US ARMY
CORPS OF ENGINEERS
PORTLAND DISTRICT

KELLOGG CREEK – HIGHWAY 99E FISH PASSAGE GEOTECHNICAL FEASIBILITY STUDY

MILWAUKIE, OREGON

SEPTEMBER 2003

REPORT

CORNFORTH
CONSULTANTS

Report to:

Corps of Engineers, Portland District
P.O. Box 2946
Portland, Oregon 97208-2946

KELLOGG CREEK - HIGHWAY 99E FISH PASSAGE
GEOTECHNICAL FEASIBILITY STUDY
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September 2003

Submitted by:

Cornforth Consultants, Inc.
10250 SW Greenburg Road, Suite 111
Portland, OR 97223

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1. INTRODUCTION

1.1 General

The information and results presented in this report were prepared in response to the "Detailed Statement of Work for Contract No. DACW57-00-D-0011, Task Order No. 16," dated April 8, 2003. This project involves the geotechnical feasibility study for fish passage improvements at the Highway 99E Kellogg Creek crossing. The proposed project may include notching and/or removal of a barrier (check dam) to restore a more natural stream channel beneath the bridge. The restoration project would restore the stream channel and approximately 14 acres of associated riparian and wetland habitats in the lower 0.75 miles of Kellogg Creek to a more natural state. The project is located in Milwaukie, Oregon, as shown in Figure 1, Vicinity Map.

Objectives. The objectives for this project are:

- Conduct difficult-access subsurface drilling program beneath the bridge.
- Coordinate with ODOT, ODFW and the City of Milwaukee.
- Drill and sample five boring locations to depths of approximately 10 to 25 feet, using HWT Casing Advancer and HQ3 coring methods.
- Perform Standard Penetration Testing (SPT) every 2½ feet in overburden soils.
- Core drill the bedrock with an HQ3-wireline coring system.
- Perform limited laboratory testing, including: water contents on SPT samples and unconfined compression testing on rock samples.
- Reduce lab data and prepare summary boring logs.
- Prepare a geotechnical feasibility study.

1.2 Available Information

The Portland District Corps of Engineers (NWP) provided a site plan and cross sections of the site.

1.3 Scope of Work

Permits

Work was delayed several months due to the need to obtain permits and permissions prior to the start of drilling. Verbal permission was obtained from ODOT to work within the structure. Through coordination and assistance by the Portland District, permissions were obtained for the work from Oregon Fish and Wildlife, NOAA and the City of Milwaukee, Oregon. It was determined, however, that the work must be performed during the in-water work period, requiring a delay of drilling until July, 2003. In addition, the drilling subcontractor filed geotechnical hole reports for each boring with Oregon Water Resources Department upon completion of the exploration program.

Coordination

Cornforth Consultants, Inc. provided the resources for all coordination efforts required for the task order, including the following:

- John Sager was the Project Manager (PM) and served as a single-point of contact and liaison between Portland District and Cornforth Consultants, Inc. Kenji Yamasaki worked on completing this report.
- Cornforth Consultants, Inc. provided all coordination and management of the work for the Corps of Engineers, Portland District.
- Corps of Engineers Portland District contacts were as follows:

  P.O.C.: Dave Scofield and Tim Kuhn

Explorations

A drilling and sampling program was completed that included logging of SPT and core samples. Details of the drilling program are presented in Section 2, Subsurface Investigation.

Inspection and Logging

An experienced geotechnical engineer logged the drilling action and samples retrieved from the borings, in accordance with EM 1110-1-1804. Classification of subsurface materials utilized ASTM D-2488, Standard Practice for Description and Identification of Soils (Visual-Manual Procedure) and Portland District approved methods for rock core logging.

Laboratory Testing

Laboratory testing was performed to define static properties of subsurface materials in accordance with EM 1110-2-1906, Laboratory Testing Procedures. Details of laboratory testing program are presented in Section 3, Laboratory Testing.

Data Analysis

Summary boring logs were prepared for all subsurface explorations. The summary logs present our interpretation of the geology at boring locations. Logging procedures followed Portland District classification standards and practices. Laboratory results were summarized and used to develop appropriate soil parameters. A cross-section was developed to show subsurface conditions and approximate bedrock locations.

Engineering Analyses of Construction Option Feasibility

Geotechnical engineering analyses were performed to recommend options for constructing a deeper channel section for two options: (1) the south side of the structure only, and (2) the entire width of the structure.

Checkpoint Meetings

The following coordination meetings were held during the progress of this study:

- Checkpoint Meeting No. 1 – reviewed the proposed field investigation for approval and included the Site Safety Plan.
- Checkpoint Meeting No. 2 – preliminary review of findings and presentation of the field results.
- Checkpoint Meeting No. 3 – follow-up to the submitted draft report

2. SUBSURFACE INVESTIGATION

2.1 General

The drilling program for this project included a total of five borings. Crux Subsurface of Spokane, Washington, Oregon, performed the exploratory drilling on July 14 through 18, 2002, using a skid/roller-mounted Burley 2000 drill rig. The boring locations where accessed by lowering the drilling equipment with a boom truck from a bridge located on a frontage road immediately adjacent to the box culvert that supports the Hwy 99E bridge deck.

2.2 Exploratory Borings

Five exploratory borings, DH-1 through DH-5 were performed within the box culvert underneath Highway 99E, which also serves as a fish passage structure. The locations of the borings and the fishway are shown on the Site Plan, Figure 2. The boreholes were drilled vertically to depths ranging from 20 to 25 feet. During drilling operations, the portable rig was anchored to the base of the concrete slab in the box culvert using 6-inch long “red head” wedge anchors. The borings were advanced using HWT casing-advancer and HQ3-wireline core drilling techniques. Disturbed samples were obtained in conjunction with Standard Penetration Tests (SPT) performed at approximately 2½-foot intervals. When competent rock was reached, HQ3-wireline coring was used for the remainder of each hole. Details of the exploratory borings, including soil descriptions and core photographs are presented on the Summary Boring Logs, Figures 3 through 7. Refer to Table 1 for a supplemental legend for the summary boring logs. Copies of field boring logs are included in Appendix A.

3. LABORATORY TESTING

3.1 General

Laboratory testing was performed to determine soil index and engineering properties. Moisture content tests and soil classifications were performed at Cornforth Consultants soil laboratory in Portland, Oregon in accordance with EM 1110-2-1906, Laboratory Testing Procedures. Unconfined Compressive Strength tests were performed on two samples by the Oregon Department of Transportation Materials Laboratory.

3.2 Soil Classification

Soil and rock core samples obtained from the field exploration program were visually re-examined in the laboratory to confirm field classifications using ASTM D-2488. Together with the results of additional laboratory testing, final soil descriptions were prepared using ASTM D-2488. Final soil classifications and descriptions are presented on the Summary Boring Logs, Figures 3 through 7.

3.3 Natural Moisture Content

Moisture contents were determined on all SPT samples retrieved from the field explorations in general accordance with ASTM D-2216. The results of all moisture content tests are shown on the Summary Boring Logs.

3.4 Unconfined Compression Tests

Two unconfined compression tests were performed on rock core specimens from borings DH-1 and DH-2. The Materials Laboratory of the Oregon Department of Transportation performed the tests. The reported unconfined compressive strength of each test is the ultimate deviator stress, calculated by dividing the ultimate applied axial load by the initial specimen cross-sectional area. The tests were performed in accordance with ASTM D-2938. The results of the unconfined compression tests are summarized in the following table and the details are included in Appendix B.

Summary of Unconfined Compression Tests

Boring No., Sample No., Depth (ft)	Soil/Rock Description	Unit Weight, pcf		Moisture Content (%)	Rock Unconfined Compressive Strength (psi)
		Sat.	Dry		
DH-1, R-2, 22.7 to 23.7	BASALT, fresh, RQ, HARD, highly fractured	167	159	4.6	7442
DH-2, R-3, 17.6 to 18.3	BASALT, fresh, RQ, HARD, highly fractured	161	151	5.9	8611

4. SUBSURFACE CONDITIONS

4.1 Subsurface Conditions

All borings were started by coring through the concrete slab that forms the base of the culvert. Refer to Figures 3 through 7 for summary boring logs. The concrete slab was determined to be 4½ to 6 inches thick. A layer of dense to very dense gravelly sand (very highly weathered basalt), was encountered immediately beneath the concrete in borings DH-2, DH-4 and DH-5 and graded to highly weathered basalt at approximately 7, 10 and 12½ feet, respectively. At these locations, it is estimated that the dense to very dense layer of gravelly sand is predominantly a residual soil resulting from weathering of basalt bedrock.

Borings DH-1 and DH-3, located at the upstream end (east side) of the box culvert, encountered loose materials below the base slab. In fact, Boring DH-1 encountered a 2-foot void beneath the slab before encountering loose gravelly sand (2½ to 9 feet) and then a medium dense to dense gravelly silty sand (9 to 14½ feet) with some zones of higher silt and clay content. Below 14½ feet, boring DH-1 encountered very dense gravelly sand (very highly weathered basalt) grading to highly weathered basalt to a depth of 25 feet. Beneath the slab, DH-3 encountered very loose sandy silt to a depth of 14 feet. Below 14 feet, DH-3 encountered very dense silty gravelly sand (very highly weathered basalt) grading to only slightly less weathered basalt with clayey zones of completely decomposed rock to a depth of 26 feet. It is estimated that the loose soils at these locations are transported soils and/or reworked residual soils. The dense and very dense soils are estimated to be residual soils resulting from weathering of basalt bedrock.

