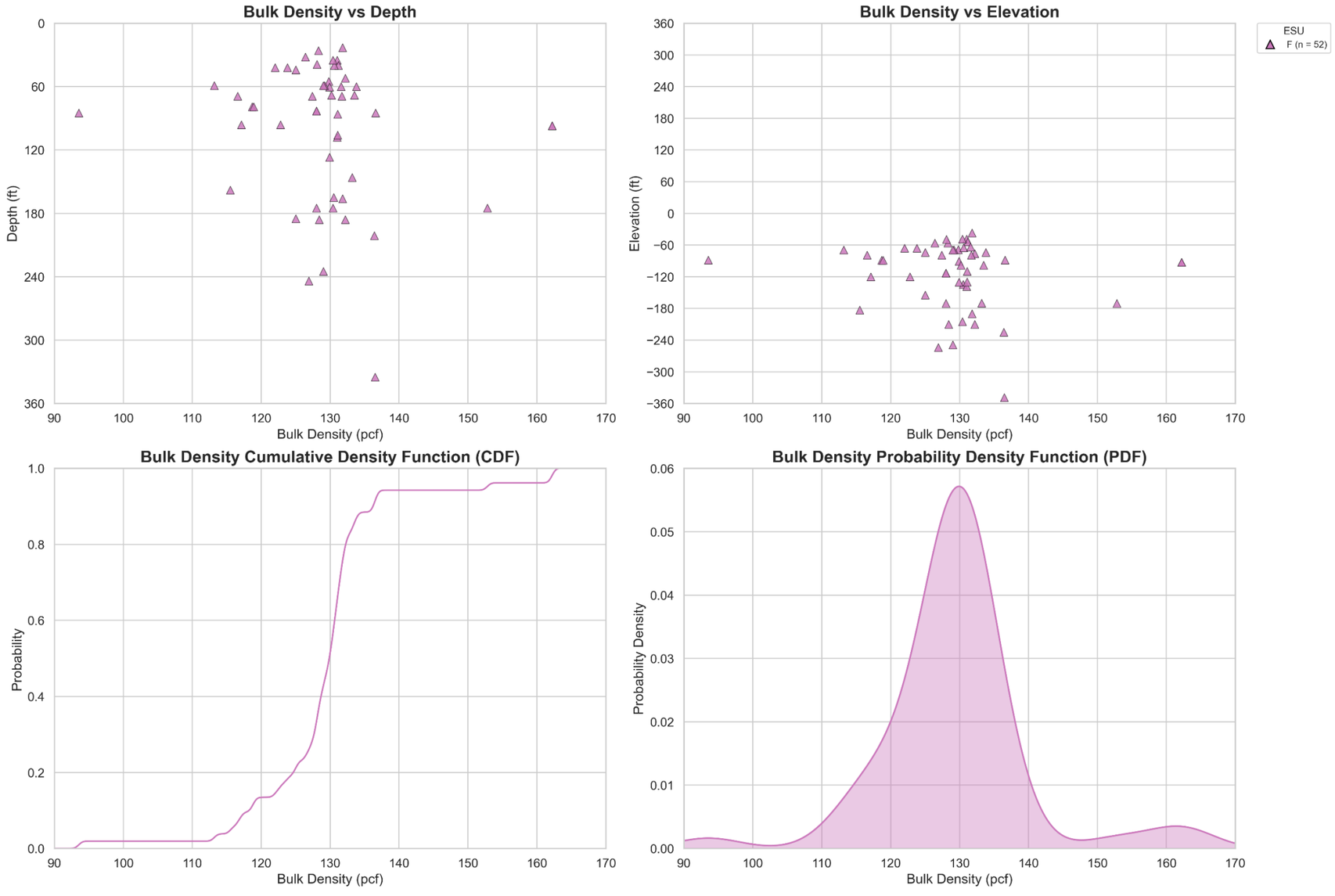
Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure **B-10**

F (n = 52) - Overwater Borings



Bulk Density – Overwater Borings, ESU F

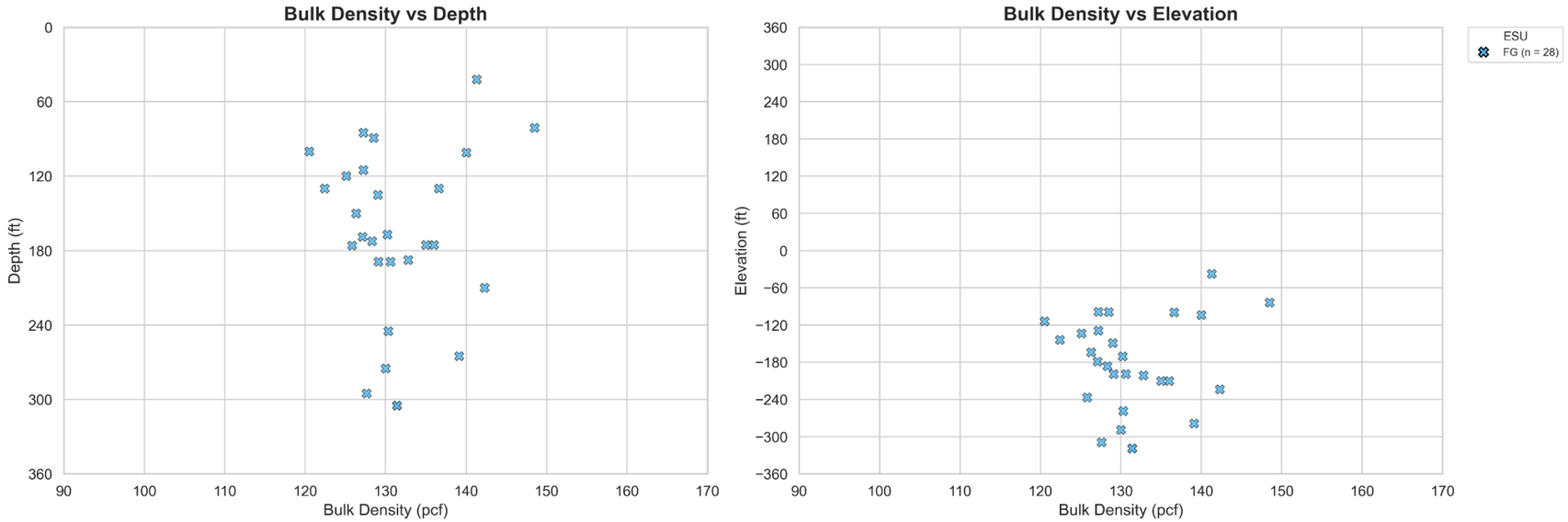
Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure
B-11

FG (n = 28) - Overwater Borings



Bulk Density – Overwater Borings, ESU FG

Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure **B-12**

NO DATA

Bulk Density – Anchorage Landside Borings, All ESUs

Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure

B-13

NO DATA

Bulk Density – Anchorage Landside Borings, ESU LS

Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure **B-14**

NO DATA

Bulk Density – Anchorage Landside Borings, ESU DG

Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure **B-15**

NO DATA

Bulk Density – Anchorage Landside Borings, ESU DS

Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure **B-16**

NO DATA

Bulk Density – Anchorage Landside Borings, ESU F

Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure **B-17**

NO DATA

Bulk Density – Anchorage Landside Borings, ESU FG

Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure

B-18

NO DATA

Bulk Density – Point MacKenzie Landside Borings, All ESUs

Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure **B-19**

NO DATA

Bulk Density – Point MacKenzie Landside Borings, ESU LS

Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure **B-20**

NO DATA

Bulk Density – Point MacKenzie Landside Borings, ESU DG

Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure **B-21**

NO DATA

Bulk Density – Point MacKenzie Landside Borings, ESU DS

Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure

B-22

NO DATA

Bulk Density – Point MacKenzie Landside Borings, ESU F

Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure **B-23**

NO DATA

Bulk Density – Point MacKenzie Landside Borings, ESU FG

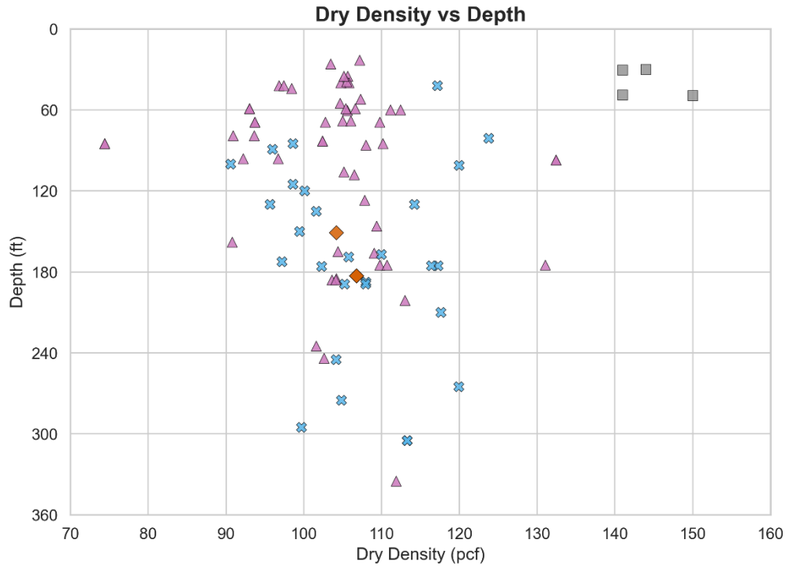
Knik Arm Tunnel Feasibility Study

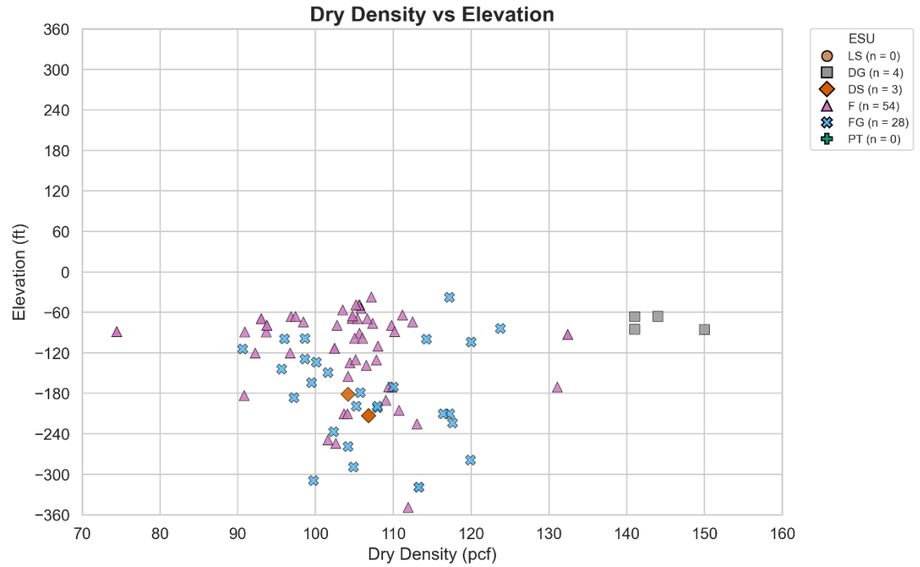
EMPRISE CONCEPTS

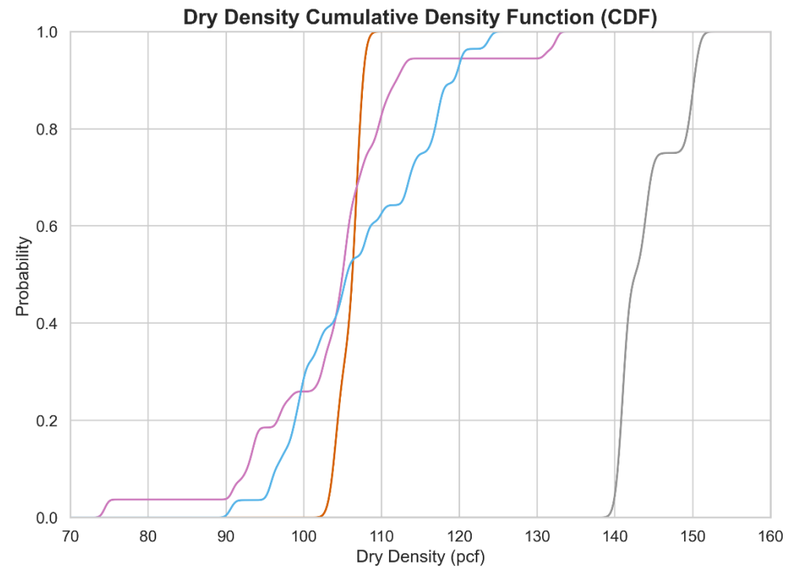
Anchorage, Alaska | August 2025

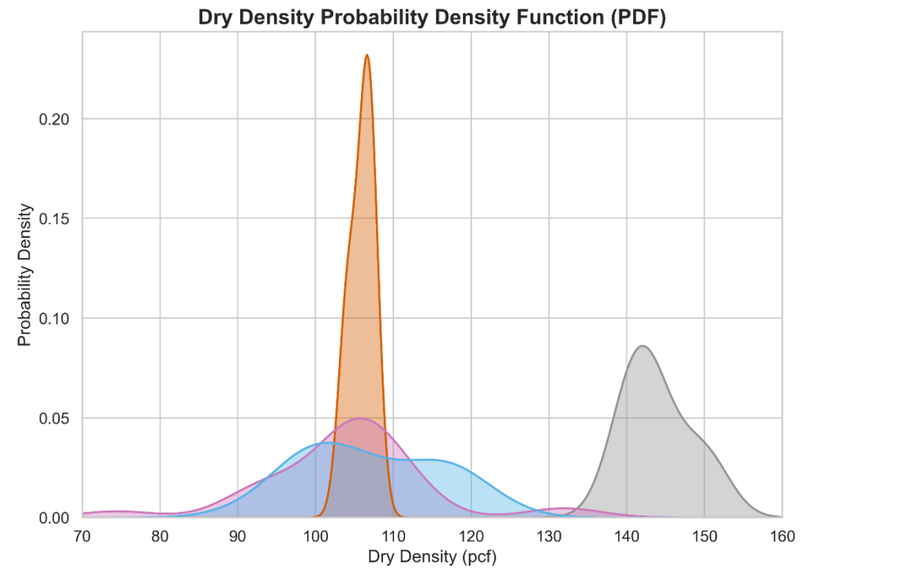
Figure **B-24**

All Borings









Dry Density – All Borings, All ESUs

Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure C-1

NO DATA

Dry Density – All Borings, ESU LS

Knik Arm Tunnel Feasibility Study

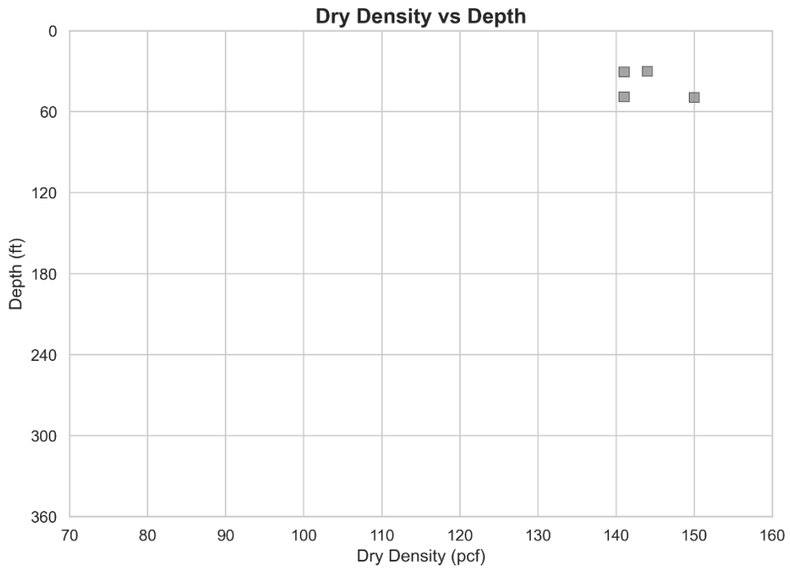
EMPRISE CONCEPTS

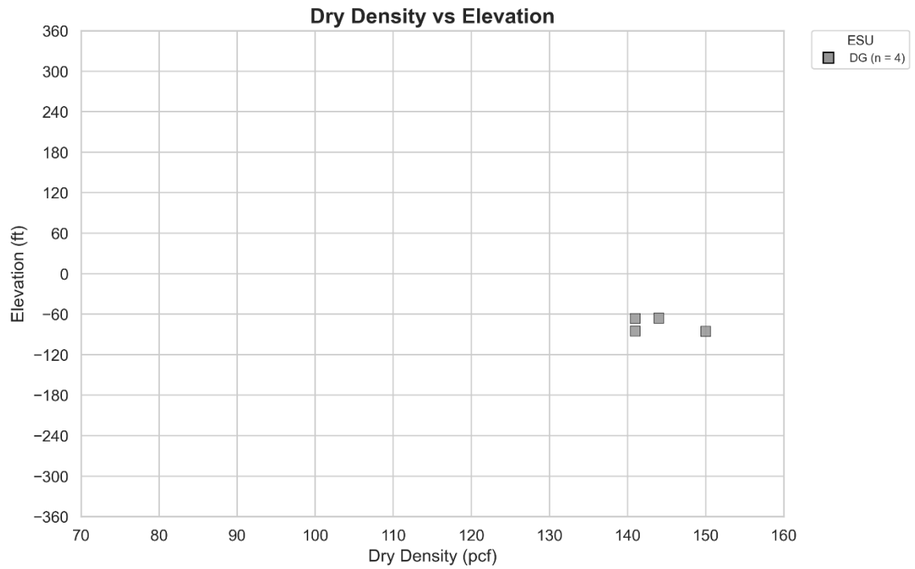
Anchorage, Alaska | August 2025

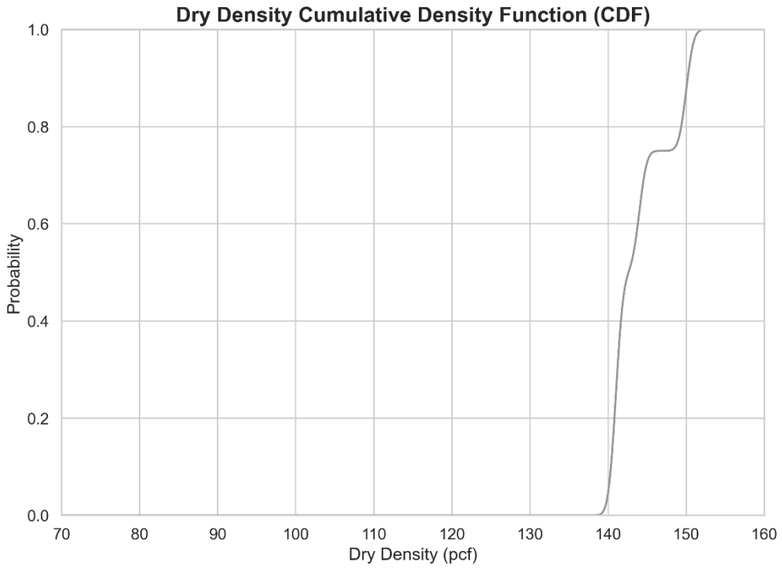
Figure

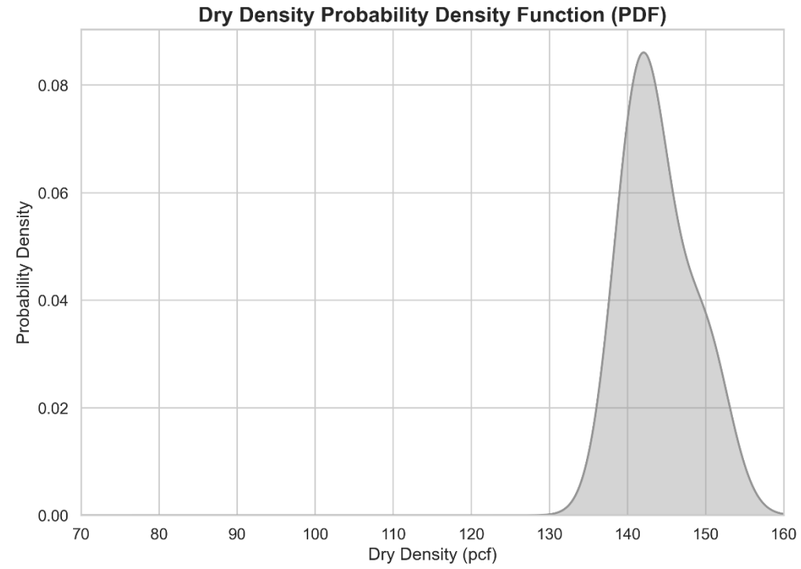
C-2

DG (n = 4) - All Borings









Dry Density – All Borings, ESU DG

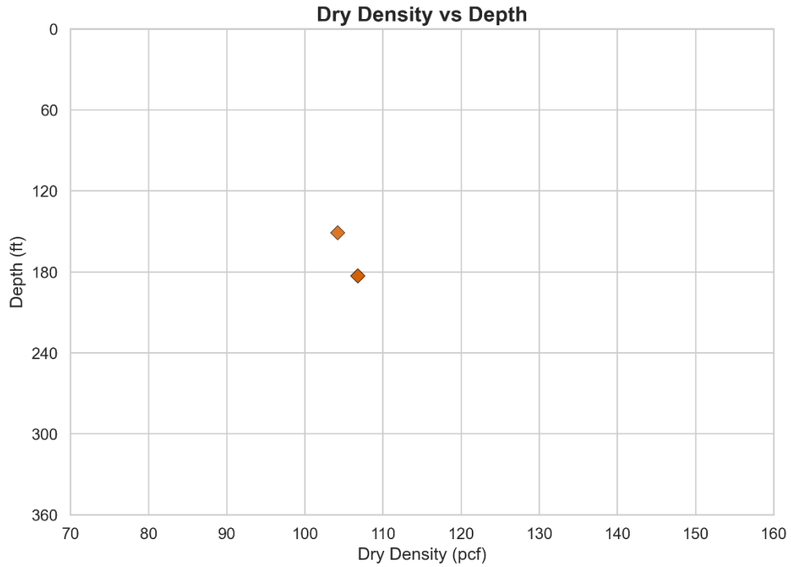
Knik Arm Tunnel Feasibility Study

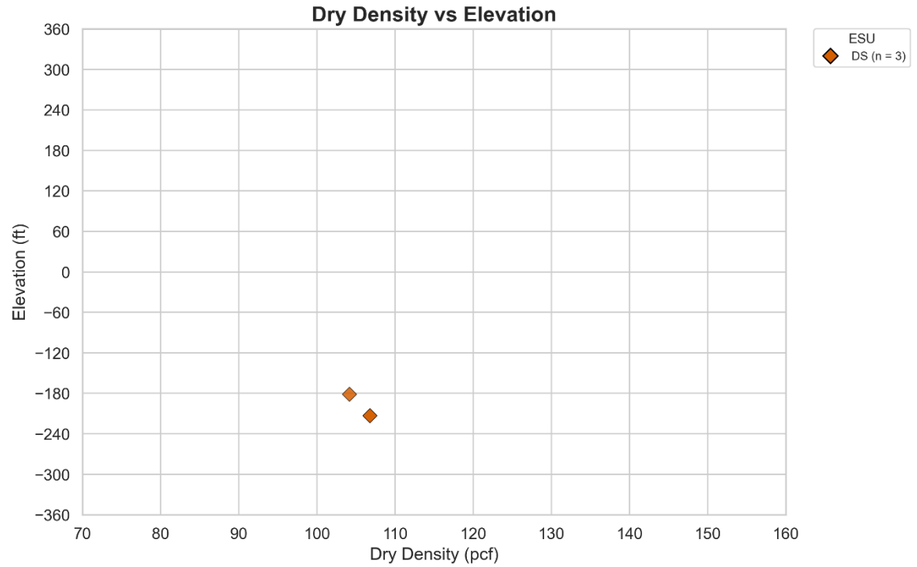
EMPRISE CONCEPTS

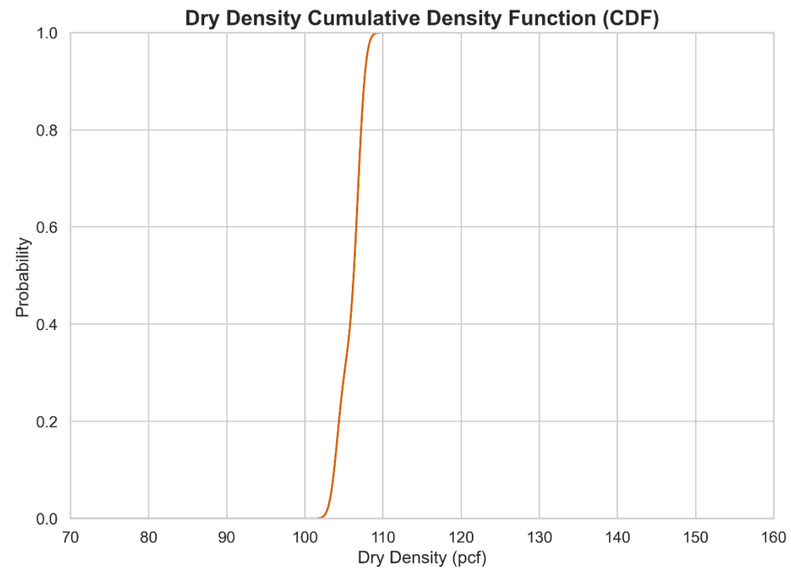
Anchorage, Alaska | August 2025

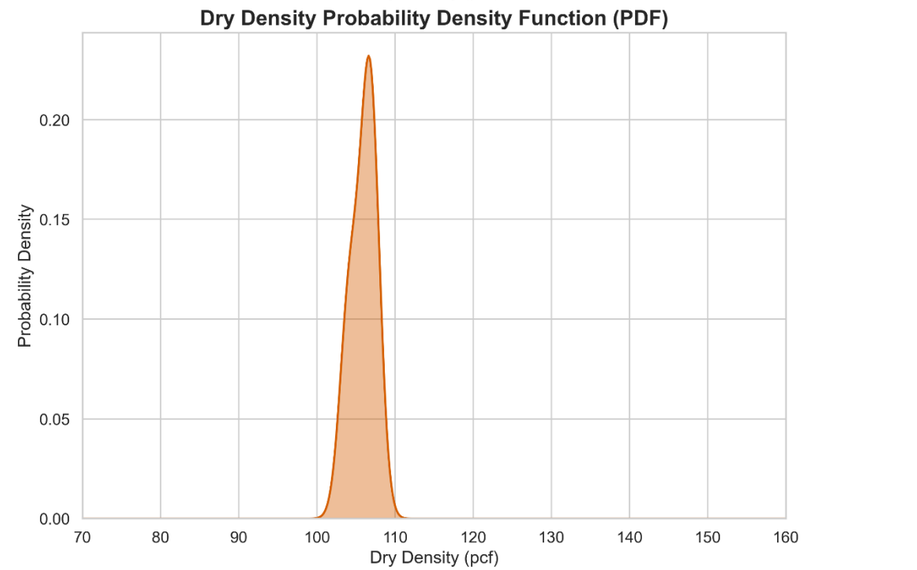
Figure C-3

DS (n = 3) - All Borings









Dry Density – All Borings, ESU DS

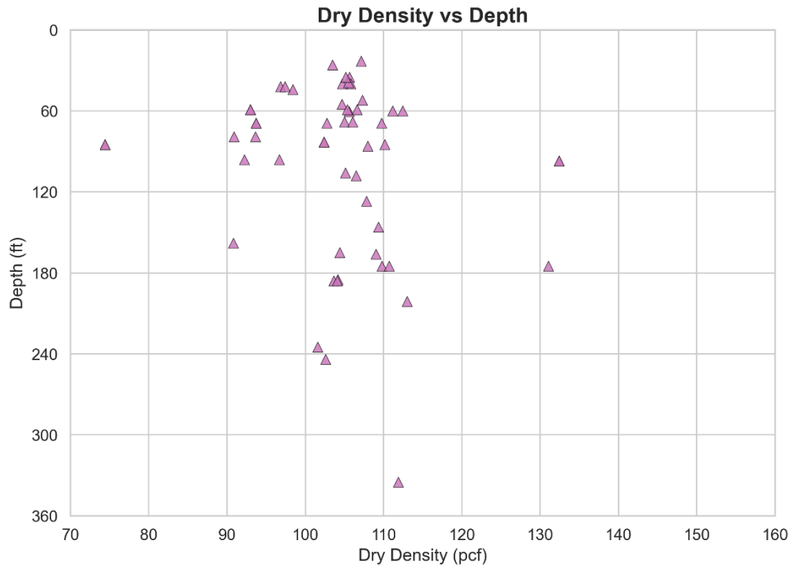
Knik Arm Tunnel Feasibility Study

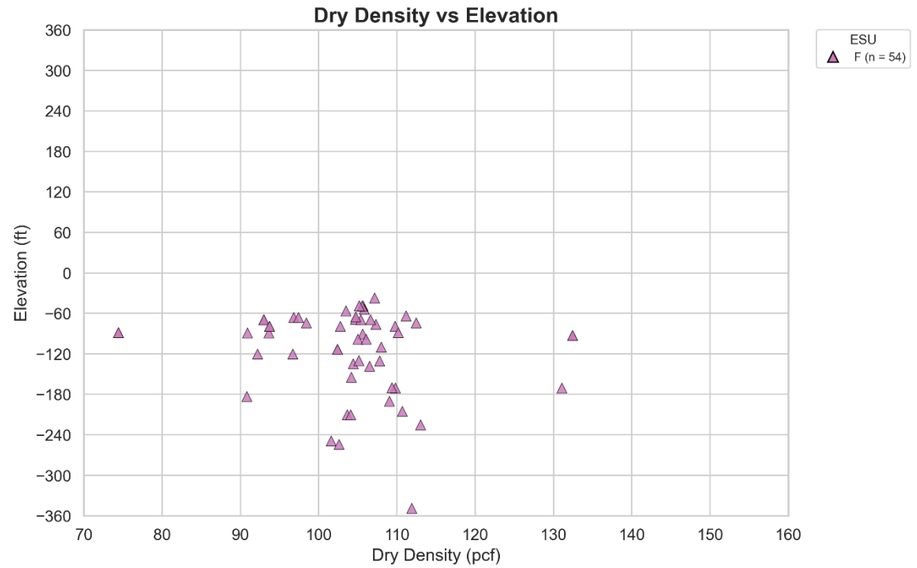
EMPRISE CONCEPTS

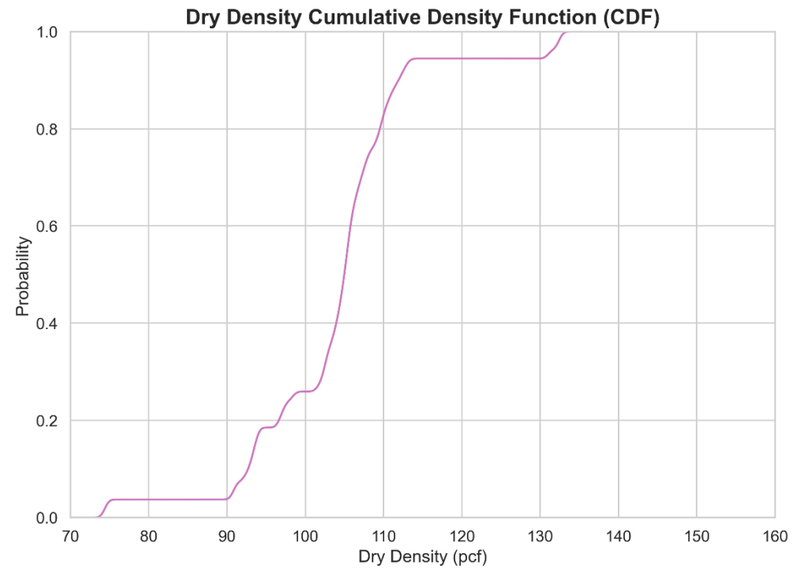
Anchorage, Alaska | August 2025

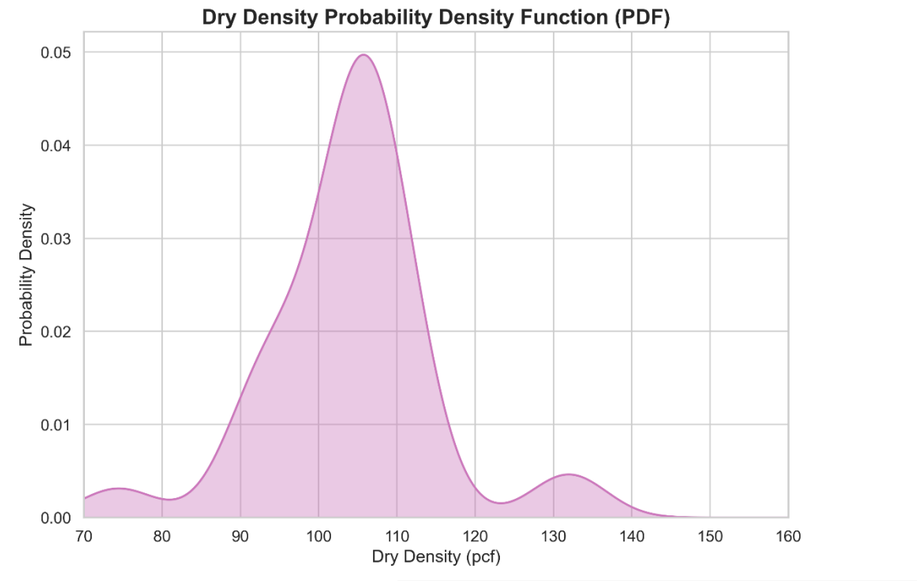
Figure
C-4

F (n = 54) - All Borings









Dry Density – All Borings, ESU F

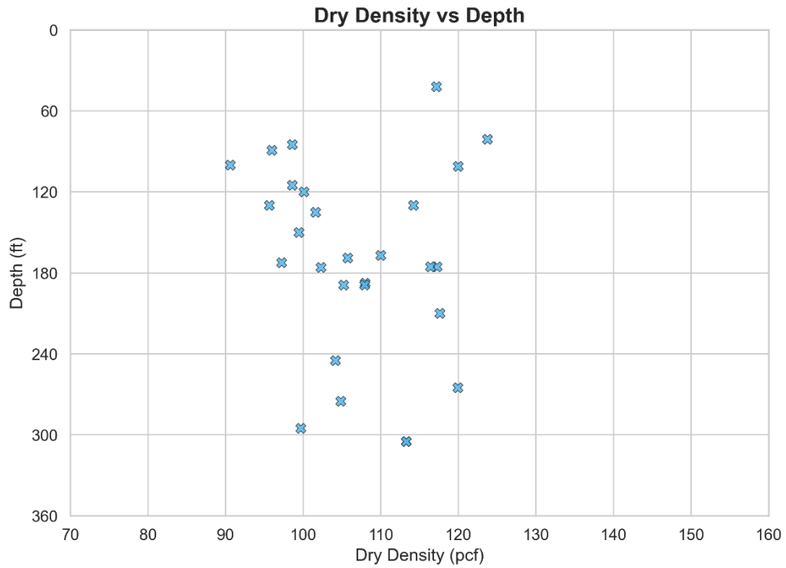
Knik Arm Tunnel Feasibility Study

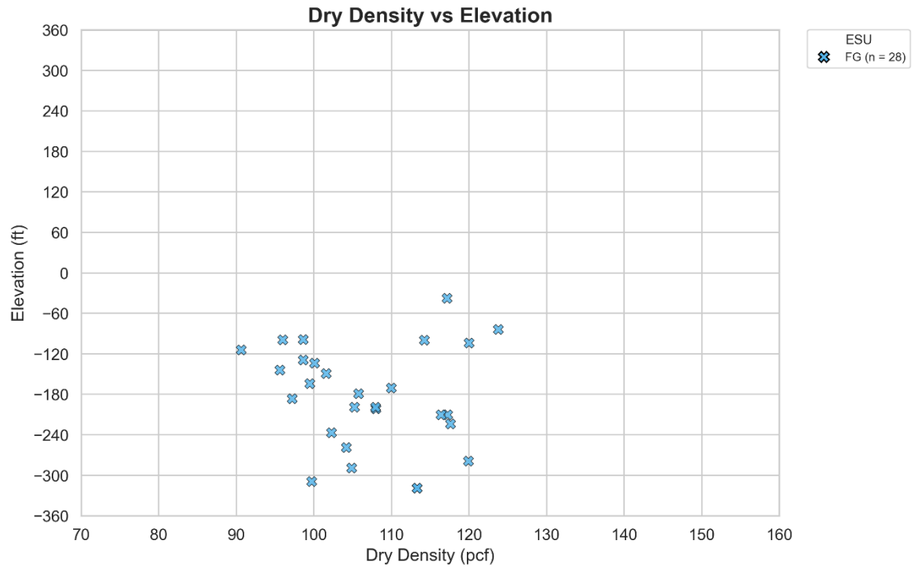
EMPRISE CONCEPTS

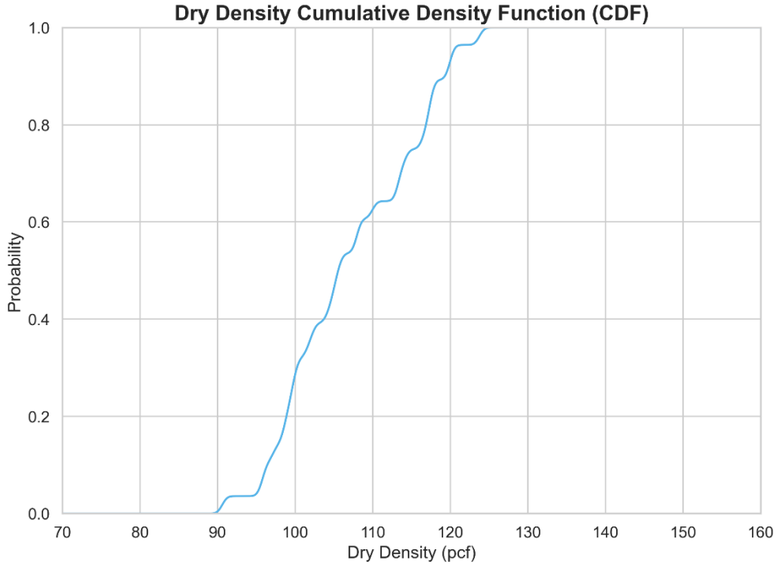
Anchorage, Alaska | August 2025

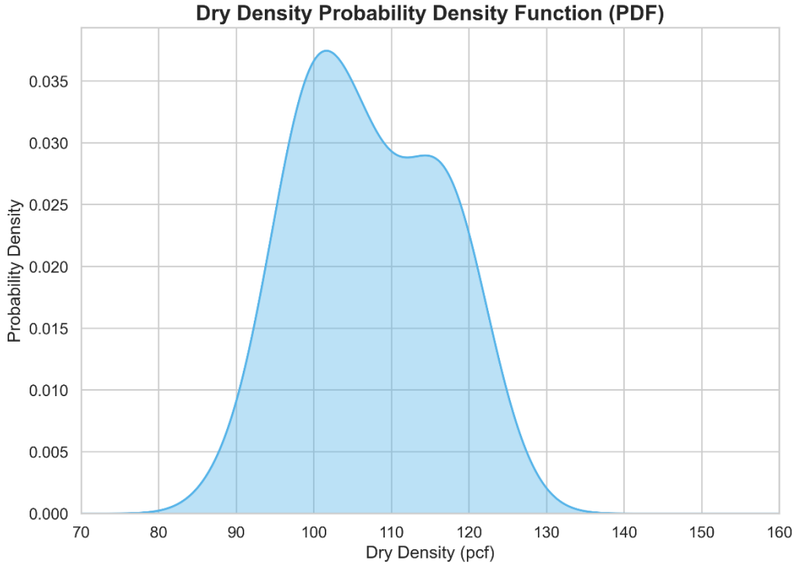
Figure C-5

FG (n = 28) - All Borings









Dry Density – All Borings, ESU FG

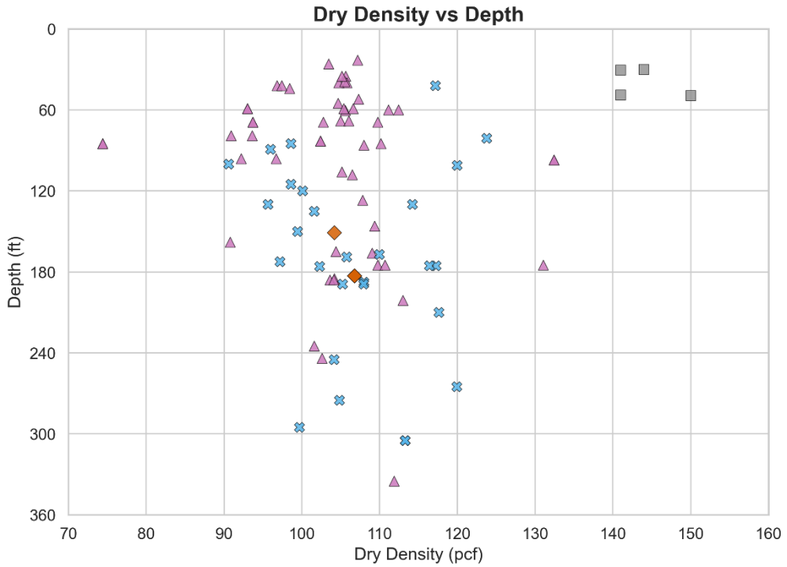
Knik Arm Tunnel Feasibility Study

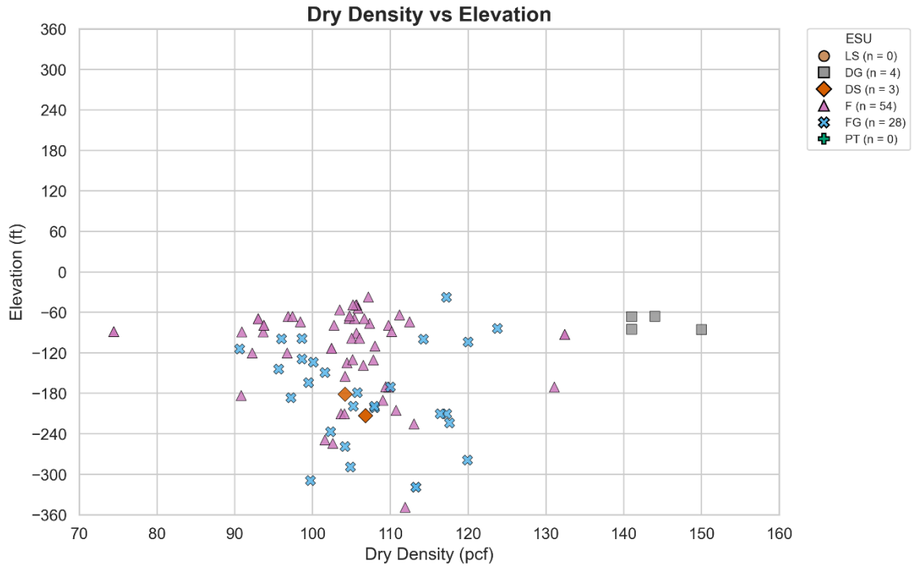
EMPRISE CONCEPTS

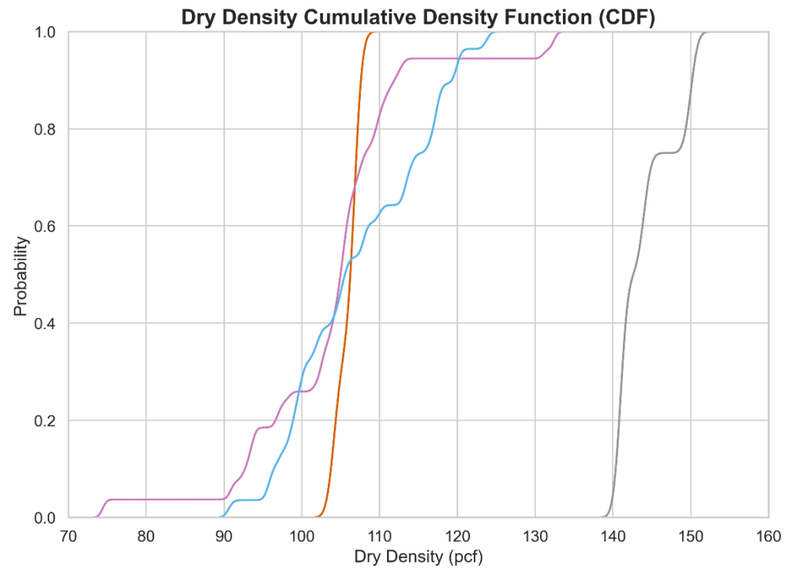
Anchorage, Alaska | August 2025

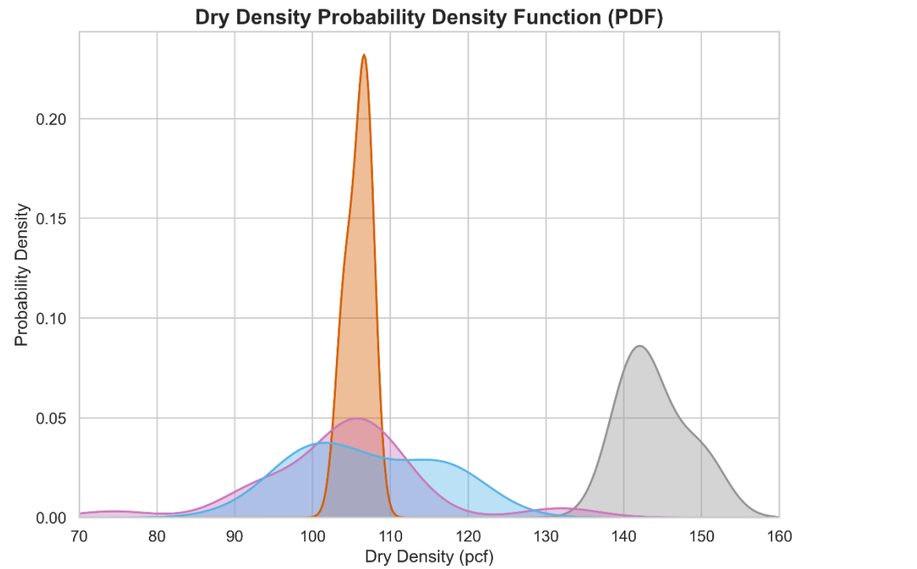
Figure C-6

Overwater Borings









Dry Density – Overwater Borings, All ESUs

Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure C-7

NO DATA

Dry Density – Overwater Borings, ESU LS

Knik Arm Tunnel Feasibility Study

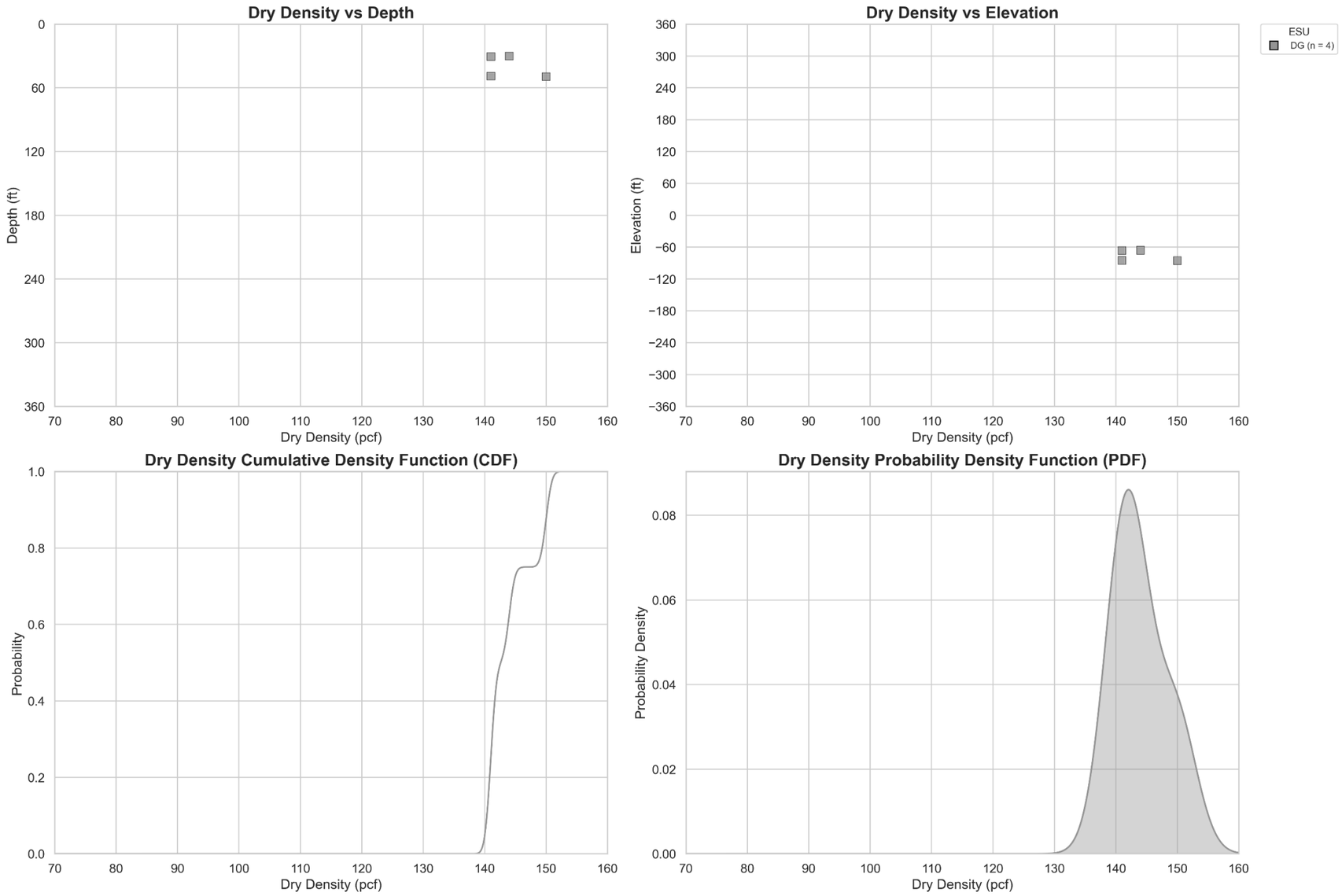
EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure

C-8

DG (n = 4) - Overwater Borings



Dry Density – Overwater Borings, ESU DG

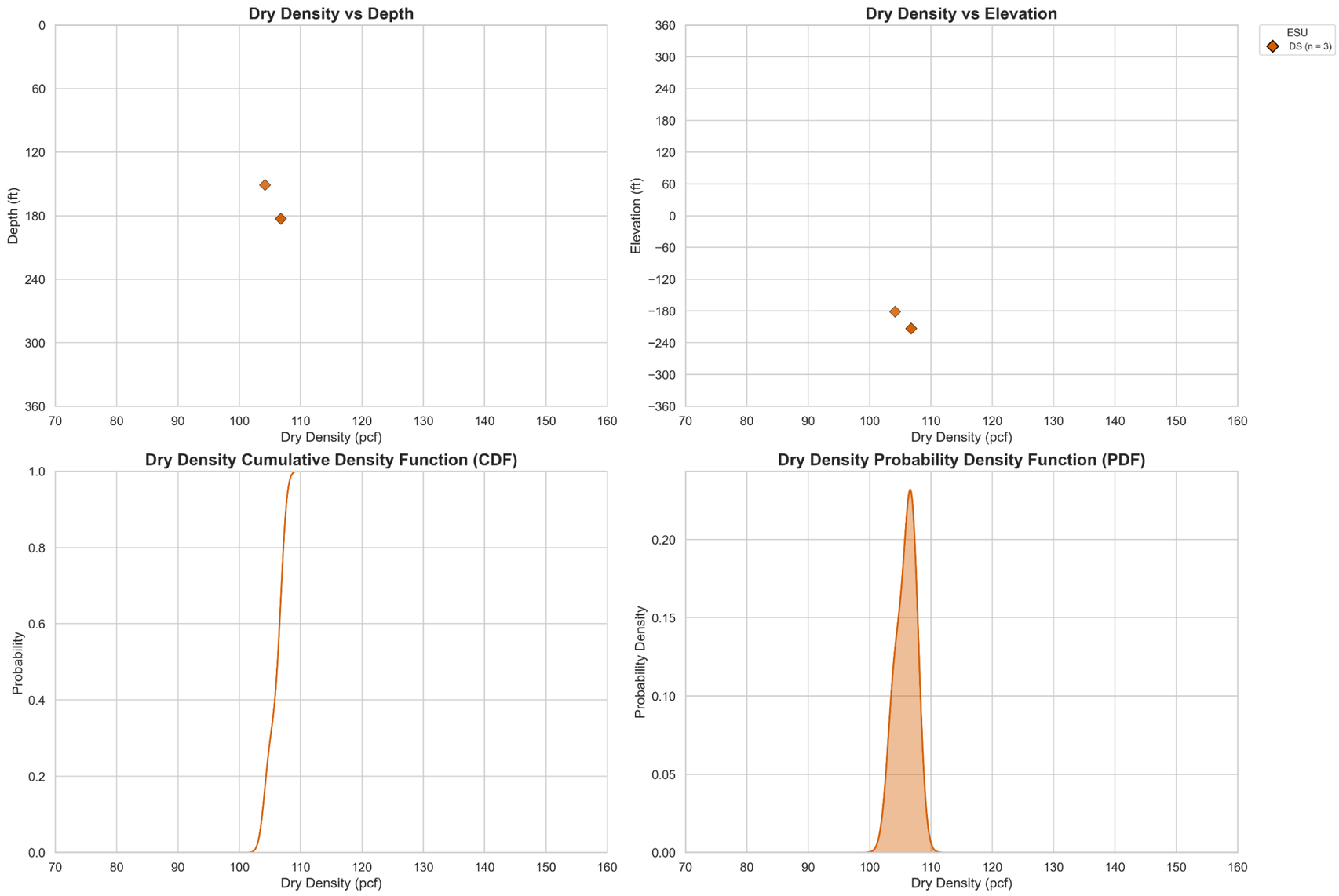
Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure C-9

DS (n = 3) - Overwater Borings



Dry Density – Overwater Borings, ESU DS

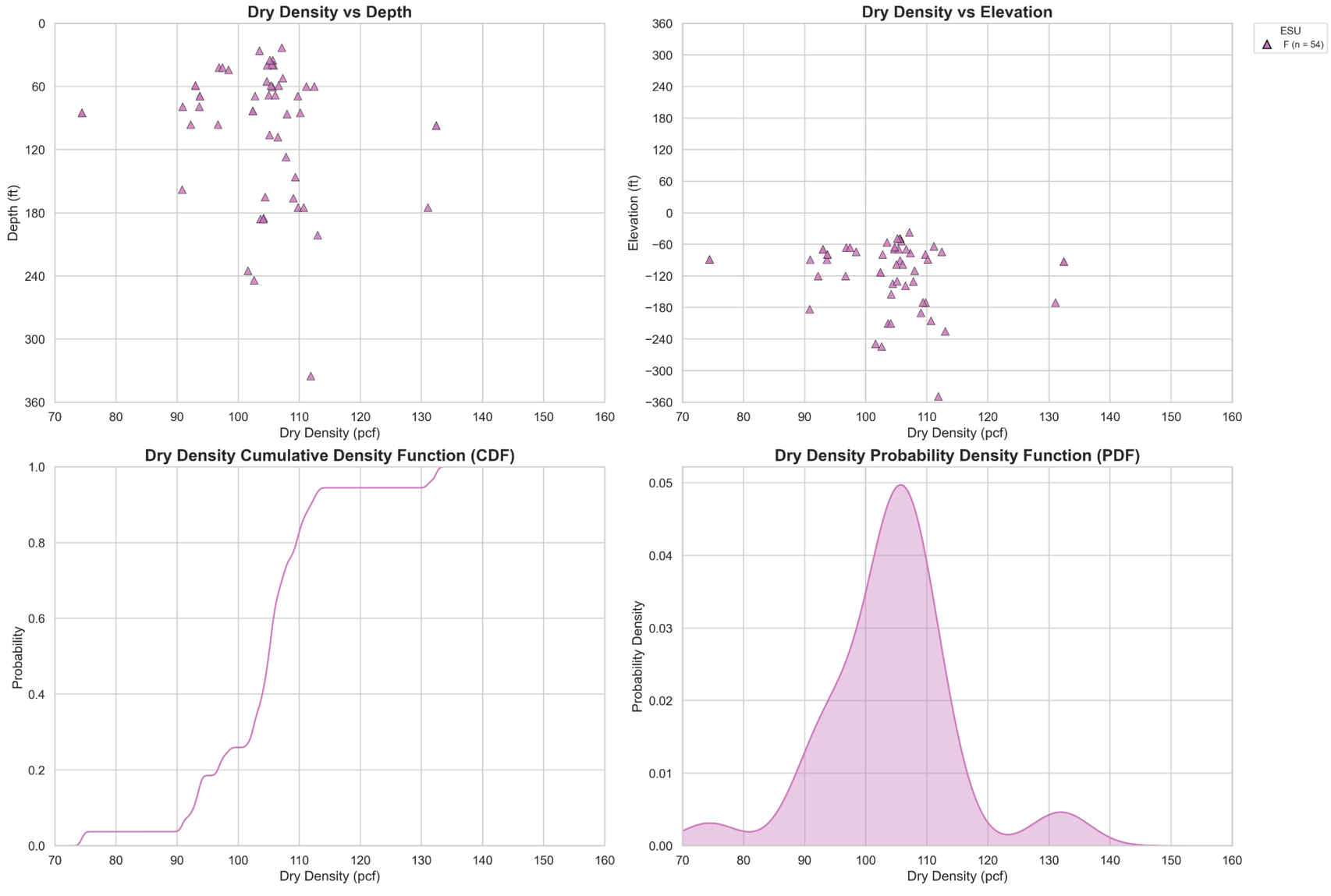
Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure
C-10

F (n = 54) - Overwater Borings



Dry Density – Overwater Borings, ESU F

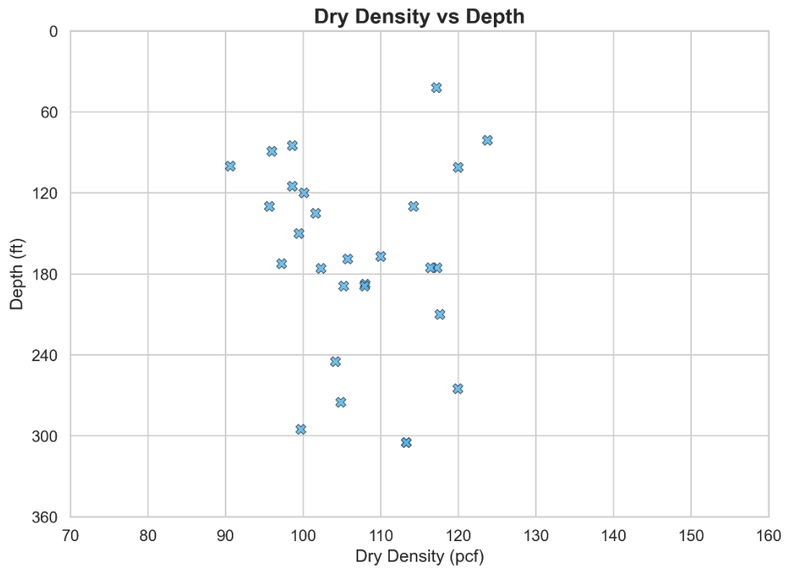
Knik Arm Tunnel Feasibility Study

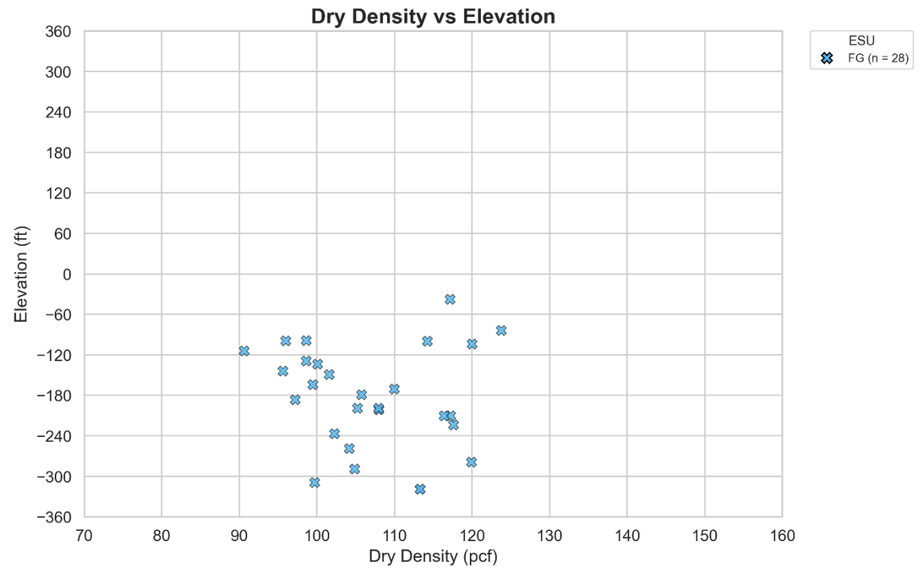
EMPRISE CONCEPTS

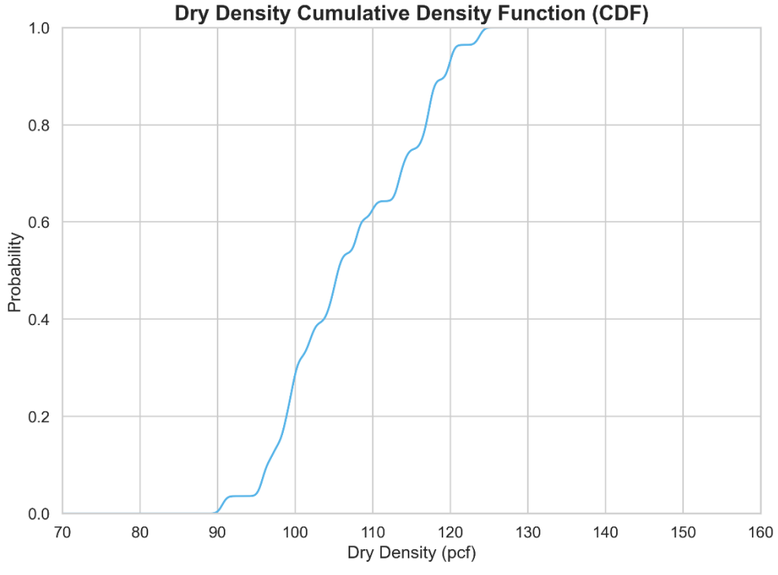
Anchorage, Alaska | August 2025

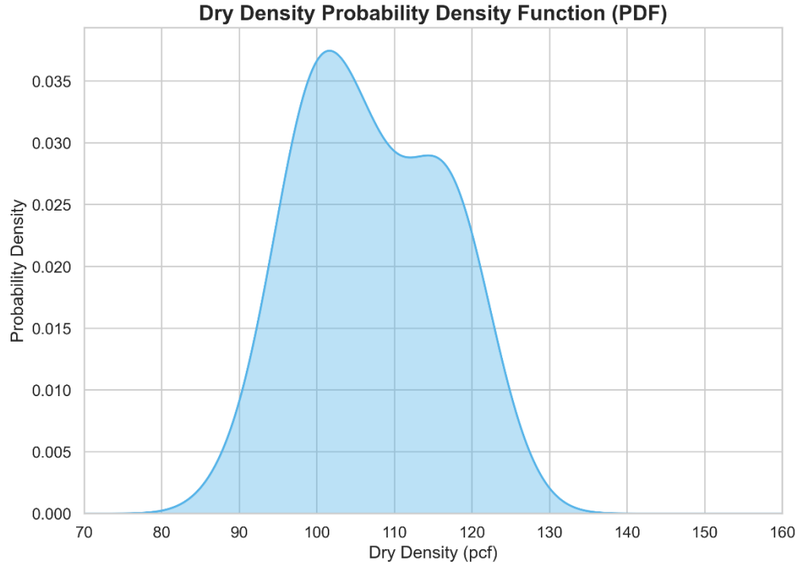
Figure C-11

FG (n = 28) - Overwater Borings









Dry Density – Overwater Borings, ESU FG

Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure C-12

NO DATA

Dry Density – Anchorage Landside Borings, All ESUs

Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure

C-13

NO DATA

Dry Density – Anchorage Landside Borings, ESU LS

Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure
C-14

NO DATA

Dry Density – Anchorage Landside Borings, ESU DG

Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure

C-15

NO DATA

Dry Density – Anchorage Landside Borings, ESU DS

Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure

C-16

NO DATA

Dry Density – Anchorage Landside Borings, ESU F

Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure

C-17

NO DATA

Dry Density – Anchorage Landside Borings, ESU FG

Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure

C-18

NO DATA

Dry Density – Point MacKenzie Landside Borings, All ESUs

Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure

C-19

NO DATA

Dry Density – Point MacKenzie Landside Borings, ESU LS

Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure

C-20

NO DATA

Dry Density – Point MacKenzie Landside Borings, ESU DG

Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure

C-21

NO DATA

Dry Density – Point MacKenzie Landside Borings, ESU DS

Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure

C-22

NO DATA

Dry Density – Point MacKenzie Landside Borings, ESU F

Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure

C-23

NO DATA

Dry Density – Point MacKenzie Landside Borings, ESU FG

Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure

C-24

All Borings

SPT N60 – All Borings, All ESUs

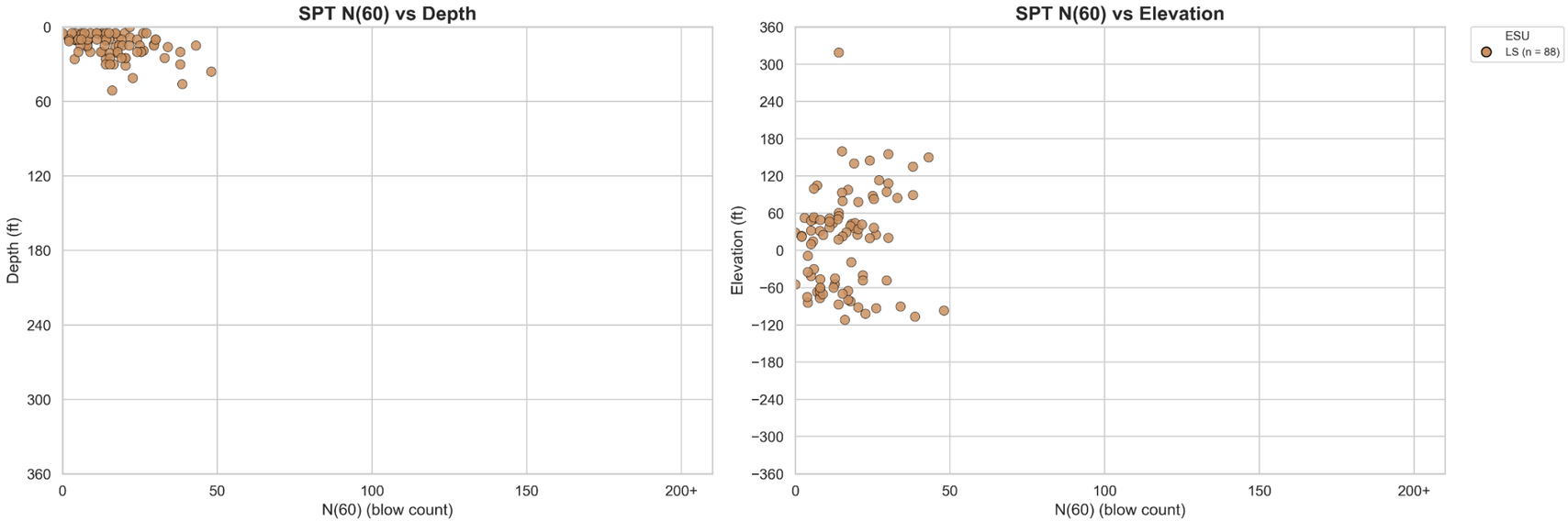
Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure D-1

LS (n = 88) - All Borings



SPT N60 – All Borings, ESU LS

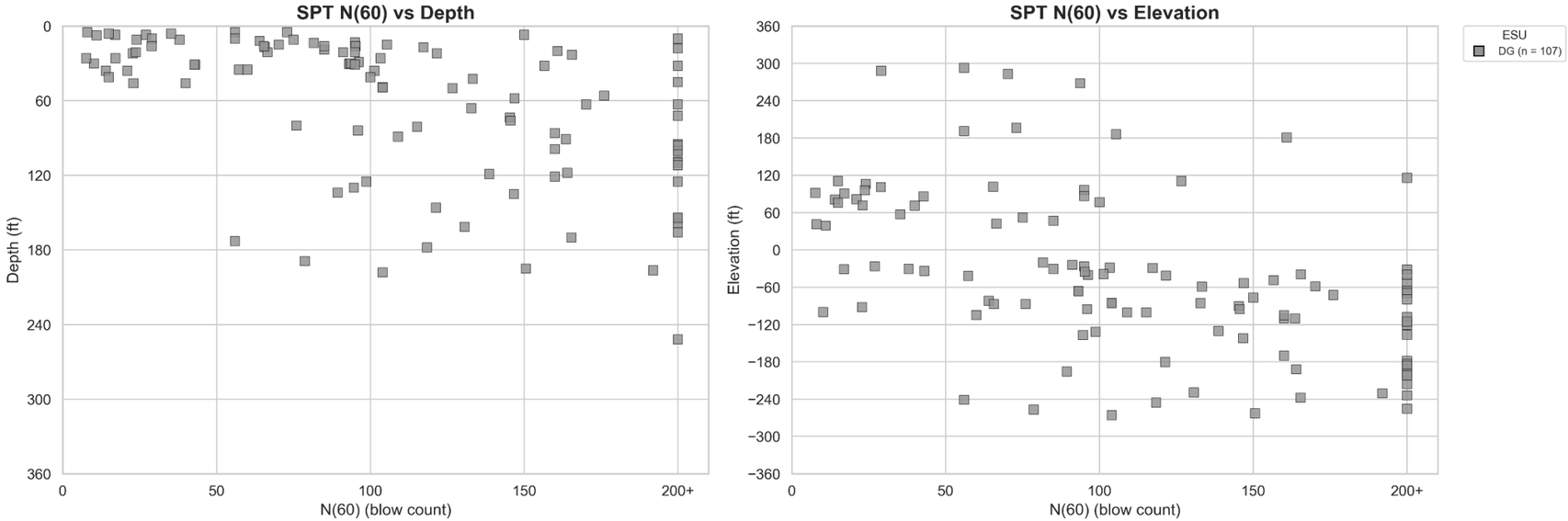
Knik Arm Tunnel Feasibility Study

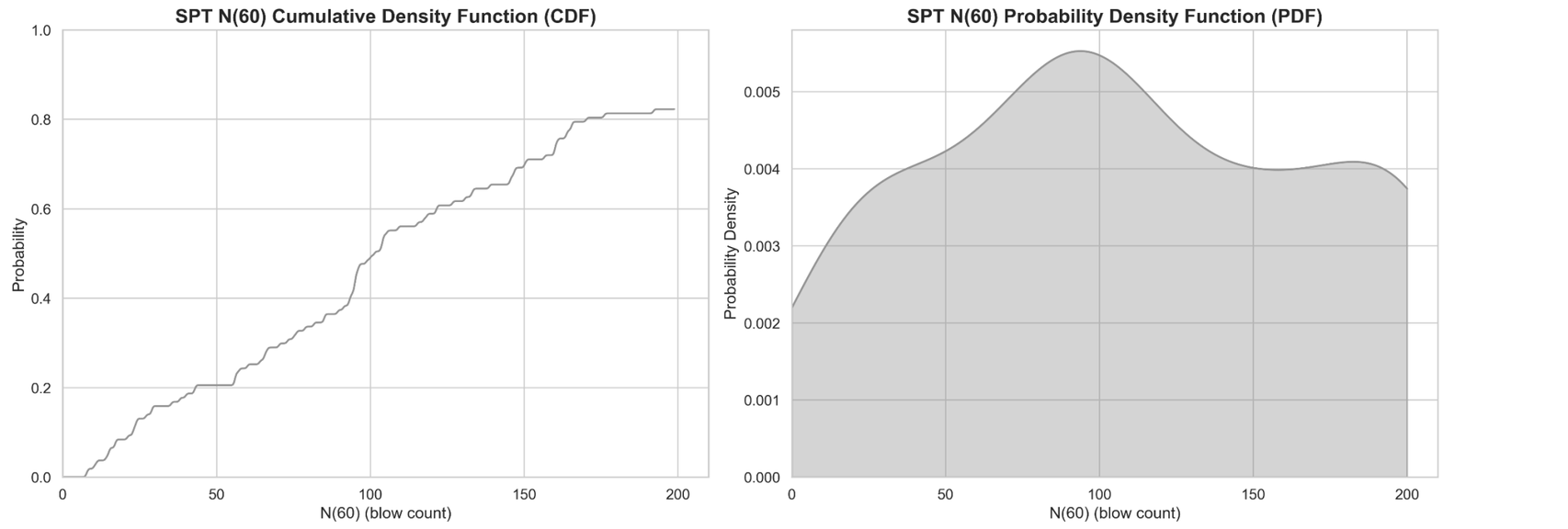
EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure **D-2**

DG (n = 107) - All Borings





SPT N60 – All Borings, ESU DG

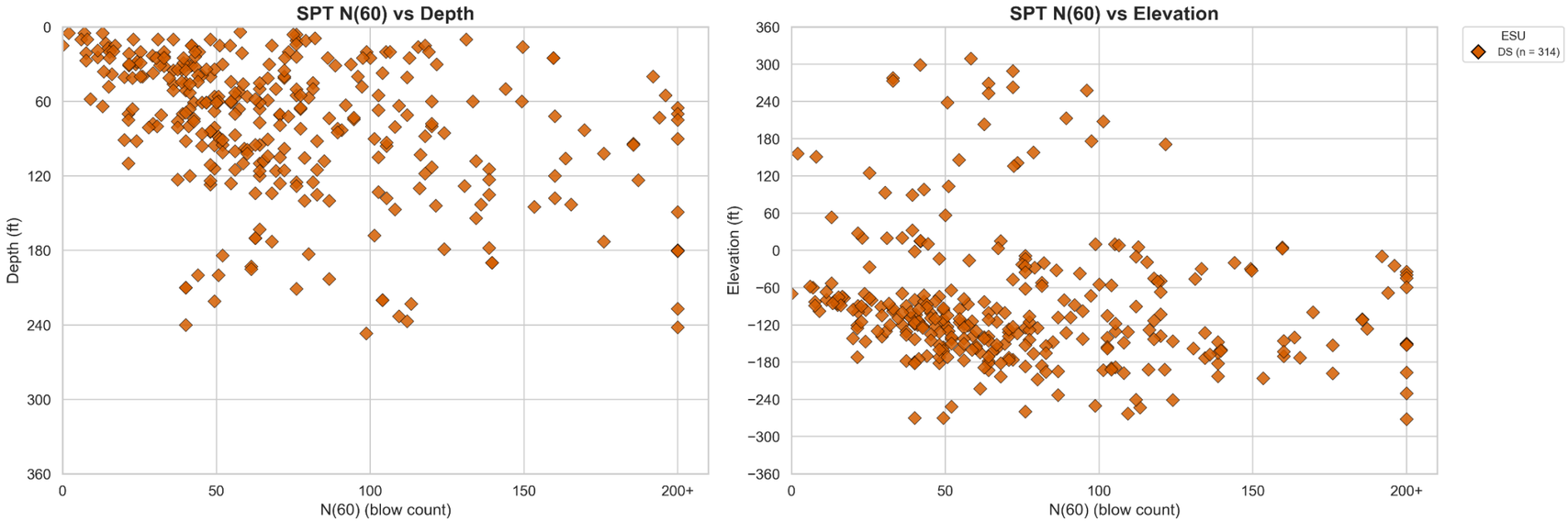
Knik Arm Tunnel Feasibility Study

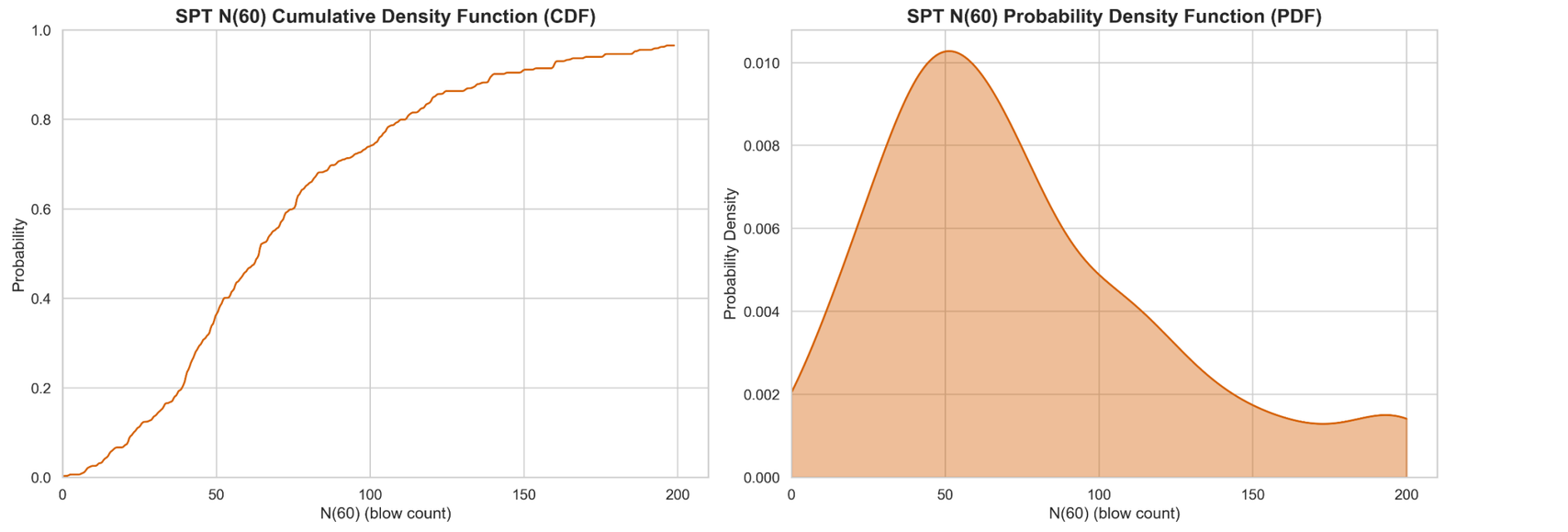
EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure D-3

