

***Geotechnical Studies
Proposed National Park
Service Housing
Marion Creek Site
Coldfoot, Alaska***

December, 1991

***United States Department of the Interior
National Park Service
12795 W. Alameda Parkway
Denver, Colorado***



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**GEOTECHNICAL STUDIES
PROPOSED NATIONAL PARK SERVICE HOUSING
MARION CREEK SITE
COLDFOOT, ALASKA**

1.0 INTRODUCTION

1.1 Purpose and Scope

This report presents the results of our geotechnical studies for the proposed National Park Service Housing at the Marion Creek site in Coldfoot, Alaska. This report describes the field and laboratory studies conducted for the site and the surface and subsurface conditions encountered at the site. In addition, this report presents our foundation recommendations for the proposed National Park Service housing structures and their appurtenances.

Our field studies were conducted to determine the general subsurface conditions at the proposed site to assist in developing foundation recommendations for the support of the proposed structures and associated roads, driveways and parking areas. The field studies were also conducted to assist in determining the feasibility of on-site sewage disposal and an on-site domestic water well. ~~The recommendations and discussions developed from the field studies would thereby aid in the design of the project.~~

Our field work consisted of drilling eight borings at the Marion Creek site. Samples from all borings were collected and delivered to our Fairbanks laboratory for testing. Laboratory studies were performed to determine soil index properties of the subsurface materials. The information collected during our studies was used to develop the recommendations for the design of the proposed foundation systems.

The scope of work accomplished for this study was in general accordance with that outlined in our proposal dated September 25, 1991. Our work was authorized by Donna K. Kalvels of The National Park Service.

1.2 Project Description and Proposed Construction

We understand that the Marion Creek site employee housing project will consist of detached, one and two story single-family structures, larger one and two story apartment/bunkhouses and a maintenance/warehouse building. We understand that the housing units will be of wood frame construction. Building sizes, location on the site, and anticipated loads were not available at the time of our studies. We also understand that a on-site sewage disposal and an on-site domestic water well is anticipated.

2.0 FIELD AND LABORATORY STUDIES

2.1 Field Explorations

The field explorations for the Marion Creek site involved drilling eight borings ranging in depth from 7 to 35 feet below the existing ground surface. These borings were drilled on November 5 through 8, 1991, using a truck-mounted CME 55 drill rig equipped with 8-inch O.D. by 3-1/4-inch I.D. hollow stem augers. The borings were drilled at locations pre-selected by Design Alaska, Inc. and are presented on the Boring Location and Site Plan, Figure 2. Boring locations and elevations of the borings were determined by surveyors from Design Alaska, Inc. In addition, a percolation test was performed to evaluate the permeability of the in-situ soils and determine their suitability for an on-site septic system. Logs of the borings including soil descriptions, sample locations, and penetration resistance are presented on Figures 3 through 10.

As the borings progressed, soil samples were generally obtained at 2.5 foot depth intervals for the first 20 feet and at 5 foot depth intervals thereafter. depth of each boring. The sampling was accomplished by driving a 3.0-inch O.D., 2.5-inch I.D. split-spoon sampler 18 inches into the soil at the base of the auger with a 300-pound drop hammer falling 30 inches onto the drill rods. For each sample, the number of blows required to advance the sampler the final 12 inches is the penetration resistance and measures the relative density of unfrozen granular soils. Soil samples recovered using this technique were classified in the field, sealed in airtight containers, and returned to our laboratory for testing.

2.2 Laboratory Testing

All samples of subsurface materials recovered during the field investigation were delivered to our laboratory in Fairbanks. The visual classifications of the samples were checked, and the samples were prepared for testing. The laboratory testing program for this project consisted of 18 water content determinations and three mechanical sieve analyses. The results of the water contents are presented on the boring logs, Figures 3 through 10. The results of the mechanical

sieve analyses are presented on Figures 11 through 13.

3.0 SITE CONDITIONS

3.1 Geology and Physiography

The Marion Creek site, located near Coldfoot, Alaska, lies at the confluence of the middle fork of the Koyukuk River and Marion Creek approximately 50 miles north of the Arctic Circle. It is located at the southwest end of the Philip Smith Mountains, on the south side of the Brooks Range physiographic province.

The Coldfoot area lies at the north edge of the Yukon-Tanana uplands, an area characterized by low mountains, plateaus and highlands with generally rolling topography, the Coldfoot area was covered by glacial ice during Pleistocene time and is generally underlain by discontinuous permafrost. Coldfoot is in an area of sparse forest vegetation.

The local geology and surficial soils generally consist of alluvially and glacially transported and deposited soils overlying lower Paleozoic and/or Precambrian metasedimentary and metamorphic rocks.

3.2 Surface Conditions

The Marion Creek site is a 35 acre parcel located about 5 miles north of Coldfoot, Alaska along the Dalton Highway. The site occupies a low bluff adjacent to Marion Creek which runs along its southern boundary. The site is also bound by the toe of a low mountain slope at its northern boundary. A short entrance road provides access to the site from the Dalton Highway to the West. At the time of our investigation, the site generally sloped gently upward in an easterly direction with elevations ranging from 1123 feet at Boring B-1 in the northwest corner to 1140 feet at Boring B-7 in the southeastern corner. The site was sparsely vegetated with black spruce typical of the region's subarctic climate. An inactive borrow pit occupying approximately 1/3 of the site's total area was located at the western end of the site. This area had been stripped of its surficial organic layer, exposing granular material. An unknown quantity

of this material appears to have been mined and removed.

3.3 Subsurface Conditions

3.3.1 Soils

Soils at the Marion Creek site, in general, consisted of a surficial organic layer underlain by a shallow layer of alluvial/slopewash silt and silty sand which was underlain by glaciofluvial and/or fluvial sandy gravel to the depths drilled. Borings in areas which were disturbed, such as the gravel pit, did not encounter the surficial organics and silty soils.

Where encountered, the surficial silt was observed to depths of between 0.5 and 1 foot. The underlying loose to medium dense silty sand was encountered at thicknesses of between 3.5 feet and 6.5 feet. Borings B-1, B-2 and B-3 encountered no surficial silt or silty sand. The sandy gravel was encountered surficially at Borings B-1, B-2 and B-3 and underlying the silt or silty sand in Borings B-4 through B-8 below depths of between 0.5 feet and 7 feet. The sandy gravel extended to the depths drilled in all of the borings. Cobbles (3 inches to 1 foot in diameter) and boulders (1 foot in diameter or greater) were occasionally encountered in the sandy gravel layer underlying the site.

3.3.2 Groundwater

At the Marion Creek site, groundwater was encountered in Boring B-3 at a depth of 14.1 feet below the existing ground surface. Groundwater was not encountered in any of the other borings during this investigation. The groundwater measurement was taken with a measuring tape at the time of drilling.

Groundwater elevations at the Marion Creek site can be expected to fluctuate seasonally and may be higher in the spring during breakup and during or after periods of precipitation.

3.3.3 Frozen Ground

Frozen soils were encountered in all of the soil borings during this investigation. Each of the borings had surficial seasonal frost which varied in thickness from 1.0 feet to 2.0 feet. In addition, permafrost was encountered in Borings B-4, B-5 and B-6 at depths below 12, 6 and 12 feet respectively, extending to the depth drilled. Boring B-8 encountered frozen soils for the entire depth drilled (16 feet). The fine grained frozen soils were generally well bonded with no visible ice present. The underlying granular frozen soils were generally moderately bonded with some segregated ice crystals visible throughout the sand and gravel matrix.

4.0 CONCLUSIONS AND RECOMMENDATIONS

4.1 Discussion

The scope of work for this study included exploration of the general subsurface conditions of the National Park Service Marion Creek Housing site in Coldfoot, Alaska. This section presents our foundation recommendations and discussions regarding site developments. The foundation recommendations and discussions which follow are specific to the Marion Creek site only and should not be construed as applicable to any other site in the Coldfoot region.

The soil conditions and characteristics which we believe are important in the design of a building foundation at this site are: active layer depth and depth of surficial frost susceptible soils; soil thaw settlement and stability of frozen soils; stability characteristics of potential deep frozen soils; and compressibility and bearing capacity of surficial thawed soils.

The soil profile encountered at undisturbed portions of the site consisted in general of a surficial organic layer underlain by fine grained, frost susceptible silt and silty sand which was underlain by granular, marginally frost susceptible sandy gravel. An area occupying approximately 1/3 of the site on its western end had been cleared to expose granular, marginally frost susceptible sandy gravel at the ground surface. Occasional cobbles and boulders were encountered within the sandy gravel layer throughout the site.

Near surface permafrost was encountered in the sparsely treed, eastern portion of the site. This permafrost was encountered in Borings B-4, B-5, B-6 and B-8 at depths below 12, 6, 12 and 2 feet, respectively. Some visible ice was observed in the frozen sandy gravel samples taken from these borings. This visible ice and the results of laboratory moisture content tests indicate that some thaw settlement could occur in these frozen soils if or when they thaw due to the influence of building heat or site modifications. Permafrost was not encountered within the borings drilled in the cleared, borrow pit portion of the site (Borings B-1, B-2 and B-3). In addition,

permafrost was not encountered within the 21.5 feet explored by Boring B-7. Deep seated permafrost may be present below the depths explored. If deep seated permafrost does exist, however, it is our opinion that thaw settlements within this permafrost will not be reflected in significant differential settlements beneath relatively small residential structures.

Based upon the information obtained from our investigations, it is our opinion that the proposed housing and maintenance structures could be adequately founded upon either conventional continuous and spread footing foundations (in areas of no near surface permafrost) bearing on compacted, structural fill, post and pad foundations bearing in deep replacement structural fill in areas of near surface permafrost.

A post and pad foundation is recommended in areas of near surface permafrost because it provides a thermal separation between the structure and the ground surface thus minimizing thawing of the subsurface soils and can be designed to permit minor re-leveling if undesirable, potentially damaging frost heaving or differential settlement occurs.

The following sections provide detailed recommendations and discussions regarding post and pad as well as conventional footing foundation construction and additional site developments.