Unconfined compression tests were performed on two intact basalt samples. Results of these strength tests are summarized in table 3.1 and indicate that the basalt tested was about 8000 psi (hard to medium hard rock). Due to the overall poor quality of the rock mass, only fresh basalt core samples could be tested, therefore, the rock tested is not representative of the entire rock mass. The strength of the rock mass would be primarily governed by the weak, very highly weathered rock and clay zones.

4.2 Groundwater

Borings DH-1 and DH-3 encountered artesian groundwater flows immediately beneath the concrete slab. The artesian flows and the loose material/void space beneath the slab likely indicate that the water behind the impoundment wall has been seeping around the wall for some time, and is likely the cause of the large voids beneath the slab. The artesian flows did not dissipate by the time the holes were sealed, therefore, a special steel plate with a neoprene gasket was required to seal the hole following drilling.

Groundwater levels in DH-2, DH-4, and DH-5 were about 10 feet below the slab, except in DH-5 the level varied up to 15 feet below the slab.

4.3 Geotechnical Cross Section

A generalized longitudinal cross-section was developed through the box culvert as shown in Figure 2. The five boring locations are projected on this figure.

5. CONSTRUCTION FEASIBILITY

5.1 General

The Detailed Statement of Work lists two main options to be assessed for construction feasibility of lowering the stream channel approximately 10 feet. This would require excavation directly adjacent to the existing bridge footings as shown in Figure 8. The two options requested for review are: (1) leaving the existing footings as-is as the channel is excavated, and (2) underpinning and/or reinforcement of footings for channel excavation. Both of these options are evaluated for two scenarios, namely, excavation of only the south half of the channel (area of existing trench) and excavation of the entire width of the channel. It is assumed for design that the upstream impoundment area would be dewatered, all sediments removed from against the impoundment wall and stream flows bypassed through the work area.

The existing foundation of the highway overpass is a large box-culvert with strip footings beneath the exterior walls and small spread footings beneath the interior columns. The exterior wall strip footings are shown as approximately 3½-feet square in cross-section with the top of the footing level with the top of the concrete base slab. The interior spread footings appear to be 3½-feet square in plan view and 2 feet deep, with the top of the footing even with the base slab except for the two upstream-most columns. It appears that the two upstream columns extend 4 to 8 feet below the base slab. The lower footings are likely a result of encountering poor foundation materials, as confirmed in Borings DH-1 and DH-3 at the upstream end of the structure.

5.2 Option 1 - Channel Excavation With No Structural Reinforcement

This option is not feasible for either channel width scenario, due to the vertical and lateral forces acting on the existing foundation elements and the type of subsurface materials. Foundation subsurface materials consist of loose soils with voids and highly weathered rock with clay seams. These materials are not adequate to support the excavation of a 10-foot deep channel immediately adjacent to the existing foundation. The existing box culvert has regularly spaced struts built into the base slab to resist lateral movements at the existing foundation level. Removing these struts and excavating the new channel will require the addition of structural elements to limit the risk of permanent deformations and/or failure of the structure.

5.3 Option 2 - Channel Excavation With Structural Reinforcement

Structural reinforcement of the existing foundation elements is required for channel excavation. Feasible construction options discussed below are: first, excavation of only the south half of the channel and secondly, excavation of the entire channel width.

Option 2A - Excavation of the South-Half of the Channel. Structural elements must be added to minimize horizontal and vertical movements of the existing culvert sidewalls and foundation. A horizontal force is required at the existing foundation level to resist lateral movements during construction and for long-term loading conditions. This force could be applied by the use of tiebacks, and may require modification to the existing foundation. Tiebacks could be steel bars grouted in drilled holes and tensioned to apply force to the face of walls. Tiebacks would have to be installed with specialized equipment due to the limited room in the culvert. Tiebacks would need to be anchored into the decomposed basalt or highly weathered basalt, and need to be designed accordingly. Tieback elements would eliminate the need for lateral beam support and allow for open channel excavation during construction and provide permanent open channel flow without obstructions. An alternative to the tieback system is the use of internal bracing such as struts to permanently resist lateral movement of the new channel walls.

To resist vertical movements of the existing foundation, a structural system should be employed to transfer the existing vertical loads to the deeper rock strata. This is of more significant importance at the upstream end of the excavation area due to the loose subsurface materials. Also, since the structure continues upstream for another 35 feet from the area of the channel excavation, differential settlements between the two sections must be limited to very small amounts.

Structural systems that could be utilized are: small diameter cast-in-place piles and micropiles. Micropiles are small diameter, bored piles in which steel bars or pipes are grouted into boreholes to form the piles. These pile systems would be designed to resist the vertical loads due to the overpass structure, and structurally connected to the existing foundation. The selected pile system must also resist lateral loads associated with the excavation and construction of the new channel. The new channel would be overexcavated and a new channel base slab, which would be a structural member, would be constructed to withstand the lateral forces at the lower wall area of the permanent structure. Once these elements are constructed, temporary supports, if utilized, could be removed. The base slab could be covered with boulders and gravel to provide a more natural stream channel appearance and function.

The Interior columns would be structurally supported by the same method utilized on the exterior wall, but some longitudinal bracing and foundation modifications may be required.

Option 2B - Excavation of the Entire Channel Width. Excavation of the entire channel width could utilize the same construction method as discussed for Option 2A for the exterior walls. In addition, interior columns would be required to be extended downward to the new channel base. To do this the existing structure would need to be temporarily supported during construction.

6. CONCLUSIONS AND RECOMMENDATIONS

6.1 General

It is our opinion that feasible construction options are available to perform the channel deepening of the Kellogg Creek – Highway 99E Fish Passage. To perform this work, the existing overpass/culvert structure must be structurally underpinned. A method for performing this work has been summarized in Section 5 and includes tiebacks and pile elements.

6.2 Recommendations

Further geotechnical studies for this project would involve the final design of tieback and pile systems to resist lateral and vertical loads for construction and long-term loading. The assistance of a structural engineer is required to determine proper design of existing and proposed foundation structural elements of the overpass/culvert structure.

CORNFORTH CONSULTANTS, INC.

By ______________________________

Kenji Yamasaki, P.E.
Associate Engineer

By ______________________________

John Sager, C.E.G.
Senior Associate Engineering Geologist

Cornforth Consultants, Inc.
Landslide Technology

Limitations in the Use and Interpretation of This Geotechnical Report

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Our professional services were performed, our findings obtained, and our recommendations prepared in accordance with generally accepted engineering principles and practices. This warranty is in lieu of all other warranties, either expressed or implied.

The geotechnical report was prepared for the use of the Owner in the design of the subject facility and should be made available to potential contractors and/or the Contractor for information on factual data only. This report should not be used for contractual purposes as a warranty of interpreted subsurface conditions such as those indicated by the interpretive boring and test pit logs, cross-sections, or discussion of subsurface conditions contained herein.

The analyses, conclusions and recommendations contained in the report are based on site conditions as they presently exist and assume that the exploratory borings, test pits, and/or probes are representative of the subsurface conditions of the site. If, during construction, subsurface conditions are found which are significantly different from those observed in the exploratory borings and test pits, or assumed to exist in the excavations, we should be advised at once so that we can review these conditions and reconsider our recommendations where necessary. If there is a substantial lapse of time between the submission of this report and the start of work at the site, or if conditions have changed due to natural causes or construction operations at or adjacent to the site, this report should be reviewed to determine the applicability of the conclusions and recommendations considering the changed conditions and time lapse.

The Summary Boring Logs are our opinion of the subsurface conditions revealed by periodic sampling of the ground as the borings progressed. The soil descriptions and interfaces between strata are interpretive and actual changes may be gradual.

The boring logs and related information depict subsurface conditions only at these specific locations and at the particular time designated on the logs. Soil conditions at other locations may differ from conditions occurring at these boring locations. Also, the passage of time may result in a change in the soil conditions at these boring locations.

Groundwater levels often vary seasonally. Groundwater levels reported on the boring logs or in the body of the report are factual data only for the dates shown.

Unanticipated soil conditions are commonly encountered on construction sites and cannot be fully anticipated by merely taking soil samples, borings or test pits. Such unexpected conditions frequently require that additional expenditures be made to attain a properly constructed project. It is recommended that the Owner consider providing a contingency fund to accommodate such potential extra costs.

This firm cannot be responsible for any deviation from the intent of this report including, but not restricted to, any changes to the scheduled time of construction, the nature of the project or the specific construction methods or means indicated in this report; nor can our firm be responsible for any construction activity on sites other than the specific site referred to in this report.

Table 1 Supplemental Legend for Summary Boring Logs
Figures 3 through 7

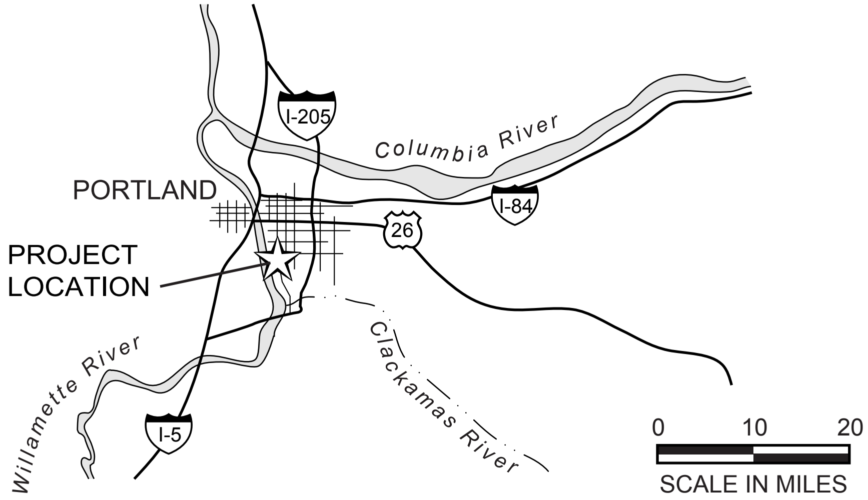
1. Subsurface material classifications were performed in general accordance with ASTM D 2487 (USCS = Unified Soil Classification System) and ASTM D 2488 (Visual-Manual Procedure), and Portland District approved methods.