DS (n = 314) - All Borings





SPT N60 – All Borings, ESU DS

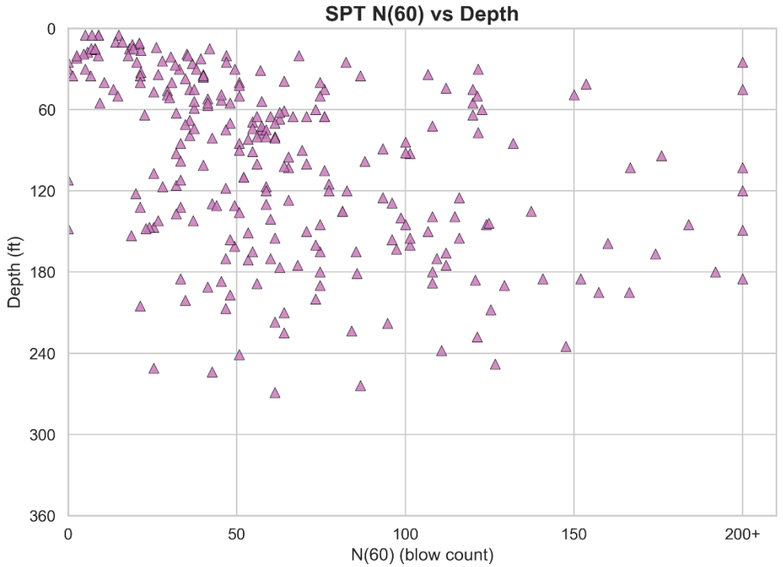
Knik Arm Tunnel Feasibility Study

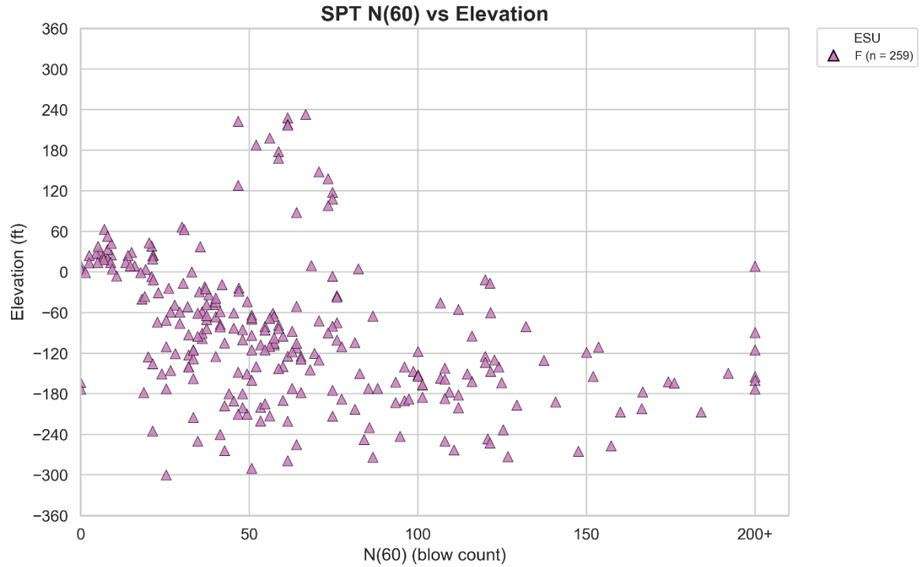
EMPRISE CONCEPTS

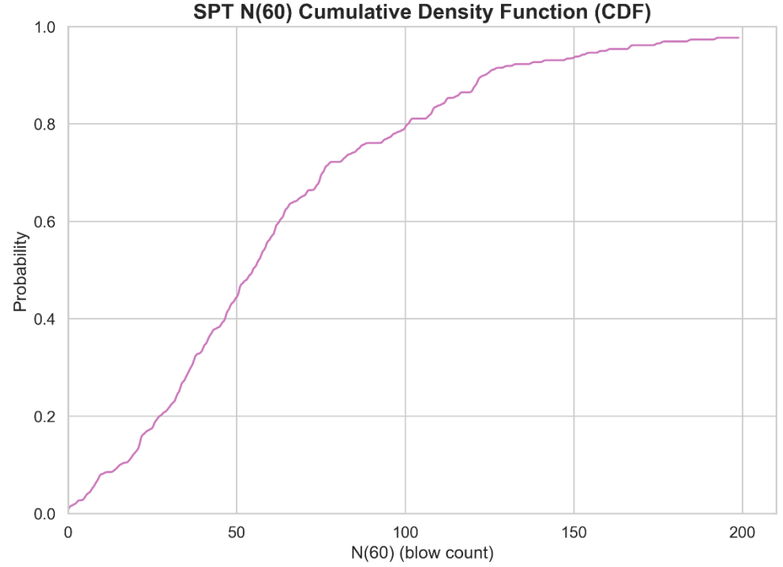
Anchorage, Alaska | August 2025

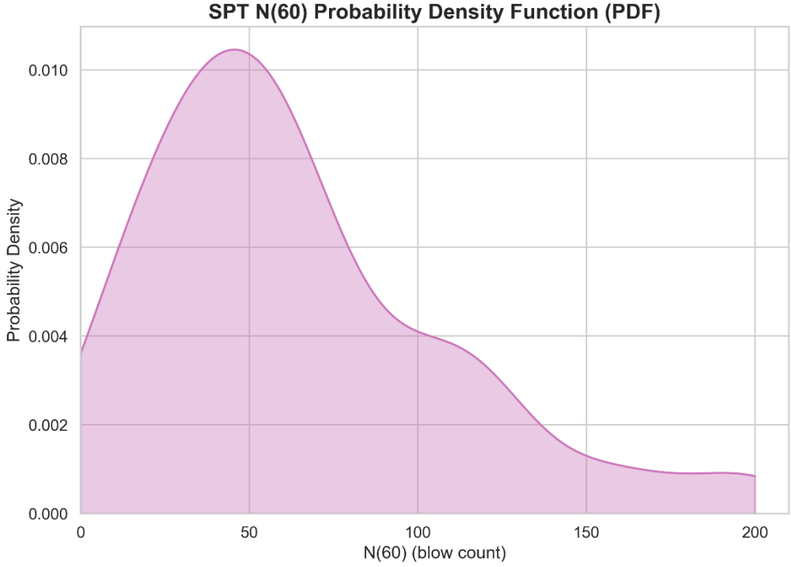
Figure **D-4**

F (n = 259) - All Borings









SPT N60 – All Borings, ESU F

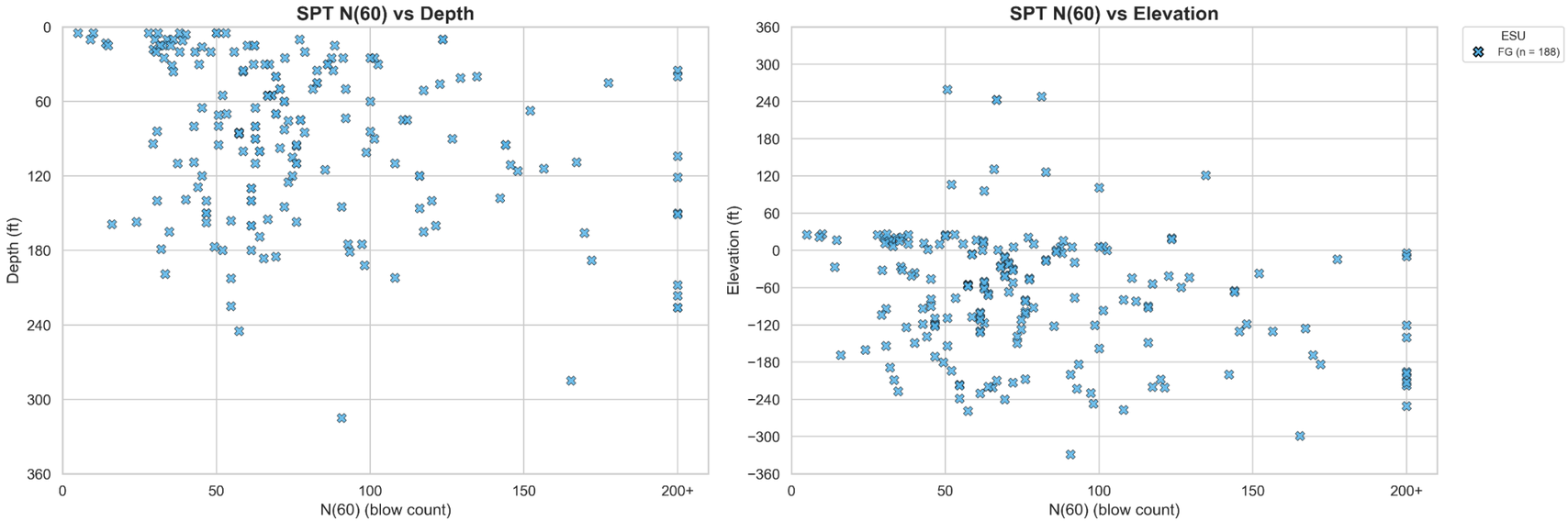
Knik Arm Tunnel Feasibility Study

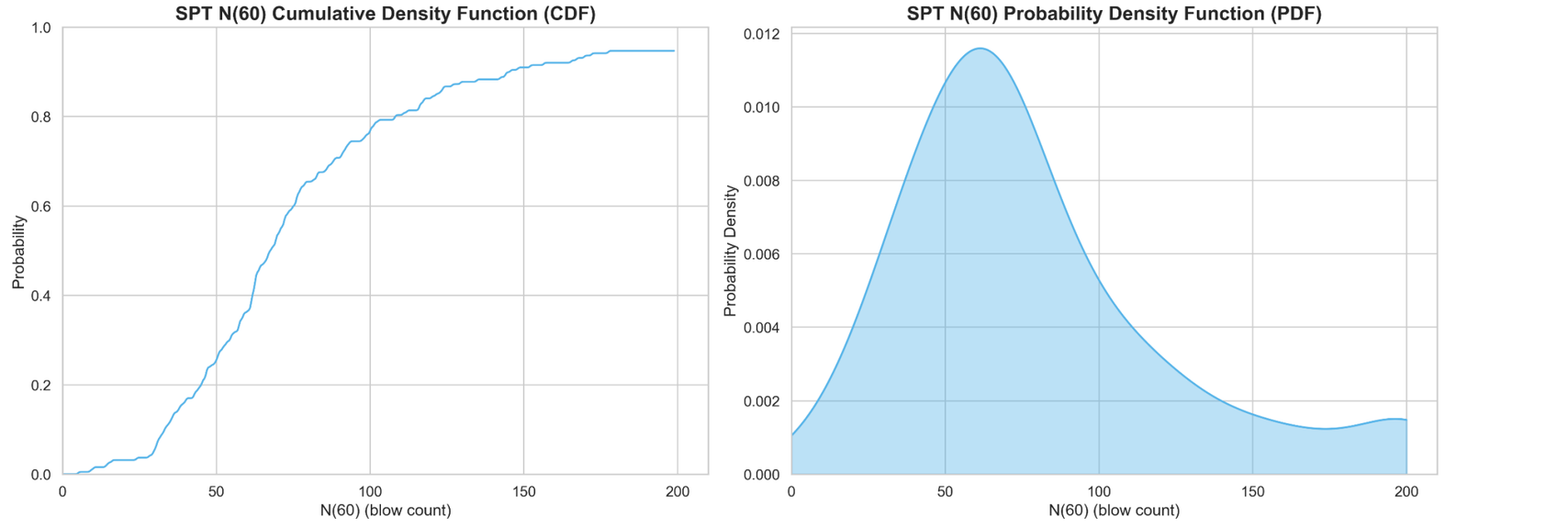
EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure **D-5**

FG (n = 188) - All Borings





SPT N60 – All Borings, ESU FG

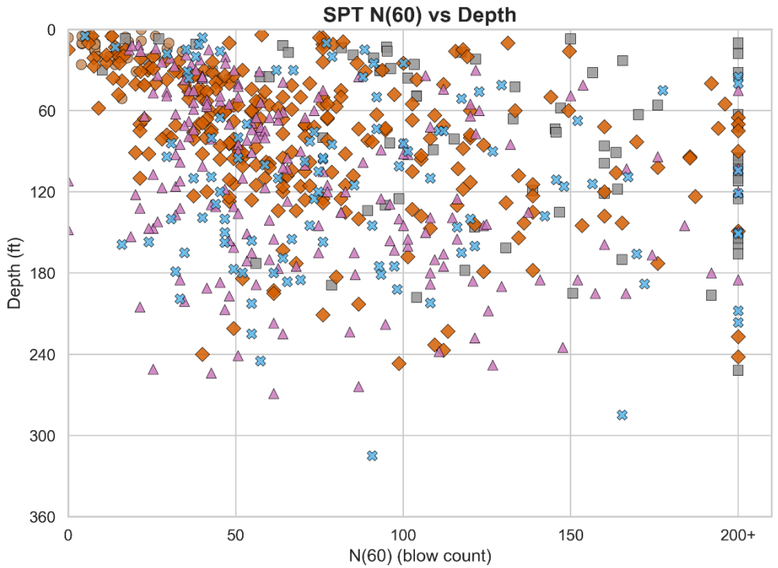
Knik Arm Tunnel Feasibility Study

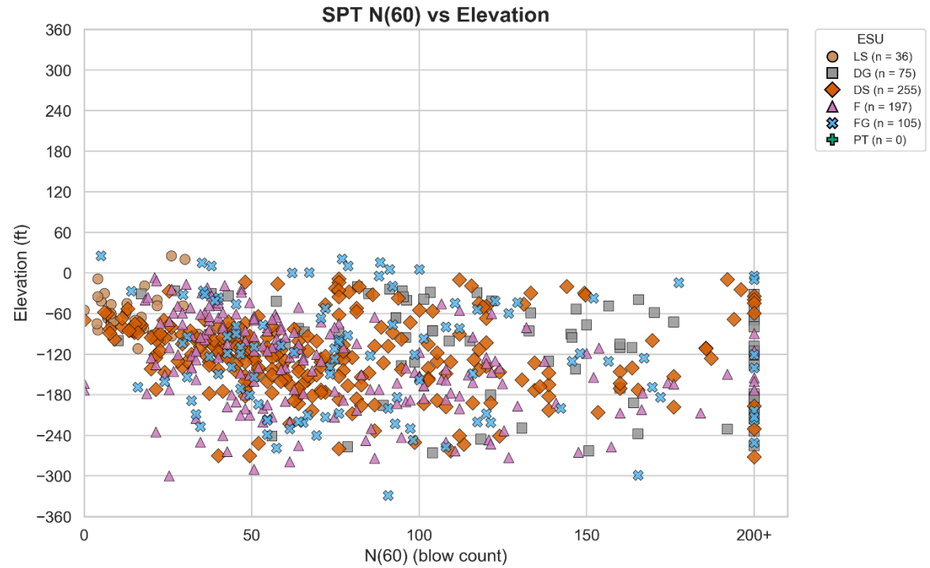
EMPRISE CONCEPTS

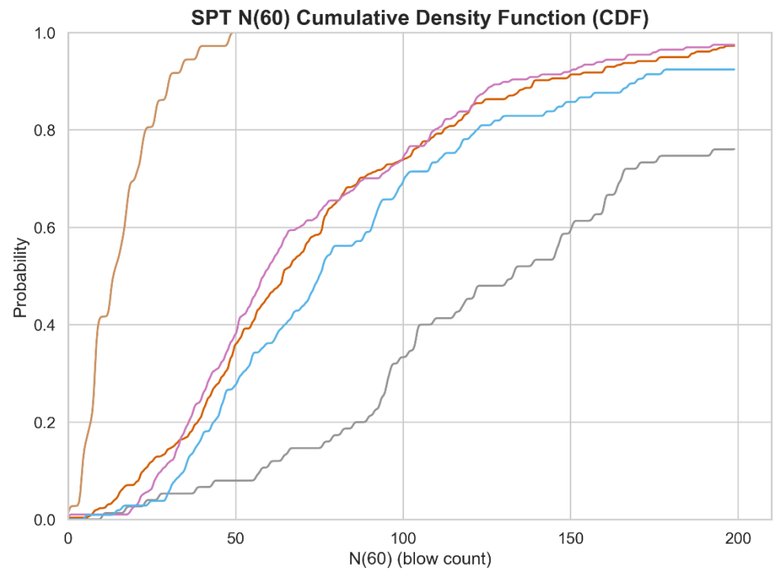
Anchorage, Alaska | August 2025

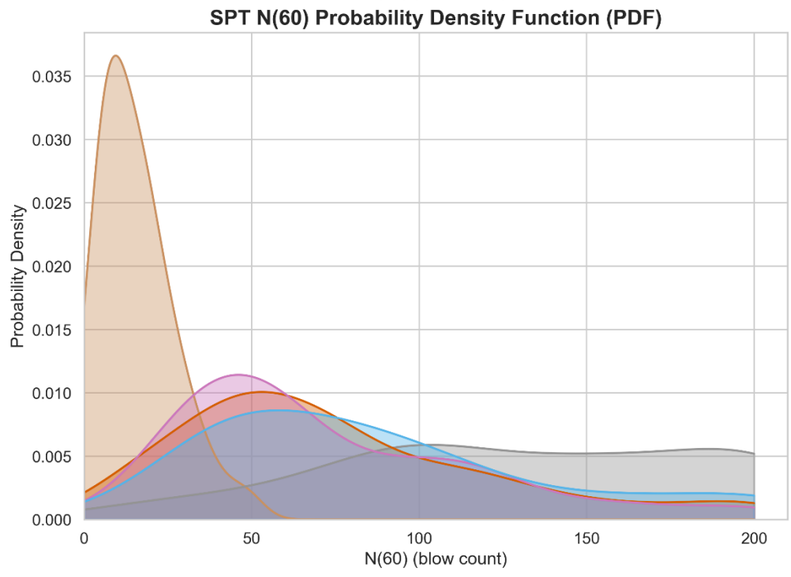
Figure **D-6**

Overwater Borings









SPT N60 – Overwater Borings, All ESUs

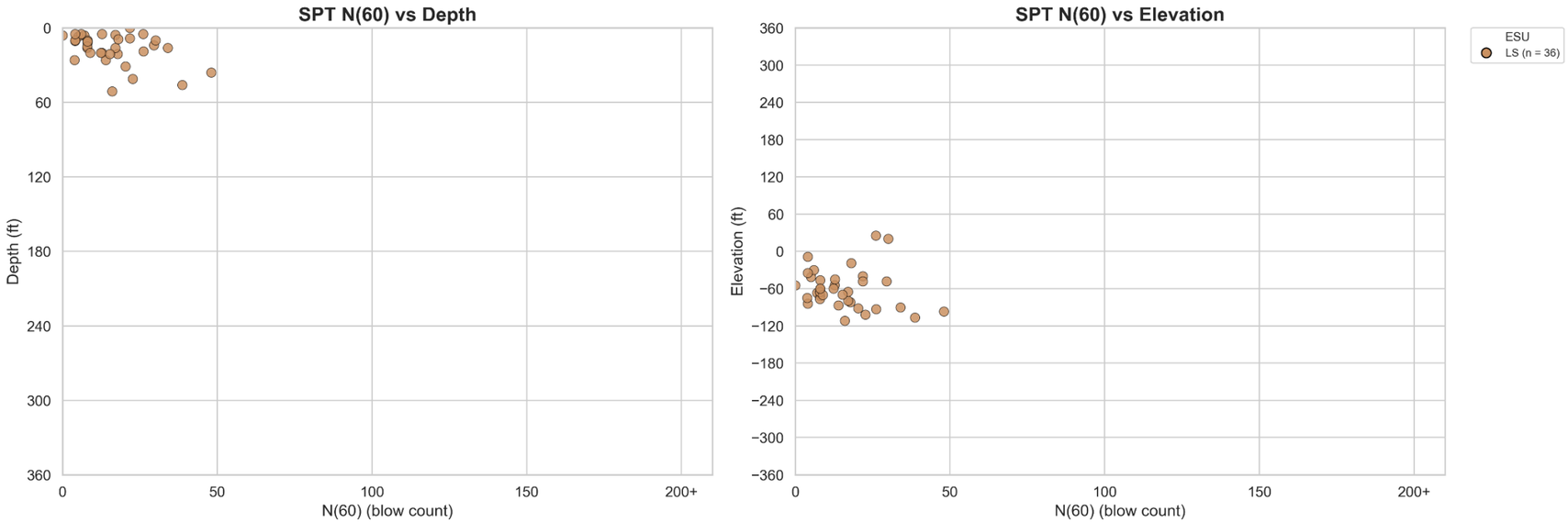
Knik Arm Tunnel Feasibility Study

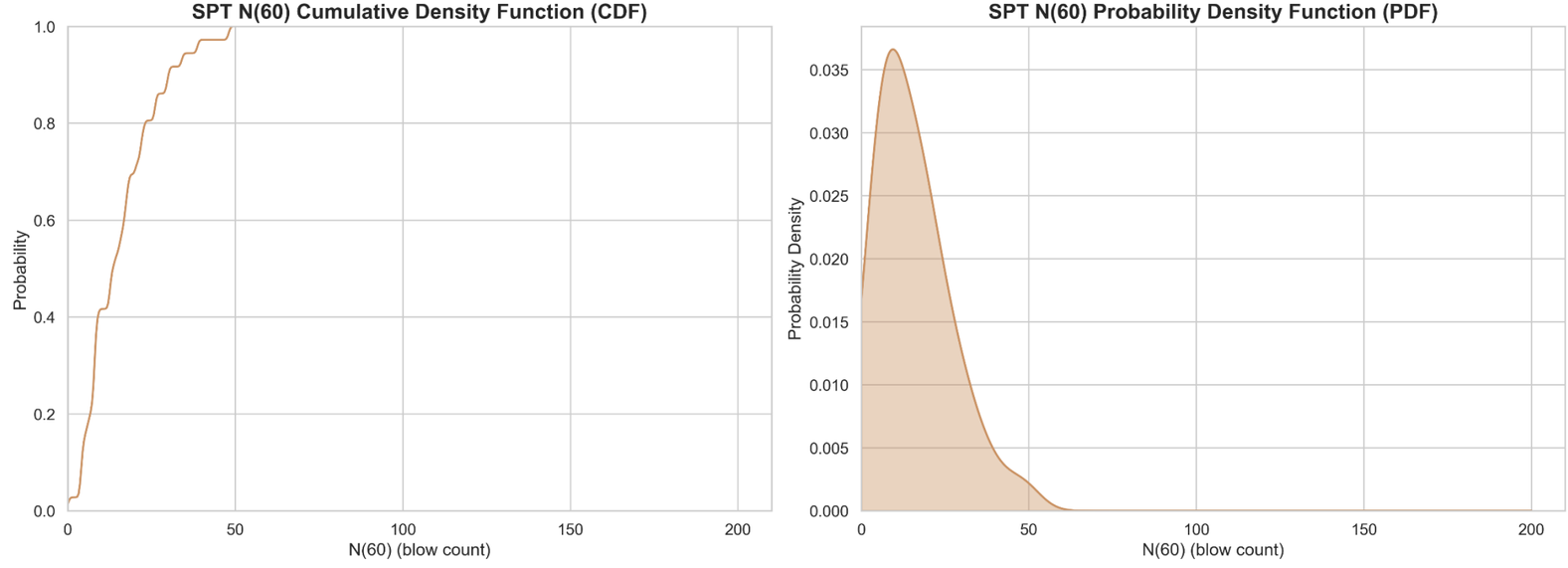
EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure **D-7**

LS (n = 36) - Overwater Borings





SPT N60 – Overwater Borings, ESU LS

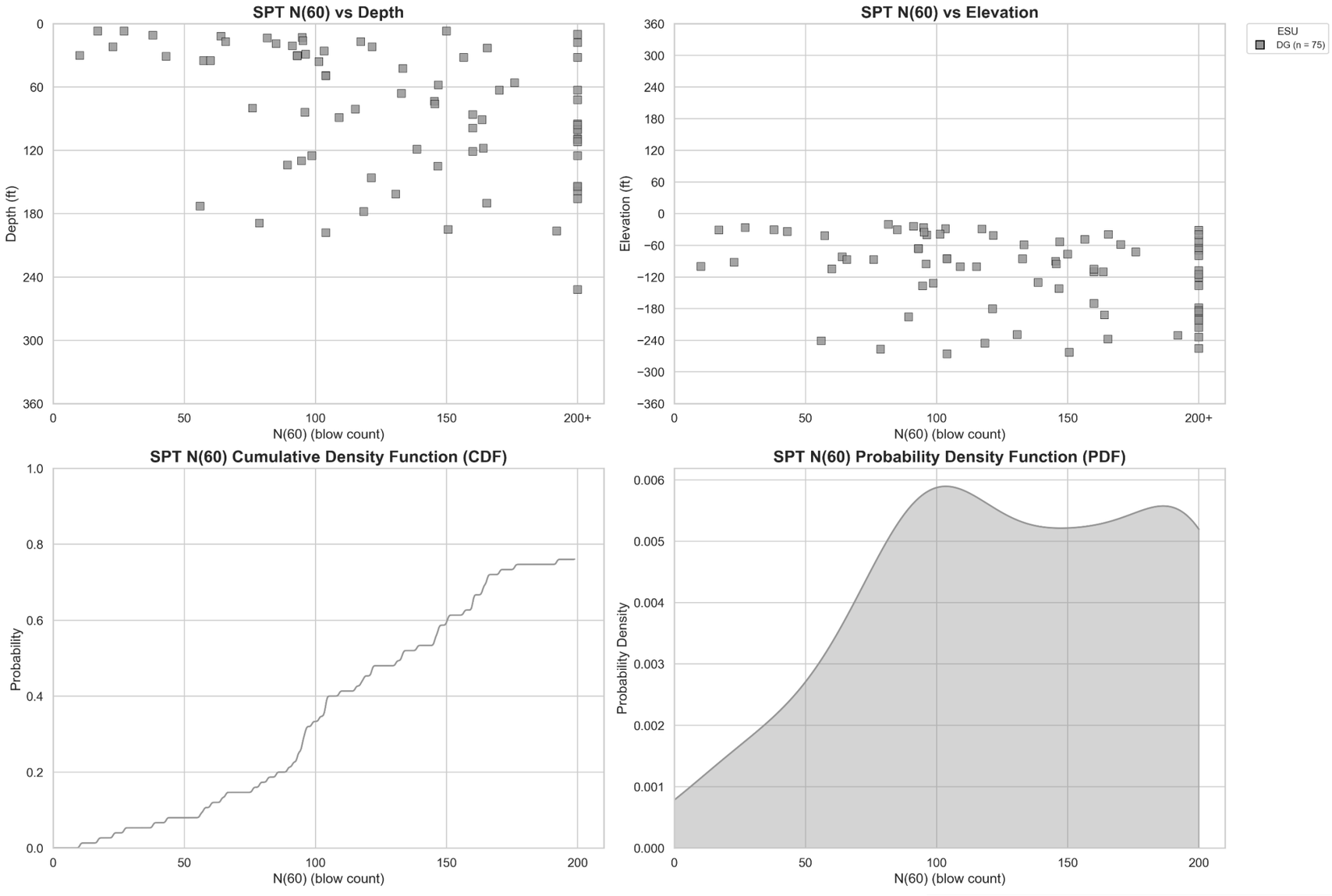
Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure **D-8**

DG (n = 75) - Overwater Borings



SPT N60 – Overwater Borings, ESU DG

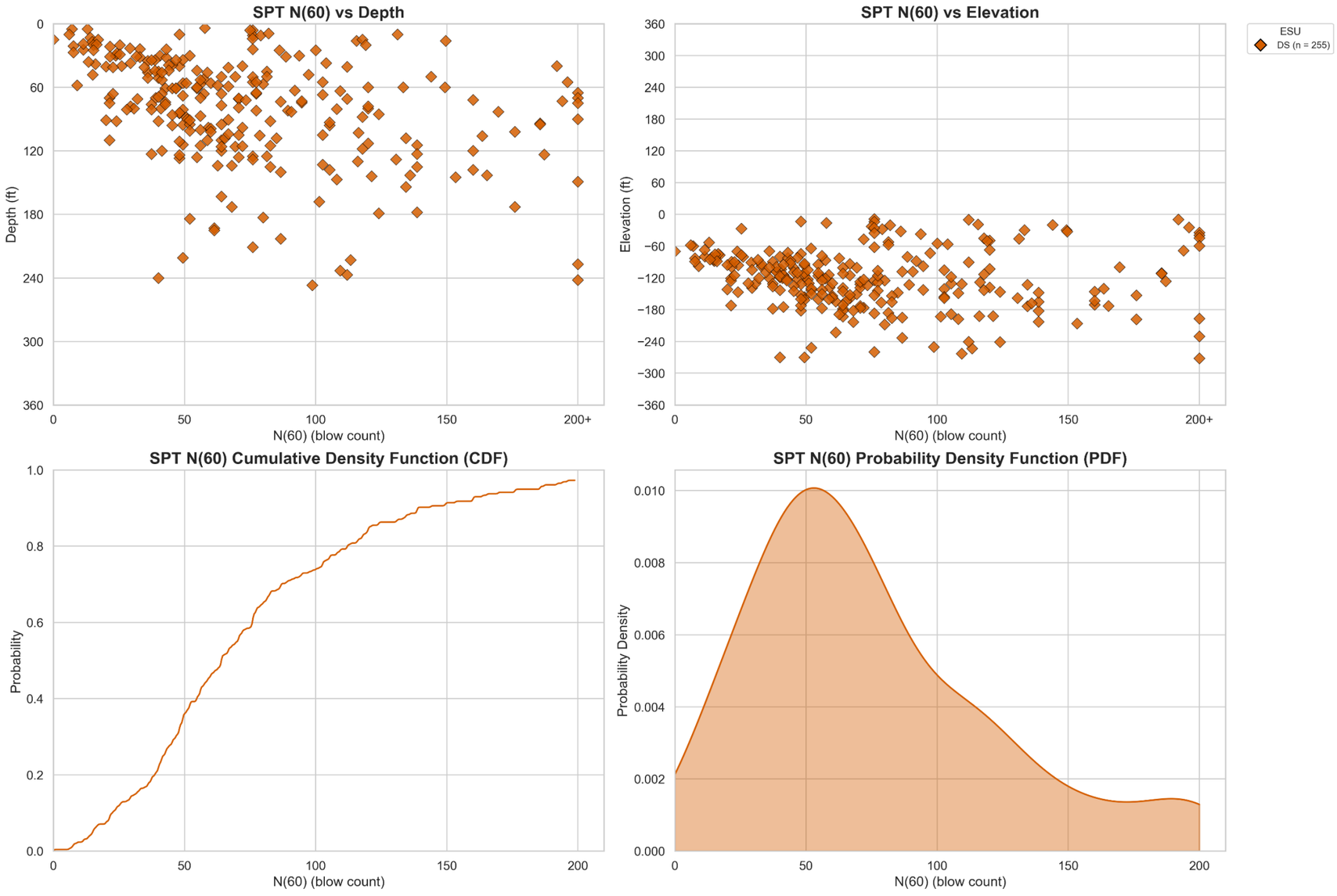
Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure **D-9**

DS (n = 255) - Overwater Borings



SPT N60 – Overwater Borings, ESU DS

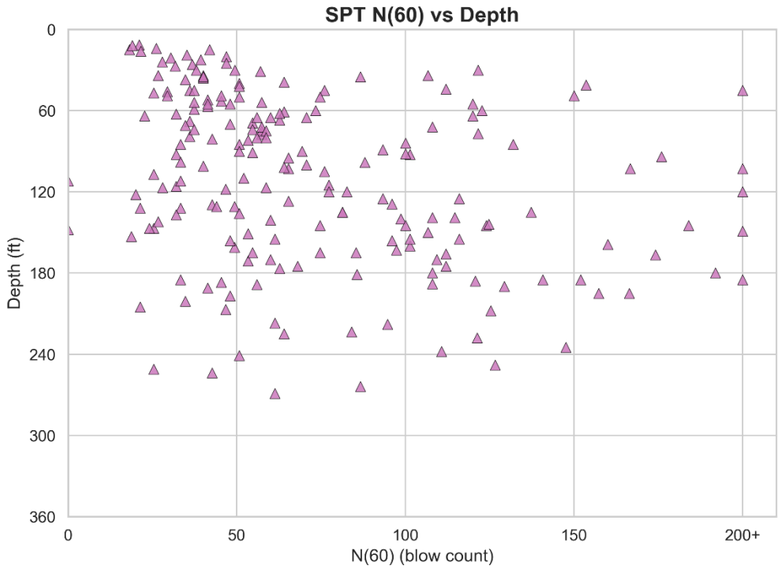
Knik Arm Tunnel Feasibility Study

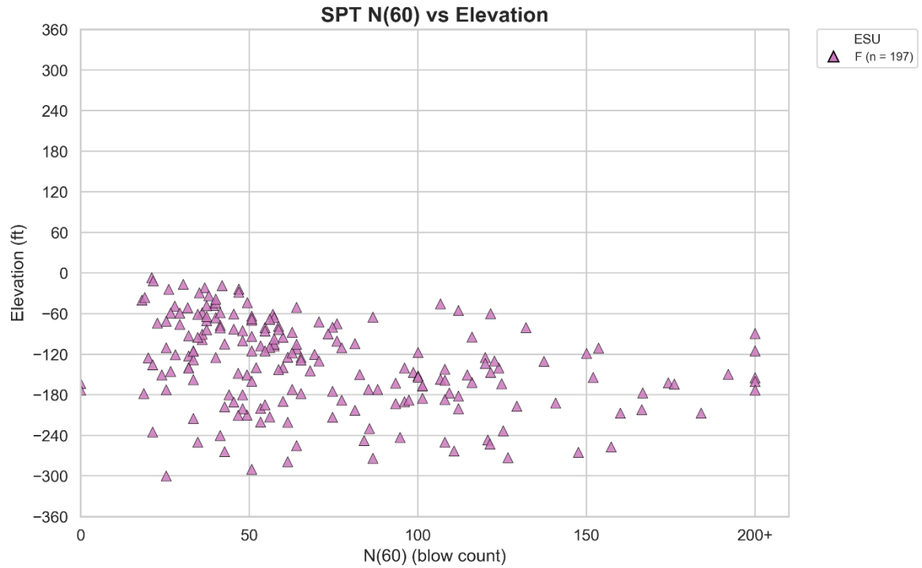
EMPRISE CONCEPTS

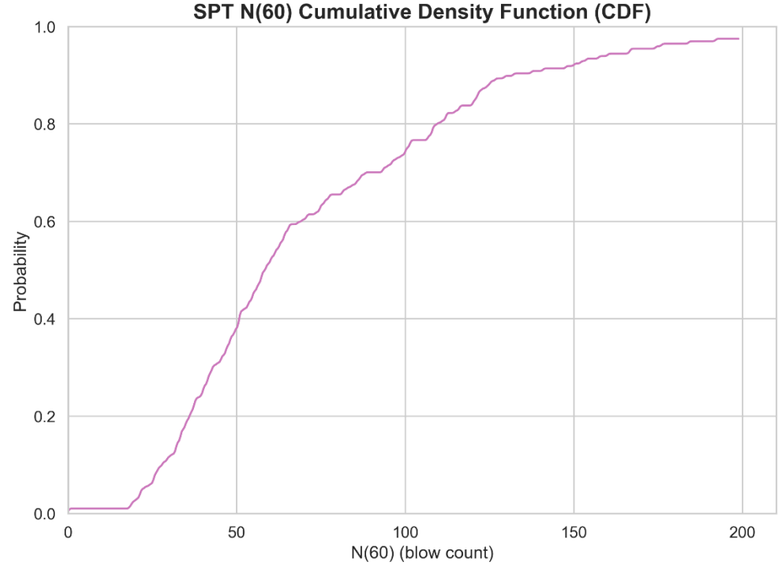
Anchorage, Alaska | August 2025

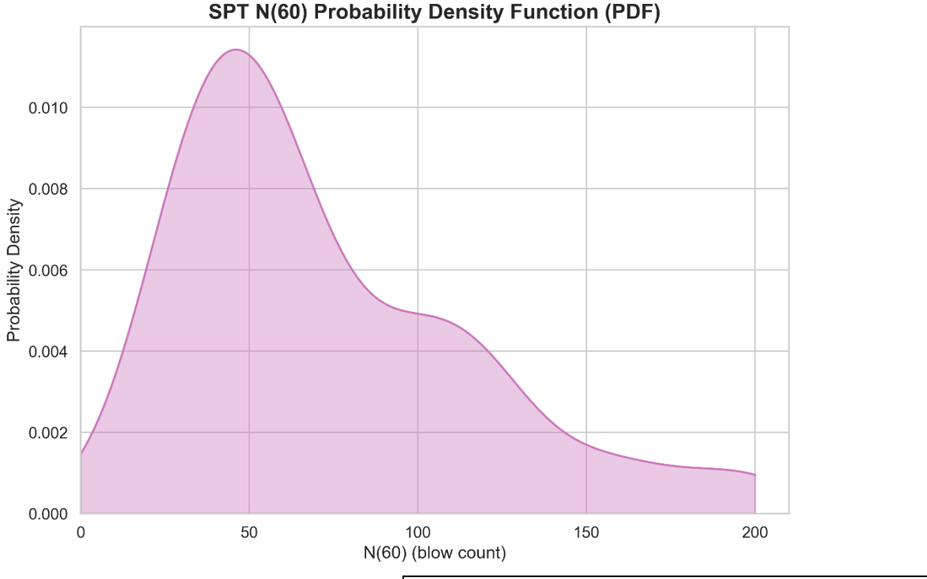
Figure **D-10**

F (n = 197) - Overwater Borings









SPT N60 – Overwater Borings, ESU F

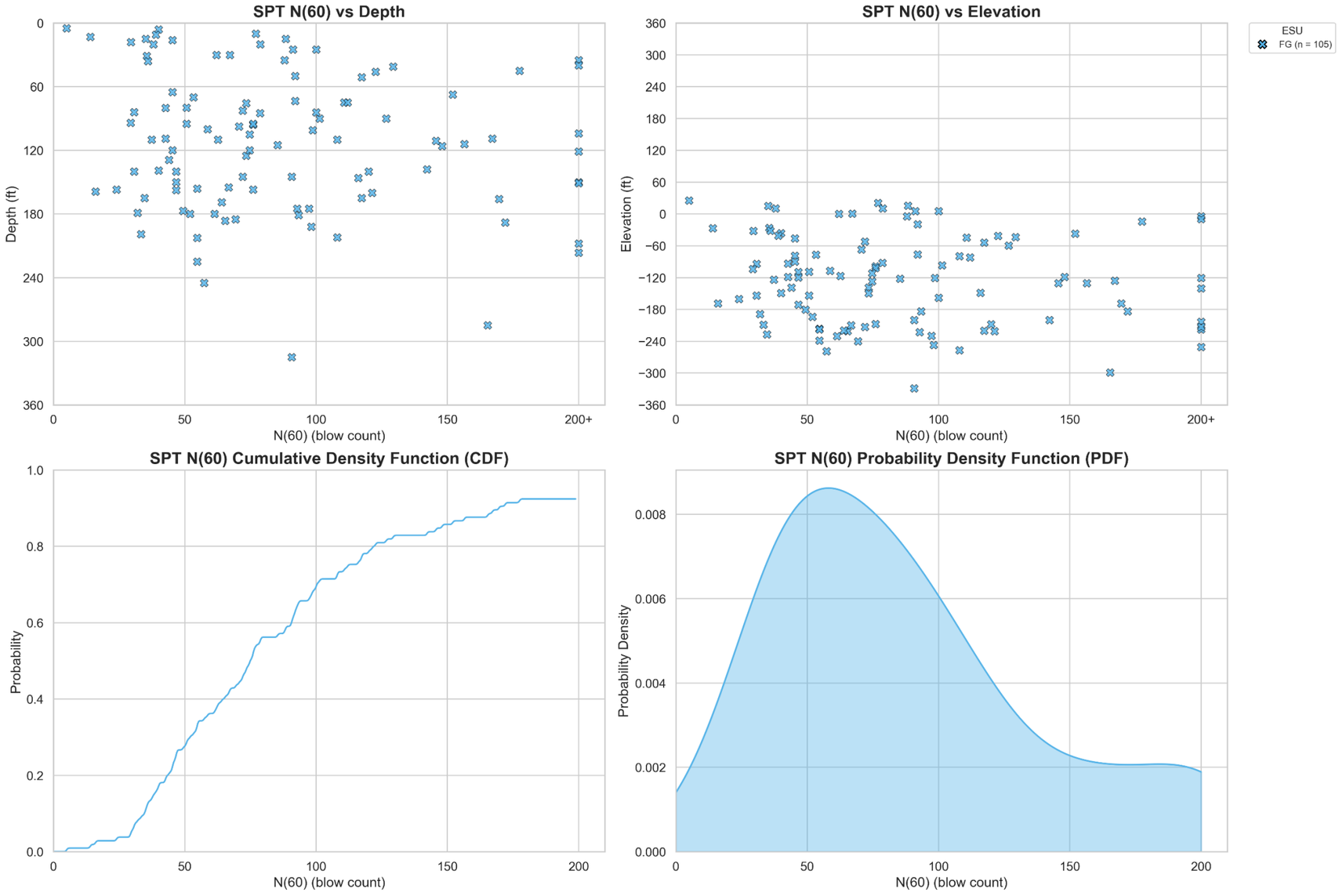
Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure **D-11**

FG (n = 105) - Overwater Borings



SPT N60 – Overwater Borings, ESU FG

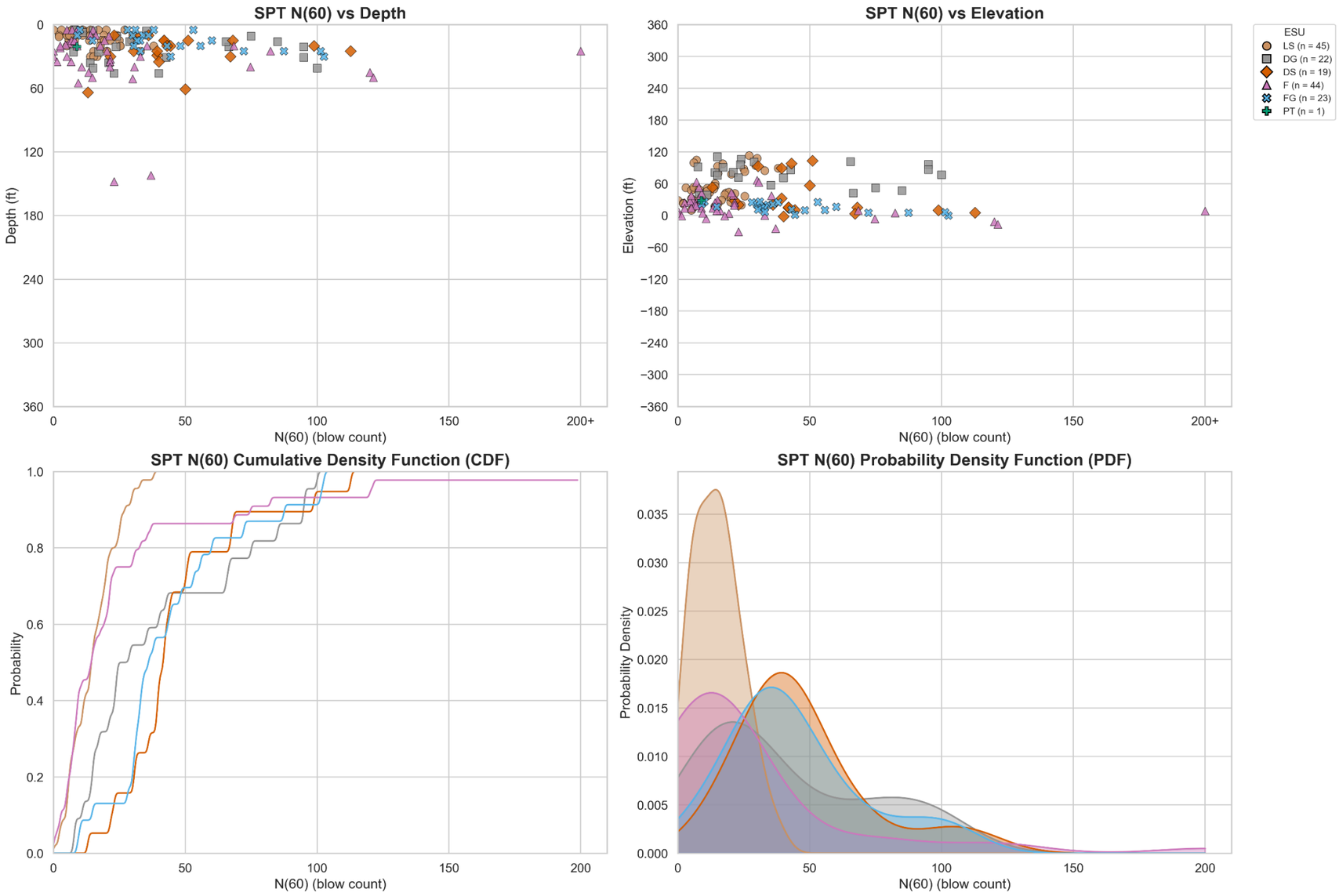
Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure **D-12**

Anchorage Landside Borings



SPT N60 – Anchorage Landside Borings, All ESUs

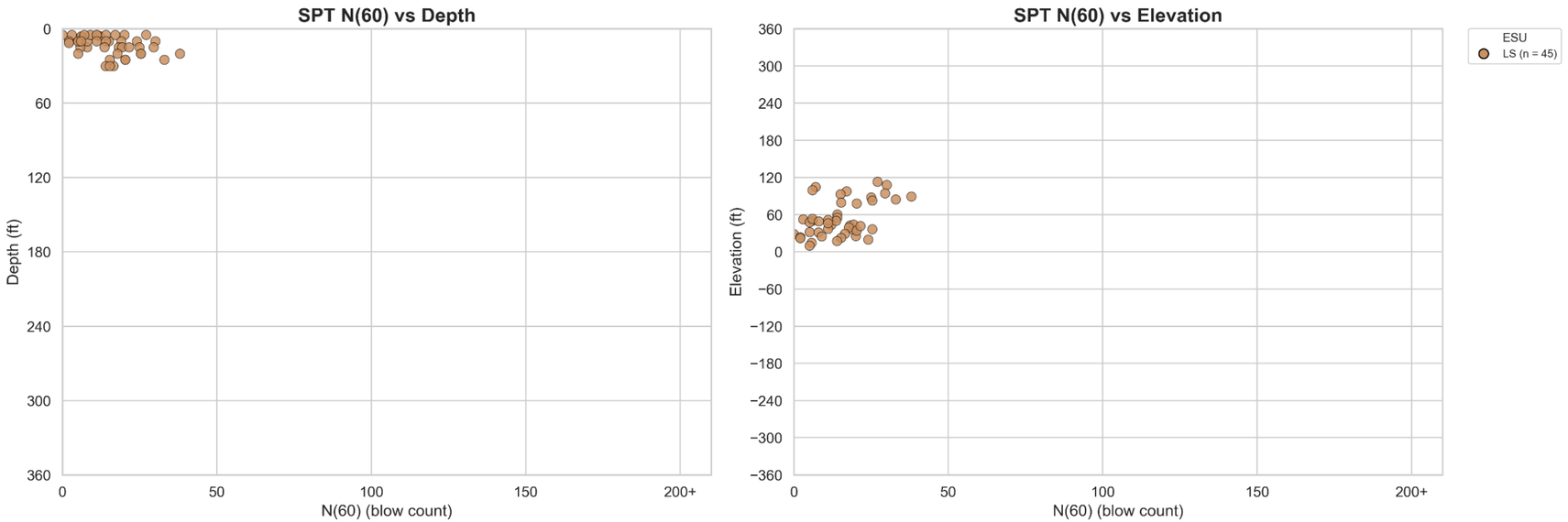
Knik Arm Tunnel Feasibility Study

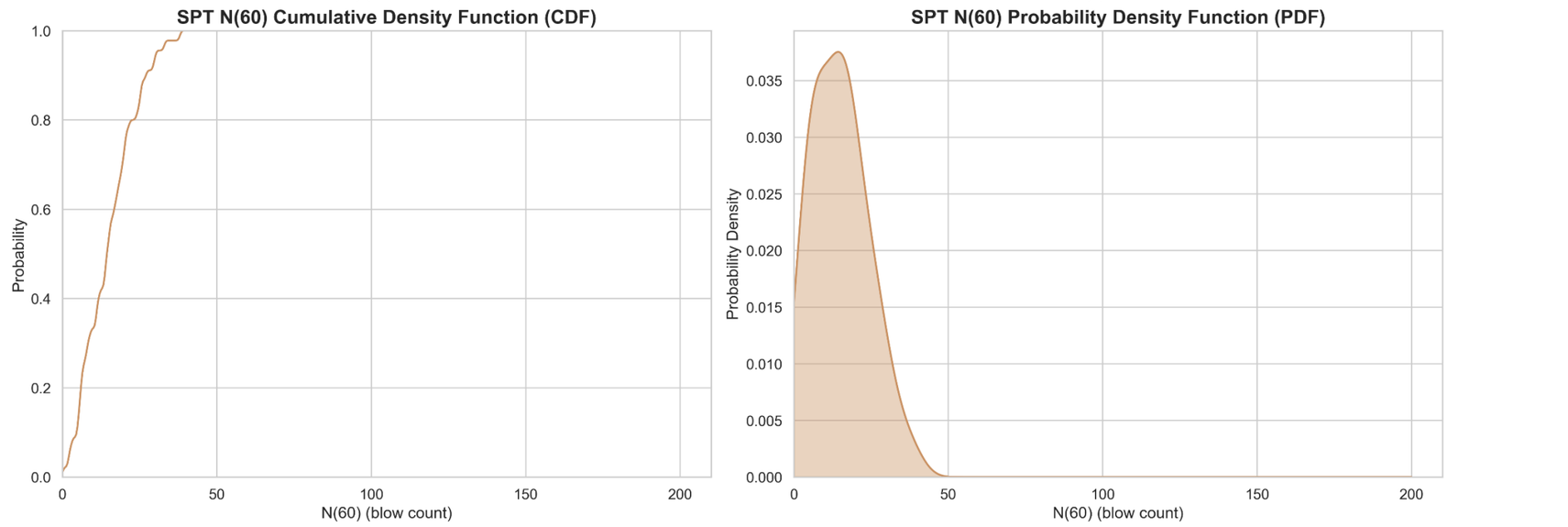
EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure **D-13**

LS (n = 45) - Anchorage Landside Borings





SPT N60 – Anchorage Landside Borings, ESU LS

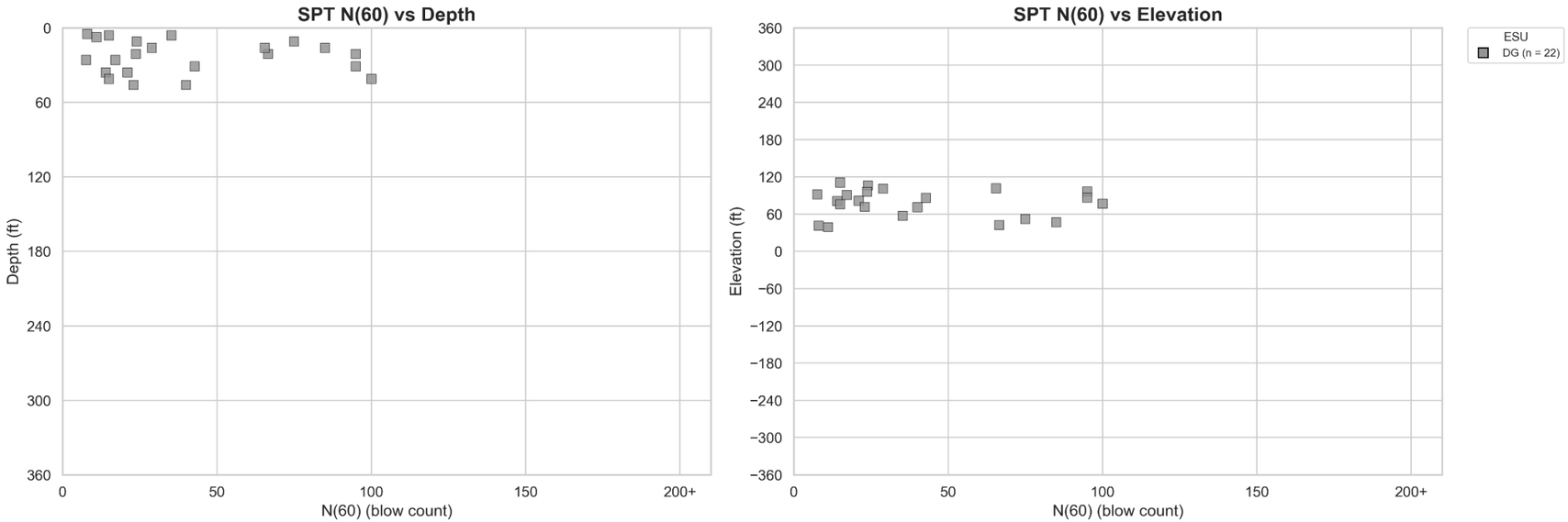
Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure **D-14**

DG (n = 22) - Anchorage Landside Borings



SPT N60 – Anchorage Landside Borings, ESU DG

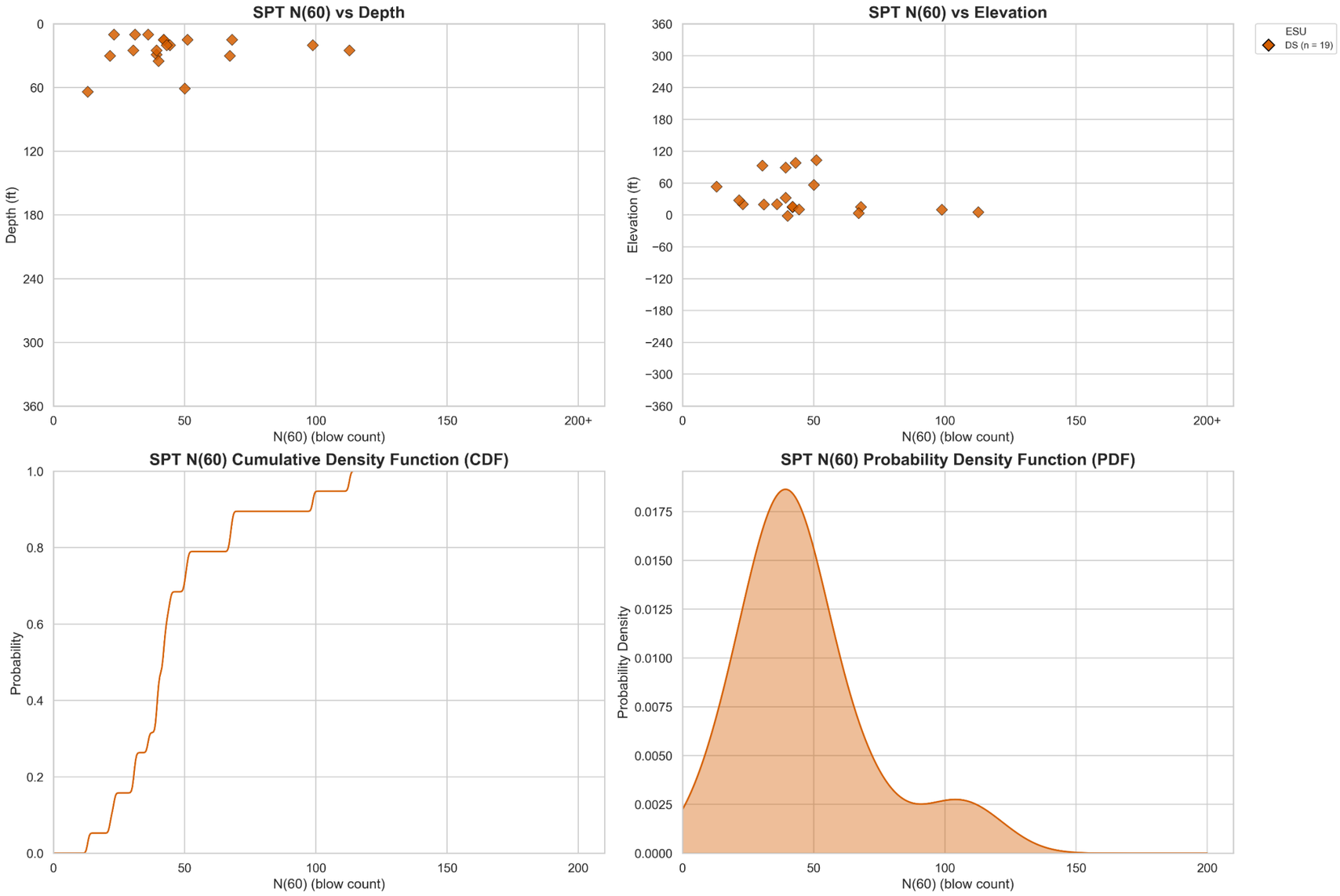
Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure **D-15**

DS (n = 19) - Anchorage Landside Borings



SPT N60 – Anchorage Landside Borings, ESU DS

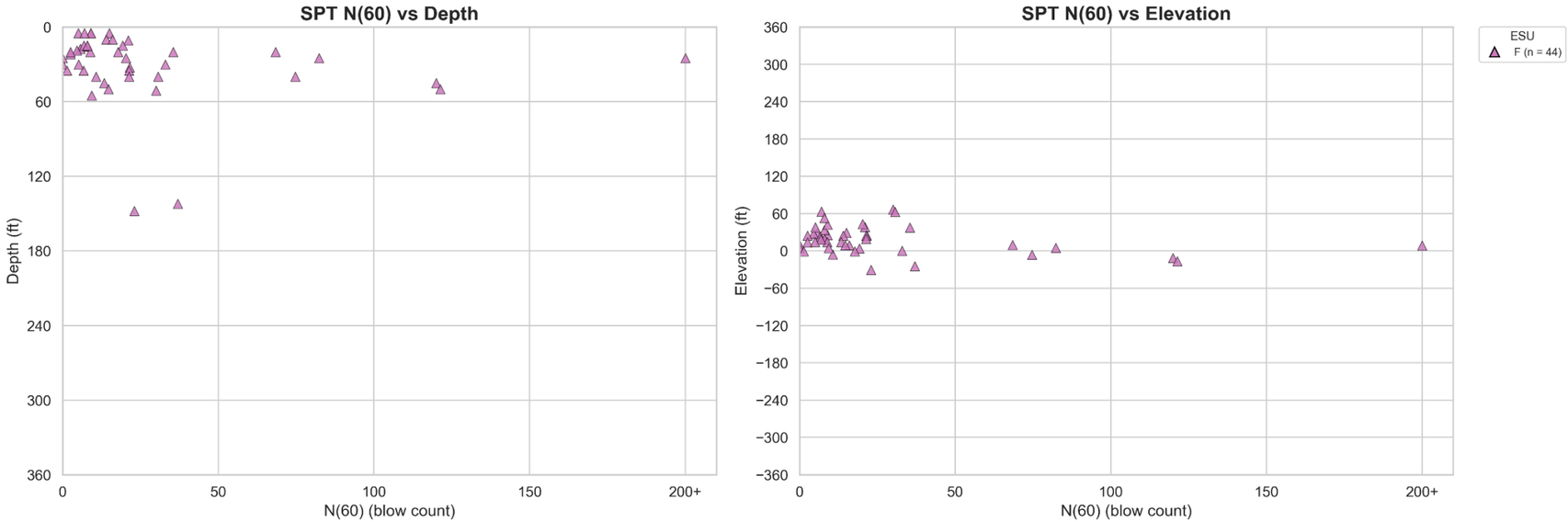
Knik Arm Tunnel Feasibility Study

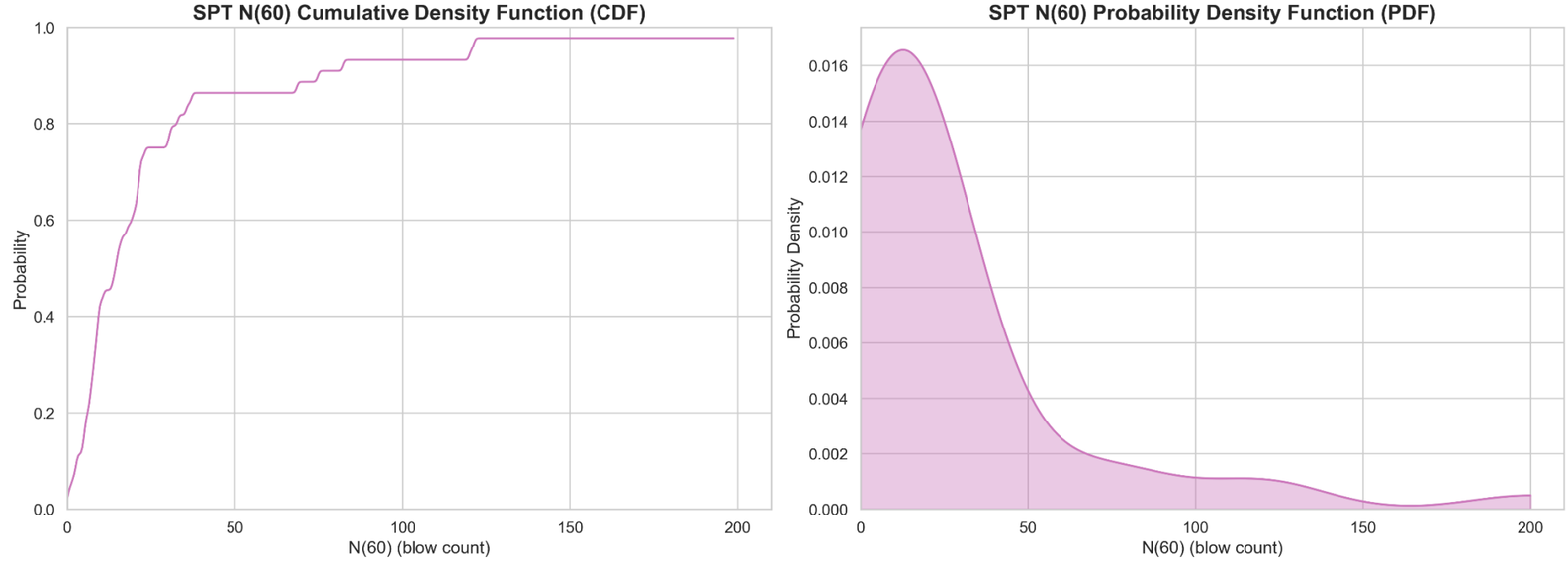
EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure **D-16**

F (n = 44) - Anchorage Landside Borings





SPT N60 – Anchorage Landside Borings, ESU F

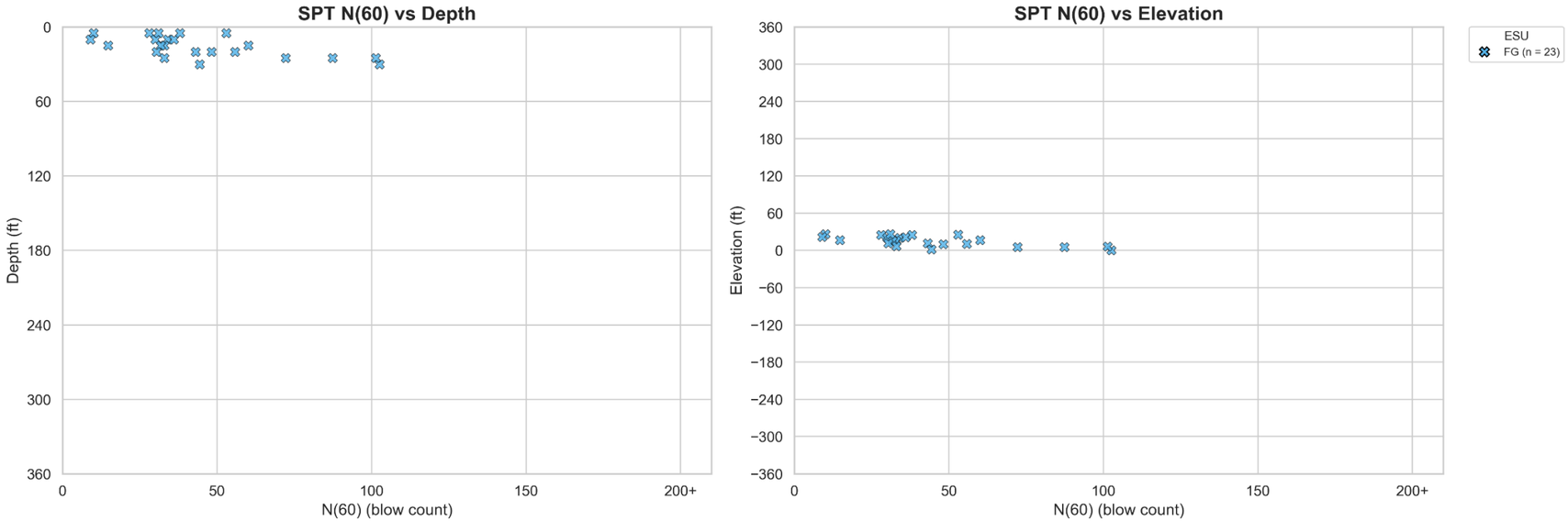
Knik Arm Tunnel Feasibility Study

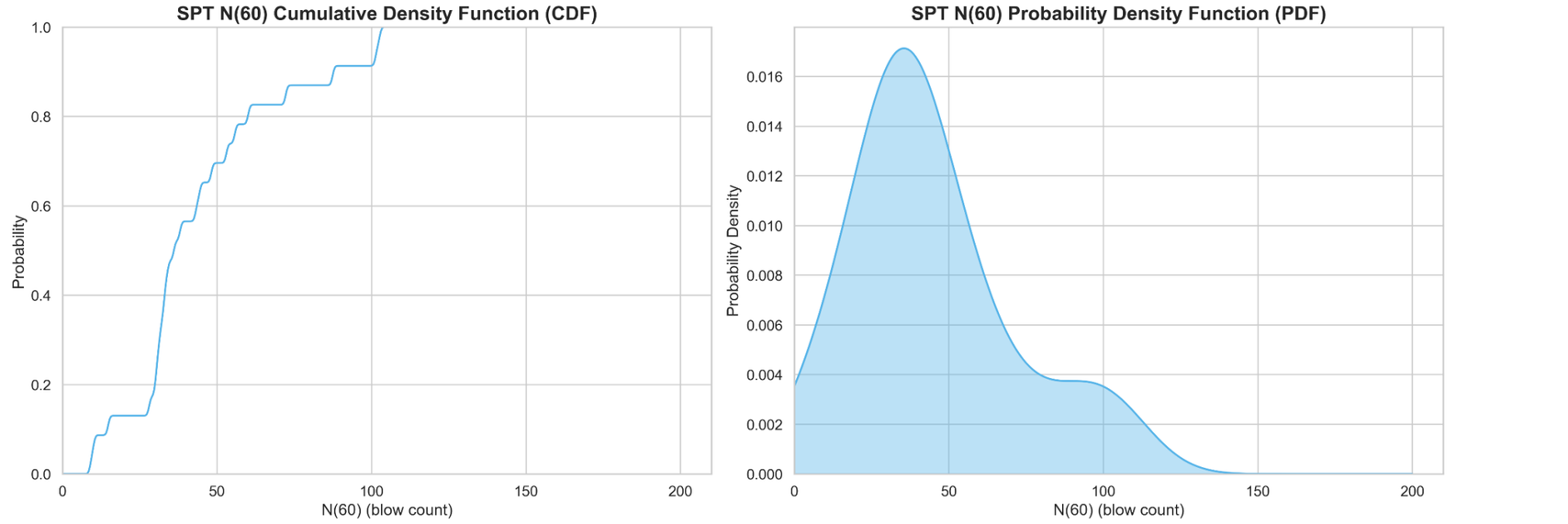
EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure **D-17**

FG (n = 23) - Anchorage Landside Borings





SPT N60 – Anchorage Landside Borings, ESU FG

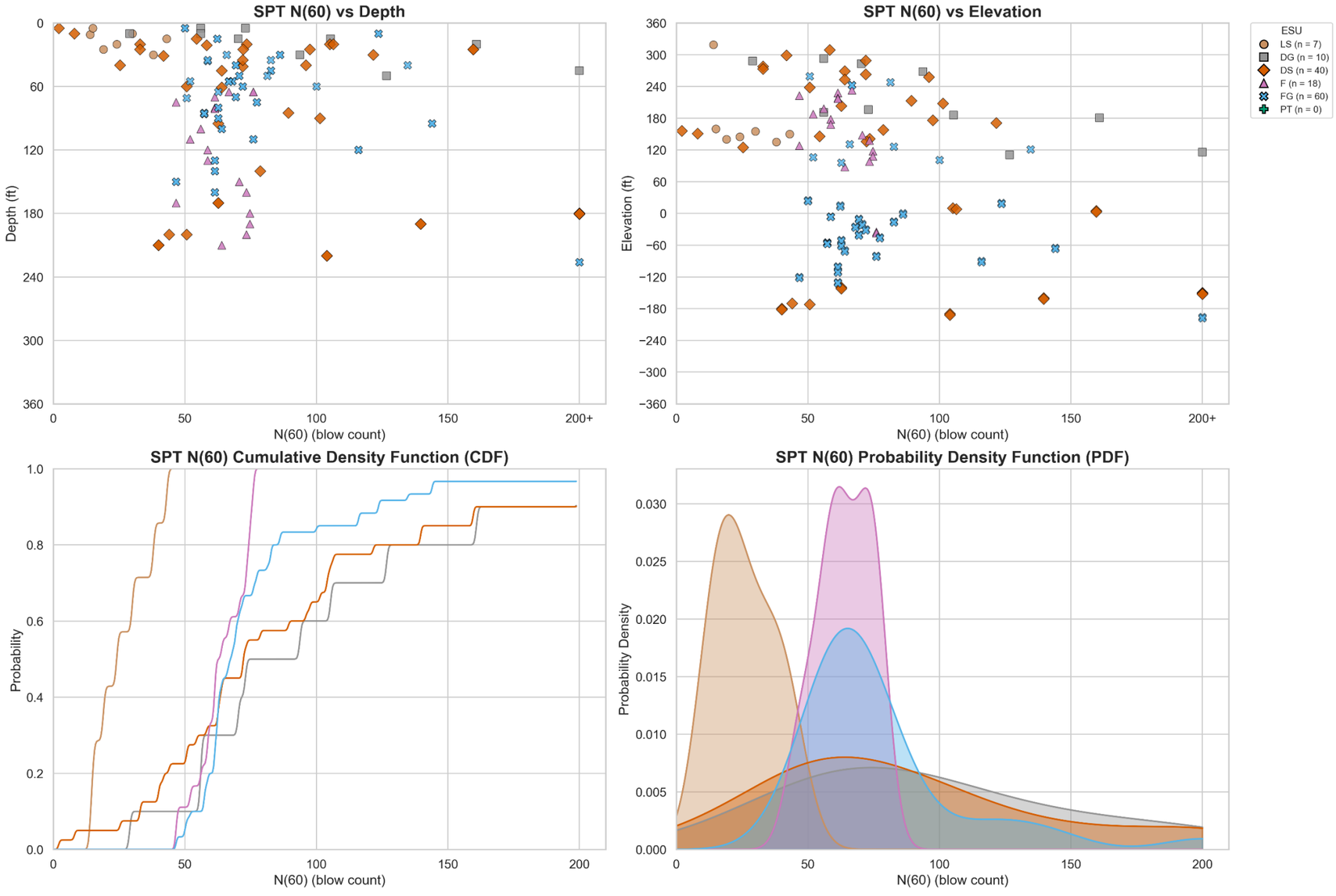
Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure **D-18**

Point MacKenzie Landside Borings



SPT N60 – Point MacKenzie Landside Borings, All ESUs

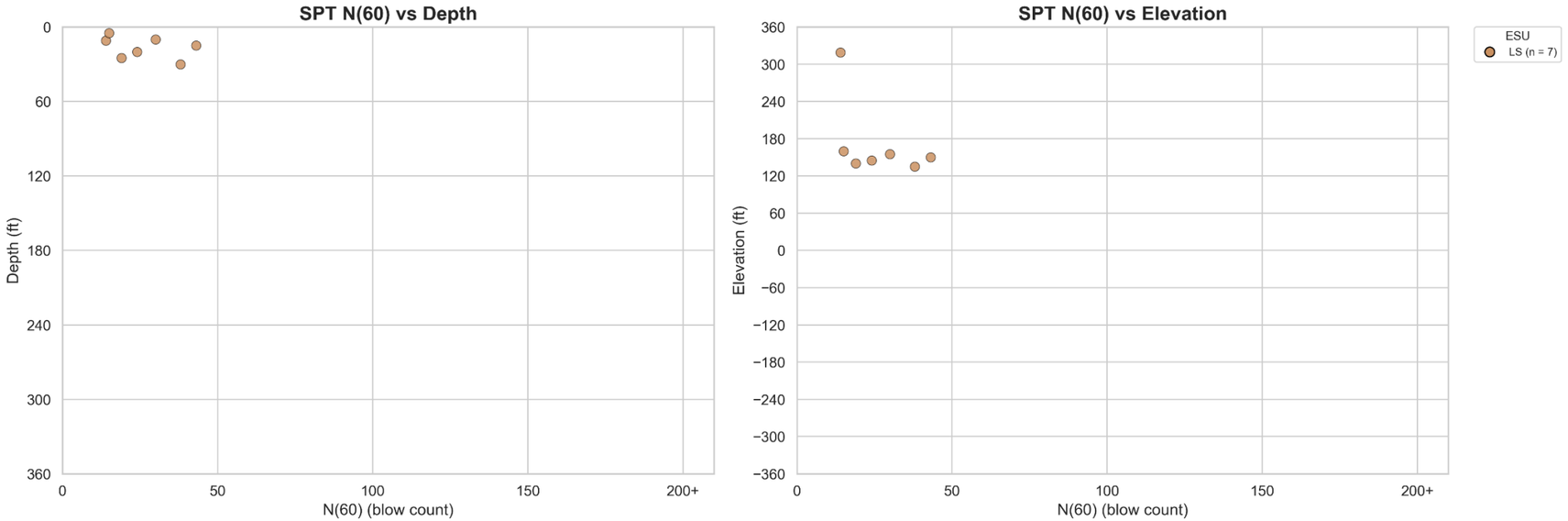
Knik Arm Tunnel Feasibility Study

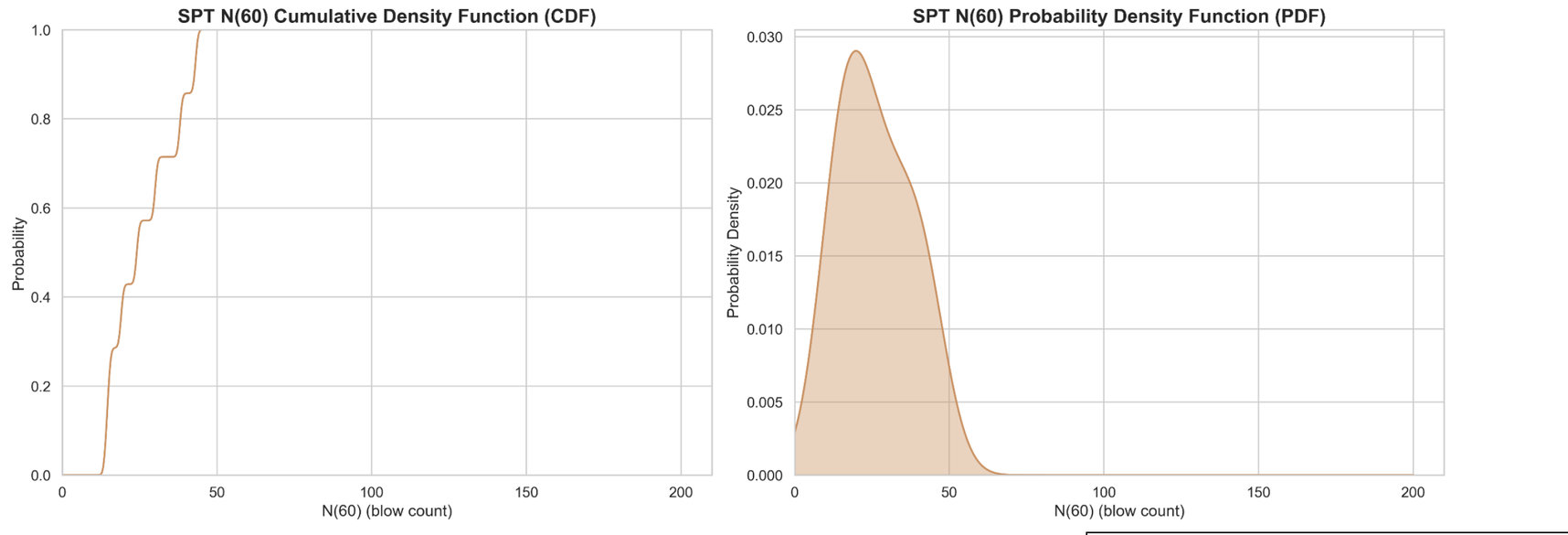
EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure D-19

LS (n = 7) - Point MacKenzie Landside Borings





SPT N60 – Point MacKenzie Landside Borings, ESU LS

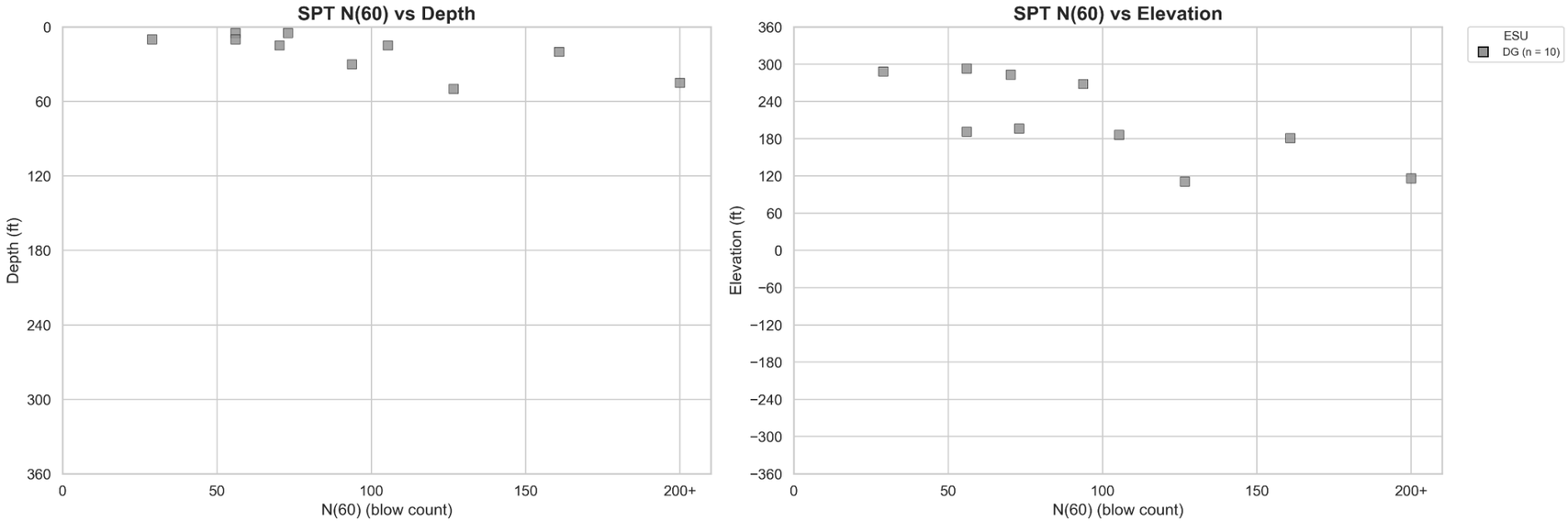
Knik Arm Tunnel Feasibility Study

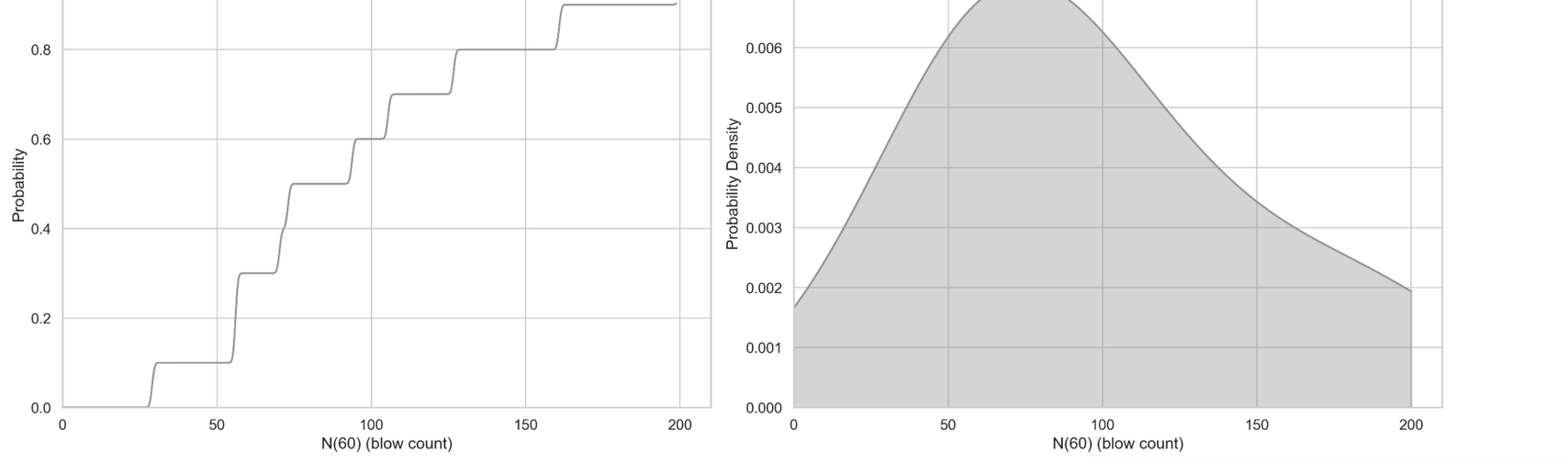
EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure **D-20**