4.2 Post and Pad Footing Recommendations

4.2.1 Construction Recommendations

A post and pad foundation could be constructed on and backfilled with either non-frost susceptible, compacted, native granular soils, or on an imported replacement structural fill. The posts supporting the structure should bear on pad foundations or footings in the compacted, native granular soils or replacement fills. This concept is illustrated schematically in Figure 14. With this foundation concept we recommend that the structure be elevated above the gravel pad by a minimum of 3 feet to reduce the transfer of heat from the structure into the subsurface soils. The base of the pads should be founded a minimum of 3 feet below grade and should be

placed on a minimum of 2 feet of compacted structural fill or re-worked and compacted, non-frozen, native granular soils meeting the gradation requirements of a structural fill.

The footings or pads should be a minimum of 3 feet wide and may be sized for a maximum allowable bearing capacity of 2000 pounds per square foot. The footings may consist of concrete or treated wood and should be designed to distribute foundation loads evenly. The posts and pads should also be designed, loaded and sized as uniformly as possible.

With this type of foundation system there is a potential for some differential foundation settlement or movement, and provisions should be incorporated into the design of the building to foundation connections to re-level the structure if necessary.

4.2.2 Site Preparation

For initial site preparation of the building footprint areas, we recommend excavating and removing all surficial organic material. Based on our borings, we believe a surficial excavations of approximately 1 foot will remove the surficial organics. Individual pad foundation sites may then be excavated and prepared as recommended. Depending on the construction techniques and post and pad spacing it may also be easier to remove all surficial silt and silty sand as part of the initial site preparation.

4.2.3 Settlements

If the foundations are designed according to these recommendations, we expect that the proposed buildings will experience total settlements of 1.5 inches or less with differential settlements of 1 inch or less under static load. These settlement estimates account for some thawing of the near surface permafrost present in the forested portion of the site due to building heat and site modifications. It should be noted, however, that local areas of higher ice content soils could be present in the area that could result in significantly higher settlement, and as such the post and pad foundations should be designed with releveled capabilities as discussed above.

4.3 Spread and Continuous Footings

4.3.1 Construction Recommendations

In areas of no near surface permafrost, such as the gravel pit, the proposed structures can be founded on continuous or spread footings bearing on compacted granular native or imported structural replacement fill, in our opinion. In this area a minimum 1-foot depth of compacted, structural fill is recommended beneath all spread and continuous footings, see Figure 15. A minimum 2-foot depth of compacted structural fill is recommended beneath any slabs on grade. The purpose of the structural fill layer is to help distribute footing loads and to provide more uniform bearing conditions beneath the footings and slabs. Footings bearing as recommended on a compacted structural fill can be designed for an allowable bearing pressure of 3000 psf.

The minimum recommended footing width is 2 feet for individual spread footings and 18 inches for continuous footings. The minimum recommended depth of embedment from bottom of footing to top of adjacent exterior grade is 4 feet for exterior footings. A minimum 2-foot depth of embedment beneath grade is recommended for interior footings of a continuously heated structure.

The recommended allowable bearing pressure can be increased by 30% for seismic loading conditions.

4.3.2 Site Preparation

If a spread and continuous footing foundation is constructed, we recommend that all frozen, organic, and compressible materials be removed from areas beneath the proposed building footprint. The base of all excavations should be proofrolled and compacted prior to the placement of backfill material to determine if any soft or compressible areas exist which may require additional over-excavation. In addition, all seasonally frozen materials should be removed or allowed to thaw in areas below the proposed building prior to construction.

4.3.3 Settlement

If the foundations are designed according to these recommendations, we expect that the proposed buildings will experience total settlements of 1 inch or less and differential settlements of ½ inch or less under static load. The potential for deep seated permafrost beyond the depths explored exists. These foundation settlement estimates are based on the assumption that this potential deep seated permafrost is not ice rich and if thawed will not be reflected in any significant differential settlements in the proposed buildings. Based on the soil conditions encountered in our borings we believe these assumptions are reasonable.

4.4 Internal Roads, Driveways and Parking Areas

We recommend that the cross section for internal roads, driveways and parking areas subject to light vehicle traffic consist of at least a 2-foot thick, compacted subbase placed over a compacted subgrade. We further recommend that the subbase course consist of a granular material meeting the structural backfill gradation requirements of Section 4.6. In our opinion, the performance of the roadway embankments would be significantly improved by the application of a 6-inch thick compacted surface course meeting Alaska DOT gradation requirements for a D-1 base course. The binding properties of the D-1 base course would provide a more durable wearing surface and would limit the segregation of larger gravel from the subbase materials to the roadway surface.

We recommend that the top 6 inches of the subgrade and the subbase layer be compacted to at least 95% of the Modified Proctor maximum dry density. If applied, the D-1 base course should be compacted to 98% of its Modified Proctor maximum dry density.

All organic and compressible silts should be removed as part of the site preparation prior to compaction of the subgrade and placement of the subbase layer. Based on our borings, we estimate that this will require excavations of approximately 1-foot within the forested portions of the site. Due to the frost susceptibility of the subgrade and subbase materials, all grading

for roadways and parking areas should incorporate adequate drainage provisions to prevent the ponding of surface runoff adjacent to roadway and parking area embankments. Infiltration of ponded water into the embankments could saturate subgrade and subbase materials resulting in increased frost heave potential and subsequent thaw softening. In areas of deep surficial silty soils the servicability of the pavement section could be improved by excavating additional silty soils and/or using a geotextile to separate subgrade and subbase soils.

4.5 Excavation Limits and Slopes

The base of the foundation excavations, should extend beyond the outside edge of the footing as defined by a 1 horizontal to 1 vertical line extending out and down from the outside bottom edges of the footings. The footings should bear in compacted, re-worked native granular soils meeting the structural fill gradation requirements given in Section 4.6 or on compacted, imported replacement structural fill. We anticipate a minimum depth of excavation on the order of 5 feet for post and pad foundations and 6 feet for continuous and spread footing foundations will be required. Additional excavation may be necessary if unsuitable soils are encountered.

In our opinion the construction of safe excavation slopes should be made the responsibility of the contractor, as he will have direct control of working conditions in the field. All applicable local, state and federal regulations relating to construction procedures should be observed. For planning purposes, slopes steeper than 1 horizontal to 1 vertical should not be planned. While the thawed surficial on-site soils may stand near vertical when cut, they may be subject to sloughing and caving when they dry out, particularly when equipment is operated nearby. Frozen soils may also be subject to sloughing as they thaw, particularly if they are ice-rich or granular.

4.6 Structural Backfill

A structural backfill should be provided beneath the footings, slabs or pads. This material should consist of unfrozen, granular, native or imported, gravelly sand or sandy gravel which

meets the following gradation limits after compaction:

<u>Size</u>	<u>% Passing</u>
4"	100
1/4"	Less than 80
200 Mesh	Less than 10 (based on the 3/4" minus fraction)

In our opinion, the in-situ granular soils encountered throughout the site, although marginally frost susceptible, are suitable as structural backfill providing they meet the above grading requirements and that the drainage and grading recommendations of Section 4.8 are followed. In order to limit the potential for frost heaving in these native soils below the building foundations, it is important that they should not be allowed to become saturated due to the infiltration of surface runoff trapped around building foundations. The availability of local borrow sources providing non-frost susceptible structural backfill has not been explored.

The fill should be placed in layers not exceeding 8 inches in loose height and the material in each layer should be compacted by a vibratory compactor to achieve a density of at least 95% of the maximum density as determined from the modified Proctor moisture-density relationship. The water content of the fill should be altered by wetting or drying as necessary to achieve the desired compaction.

All fill should consist of unfrozen material and should be placed at above-freezing air temperatures. If previously placed, uncompacted fill freezes, for instance overnight, the frozen material should be excavated and wasted or allowed to thaw and be recompacted prior to the placing of additional fill.

The structural backfill should be brought up at the same rate on both sides of footings or pads. We further recommend that fill within 5 feet of proposed footings be compacted with hand-

operated vibratory compactors weighing less than 300 pounds.

4.7 Non-Structural Backfill

Non-structural fills may be used to raise the site level for landscaping or to backfill utility trenches outside of the structures, driveways, and parking areas. Non-structural fills may consist of silts and sands from the building excavation. However, it should not contain topsoil or organics. Maximum lift thickness for non-structural fill should not exceed 12 inches in loose height. This material should be compacted to at least 90% of the maximum density obtained from the modified Proctor compaction test. Drying or wetting of the soil may be necessary to obtain compaction.

4.8 Drainage and Grading

In all cases the driveways, parking areas and the developed portion of the site, in general, should be sloped to direct all roof runoff and surface water away from the proposed structures. Landscaping fills should also be placed to prevent ponding of water near the proposed structures or infiltration of large quantities of water into soils near the foundation systems.

4.9 On-Site Sewage Disposal

Based on the subsurface conditions encountered and data from the percolation test performed during this investigation, we believe it is feasible to provide on-site sewage disposal with a septic tank and leach field system. Because of the near surface permafrost encountered in the eastern, forested area of the site, the percolation test was performed in the thawed, granular soil of the borrow pit area adjacent to Boring B-2 at a depth of approximately 10 feet. We believe that the thawed, granular sandy gravel underlying the western, cleared borrow pit area is sufficiently permeable to support a leach field. A percolation rate of a minimum of 10 minutes/inch was determined as an adequate design rate for the thawed granular soils encountered.

Due to the relatively deep depth of seasonal frost penetration anticipated at the site, especially

in areas cleared of their insulative organic cover, it may be appropriate to insulate sewage collection piping, septic tanks and leach fields to reduce the potential for freeze-up. Insulation of these exterior systems may be accomplished through insulated utilidors, sprayed polyurethane foam insulation with a waterproof coating, rigid polystyrene "blue board" insulation suitable for direct burial, increased depth of burial and the mounding of soils over backfilled excavations to levels above original grade.

4.10 Domestic Water Well

Groundwater at the Marion Creek site was encountered at a depth of 14.1 feet below the existing ground surface in Boring B-1. Groundwater was not encountered in any of the other borings during this investigation.

Although near surface permafrost was encountered in the borings located within the eastern forested portion of the site, no near surface permafrost was encountered in the borings located within the western, cleared portion of the site. It appears that the modification of clearing the site of its insulative organic cover during borrow pit operations has created a thaw bulb in any near surface permafrost underlying the cleared area. However, the potential for deep seated permafrost located beneath the depths explored in the cleared area (35 feet) does exist.