2. Plasticity Descriptions of Soils
   - PLASTIC – The ability to roll the soil into a 1/8-inch string at some moisture content.
   - APL – Above the Plastic Limit. Refers to the natural moisture content of the material. Able to roll the soil into a 1/8-inch string without adding water.
   - BPL – Below the Plastic Limit. The soil cannot be rolled into a 1/8-inch string without the addition of water.
   - NP – Non Plastic. Cannot roll the soil into a 1/8-inch string at any moisture content.

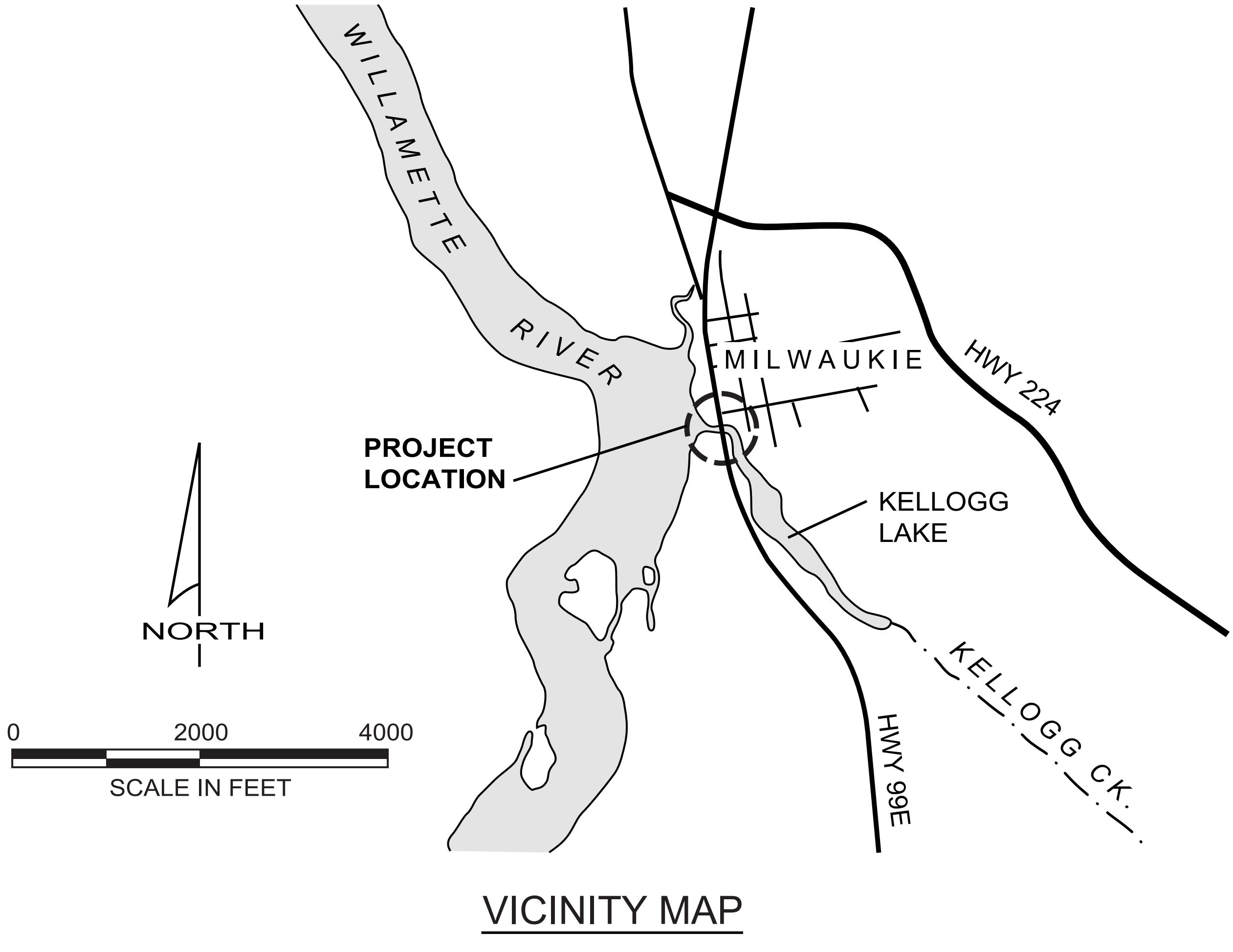
3. Rock Core Quality Descriptors
   - CORE RECOVERY – The ratio of the total length of recovered cores to the length of the core run.
   - RQD (Rock Quality Designation) – The ratio of the total length of core pieces greater than 4 inches in length to the length of the core run.

4. Field Compressive Strength of Rock

   Based on reactions to impact loading by means of a one-pound ball-peen hammer (or a well rounded pick end of a G-hammer).
   - MQ – Moldable Quality. The rock material is moldable, and therefore must be completely to partly decomposed.
   - CQ – Crush Quality. A reaction under the point of impact producing a shearing and upthrusting of adjacent mineral grains.
   - DQ – Dent Quality. A reaction under the point of impact producing a dent or depression. It indicates the presence of "pore space" between the mineral grains.
   - PQ – Pit Quality. A reaction under the point of impact producing a "shatter cone" and an explosive departure of mineral fragments. Results in a shallow rough pit.
   - RQ – Rebound Quality. A reaction under the point of impact in which there is no reaction by the rock.