DG (n = 10) - Point MacKenzie Landside Borings





SPT N60 – Point MacKenzie Landside Borings, ESU DG

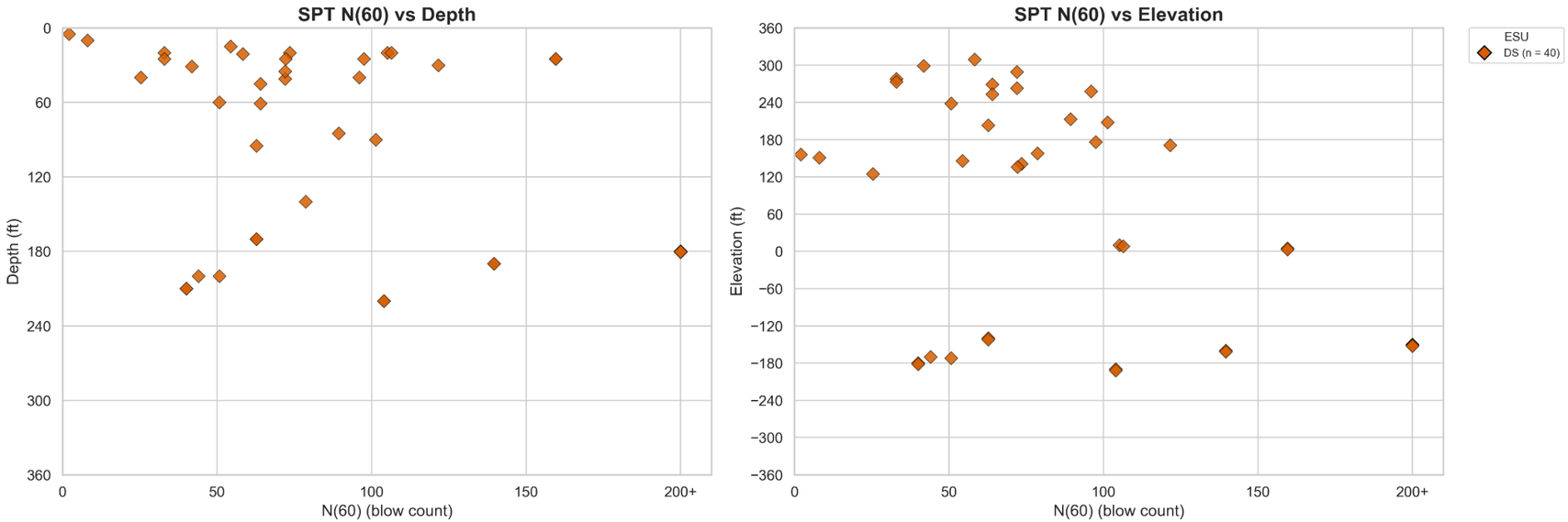
Knik Arm Tunnel Feasibility Study

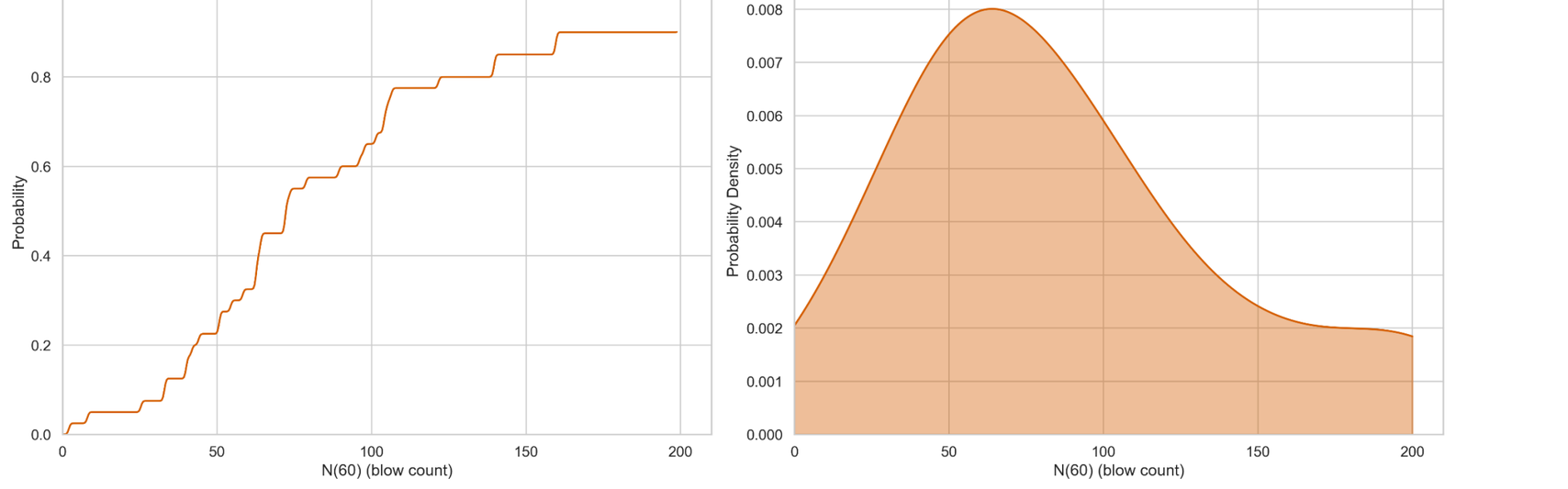
EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure
D-21

DS (n = 40) - Point MacKenzie Landside Borings





SPT N60 – Point MacKenzie Landside Borings, ESU DS

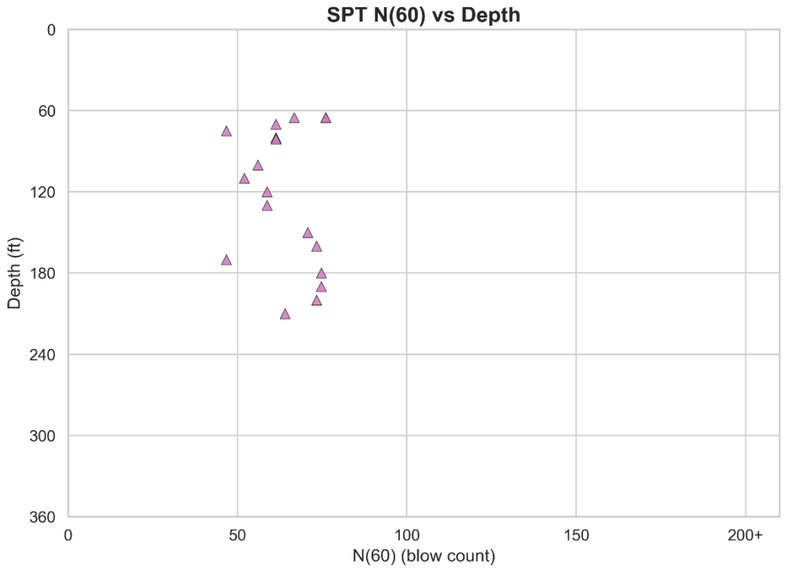
Knik Arm Tunnel Feasibility Study

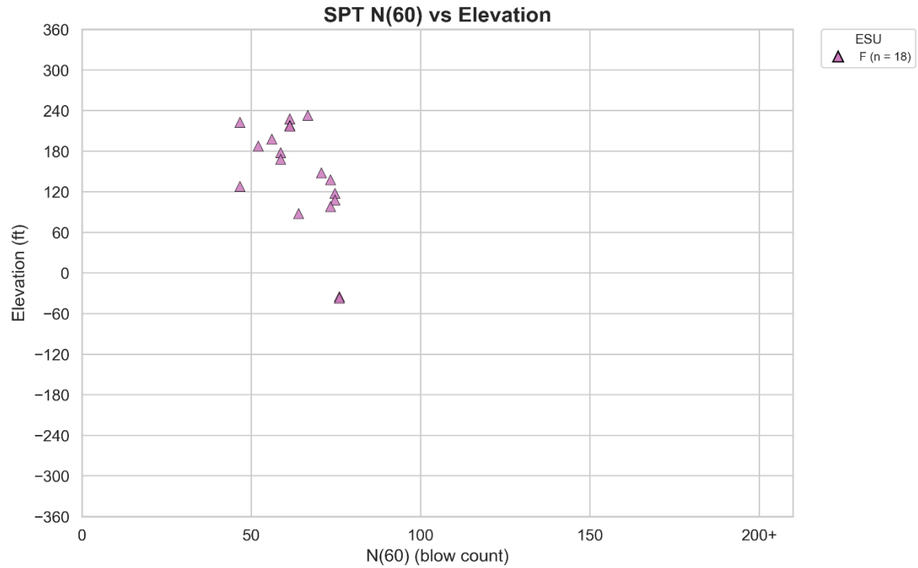
EMPRISE CONCEPTS

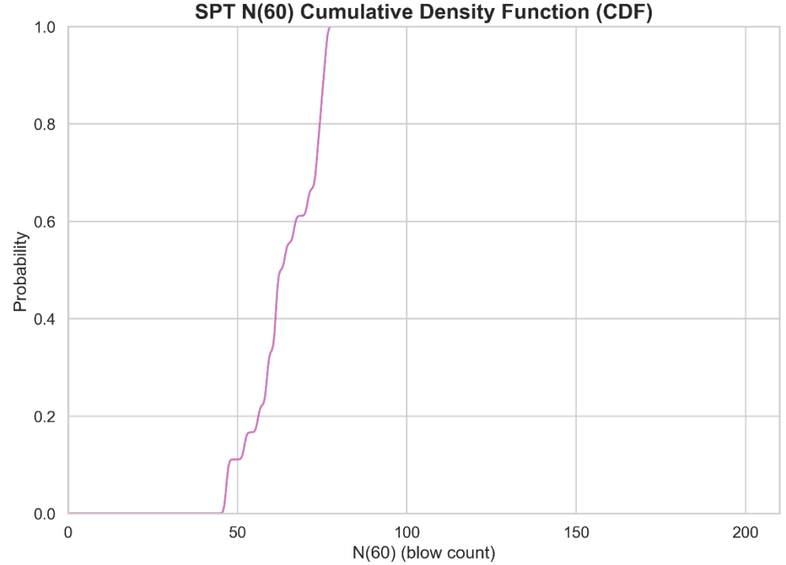
Anchorage, Alaska | August 2025

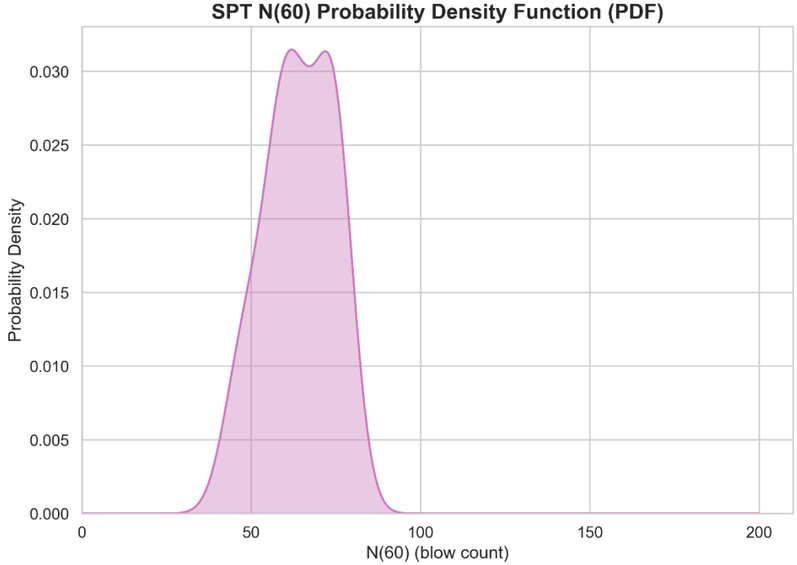
Figure **D-22**

F (n = 18) - Point MacKenzie Landside Borings









SPT N60 – Point MacKenzie Landside Borings, ESU F

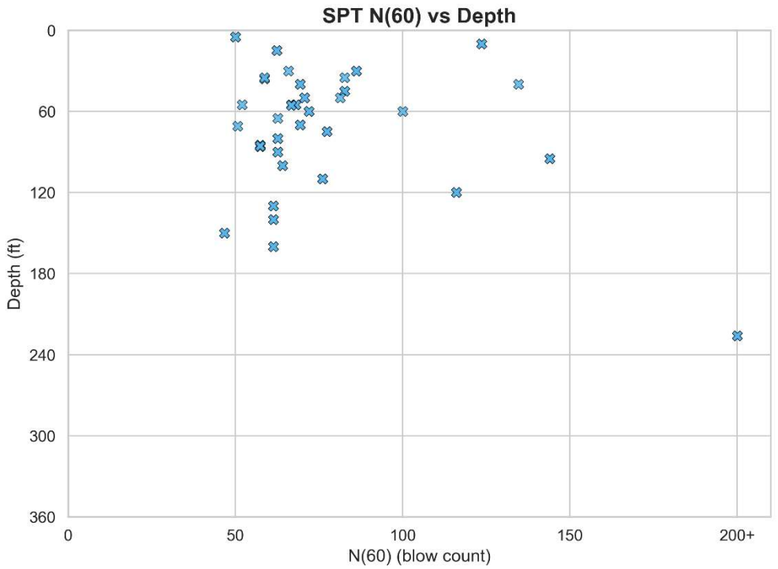
Knik Arm Tunnel Feasibility Study

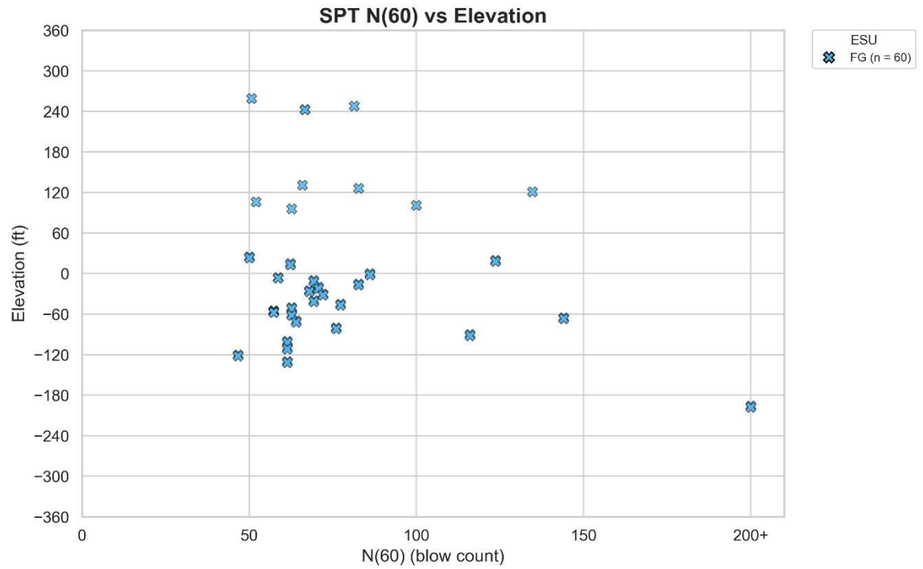
EMPRISE CONCEPTS

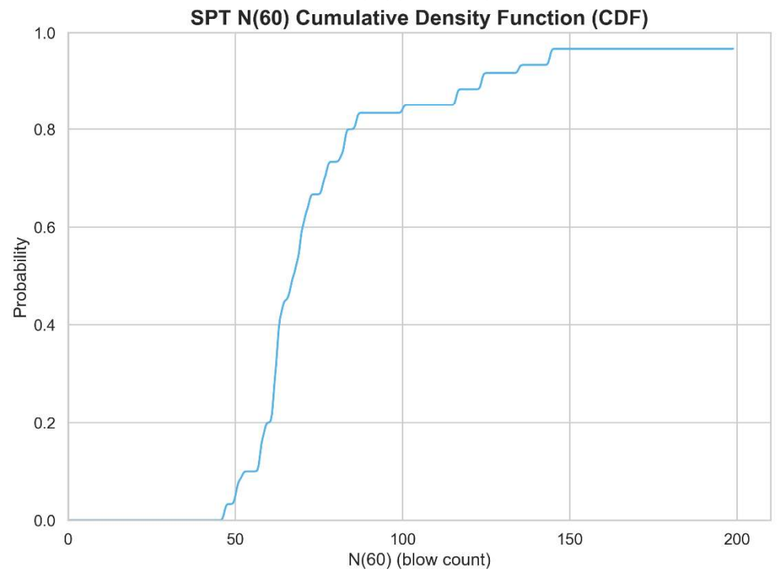
Anchorage, Alaska | August 2025

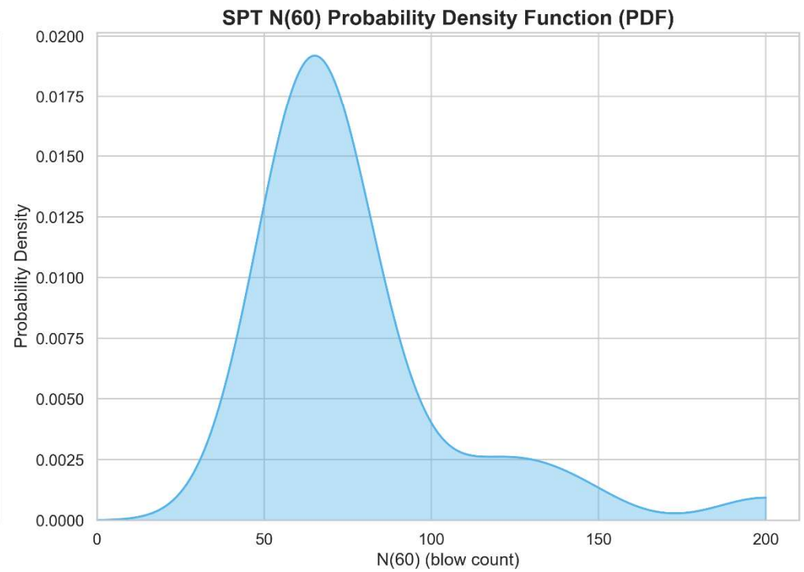
Figure
D-23

FG (n = 60) - Point MacKenzie Landside Borings









SPT N60 – Point MacKenzie Landside Borings, ESU FG

Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure D-24

All Borings

SPT N160 – All Borings, All ESUs

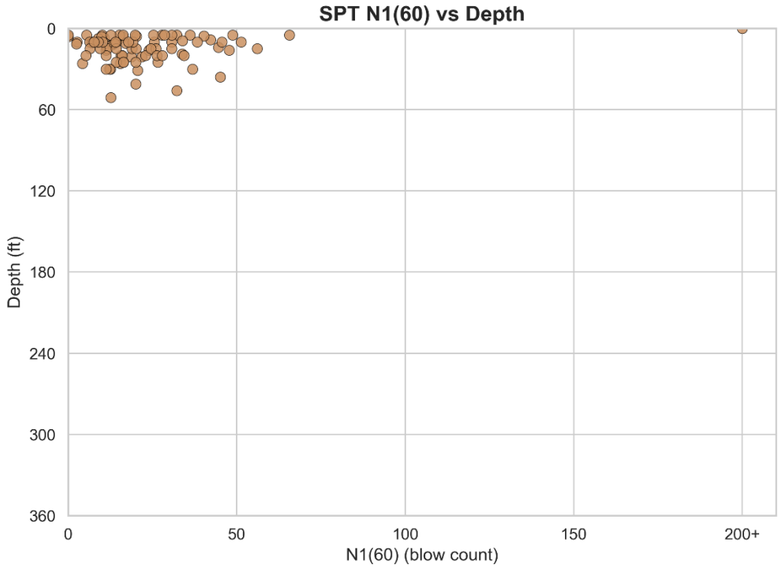
Knik Arm Tunnel Feasibility Study

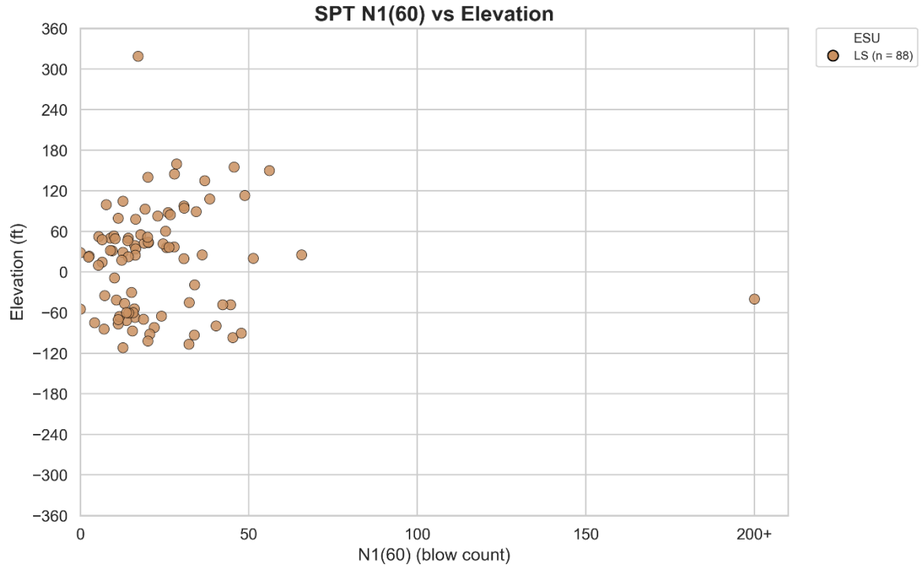
EMPRISE CONCEPTS

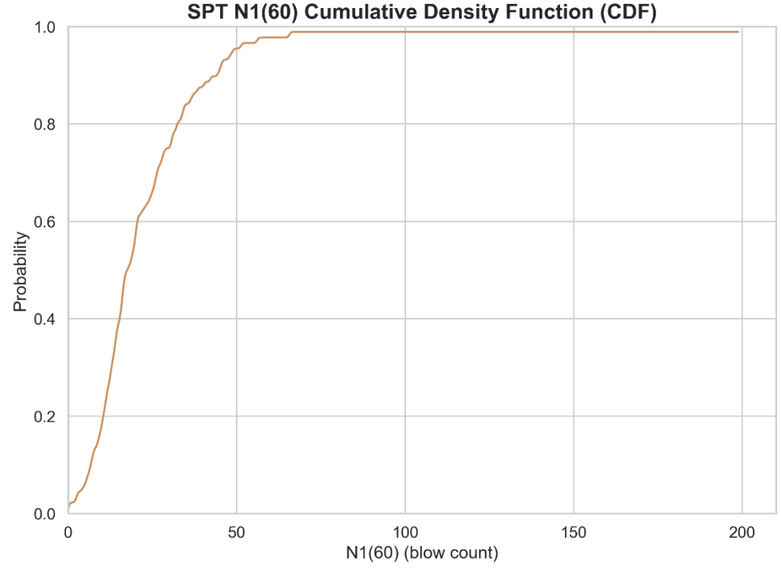
Anchorage, Alaska | August 2025

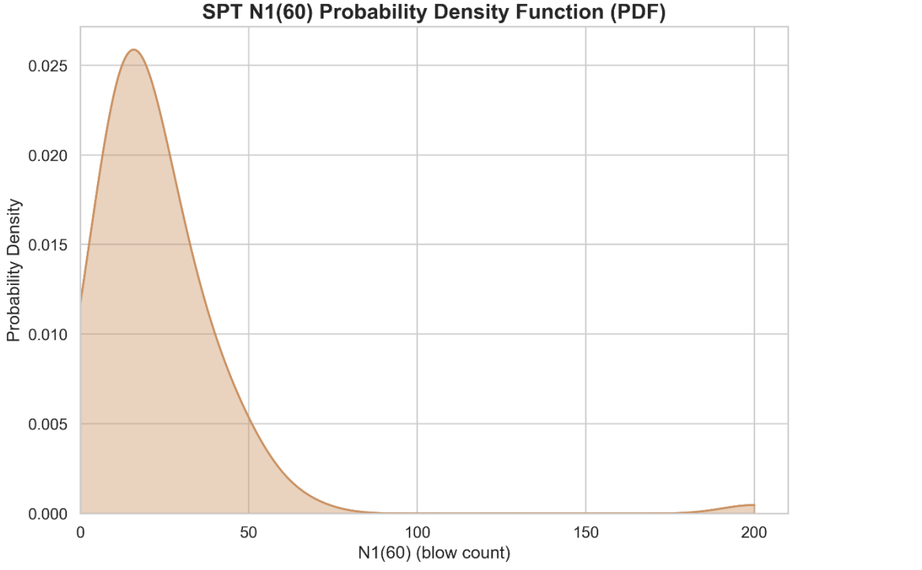
Figure **E-1**

LS (n = 88) - All Borings









SPT N160 – All Borings, ESU LS

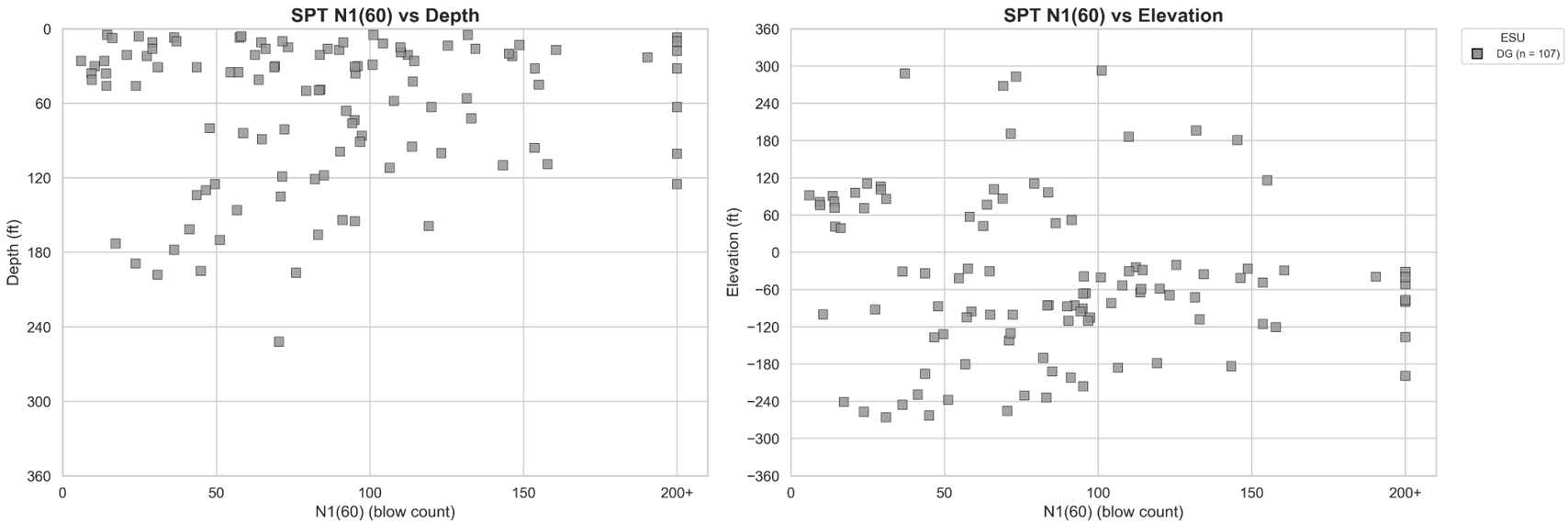
Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure **E-2**

DG (n = 107) - All Borings



SPT N160 – All Borings, ESU DG

Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure **E-3**

DS (n = 314) - All Borings

SPT N160 – All Borings, ESU DS

Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure **E-4**

F (n = 259) - All Borings

SPT N160 – All Borings, ESU F

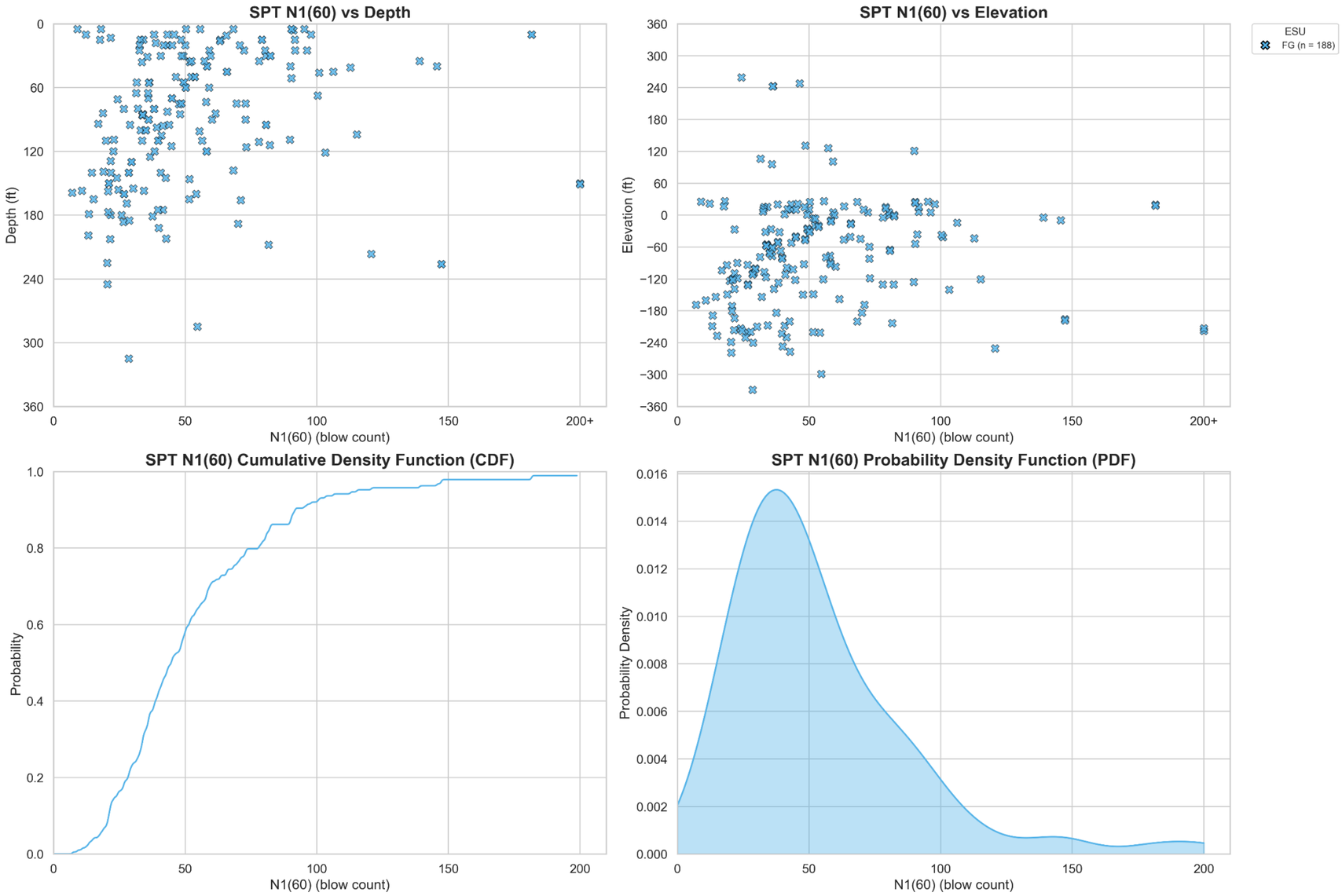
Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure **E-5**

FG (n = 188) - All Borings



SPT N160 – All Borings, ESU FG

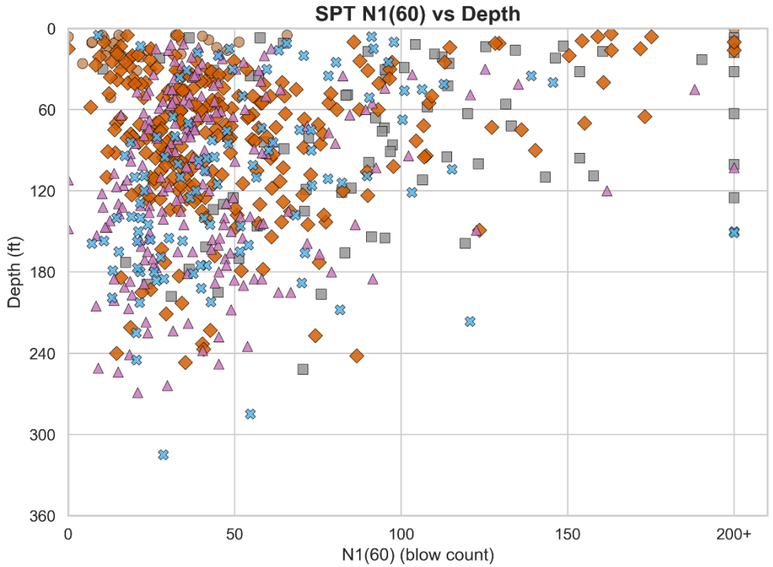
Knik Arm Tunnel Feasibility Study

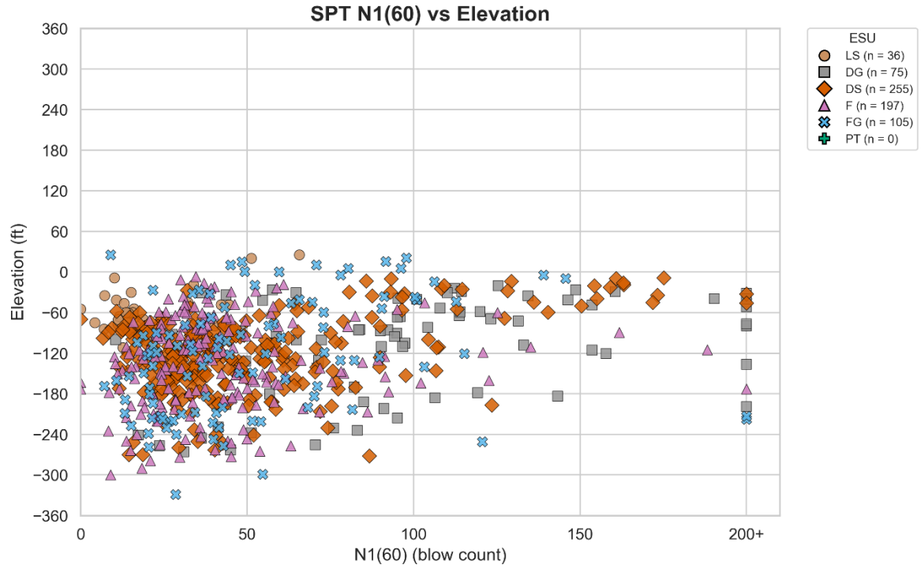
EMPRISE CONCEPTS

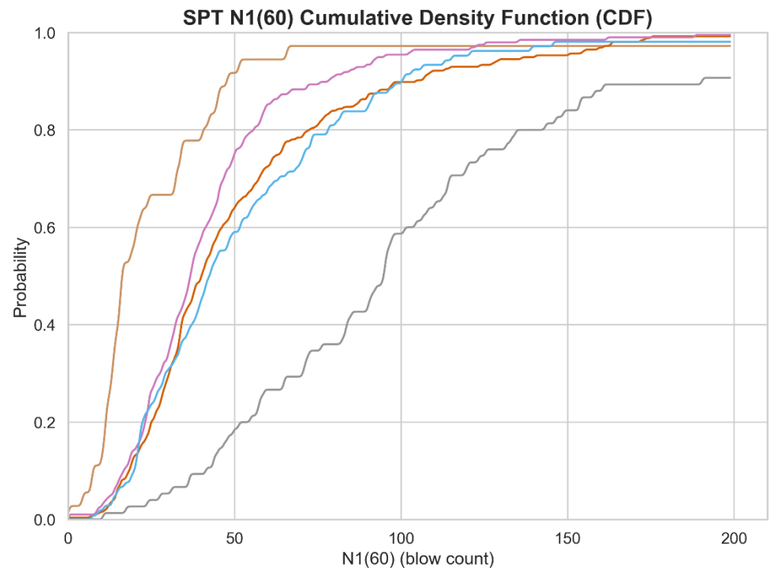
Anchorage, Alaska | August 2025

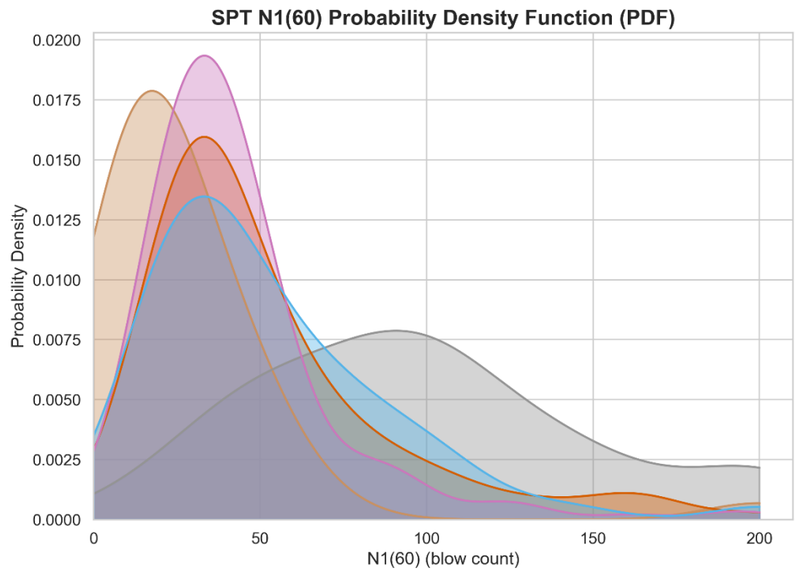
Figure **E-6**

Overwater Borings









SPT N160 – Overwater Borings, All ESUs

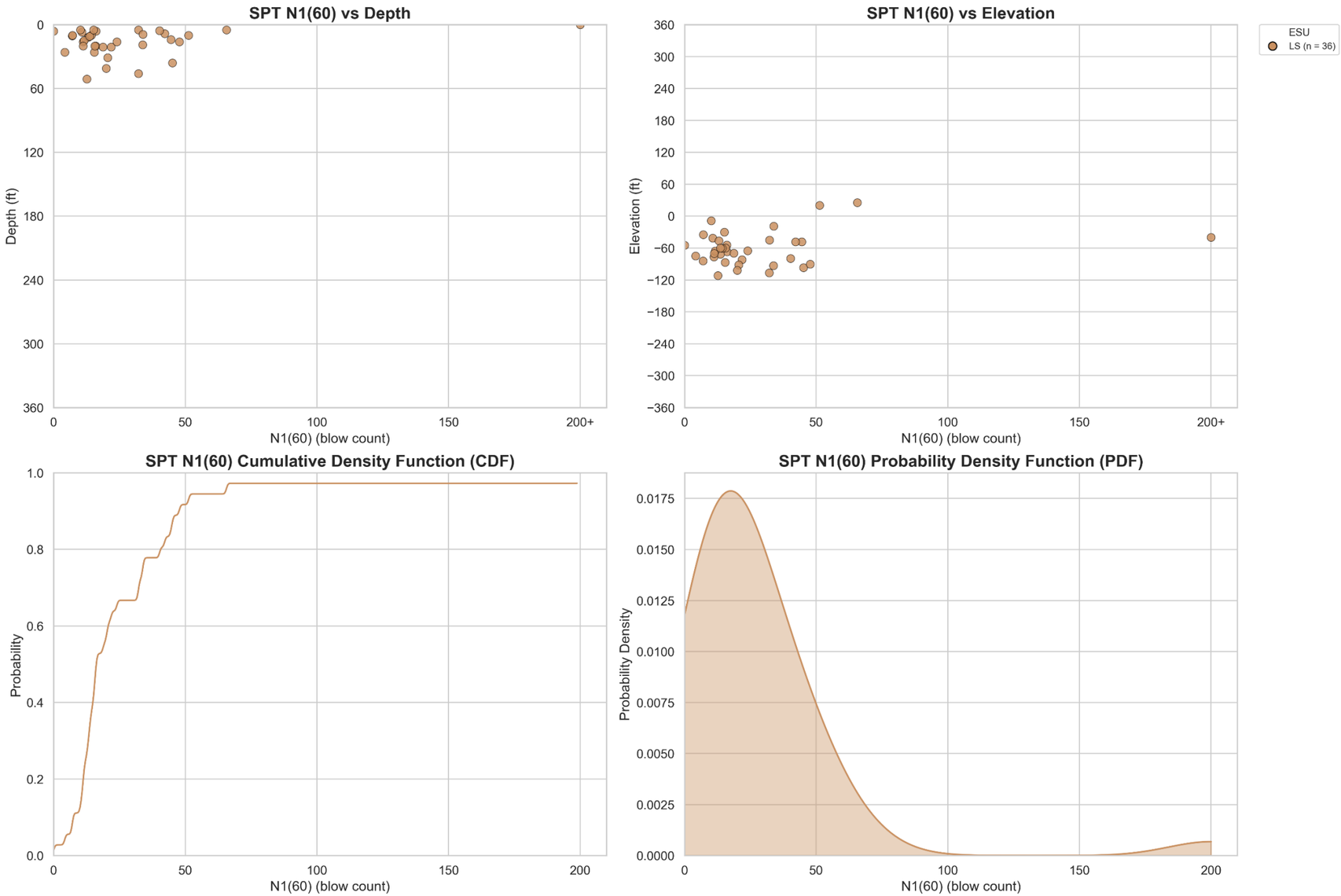
Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure **E-7**

LS (n = 36) - Overwater Borings



SPT N160 – Overwater Borings, ESU LS

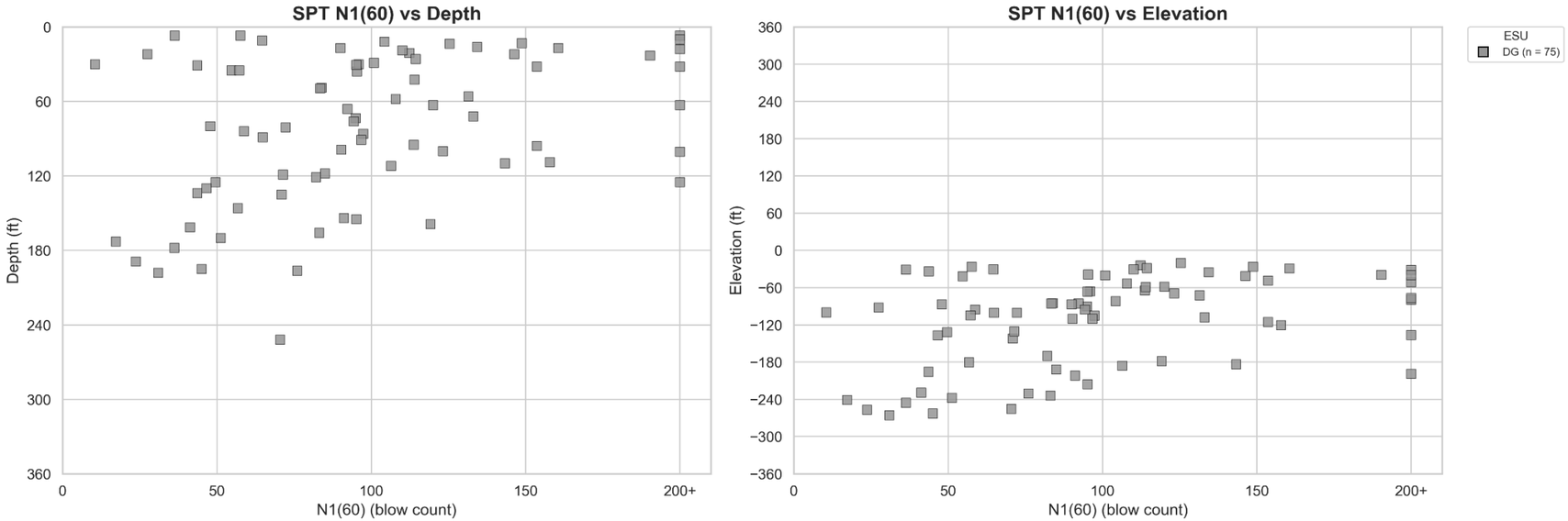
Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure **E-8**

DG (n = 75) - Overwater Borings



SPT N160 – Overwater Borings, ESU DG

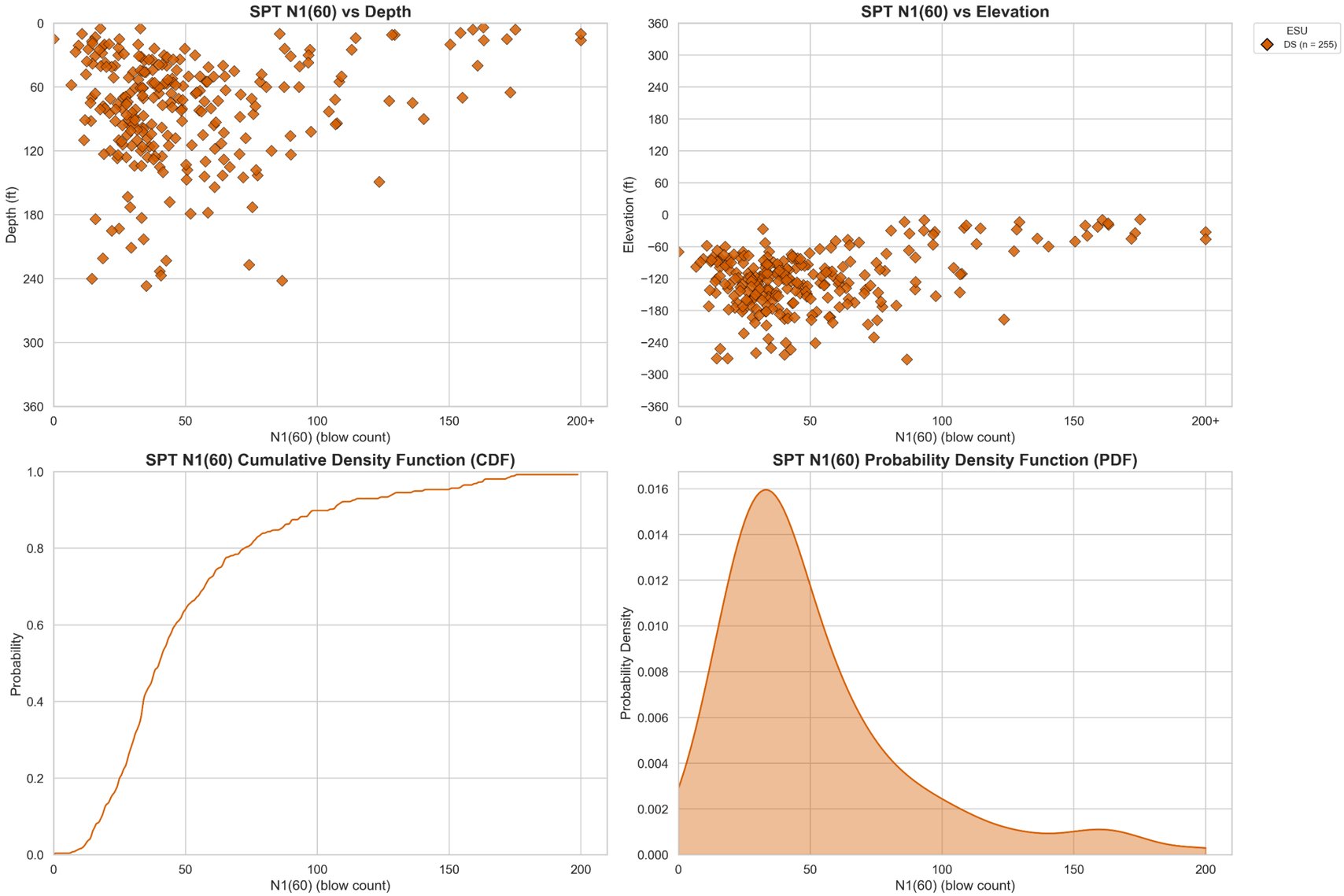
Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure **E-9**

DS (n = 255) - Overwater Borings



SPT N160 – Overwater Borings, ESU DS

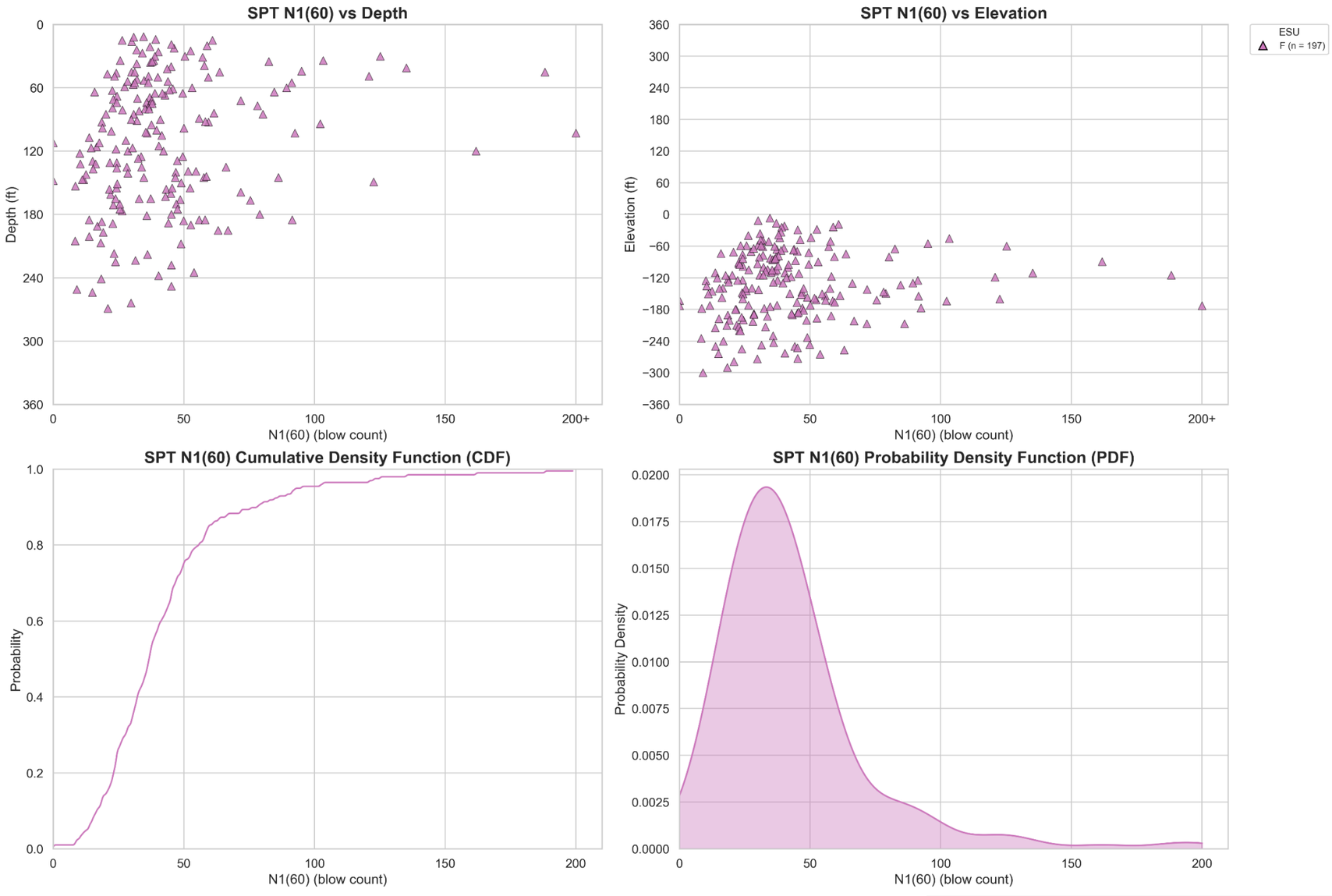
Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure **E-10**

F (n = 197) - Overwater Borings



SPT N160 – Overwater Borings, ESU F

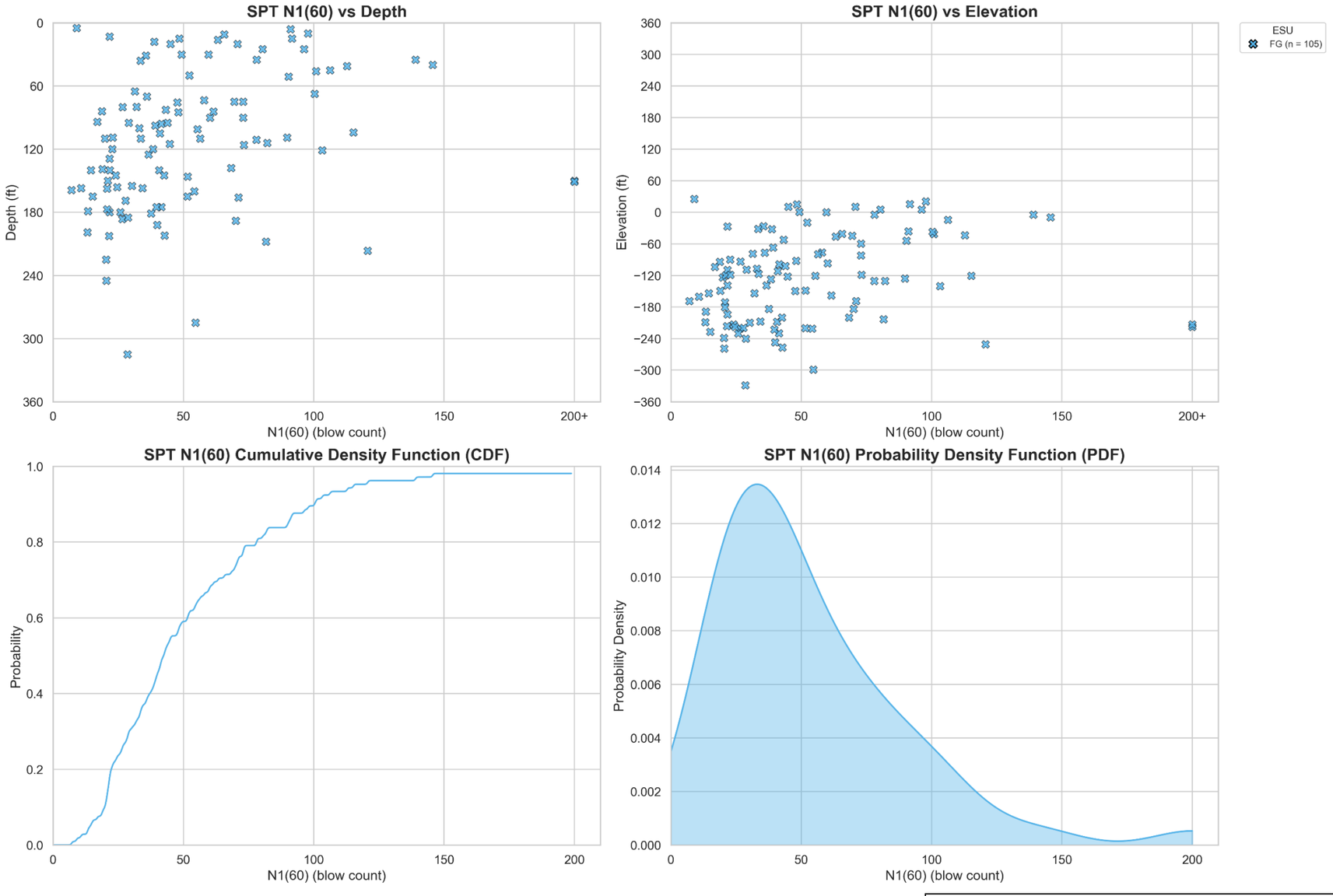
Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure **E-11**

FG (n = 105) - Overwater Borings



SPT N160 – Overwater Borings, ESU FG

Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure **E-12**

Anchorage Landside Borings

SPT N160 – Anchorage Landside Borings, All ESUs

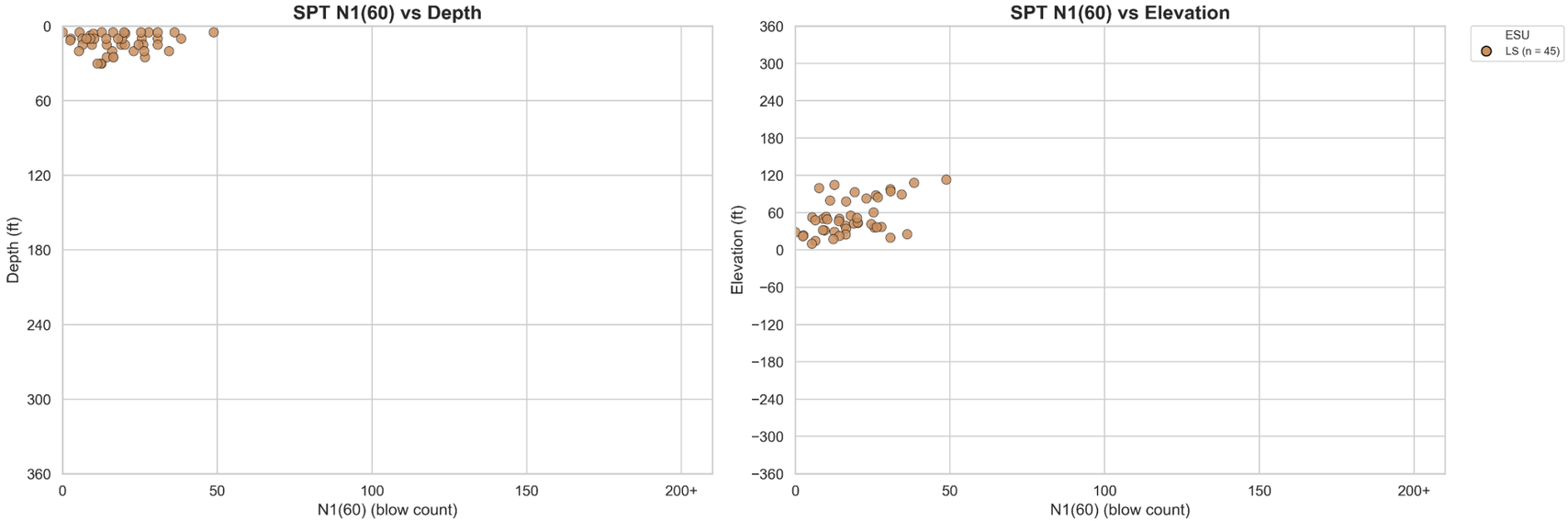
Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure **E-13**

LS (n = 45) - Anchorage Landside Borings



SPT N160 – Anchorage Landside Borings, ESU LS

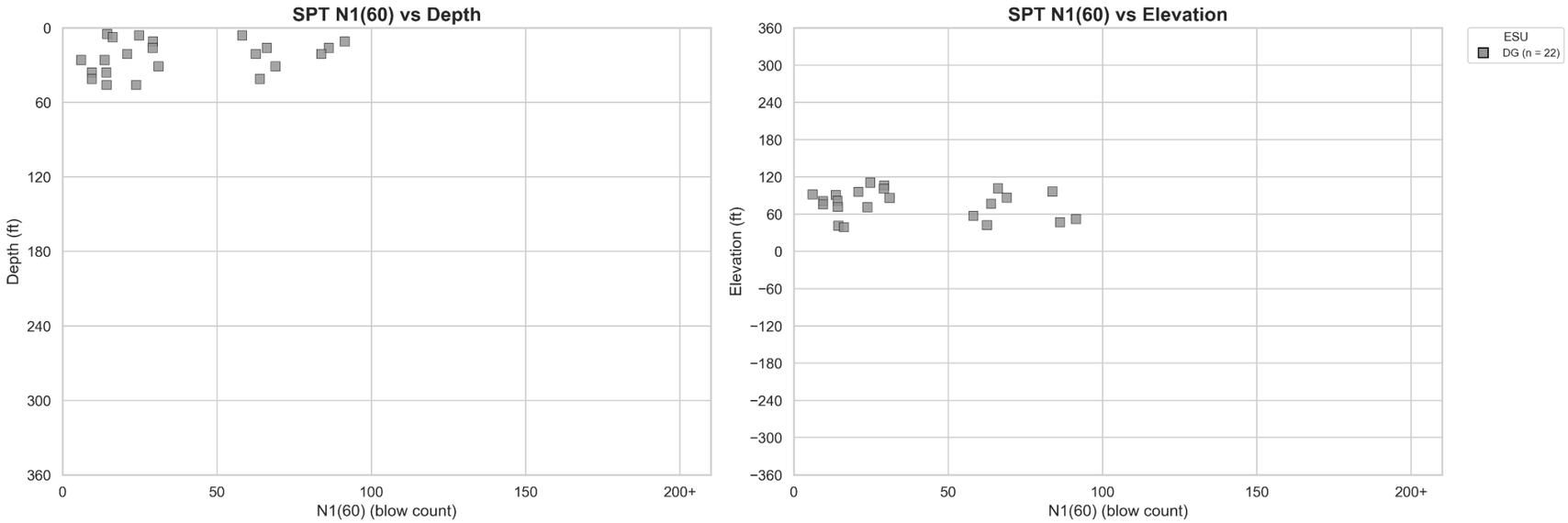
Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure **E-14**

DG (n = 22) - Anchorage Landside Borings



SPT N160 – Anchorage Landside Borings, ESU DG

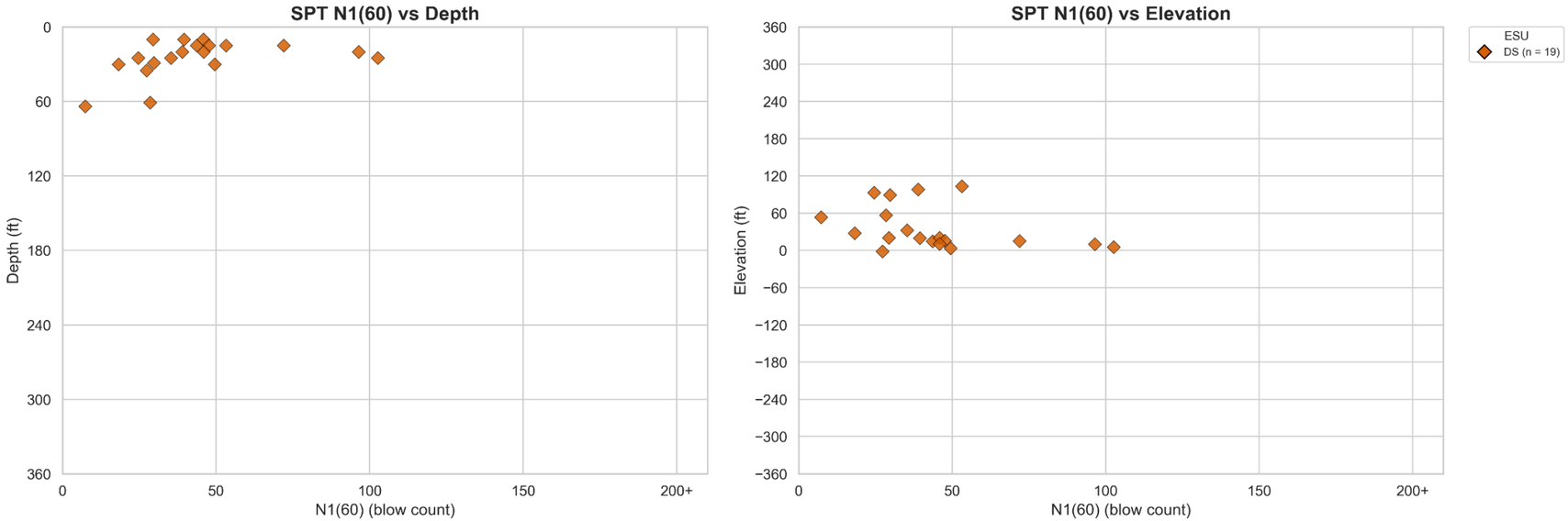
Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure **E-15**

DS (n = 19) - Anchorage Landside Borings



SPT N160 – Anchorage Landside Borings, ESU DS

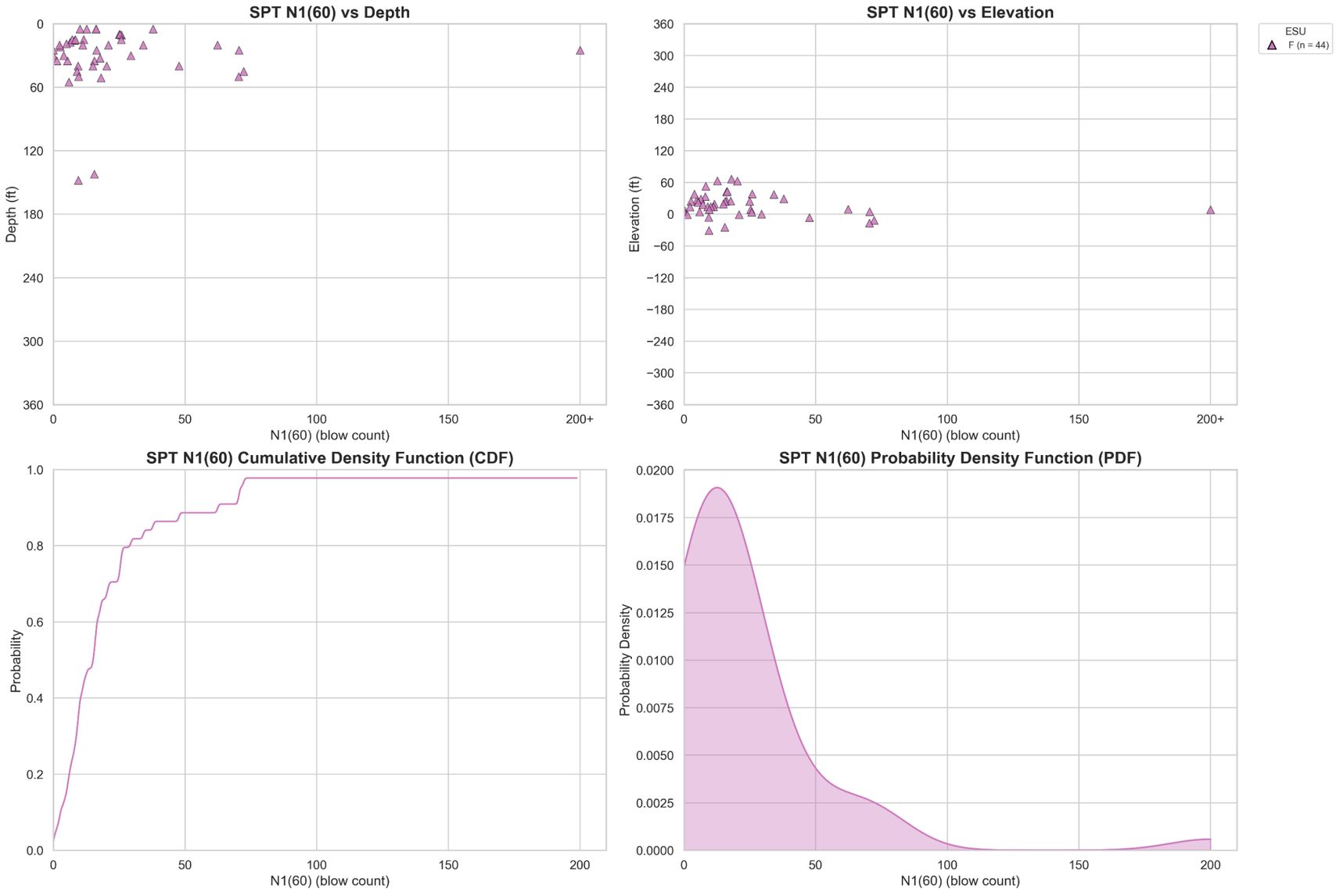
Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure **E-16**

F (n = 44) - Anchorage Landside Borings



SPT N160 – Anchorage Landside Borings, ESU F

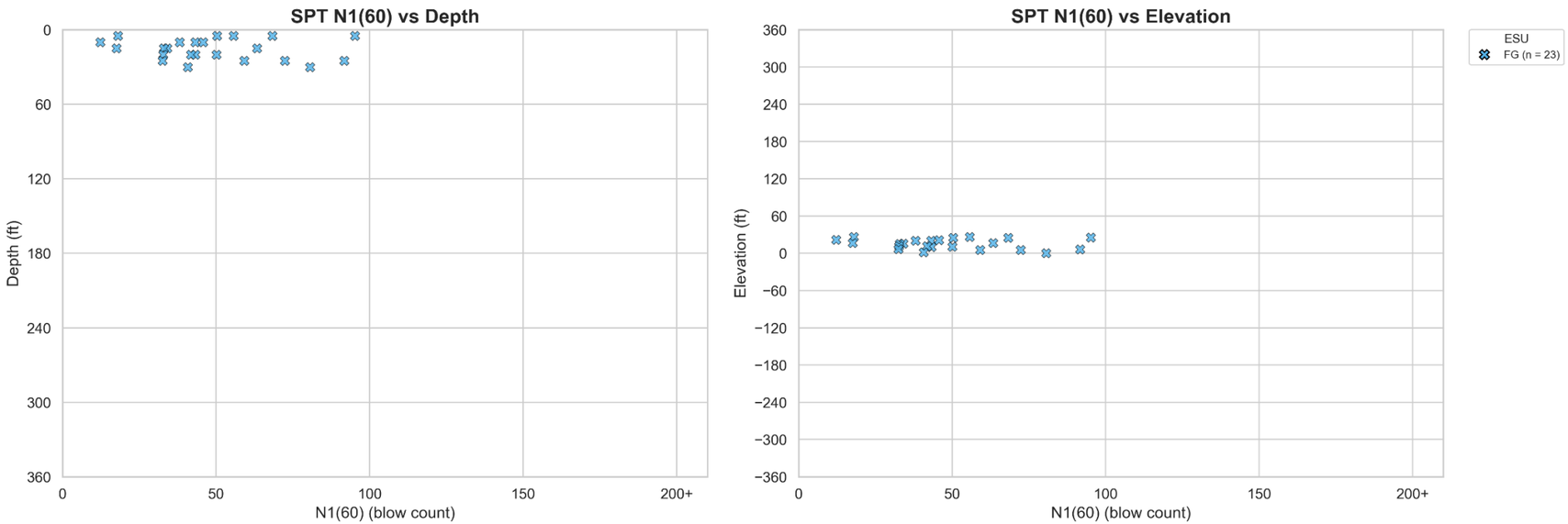
Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure **E-17**

FG (n = 23) - Anchorage Landside Borings



SPT N160 – Anchorage Landside Borings, ESU FG

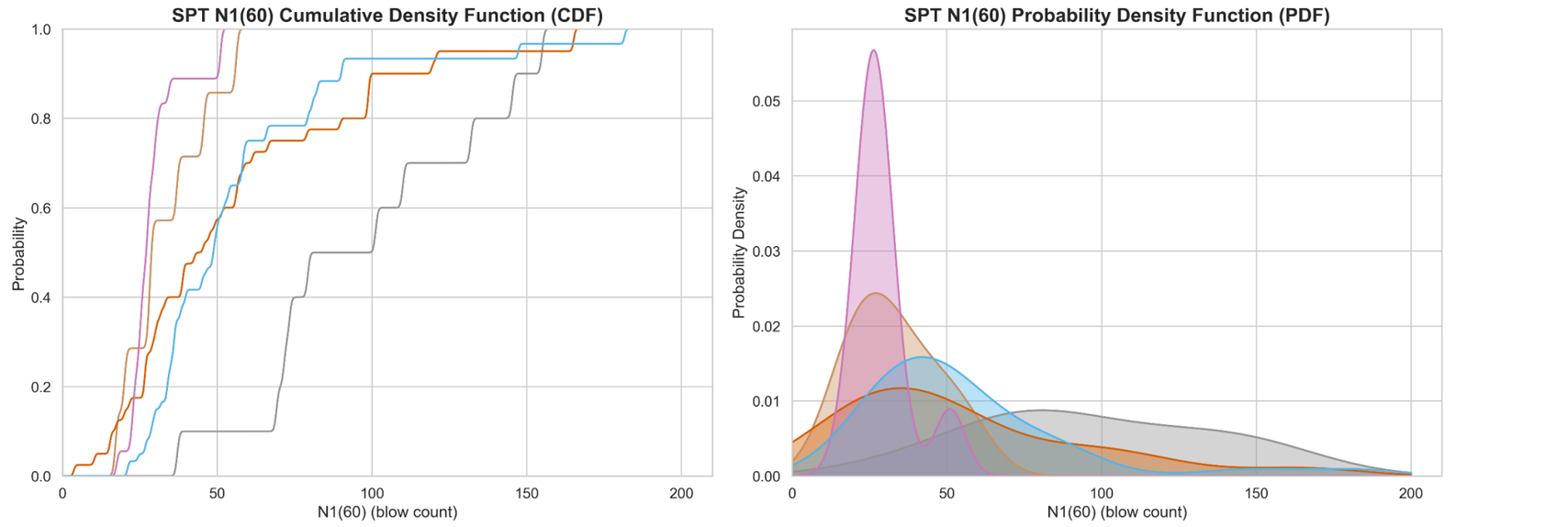
Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure **E-18**

Point MacKenzie Landside Borings



SPT N160 – Point MacKenzie Landside Borings, All ESUs

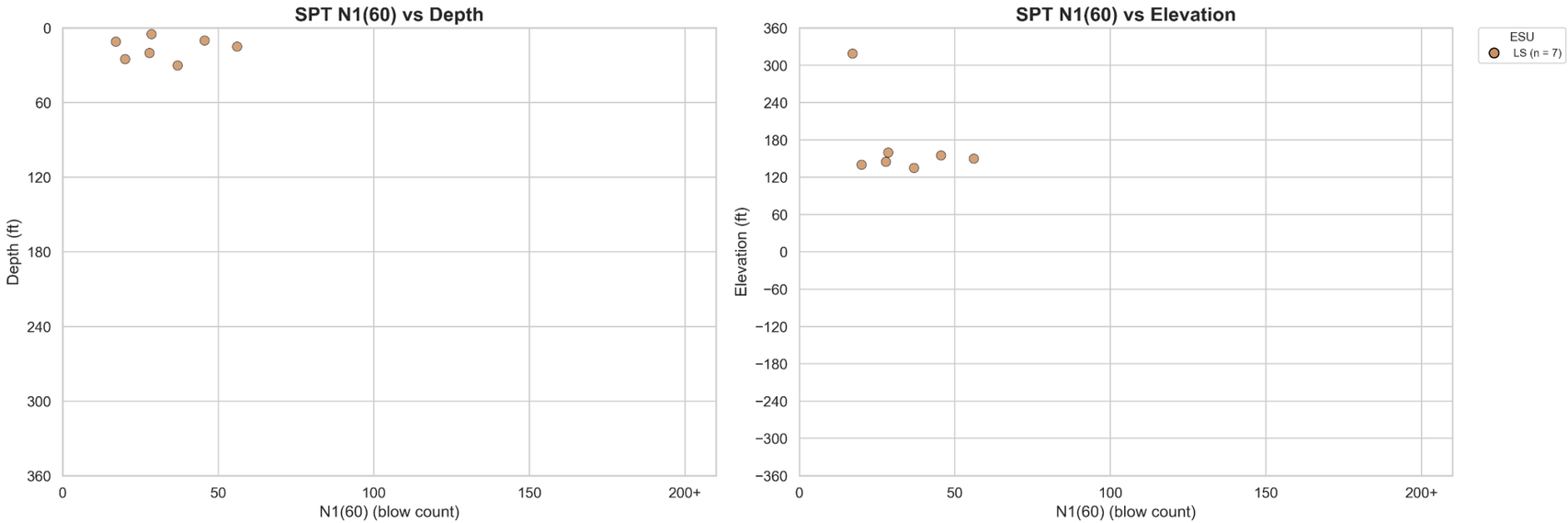
Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure
E-19

LS (n = 7) - Point MacKenzie Landside Borings



SPT N160 – Point MacKenzie Landside Borings, ESU LS

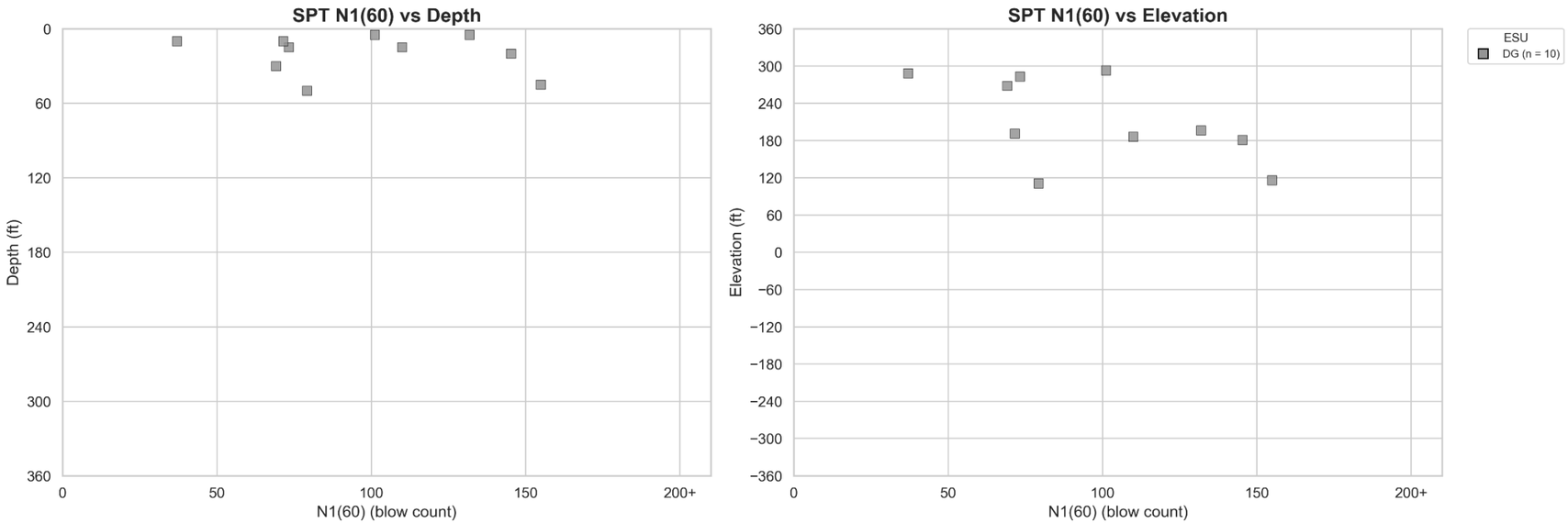
Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure **E-20**

DG (n = 10) - Point MacKenzie Landside Borings



SPT N160 – Point MacKenzie Landside Borings, ESU DG

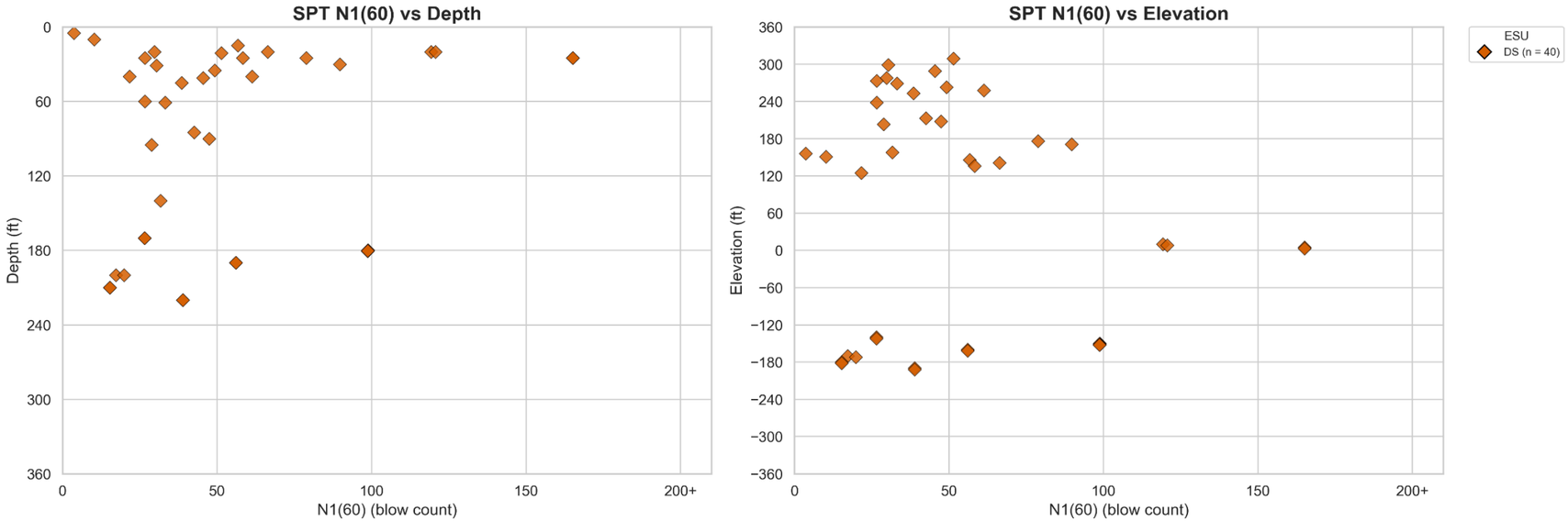
Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure **E-21**