It is difficult to determine aquifer characteristics from the limited information gathered from a single shallow boring. Potentially, the groundwater encountered in Boring B-3 represents a viable potable or gray water source. Additional exploration would be required to more fully define the characteristics of this potential aquifer. Characteristics of interest include in situ water quality, depth of thawed, water bearing strata, recharge sources such as connected regional aquifers and limiting boundary conditions such as underlying permafrost. The past and future site use should also be considered in regard to potential groundwater contamination via the infiltration of surface discharged contaminants.

It should be noted that the nearby services at Coldfoot are reported to utilize two domestic water wells of 45 feet and 37 in depth respectively to service the restaurant and employee housing.

Any domestic use water wells emplaced at the Marion Creek site should be installed and tested in accordance with all applicable Alaska D.E.C. regulations.

5.0 LIMITATIONS

The analyses, conclusions and recommendations contained in this report are based on site conditions as they presently exist and further assume that the exploratory borings are representative of the subsurface conditions throughout the site, that is, that the subsurface conditions everywhere are not significantly different from those disclosed by the exploration. If, during construction, subsurface conditions different from those encountered in the exploratory holes are observed or appear to be present beneath excavations, advise us at once so we can review these conditions and reconsider our recommendations, when necessary.

Unanticipated soil conditions are commonly encountered and cannot be fully determined by merely taking soil samples or test borings. Such unexpected conditions frequently require that additional expenditures be made to obtain a properly constructed project. Therefore, some contingency fund is recommended to accommodate such potential extra costs.

If substantial time has elapsed between the submission of this report and the start of work at the site, or if conditions have changed because of natural causes or construction operations at or adjacent to the site, we recommend that this report be reviewed to determine the applicability of the conclusions and recommendations considering the time lapse or changed conditions.

If you desire, we will review those portions of the plans and specifications which pertain to earthwork and foundations to determine if they are consistent with our recommendations. In addition, we are available to observe construction, particularly the excavation, compaction of structural fill, preparation of all foundations, and quality control testing of Portland cement concrete.

This report was prepared for the exclusive use of the owner and architect and/or engineer in the design of the subject facility. It should be made available to prospective contractors and/or the

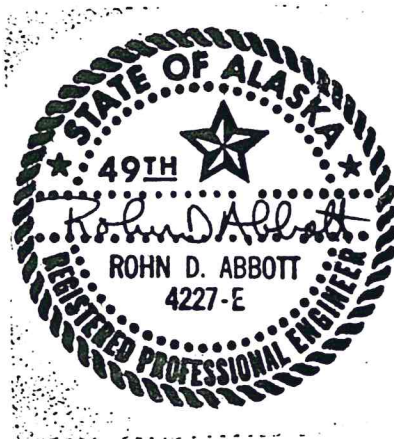
contractor for information on factual data only and not as a warranty of subsurface conditions such as those interpreted from the boring logs and presented in discussions of subsurface conditions included in this report.

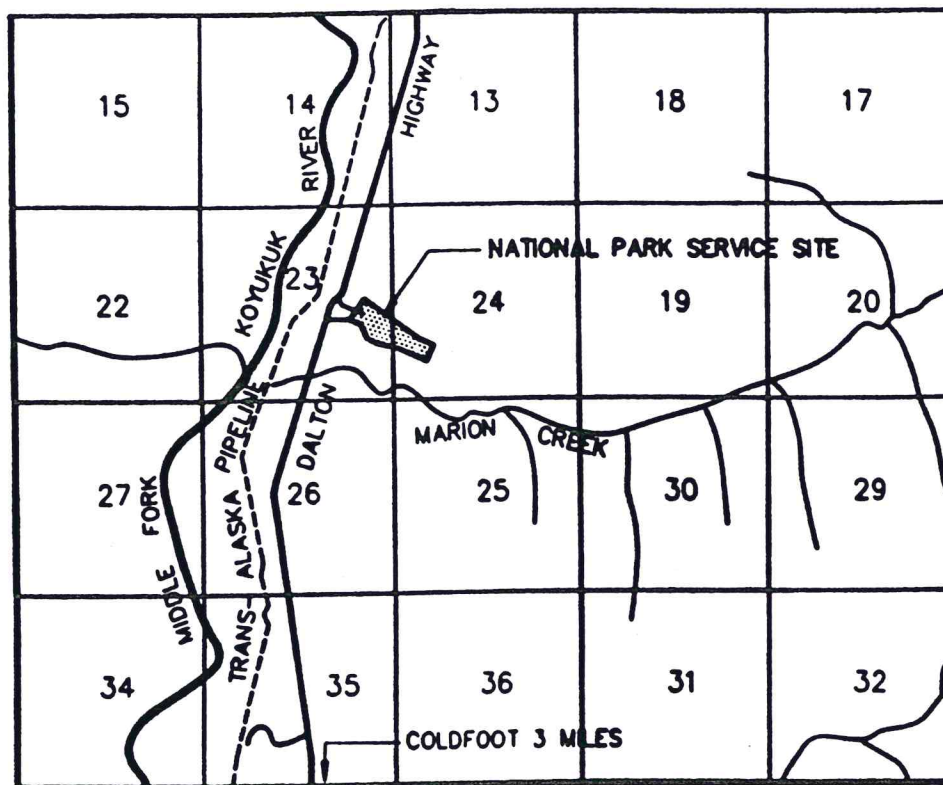
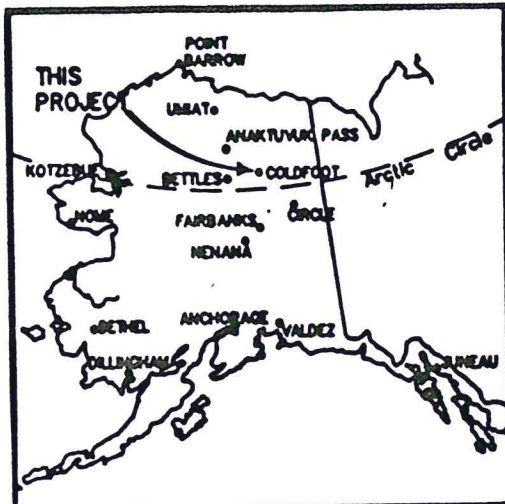
Sincerely,

SHANNON & WILSON, INC.

By Rohn D. Abbott
Rohn D. Abbott, P.E.
Senior Vice President

RDA:DD





VICINITY MAP

U.S.G.S. QUAD: WISEMAN (B-1), ALASKA
SCALE: 1" = 1 MILE

National Park Service Housing
Coldfoot, Alaska

SITE LOCATION MAP

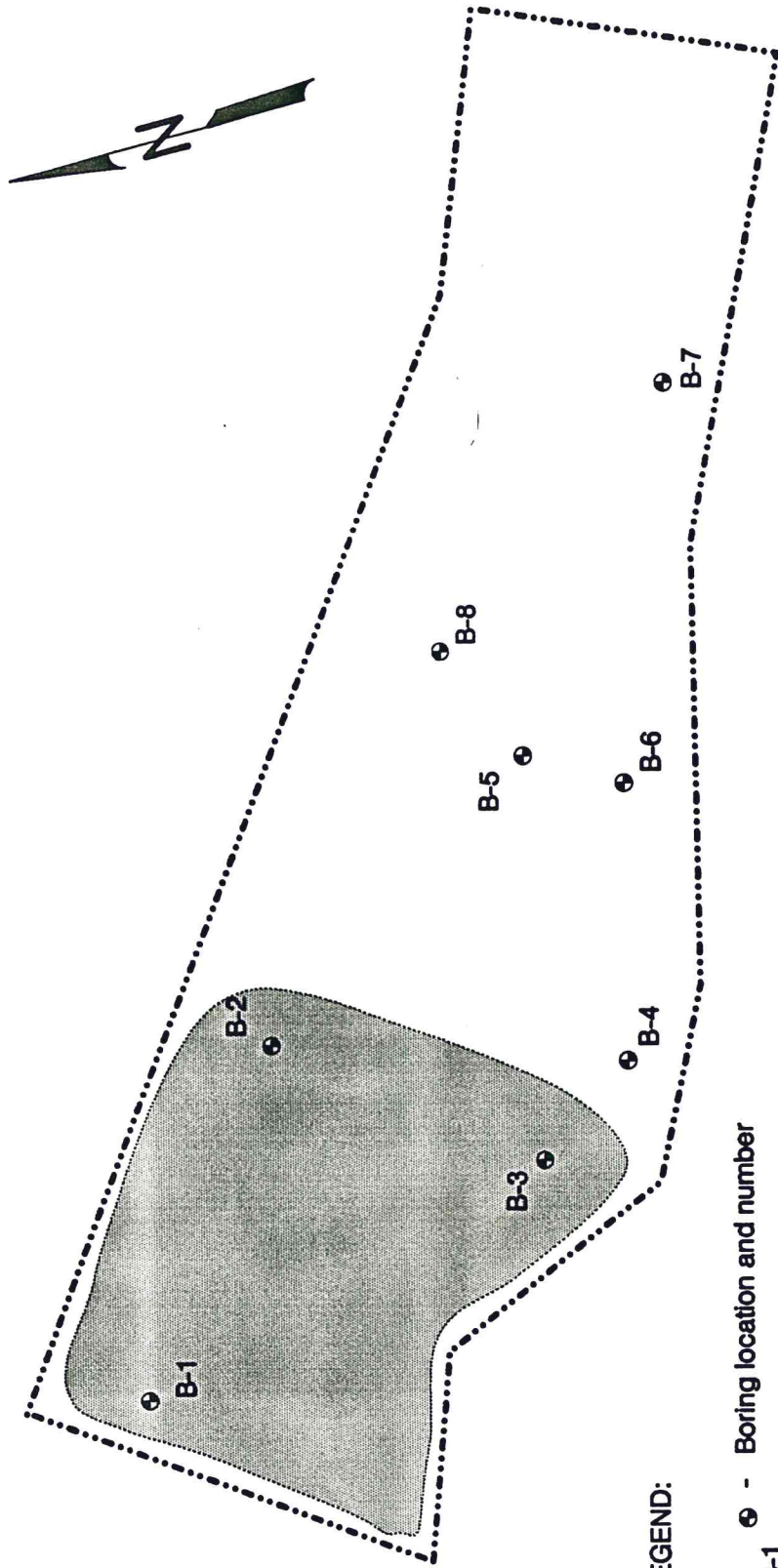
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Fig. 1



LEGEND:

⊕ - Boring location and number

----- Property Boundary

----- Approximate Limits of Borrow Pit

Approximate Scale: 1" = 300 feet

Reference: Drawing is based on a boundary survey dated 10/30/91 supplied by Design Alaska, Inc.