AREA LOCATION MAP



VICINITY MAP

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1507\F01 MWT

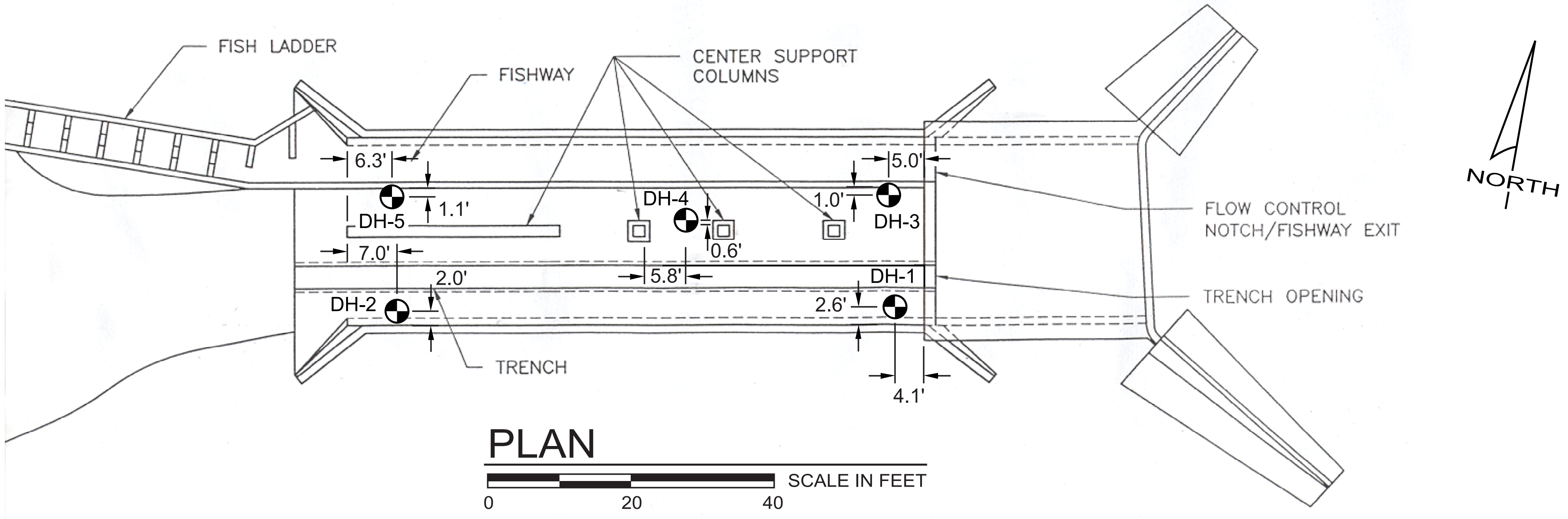
VICINITY MAP

KELLOGG CK./HWY. 99E FISH BYPASS
MILWAUKIE, OREGON

SEP 2003

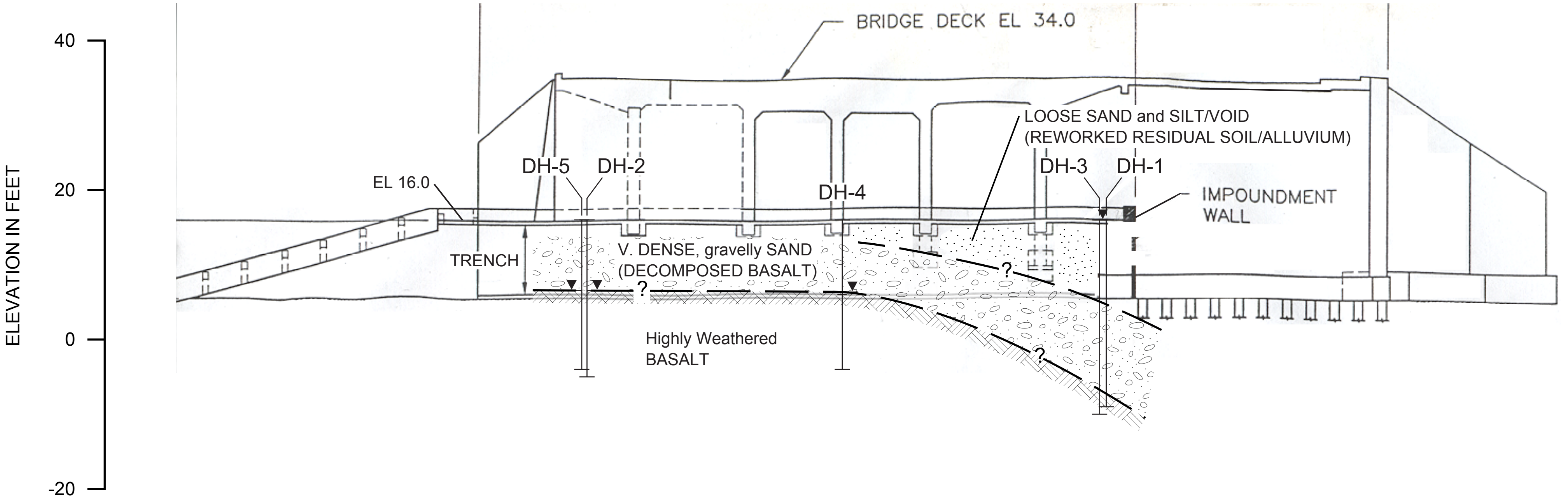
PROJ. 1507

FIG. 1



PLAN

SCALE IN FEET



ELEVATION

SCALE IN FEET
0 20 40

LEGEND

DH-1 ⊕	BORING DESIGNATION AND LOCATION
DH-1	BORING DESIGNATION AND DEPTH
▼	WATER LEVEL OBSERVED DURING DRILLING IN JULY 2003
—?—	INTERPRETED GEOLOGIC CONTACT ALONG CENTERLINE OF CULVERT

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1507\F02 MWT

SITE PLAN AND LONGITUDINAL CROSS SECTION

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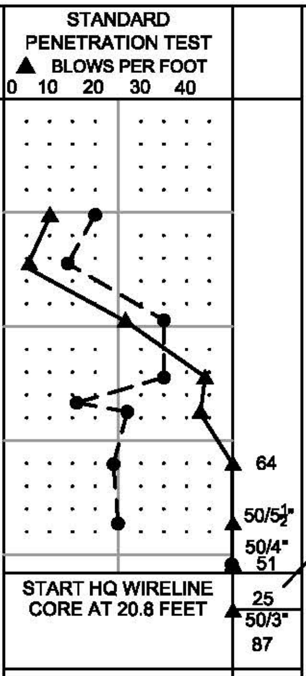
FIG. 2

ELEV.	DEPTH IN FEET	USCS SYMBOL	MATERIAL DESCRIPTION SURFACE ELEV. (FT.) 16 (approx.)	SAMPLES NO.	SAMPLES S.P.T.	GROUND WATER DEPTH
15½	½		5 in. concrete	1		NOTE 2
13½	2½		5 in. to 2½ ft. VOID			
		SP	Gravelly SAND, trace silt, gray/brown, LOOSE, wet, NP (REWORKED RESIDUAL SOIL/ALLUVIUM)	2		
				3	10	
				4	6	
7	9	SP-SM	Gravelly, silty SAND, gray/brown, DENSE, wet, NP with a zone of slightly clayey silty SAND, BPL (DECOMPOSED BEDROCK)	5	27	
				6		
				7	44	
				8	43	
1½	14½	SP	Gravelly SAND, trace silt, gray/brown, VERY DENSE, wet, NP (DECOMPOSED BEDROCK)	9	64	
				10	50/5½"	
			RUN NO.	11	50/4"	CORE RECV. %
-5	21		BASALT, gray, fresh to completely decomposed, RQ to MQ, HARD to SOFT, highly fractured (HIGHLY WEATHERED BEDROCK)	R-1	100	
				12	50/3"	
				R-2	100	
-9	25		Bottom of Boring: 25 feet			

STANDARD PENETRATION TEST
▲ BLOWS PER FOOT



LEGEND

- ▨ 2" S.P.T. SAMPLE
- * SAMPLE NOT RECOVERED
- ▬ CONCRETE CORE SAMPLE
- ☒ G GRAB SAMPLE
- ▨ IMPERVIOUS SEAL
- ▼ WATER LEVEL
- ■ PIEZOMETER TIP
- ├─●─┤ LIQUID LIMIT, NATURAL WATER CONTENT, PLASTIC LIMIT
- ● WATER CONTENT IN PERCENT

NOTES

1. MATERIAL DESCRIPTIONS AND INTERFACES ARE INTERPRETIVE AND ACTUAL CHANGES MAY BE GRADUAL.
2. ARTESIAN GROUNDWATER FLOWS DURING AND SUBSEQUENT TO DRILLING.
3. SEE TABLE 1 OF REPORT FOR SUPPLEMENTAL LEGEND.

1507\Borings MWT

DRILLER: CRUX SUBSURFACE
DATE START: 7/14/03 FINISH: 7/15/03
DRILLING TECHNIQUE: HWT Casing advancer and HQ3 wireline

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SUMMARY BORING LOG
DH-1 (1 of 2)

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FIG. 3

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CORE PHOTOGRAPHS
DH-1 (2 of 2)

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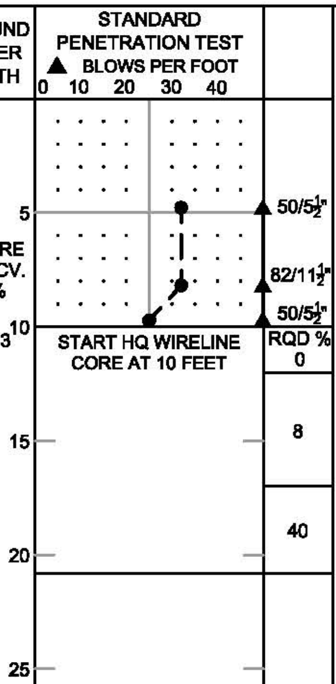
FIG. 3

1507\F03_2 MWT

ELEV.	DEPTH IN FEET	USCS SYMBOL	MATERIAL DESCRIPTION SURFACE ELEV. (FT.) 16 (approx.)	SAMPLES NO.	SAMPLES S.P.T.	GROUND WATER DEPTH	RQD %
15½	½		4½ in. concrete	1			
		SP	Silty, gravelly SAND, gray/brown, VERY DENSE, wet, NP with zones of silty clayey SAND, BPL (DECOMPOSED BEDROCK)	2			
				3	50/5½"		50/5½"
9	7		BASALT, gray/brown, fresh to completely decomposed, RQ to MQ, HARD to SOFT, highly fractured (HIGHLY WEATHERED BEDROCK)	4	82/11½		82/11½"
				5	50/5½"	▼ 7/15/03	50/5½"
			RUN NO.	R-1	100 (CORE RECV. %)		0
				R-2	100		8
			near vertical slickensides at approx. 20 to 21 feet	R-3	100		40
-5	21		Bottom of Boring: 21 feet				



LEGEND

- ▨ 2" S.P.T. SAMPLE
- * SAMPLE NOT RECOVERED
- CONCRETE CORE SAMPLE
- ☒ G GRAB SAMPLE
- IMPERVIOUS SEAL
- ▼ WATER LEVEL
- ■ PIEZOMETER TIP
- LIQUID LIMIT
- NATURAL WATER CONTENT
- PLASTIC LIMIT
- ● WATER CONTENT IN PERCENT

NOTES

1. MATERIAL DESCRIPTIONS AND INTERFACES ARE INTERPRETIVE AND ACTUAL CHANGES MAY BE GRADUAL.
2. WATER LEVEL IS FOR DATE SHOWN AND MAY VARY WITH TIME OF YEAR.
3. SEE TABLE 1 OF REPORT FOR SUPPLEMENTAL LEGEND.

1507\Borings MWT

DRILLER: CRUX SUBSURFACE
DATE START: 7/15/03 FINISH: 7/15/03
DRILLING TECHNIQUE: HWT Casing advancer and HQ3 wireline

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SUMMARY BORING LOG
DH-2 (1 of 2)

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FIG. 4

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CORE PHOTOGRAPHS
DH-2 (2 of 2)

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PROJ. 1507

FIG. 4

1507\F04_2 MWT

SURFACE ELEV. (FT.) 16 (approx.)

ELEV.	DEPTH IN FEET	USCS SYMBOL	MATERIAL DESCRIPTION
15½	½		6 in. concrete
		SM-ML	Sandy SILT, trace clay, gray, VERY LOOSE, moist, BPL with layers of clayey SILT, wet, moist, SOFT, APL (REWORKED RESIDUAL SOIL/ALLUVIUM) ...becomes gravelly at 11 feet
2	14	SP-SM	Silty, gravelly SAND, gray/brown, DENSE to VERY DENSE, wet, NP (DECOMPOSED BEDROCK)
-8	24		BASALT, brown/gray, completely decomposed, MQ, SOFT, highly fractured with clayey material in fractures (DECOMPOSED TO HIGHLY WEATHERED BEDROCK)
-10	26		Bottom of Boring: 26 feet

SAMPLES

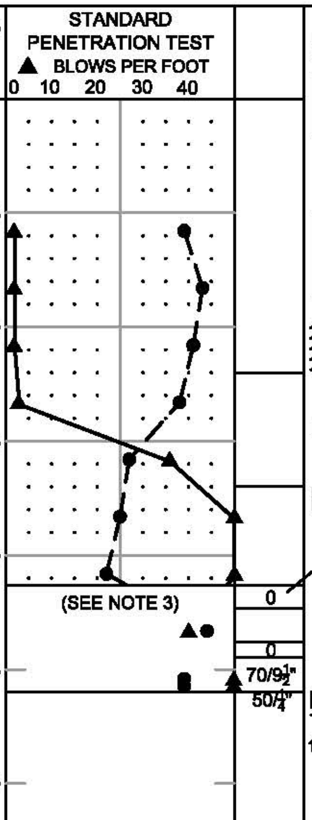
NO.	S.P.T.
1	2
2	2
3	2
4	3
5	36
6	79
7	64
R-1	100
8	40
R-2	100
9	70/9½"
10	50/¼"*

RUN NO.