DS (n = 40) - Point MacKenzie Landside Borings



SPT N160 – Point MacKenzie Landside Borings, ESU DS

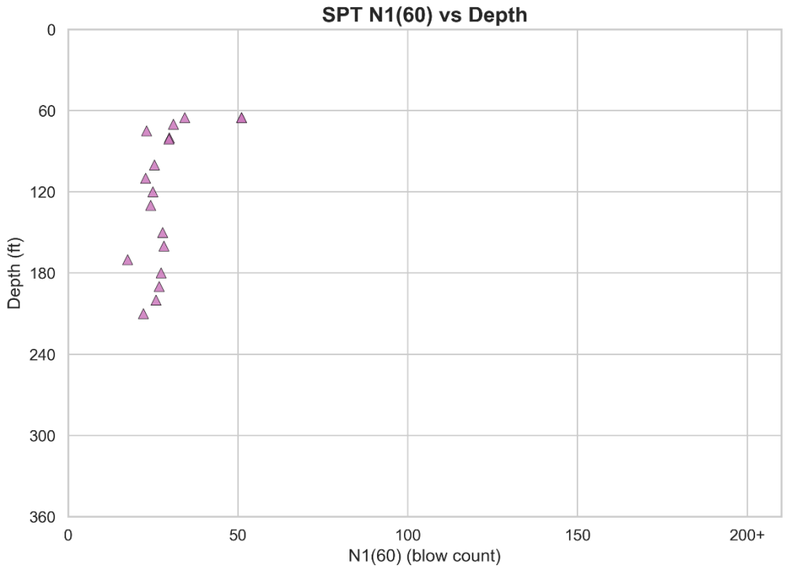
Knik Arm Tunnel Feasibility Study

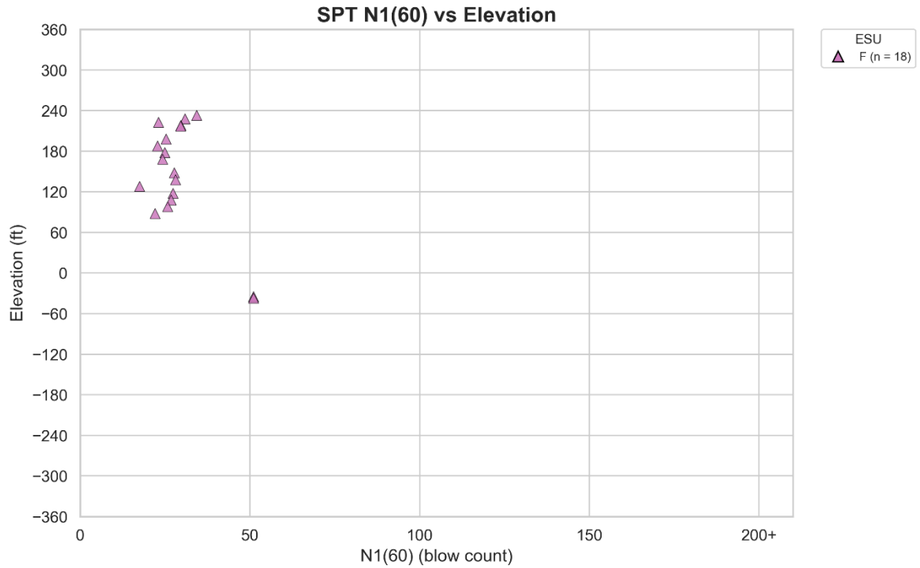
EMPRISE CONCEPTS

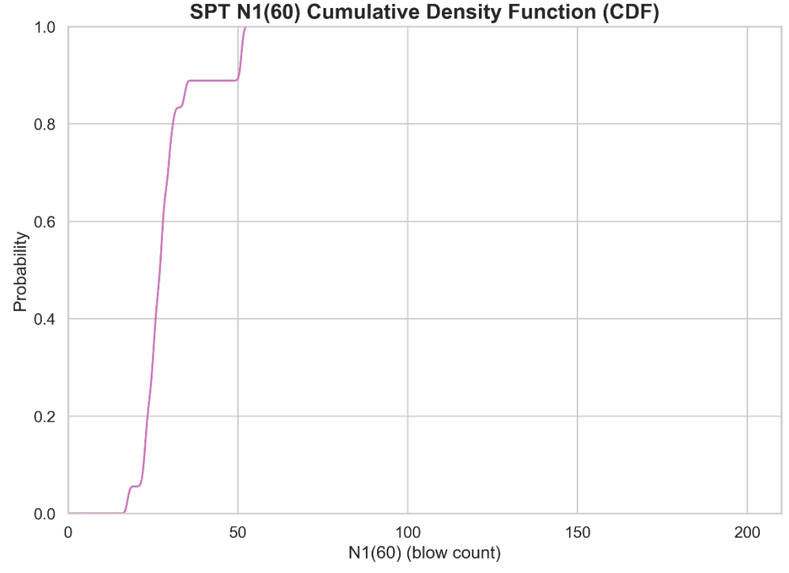
Anchorage, Alaska | August 2025

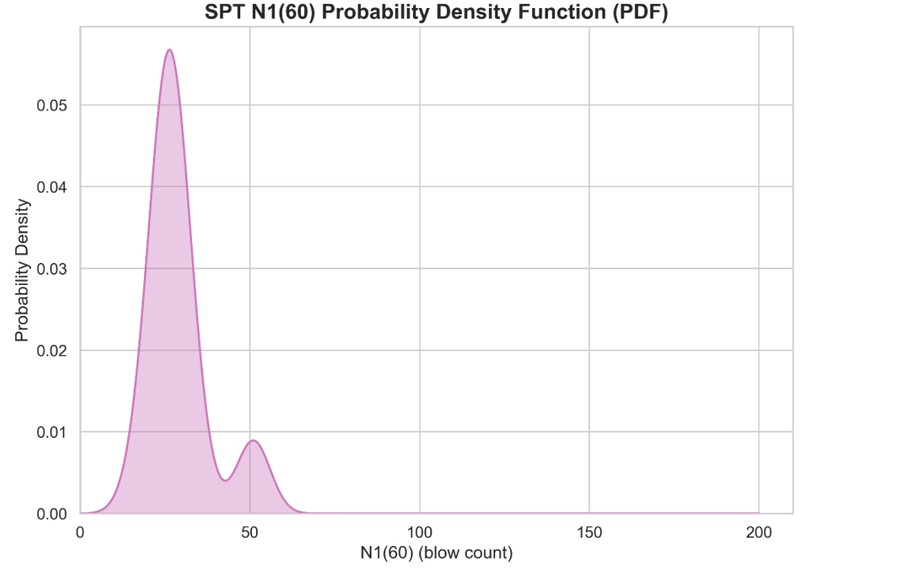
Figure **E-22**

F (n = 18) - Point MacKenzie Landside Borings









SPT N160 – Point MacKenzie Landside Borings, ESU F

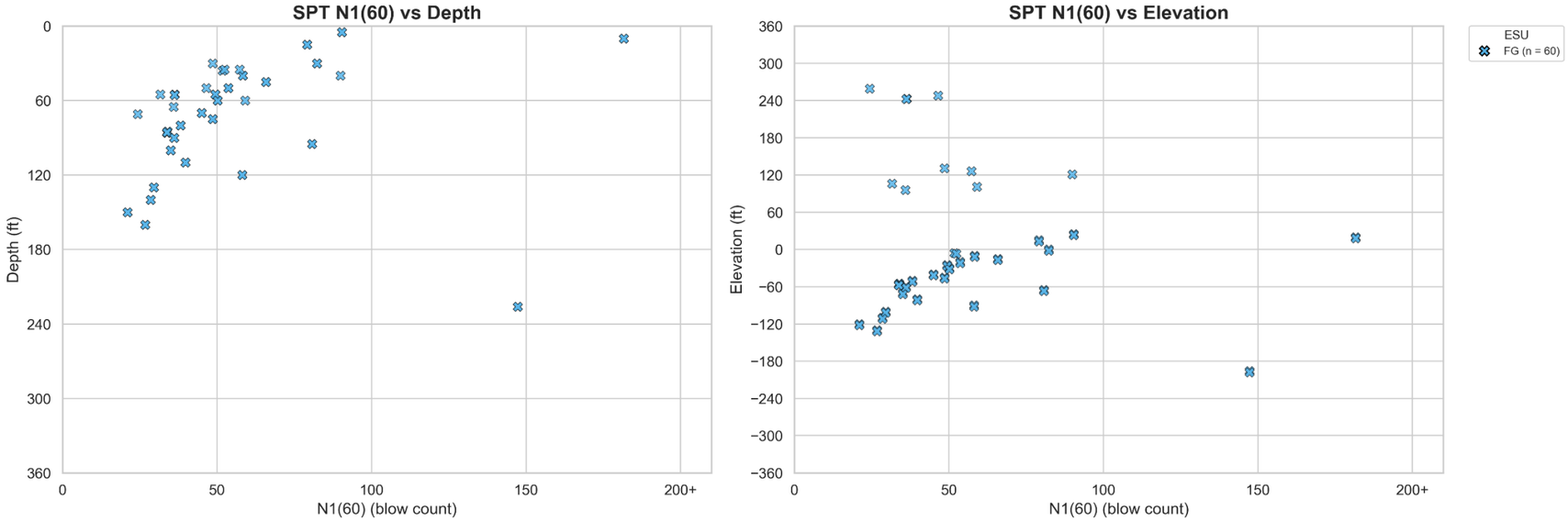
Knik Arm Tunnel Feasibility Study

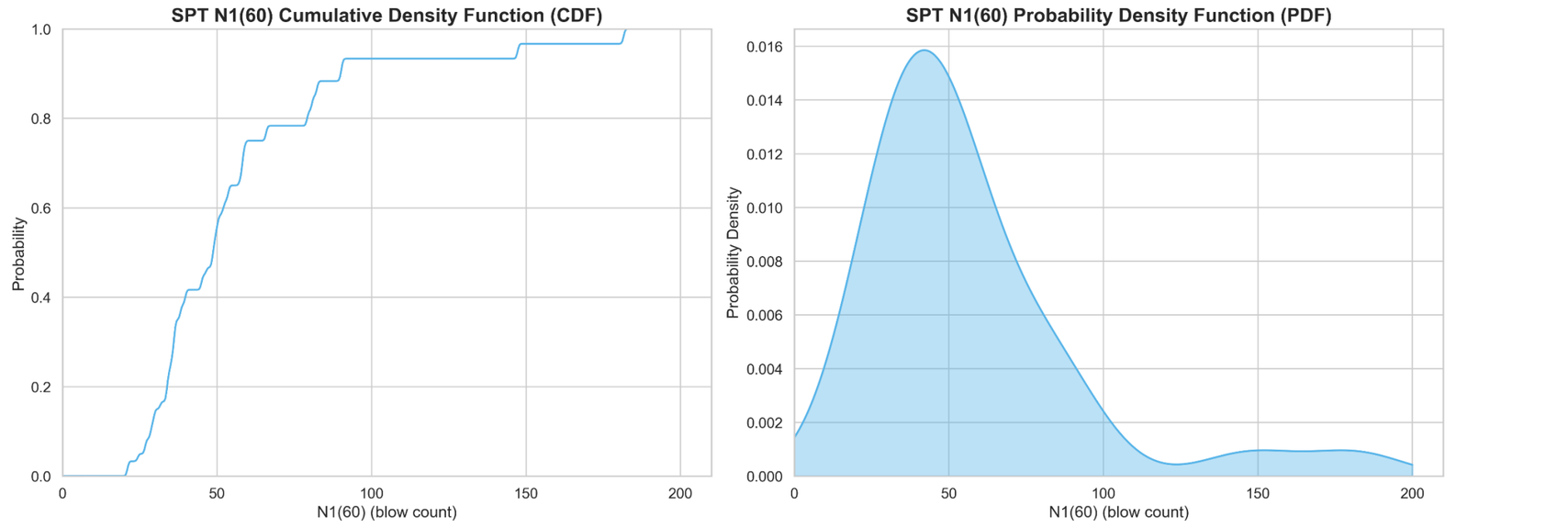
EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure **E-23**

FG (n = 60) - Point MacKenzie Landside Borings





SPT N160 – Point MacKenzie Landside Borings, ESU FG

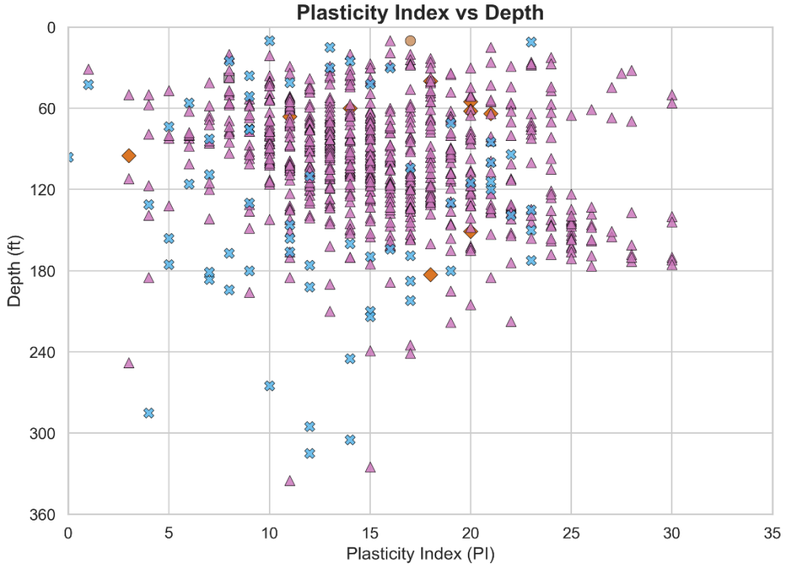
Knik Arm Tunnel Feasibility Study

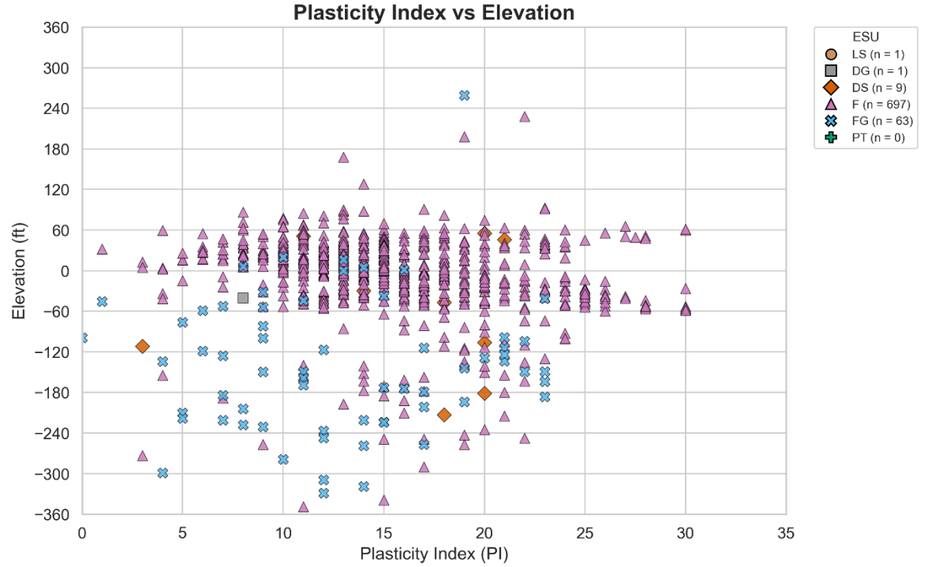
EMPRISE CONCEPTS

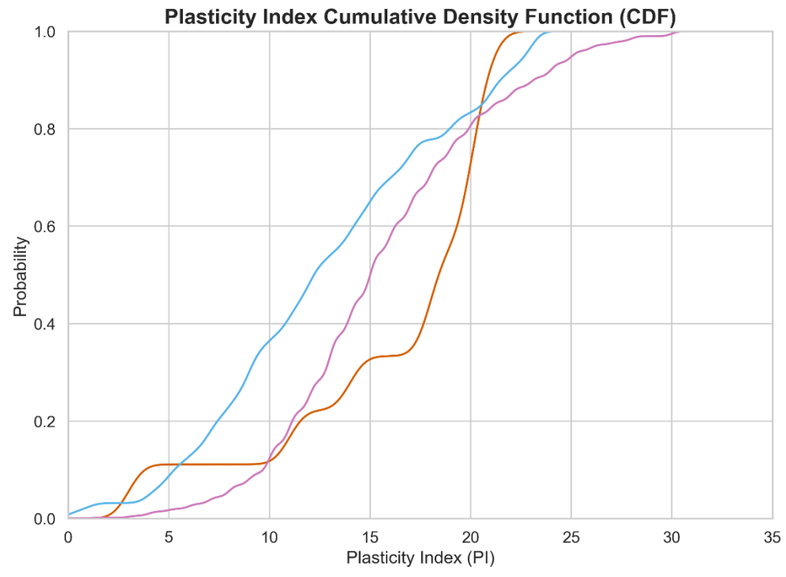
Anchorage, Alaska | August 2025

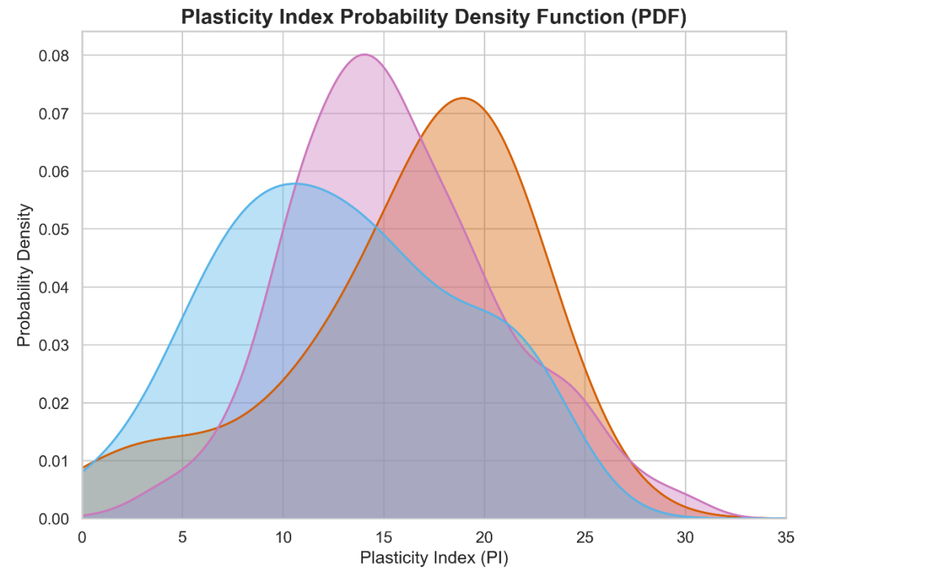
Figure **E-24**

All Borings









Plasticity Index – All Borings, All ESUs

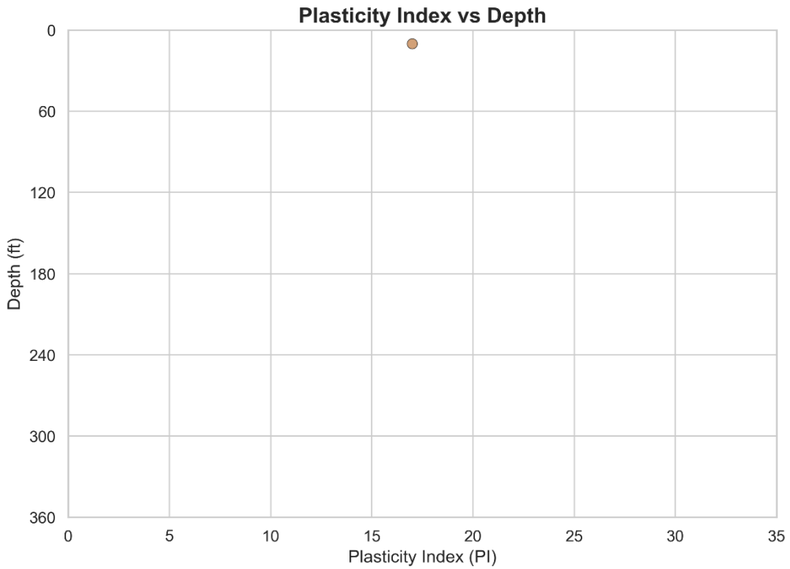
Knik Arm Tunnel Feasibility Study

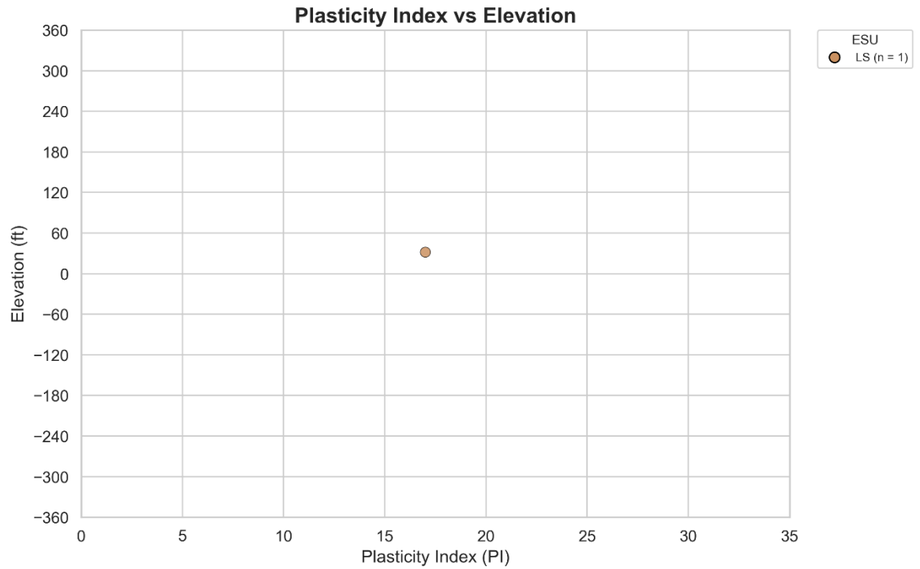
EMPRISE CONCEPTS

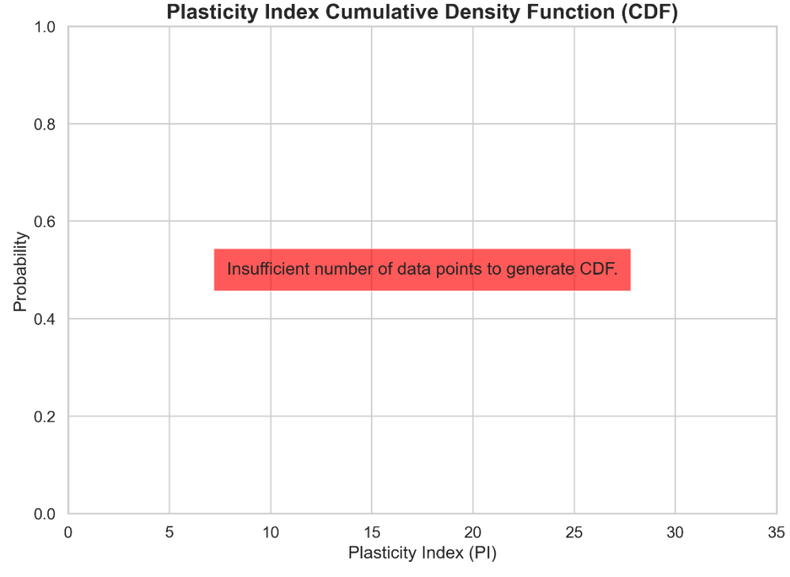
Anchorage, Alaska | August 2025

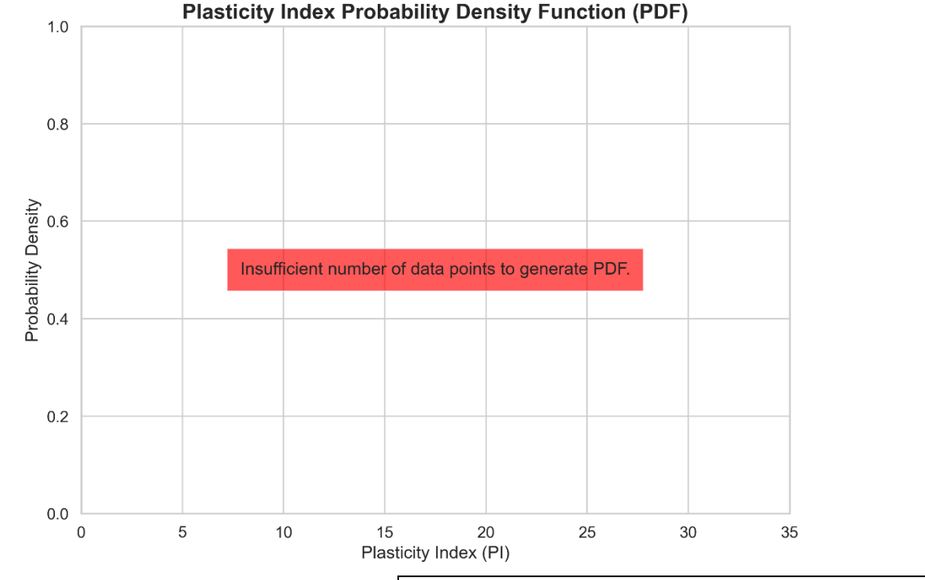
Figure **F-1**

LS (n = 1) - All Borings









Plasticity Index – All Borings, ESU LS

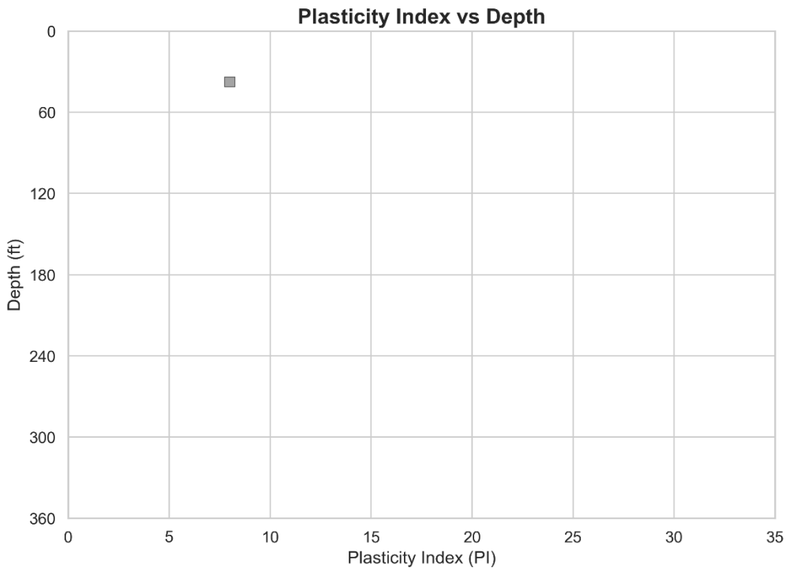
Knik Arm Tunnel Feasibility Study

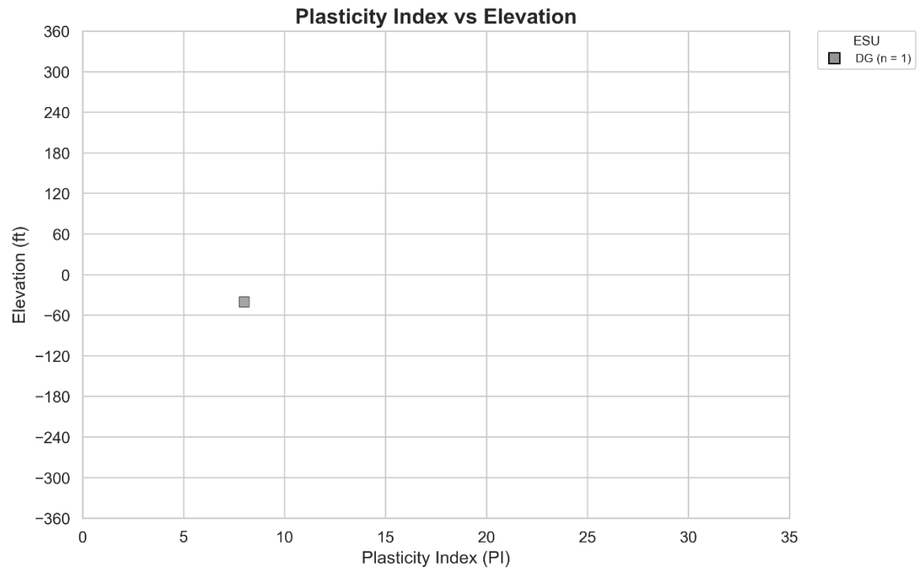
EMPRISE CONCEPTS

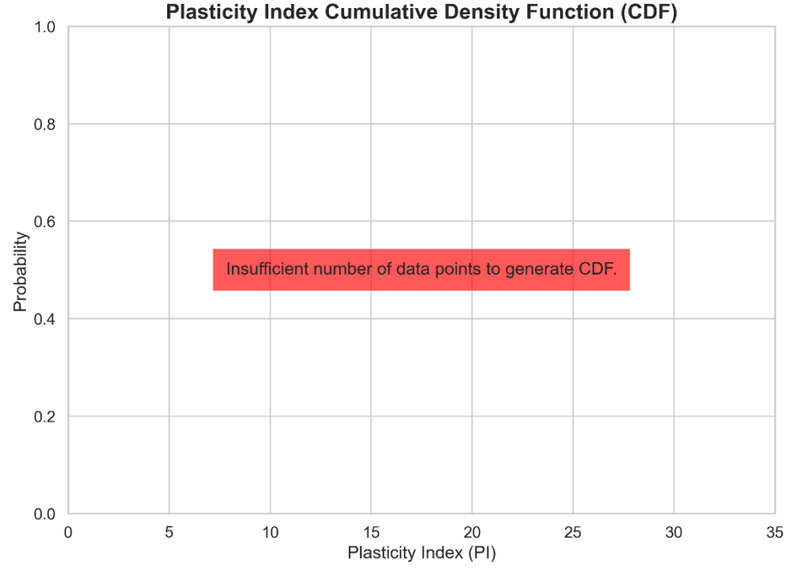
Anchorage, Alaska | August 2025

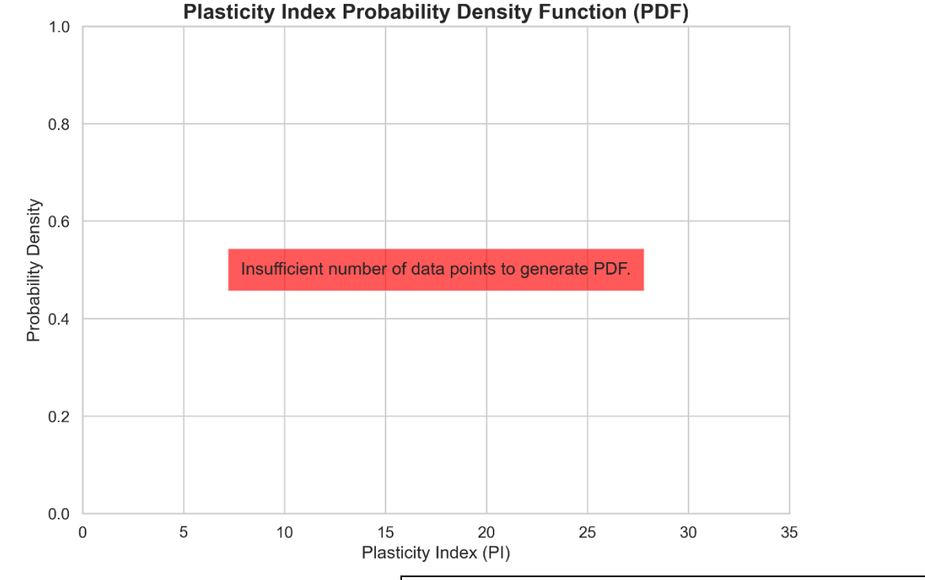
Figure **F-2**

DG (n = 1) - All Borings









Plasticity Index – All Borings, ESU DG

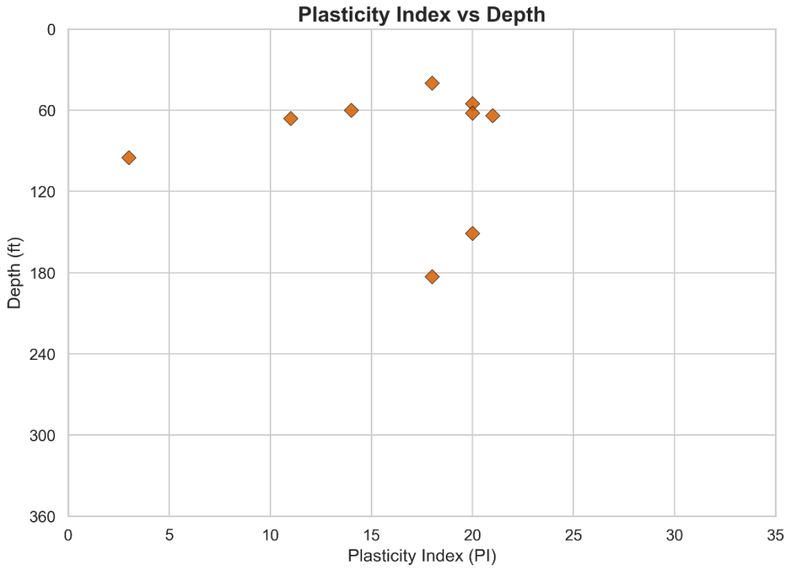
Knik Arm Tunnel Feasibility Study

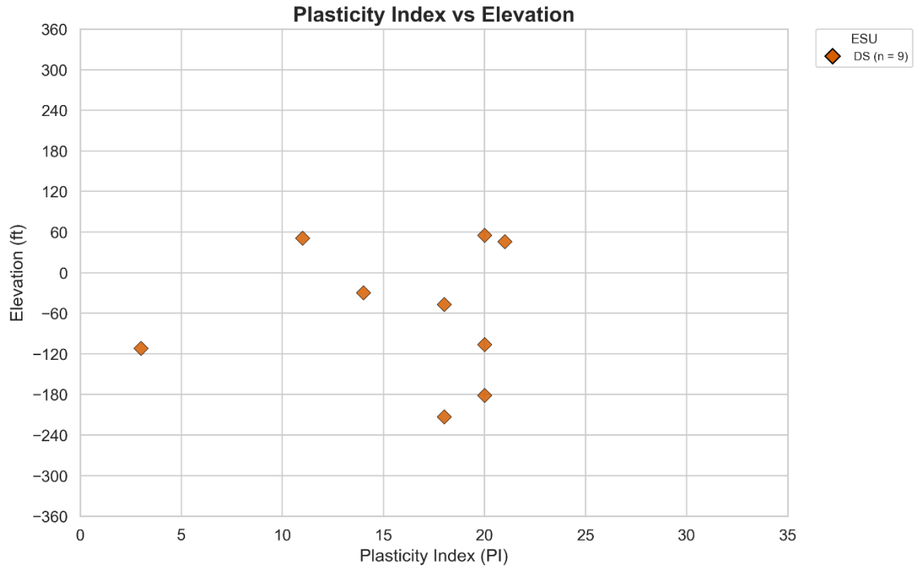
EMPRISE CONCEPTS

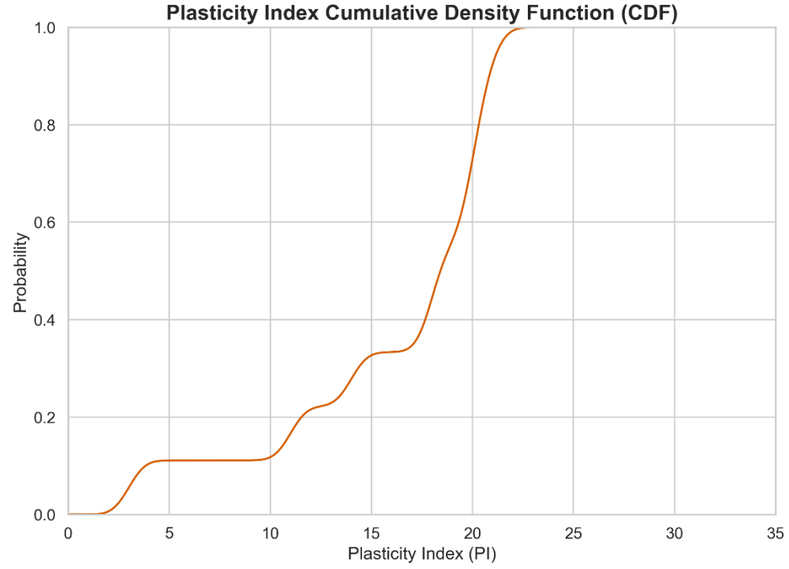
Anchorage, Alaska | August 2025

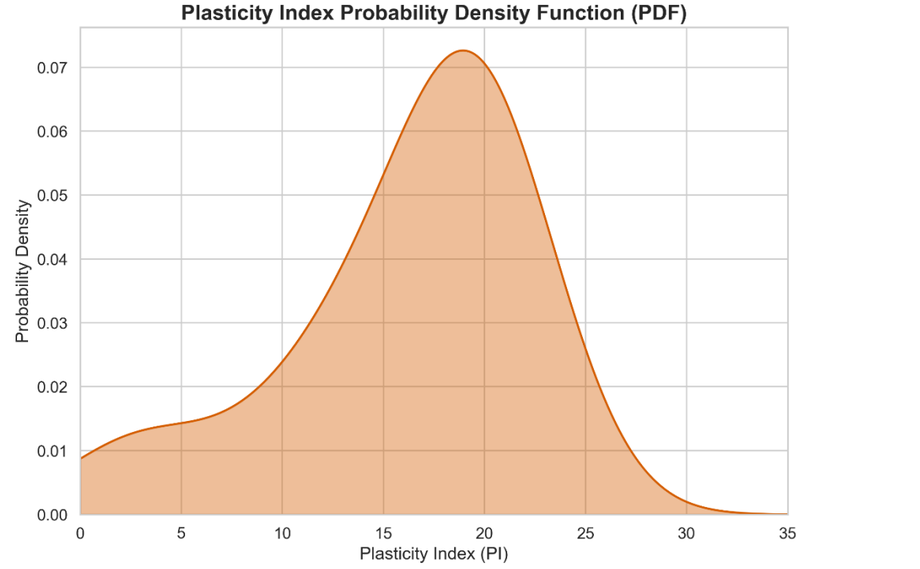
Figure **F-3**

DS (n = 9) - All Borings









Plasticity Index – All Borings, ESU DS

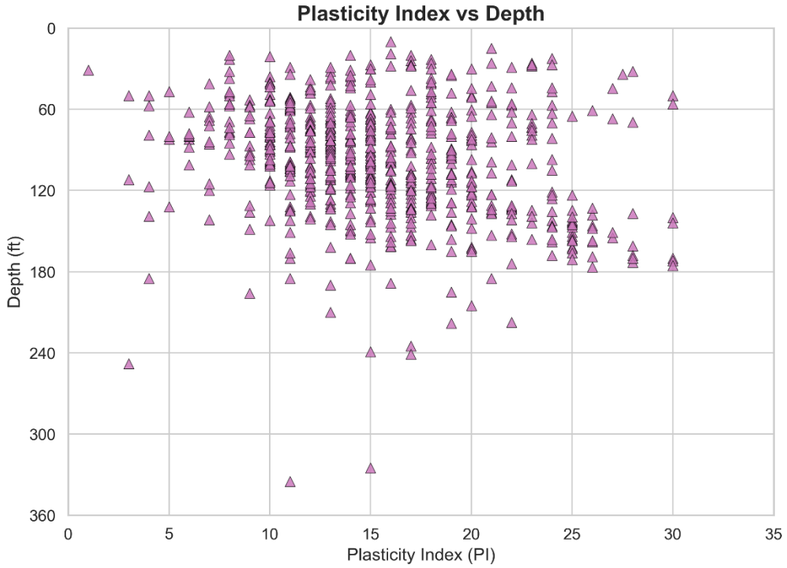
Knik Arm Tunnel Feasibility Study

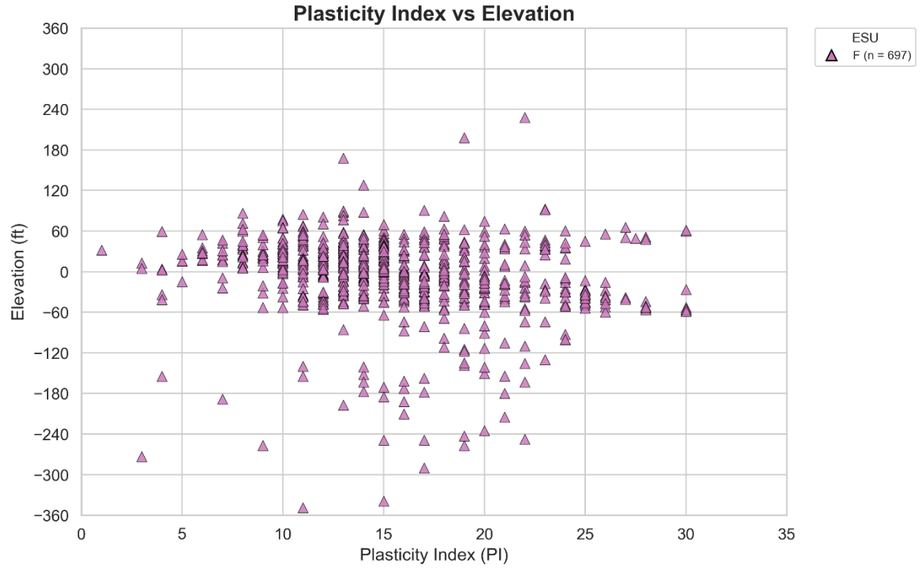
EMPRISE CONCEPTS

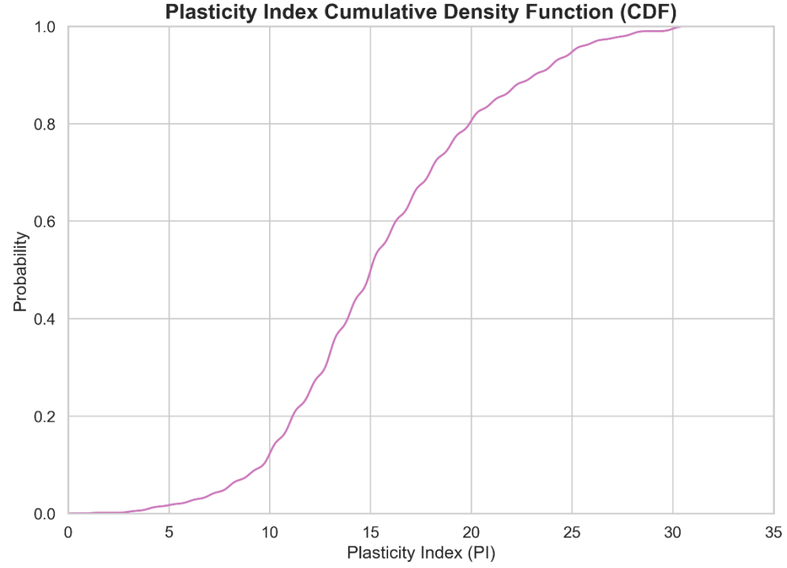
Anchorage, Alaska | August 2025

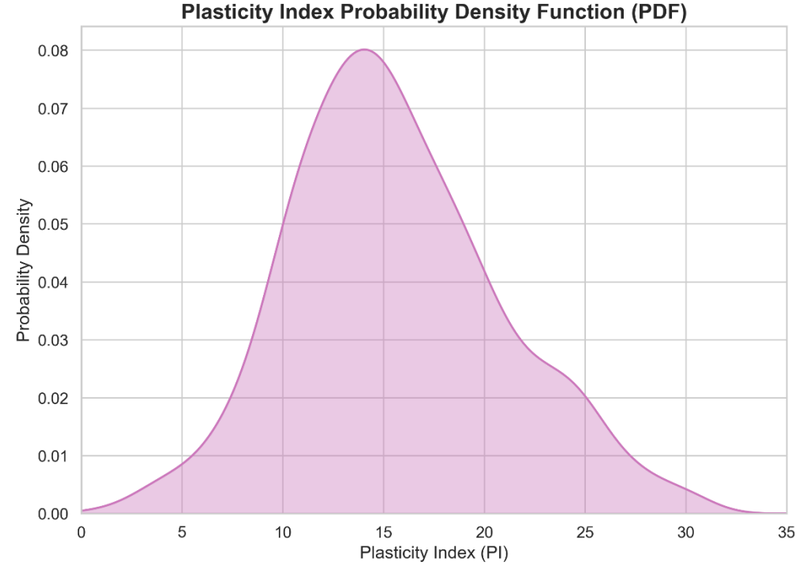
Figure **F-4**

F (n = 697) - All Borings









Plasticity Index – All Borings, ESU F

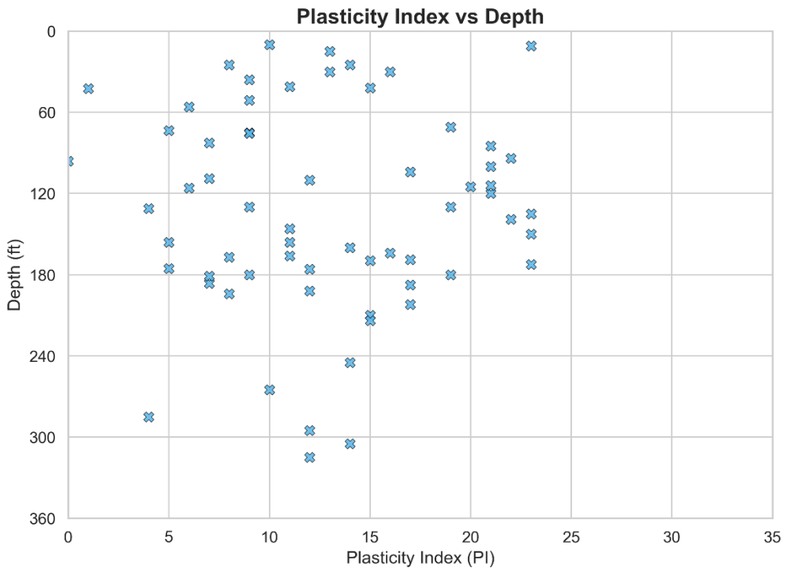
Knik Arm Tunnel Feasibility Study

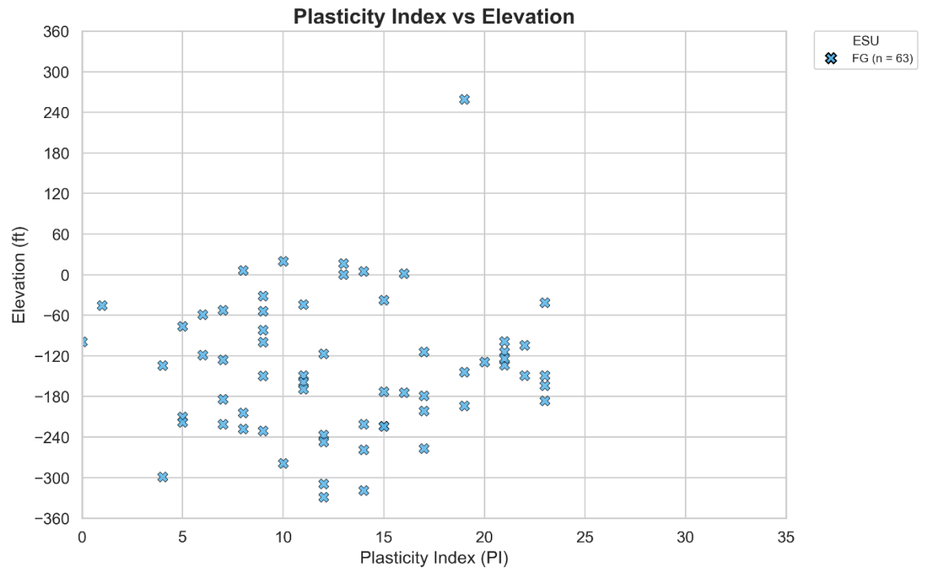
EMPRISE CONCEPTS

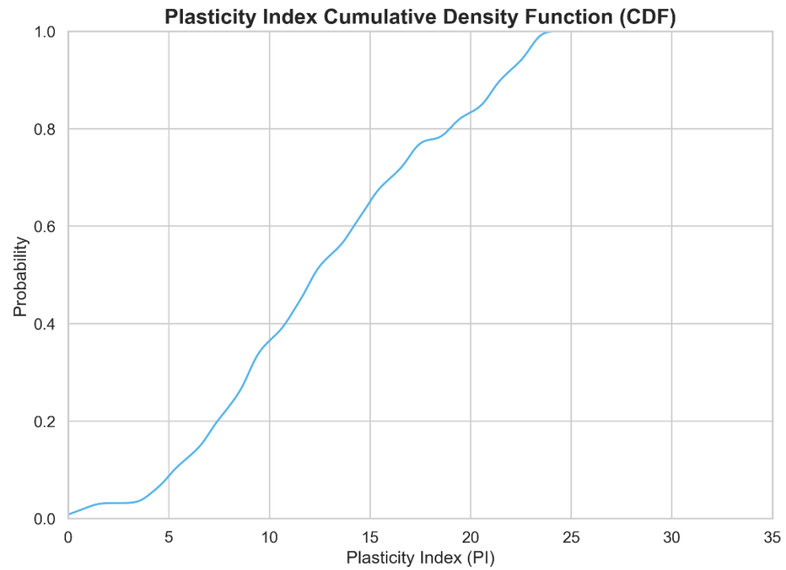
Anchorage, Alaska | August 2025

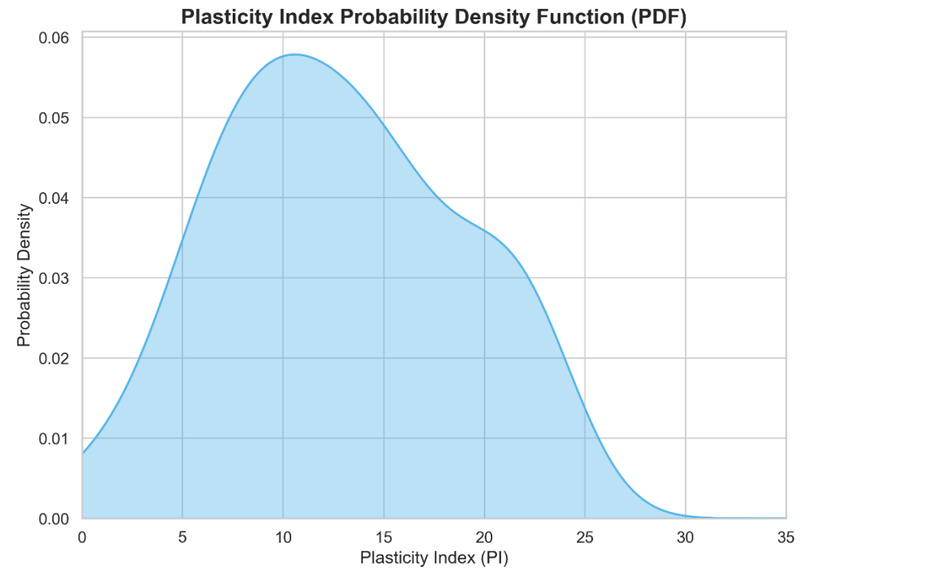
Figure **F-5**

FG (n = 63) - All Borings









Plasticity Index – All Borings, ESU FG

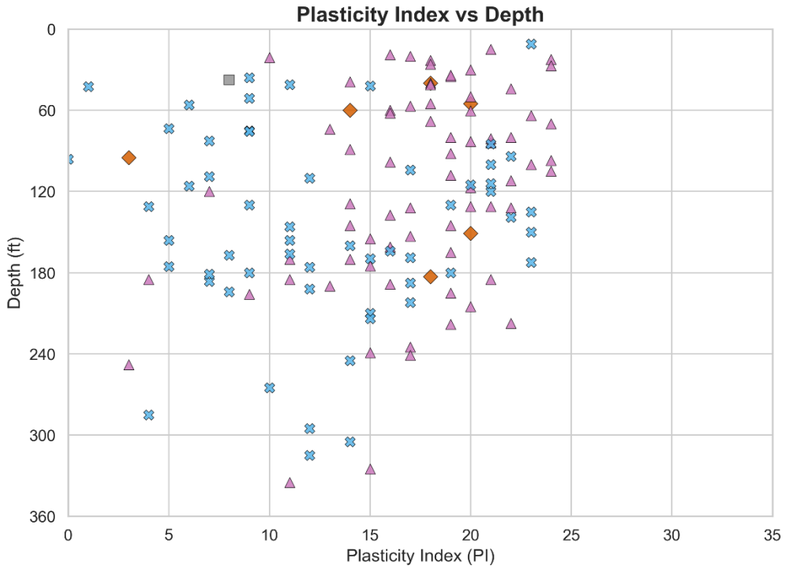
Knik Arm Tunnel Feasibility Study

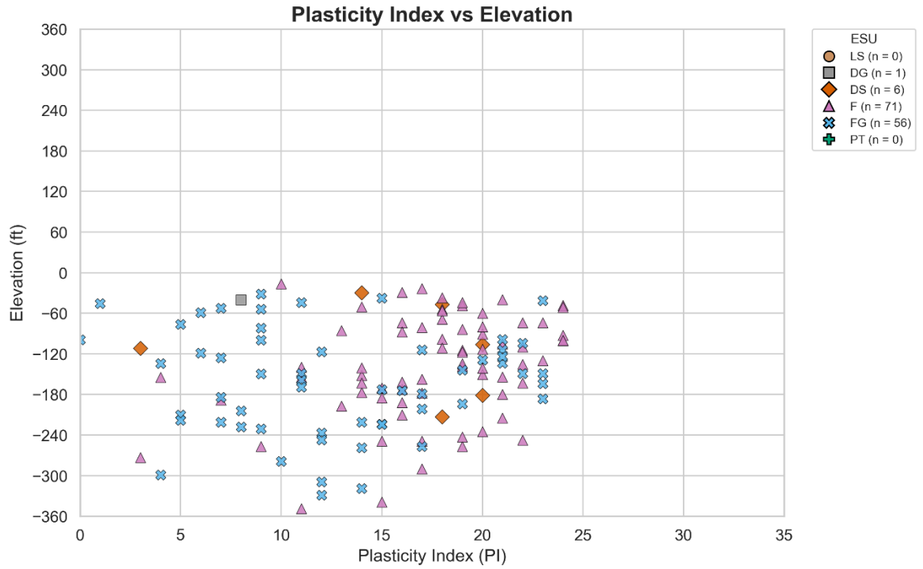
EMPRISE CONCEPTS

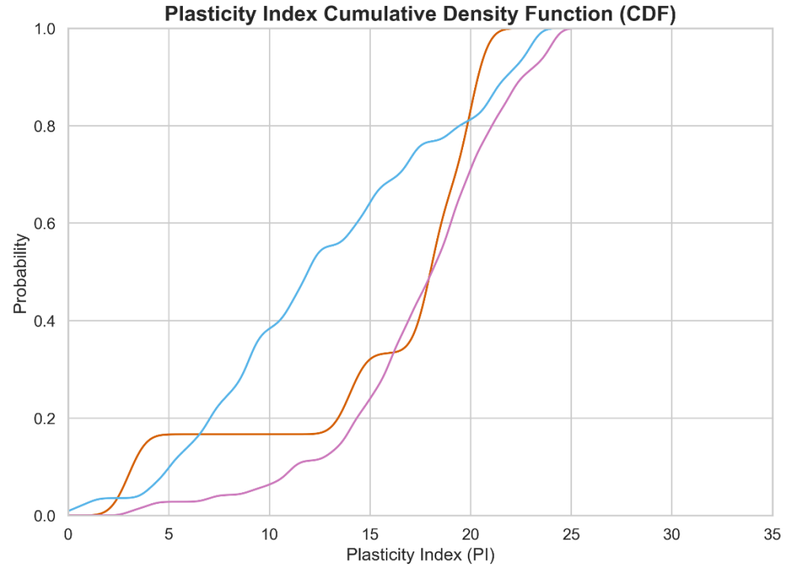
Anchorage, Alaska | August 2025

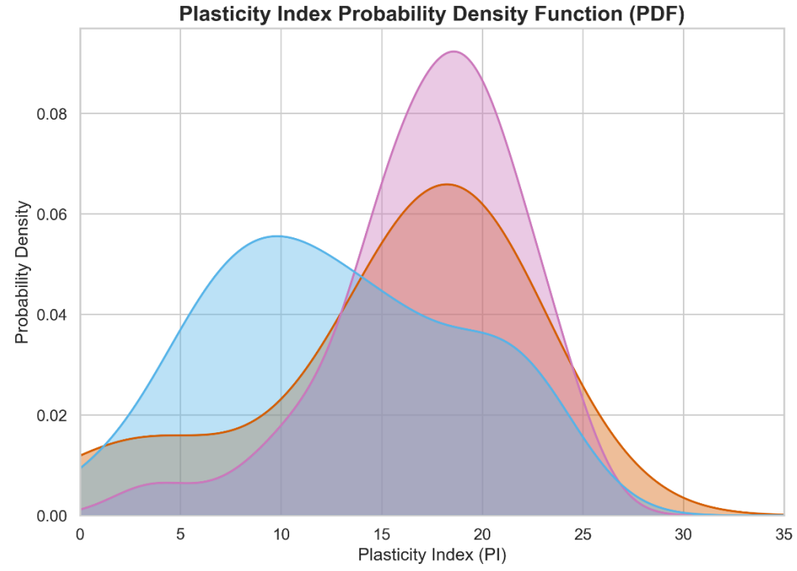
Figure **F-6**

Overwater Borings









Plasticity Index – Overwater Borings, All ESUs

Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure **F-7**

NO DATA

Plasticity Index – Overwater Borings, ESU LS

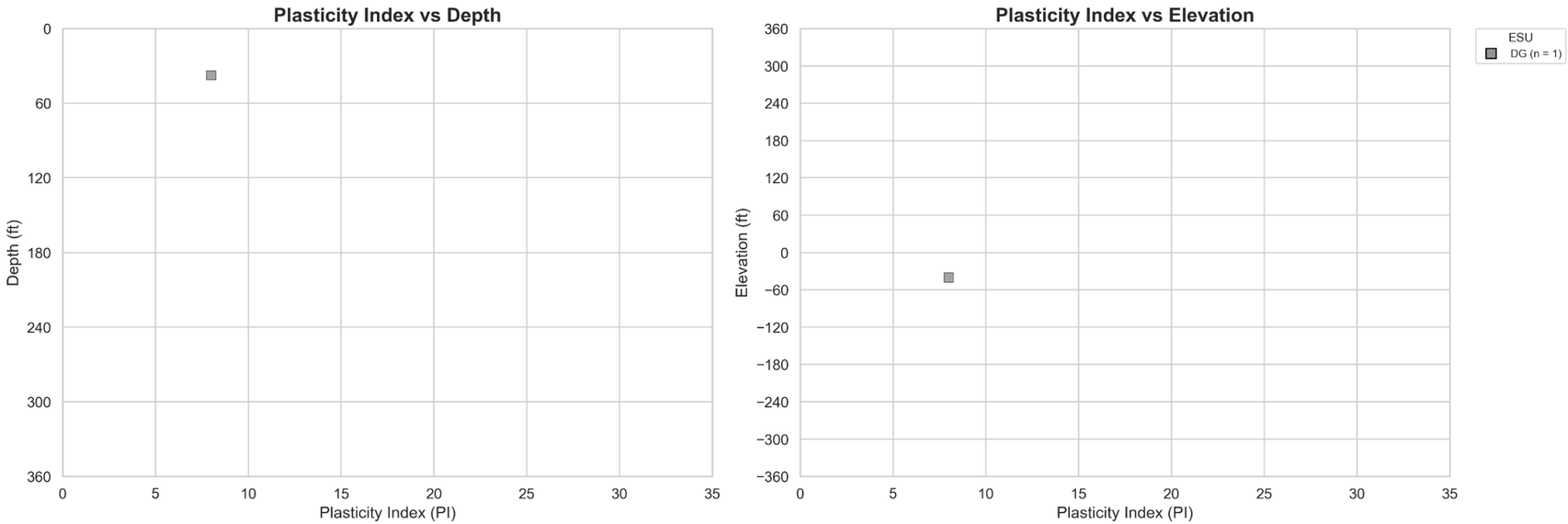
Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure
F-8

DG (n = 1) - Overwater Borings



Plasticity Index – Overwater Borings, ESU DG

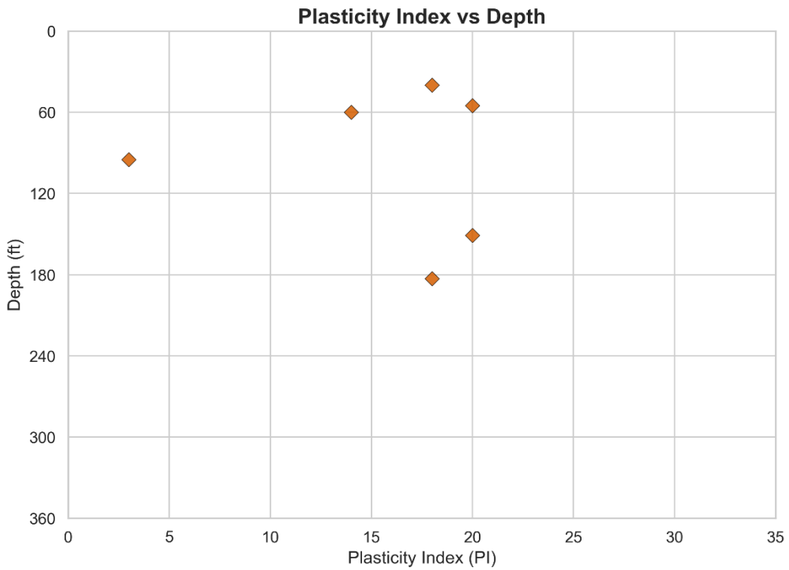
Knik Arm Tunnel Feasibility Study

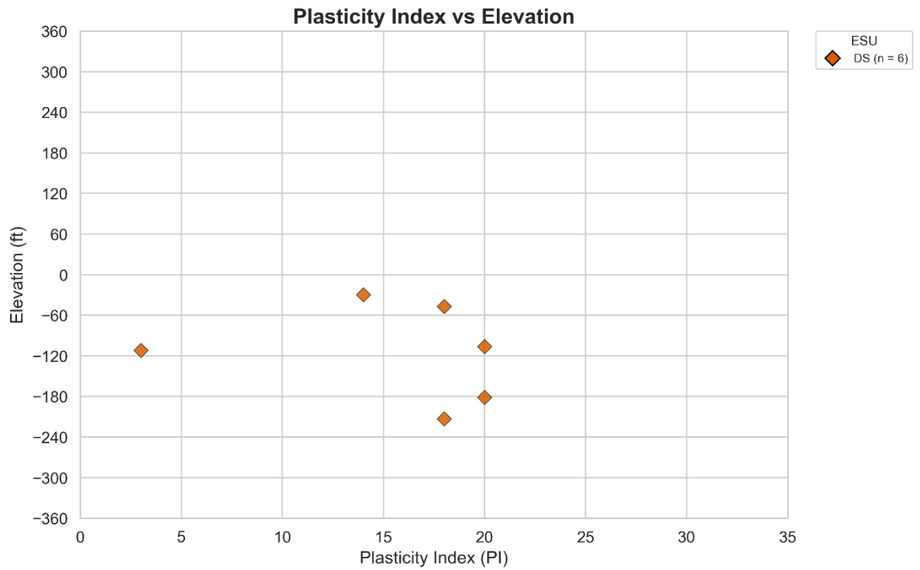
EMPRISE CONCEPTS

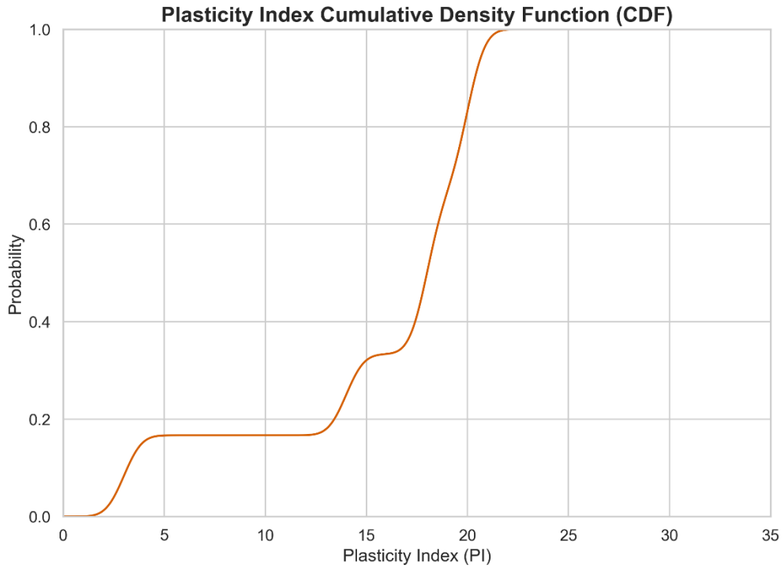
Anchorage, Alaska | August 2025

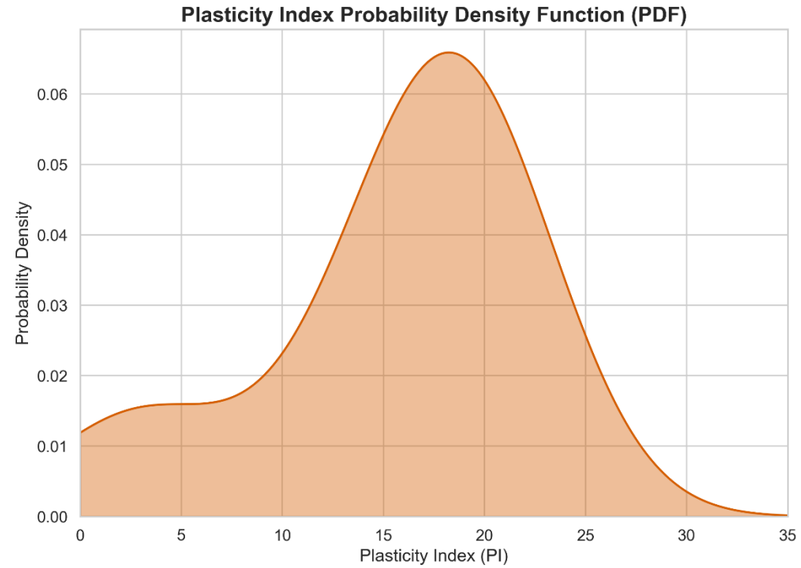
Figure
F-9

DS (n = 6) - Overwater Borings









Plasticity Index – Overwater Borings, ESU DS

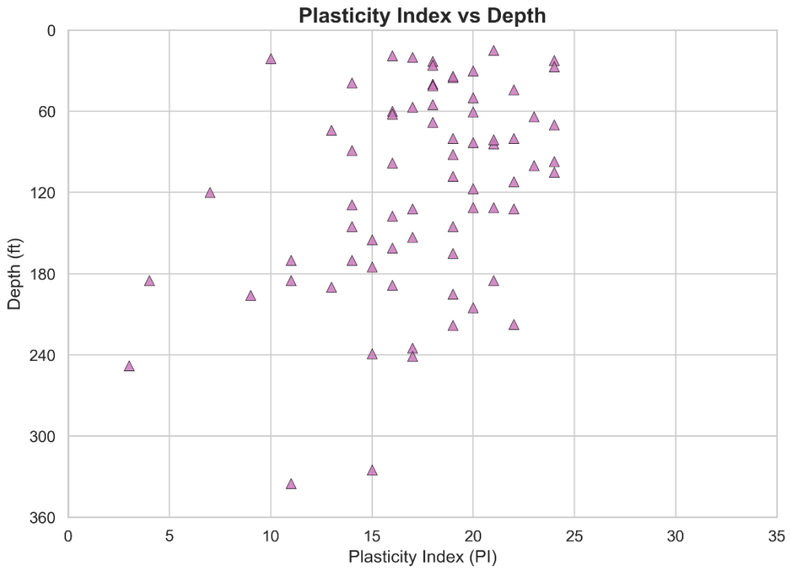
Knik Arm Tunnel Feasibility Study

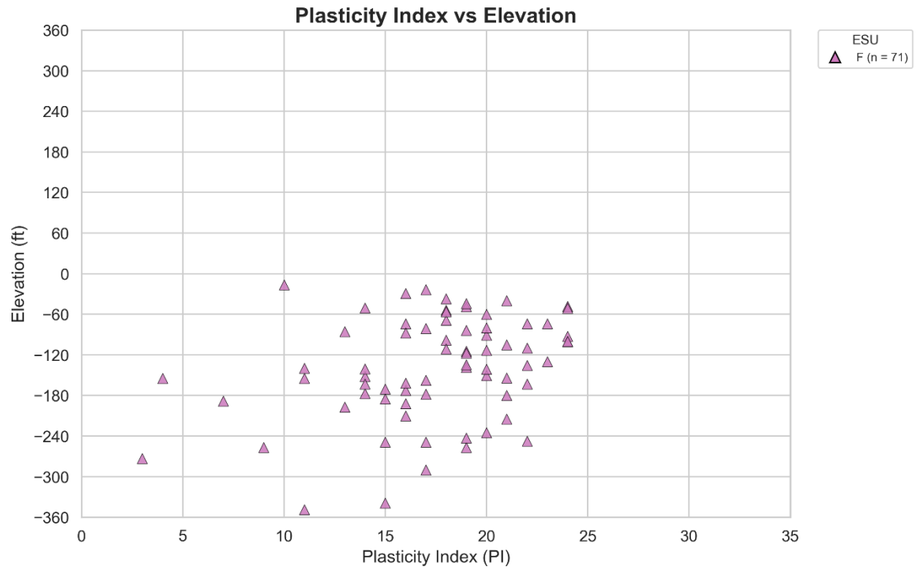
EMPRISE CONCEPTS

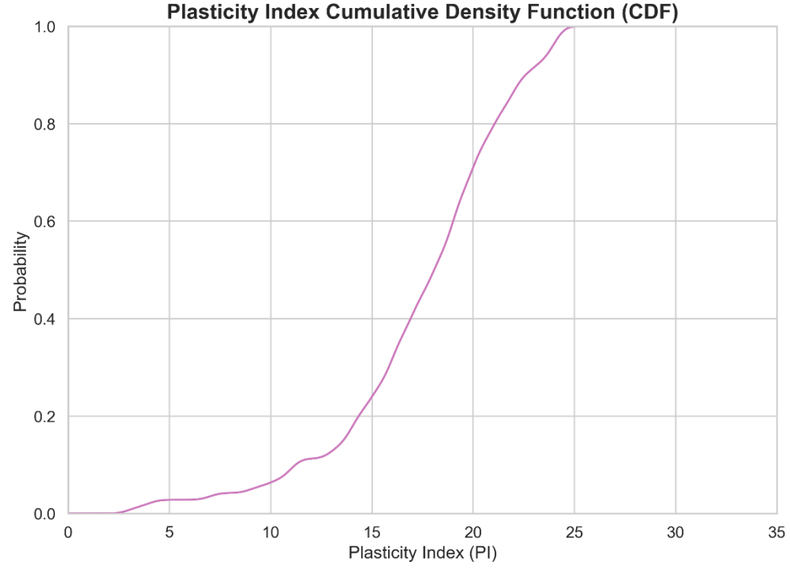
Anchorage, Alaska | August 2025

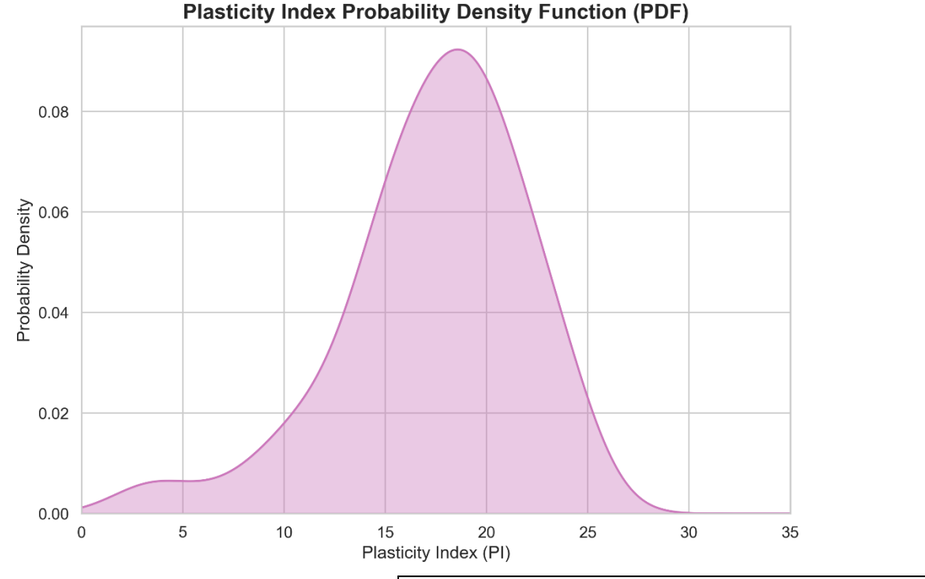
Figure **F-10**

F (n = 71) - Overwater Borings









Plasticity Index – Overwater Borings, ESU F

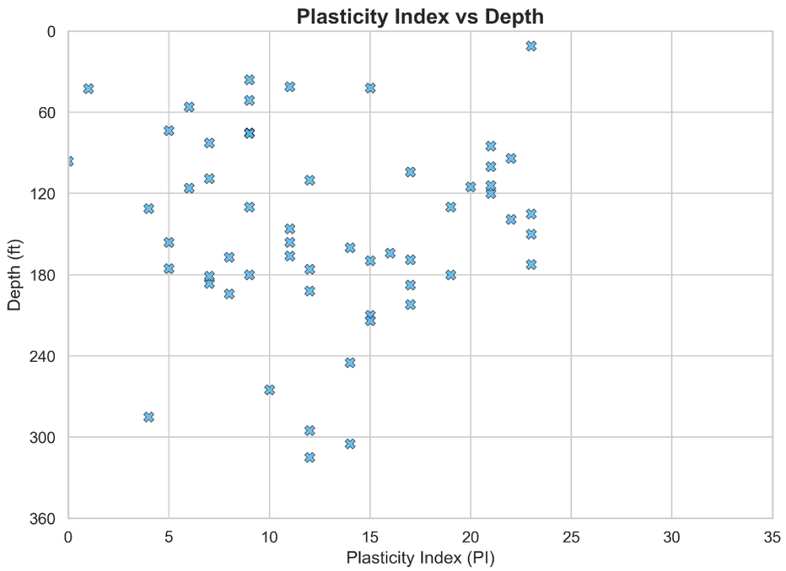
Knik Arm Tunnel Feasibility Study

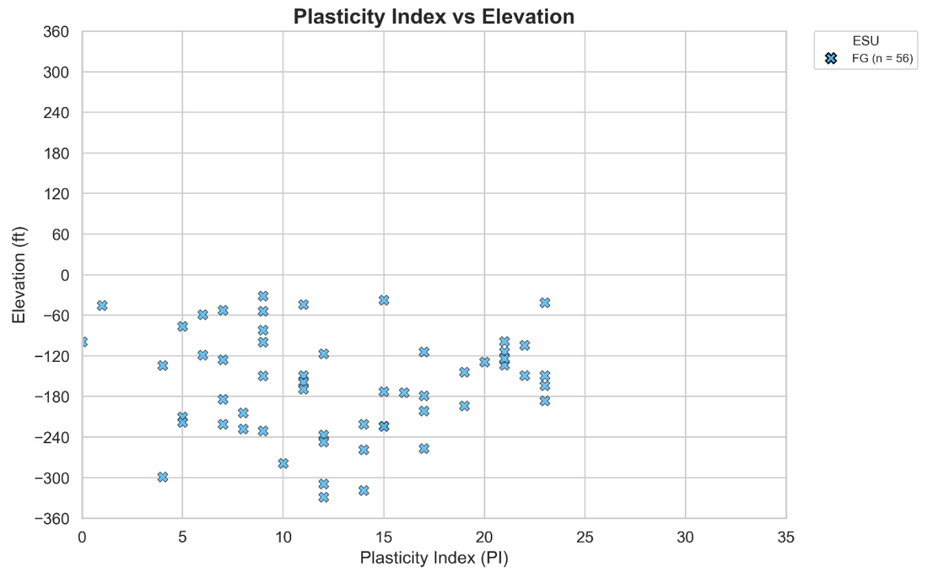
EMPRISE CONCEPTS

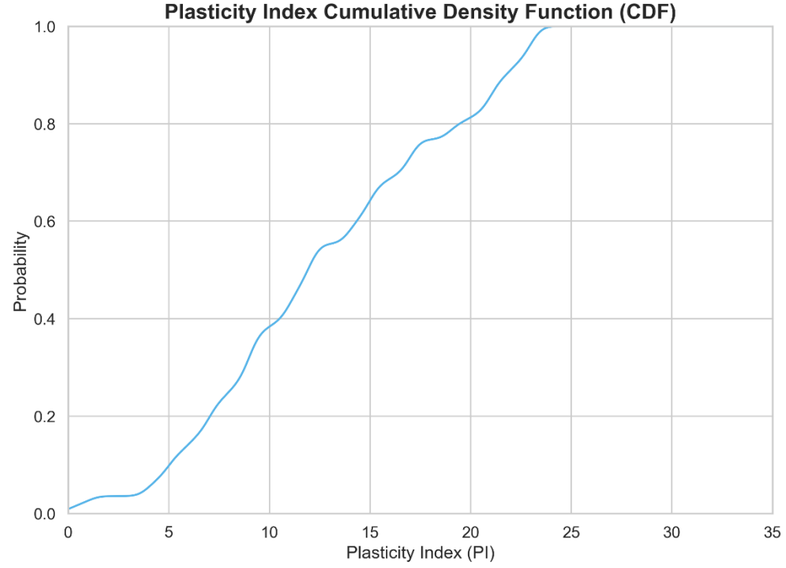
Anchorage, Alaska | August 2025

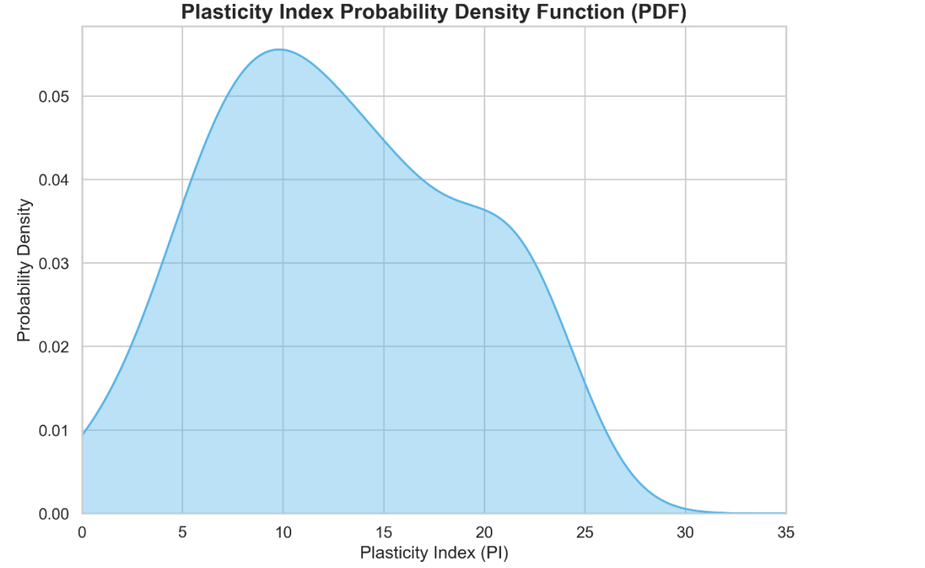
Figure **F-11**

FG (n = 56) - Overwater Borings









Plasticity Index – Overwater Borings, ESU FG

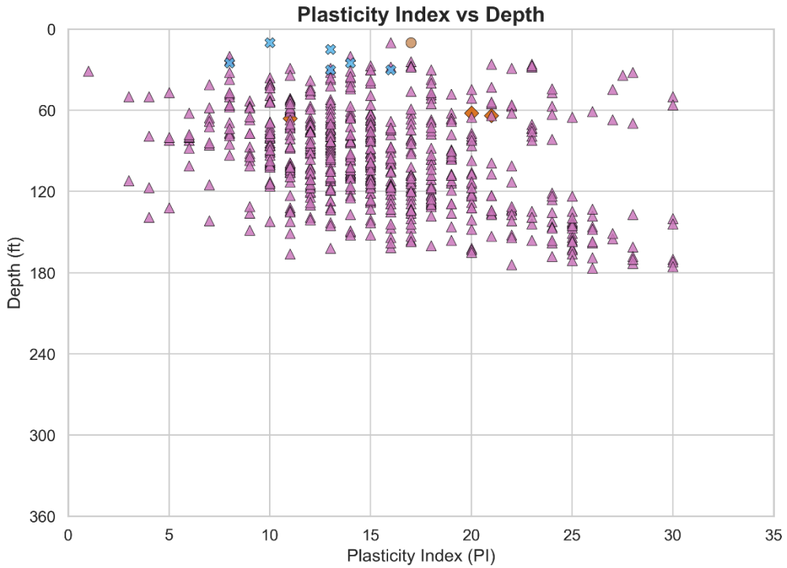
Knik Arm Tunnel Feasibility Study

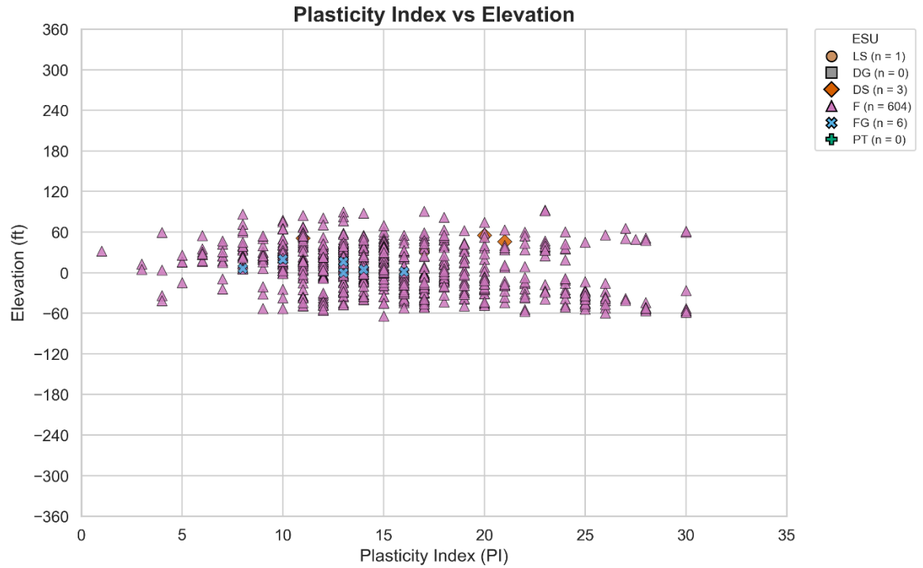
EMPRISE CONCEPTS

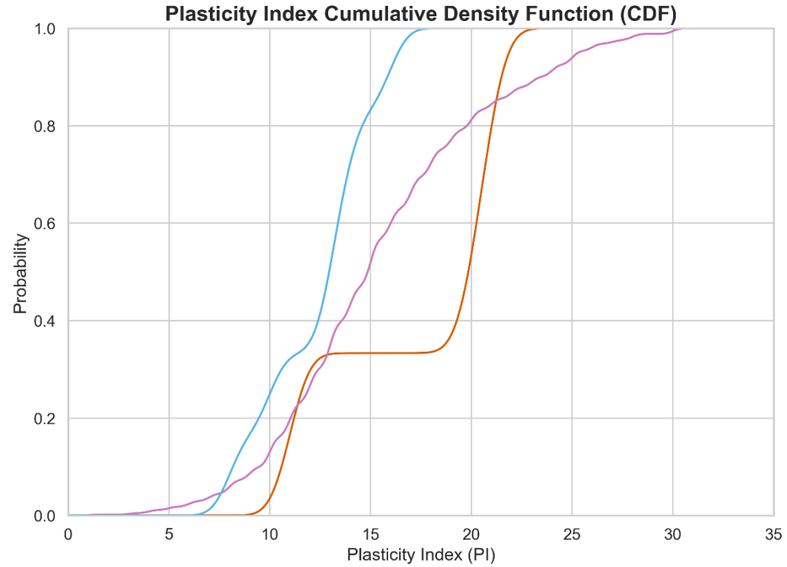
Anchorage, Alaska | August 2025

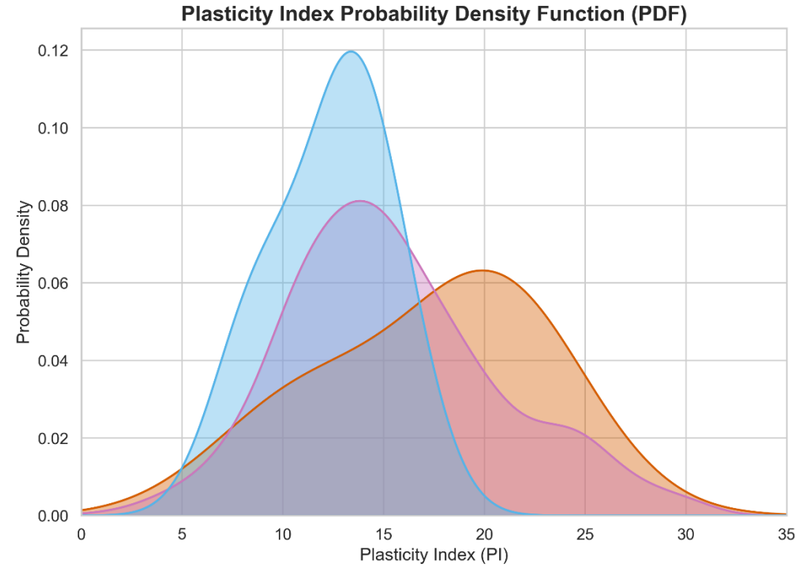
Figure **F-12**

Anchorage Landside Borings









Plasticity Index – Anchorage Landside Borings, All ESUs

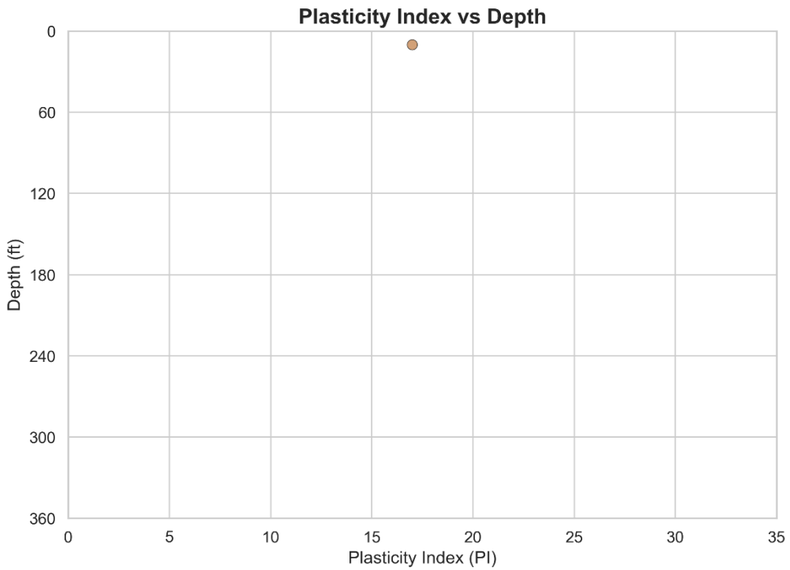
Knik Arm Tunnel Feasibility Study

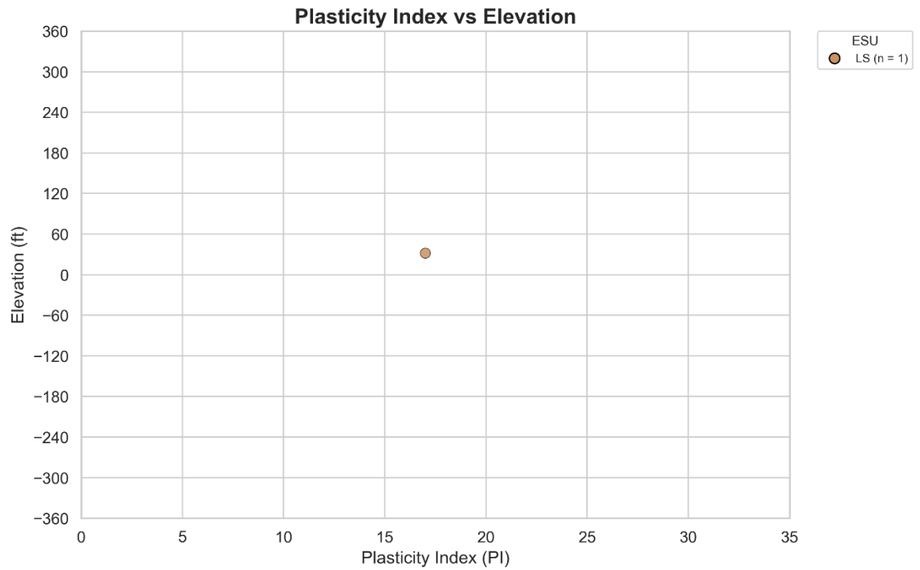
EMPRISE CONCEPTS

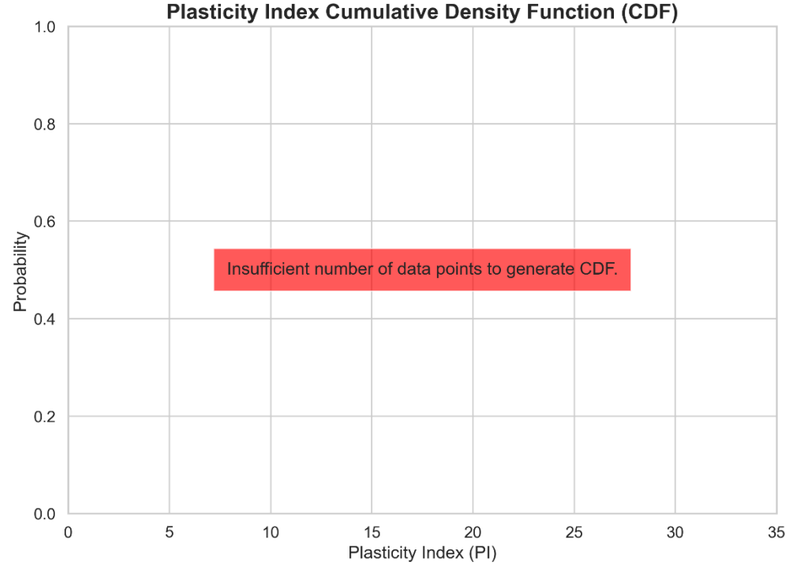
Anchorage, Alaska | August 2025

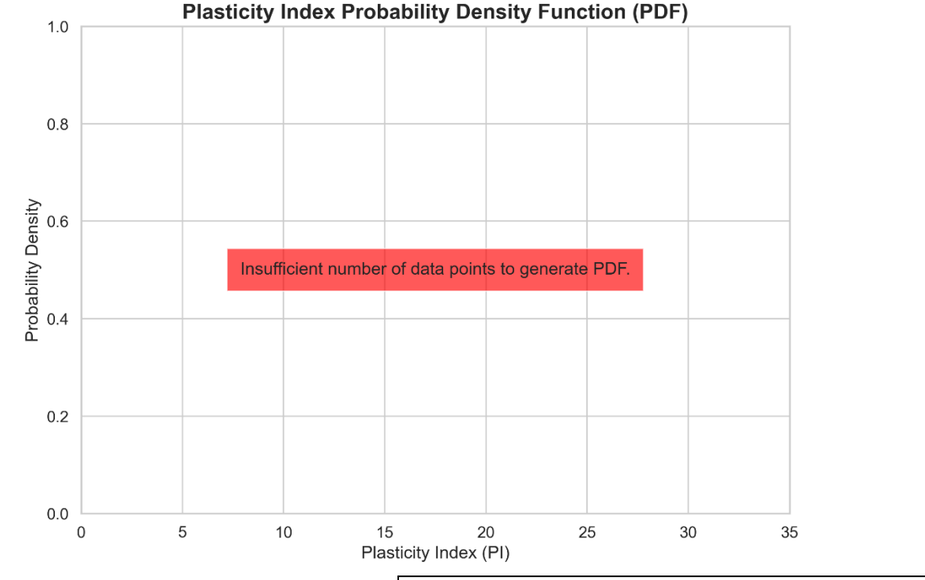
Figure **F-13**

LS (n = 1) - Anchorage Landside Borings









Plasticity Index – Anchorage Landside Borings, ESU LS

Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure **F-14**

NO DATA

Plasticity Index – Anchorage Landside Borings, ESU DG

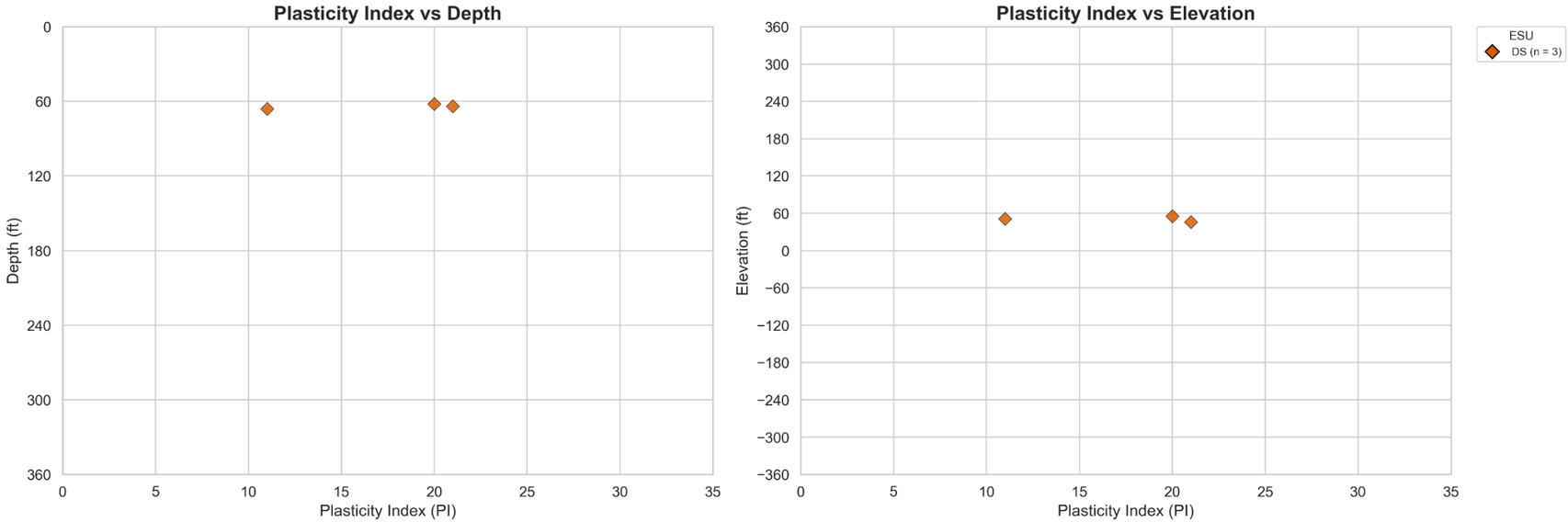
Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure **F-15**