National Park Service Housing
Coldfoot, Alaska

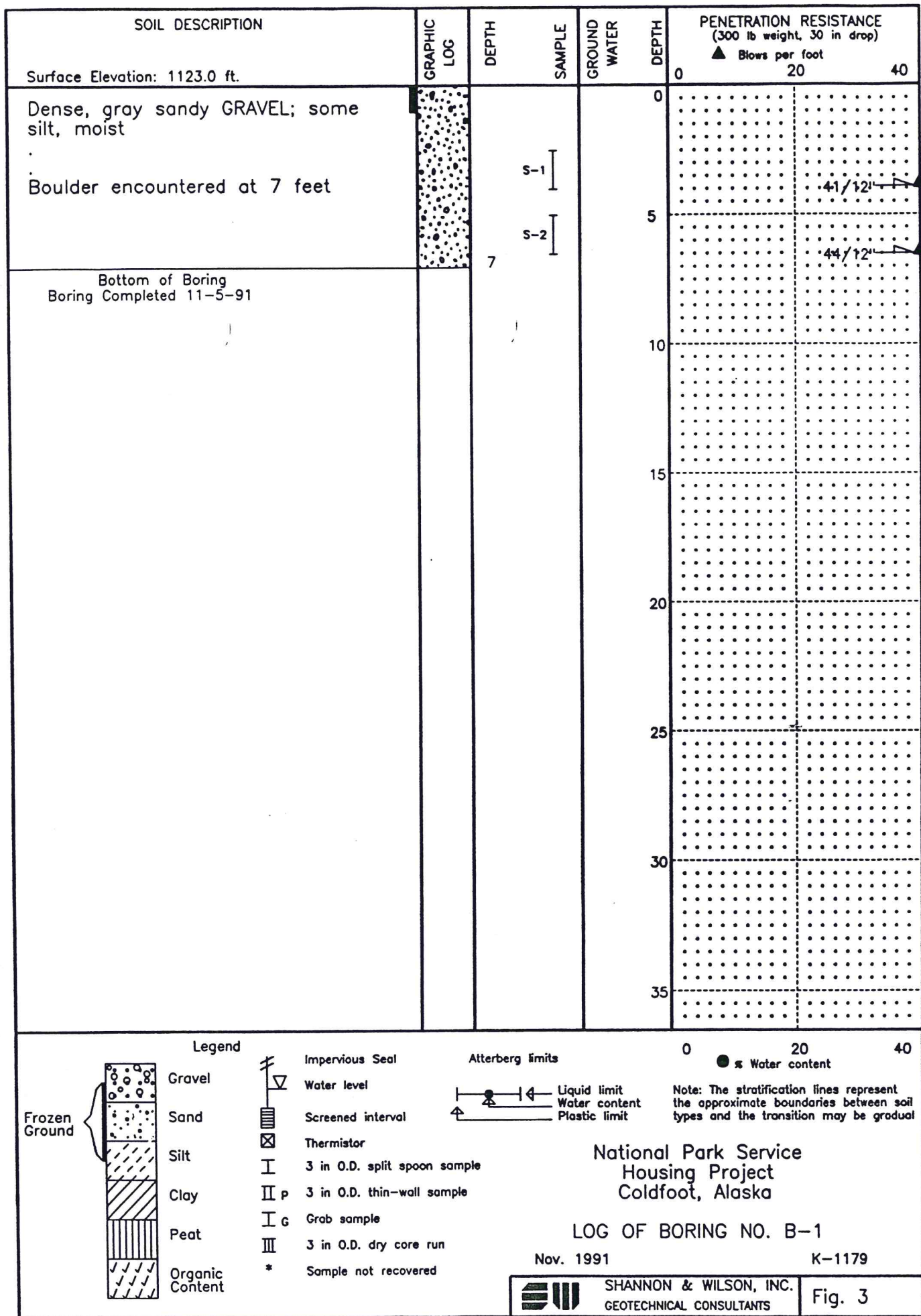
K-1179 BORING LOCATION AND SITE PLAN

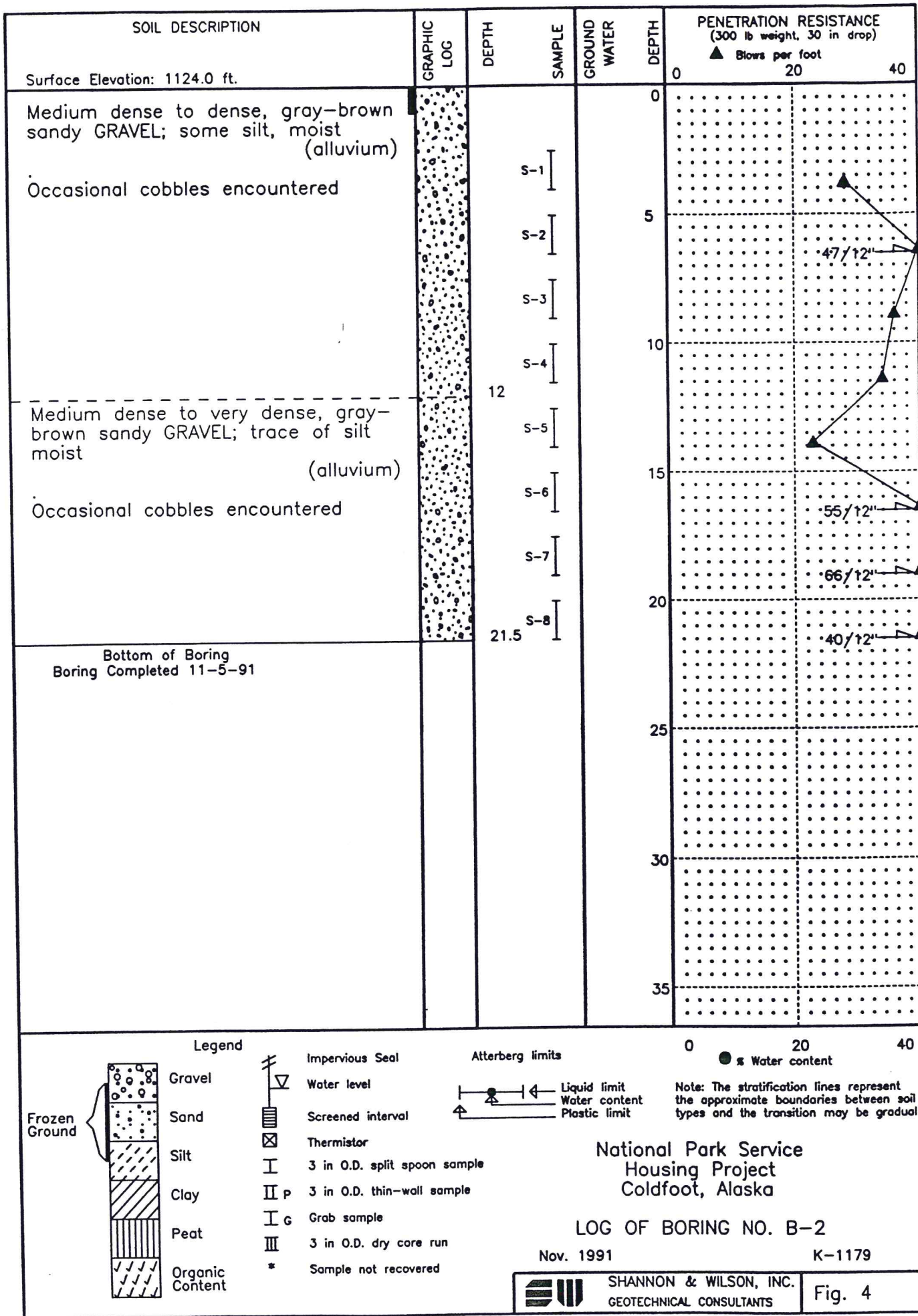
Nov. 1991

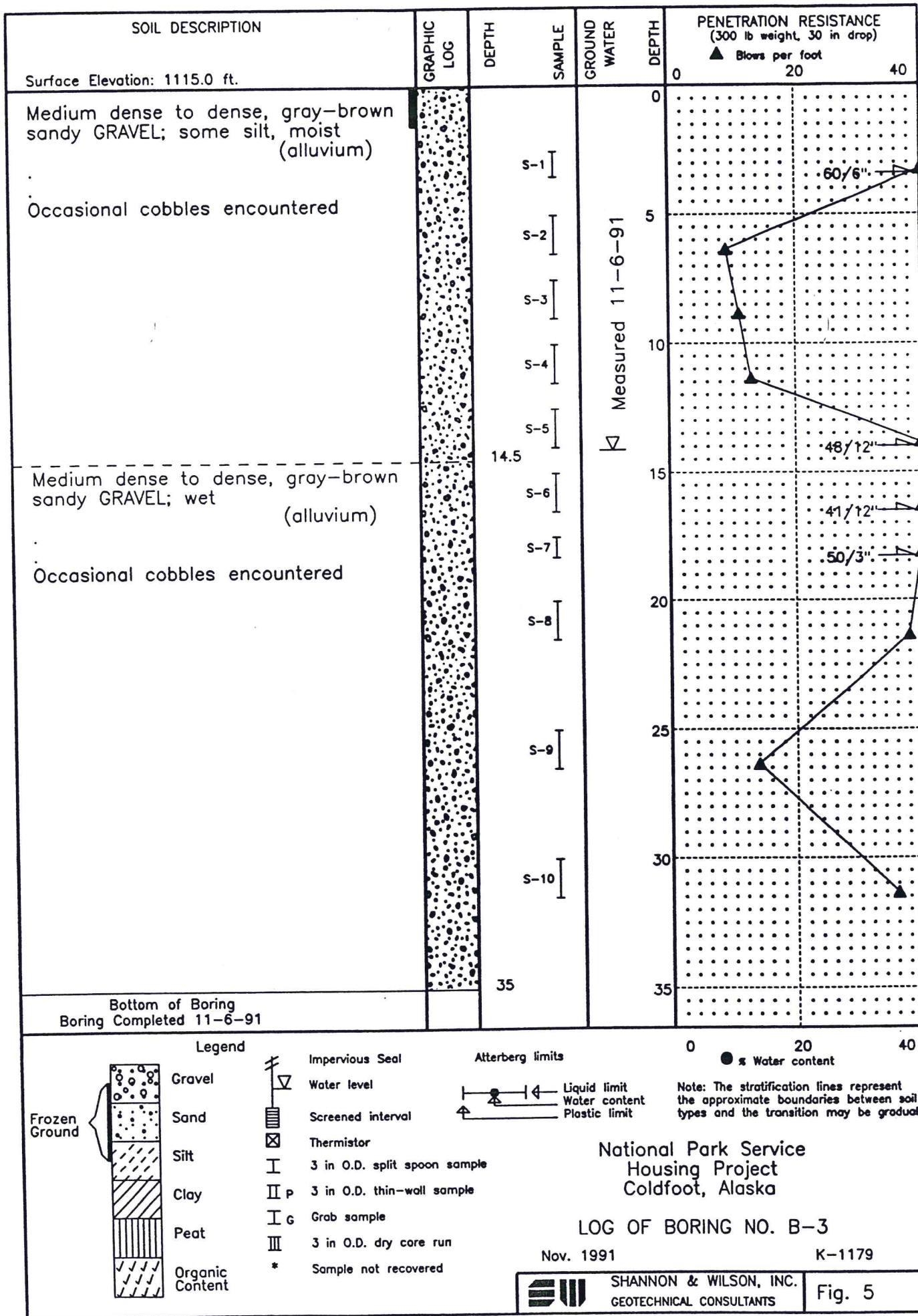
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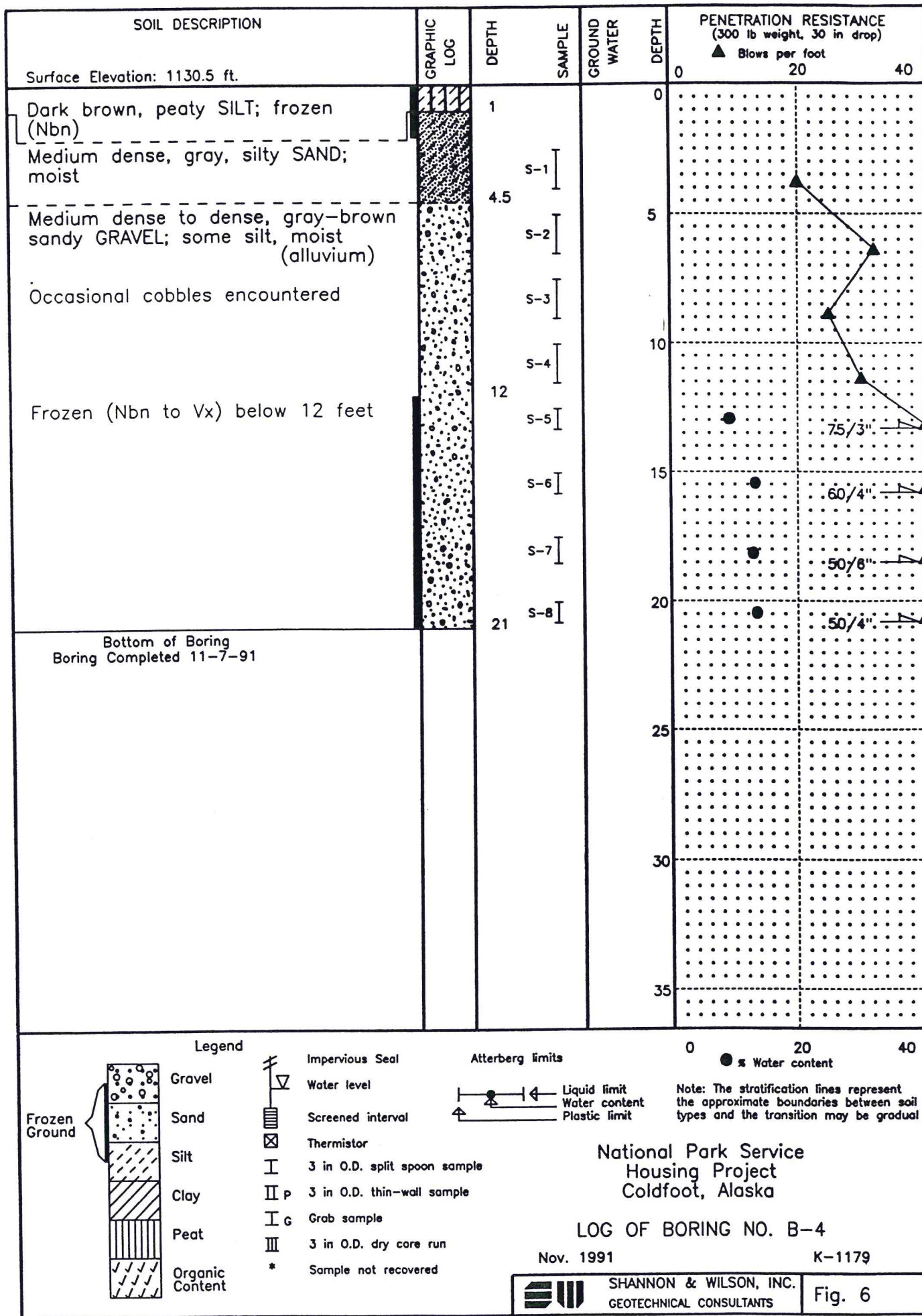
Fig. 2