CORE RECV. %

GROUND WATER DEPTH

NOTE 2



LEGEND

▨ 2" S.P.T. SAMPLE

* SAMPLE NOT RECOVERED

CONCRETE CORE SAMPLE

☒ G GRAB SAMPLE

IMPERVIOUS SEAL

▼ WATER LEVEL

■ PIEZOMETER TIP

LIQUID LIMIT

NATURAL WATER CONTENT

PLASTIC LIMIT

● WATER CONTENT IN PERCENT

NOTES

1. MATERIAL DESCRIPTIONS AND INTERFACES ARE INTERPRETIVE AND ACTUAL CHANGES MAY BE GRADUAL.
2. ARTESIAN GROUNDWATER FLOWS DURING AND SUBSEQUENT TO DRILLING.
3. WIRELINE CORE FROM 21.3 TO 22.3 FT. AND FROM 23.8 FT. TO 24.5 FT.
4. SEE TABLE 1 OF REPORT FOR SUPPLEMENTAL LEGEND.

1507\Borings MWT

DRILLER: CRUX SUBSURFACE
DATE START: 7/15/03 FINISH: 7/16/03
DRILLING TECHNIQUE: HWT Casing advancer and HQ3 wireline

CORNFORTH CONSULTANTS
10250 S.W. Greenburg Road, Suite 111
Portland, Oregon 97223
Phone 503-452-1100 Fax 503-452-1528

SUMMARY BORING LOG
DH-3 (1 of 2)

KELLOGG CK./HWY 99E FISH PASSAGE
MILWAUKIE, OREGON

SEP 2003

PROJ. 1507

FIG. 5

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CONSULTANTS

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Portland, Oregon 97223
Phone 503-452-1100 Fax 503-452-1528

CORE PHOTOGRAPHS
DH-3 (2 of 2)

KELLOGG CK./HWY. 99E FISH BYPASS
MILWAUKIE, OREGON

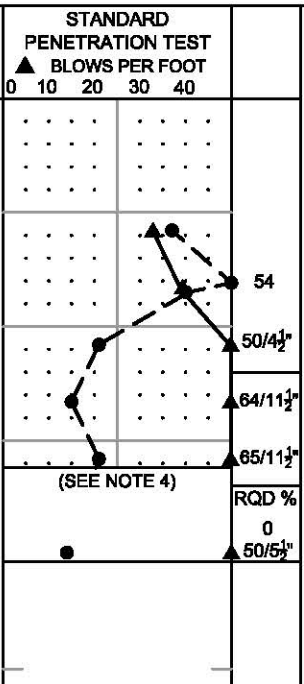
SEP 2003

PROJ. 1507

FIG. 5

1507\F05_2 MWT

ELEV.	DEPTH IN FEET	USCS SYMBOL	MATERIAL DESCRIPTION SURFACE ELEV. (FT.) 16 (approx.)	SAMPLES NO.	S.P.T.	GROUND WATER DEPTH
15½	½		6 in. concrete			
		SP	Silty, gravelly SAND, brown/gray, DENSE, wet, NP with zones of silty, clayey SAND, BPL (DECOMPOSED BEDROCK)	1	33	
				2	39	7/17/03
6	10		BASALT, brown/gray, partly to completely decomposed, CQ to MQ, SOFT to VERY SOFT, intensely fractured, clayey material 14 to 15 feet and smaller zones to 20 feet (HIGHLY WEATHERED BEDROCK)	3	50/4½"	▼
				4	64/11½"	
				5	65/11½"	
				RUN NO.		CORE RECV. %
				R-1	100	
				6	50/5½"	
-4	20		Bottom of Boring: 20.3 feet			



LEGEND

- ▨ 2" S.P.T. SAMPLE
- * SAMPLE NOT RECOVERED
- CONCRETE CORE SAMPLE
- ☒ G GRAB SAMPLE
- IMPERVIOUS SEAL
- ▼ WATER LEVEL
- ■ PIEZOMETER TIP
- LIQUID LIMIT
- NATURAL WATER CONTENT
- PLASTIC LIMIT
- ● WATER CONTENT IN PERCENT

NOTES

1. MATERIAL DESCRIPTIONS AND INTERFACES ARE INTERPRETIVE AND ACTUAL CHANGES MAY BE GRADUAL.
2. WATER LEVEL IS FOR DATE SHOWN AND MAY VARY WITH TIME OF YEAR.
3. RETURN OF DRILLING FLUID AT APPROX. 10-25% FROM 5 TO 20 FT.
4. WIRELINE CORE FROM 16.2 TO 19.5 FT.
5. SEE TABLE 1 OF REPORT FOR SUPPLEMENTAL LEGEND.

1507\Borings MWT

DRILLER: CRUX SUBSURFACE
DATE START: 7/16/03 FINISH: 7/17/03
DRILLING TECHNIQUE: HWT Casing advancer and HQ3 wireline

CORNFORTH CONSULTANTS
10250 S.W. Greenburg Road, Suite 111
Portland, Oregon 97223
Phone 503-452-1100 Fax 503-452-1528

SUMMARY BORING LOG
DH-4 (1 of 2)

KELLOGG CK./HWY 99E FISH PASSAGE
MILWAUKIE, OREGON

SEP 2003
PROJ. 1507
FIG. 6

CORNFORTH
CONSULTANTS
10250 S.W. Greenburg Road, Suite 111
Portland, Oregon 97223
Phone 503-452-1100 Fax 503-452-1528

CORE PHOTOGRAPHS
DH-4 (2 of 2)

KELLOGG CK./HWY. 99E FISH BYPASS
MILWAUKIE, OREGON

SEP 2003

PROJ. 1507

FIG. 6

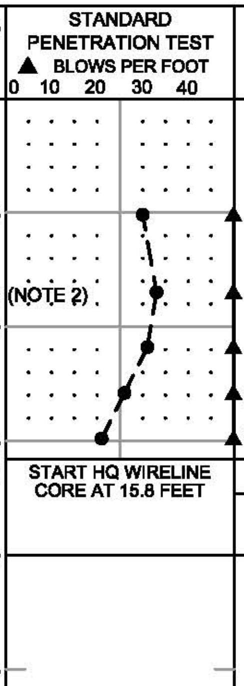
1507\F06_2 MWT

ELEV.	DEPTH IN FEET	USCS SYMBOL	MATERIAL DESCRIPTION SURFACE ELEV. (FT.) 16 (approx.)	SAMPLES NO.	SAMPLES S.P.T.	GROUND WATER DEPTH	STANDARD PENETRATION TEST ▲ BLOWS PER FOOT	
15½	½		6 in. concrete					
		SP	Silty, gravelly SAND, brown/gray, VERY DENSE, moist, NP, w/ zones of higher silt content (DECOMPOSED BEDROCK)	1	95/9"			95/9"
				2	86	7/17/03 (NOTE 2)		86
				3	85			85
				4	50/5½"			50/5½"
3½	12½		BASALT, gray/brown, fresh to completely decomposed, RQ to MQ, HARD to SOFT, highly fractured (HIGHLY WEATHERED BEDROCK)	5	50/5½"	7/18/03 (NOTE 2)		50/5½"
				R-1	100		START HQ WIRELINE CORE AT 15.8 FEET	40
				R-2	100			33
-4	20		Bottom of Boring: 20.0 feet					

RUN NO.

CORE RECV. %

RQD %



LEGEND

- ▨ 2" S.P.T. SAMPLE
- * SAMPLE NOT RECOVERED
- CONCRETE CORE SAMPLE
- ☒ G GRAB SAMPLE
- IMPERVIOUS SEAL
- ▼ WATER LEVEL
- ■ PIEZOMETER TIP
- LIQUID LIMIT
- NATURAL WATER CONTENT
- PLASTIC LIMIT
- ● WATER CONTENT IN PERCENT

NOTES

1. MATERIAL DESCRIPTIONS AND INTERFACES ARE INTERPRETIVE AND ACTUAL CHANGES MAY BE GRADUAL.
2. GROUNDWATER LEVEL VARIED FROM 10 TO 15 FEET BELOW SURFACE.
3. NO RETURN OF DRILLING FLUIDS FROM APPROX. 1 T0 12 FT. AND APPROX. 20% RETURN 12 TO 20 FT.
4. SEE TABLE 1 OF REPORT FOR SUPPLEMENTAL LEGEND.