DS (n = 3) - Anchorage Landside Borings



Plasticity Index – Anchorage Landside Borings, ESU DS

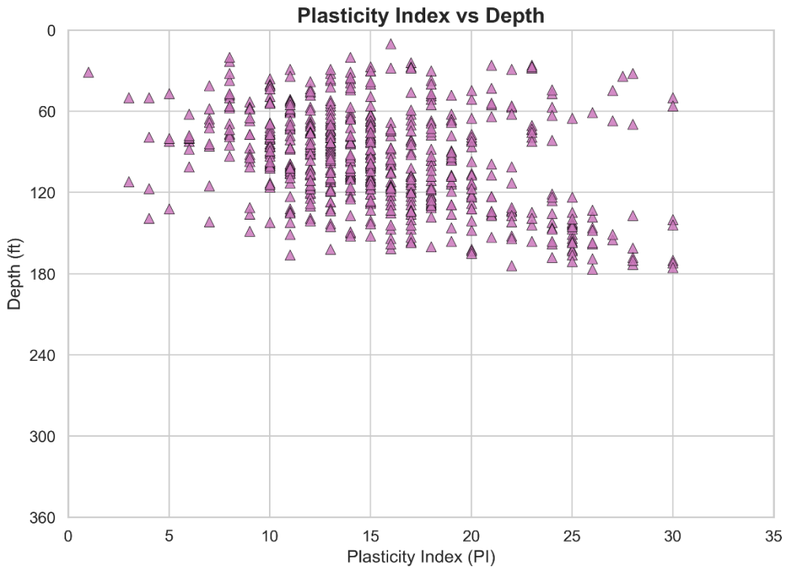
Knik Arm Tunnel Feasibility Study

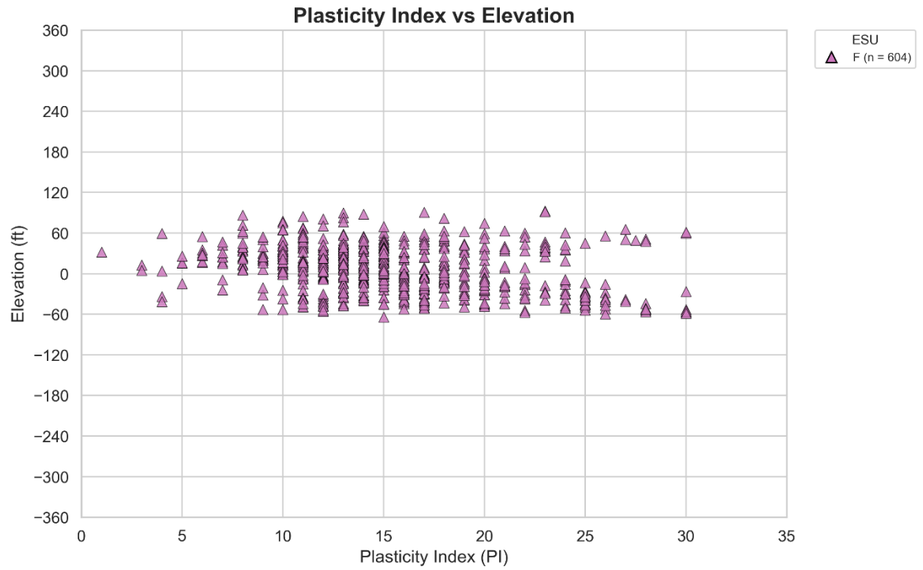
EMPRISE CONCEPTS

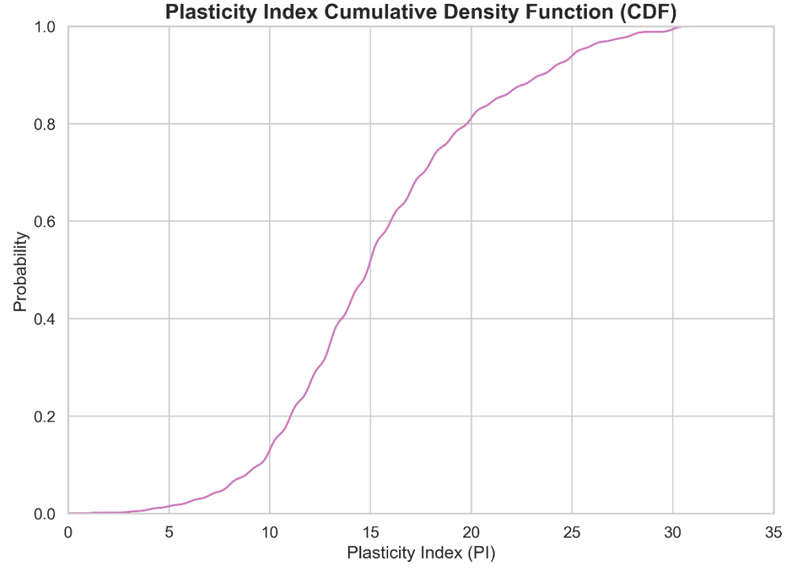
Anchorage, Alaska | August 2025

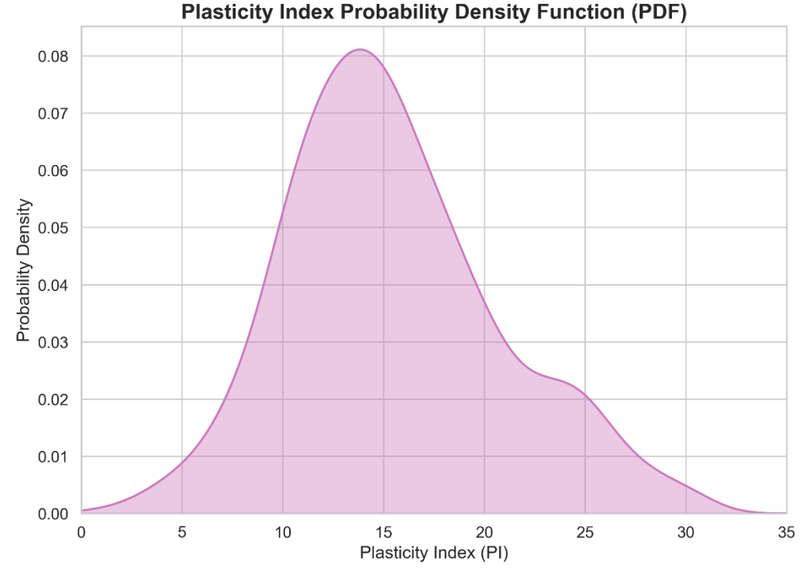
Figure
F-16

F (n = 604) - Anchorage Landside Borings









Plasticity Index – Anchorage Landside Borings, ESU F

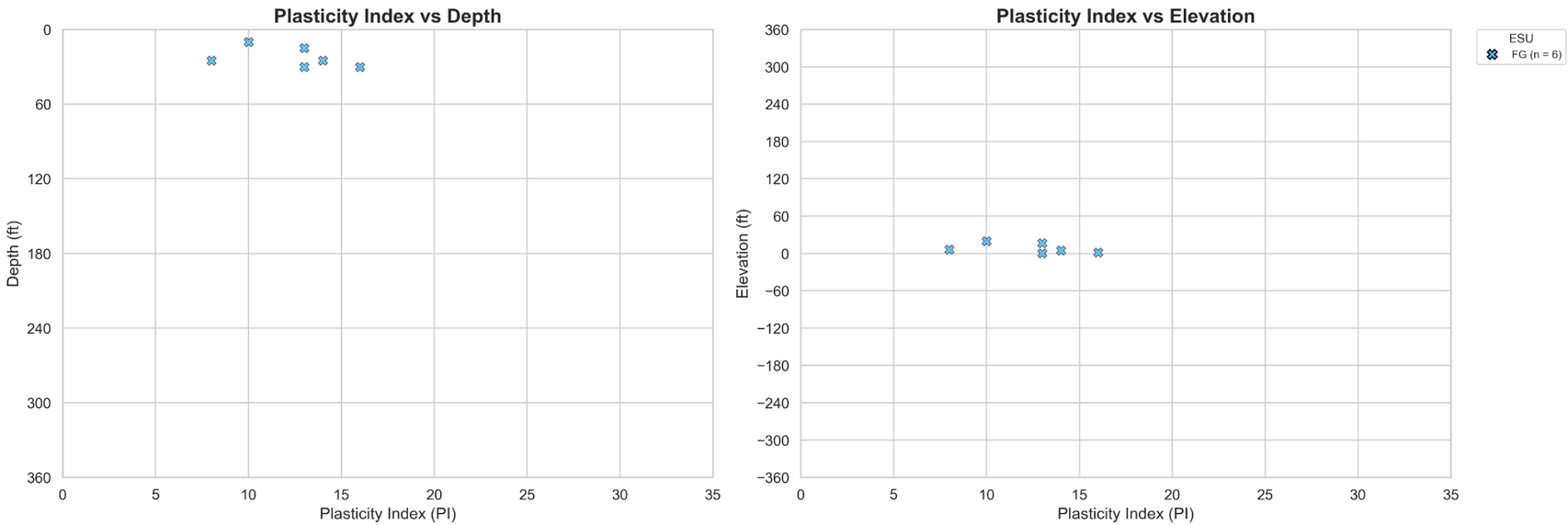
Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure **F-17**

FG (n = 6) - Anchorage Landside Borings



Plasticity Index – Anchorage Landside Borings, ESU FG

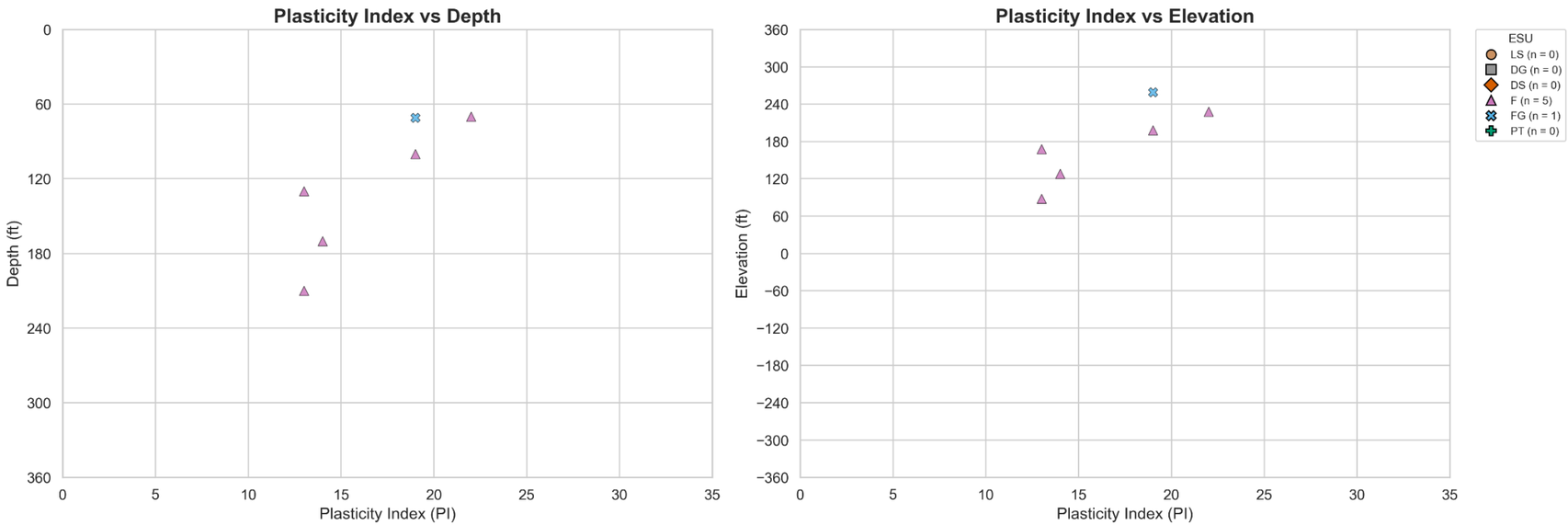
Knik Arm Tunnel Feasibility Study

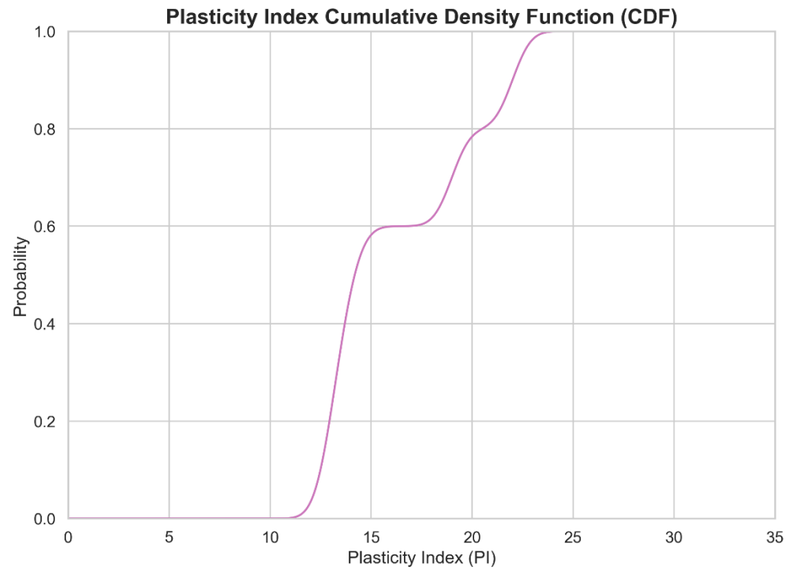
EMPRISE CONCEPTS

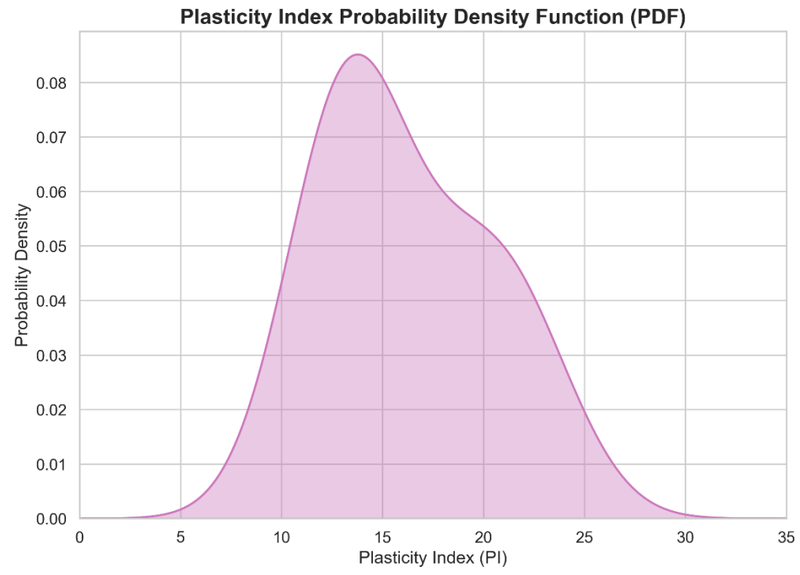
Anchorage, Alaska | August 2025

Figure F-18

Point MacKenzie Landside Borings







Plasticity Index–Point MacKenzie Landside Borings, All ESUs

Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure **F-19**

NO DATA

Plasticity Index– Point MacKenzie Landside Borings, ESU LS

Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure

F-20

NO DATA

Plasticity Index–Point MacKenzie Landside Borings, ESU DG

Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure **F-21**

NO DATA

Plasticity Index–Point MacKenzie Landside Borings, ESU DS

Knik Arm Tunnel Feasibility Study

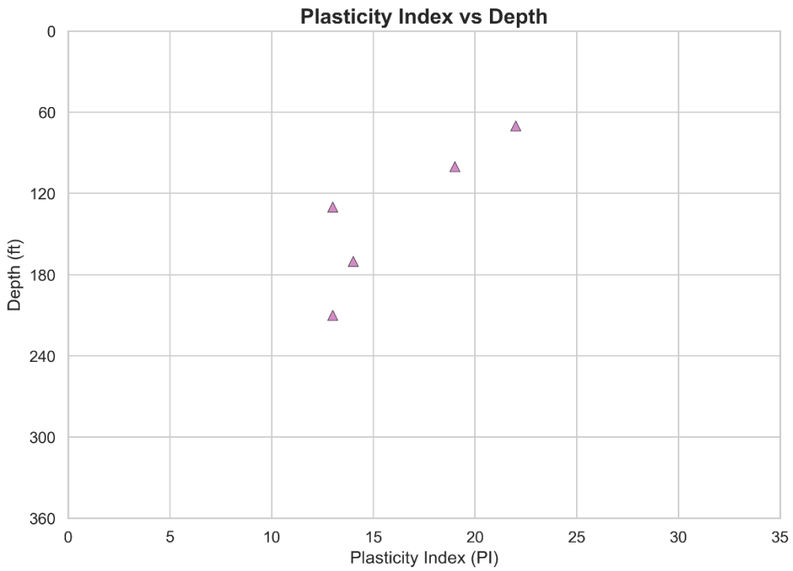
EMPRISE CONCEPTS

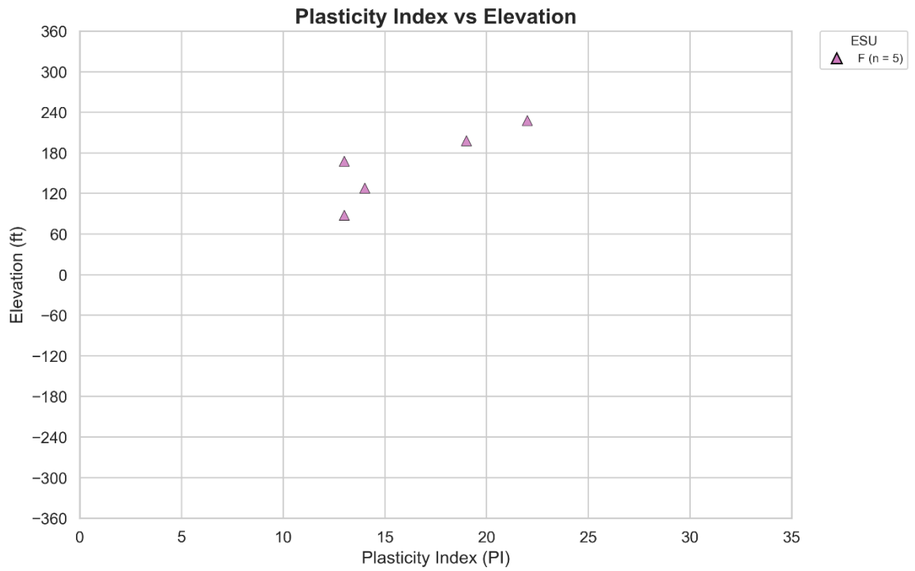
Anchorage, Alaska | August 2025

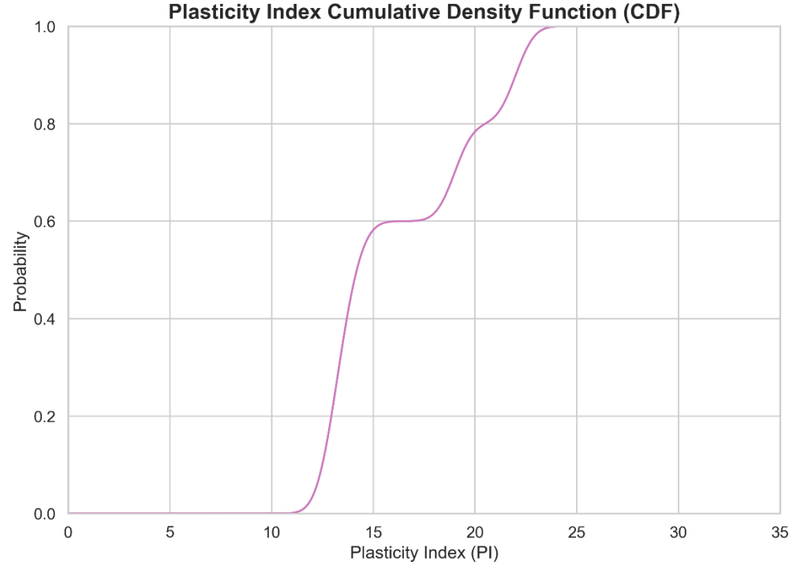
Figure

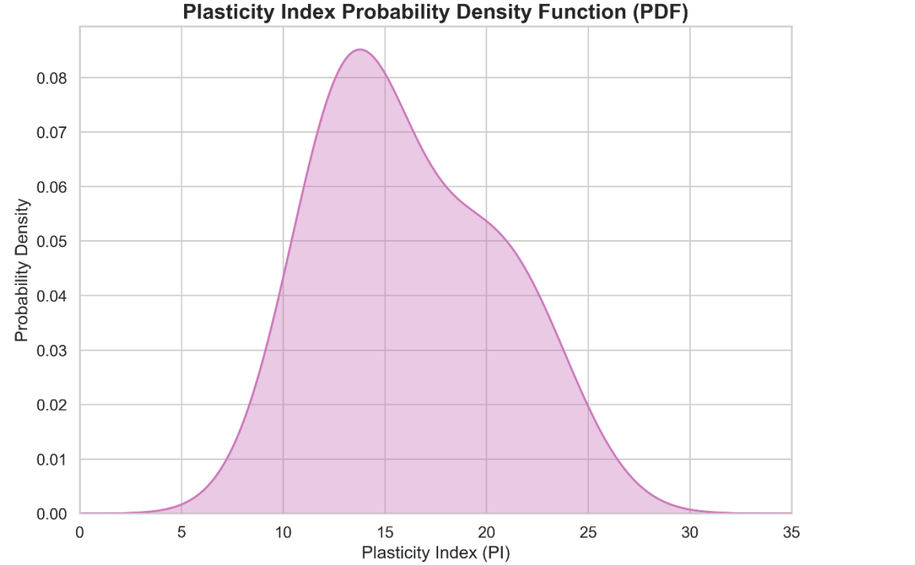
F-22

F (n = 5) - Point MacKenzie Landside Borings









Plasticity Index – Point MacKenzie Landside Borings, ESU F

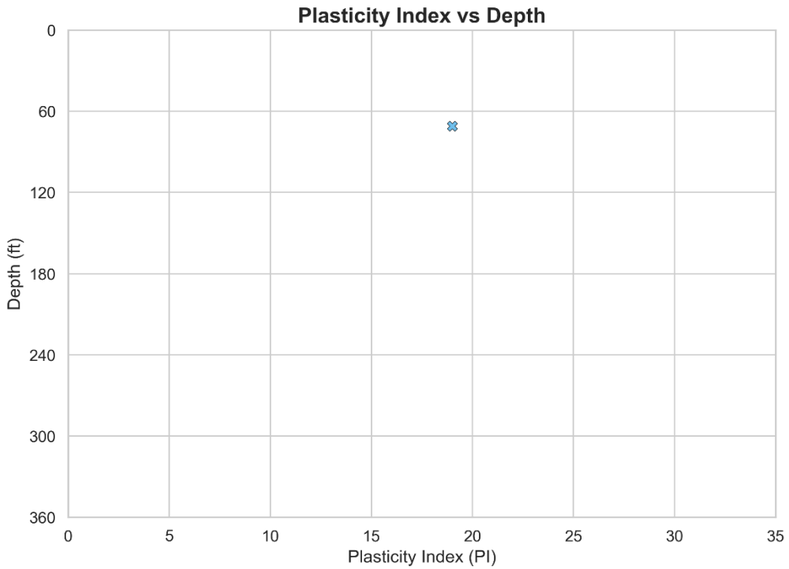
Knik Arm Tunnel Feasibility Study

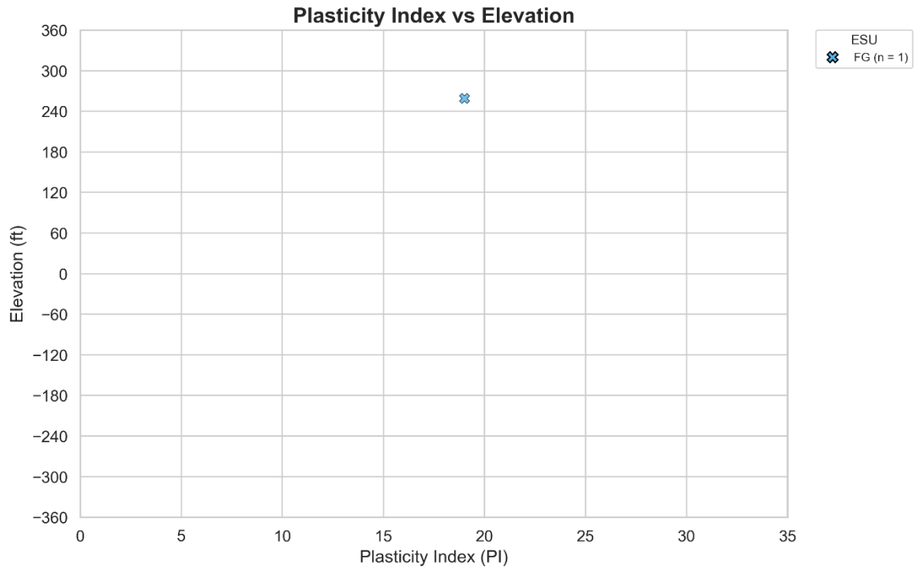
EMPRISE CONCEPTS

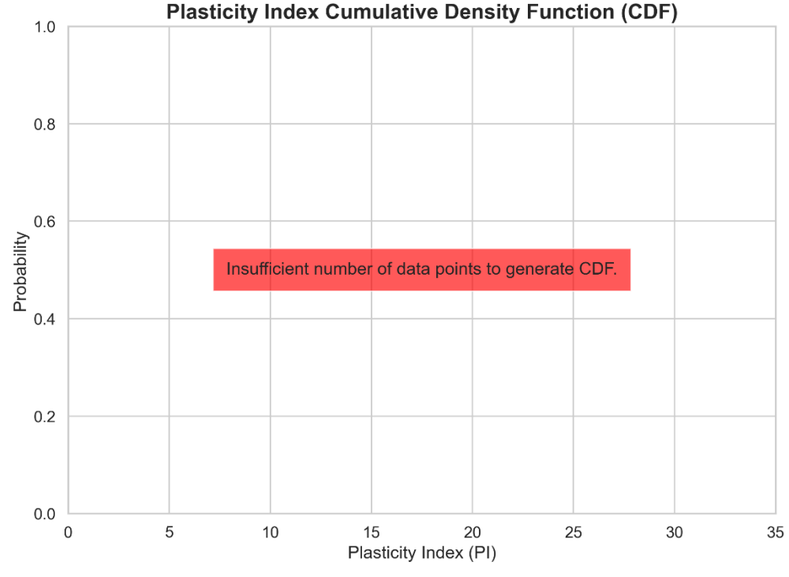
Anchorage, Alaska | August 2025

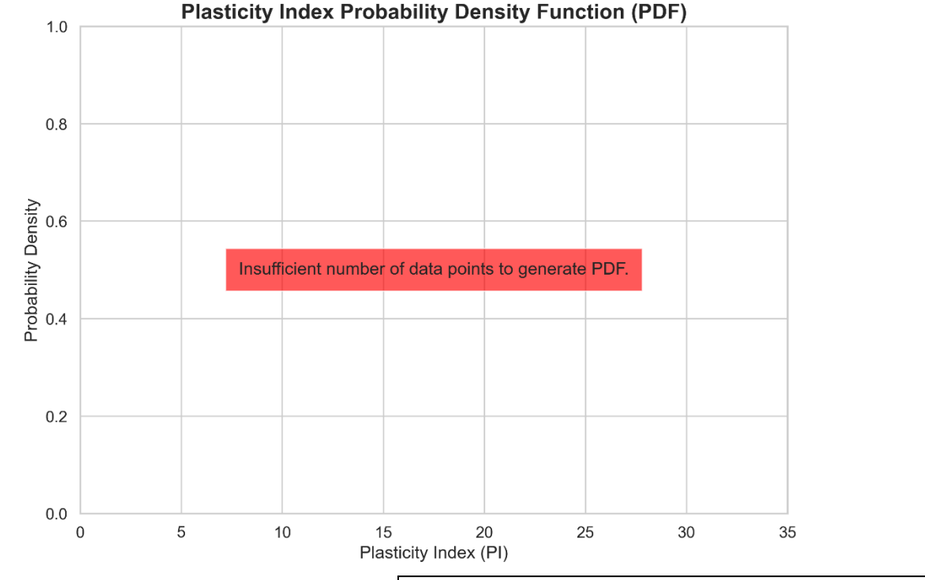
Figure **F-23**

FG (n = 1) - Point MacKenzie Landside Borings









Plasticity Index–Point MacKenzie Landside Borings, ESU FG

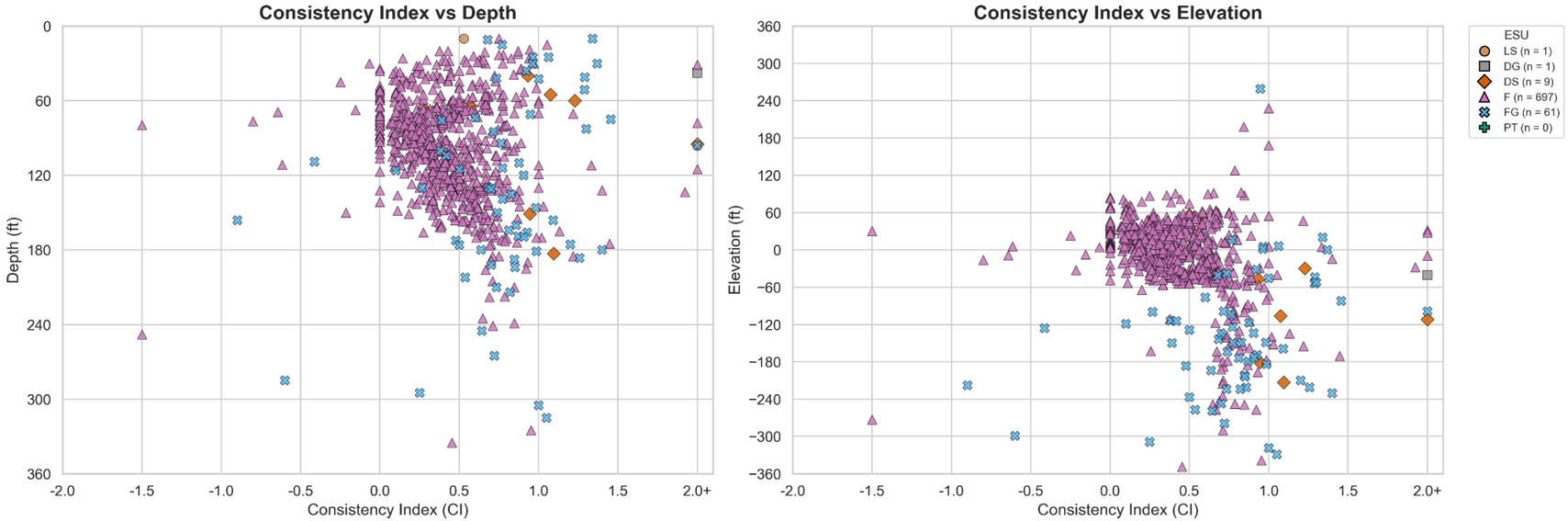
Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure **F-24**

All Borings



Consistency Index – All Borings, All ESUs

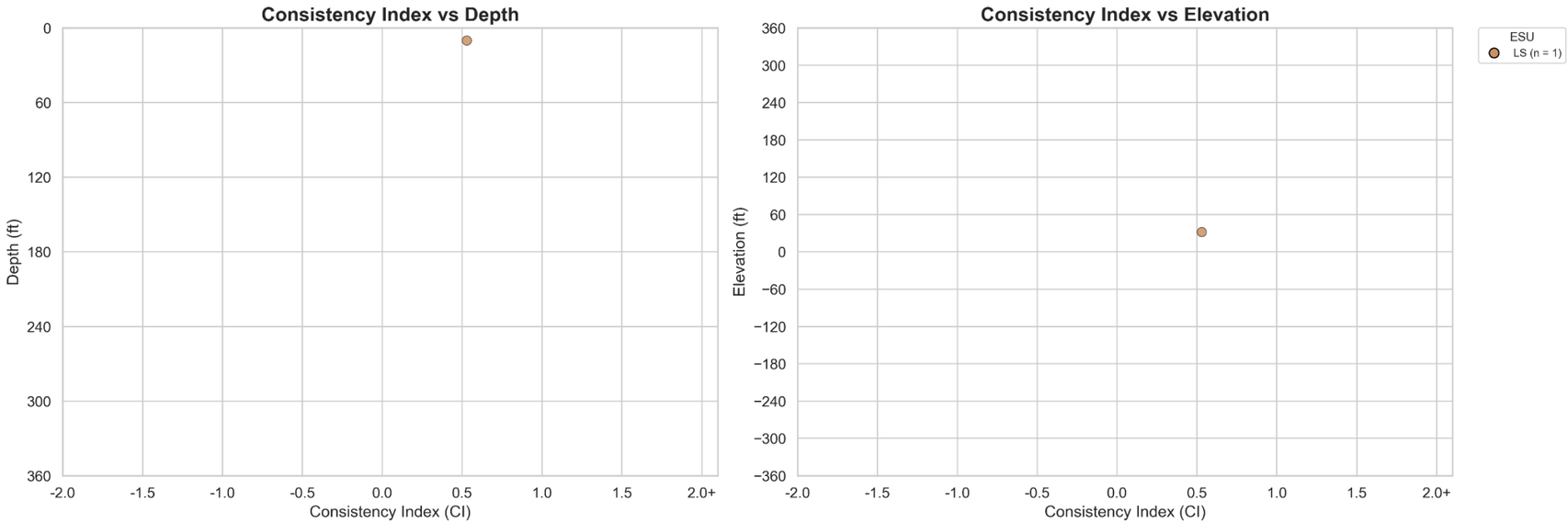
Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure G-1

LS (n = 1) - All Borings



Consistency Index – All Borings, ESU LS

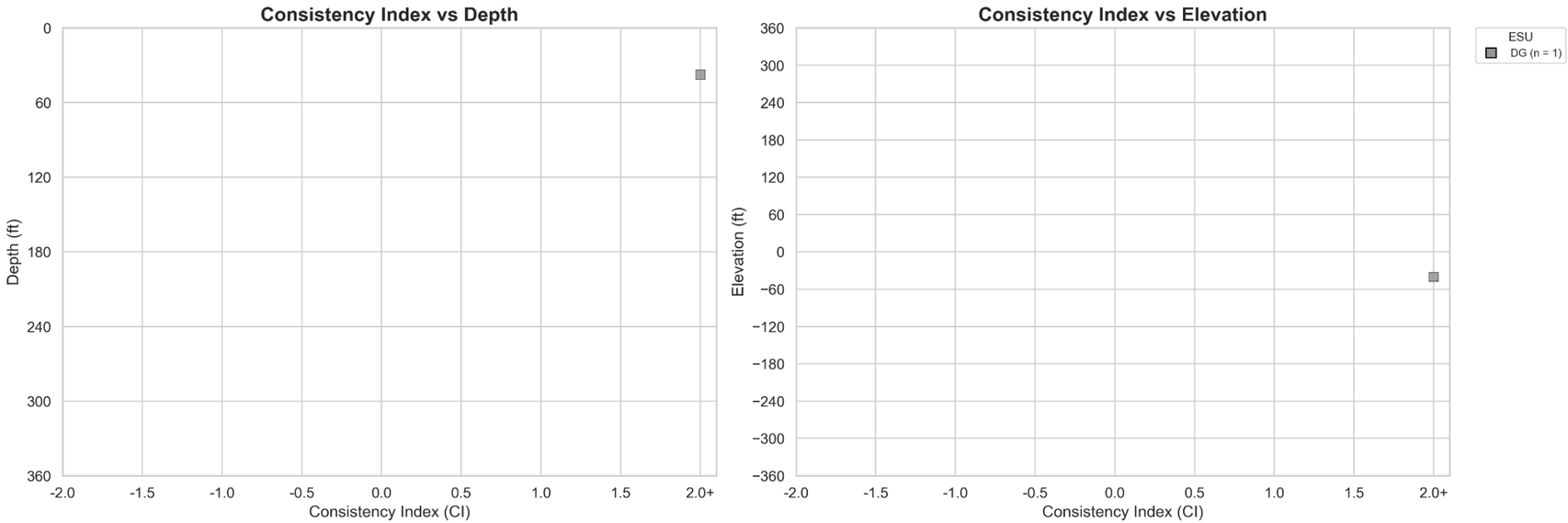
Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure **G-2**

DG (n = 1) - All Borings



Consistency Index – All Borings, ESU DG

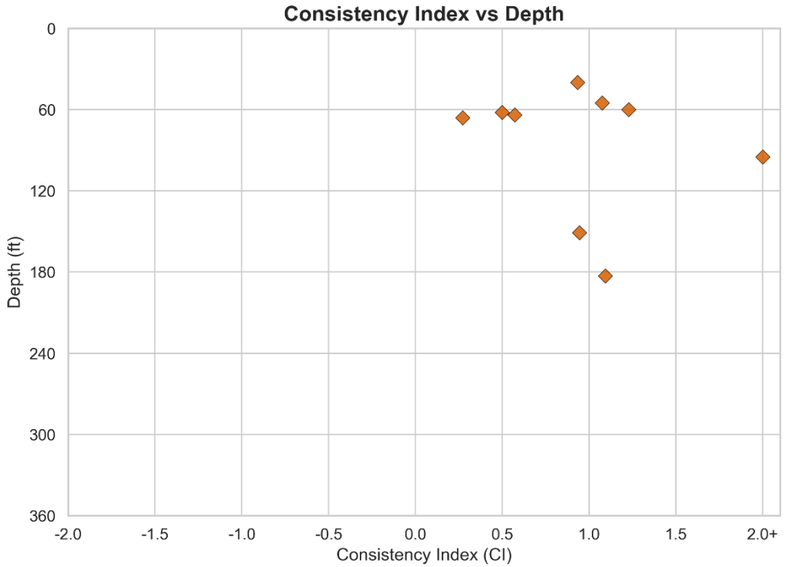
Knik Arm Tunnel Feasibility Study

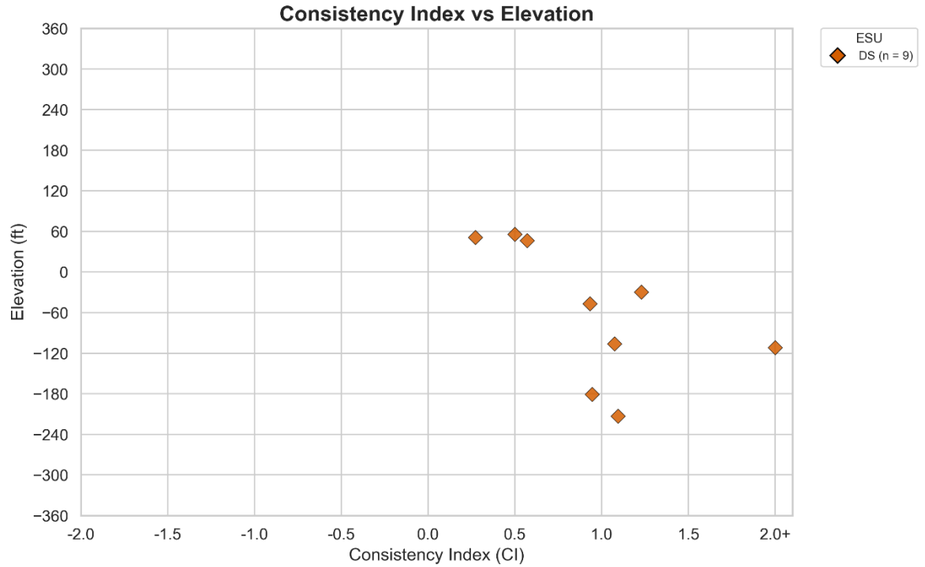
EMPRISE CONCEPTS

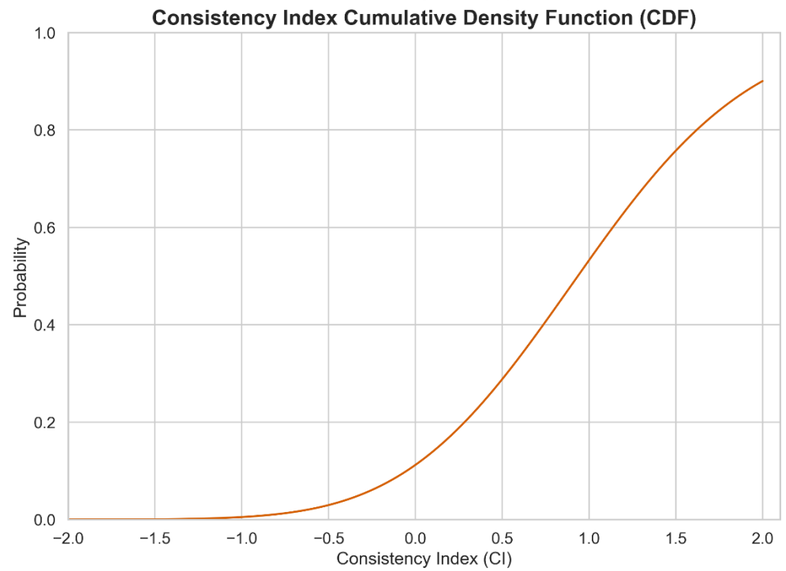
Anchorage, Alaska | August 2025

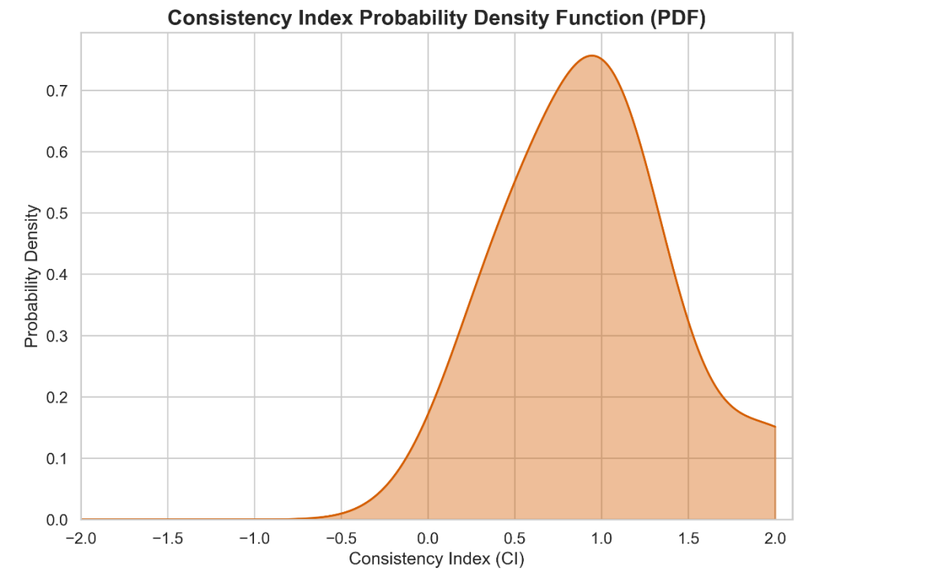
Figure **G-3**

DS (n = 9) - All Borings









Consistency Index – All Borings, ESU DS

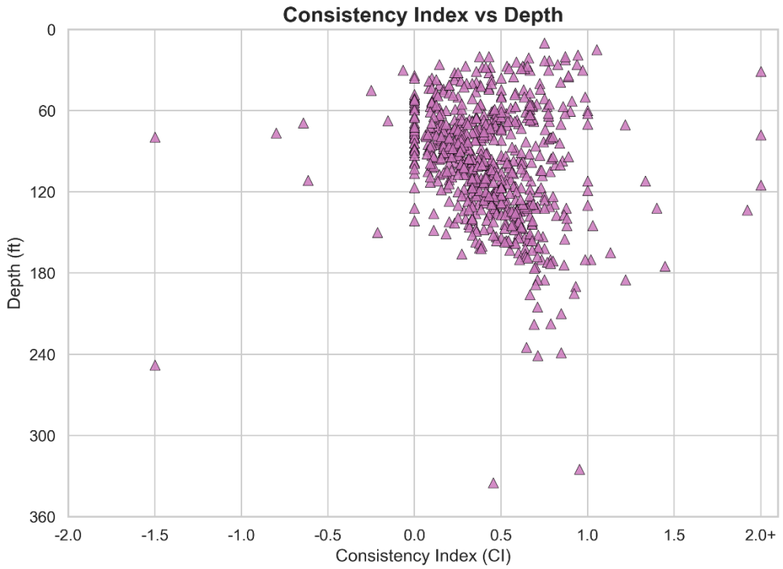
Knik Arm Tunnel Feasibility Study

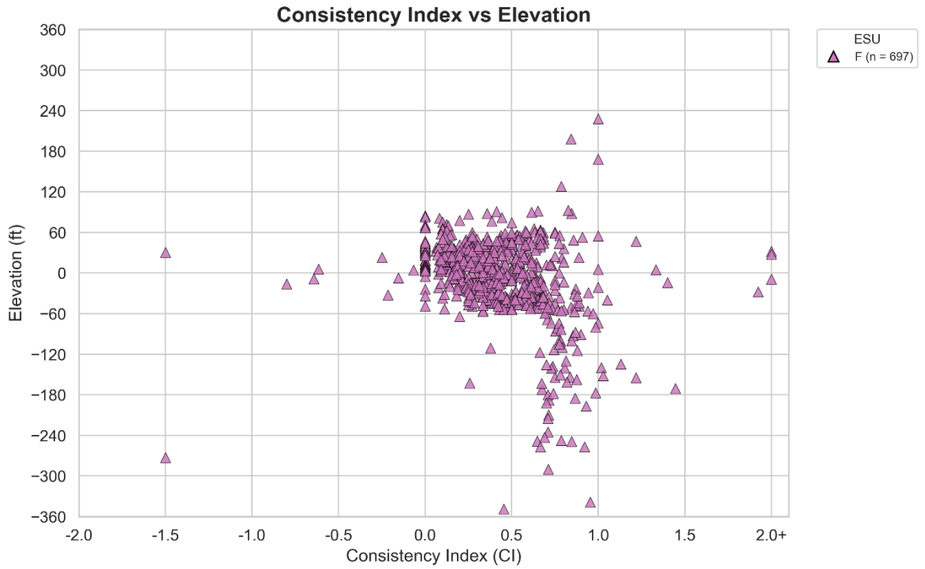
EMPRISE CONCEPTS

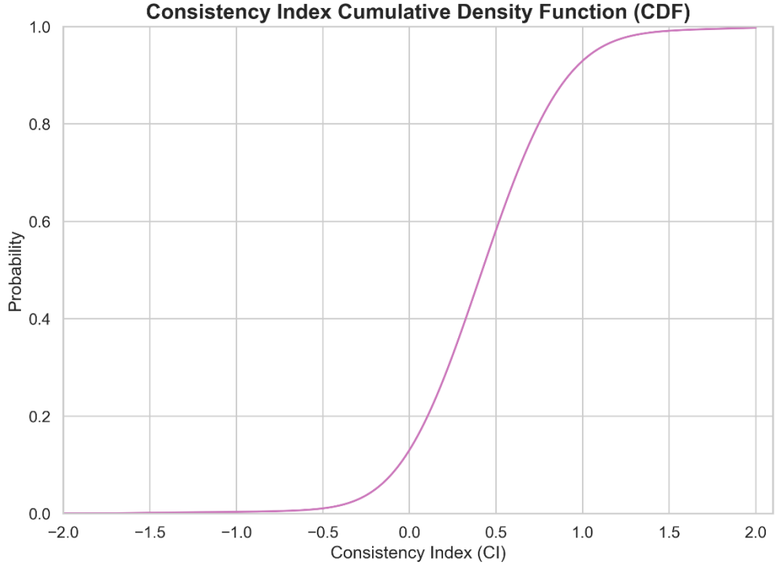
Anchorage, Alaska | August 2025

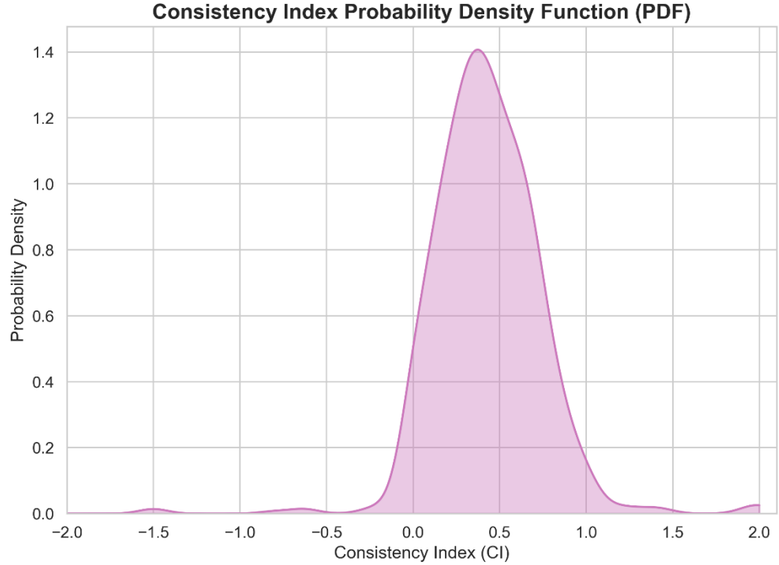
Figure **G-4**

F (n = 697) - All Borings









Consistency Index – All Borings, ESU F

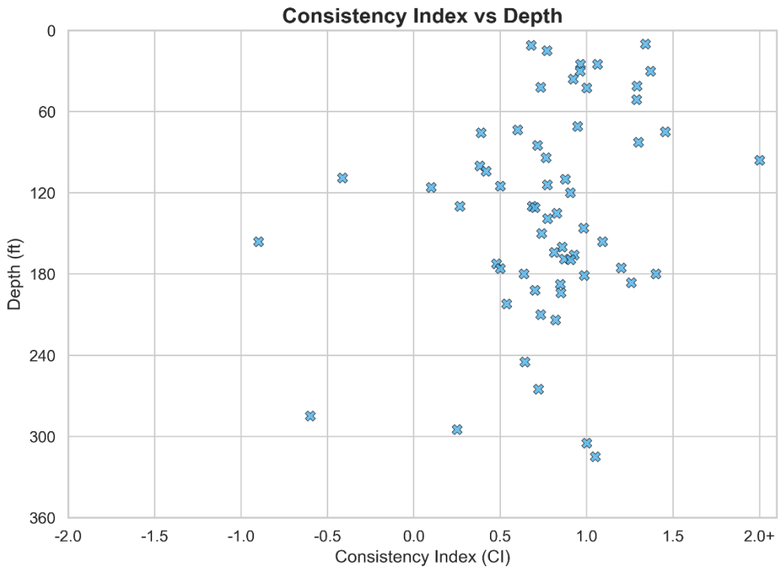
Knik Arm Tunnel Feasibility Study

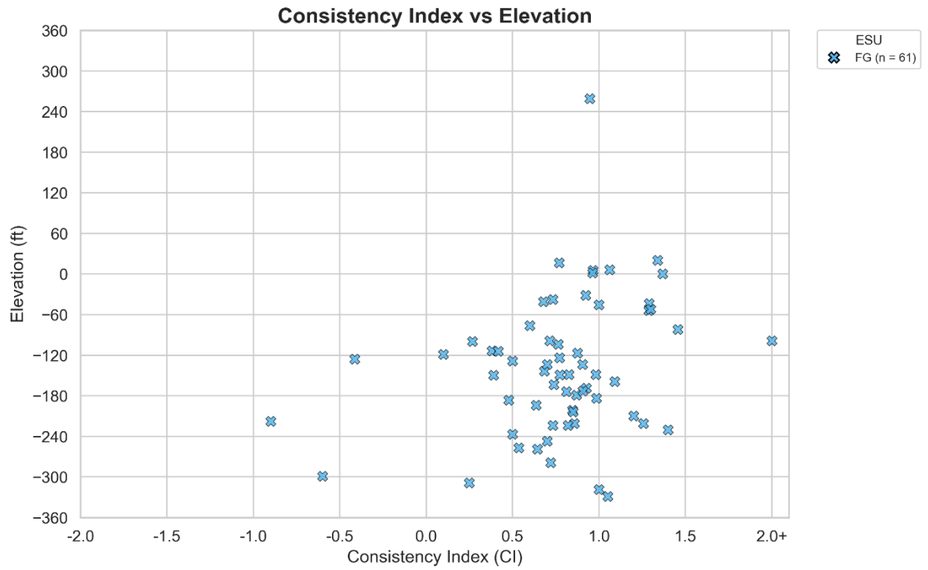
EMPRISE CONCEPTS

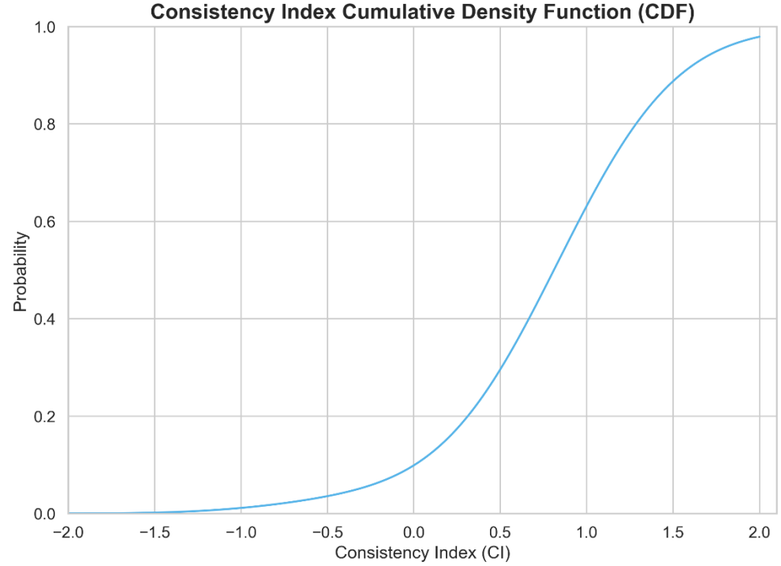
Anchorage, Alaska | August 2025

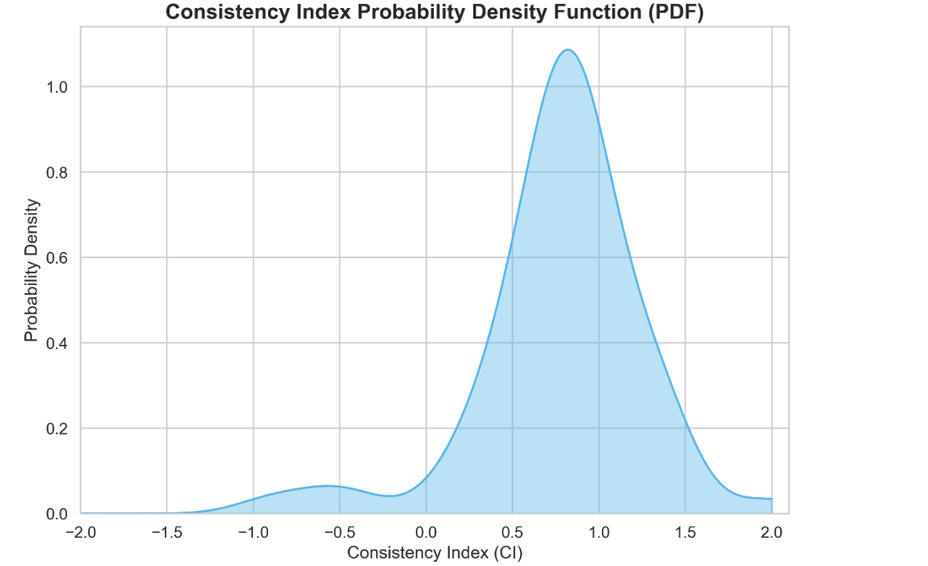
Figure **G-5**

FG (n = 61) - All Borings









Consistency Index – All Borings, ESU FG

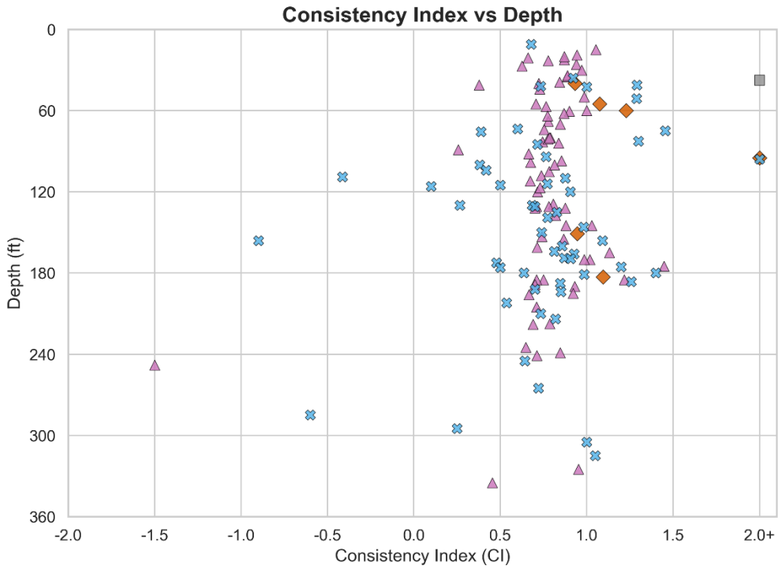
Knik Arm Tunnel Feasibility Study

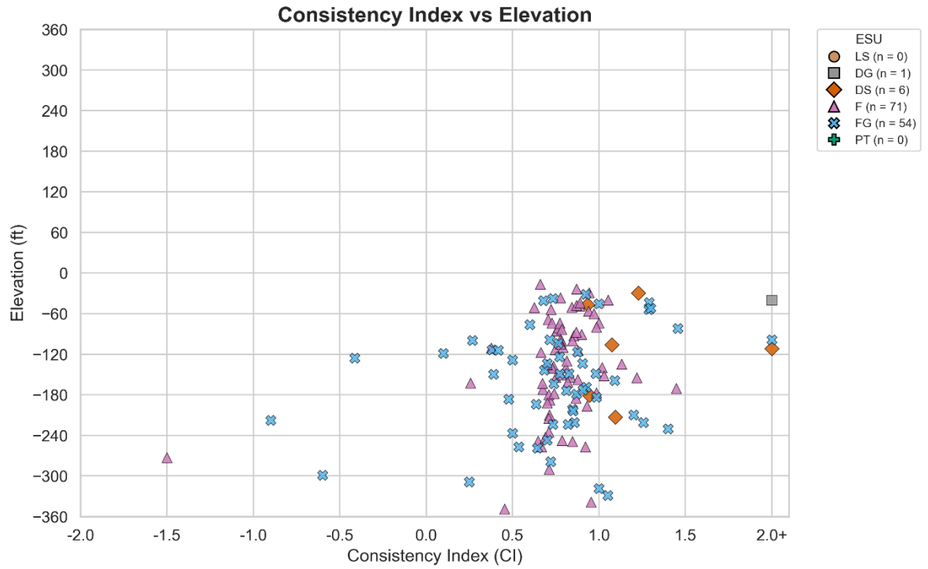
EMPRISE CONCEPTS

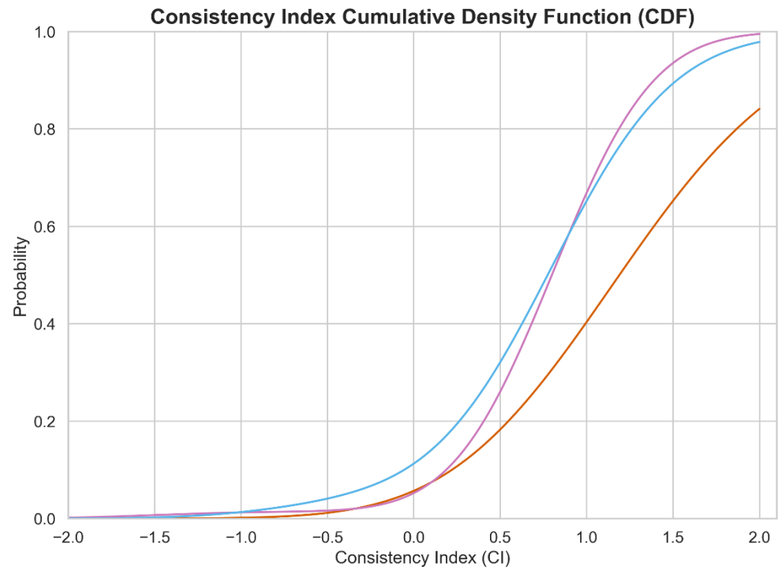
Anchorage, Alaska | August 2025

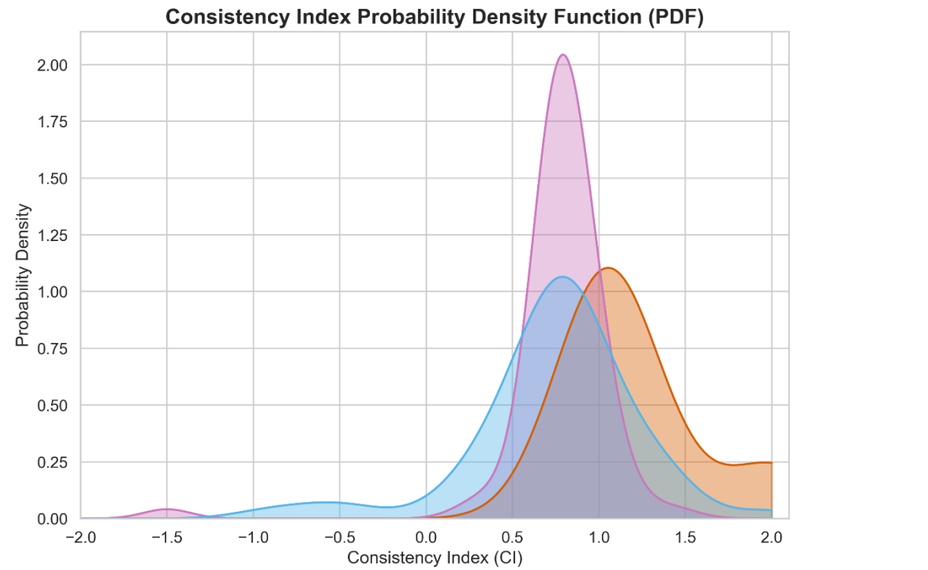
Figure **G-6**

Overwater Borings









Consistency Index – Overwater Borings, All ESUs

Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure **G-7**

NO DATA

Consistency Index – Overwater Borings, ESU LS

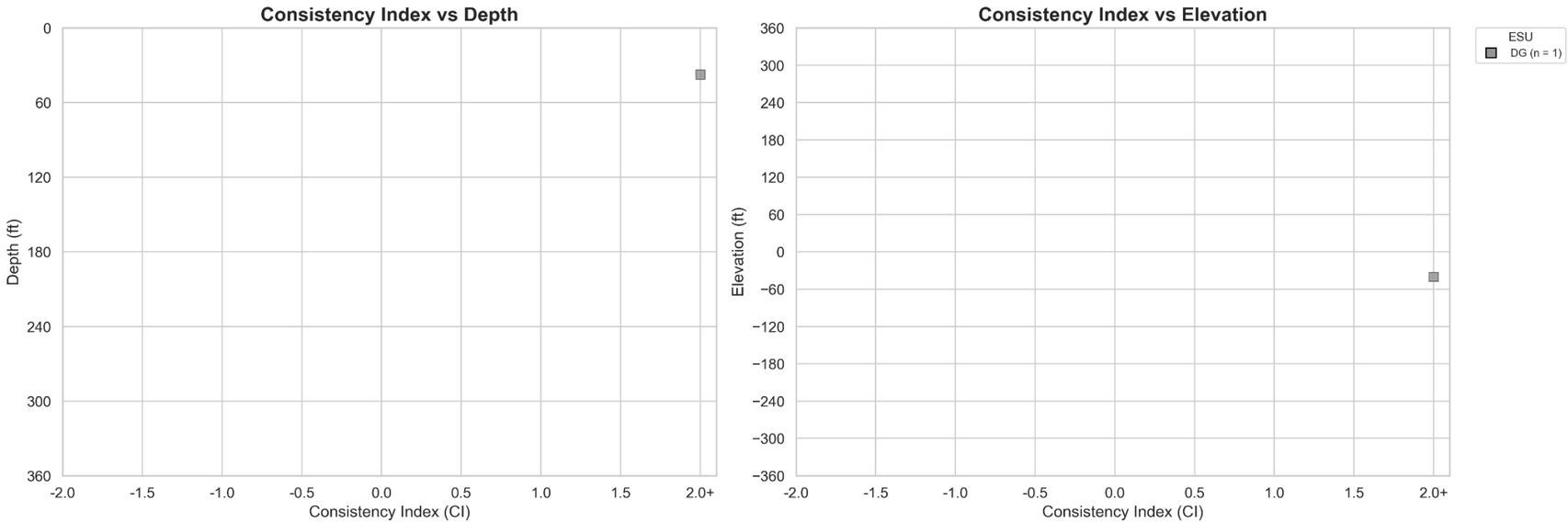
Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure **G-8**

DG (n = 1) - Overwater Borings



Consistency Index – Overwater Borings, ESU DG

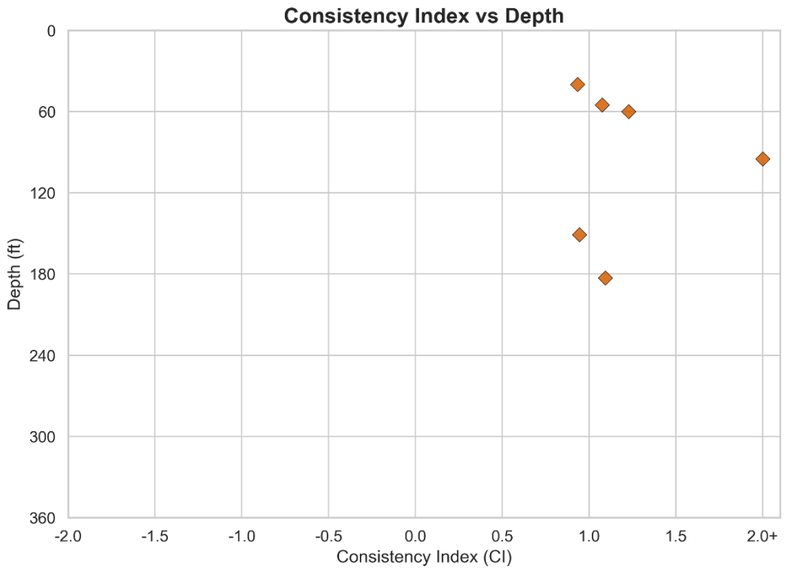
Knik Arm Tunnel Feasibility Study

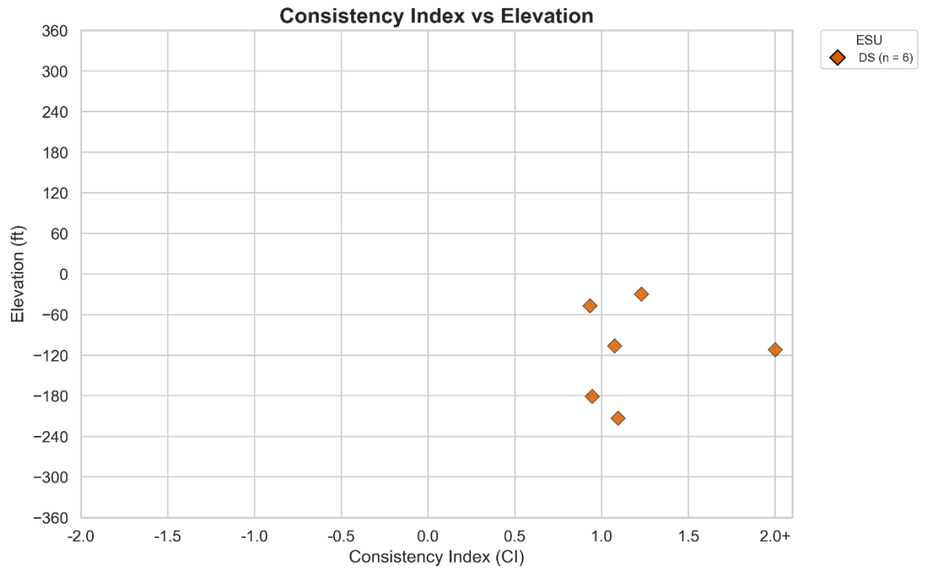
EMPRISE CONCEPTS

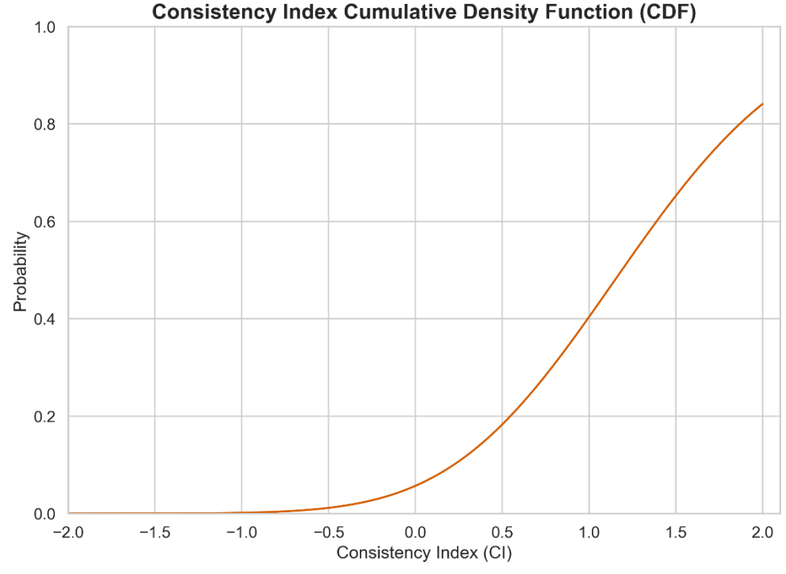
Anchorage, Alaska | August 2025

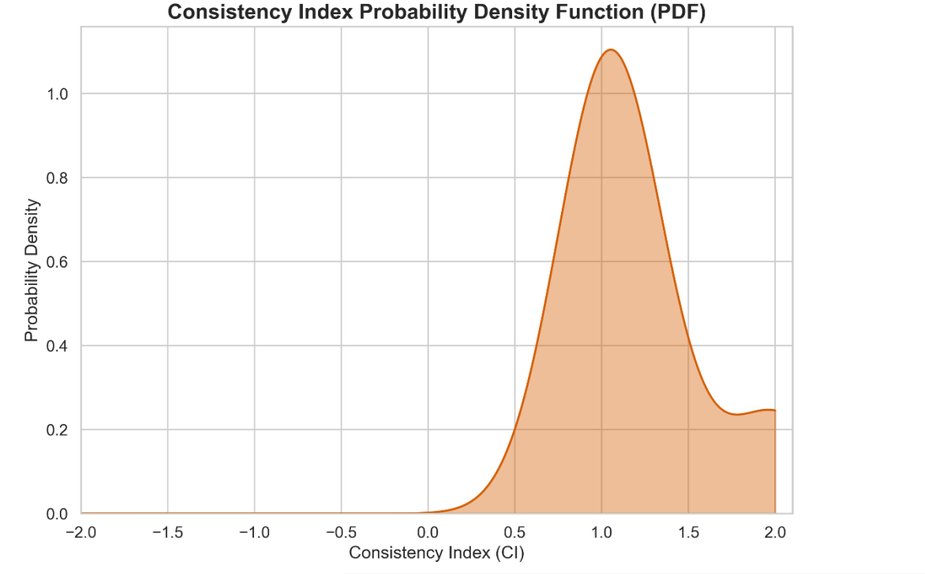
Figure
G-9

DS (n = 6) - Overwater Borings









Consistency Index – Overwater Borings, ESU DS

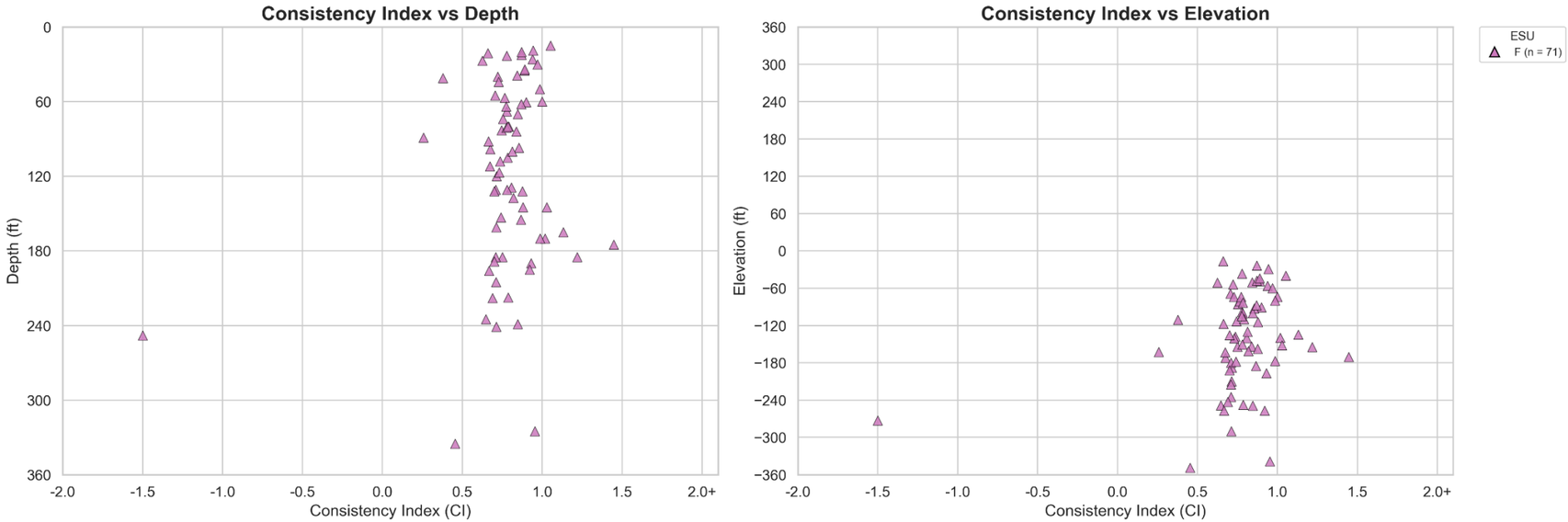
Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure **G-10**