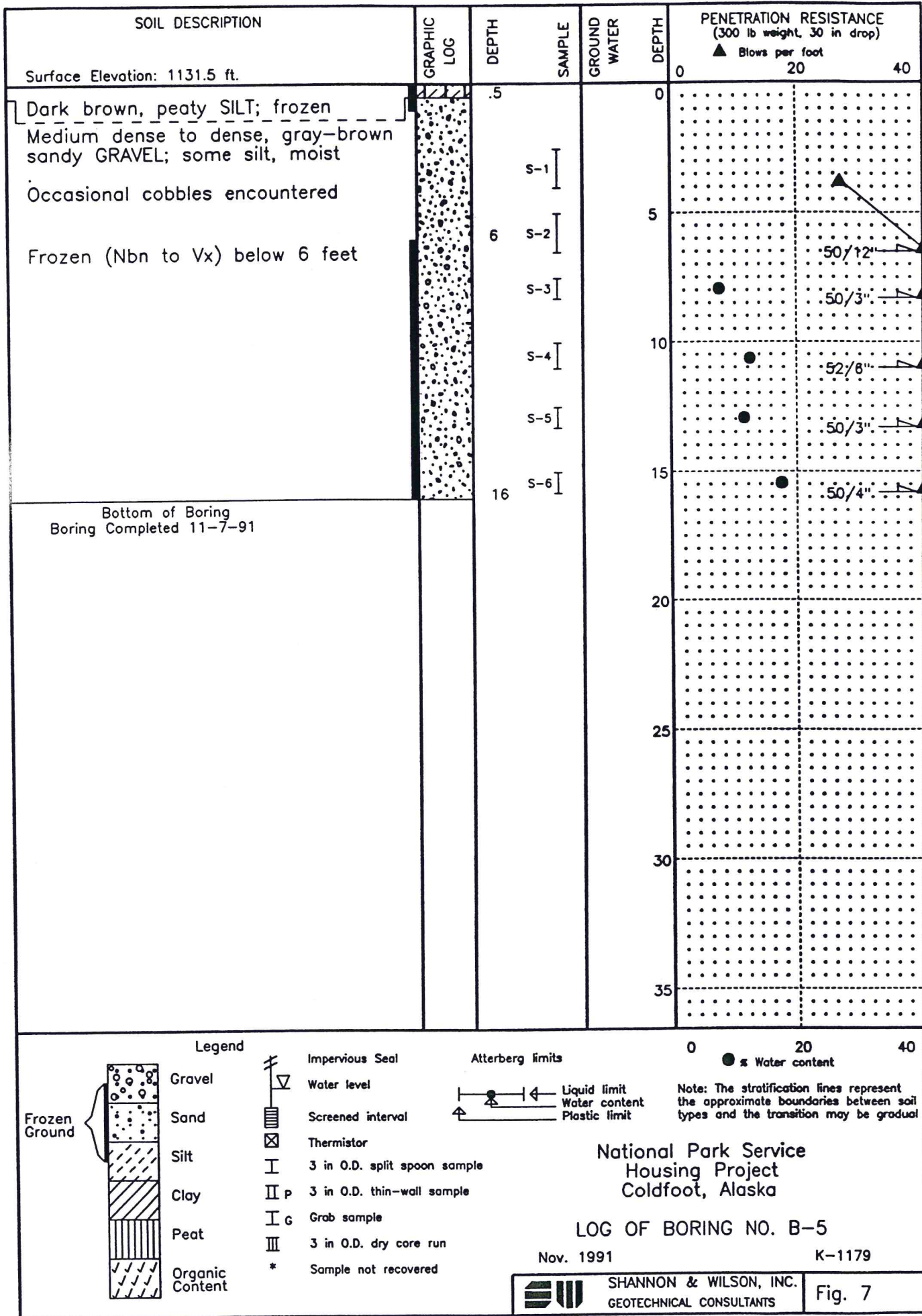
Fig. 2

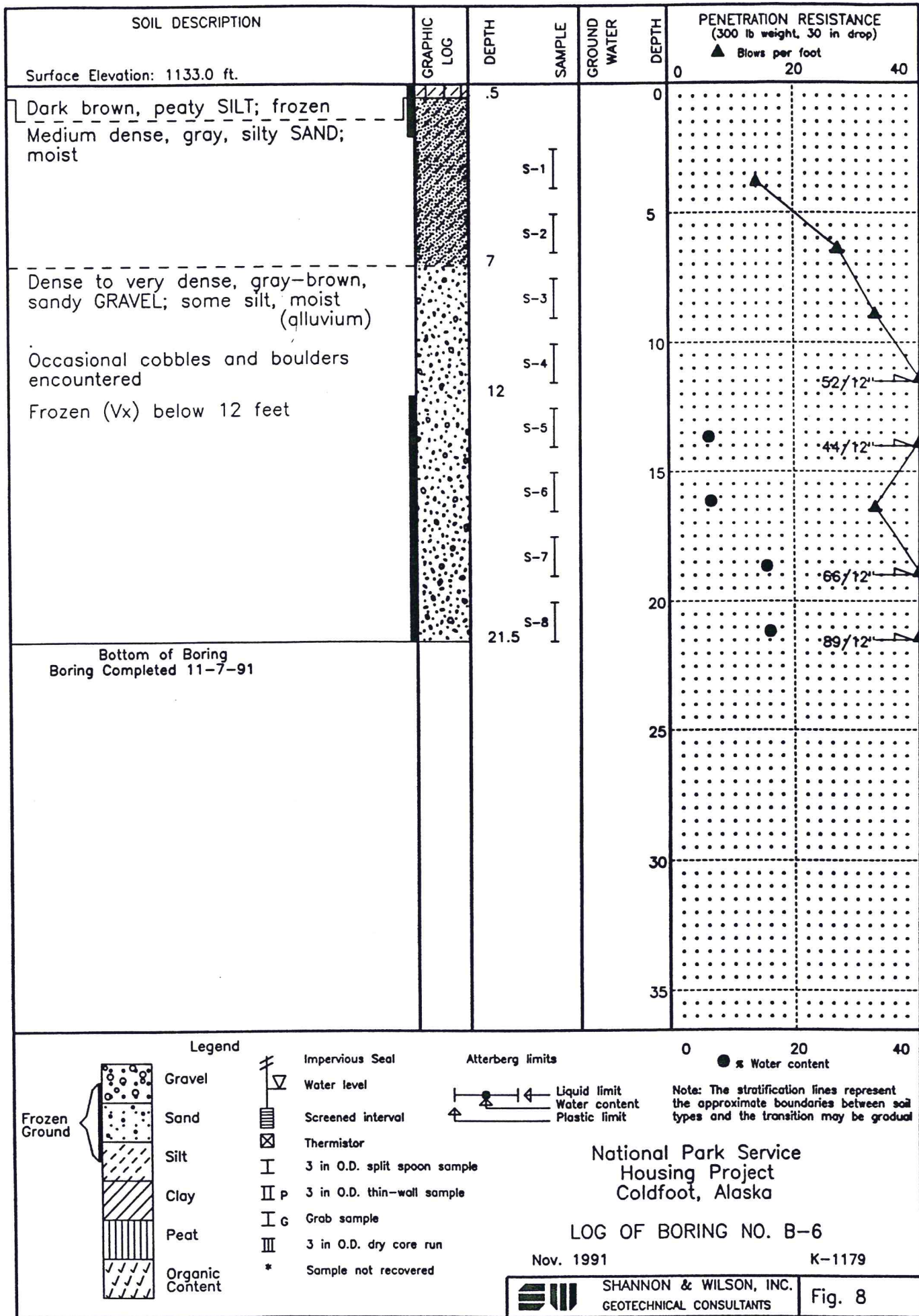


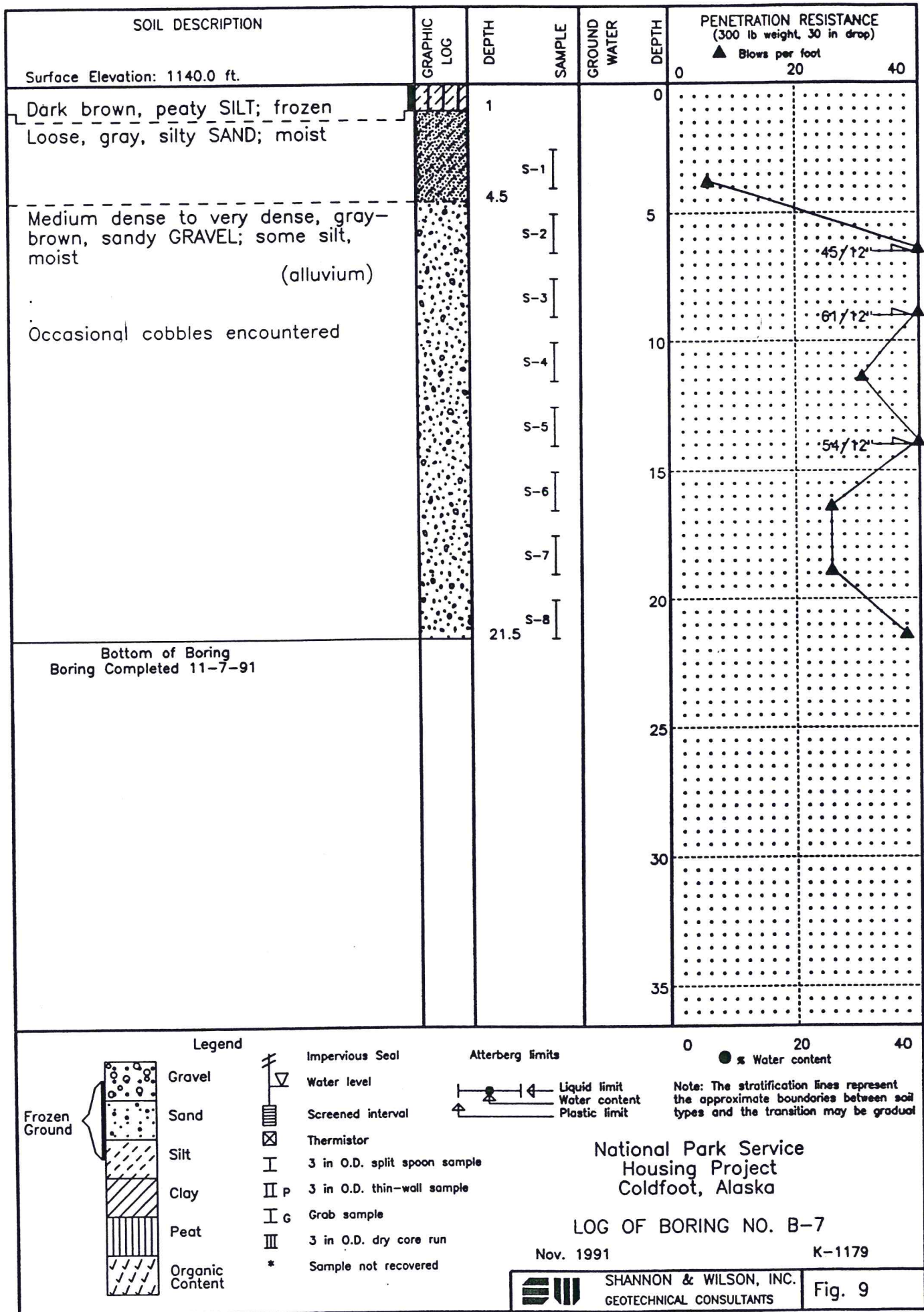


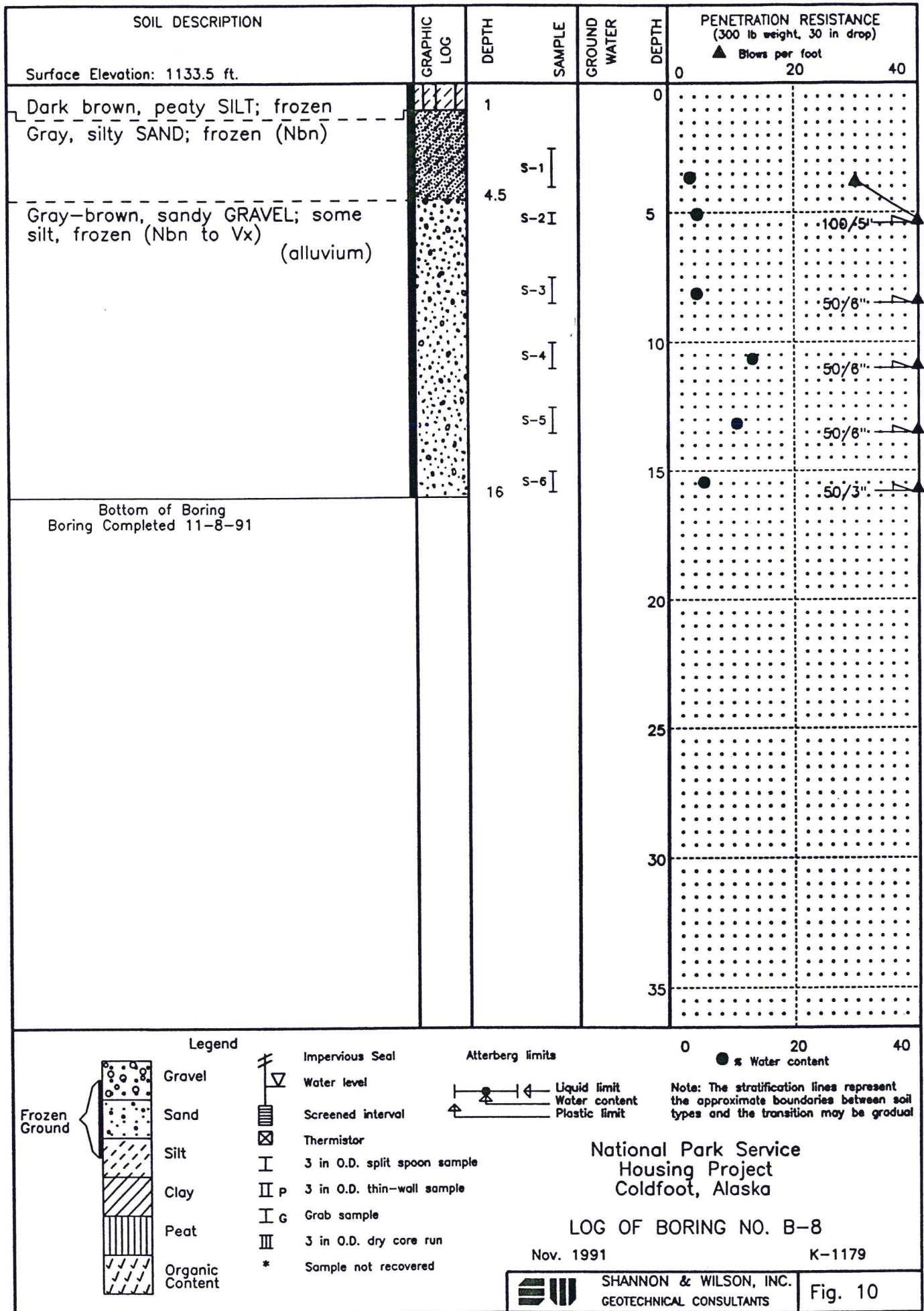






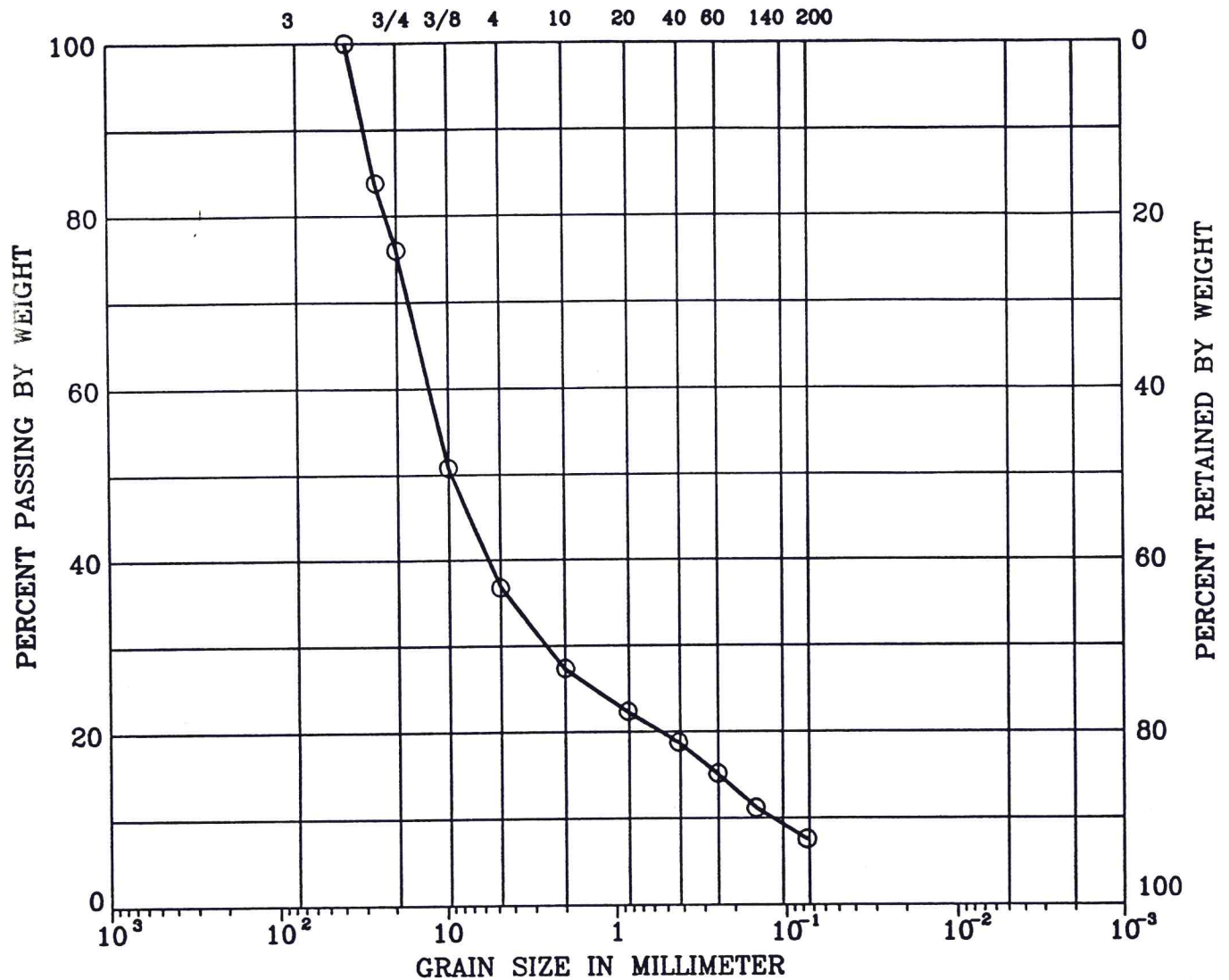






UNIFIED SOIL CLASSIFICATION

COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	