1507\Borings MWT

DRILLER: CRUX SUBSURFACE
DATE START: 7/17/03 FINISH: 7/18/03
DRILLING TECHNIQUE: HWT Casing advancer and HQ3 wireline

CORNFORTH CONSULTANTS
10250 S.W. Greenburg Road, Suite 111
Portland, Oregon 97223
Phone 503-452-1100 Fax 503-452-1528

SUMMARY BORING LOG
DH-5 (1 of 2)

KELLOGG CK./HWY 99E FISH PASSAGE
MILWAUKIE, OREGON

SEP 2003
PROJ. 1507
FIG. 7

CORE PHOTOGRAPHS
DH-5 (2 of 2)

KELLOGG CK./HWY. 99E FISH BYPASS
MILWAUKIE, OREGON

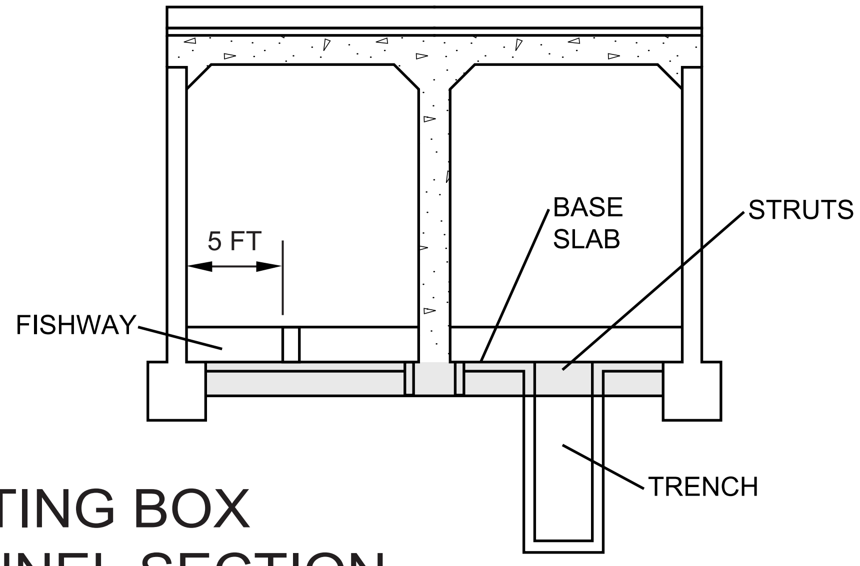
CORNFORTH CONSULTANTS
10250 S.W. Greenburg Road, Suite 111
Portland, Oregon 97223
Phone 503-452-1100 Fax 503-452-1528

SEP 2003

PROJ. 1507

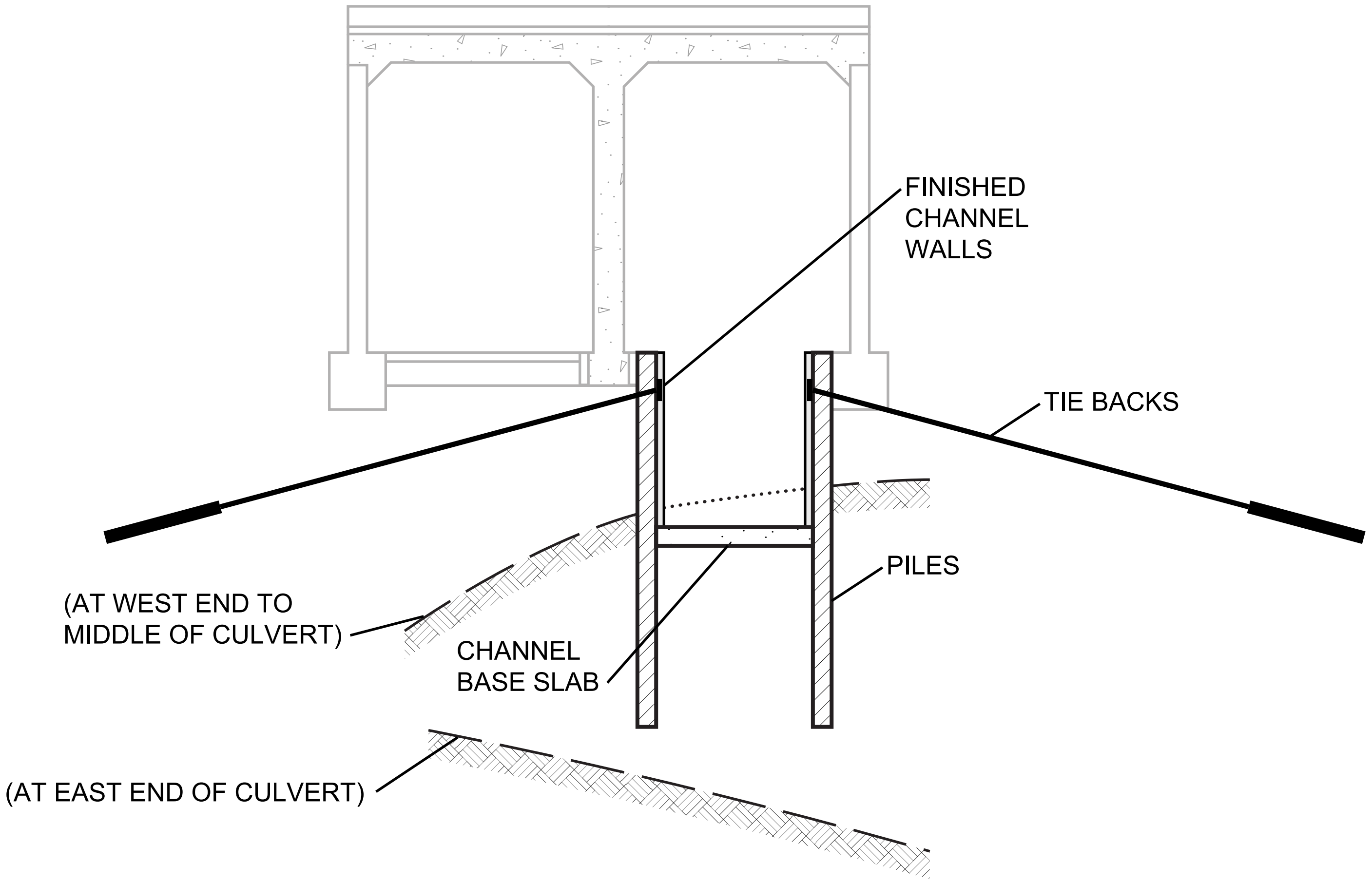
FIG. 7

1507\F07_2 MWT



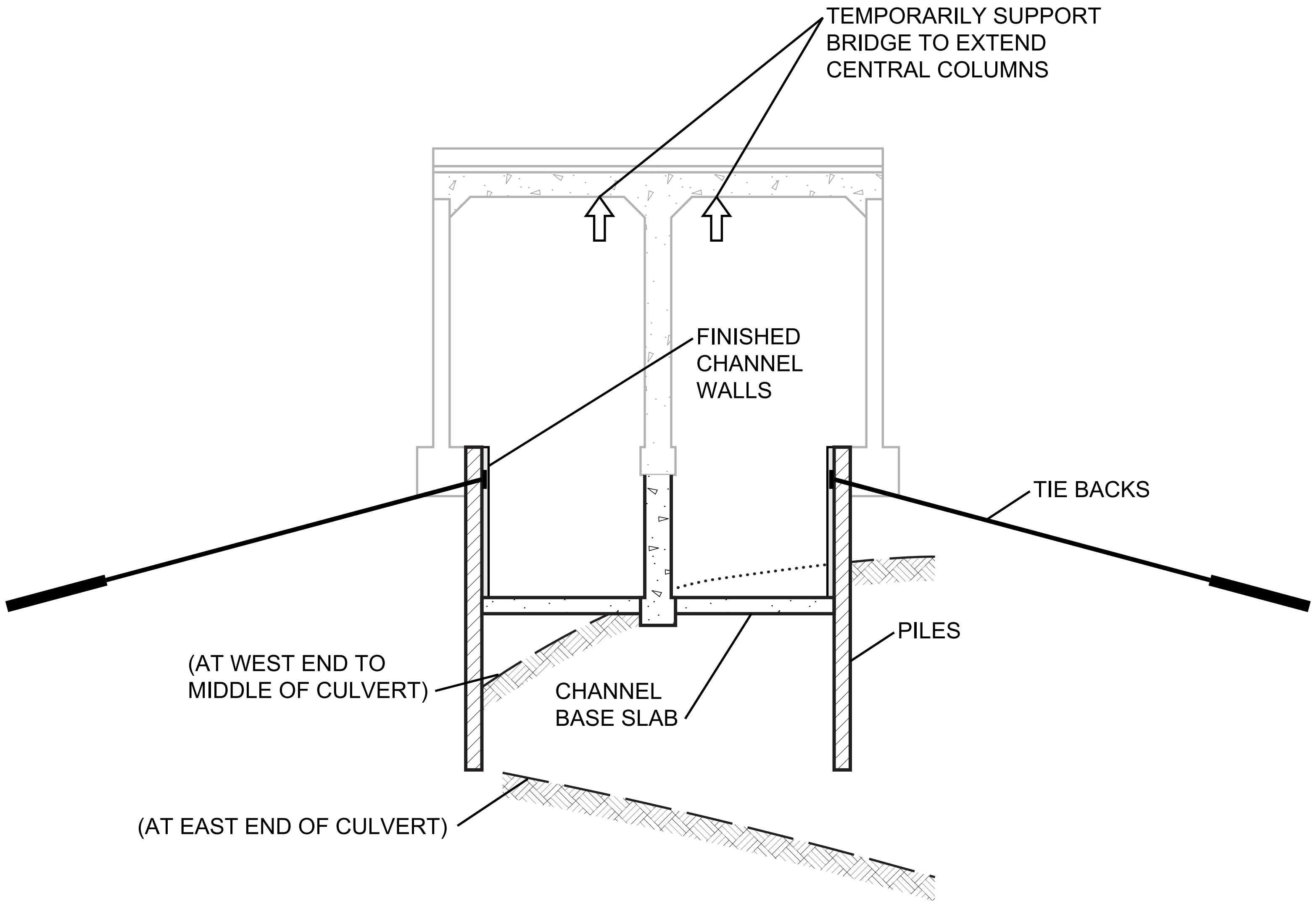
EXISTING BOX CHANNEL SECTION

SCALE IN FEET
0 10 20



OPTION 2A - EXCAVATION OF SOUTH HALF OF CHANNEL

SCALE IN FEET
0 10 20



OPTION 2B - EXCAVATION OF ENTIRE CHANNEL WIDTH

SCALE IN FEET
0 10 20

LEGEND

▨ INTERPRETED TOP OF HIGHLY WEATHERED BASALT. SEE FIGURE 2 FOR OVERLYING MATERIALS.