F (n = 71) - Overwater Borings



Consistency Index – Overwater Borings, ESU F

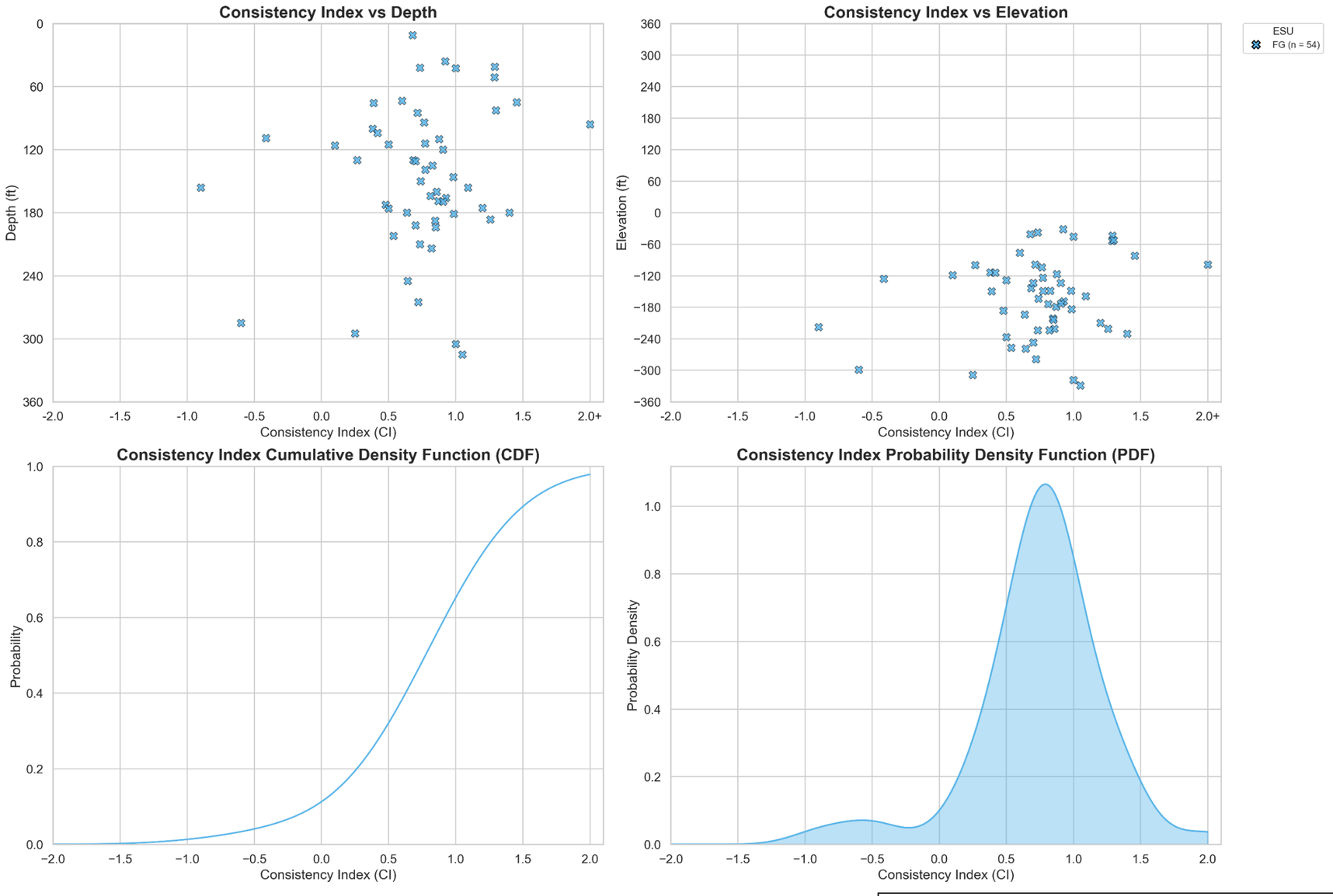
Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure G-11

FG (n = 54) - Overwater Borings



Consistency Index – Overwater Borings, ESU FG

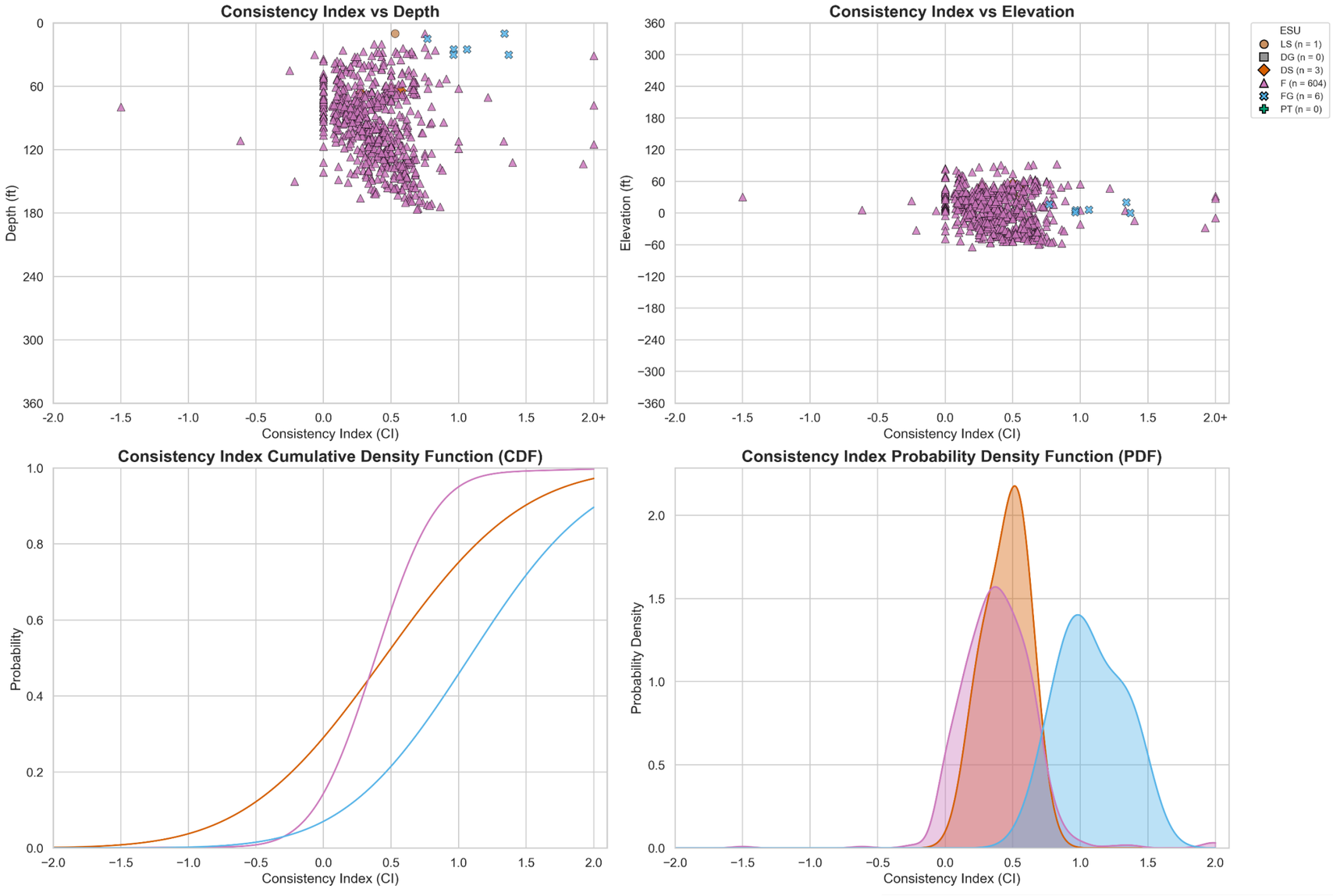
Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure **G-12**

Anchorage Landside Borings



Consistency Index – Anchorage Landside Borings, All ESUs

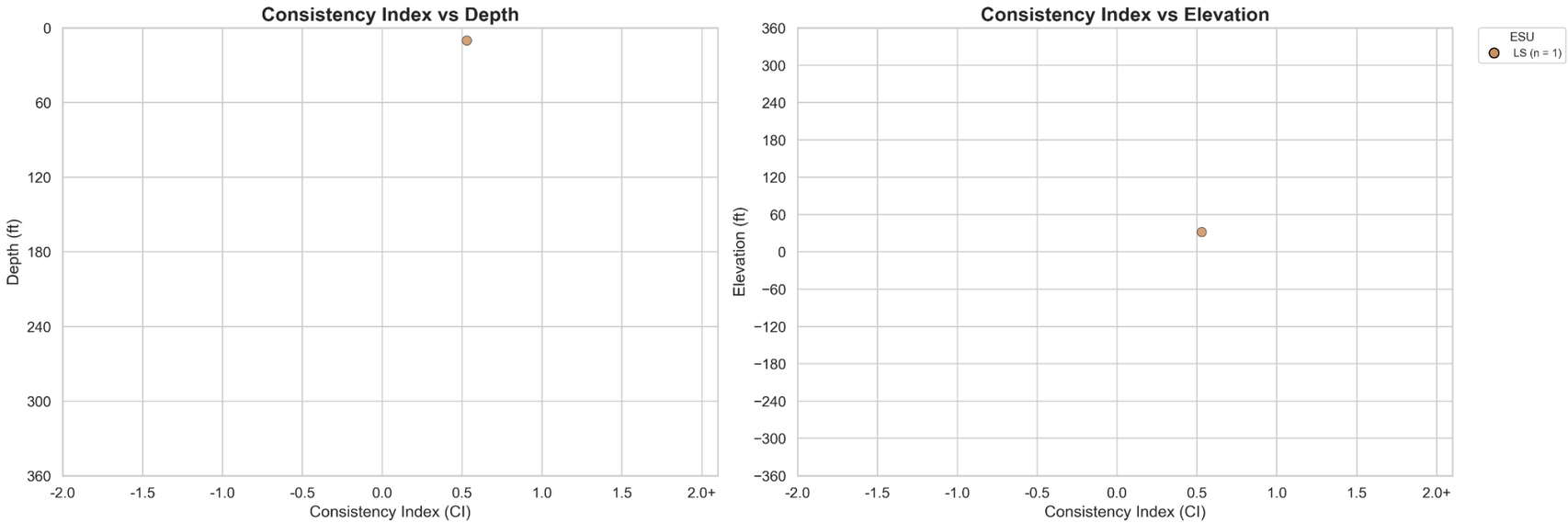
Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure G-13

LS (n = 1) - Anchorage Landside Borings



Consistency Index – Anchorage Landside Borings, ESU LS

Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure **G-14**

NO DATA

Consistency Index – Anchorage Landside Borings, ESU DG

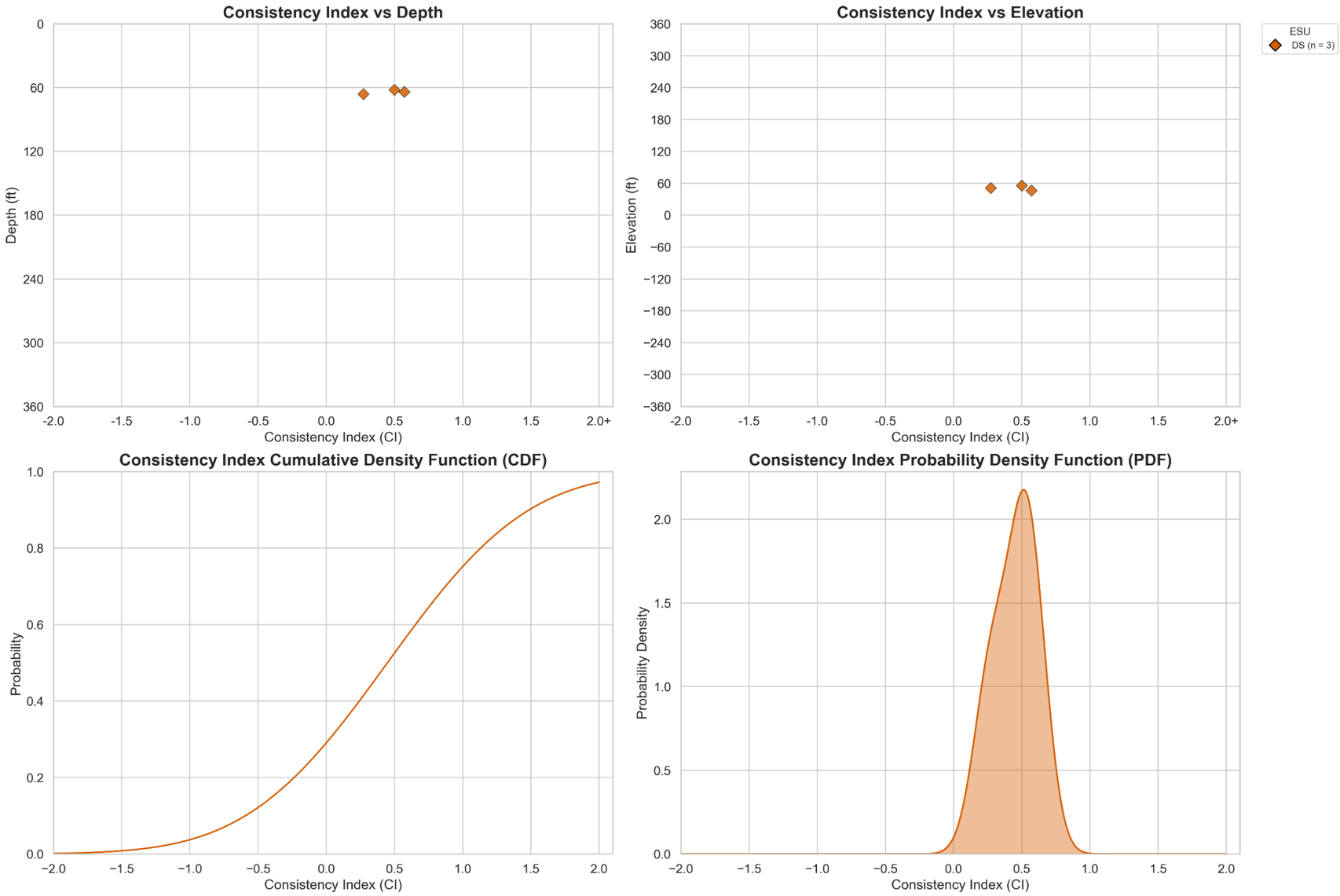
Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure
G-15

DS (n = 3) - Anchorage Landside Borings



Consistency Index – Anchorage Landside Borings, ESU DS

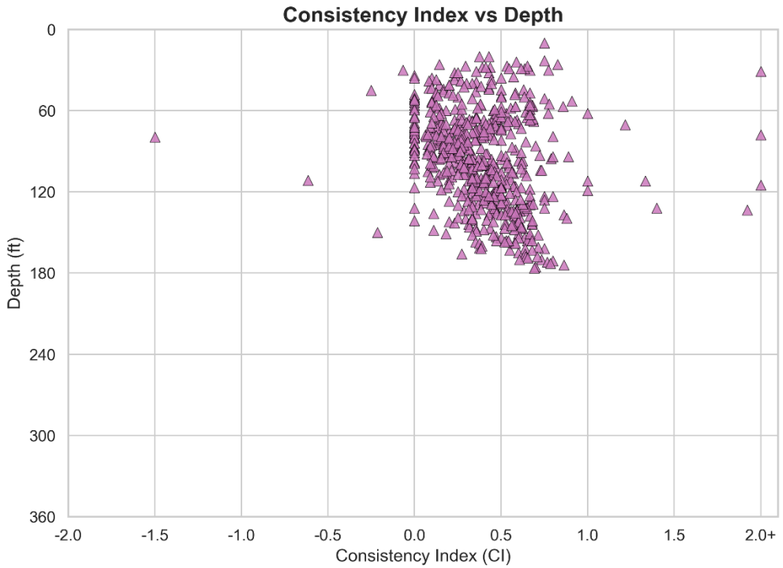
Knik Arm Tunnel Feasibility Study

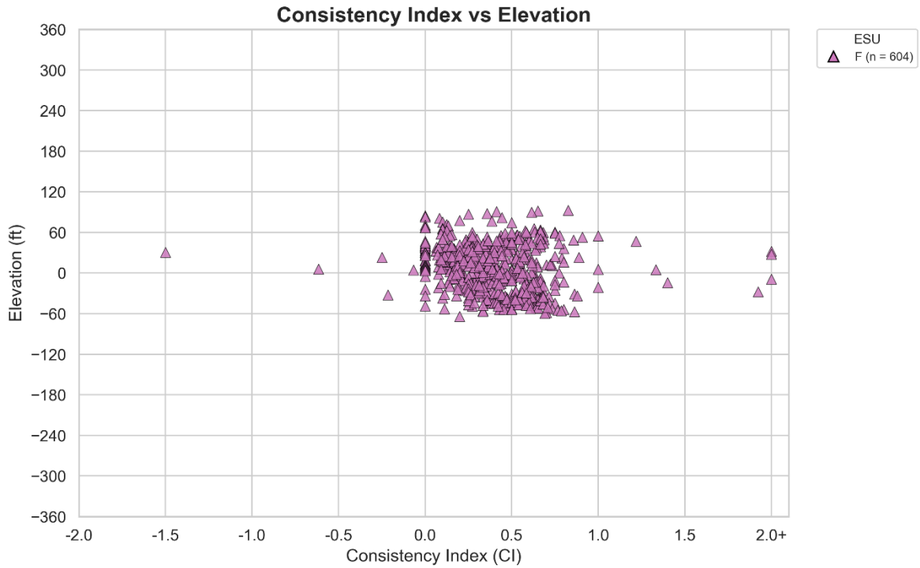
EMPRISE CONCEPTS

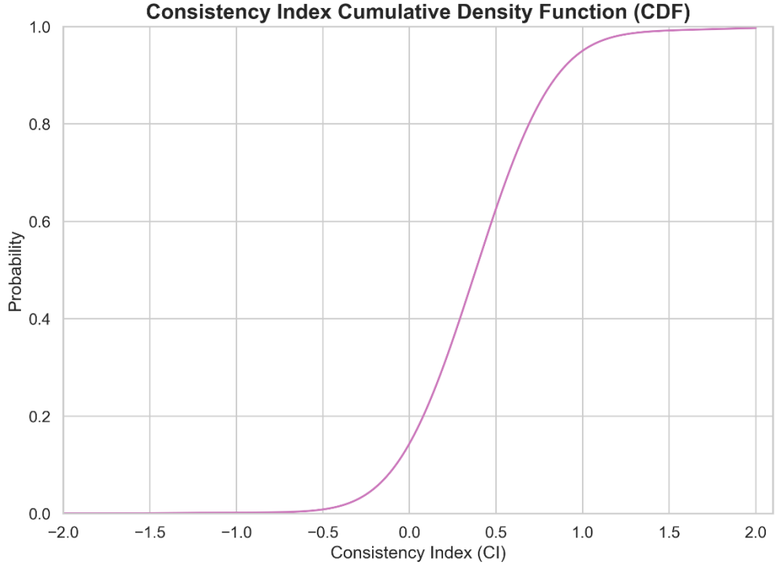
Anchorage, Alaska | August 2025

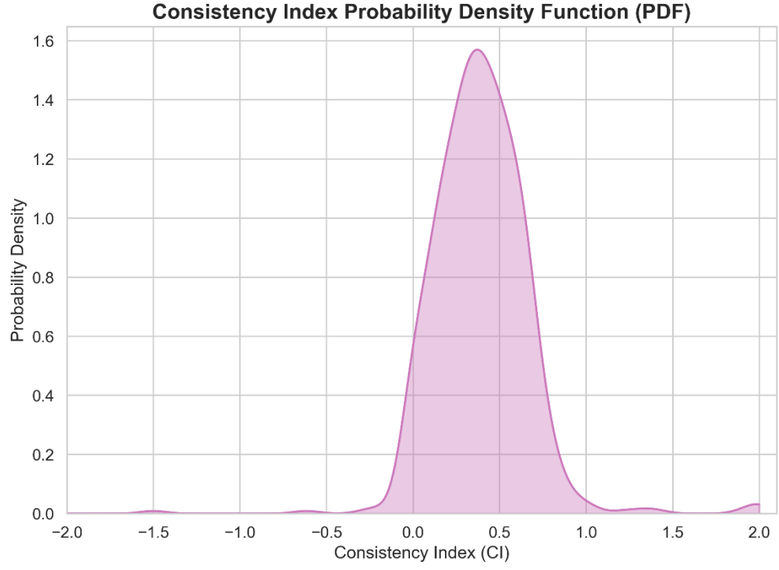
Figure **G-16**

F (n = 604) - Anchorage Landside Borings









Consistency Index – Anchorage Landside Borings, ESU F

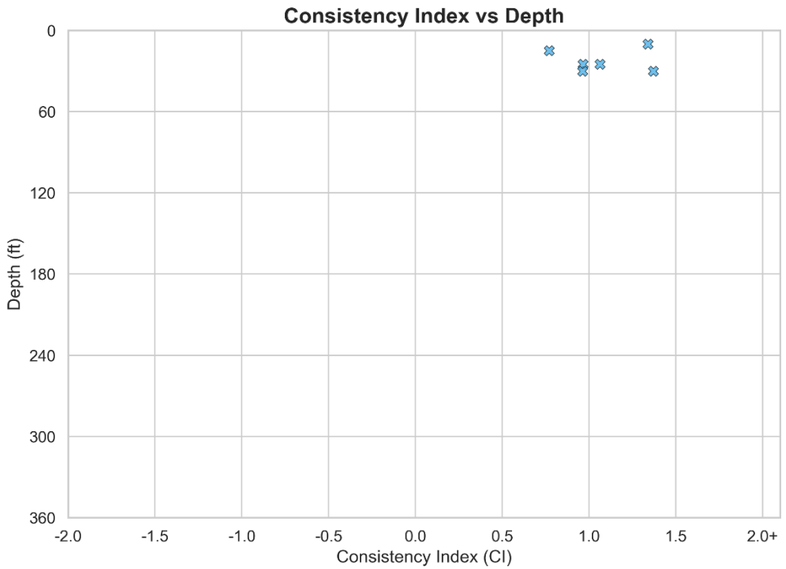
Knik Arm Tunnel Feasibility Study

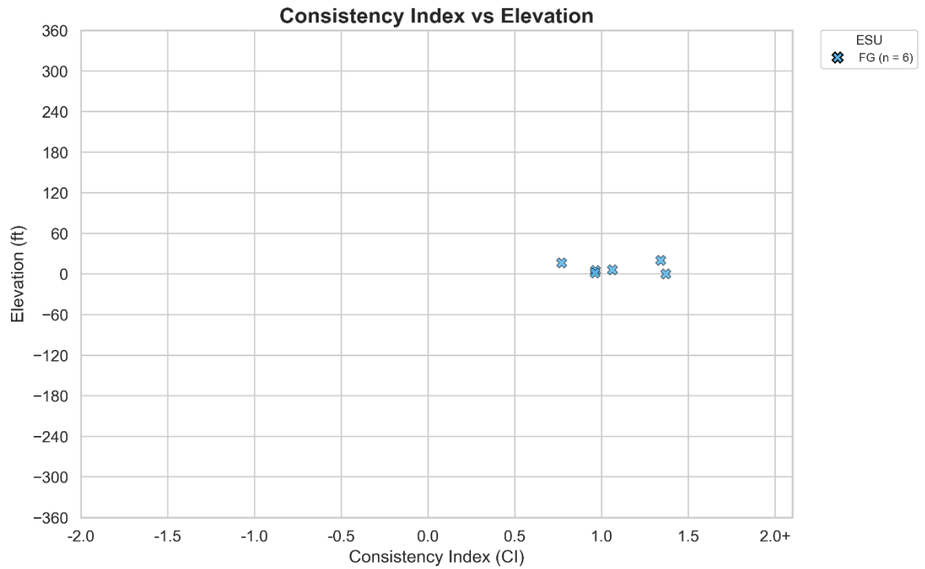
EMPRISE CONCEPTS

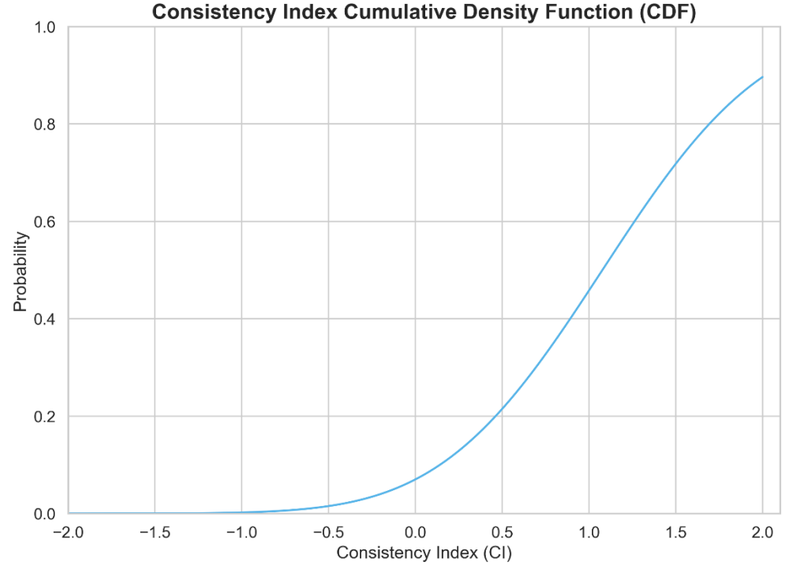
Anchorage, Alaska | August 2025

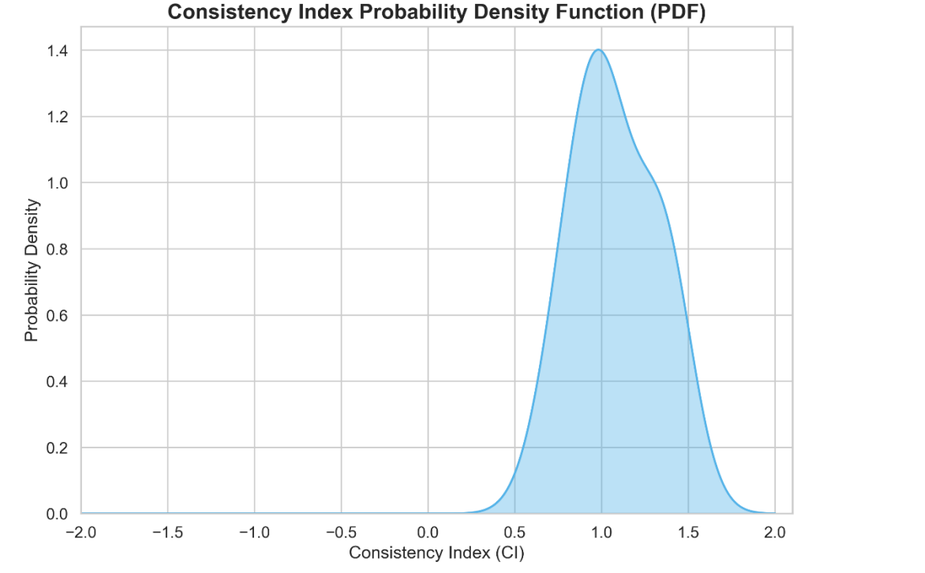
Figure G-17

FG (n = 6) - Anchorage Landside Borings









Consistency Index – Anchorage Landside Borings, ESU FG

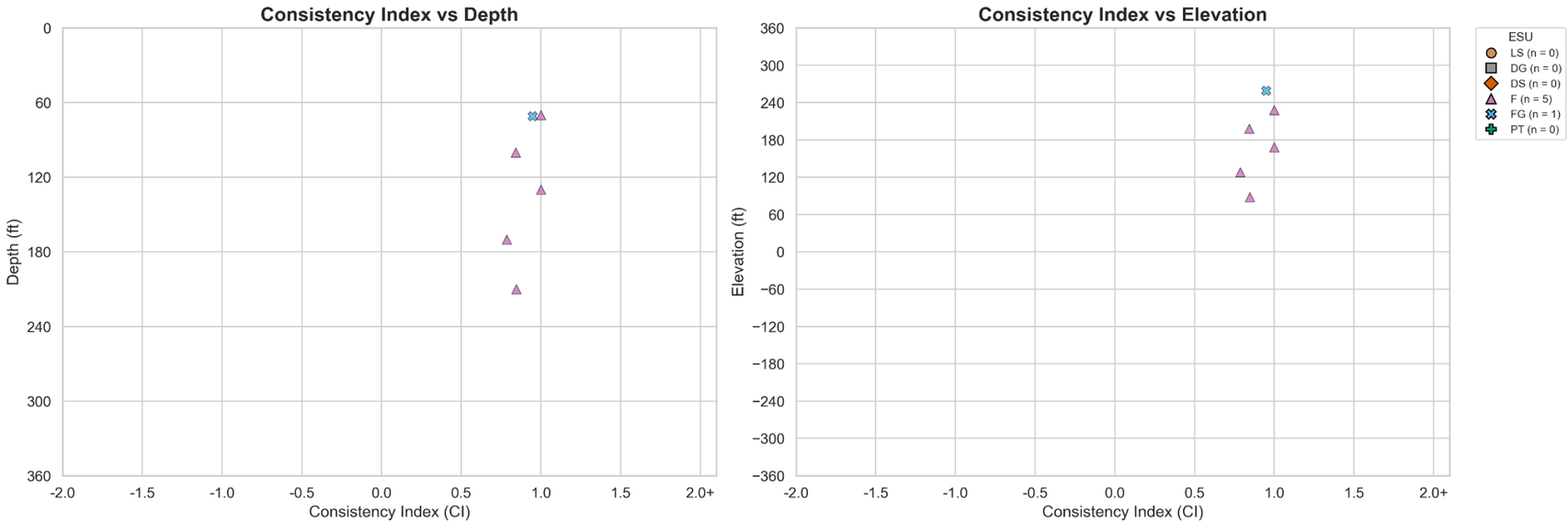
Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure G-18

Point MacKenzie Landside Borings



Consistency Index–Point MacKenzie Landside Borings, All ESUs

Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure **G-19**

NO DATA

Consistency Index–Point MacKenzie Landside Borings, ESU LS

Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure
G-20

NO DATA

Consistency Index–Point MacKenzie Landside Borings, ESU DG

Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure
G-21

NO DATA

Consistency Index–Point MacKenzie Landside Borings, ESU DS

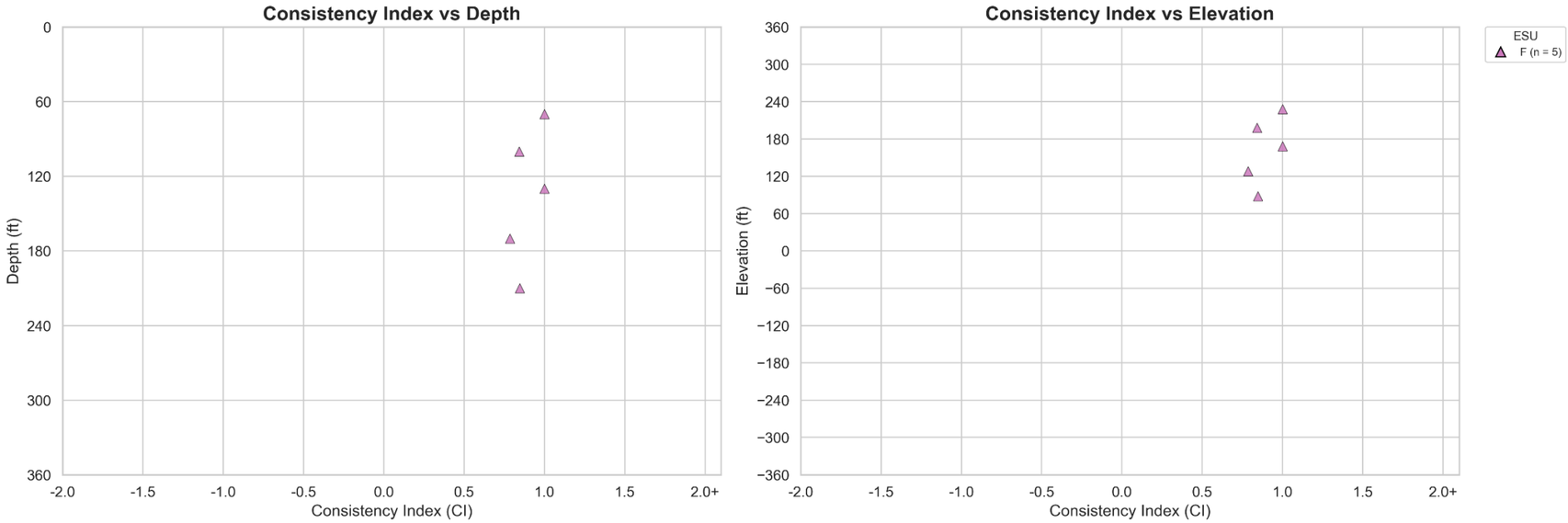
Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure
G-22

F (n = 5) - Point MacKenzie Landside Borings



Consistency Index–Point MacKenzie Landside Borings, ESU F

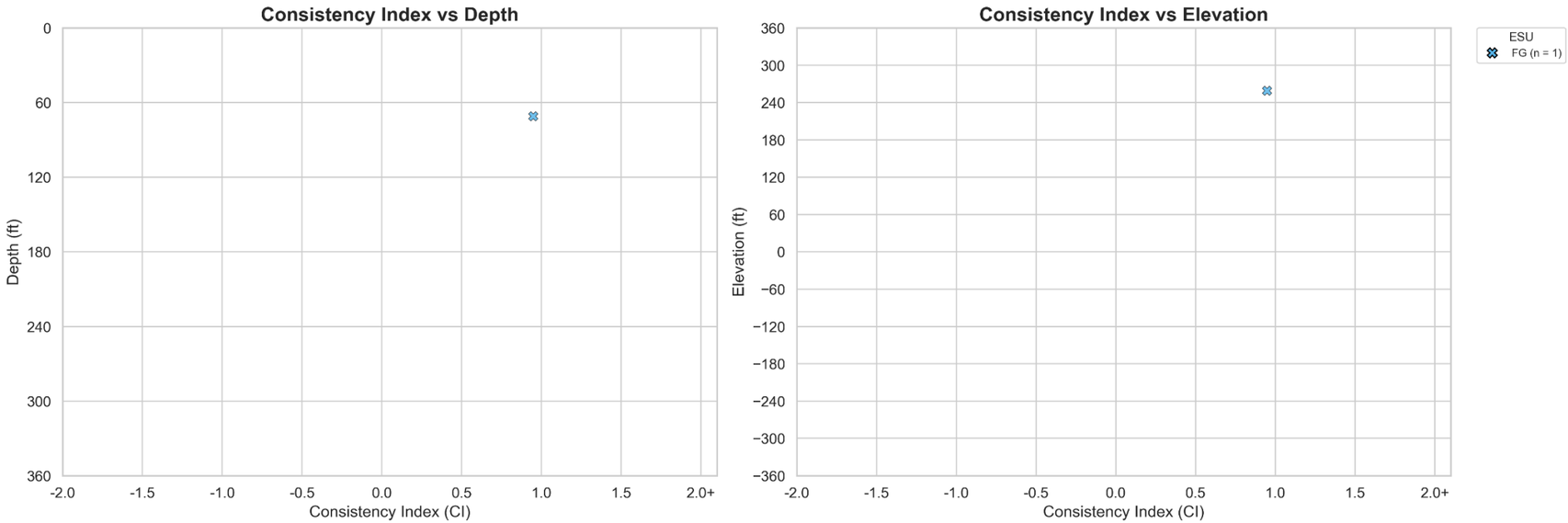
Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure **G-23**

FG (n = 1) - Point MacKenzie Landside Borings



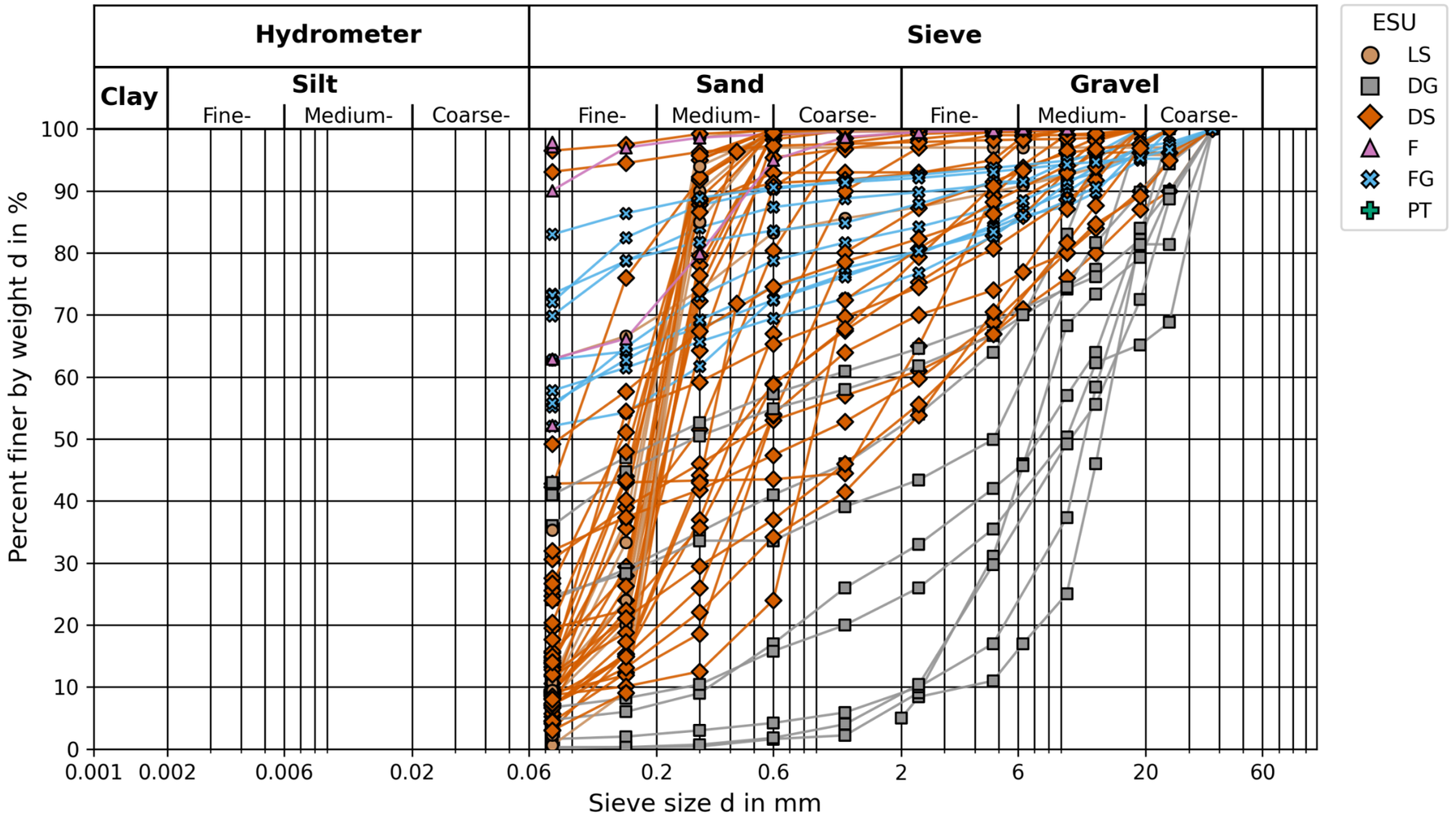
Consistency Index–Point MacKenzie Landside Borings, ESU FG

Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure **G-24**



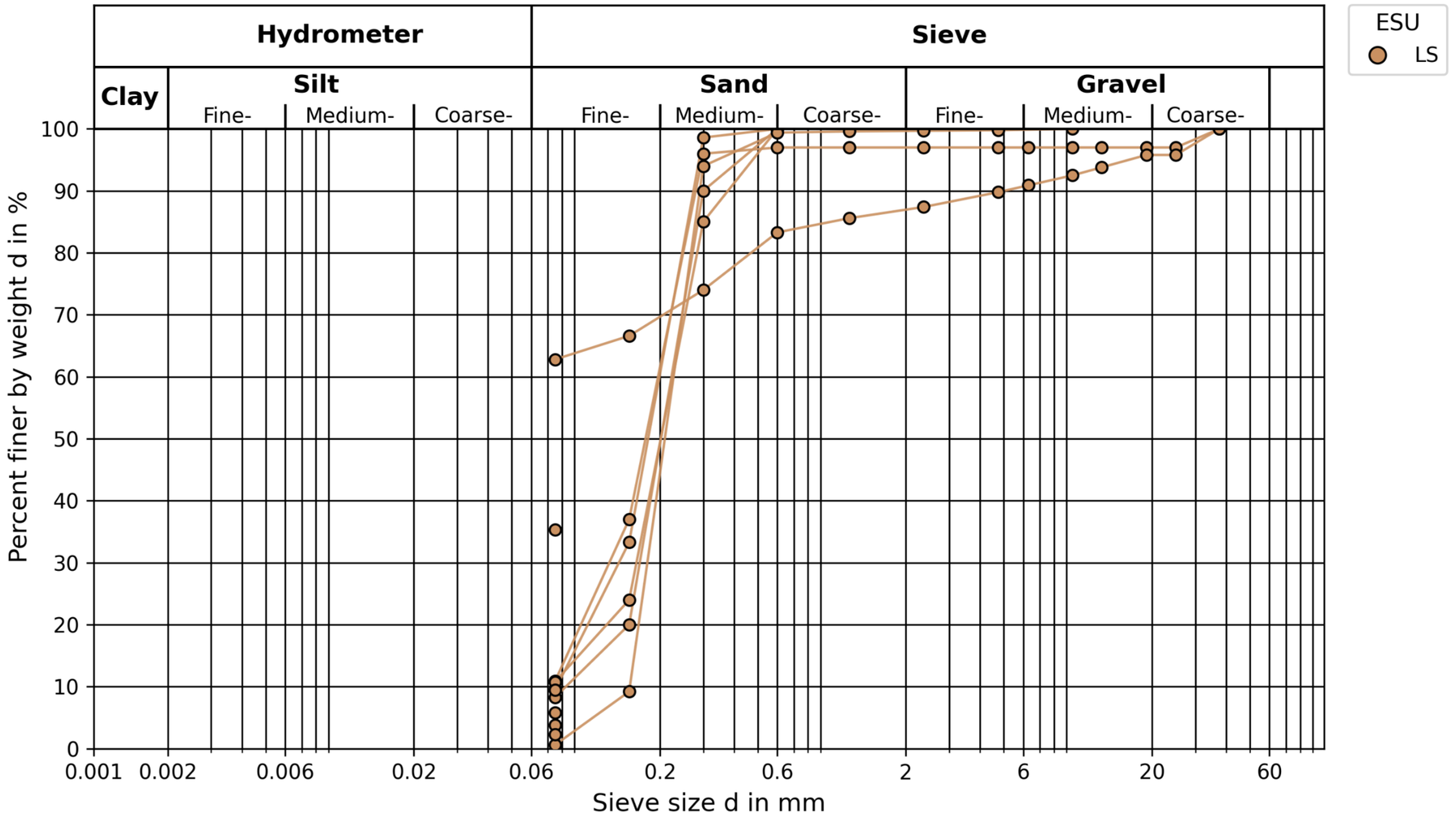
Grain Size Distribution – All Borings, All ESUs

Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure H-1



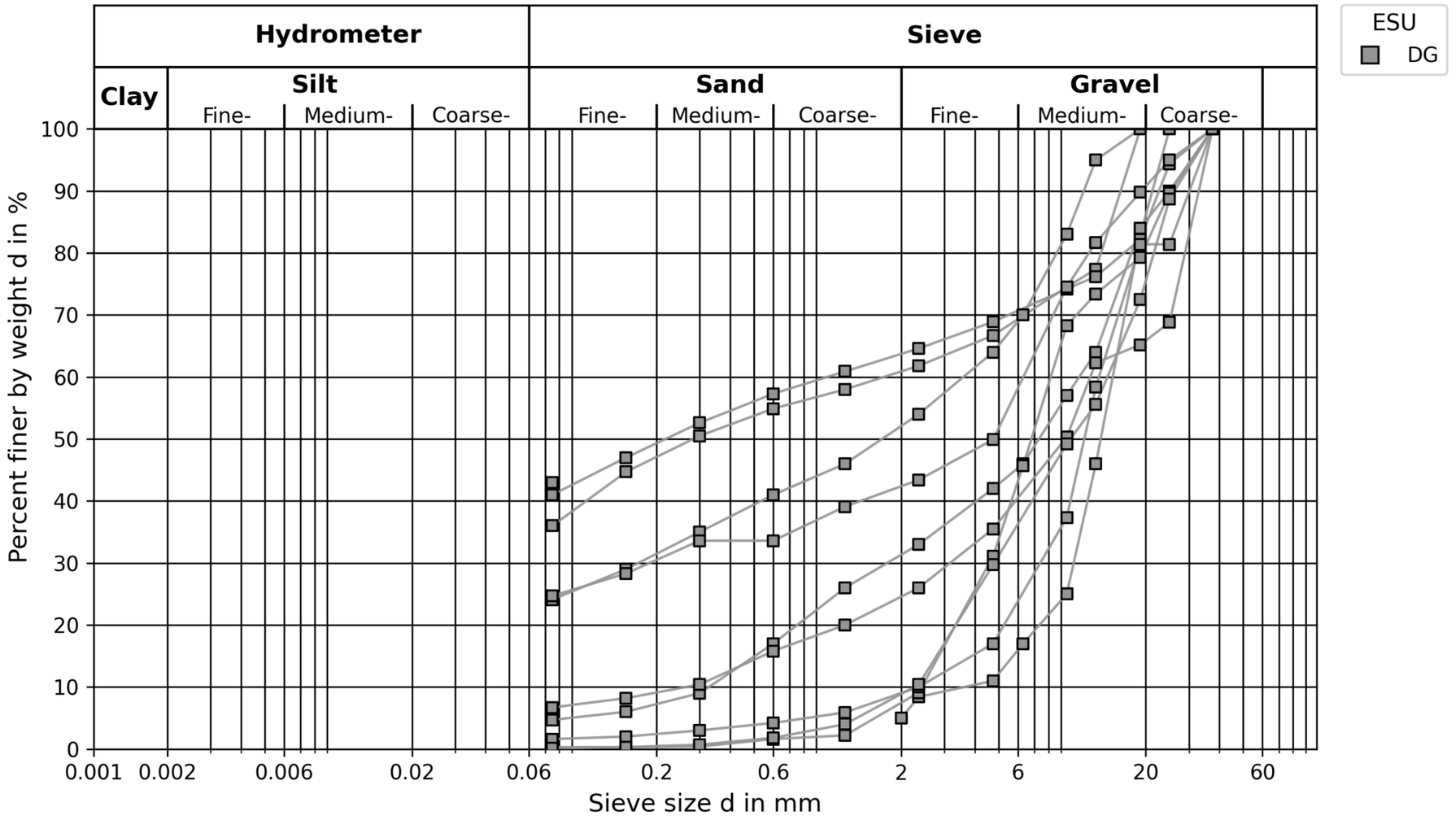
Grain Size Distribution – All Borings, ESU LS

Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure **H-2**



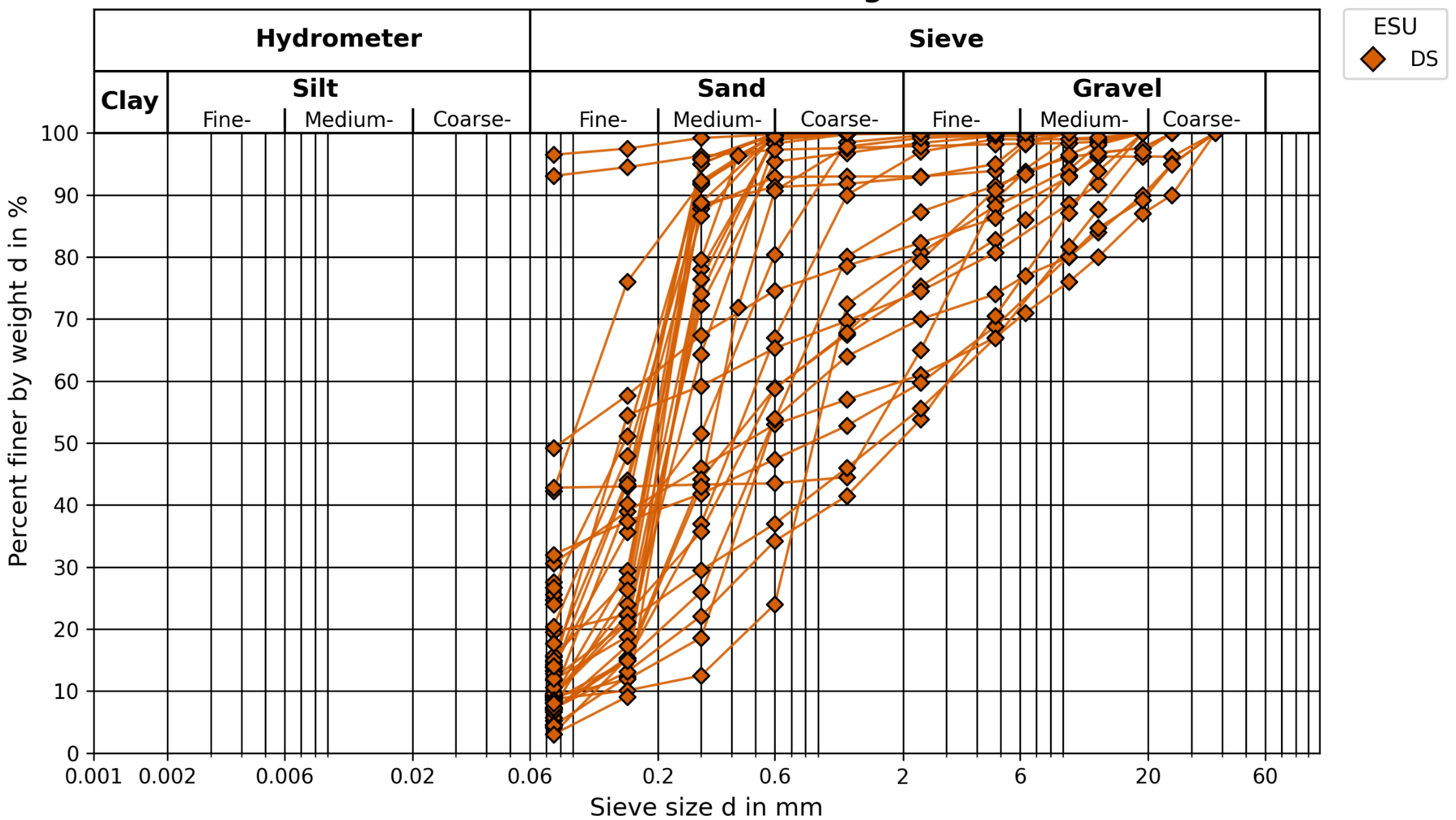
Grain Size Distribution – All Borings, ESU DG

Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure H-3



Grain Size Distribution – All Borings, ESU DS

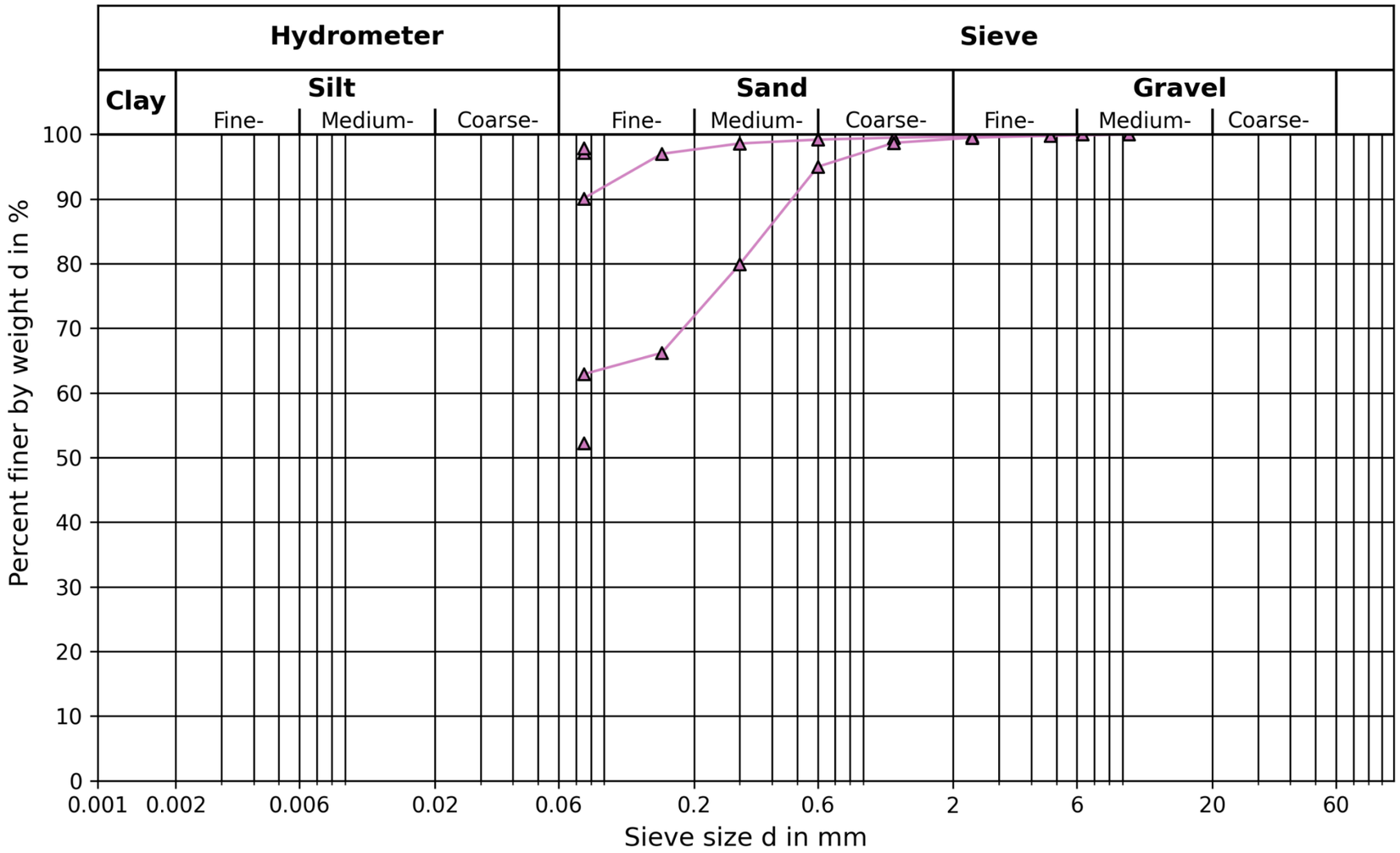
Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure **H-4**

GSD — F — All Borings



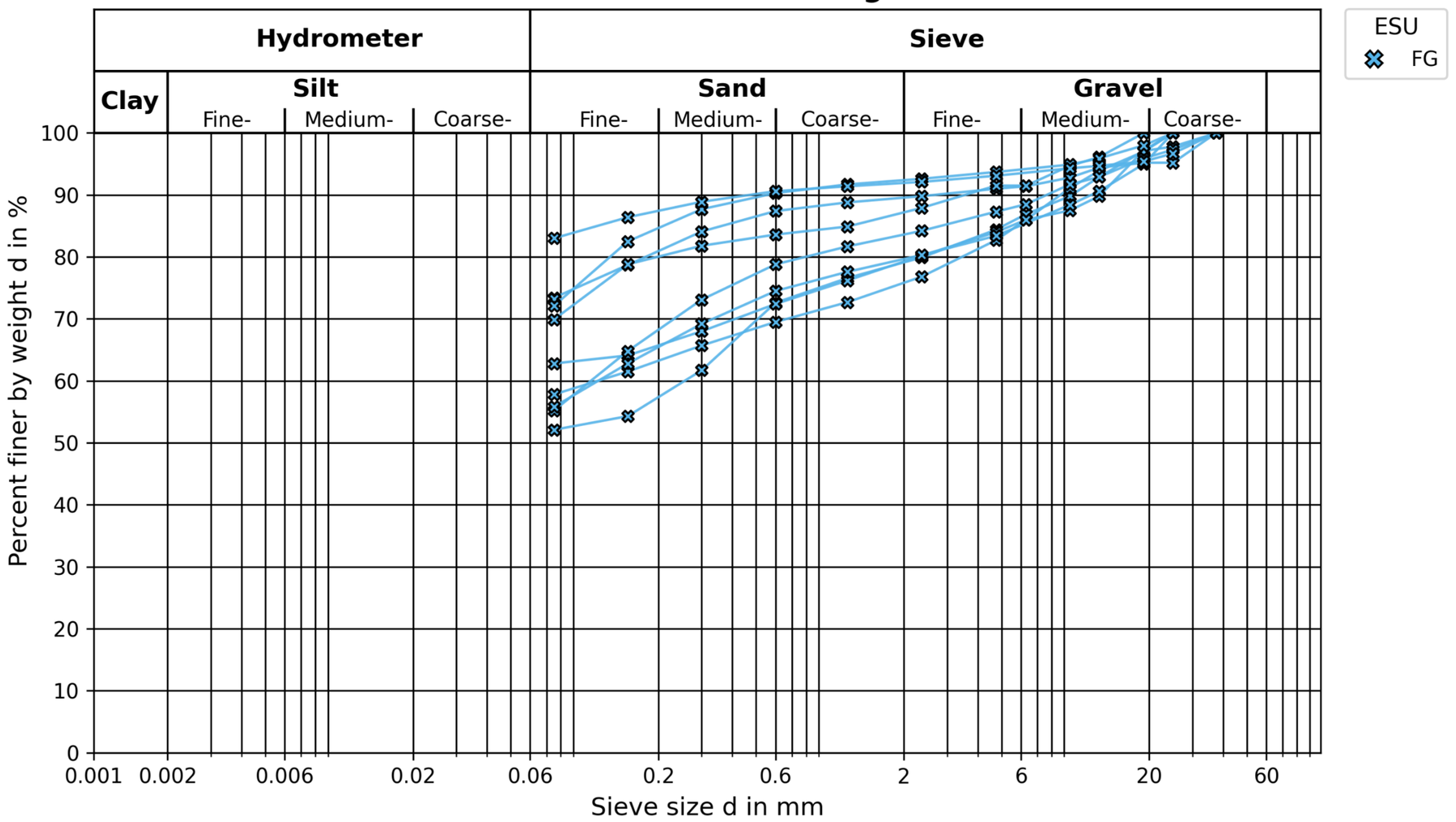
Grain Size Distribution – All Borings, ESU F

Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure **H-5**



Grain Size Distribution – All Borings, ESU FG

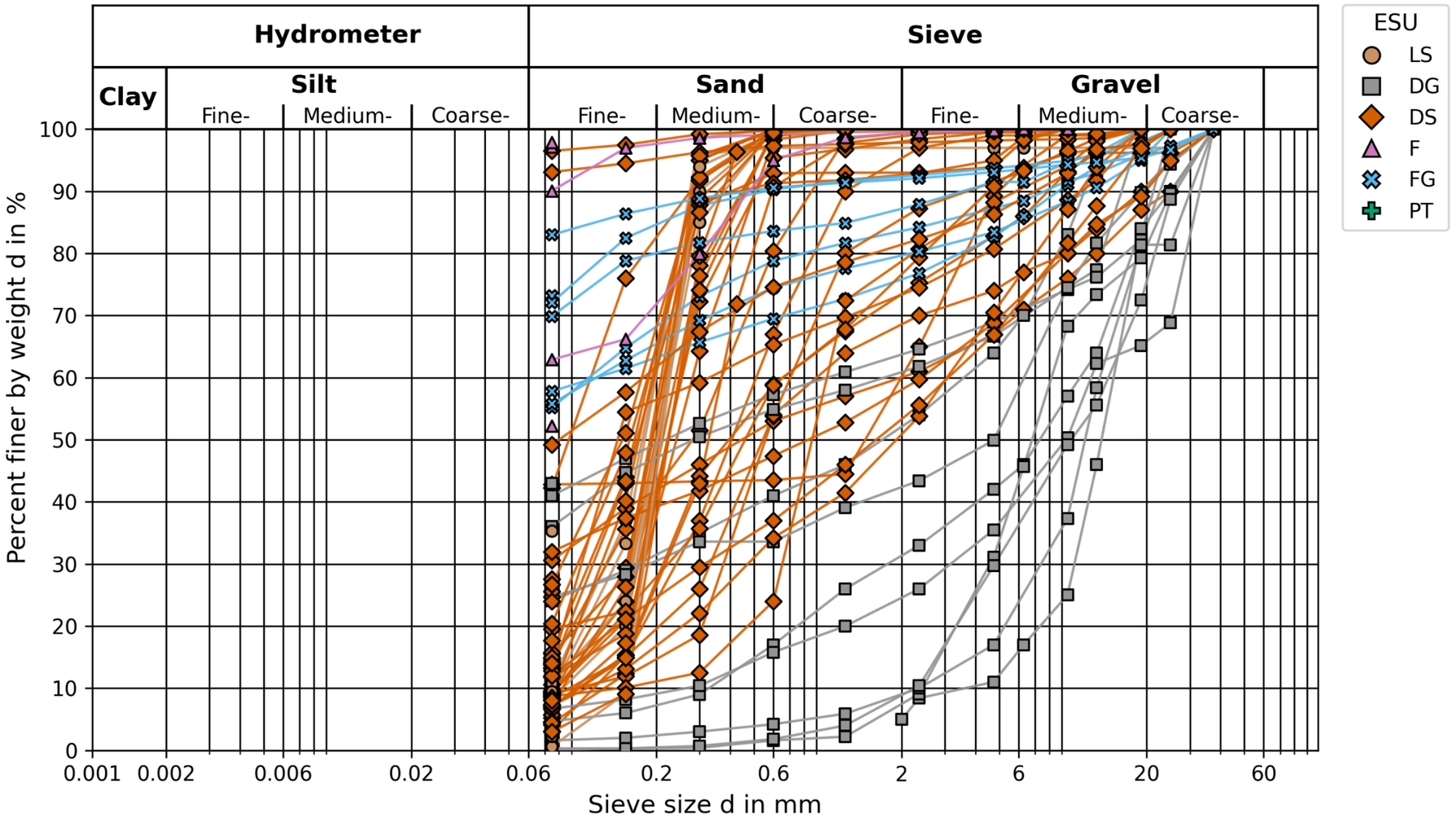
Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure **H-6**

Grain Size Distribution — Overwater Borings



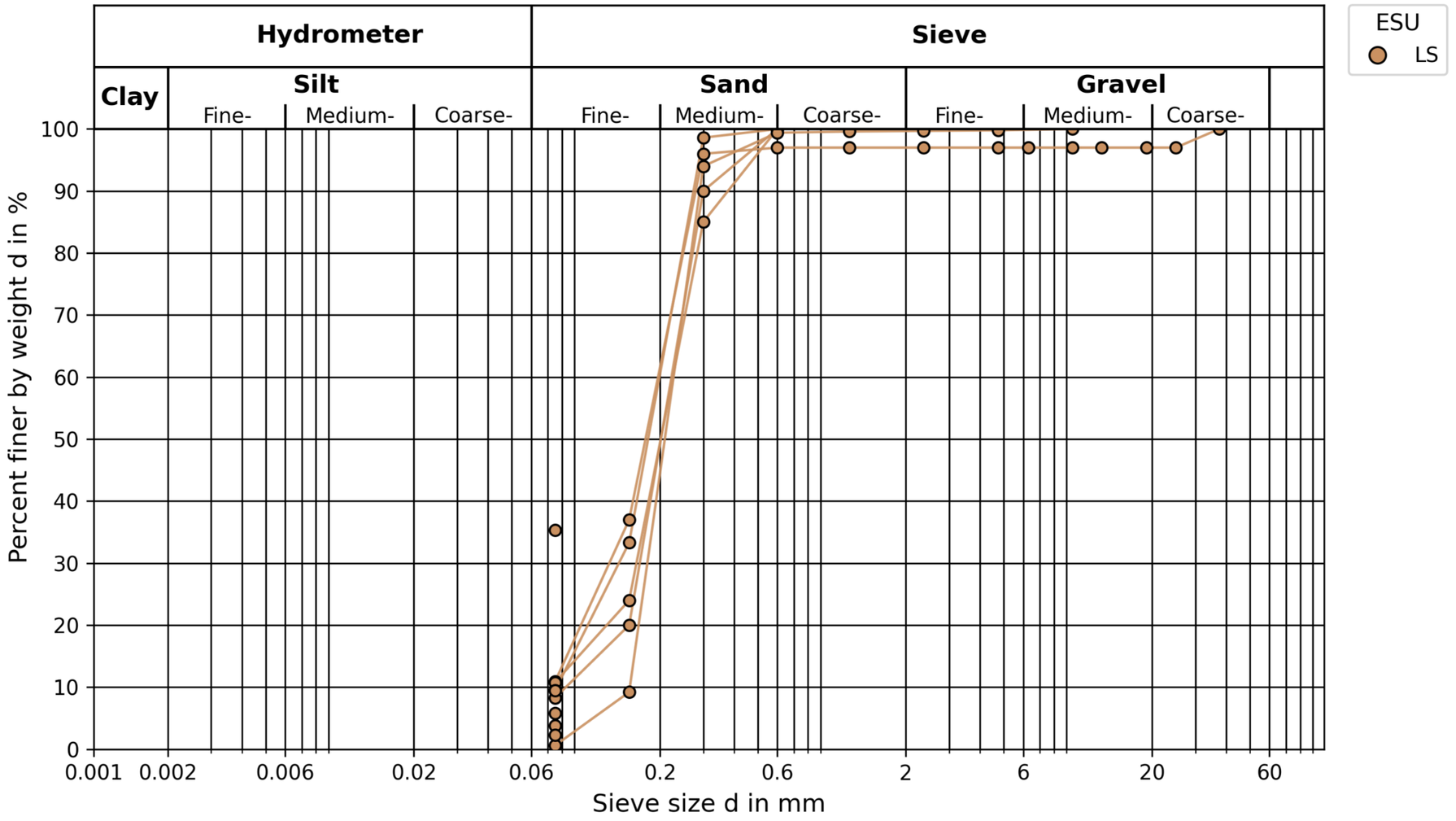
Grain Size Distribution – Overwater Borings, All ESUs

Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure H-7



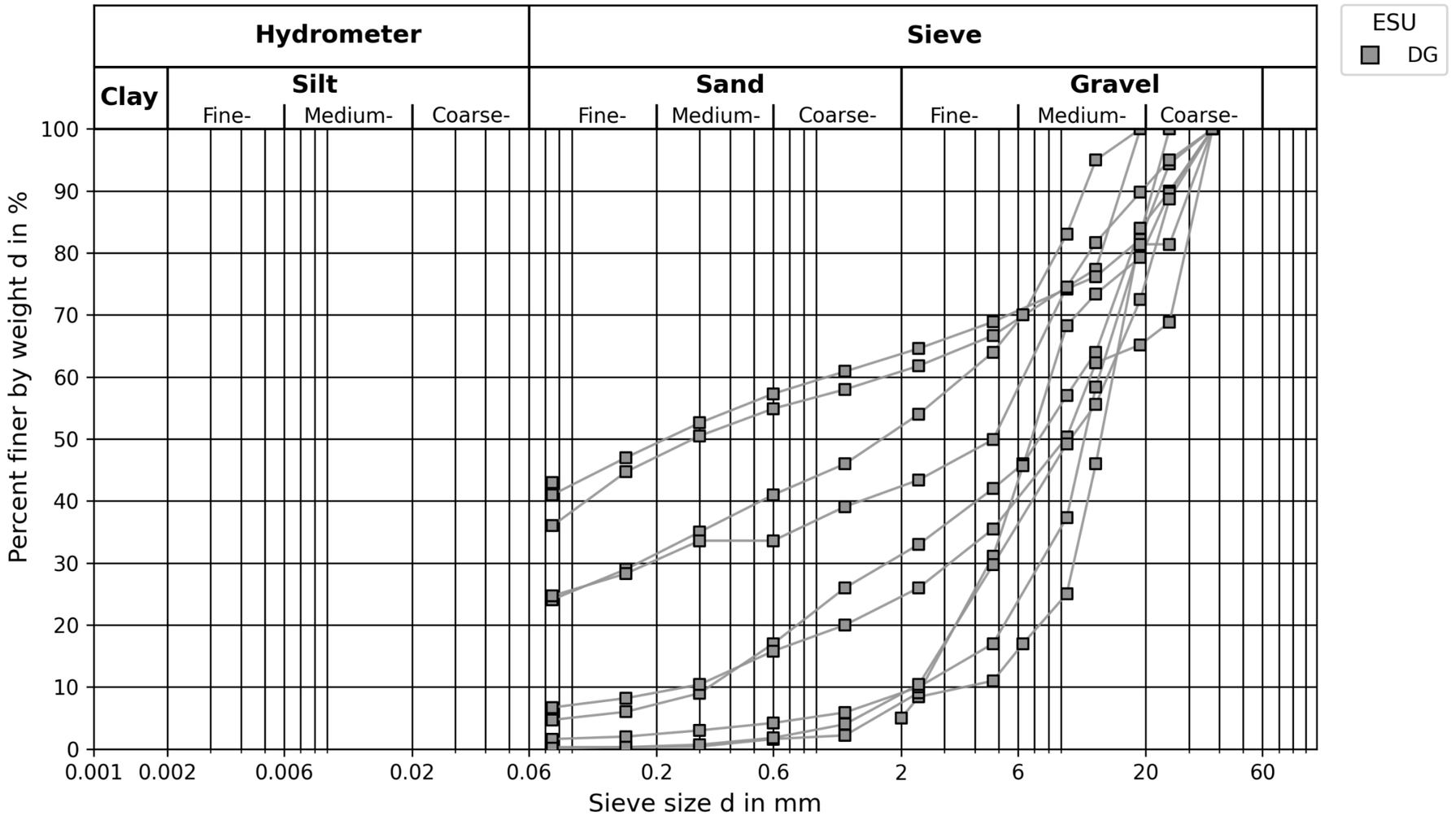
Grain Size Distribution – Overwater Borings, ESU LS

Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure
H-8



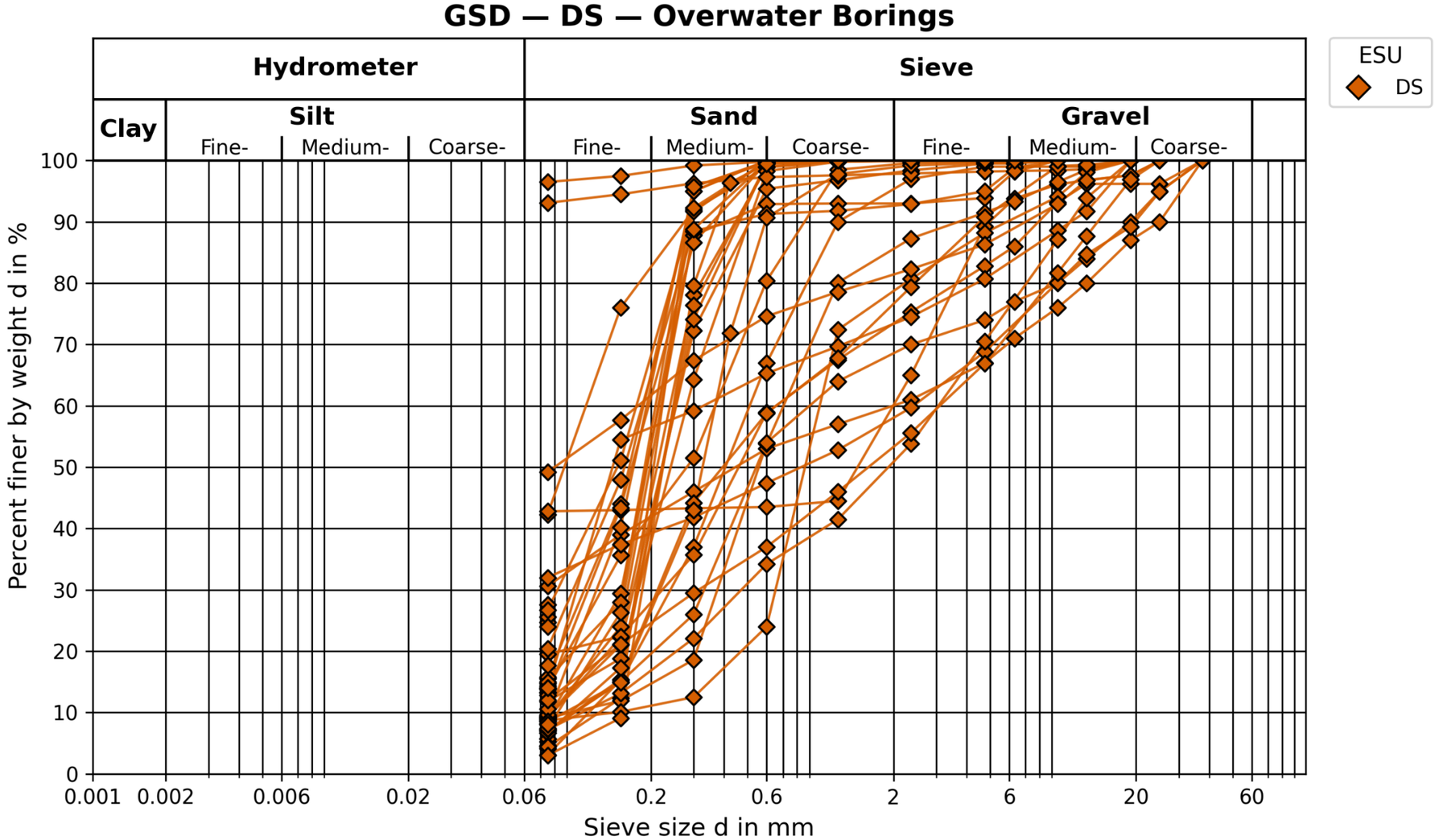
Grain Size Distribution – Overwater Borings, ESU DG

Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure H-9



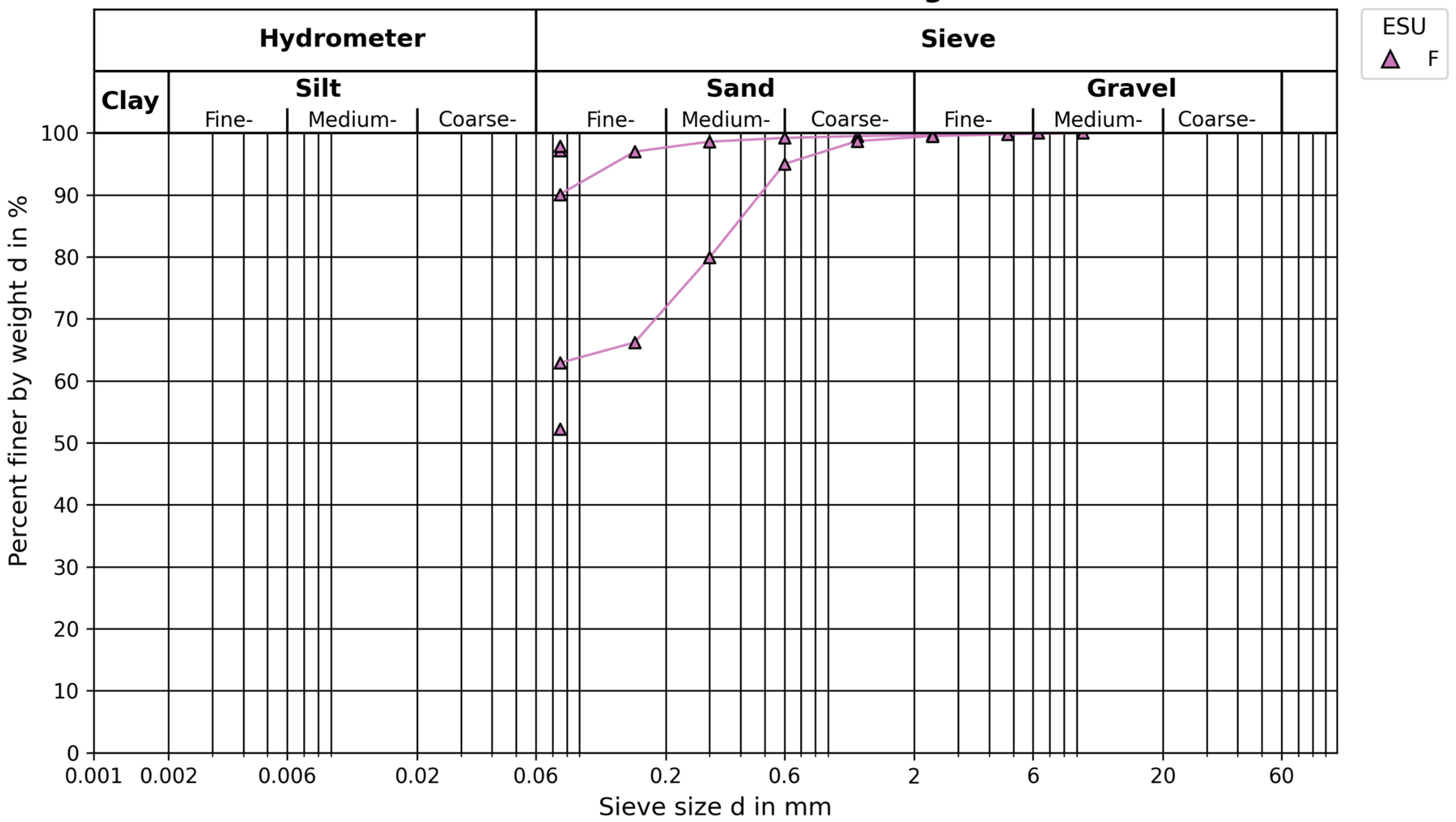
Grain Size Distribution – Overwater Borings, ESU DS

Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure **H-10**



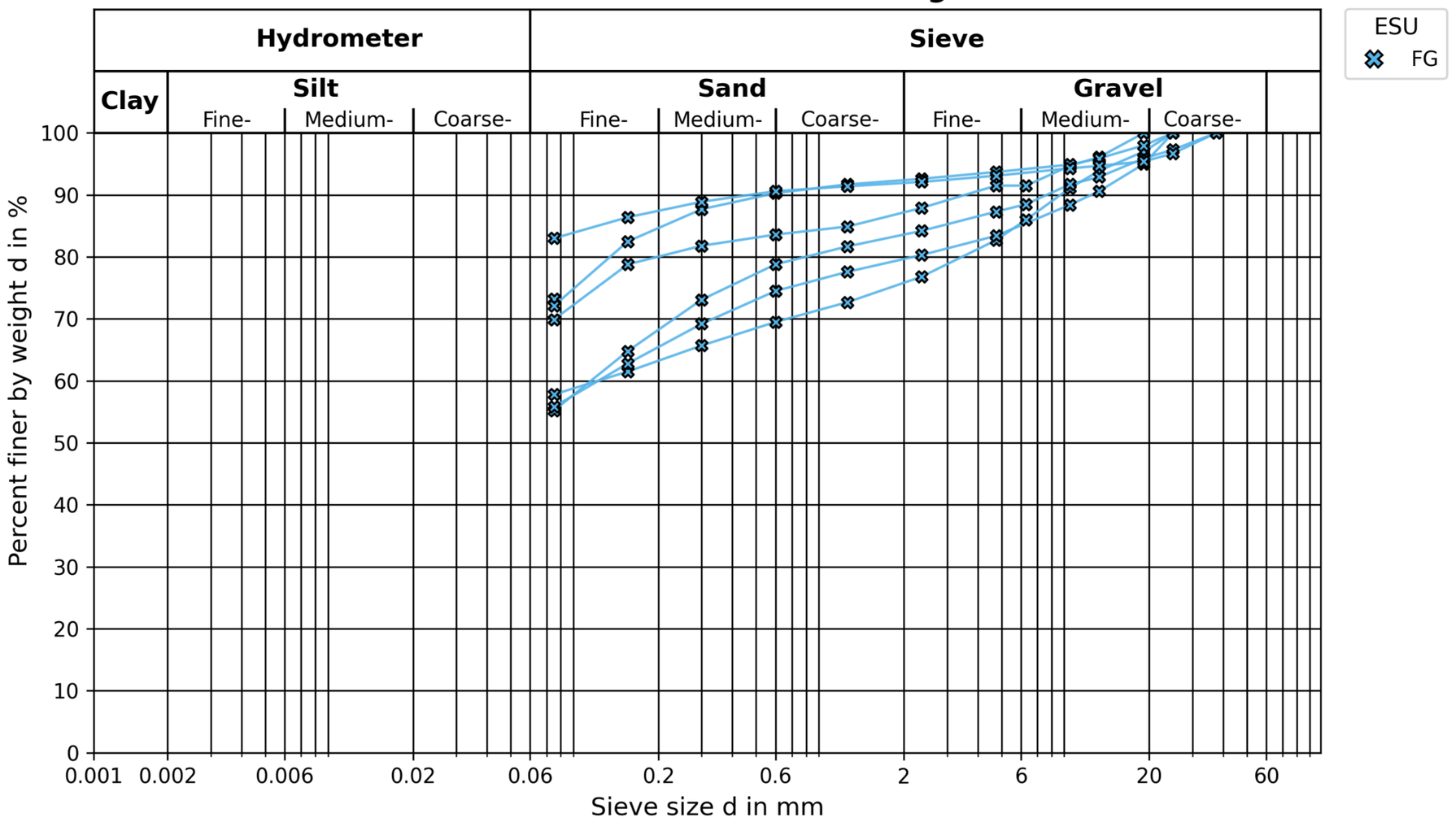
Grain Size Distribution – Overwater Borings, ESU F

Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure **H-11**



Grain Size Distribution – Overwater Borings, ESU FG

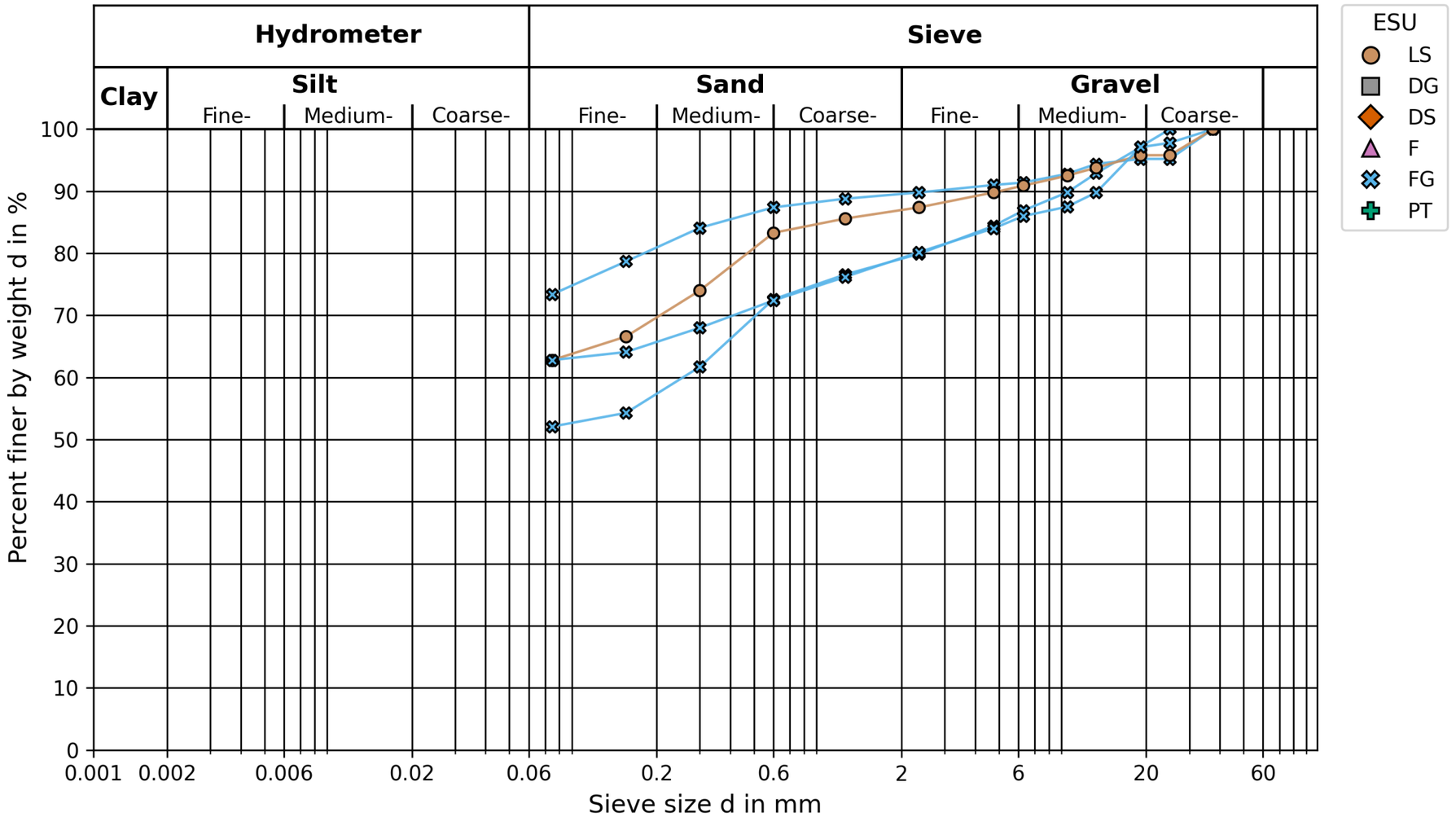
Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure **H-12**

Grain Size Distribution — Anchorage Landside Borings



Grain Size Distribution – Anchorage Landside Borings, All ESUs

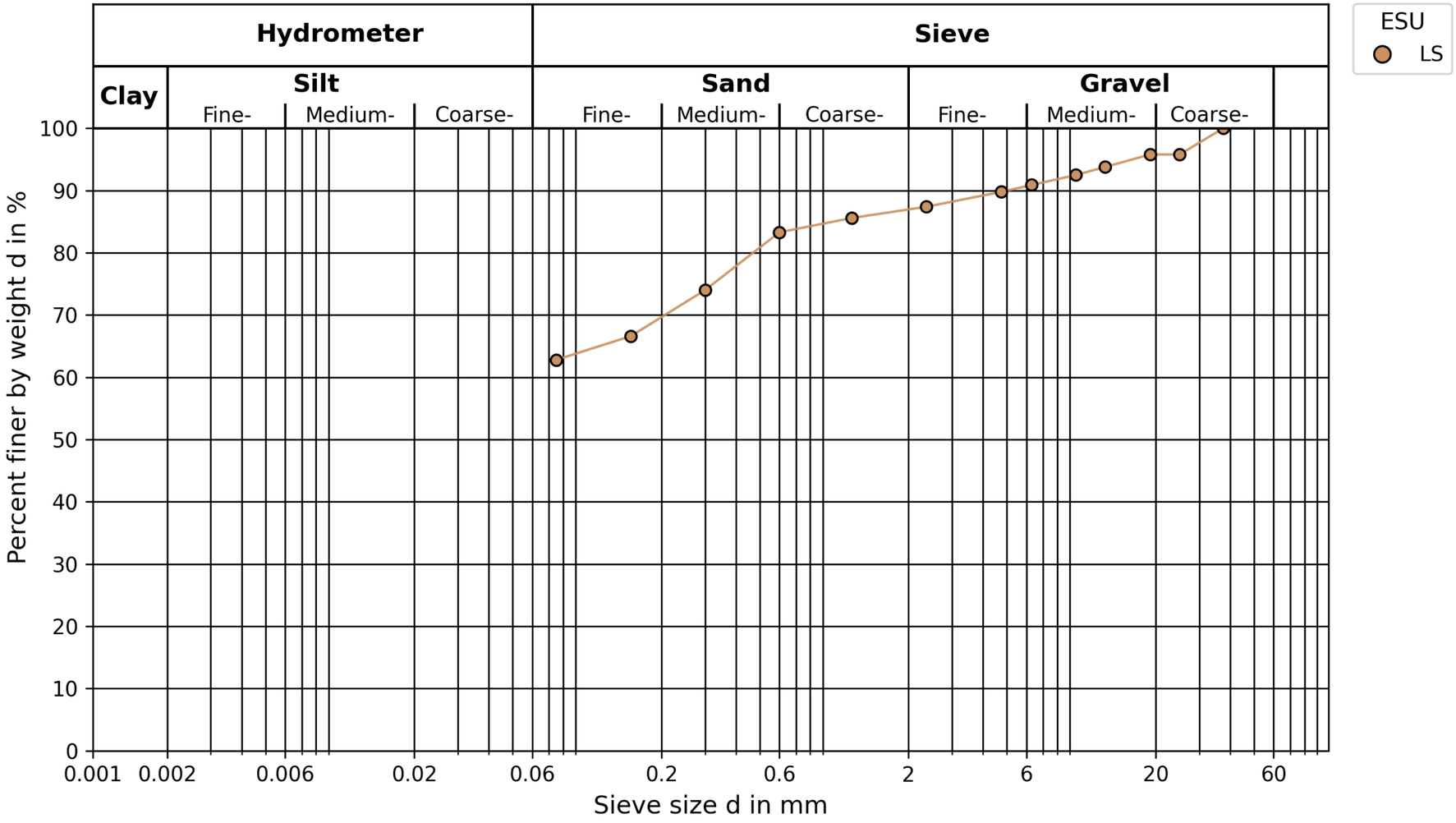
Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure **H-13**

GSD — LS — Anchorage Landside Borings



Grain Size Distribution – Anchorage Landside Borings, ESU LS

Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure **H-14**

NO DATA

Grain Size Distribution – Anchorage Landside Borings, ESU DG

Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure **H-15**

NO DATA

Grain Size Distribution – Anchorage Landside Borings, ESU DS

Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure

H-16

NO DATA

Grain Size Distribution – Anchorage Landside Borings, ESU F

Knik Arm Tunnel Feasibility Study

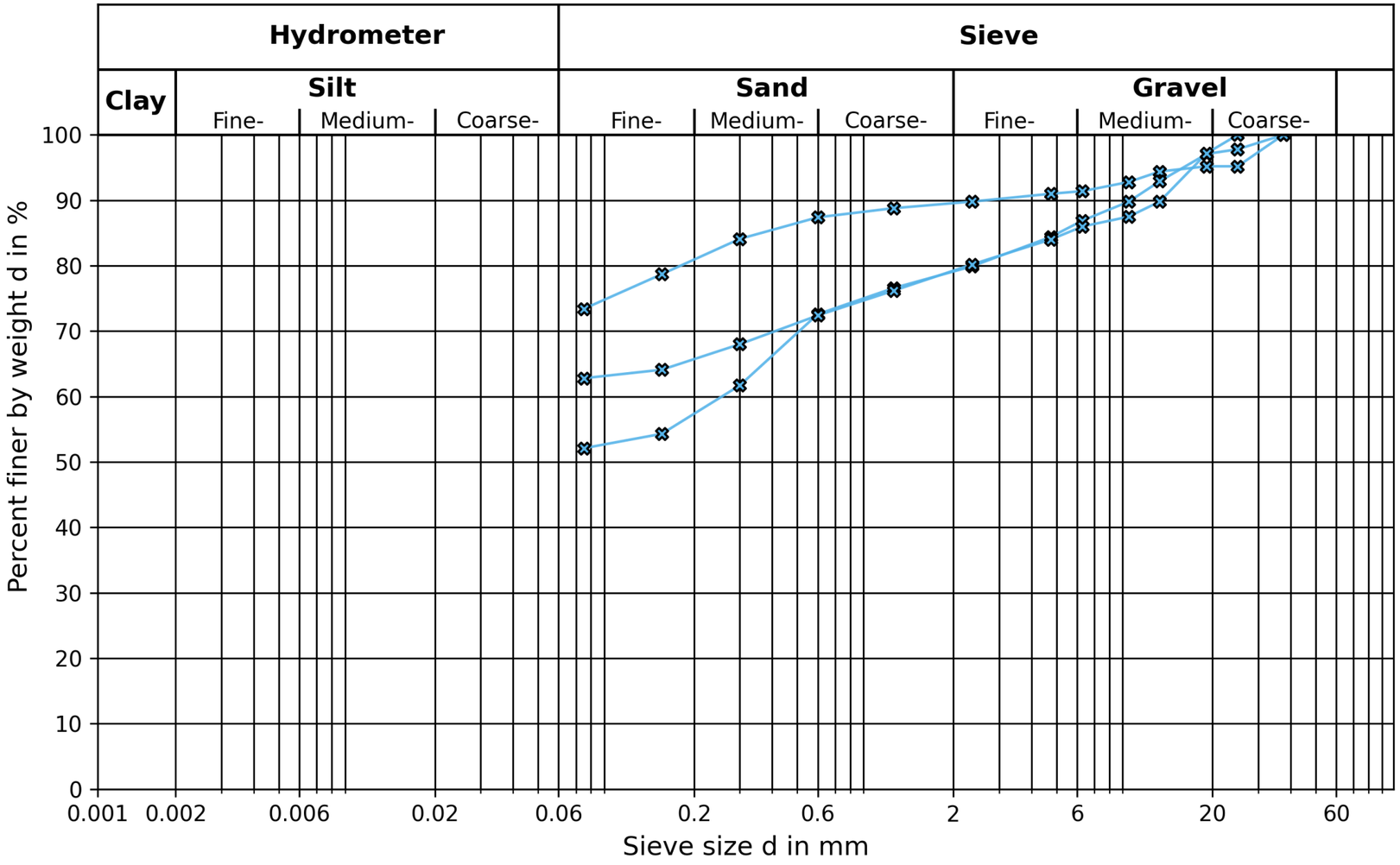
EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure

H-17

GSD — FG — Anchorage Landside Borings



Grain Size Distribution – Anchorage Landside Borings, ESU FG

Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure **H-18**

NO DATA

Grain Size Distribution – Point MacKenzie Landside Borings, All ESUs

Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure

H-19

NO DATA

Grain Size Distribution – Point MacKenzie Landside Borings, ESU LS

Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure

H-20

NO DATA

Grain Size Distribution – Point MacKenzie Landside Borings, ESU DG

Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure

H-21

NO DATA

Grain Size Distribution – Point MacKenzie Landside Borings, ESU DS

Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure

H-22

NO DATA

Grain Size Distribution – Point MacKenzie Landside Borings, ESU F

Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure

H-23

NO DATA

Grain Size Distribution – Point MacKenzie Landside Borings, ESU FG

Knik Arm Tunnel Feasibility Study

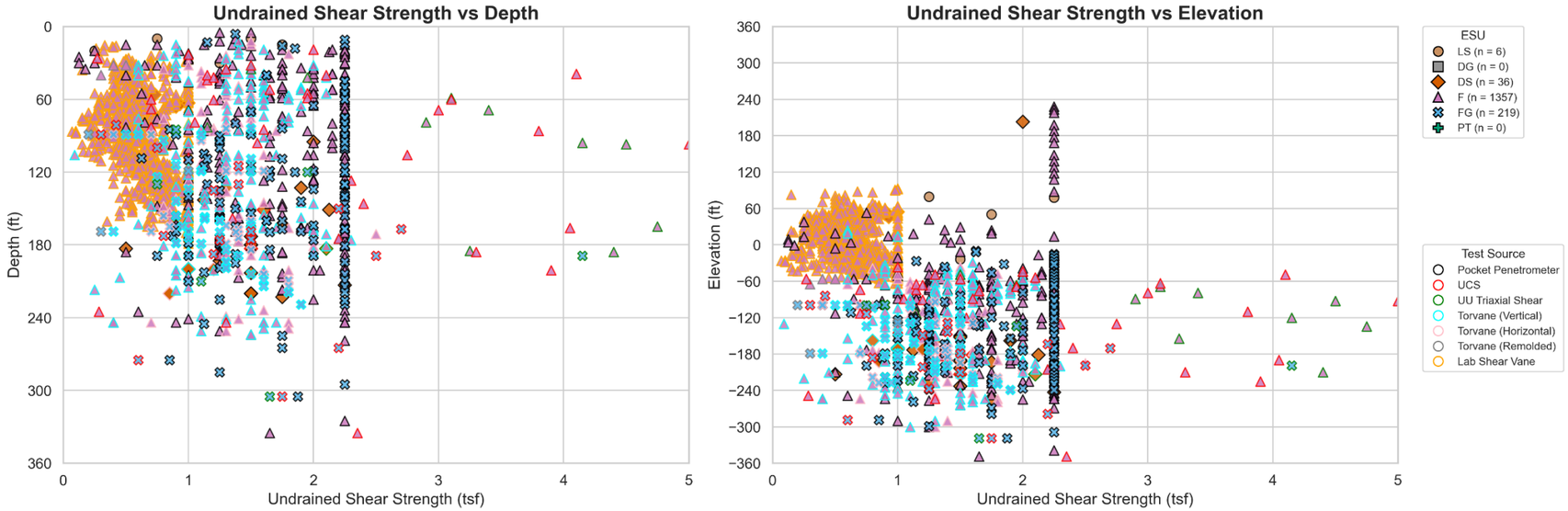
EMPRISE CONCEPTS

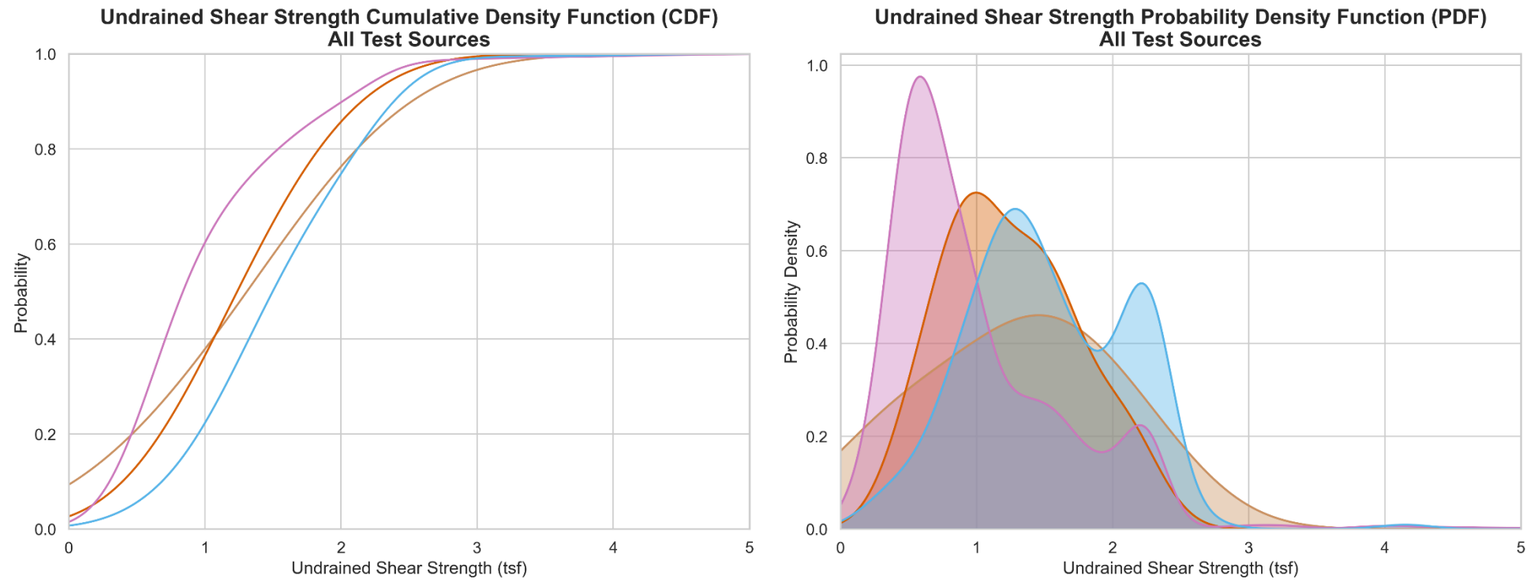
Anchorage, Alaska | August 2025

Figure

H-24

All Borings





Undrained Shear Strength – All Borings, All ESUs

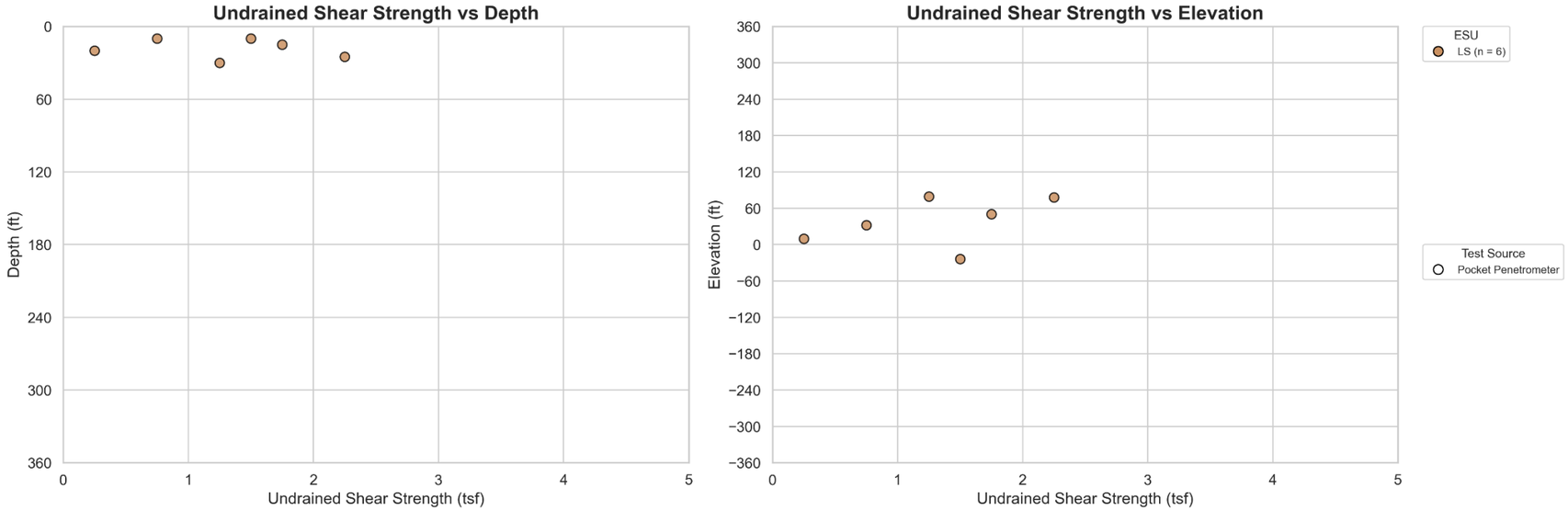
Knik Arm Tunnel Feasibility Study

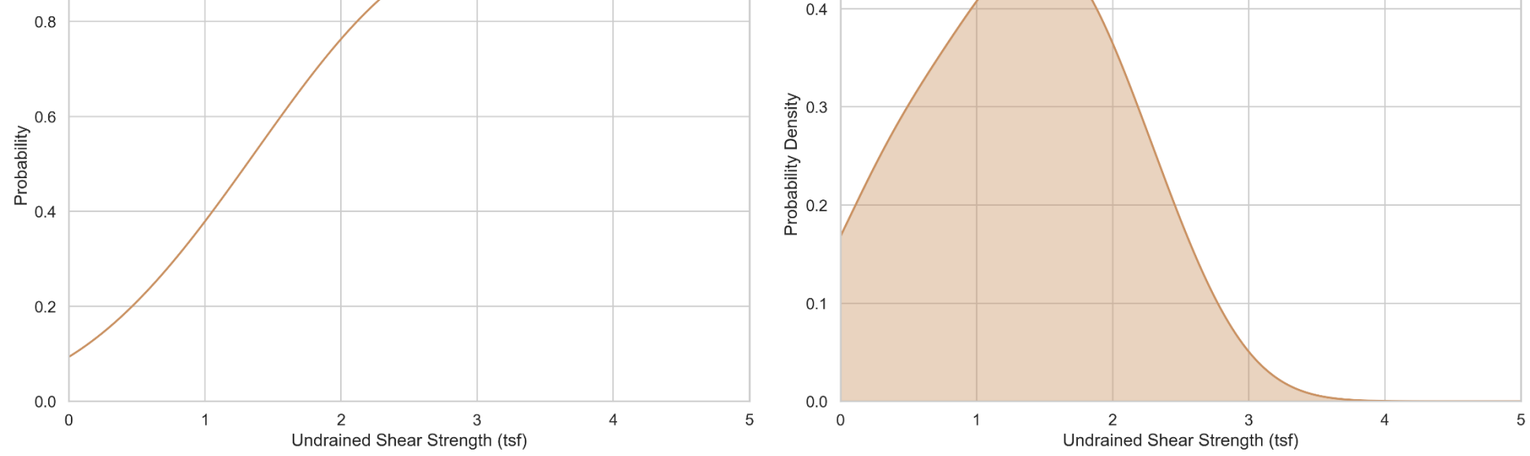
EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure I-1

LS (n = 6) - All Borings





Undrained Shear Strength – All Borings, ESU LS

Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure I-2

NO DATA

Undrained Shear Strength – All Borings, ESU DG

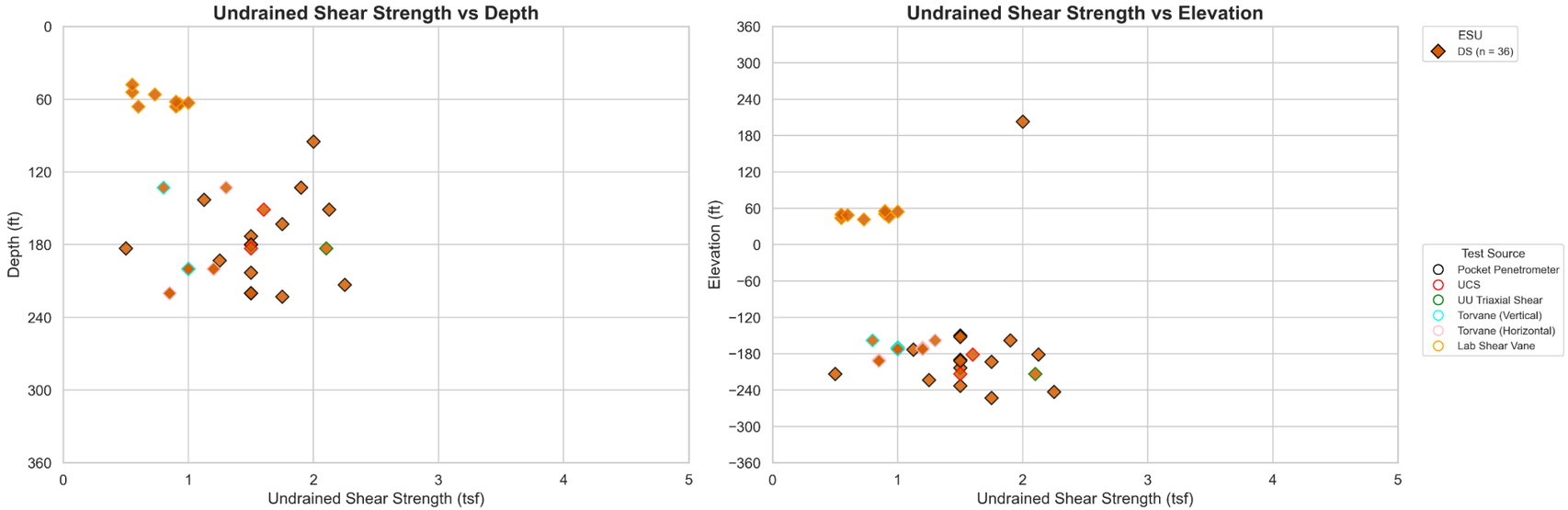
Knik Arm Tunnel Feasibility Study

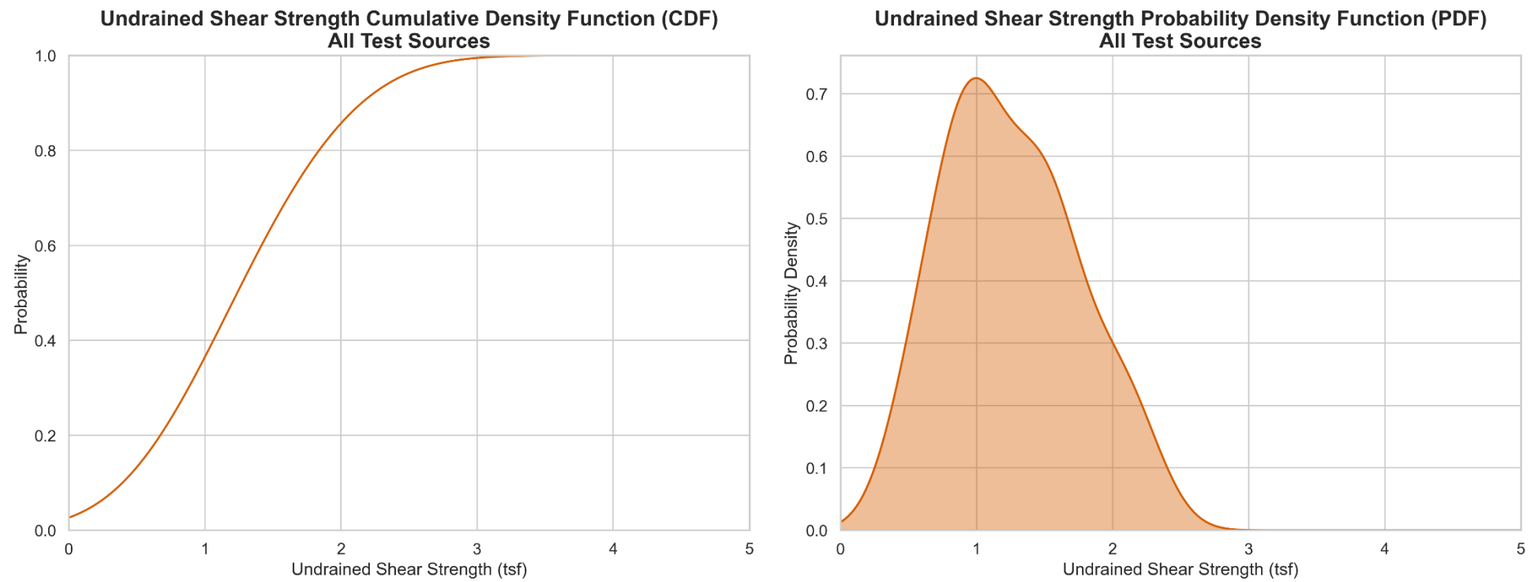
EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure
I-3

DS (n = 36) - All Borings





Undrained Shear Strength – All Borings, ESU DS

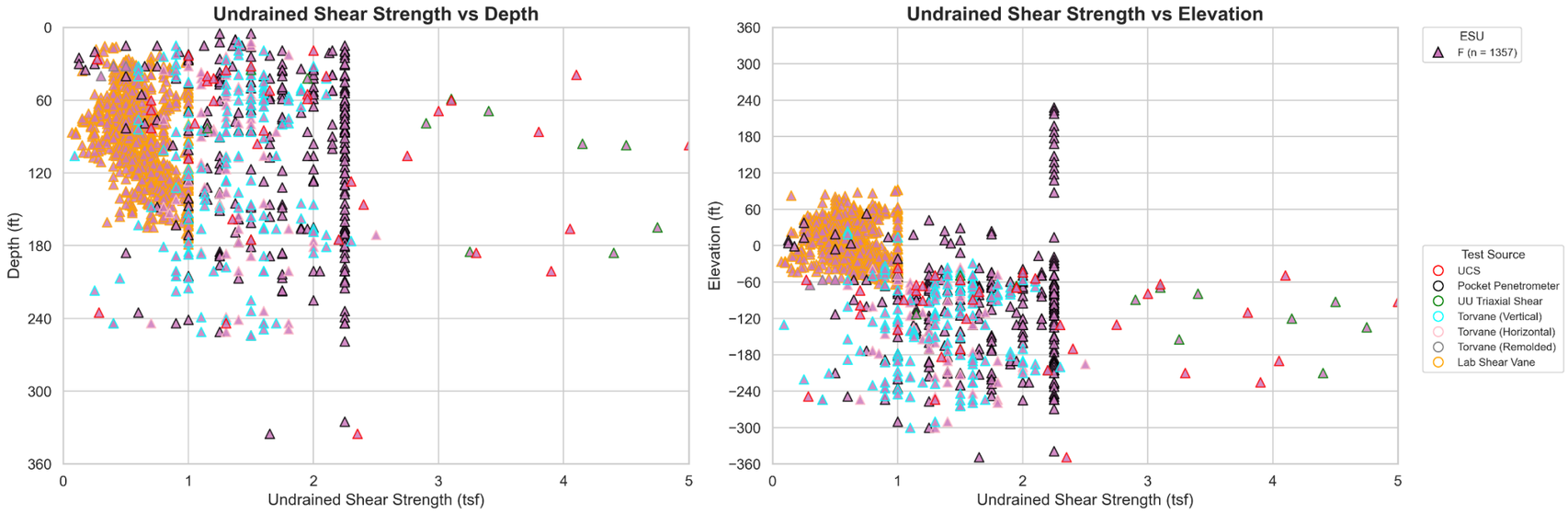
Knik Arm Tunnel Feasibility Study

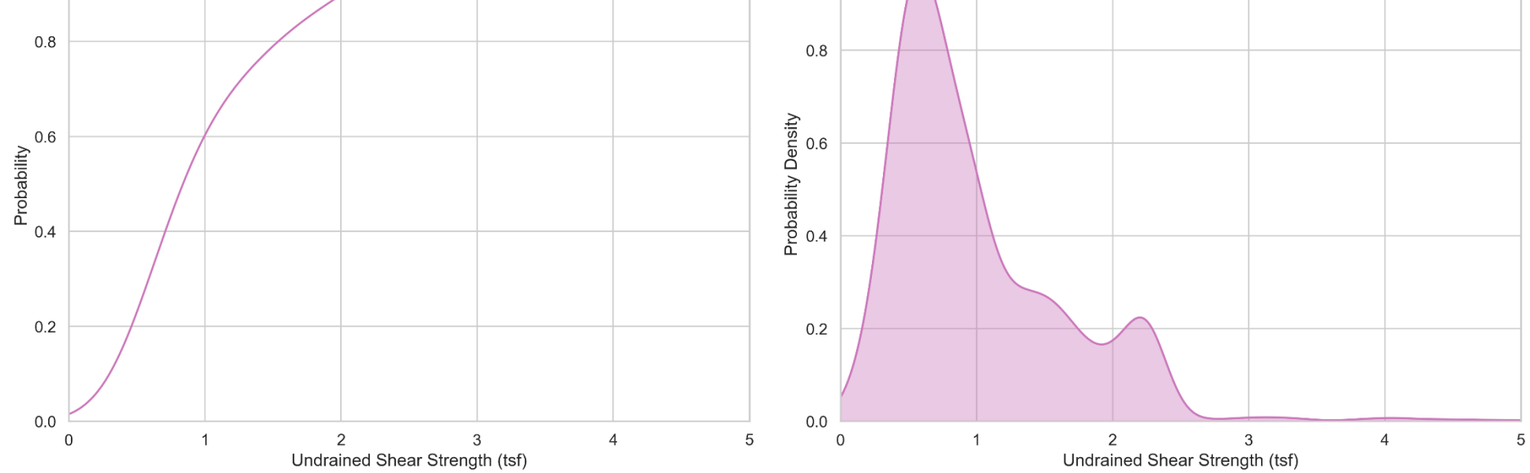
EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure
I-4

F (n = 1357) - All Borings





Undrained Shear Strength – All Borings, ESU F

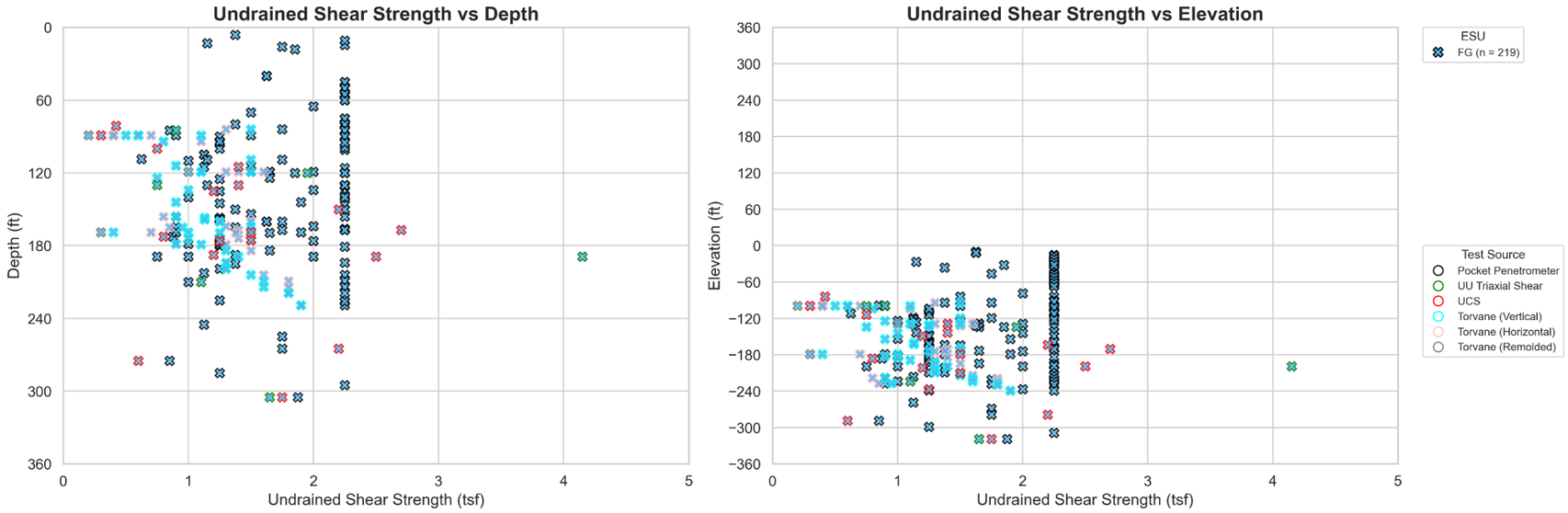
Knik Arm Tunnel Feasibility Study

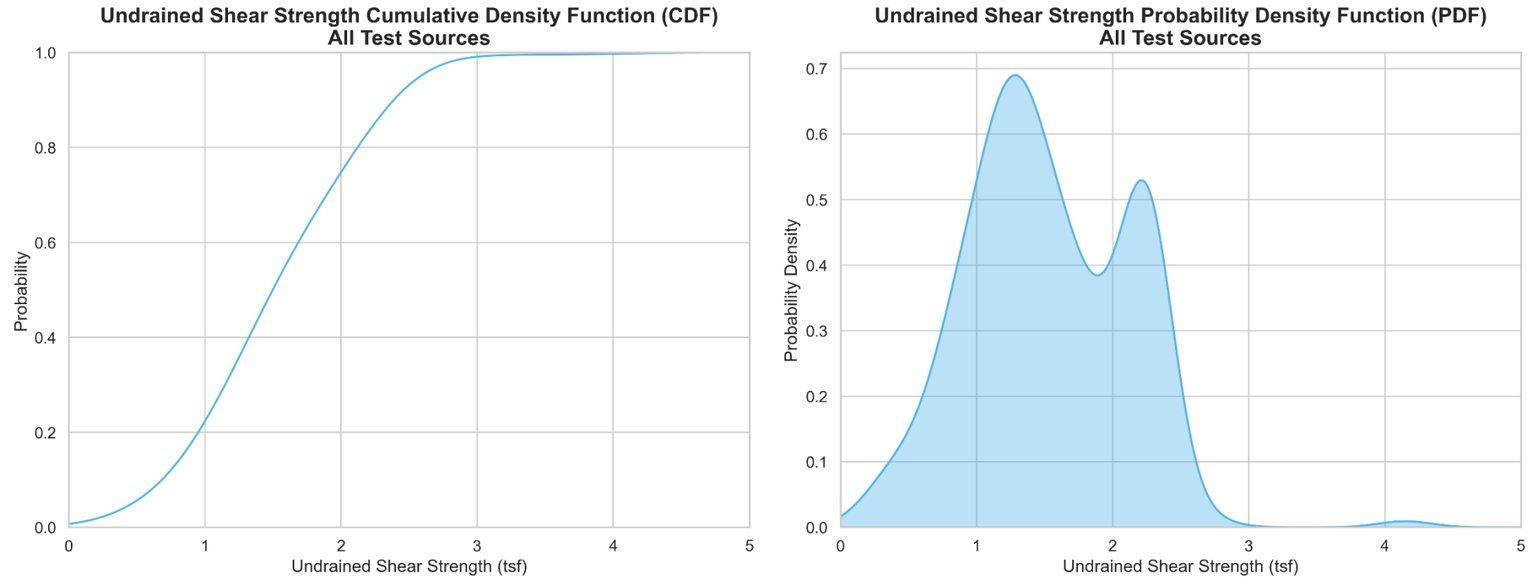
EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure I-5

FG (n = 219) - All Borings





Undrained Shear Strength – All Borings, ESU FG

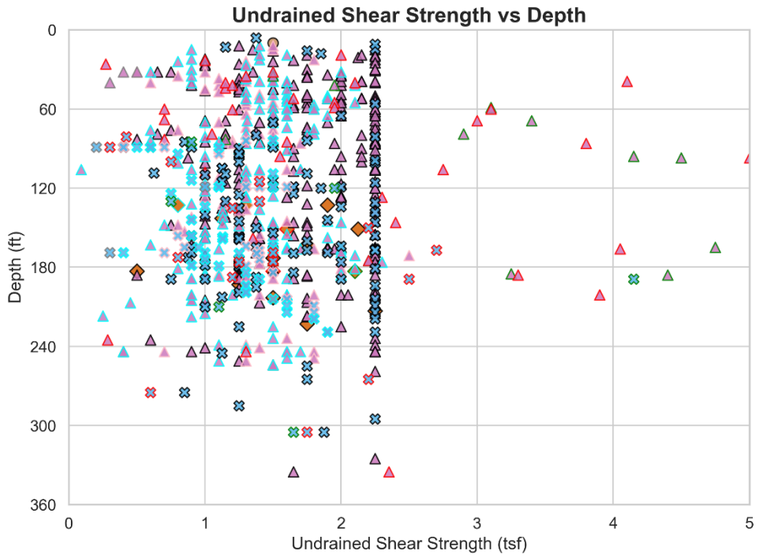
Knik Arm Tunnel Feasibility Study

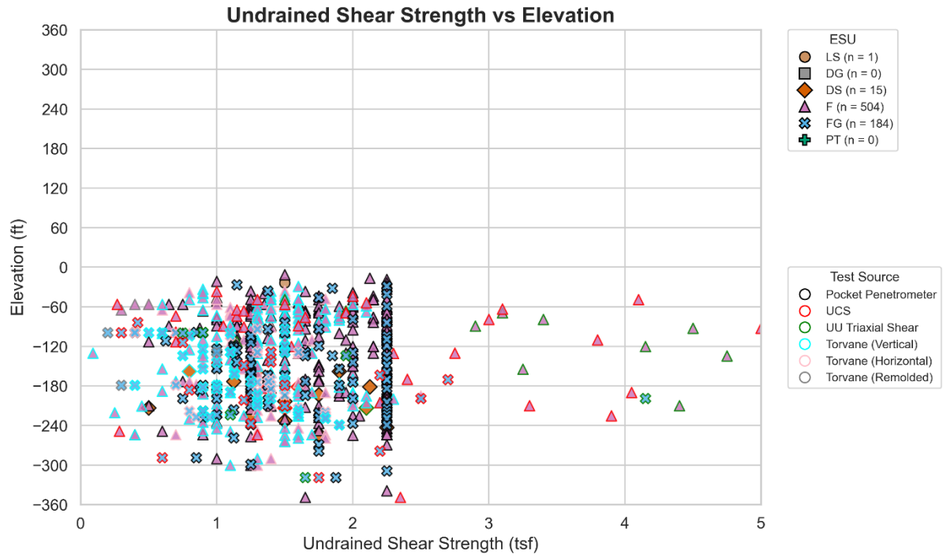
EMPRISE CONCEPTS

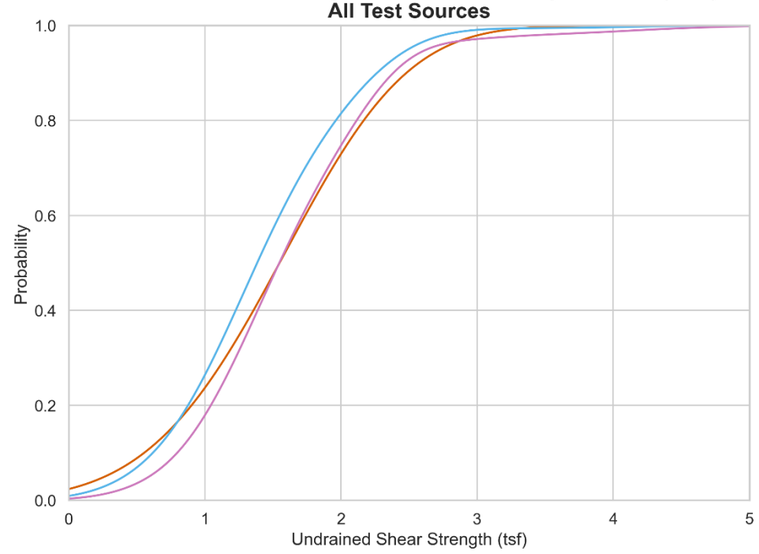
Anchorage, Alaska | August 2025

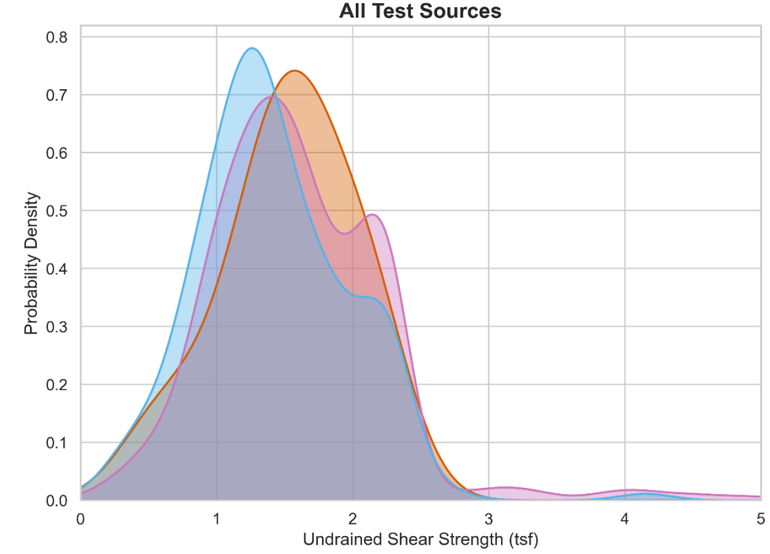
Figure
I-6

Overwater Borings









Undrained Shear Strength – Overwater Borings, All ESUs

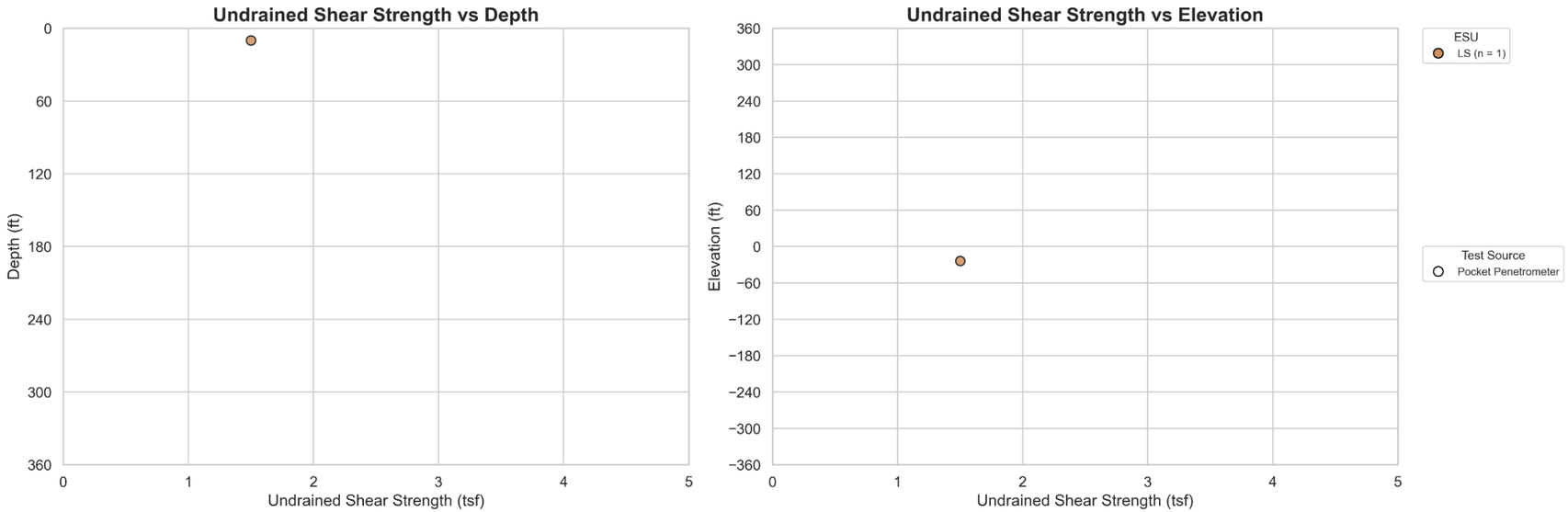
Knik Arm Tunnel Feasibility Study

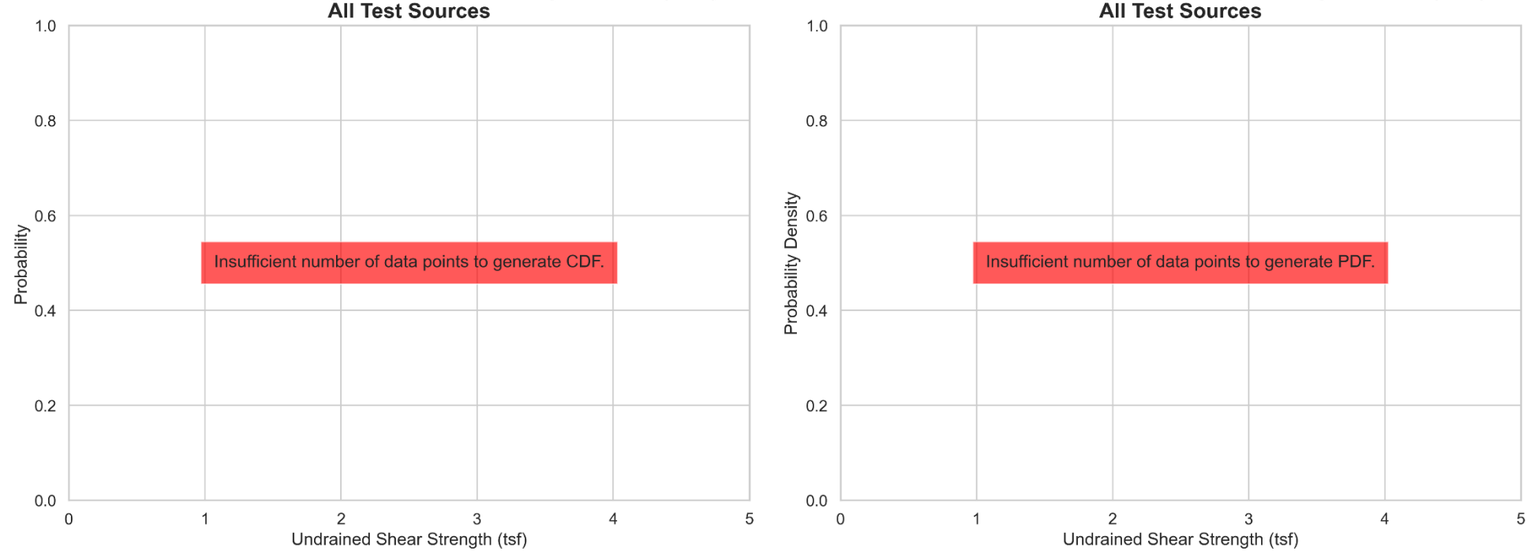
EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure I-7

LS (n = 1) - Overwater Borings





Undrained Shear Strength – Overwater Borings, ESU LS

Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure
I-8

NO DATA

Undrained Shear Strength – Overwater Borings, ESU DG

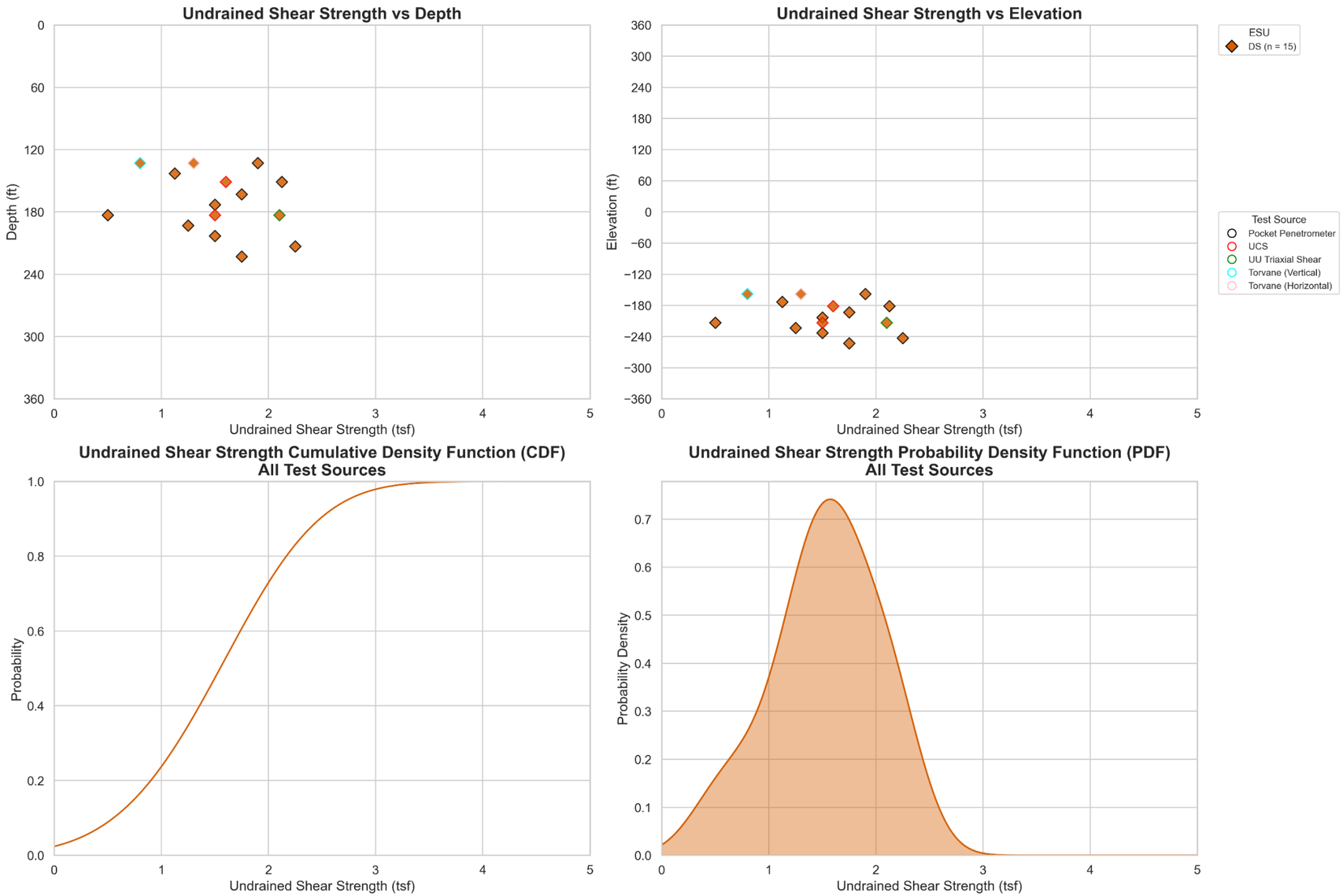
Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure
I-9

DS (n = 15) - Overwater Borings



Undrained Shear Strength – Overwater Borings, ESU DS

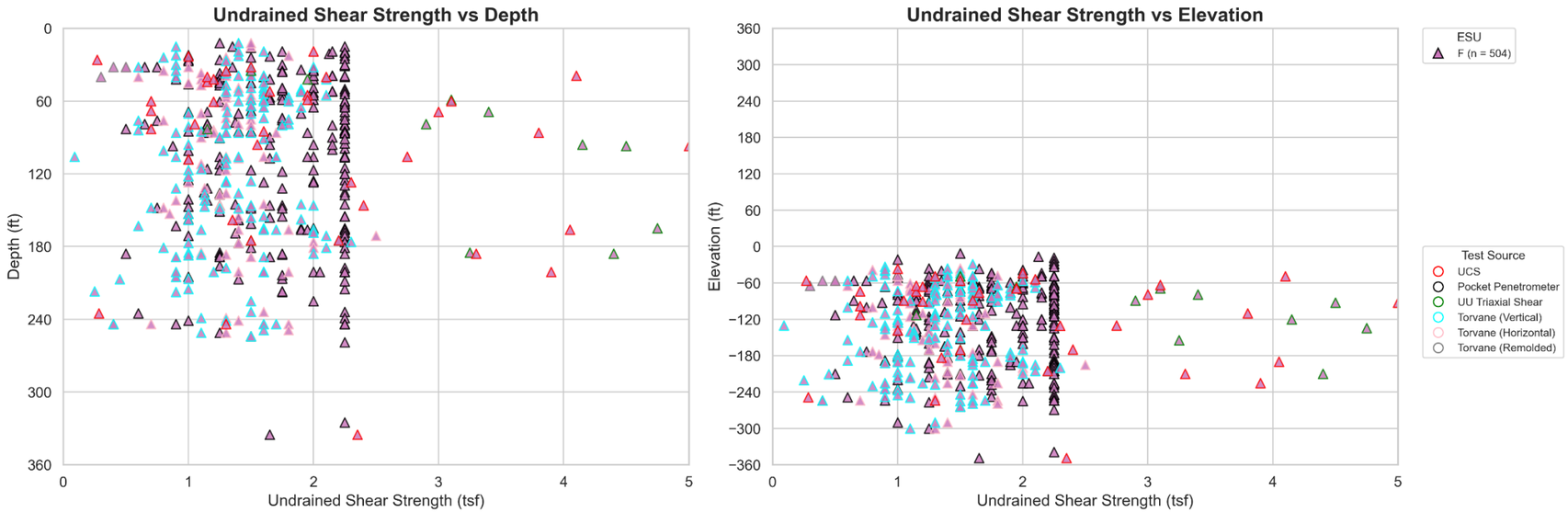
Knik Arm Tunnel Feasibility Study

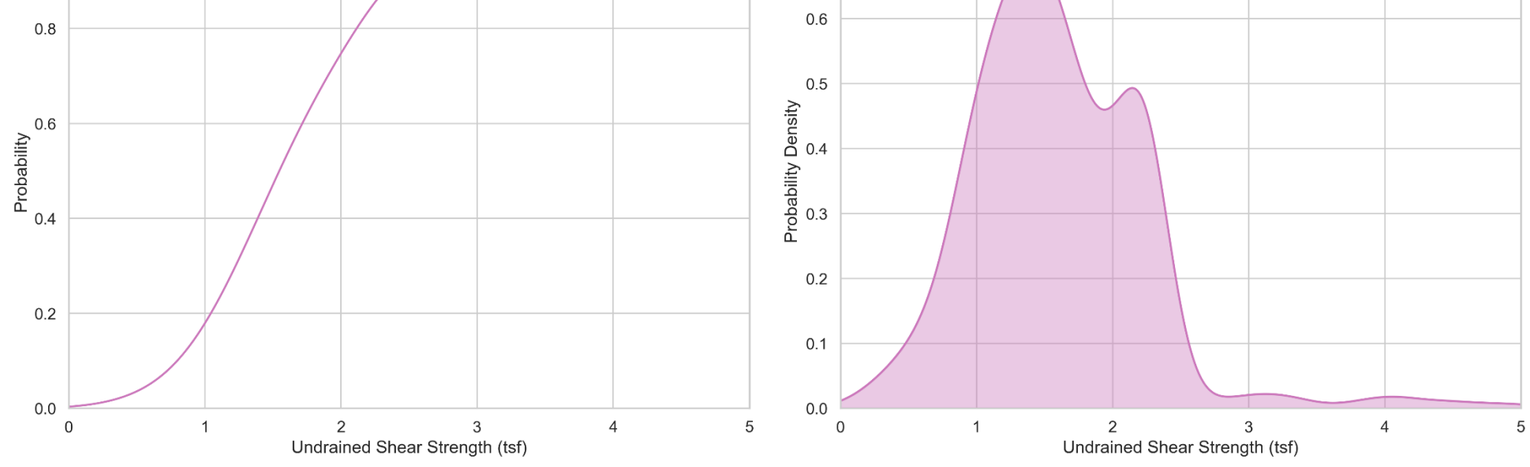
EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure
I-10

F (n = 504) - Overwater Borings





Undrained Shear Strength – Overwater Borings, ESU F

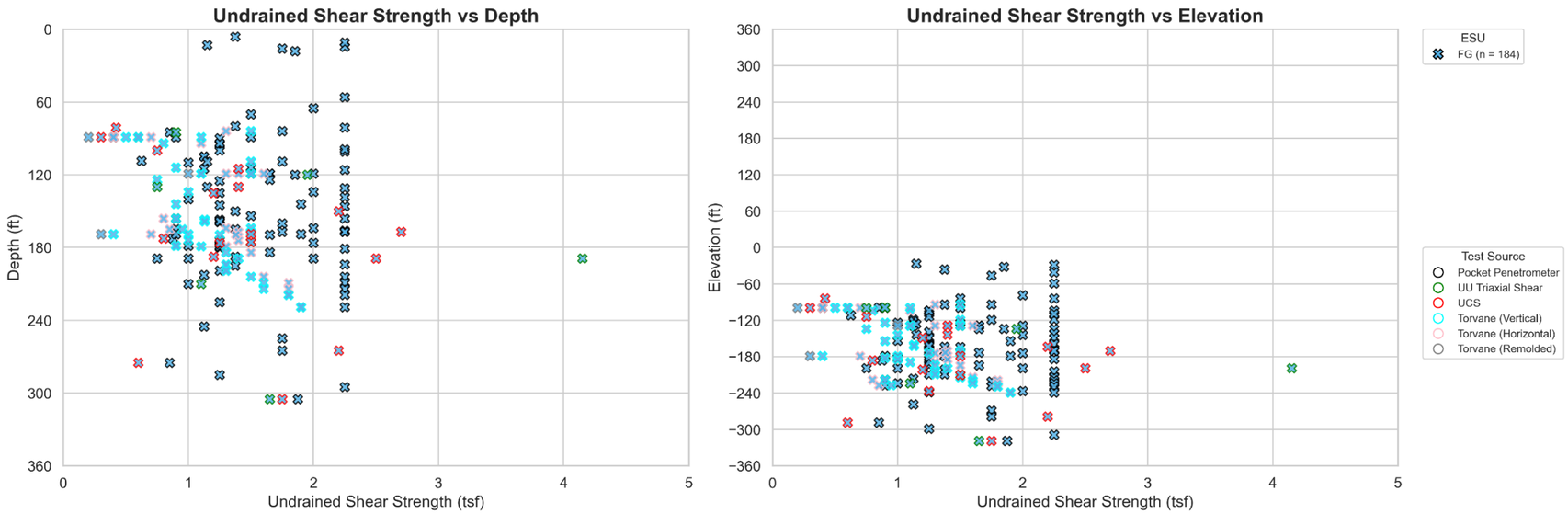
Knik Arm Tunnel Feasibility Study

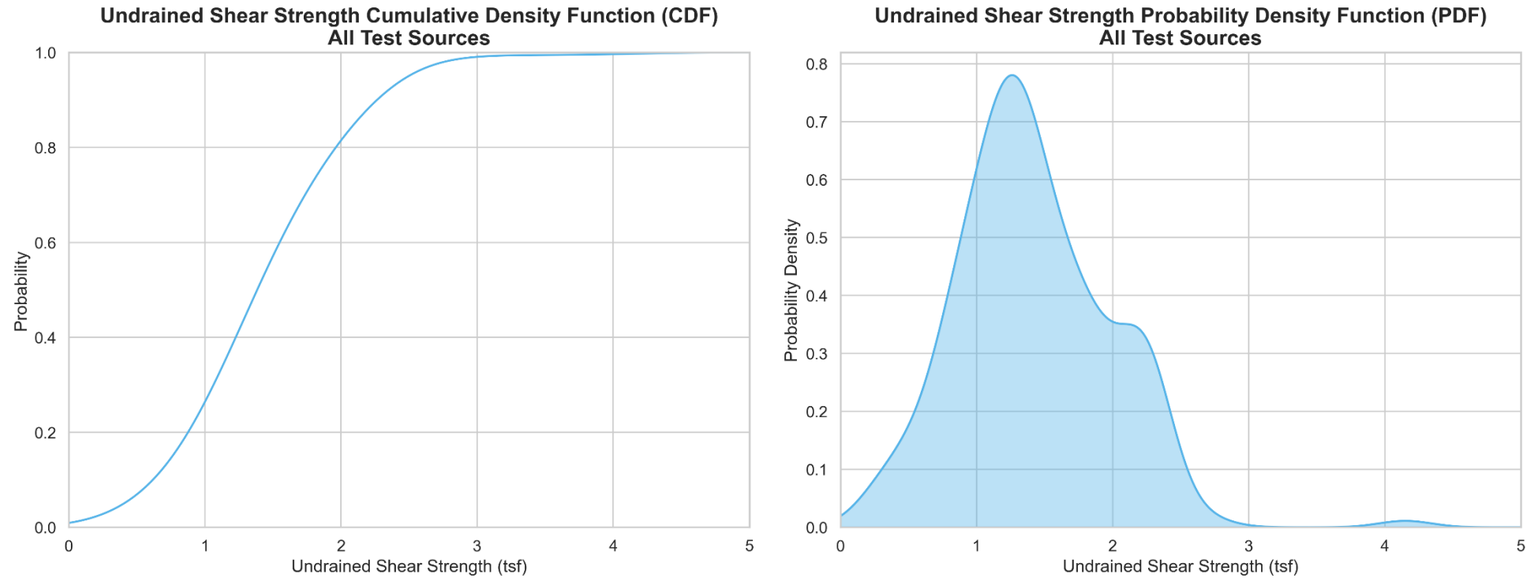
EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure I-11

FG (n = 184) - Overwater Borings





Undrained Shear Strength – Overwater Borings, ESU FG

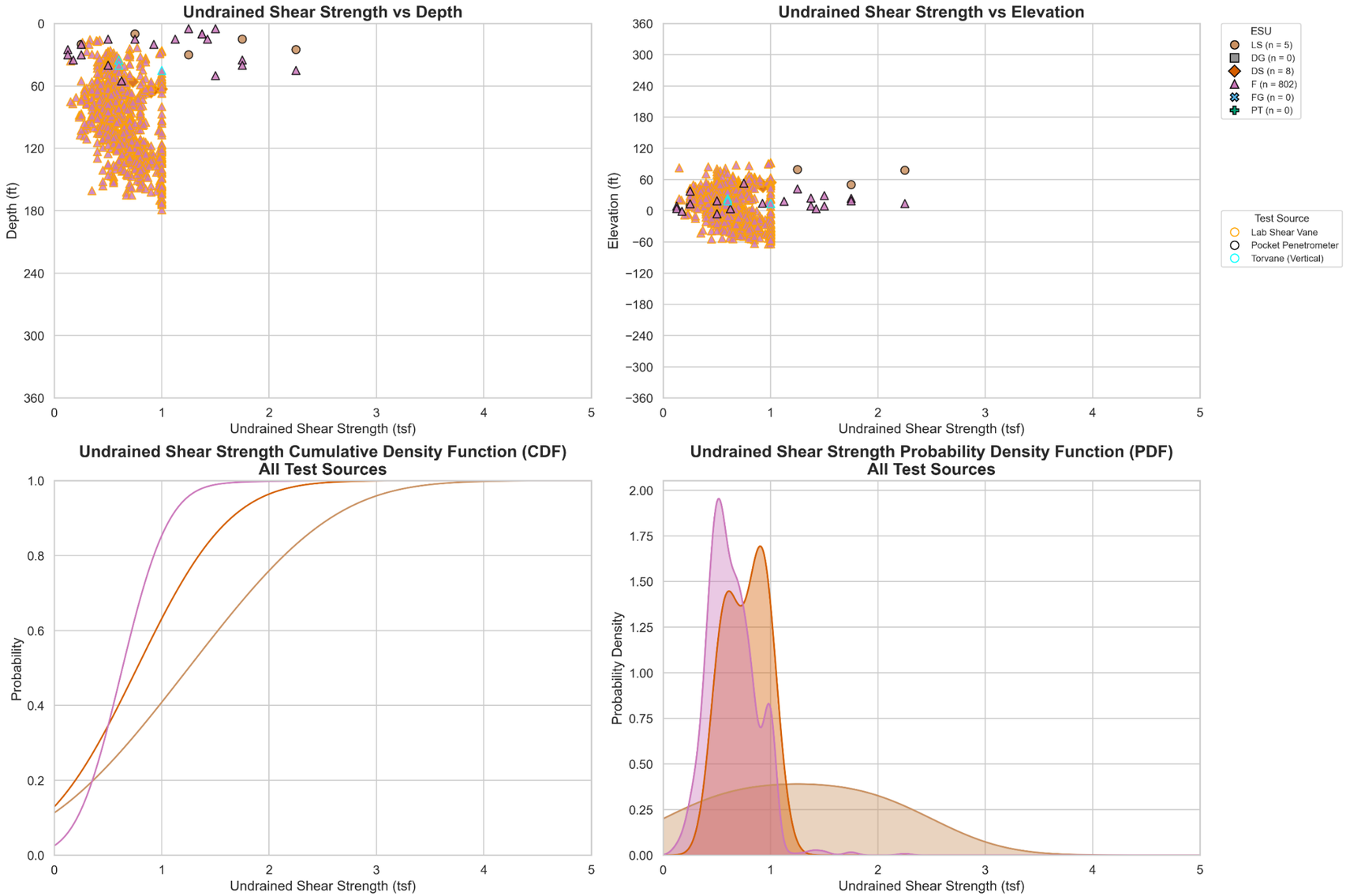
Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure
I-12

Anchorage Landside Borings



Undrained Shear Strength – Anchorage Landside Borings, All ESUs

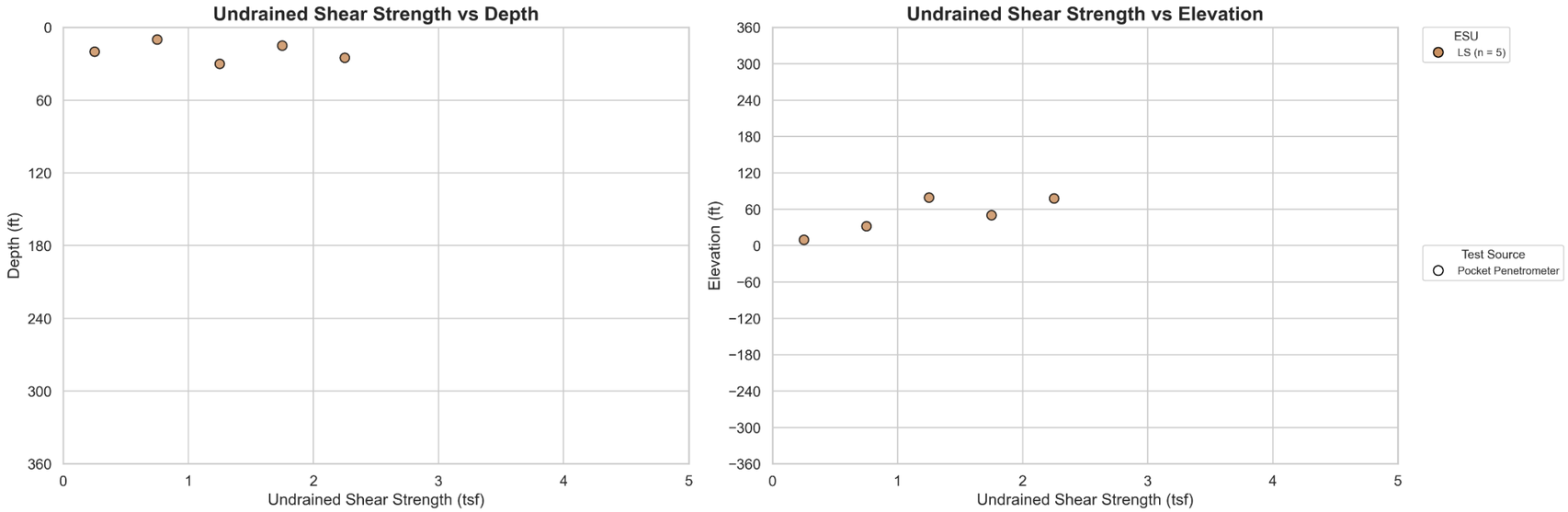
Knik Arm Tunnel Feasibility Study

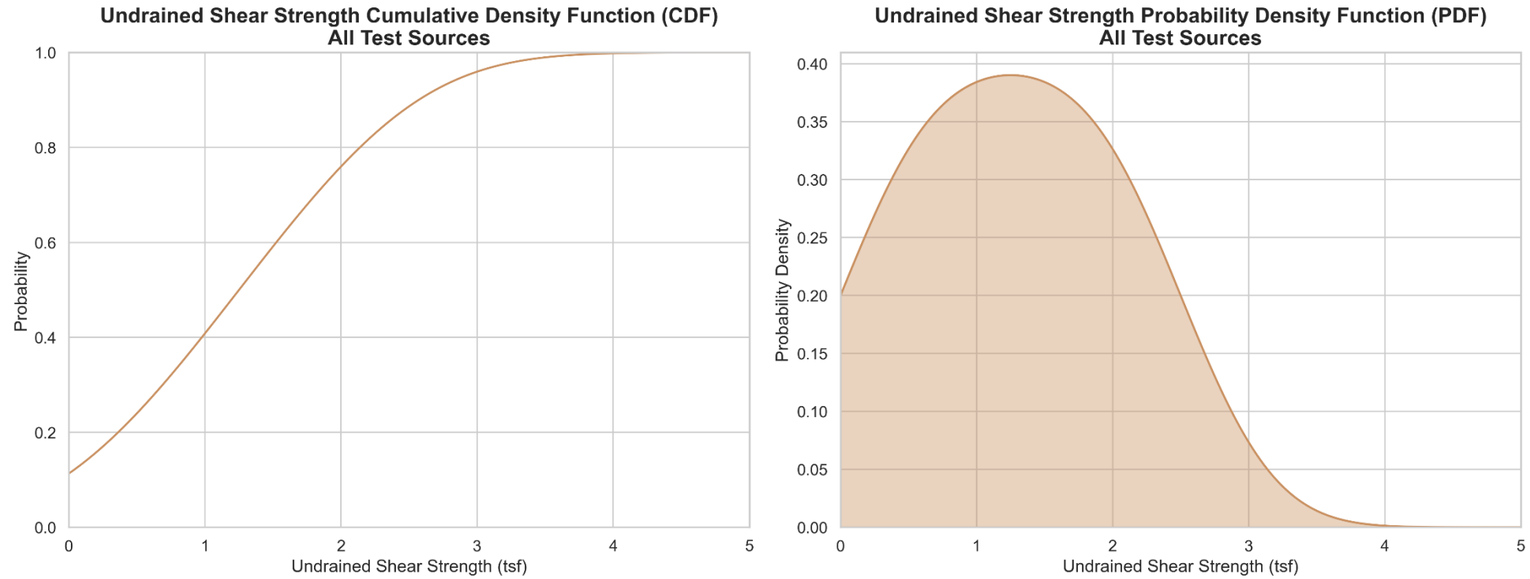
EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure I-13