U.S. SIEVE SIZE IN INCHES			U.S. STANDARD SIEVE No.			HYDROMETER



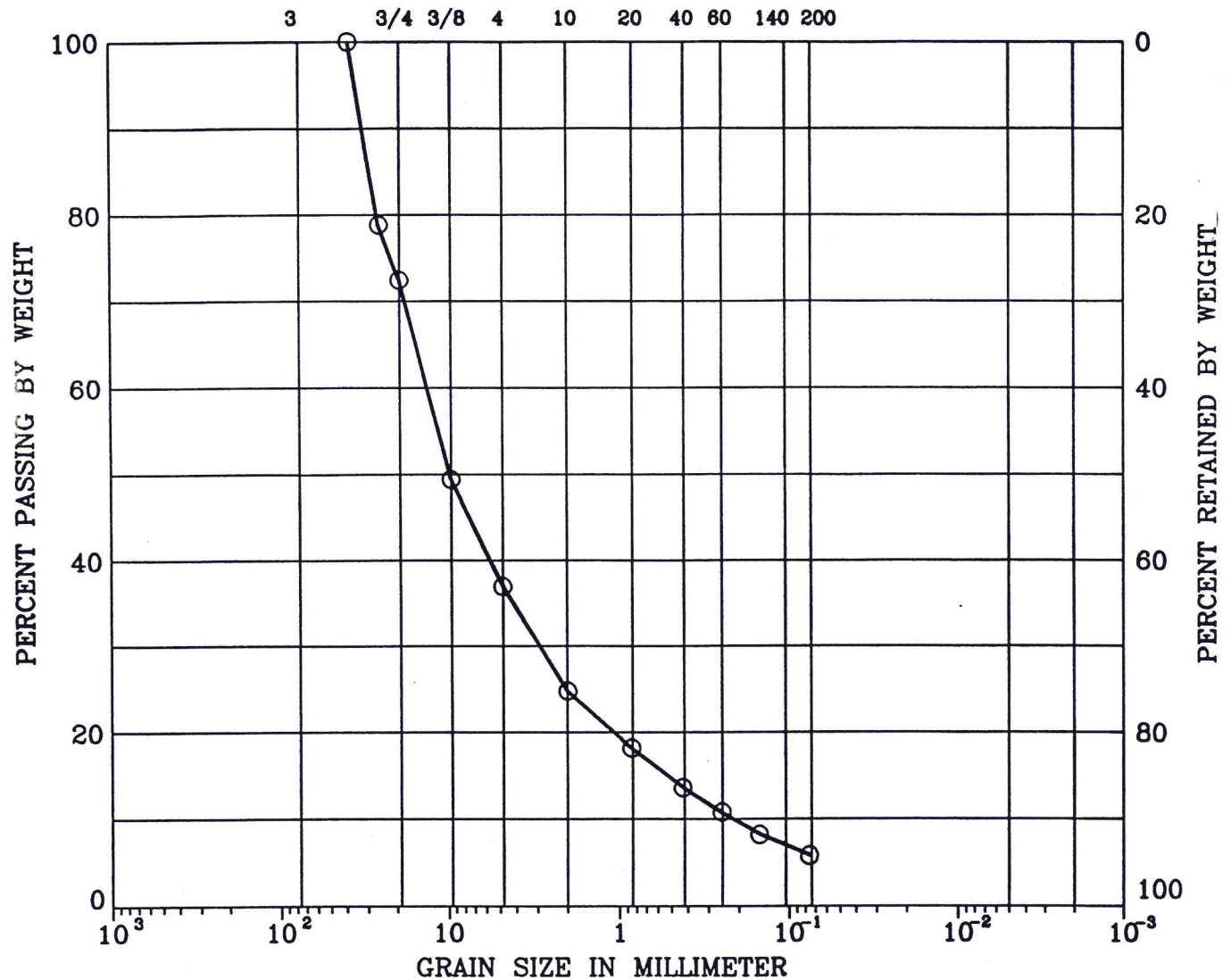
SYMBOL	BORING	DEPTH (ft)	LL (%)	PI (%)	DESCRIPTION
O	B-1,S-2	6.0			GP

Remark : Coldfoot Housing Project

Project No. K1179	National Park Service
SHANNON & WILSON, INC. Geotechnical Consultants	GRAIN SIZE DISTRIBUTION Figure No. 11