1507\F08 MWT

CORNFORTH CONSULTANTS
10250 S.W. Greenburg Road, Suite 111
Portland, Oregon 97223
Phone 503-452-1100 Fax 503-452-1528

CHANNEL CROSS SECTION & CONCEPTUAL OPTIONS

KELLOGG CK./HWY. 99E FISH BYPASS
MILWAUKIE, OREGON

SEP 2003

PROJ. 1507

FIG. 8

Appendix A

Field Boring Log Sheets

Landslide Technology
10250 SW Greenburg Road
Portland, Oregon 97223

JOB NO. 1507

REPORT OF EXPLORATION

JOB Kellogg Creek

CLIENT USACOE

FIELD OBSERVER J. Harris

DRILL CONTRACTOR CRUX

DRILL RIG burley 2000

DRILLING METHOD HWT casing Adv.

DRILL BIT oversized bit ~5"

CIRCULATION: ☒ MUD Light/ ☐ WATER ☐ AIR ☐ NONE

BORING NO. DH-1

SHT. 1 / 4

LOCATION ON SITE SE corner of underpass

GROUND ELEVATION conc. slab.

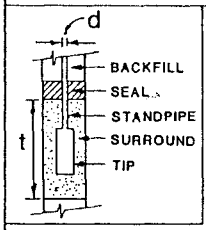
DATE 7-14-03

SAMPLE DATA

SAMPLE NO.	TYPE OF SAMPLE	DEPTH OF SAMPLE (FT.) FROM	DEPTH OF SAMPLE (FT.) TO	DRIVING RESISTANCE BLOWS/6 IN.	LENGTH SAMPLE (FT.)	FIELD DESCRIPTION
S-1						Drill Casing Adv. OD-HWT 0-5" plug of concrete → water flowing out
S-2	sm. cobble out of casing shoe @ 3½-4'					5"-2'6" → no material - void 2'6"-3'6" very loose matl. → trying to seat bit
S-3	SPT	4 -	$5^{\underline{5}}$	12/6/14 ⑩	$0^{\underline{5}}$	Loose, sand & Gravel, Gray, angular to rounded, 2-5% fde's
S-4	SPT	$6^{\underline{1}}$	$7^{\underline{6}}$	6/3/3 ⑥	$0^{\underline{6}}$	LOOSE, sandy gravel, tr. silt, Gray w/ brown, not well graded, angular to rounded, 5% fines
S-5	SPT	$8^{\underline{6}}$	$10^{\underline{1}}$	7/13/14 ㉗	$1^{\underline{2}}$	M. DENSE, gravelly silty sand, gray, 4" 4"-18", M. DENSE silty fine sand, gray to brown, 10-15% fines
						driller note: much smoother @ $9^{\underline{1}}$

DEPTH (FT.) FROM	DEPTH (FT.) TO	SUMMARY FIELD BORING LOG

FIELD INSTRUMENTATION



☐ PIEZOMETER ☐ OBSERVATION WELL

TIP TYPE

TIP LENGTH FT. DEPTH FT

d = IN. t = FT

SURROUND MATERIAL

SEAL

BACKFILL

SURFACE SEAL

☐ INCLINOMETER CASING (BUTT JOINTS)

DIA. IN. LENGTH FT

BACKFILL

STICKUP FT. FIRST JOINT AT FT

GROUNDWATER

☐ NO FREE GROUNDWATER OBSERVED

GROUNDWATER HIT AT FT.
(DRILLER ESTIMATE)

☐ TIME CHARGES BY DRILLER

DETAILS

Landslide Technology
10250 SW Greenburg Road
Portland, Oregon 97223

JOB NO. 1507

REPORT OF EXPLORATION

JOB Kellogg Creek
CLIENT USACOE

FIELD OBSERVER J.Harris
DRILL CONTRACTOR CRUX
DRILL RIG Burley 2000
DRILLING METHOD HQ Core
DRILL BIT Rock Coring/diam. impreg.
CIRCULATION: ☐ MUD ☒ WATER ☐ AIR ☐ NONE

BORING NO. DH - 1
SHT. 2/4
LOCATION ON SITE SE hole
GROUND ELEVATION slab
DATE 7-14-03

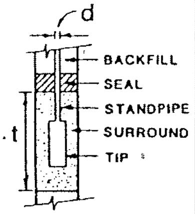
SAMPLE DATA

SAMPLE NO.	TYPE OF SAMPLE	DEPTH OF SAMPLE (FT.) FROM	DEPTH OF SAMPLE (FT.) TO	DRIVING RESISTANCE BLOWS/6 IN.	LENGTH SAMPLE (FT.)	FIELD DESCRIPTION
7:30 S-6	HQ misc.	4^{5}	11^{1}	—	1^{0}	sW.tch to HQ core rods @ 11^{1} due to probs w/ casing adv. HQ redrill ~4^{5} - 11^{1} S-6 is misc. gravel + in barrel loose.
S-7	SPT	11^{1}	12^{6}	10/19/25 (44)	1^{3}	DENSE, silty sand to gravelly silty SAND, br to gray, 10-15% fines /
S-8	SPT	12^{6}	14^{1}	11/17/25 (43)	1^{2}	Ⓐ 2^{6} - 13^{3} silty gravelly sand, angular, m-coarse, 10% fines, gray Ⓑ 13^{3} - 14^{1} slightly clayey, silty f.-m sand, brown, 10-20% fines.
S-9	SPT	14^{9}	16^{4}	13/27/37 (64)	1^{1}	brown to gray, v. Dense, highly weathered rock, / gravelley sand to sandy gravel, w/ tr. silt, 5% fines

SUMMARY FIELD BORING LOG

DEPTH (FT.) FROM	DEPTH (FT.) TO	SUMMARY FIELD BORING LOG

FIELD INSTRUMENTATION



☐ PIEZOMETER ☐ OBSERVATION WELL
TIP TYPE
TIP LENGTH ____ FT. DEPTH ____ FT.
d = ____ IN. t = ____ FT.
SURROUND MATERIAL
SEAL
BACKFILL
SURFACE SEAL

☐ INCLINOMETER CASING (BUTT JOINTS)
DIA. ____ IN. LENGTH ____ FT
BACKFILL
STICKUP ____ FT. FIRST JOINT AT ____ FT

GROUNDWATER

☐ NO FREE GROUNDWATER OBSERVED
GROUNDWATER HIT AT ____ FT. (DRILLER ESTIMATE)

☐ TIME CHARGES BY DRILLER
DETAILS

Landslide Technology

10250 SW Greenburg Road
Portland, Oregon 97223

REPORT OF EXPLORATION

JOB NO. 1507

JOB Kellog Creek

CLIENT

FIELD OBSERVER J. Harris

DRILL CONTRACTOR Crux

BORING NO. DH-1

SHT. 3 / 4

DRILL RIG Burley 2000

LOCATION ON SITE SE

DRILLING METHOD HQ Casing

DRILL BIT Dia drill (rock bit)

GROUND ELEVATION

CIRCULATION: ☒ MUD light ez mud ☐ WATER ☐ AIR ☐ NONE

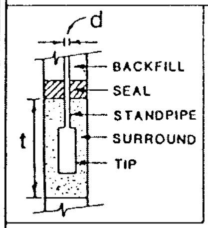
DATE 7-14-03

SAMPLE DATA

SAMPLE NO.	TYPE OF SAMPLE	DEPTH OF SAMPLE (FT.)		DRIVING RESISTANCE BLOWS/6 IN.	LENGTH SAMPLE (FT.)	FIELD DESCRIPTION
		FROM	TO			
						HQ Core (Casing Adv.) 14^9-16^9 blocked off very weather rock –
S-10	SPT	17^4	18^4	35/50 5½"	0^9	grey to red-brown, V. Dense, slightly silty gravelley sand – relic rock texture, <5% fines
						driller – off & on hard/soft – mat'l, temp. blocks off during coring
S-11	SPT	19^9	20^8	40 / 50/4"	0^4	gray, silty gravelly sand, 10-15% fines V. Dense, relic rock struct weathered BASALT
– Switch to HQ3 – @ 20^8					–	see core log
S-12	SPT	22^4	22^7	50/3"	0^2	gray-brown silty gravelly sand, V. Dense weath. BASALT, <10% fines
HQ3 – BOH @ 25						see core log

DEPTH (FT.)		SUMMARY FIELD BORING LOG
FROM	TO	

FIELD INSTRUMENTATION



☐ PIEZOMETER ☐ OBSERVATION WELL

TIP TYPE

TIP LENGTH ____ FT. DEPTH ____ FT.

d = ____ IN. t = ____ FT.

SURROUND MATERIAL

SEAL

BACKFILL

SURFACE SEAL

☐ INCLINOMETER CASING (BUTT JOINTS)

DIA. ____ IN. LENGTH ____ FT

BACKFILL

STICKUP ____ FT. FIRST JOINT AT ____ FT

GROUNDWATER

☐ NO FREE GROUNDWATER OBSERVED

GROUNDWATER HIT AT ____ FT. (DRILLER ESTIMATE)

☐ TIME CHARGES BY DRILLER

DETAILS

Hole No.