LS (n = 5) - Anchorage Landside Borings





Undrained Shear Strength – Anchorage Landside Borings, ESU LS

Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure **I-14**

NO DATA

Undrained Shear Strength – Anchorage Landside Borings, ESU DG

Knik Arm Tunnel Feasibility Study

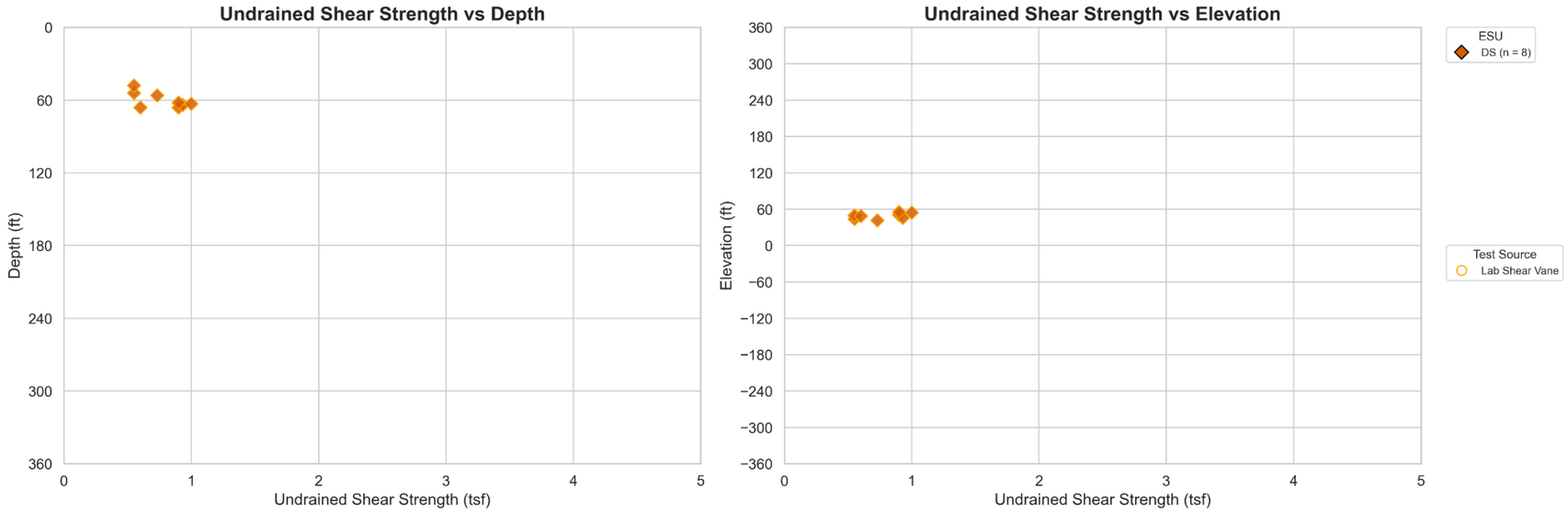
EMPRISE CONCEPTS

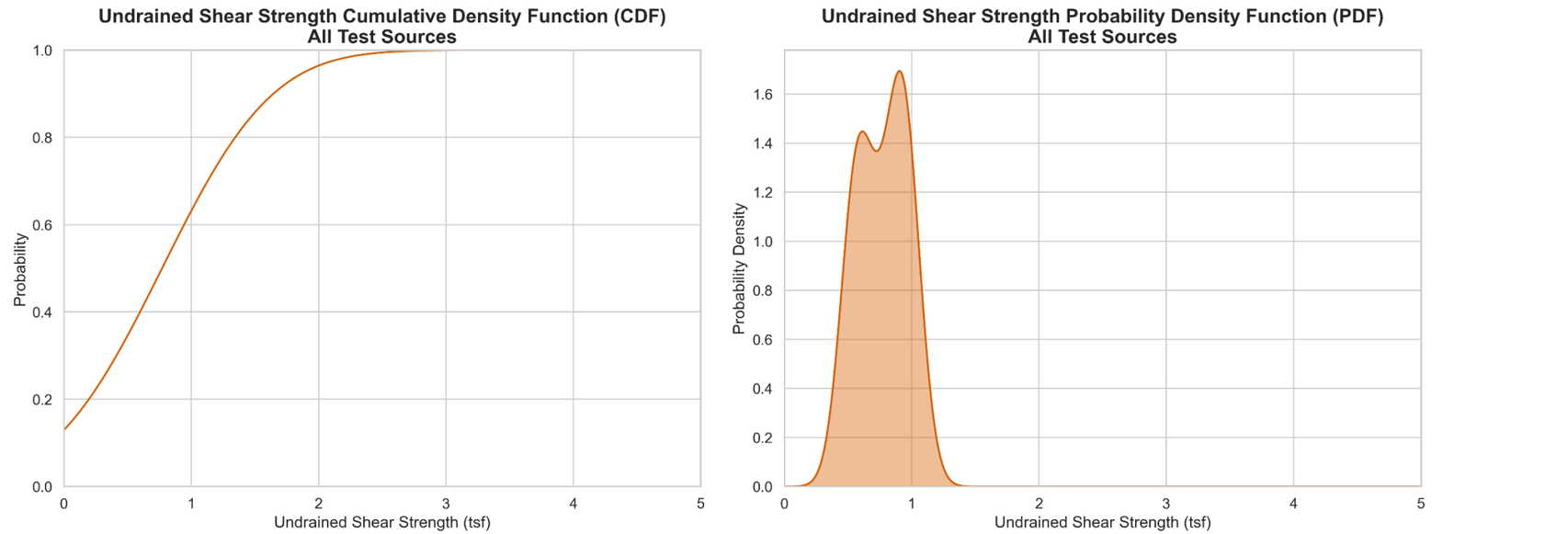
Anchorage, Alaska | August 2025

Figure

I-15

DS (n = 8) - Anchorage Landside Borings





Undrained Shear Strength – Anchorage Landside Borings, ESU DS

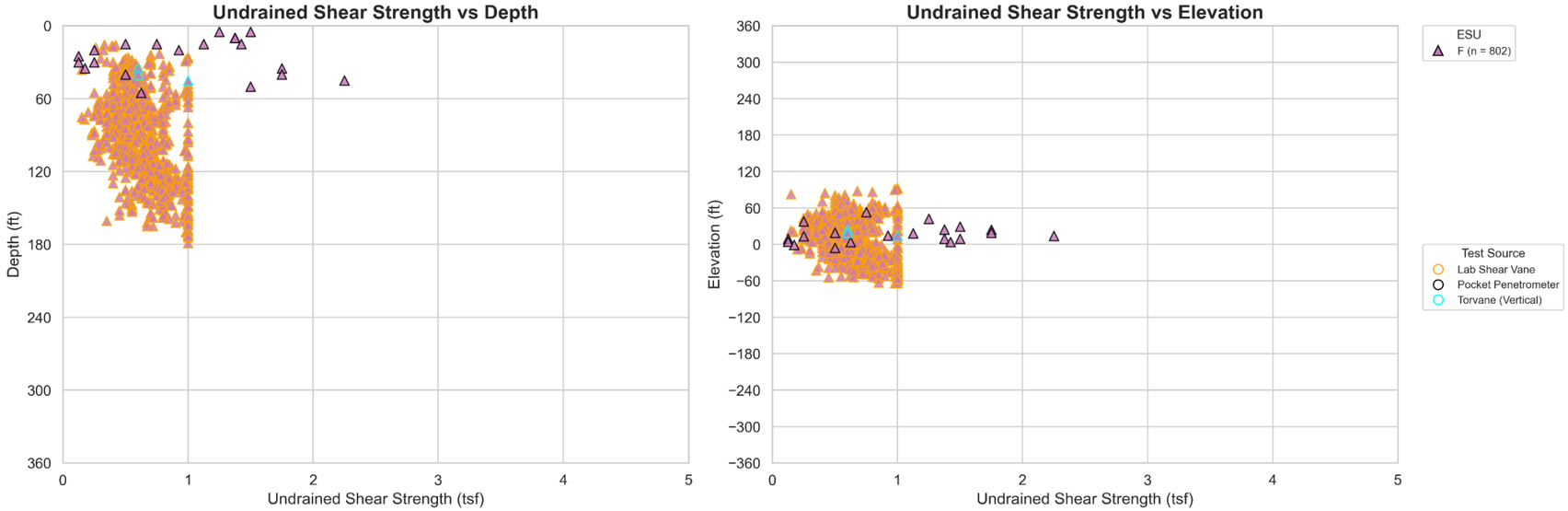
Knik Arm Tunnel Feasibility Study

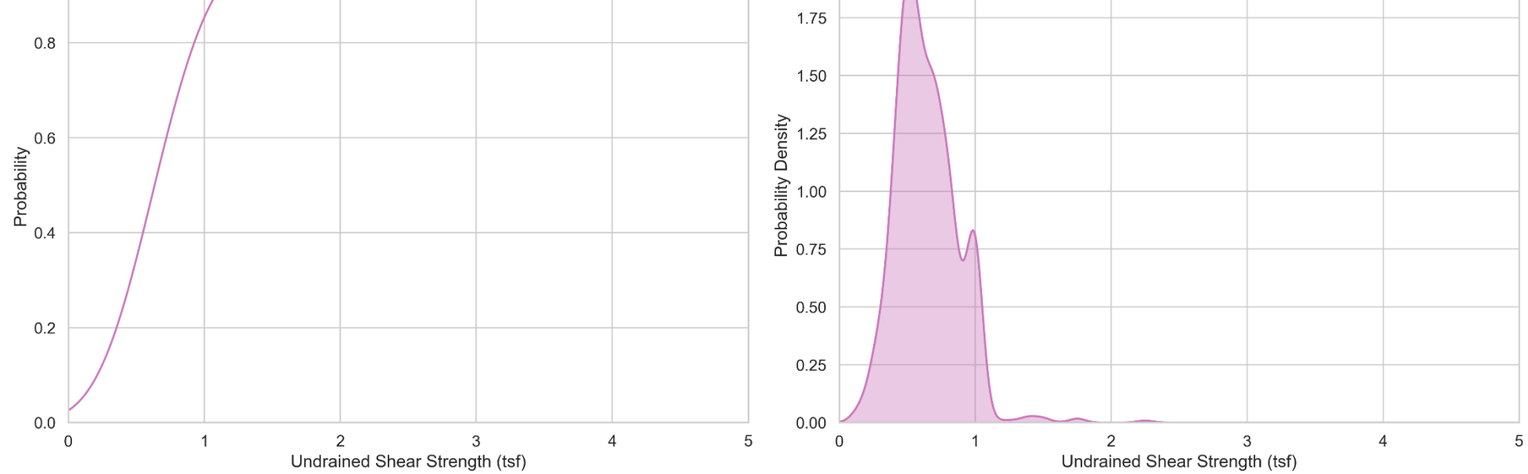
EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure I-16

F (n = 802) - Anchorage Landside Borings





Undrained Shear Strength – Anchorage Landside Borings, ESU F

Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure I-17

NO DATA

Undrained Shear Strength – Anchorage Landside Borings, ESU FG

Knik Arm Tunnel Feasibility Study

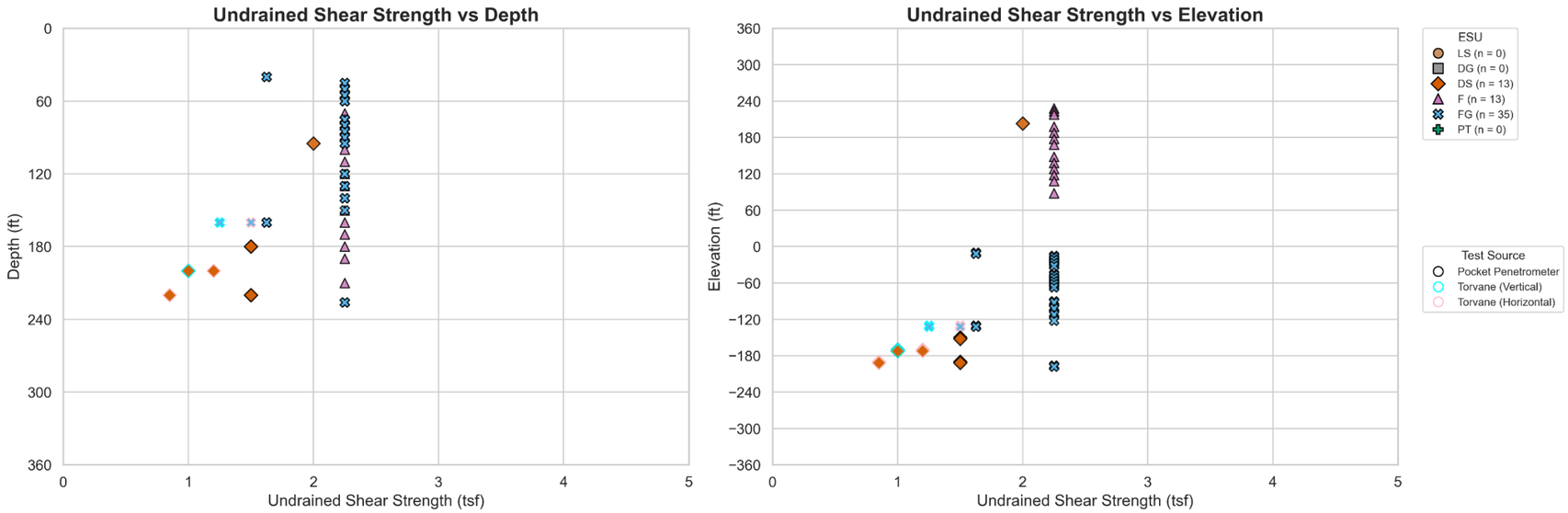
EMPRISE CONCEPTS

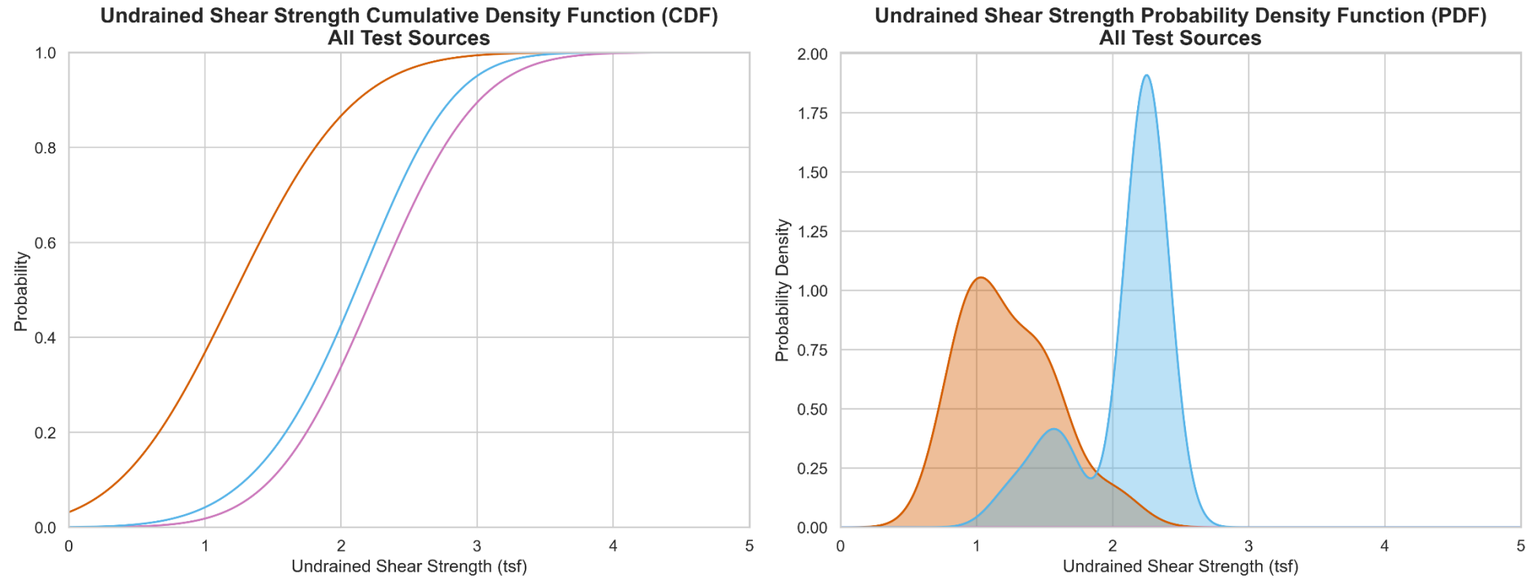
Anchorage, Alaska | August 2025

Figure

I-18

Point MacKenzie Landside Borings





Undrained Shear Strength – Point MacKenzie Landside Borings, All ESUs

Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure I-19

NO DATA

Undrained Shear Strength – Point MacKenzie Landside Borings, ESU LS

Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure

I-20

NO DATA

Undrained Shear Strength – Point MacKenzie Landside Borings, ESU DG

Knik Arm Tunnel Feasibility Study

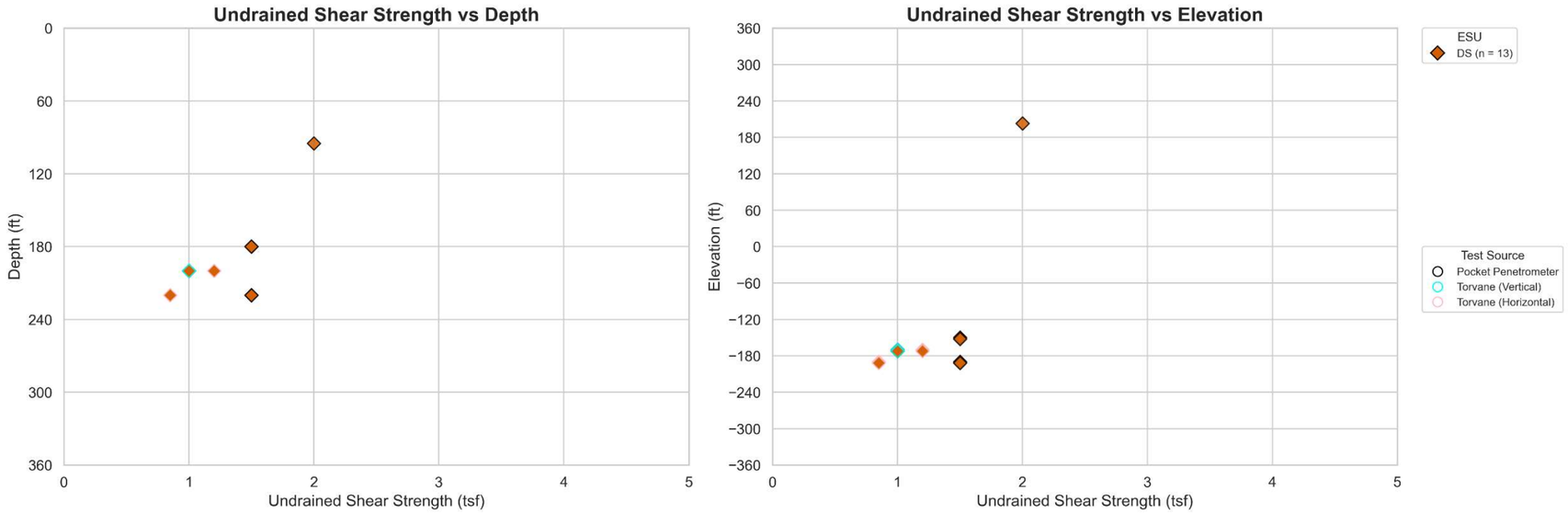
EMPRISE CONCEPTS

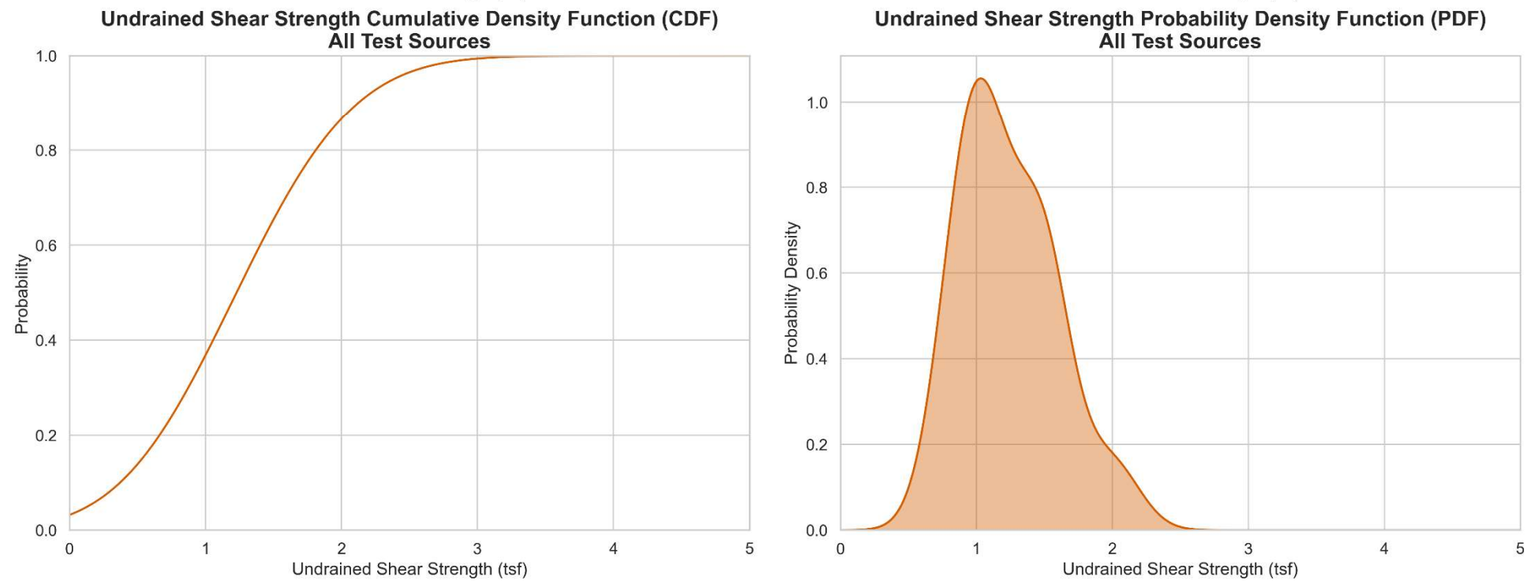
Anchorage, Alaska | August 2025

Figure

I-21

DS (n = 13) - Point MacKenzie Landside Borings





Undrained Shear Strength – Point MacKenzie Landside Borings, ESU DS

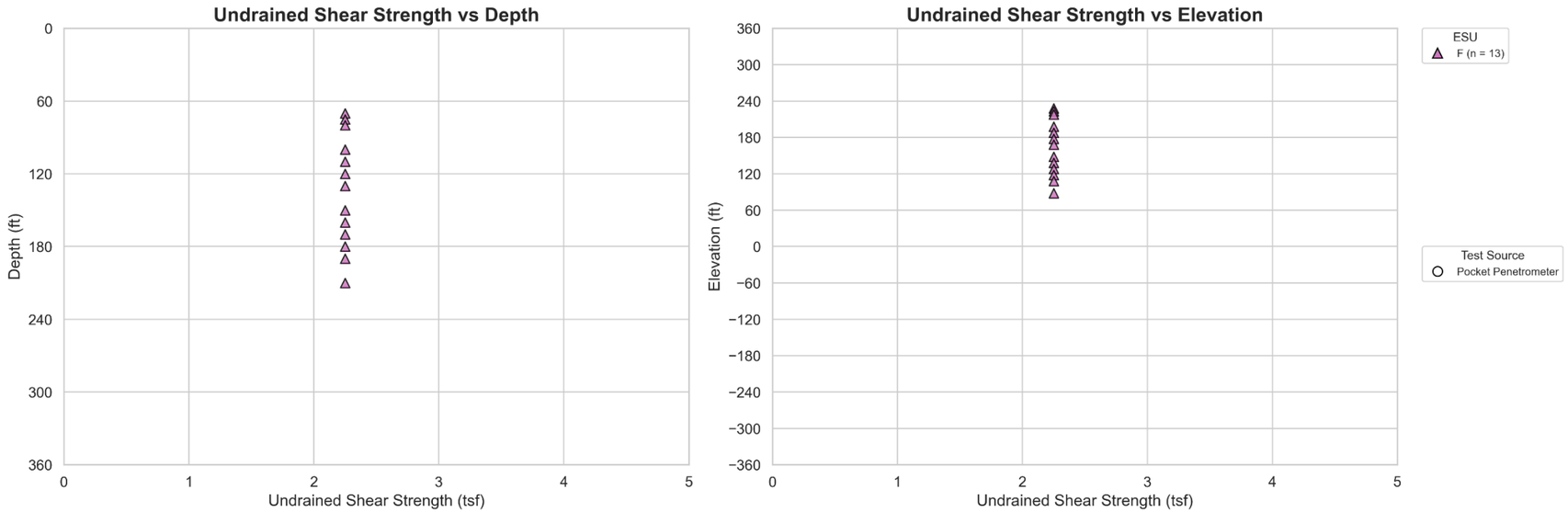
Knik Arm Tunnel Feasibility Study

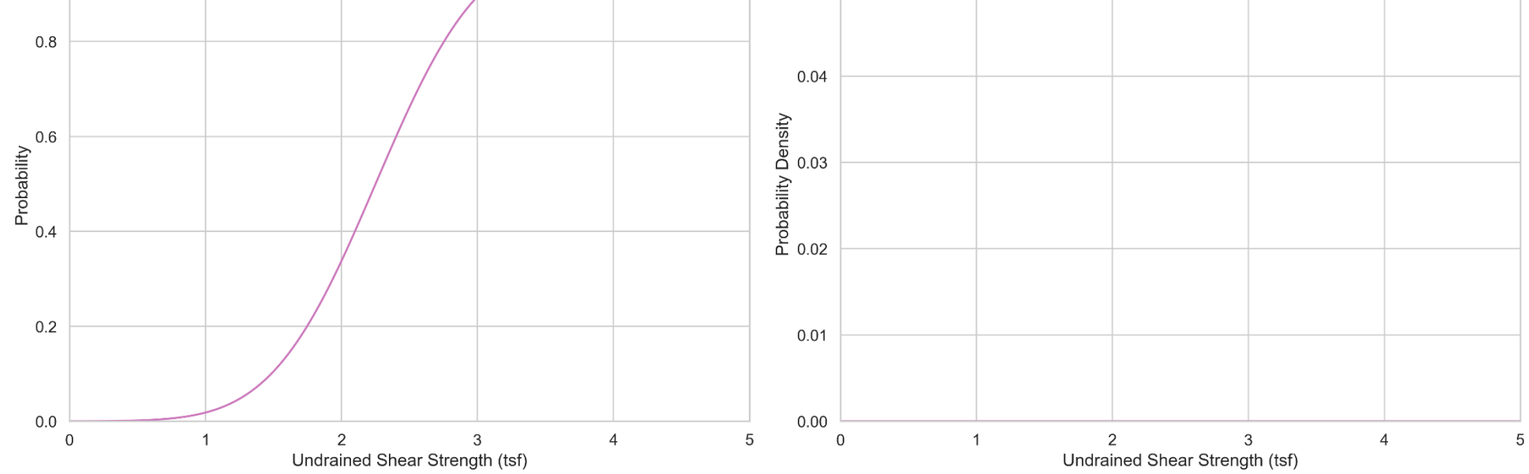
EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure I-22

F (n = 13) - Point MacKenzie Landside Borings





Undrained Shear Strength – Point MacKenzie Landside Borings, ESU F

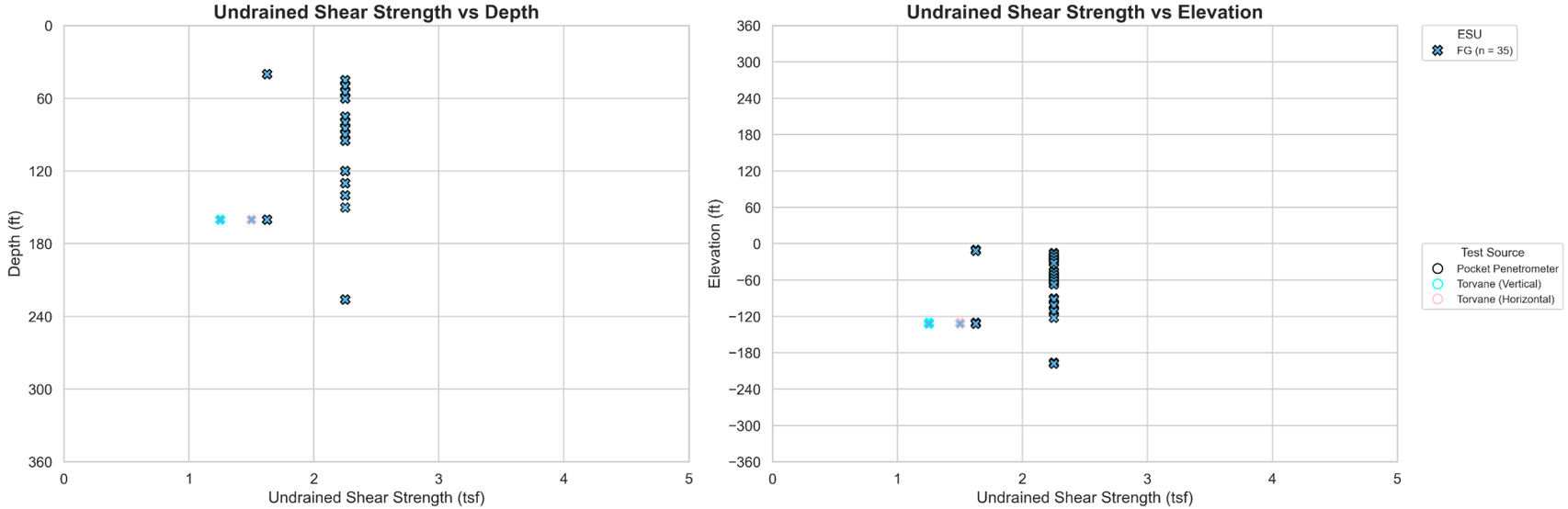
Knik Arm Tunnel Feasibility Study

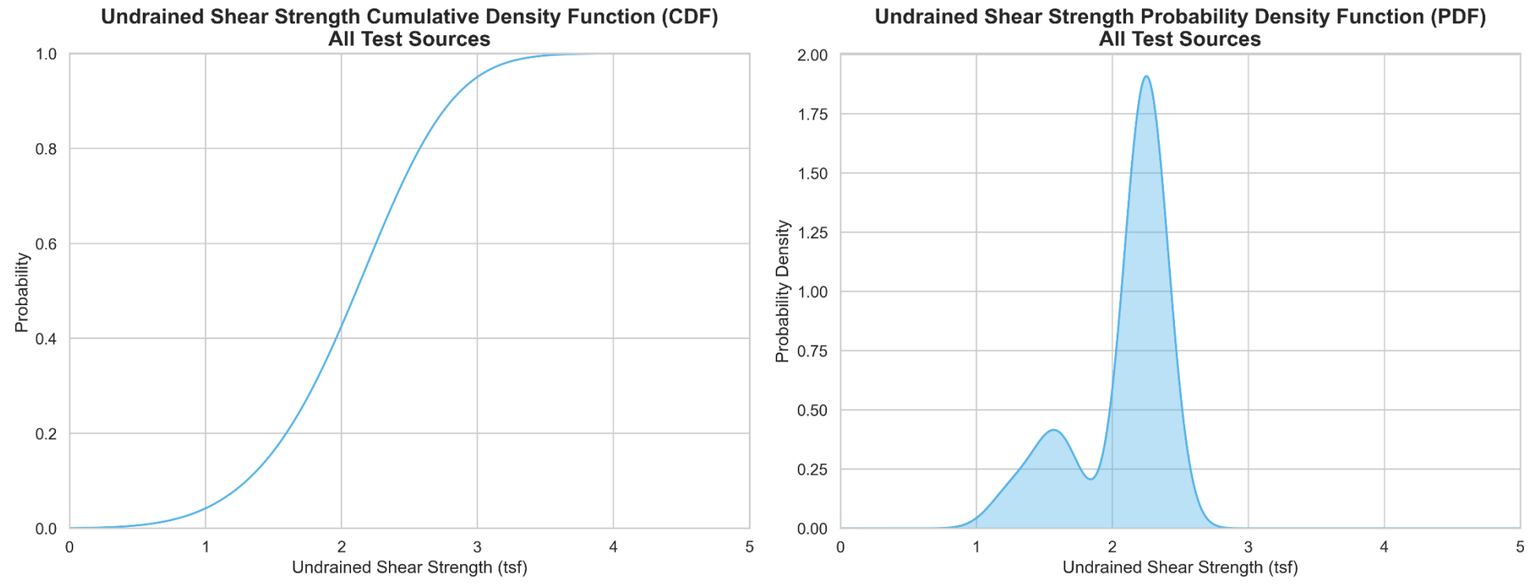
EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure I-23

FG (n = 35) - Point MacKenzie Landside Borings





Undrained Shear Strength – Point MacKenzie Landside Borings, ESU FG

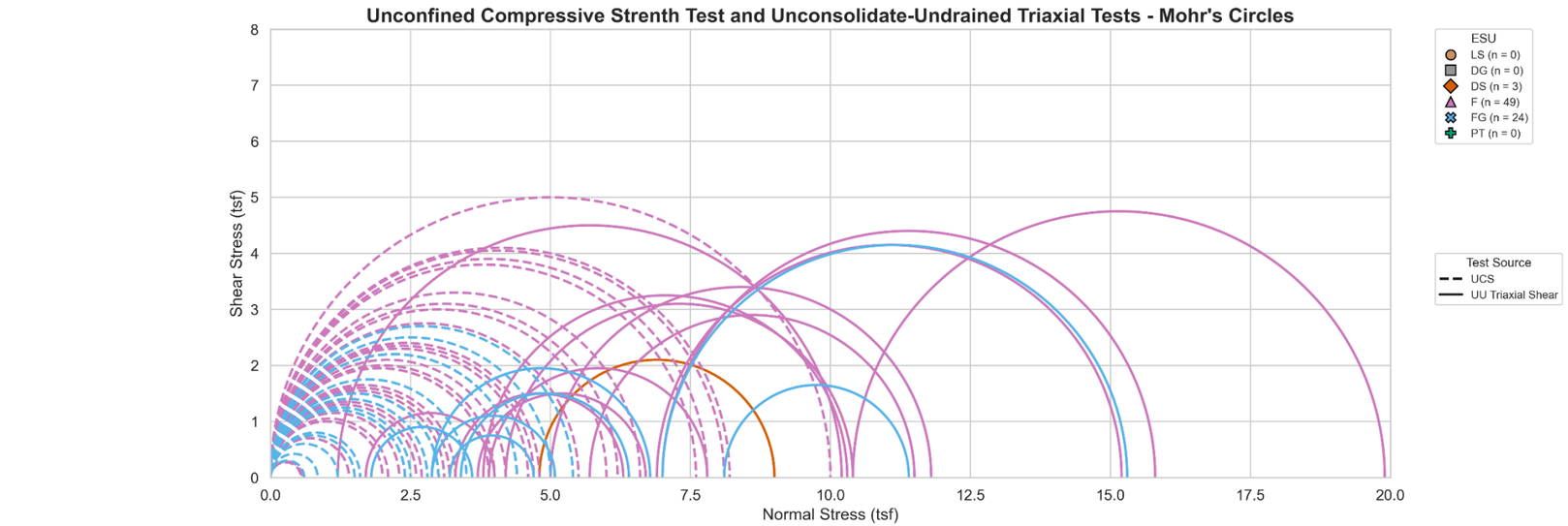
Knik Arm Tunnel Feasibility Study

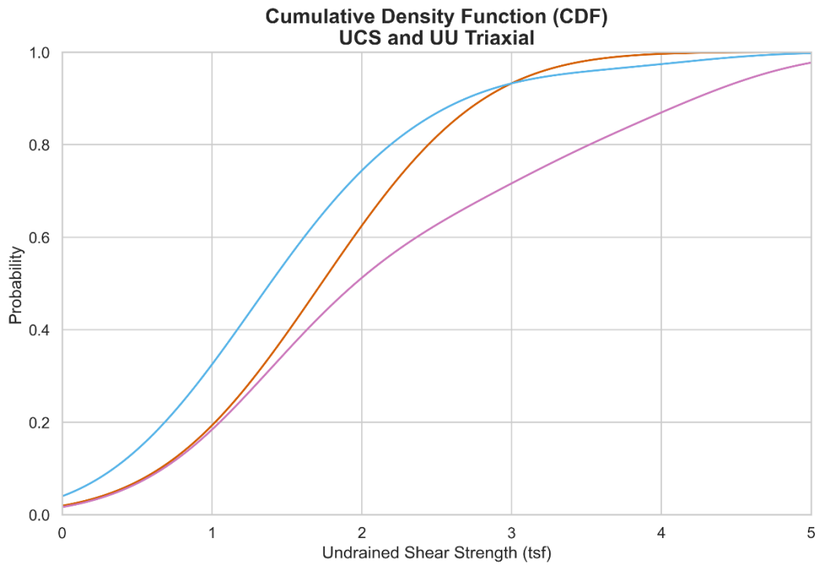
EMPRISE CONCEPTS

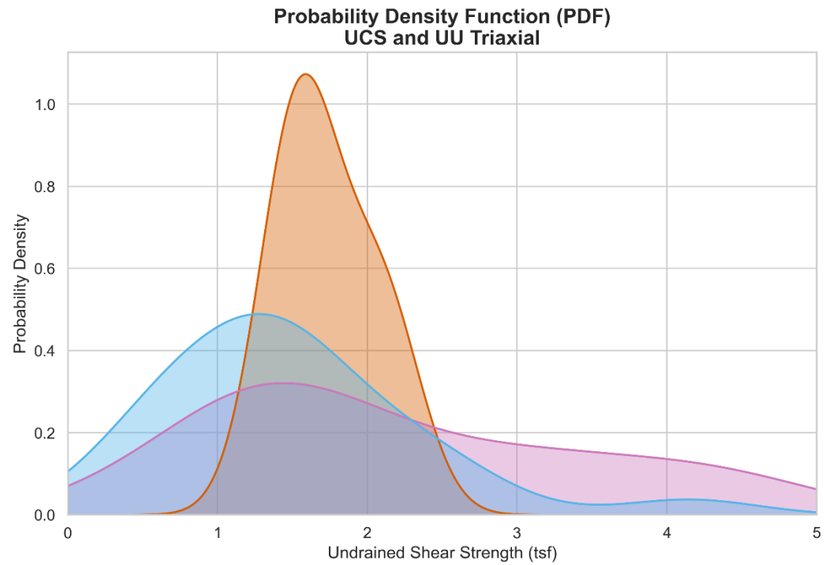
Anchorage, Alaska | August 2025

Figure I-24

All Borings







Unconfined Compressive Strength Test and Unconsolidated-Undrained Triaxial Tests – Mohr's Circles – All Borings, All ESUs

Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure J-1

NO DATA

Unconfined Compressive Strength Test and Unconsolidated-Undrained Triaxial Tests – Mohr's Circles – All Borings, ESU LS

Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure J-2

NO DATA

Unconfined Compressive Strength Test and Unconsolidated-Undrained Triaxial Tests – Mohr's Circles – All Borings, ESU DG

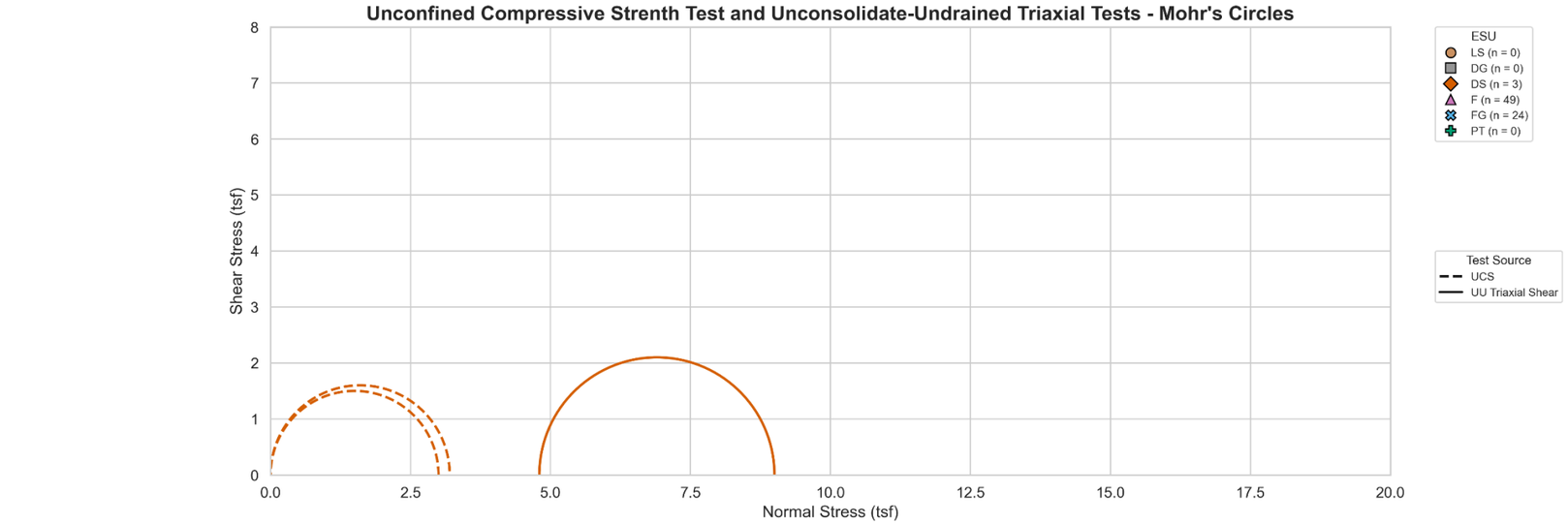
Knik Arm Tunnel Feasibility Study

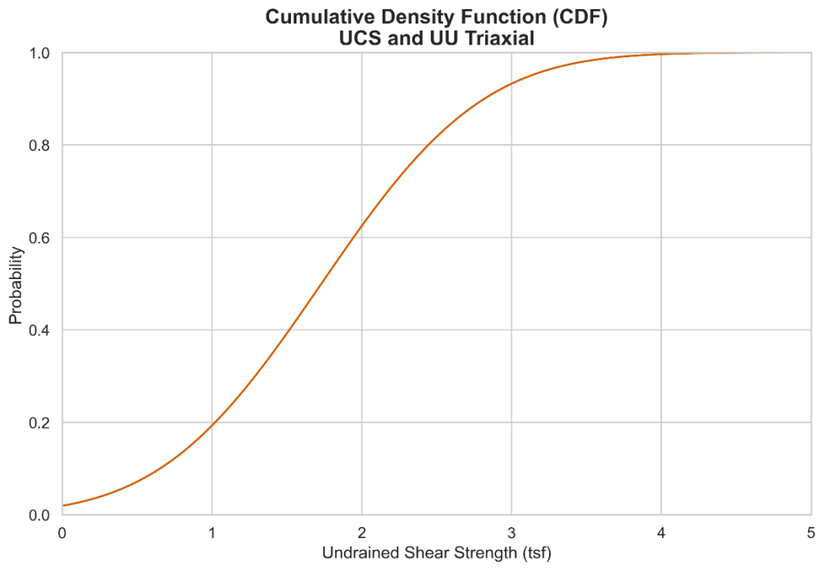
EMPRISE CONCEPTS

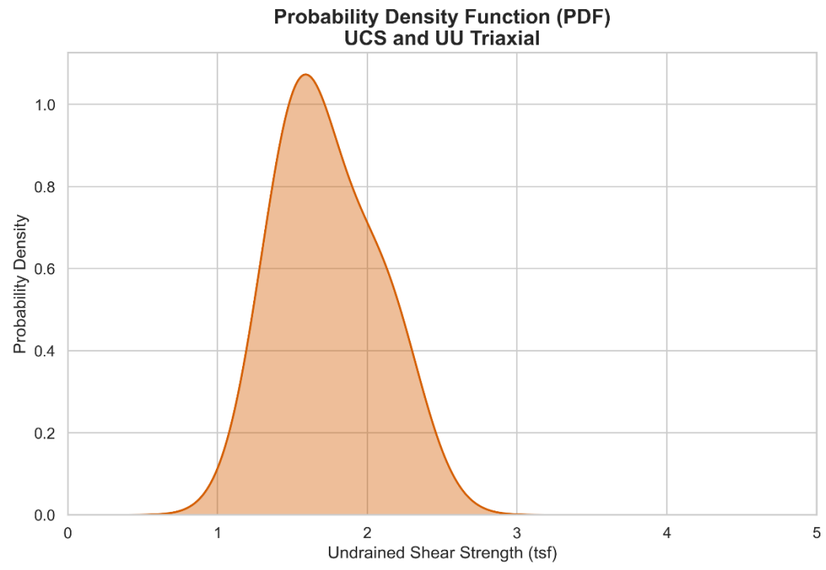
Anchorage, Alaska | August 2025

Figure
J-3

DS (n = 3) - All Borings







Unconfined Compressive Strength Test and Unconsolidated-Undrained Triaxial Tests – Mohr's Circles – All Borings, ESU DS

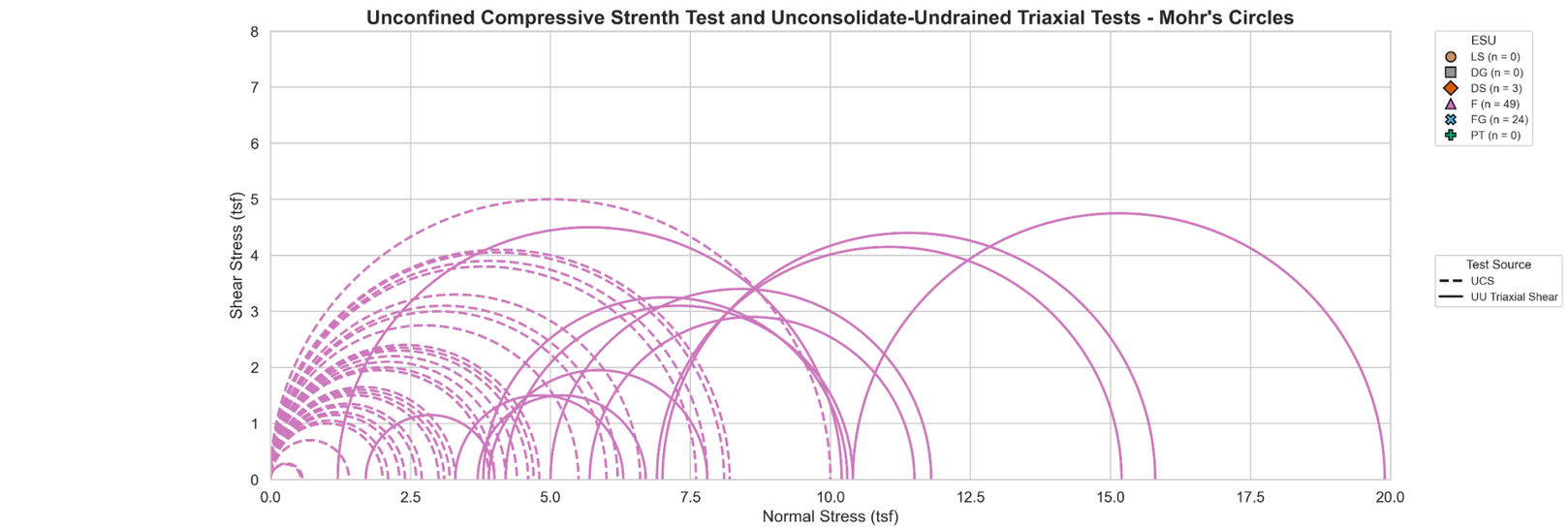
Knik Arm Tunnel Feasibility Study

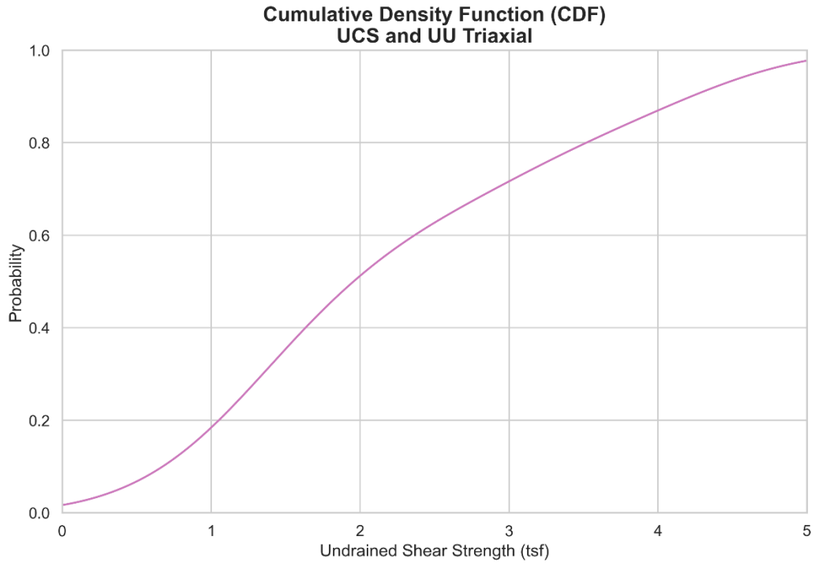
EMPRISE CONCEPTS

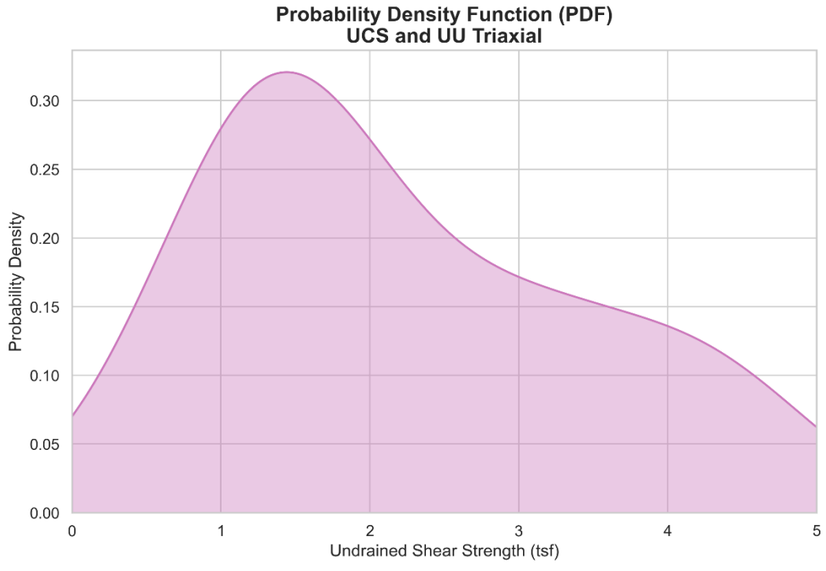
Anchorage, Alaska | August 2025

Figure **J-4**

F (n = 49) - All Borings







Unconfined Compressive Strength Test and Unconsolidated-Undrained Triaxial Tests – Mohr's Circles – All Borings, ESU F

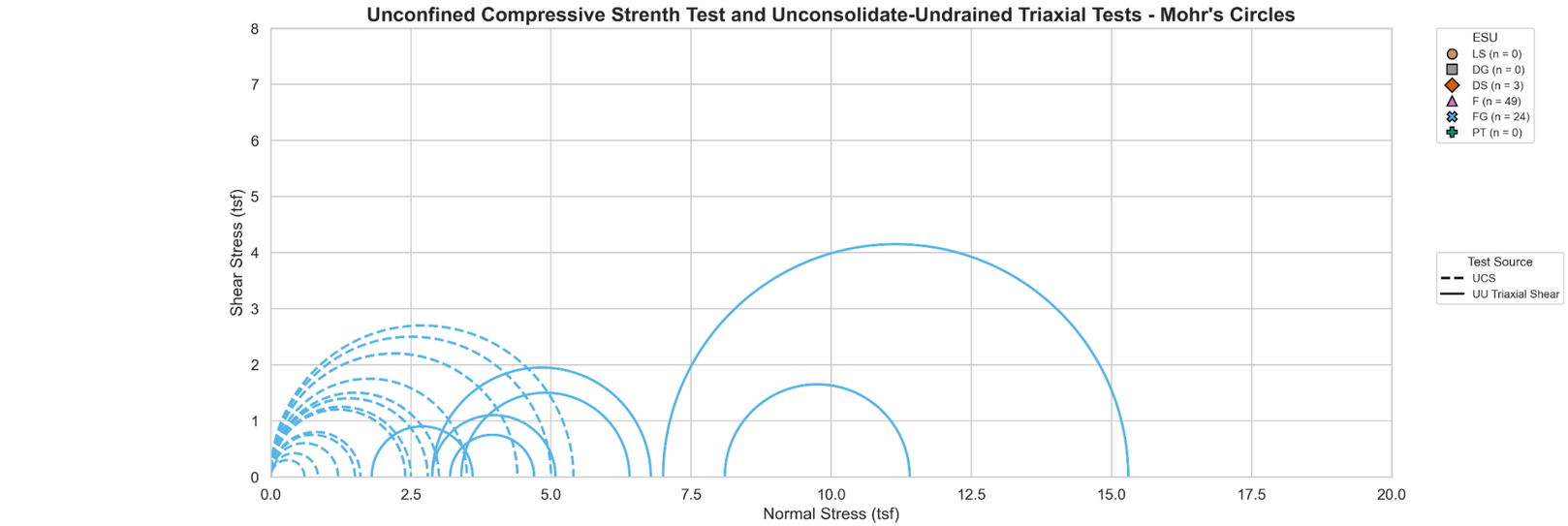
Knik Arm Tunnel Feasibility Study

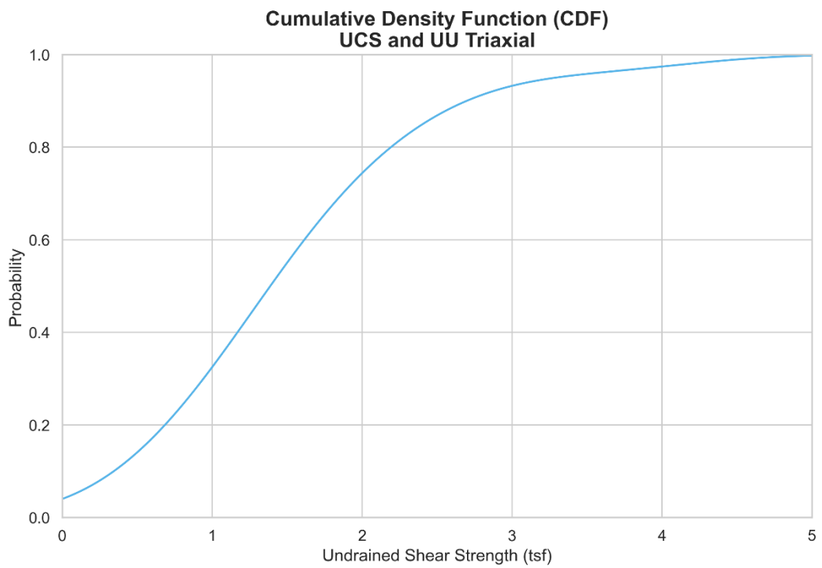
EMPRISE CONCEPTS

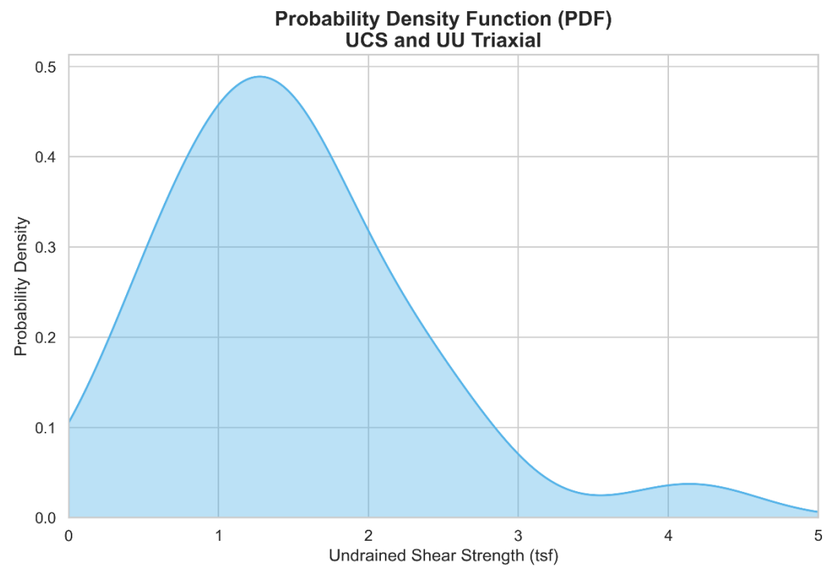
Anchorage, Alaska | August 2025

Figure
J-5

FG (n = 24) - All Borings







Unconfined Compressive Strength Test and Unconsolidated-Undrained Triaxial Tests – Mohr's Circles – All Borings, ESU FG

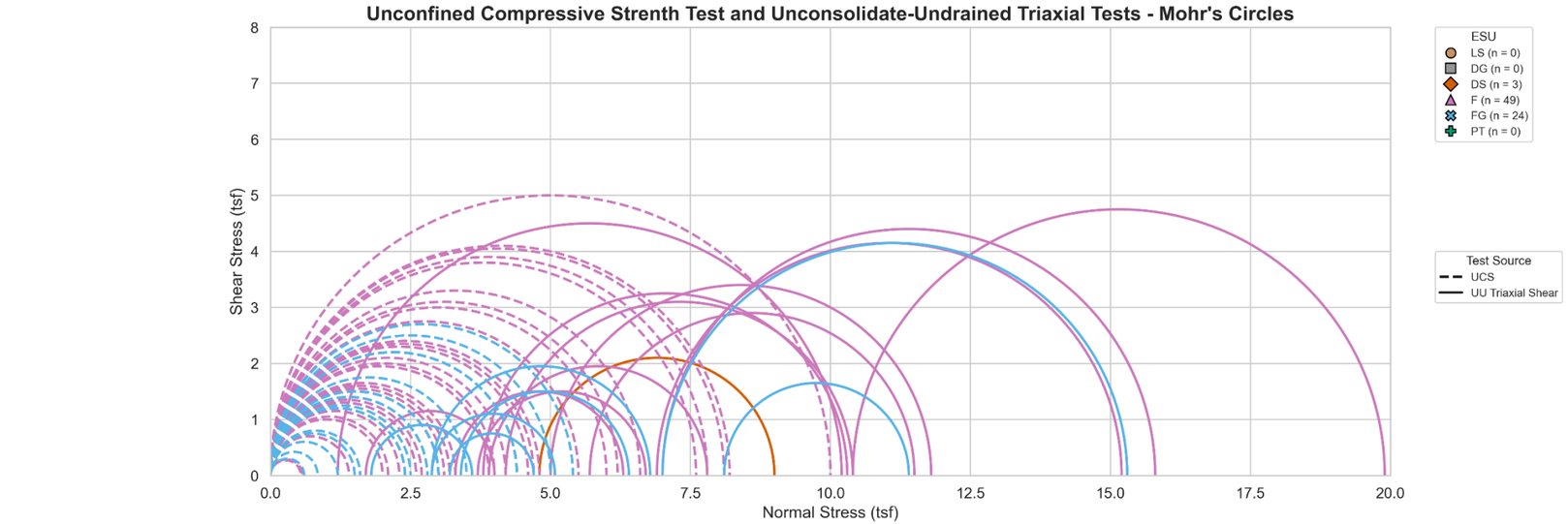
Knik Arm Tunnel Feasibility Study

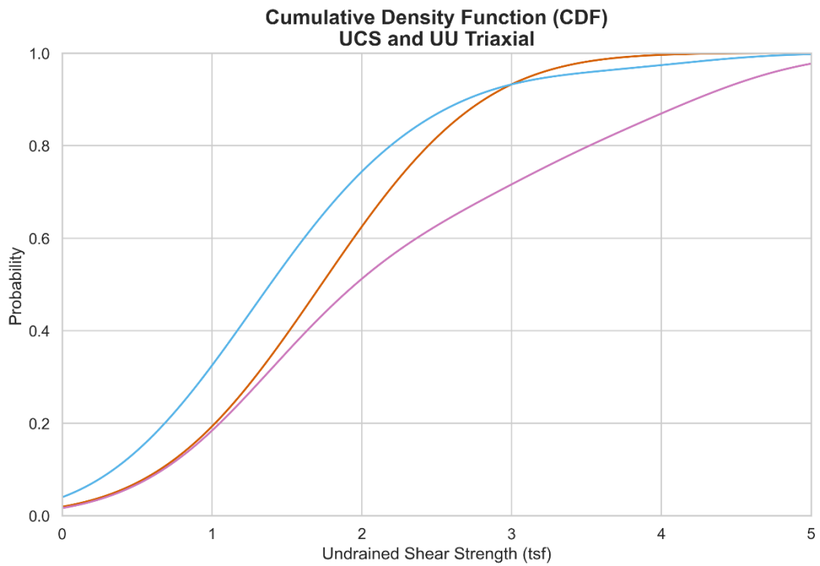
EMPRISE CONCEPTS

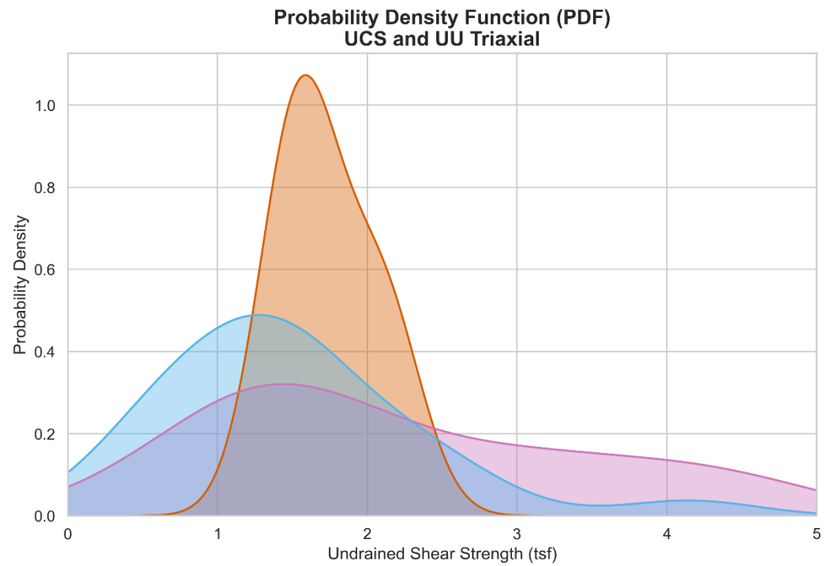
Anchorage, Alaska | August 2025

Figure J-6

Overwater Borings







Unconfined Compressive Strength Test and Unconsolidated-Undrained Triaxial Tests – Mohr's Circles – Overwater Borings, All ESUs

Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure J-7

NO DATA

Unconfined Compressive Strength Test and Unconsolidated-Undrained Triaxial Tests – Mohr's Circles – Overwater Borings, ESU LS

Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure

J-8

NO DATA

Unconfined Compressive Strength Test and Unconsolidated-Undrained Triaxial Tests – Mohr's Circles – Overwater Borings, ESU DG

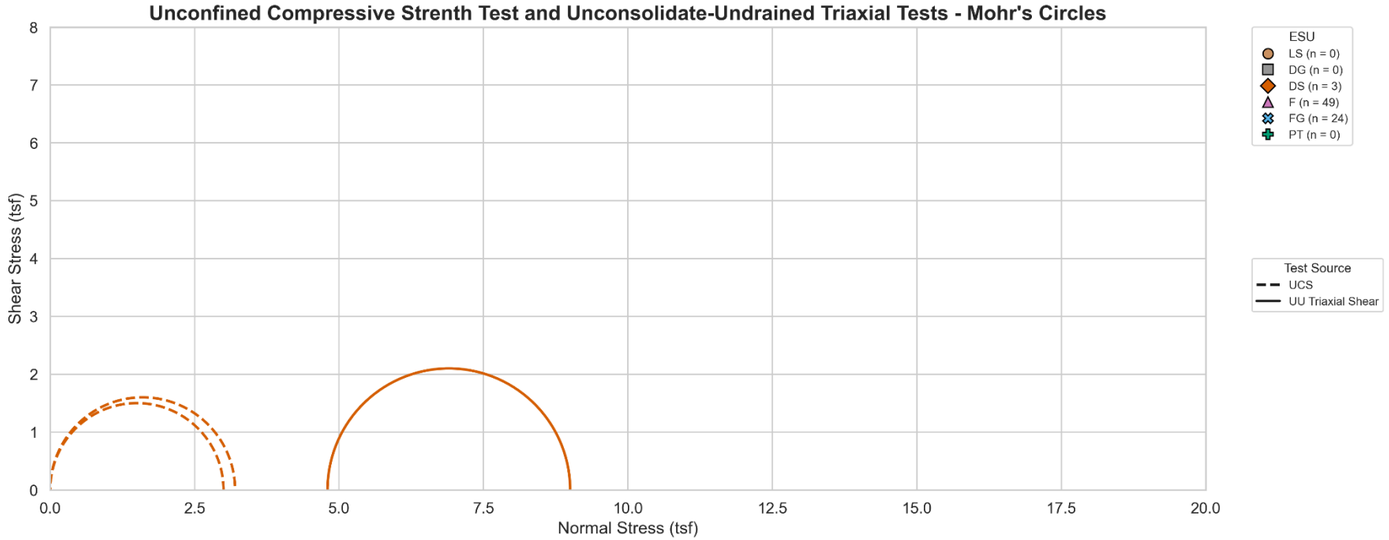
Knik Arm Tunnel Feasibility Study

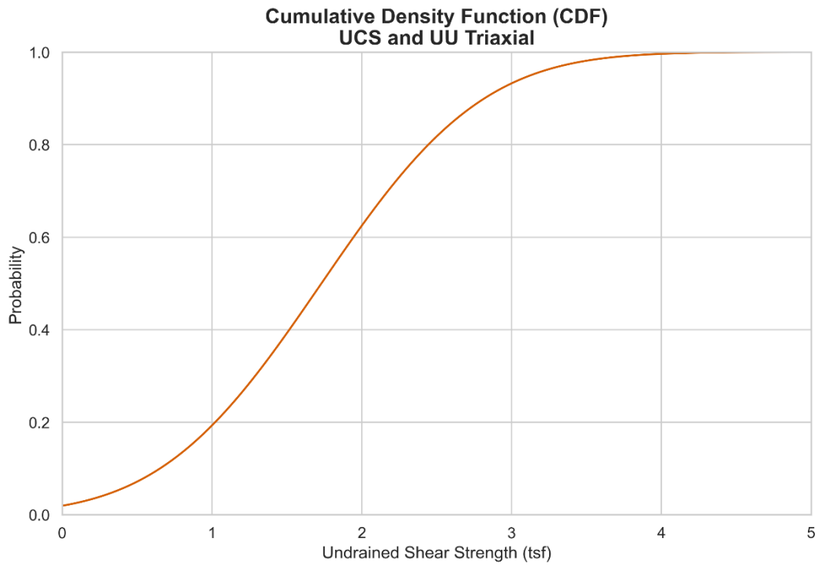
EMPRISE CONCEPTS

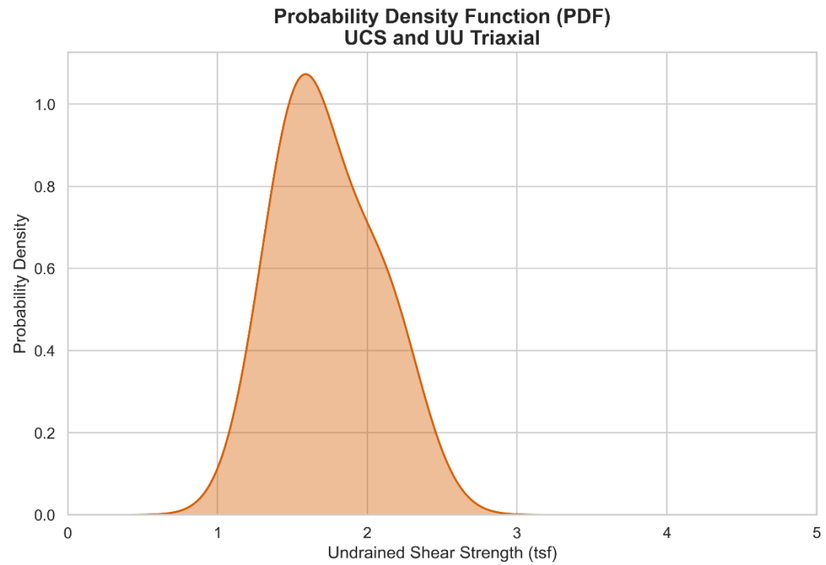
Anchorage, Alaska | August 2025

Figure **J-9**

DS (n = 3) - Overwater Borings







Unconfined Compressive Strength Test and Unconsolidated-Undrained Triaxial Tests – Mohr's Circles – Overwater Borings, ESU DS

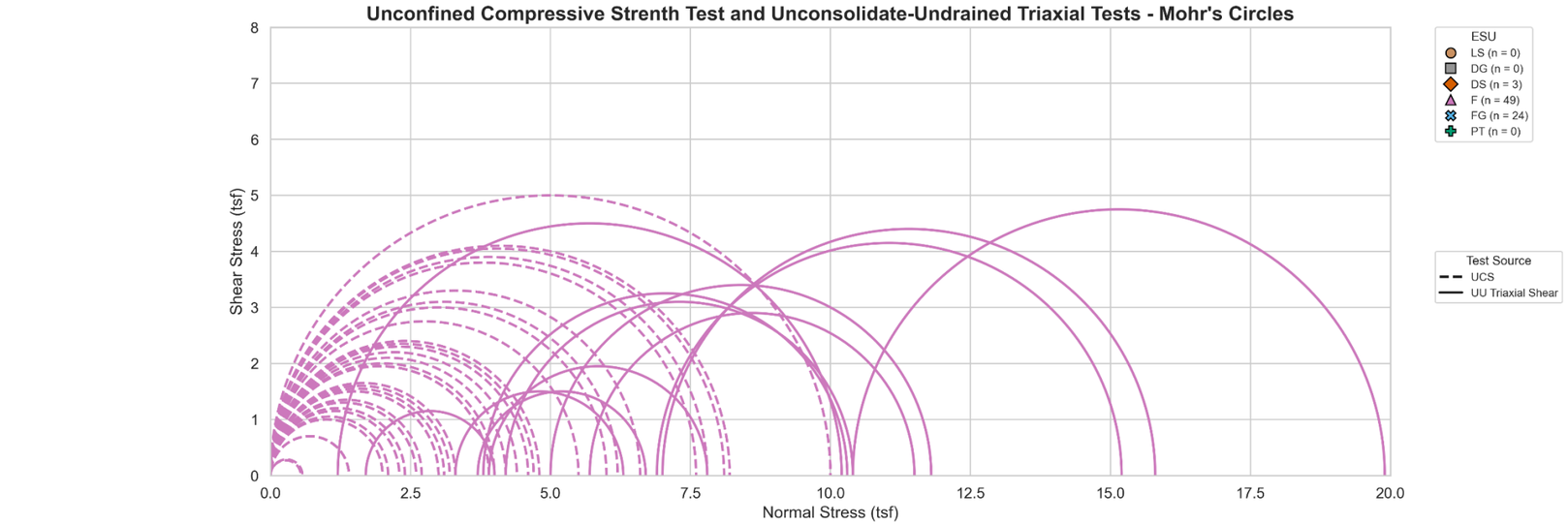
Knik Arm Tunnel Feasibility Study

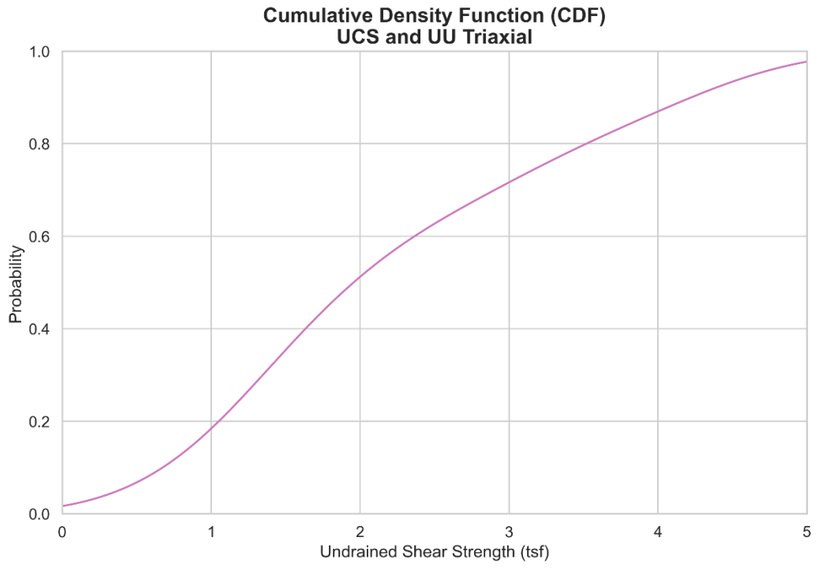
EMPRISE CONCEPTS

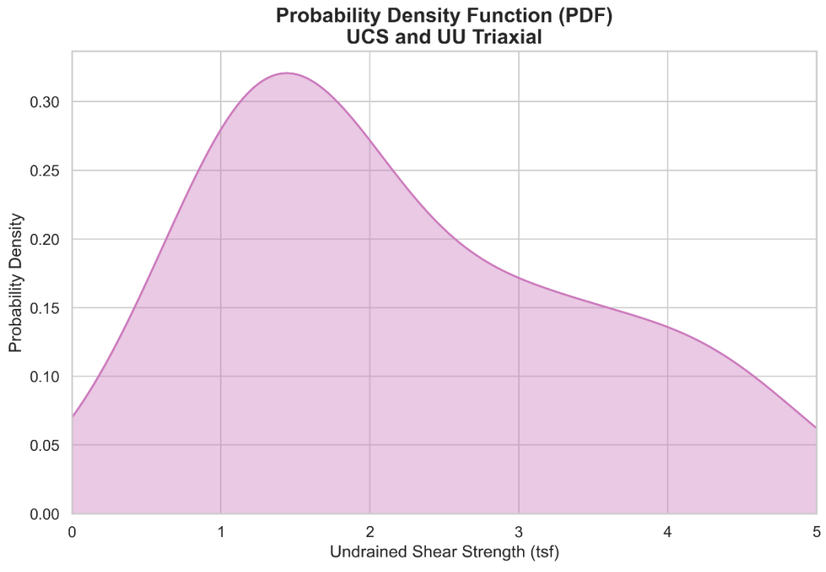
Anchorage, Alaska | August 2025

Figure **J-10**

F (n = 49) - Overwater Borings







Unconfined Compressive Strength Test and Unconsolidated-Undrained Triaxial Tests – Mohr's Circles – Overwater Borings, ESU F

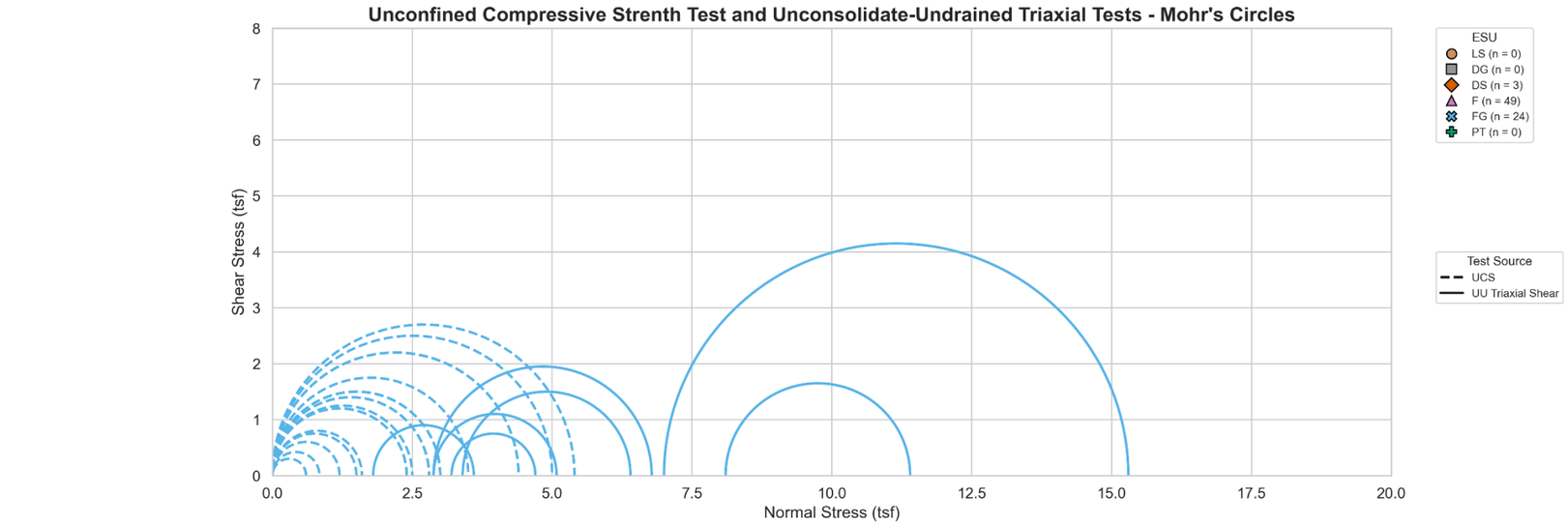
Knik Arm Tunnel Feasibility Study

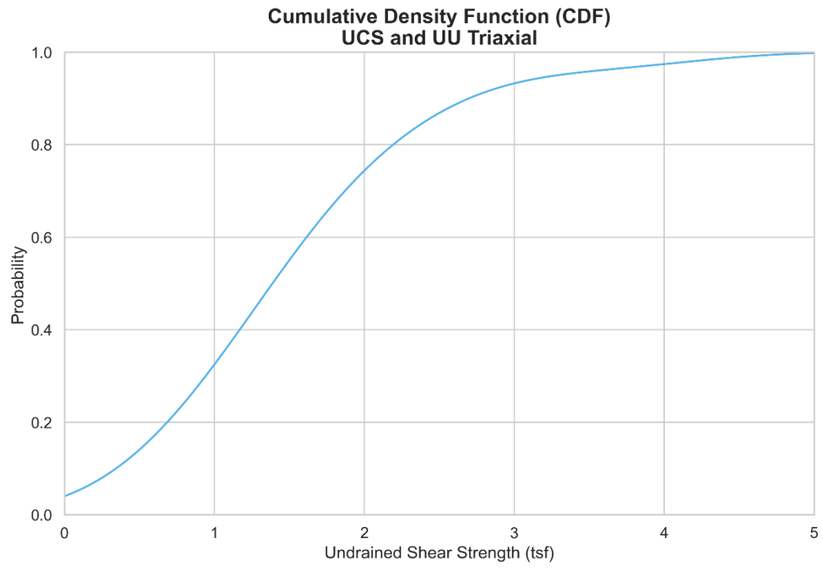
EMPRISE CONCEPTS

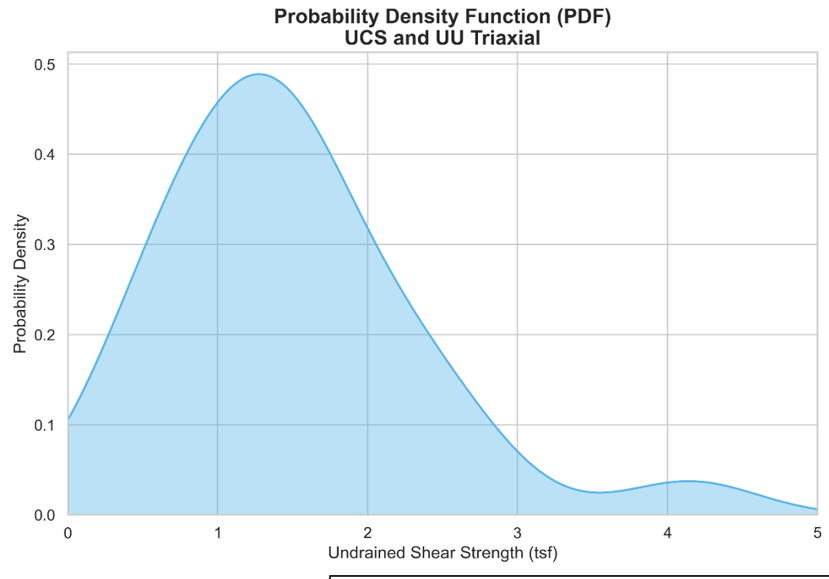
Anchorage, Alaska | August 2025

Figure J-11

FG (n = 24) - Overwater Borings







Unconfined Compressive Strength Test and Unconsolidated-Undrained Triaxial Tests – Mohr's Circles – Overwater Borings, ESU FG

Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure J-12

NO DATA

Unconfined Compressive Strength Test and Unconsolidated-Undrained Triaxial Tests – Mohr's Circles –Anchorage Landside Borings, All ESUs

Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure

J-13

NO DATA

Unconfined Compressive Strength Test and Unconsolidated-Undrained Triaxial Tests – Mohr's Circles – Anchorage Landside Borings, ESU LS

Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure

J-14

NO DATA

Unconfined Compressive Strength Test and Unconsolidated-Undrained Triaxial Tests – Mohr's Circles – Anchorage Landside Borings, ESU DG

Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure

J-15

NO DATA

Unconfined Compressive Strength Test and Unconsolidated-Undrained Triaxial Tests – Mohr's Circles – Anchorage Landside Borings, ESU DS

Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure

J-16

NO DATA

Unconfined Compressive Strength Test and Unconsolidated-Undrained Triaxial Tests – Mohr's Circles – Anchorage Landside Borings, ESU F

Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure

J-17

NO DATA

Unconfined Compressive Strength Test and Unconsolidated-Undrained Triaxial Tests – Mohr's Circles – Anchorage Landside Borings, ESU FG

Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure

J-18

NO DATA

Unconfined Compressive Strength Test and Unconsolidated-Undrained Triaxial Tests – Mohr's Circles – Point MacKenzie Landside Borings, All ESUs

Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure

J-19

NO DATA

Unconfined Compressive Strength Test and Unconsolidated-Undrained Triaxial Tests – Mohr's Circles – Point MacKenzie Landside Borings, ESU LS

Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure

J-20

NO DATA

Unconfined Compressive Strength Test and Unconsolidated-Undrained Triaxial Tests – Mohr's Circles – Point MacKenzie Landside Borings, ESU DG

Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure

J-21

NO DATA

Unconfined Compressive Strength Test and Unconsolidated-Undrained Triaxial Tests – Mohr's Circles – Point MacKenzie Landside Borings, ESU DS

Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure

J-22

NO DATA

Unconfined Compressive Strength Test and Unconsolidated-Undrained Triaxial Tests – Mohr's Circles – Point MacKenzie Landside Borings, ESU F

Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure

J-23

NO DATA

Unconfined Compressive Strength Test and Unconsolidated-Undrained Triaxial Tests – Mohr's Circles – Point MacKenzie Landside Borings, ESU FG

Knik Arm Tunnel Feasibility Study

EMPRISE CONCEPTS

Anchorage, Alaska | August 2025

Figure **J-24**