UNIFIED SOIL CLASSIFICATION

COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	
U.S. SIEVE SIZE IN INCHES			U.S. STANDARD SIEVE No.			HYDROMETER



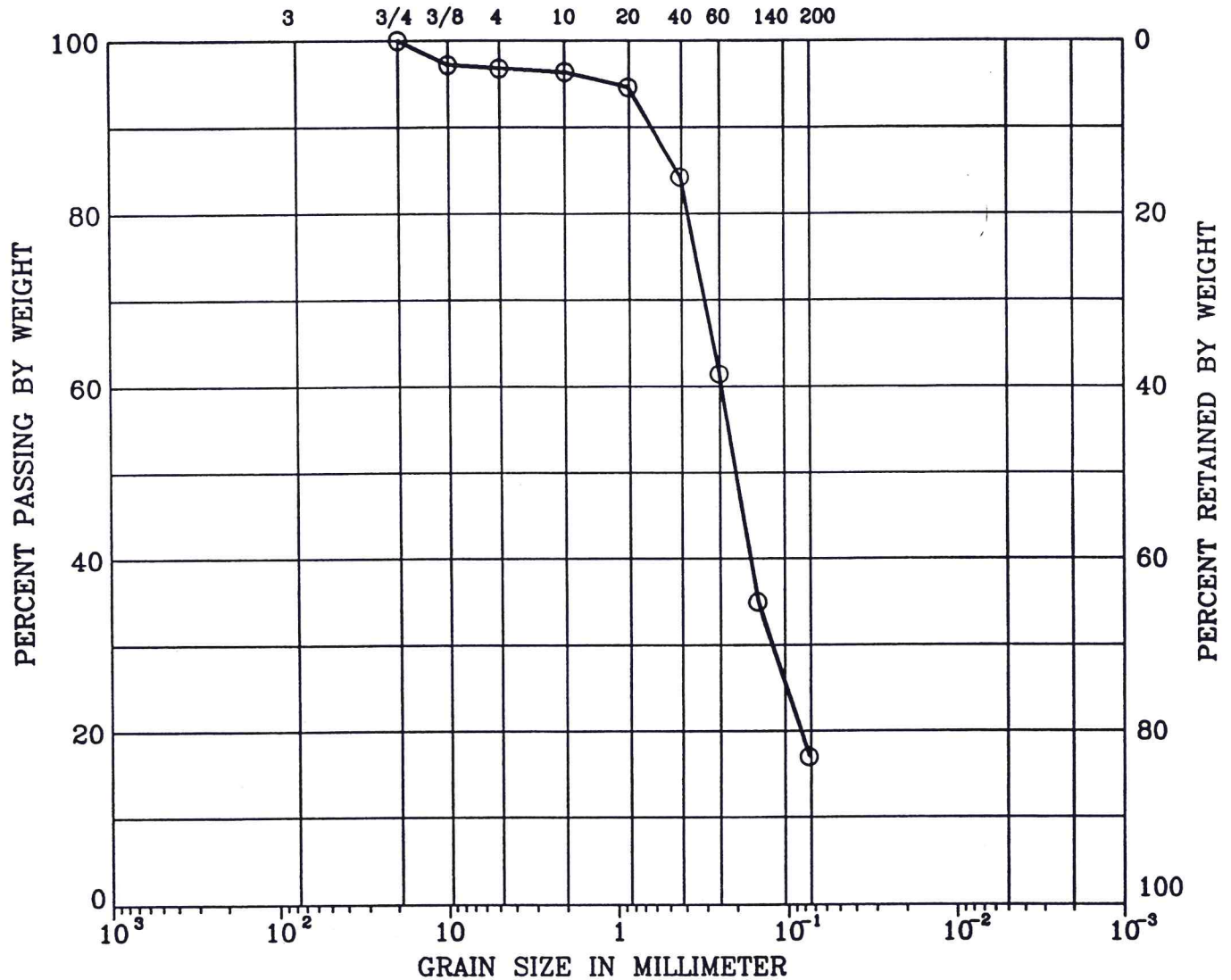
SYMBOL	BORING	DEPTH (ft)	LI (%)	PI (%)	DESCRIPTION
O	B-2,S-3	8.5			GW

Remark : Coldfoot Housing Project

Project No. K1179	National Park Service
SHANNON & WILSON, INC. Geotechnical Consultants	GRAIN SIZE DISTRIBUTION Figure No. 12

UNIFIED SOIL CLASSIFICATION

COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	
U.S. SIEVE SIZE IN INCHES			U.S. STANDARD SIEVE No.			HYDROMETER



SYMBOL	BORING	DEPTH (ft)	LL (%)	PI (%)	DESCRIPTION
○	B-6,S-1	3.5			SM

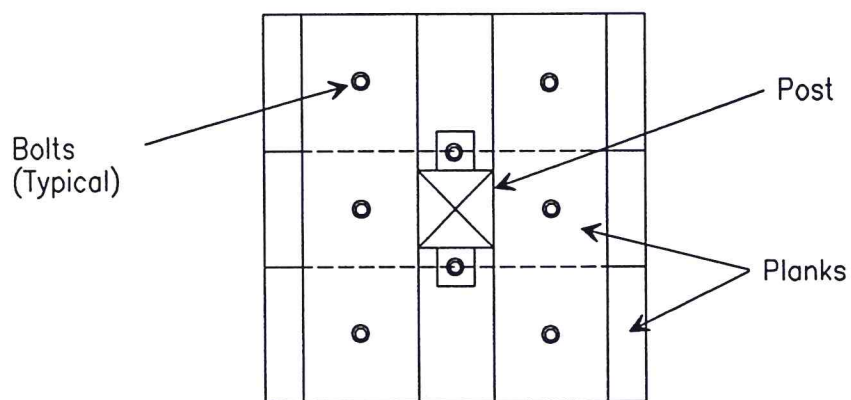
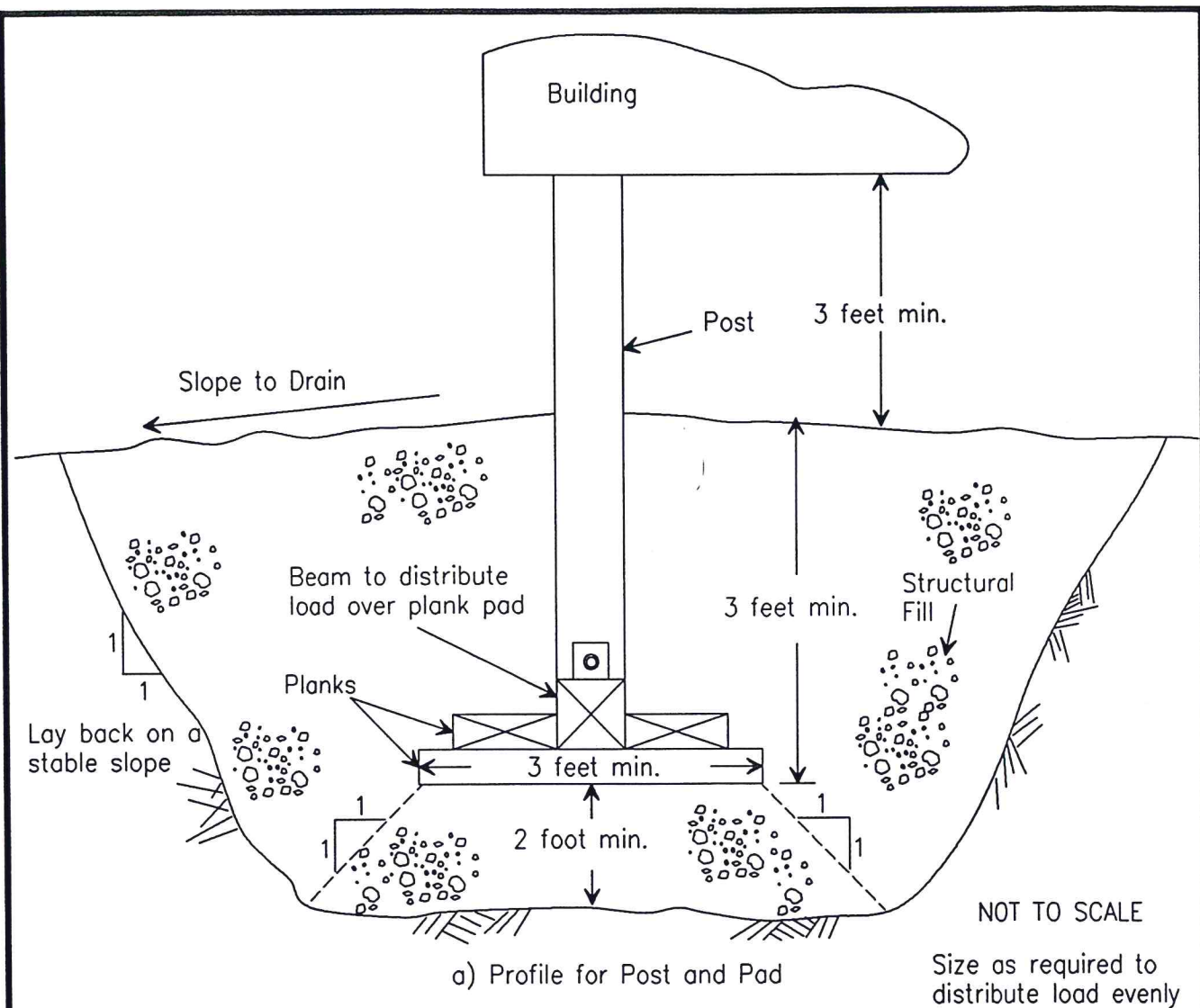
Remark : Coldfoot Housing Project

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National Park Service

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GRAIN SIZE DISTRIBUTION Figure No. 13



Notes: 1) Post and Pad details shown for treated wood are conceptual. A structural engineer should design details of pad.

2) Pad could also consist of reinforced concrete.

National Park Service Housing
Coldfoot, Alaska

POST AND PAD
FOUNDATION RECOMMENDATIONS

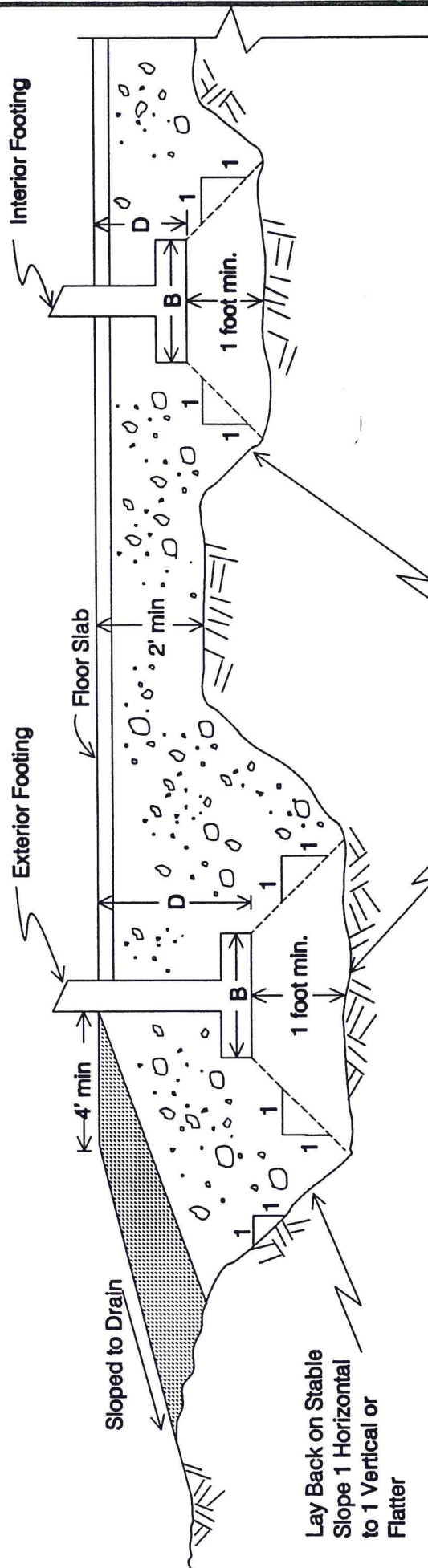
Job No. K-1179

Dec 1991



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Fig. 14



NOT TO SCALE

LEGEND:



- Structural Backfill (See Report for placement details.)



- Non-Structural Backfill (See Report for placement details.)

B - Footing Width: 1.5 feet minimum for continuous footings
2 feet minimum for spread footings

D - Footing Depth: 4 foot minimum for exterior footings
2 foot minimum for interior footings

FOUNDATION RECOMMENDATIONS

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Fig. 15