DRILLING LOG	DIVISION	INSTALLATION DH-1 [illegible]
SHEET 4 OF 4 SHEETS		

1. PROJECT
Kellogg Creek

2. LOCATION (Coordinates or Station)
Underpass / Creek passage

3. DRILLING AGENCY
CRUX

4. HOLE NO. (As shown on drawing title and file number) —

5. NAME OF DRILLER
Chistopher Brown

6. DIRECTION OF HOLE
☒ VERTICAL ☐ INCLINED ______ DEG. FROM VERT.

7. THICKNESS OF OVERBURDEN —

8. DEPTH DRILLED INTO ROCK —

9. TOTAL DEPTH OF HOLE 25⁰

10. SIZE AND TYPE OF BIT

11. DATUM FOR ELEVATION SHOWN (*TBM or MSL*)
Conc. Slab.

12. MANUFACTURER'S DESIGNATION OF DRILL
Burley 2000

13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN | DISTURBED 12 | UNDISTURBED —

14. TOTAL NUMBER CORE BOXES 1

15. ELEVATION GROUND WATER artesian

16. DATE HOLE | STARTED 7-14-03 | COMPLETED 7-15-03

17. ELEVATION TOP OF HOLE Conc. Slab

18. TOTAL CORE RECOVERY FOR BORING 100 %

19. SIGNATURE OF INSPECTOR

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (*Description*) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (*Drilling time, water loss, depth of weathering, etc., if significant*) g
20						
21	20⁸		SOFT (R2) w/ zones of (R0), sl. to mod. weathered BASALT, some vesicles, highly jointed / -soil (R0) weath. fract gray/brown	100%	BOX 1 RUN 1	D = 1.6 R = 1.6 Q = 0.4 RQD = 25%
22	22⁴ 22⁷	X	SPT		X	SPT
23 24 25	25⁰		Med. R3 to Hard R4, sl. weathered to fresh / BASALT highly to ~~mod.~~ jointed, some vesicles (small - soil-like (R0) weathered zone) gray-brown	100%	RUN 2	D = 2³ R = 2³ Q = 2⁰ RQD = 87%

BOH @ 25'

Landslide Technology

10250 SW Greenburg Road
Portland, Oregon 97223

REPORT OF EXPLORATION

JOB NO. 1507

JOB Kelloggs Creek

CLIENT ~~USA COE~~ PDX

FIELD OBSERVER J. Harris

DRILL CONTRACTOR Crux

BORING NO. DH-2

SHT. 1/2

DRILL RIG Burley 2000

LOCATION ON SITE SW Corner of conc. slab.

DRILLING METHOD Casing Adv. HWT → HQ

DRILL BIT AWT casing bit/no tricone 0-2'

GROUND ELEVATION Slab.

CIRCULATION: ☐ MUD ☐ WATER ☐ AIR ☐ NONE

DATE 7-15-03

SAMPLE DATA

SAMPLE NO.	TYPE OF SAMPLE	DEPTH OF SAMPLE (FT.)		DRIVING RESISTANCE BLOWS/6 IN.	LENGTH SAMPLE (FT.)	FIELD DESCRIPTION
		FROM	TO			
S-1	conc. core	0	4½"	concrete plug.	X	HWT 4⅞ OD/ 4¼ ID. 0-4½" concrete / came out in 2 separate plugs – no water flowing out drill to ~~2~~ 1½' switch to HQ core rods
S-2	loose core sample	1^{5}	4^{5}	—		brown, Dense, to HARD, silty clayey Sand w/ zone of sandy clay –
S-3	SPT	4^{5}	5^{5}	$29/\frac{50}{5\frac{1}{2}''}$	0^{9}	brown-gray, silty gravelly sand, 15-20% fines last 2" → gray weather rock -
S-4	SPT	7^{0}	8^{5}	$28/32/\frac{50}{5\frac{1}{2}''}$	1^{5}	gray sl. gravelly silty sand, 13% fines (V. highly weathered Basalt)
S-5	SPT	9^{5}	9^{9}	50/5"	0^{4}	gray/brown, silty gravelly sand, 10% fines (weath BASALT) → drill notes fract. rock @ ~10½' switch to HQ coring @ 10^{0}

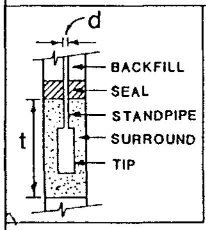
DEPTH (FT.)		SUMMARY FIELD BORING LOG
FROM	TO	

GROUNDWATER

☐ NO FREE GROUNDWATER OBSERVED

GROUNDWATER HIT AT ______ FT.
(DRILLER ESTIMATE)

FIELD INSTRUMENTATION



☐ PIEZOMETER ☐ OBSERVATION WELL

TIP TYPE ______

TIP LENGTH ______ FT. DEPTH ______ FT

d = ______ IN. t = ______ FT

SURROUND MATERIAL ______

SEAL ______

BACKFILL ______

SURFACE SEAL ______

☐ INCLINOMETER CASING (BUTT JOINTS)

DIA. ______ IN. LENGTH ______ FT

BACKFILL ______

STICKUP ______ FT. FIRST JOINT AT ______ FT

☐ TIME CHARGES BY DRILLER

DETAILS ______

Hole No.

DRILLING LOG

DIVISION

INSTALLATION DH-1002

SHEET 2 OF 2 SHEETS

1. PROJECT Kellogg Creek

2. LOCATION (Coordinates or Station) SW slab area.

3. DRILLING AGENCY Crux

4. HOLE NO. (As shown on drawing title and file number) DH-1002

5. NAME OF DRILLER Christopher Brown

6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED ______ DEG. FROM VERT.

7. THICKNESS OF OVERBURDEN Conc 5"/soil 5"-10^{0}'

8. DEPTH DRILLED INTO ROCK 11'

9. TOTAL DEPTH OF HOLE 21^{0}'

10. SIZE AND TYPE OF BIT

11. DATUM FOR ELEVATION SHOWN (TBM or MSL) Slab.

12. MANUFACTURER'S DESIGNATION OF DRILL Burley 2000

13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN | DISTURBED 5 | UNDISTURBED —

14. TOTAL NUMBER CORE BOXES 2

15. ELEVATION GROUND WATER ~10'

16. DATE HOLE | STARTED 7-15-03 | COMPLETED 7-15-03

17. ELEVATION TOP OF HOLE Conc Slab.

18. TOTAL CORE RECOVERY FOR BORING %

19. SIGNATURE OF INSPECTOR MOA

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	10^{0}		Med. Hard (R4), highly weathered BASALT, highly to v. highly jointed some vesicularity, green-yellow mineralization in rock.	100	Box 1 Run 1	D 2^{0} C 2^{0} Q 0 12:10-12:30 RQD=0%
	12^{0}		med. Hard (R4) highly weath. BASALT, v. highly jointed vesicular, (some zones of R1-R2 weathered rock)	100	RUN 2	5^{0} 5^{0} 0^{4} st 12:35- RQD=8%
	17		Med. Hard (R4) BASALT, highly weath. highly to v. highly jointed, vesicular (zones of R2-R1 more highly weathered matl.) slickensides observed.	100	RUN 3 18^{5} BOX 2	4^{0} 4^{0} $1\underline{6}$ -1:20 end RQD=40%
	21^{0}		BOH - 21^{0}			

Landslide Technology
10250 SW Greenburg Road
Portland, Oregon 97223

REPORT OF EXPLORATION

JOB NO. 1507

JOB Kellogg creek

CLIENT US COE PDX

FIELD OBSERVER J. Harris

DRILL CONTRACTOR Crux

BORING NO. DH-3

SHT. 1/4

DRILL RIG Burley 2000

LOCATION ON SITE NE corner of slab area outside fishway

DRILLING METHOD

DRILL BIT

GROUND ELEVATION

CIRCULATION: ☒ MUD ☐ WATER ☐ AIR ☐ NONE — tight ez mud —

DATE 7-15-03

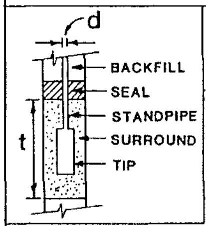
SAMPLE DATA

SAMPLE NO.	TYPE OF SAMPLE	DEPTH OF SAMPLE (FT.) FROM	DEPTH OF SAMPLE (FT.) TO	DRIVING RESISTANCE BLOWS/6 IN.	LENGTH SAMPLE (FT.)	FIELD DESCRIPTION
						0-6" conc. — no plug recovered — water flowing 6" — 4^{8} loose granular matl → driller comment
S-1	SPT	4^{8}	6^{3}	11/1/1	0^{6}	SOFT to very LOOSE sandy SILT, 35% fines, MUCK, tr. clay, gray alluvium
						very very loose drilling 4^{8} — 7^{3} may be void 4^{8} — 7^{3}
S-2	SPT	7^{3}	8^{8}	1/1/1	1^{5}	VERY LOOSE, sandy SILT, slight clayey 35+% fines, gray, alluvium, tr. rounded gravel — drilling → very soft matl — no resistance
S-3	SPT	9^{8}	11^{3}	1/1/1	1^{5}	Ⓐ 9^{8} — 10^{5} gray, V. Loose, sl. clayey sandy SILT, tr. org. ??, 50% fines Ⓑ 10^{5} — 11^{3} Brown, ~~sl. sandy~~, silty CLAY SOFT to V. SOFT, tr. course sand +50% fines
					(10^{0}')	→ less soft drilling → still drills very easy
S-4	SPT	12^{3}	13^{8}	3/1/2	0^{8}	— LOOSE, silty, gravelly sand, 15% fines highly weathered rock gravel

SUMMARY FIELD BORING LOG

DEPTH (FT.) FROM	DEPTH (FT.) TO	SUMMARY FIELD BORING LOG

FIELD INSTRUMENTATION



☐ PIEZOMETER ☐ OBSERVATION WELL

TIP TYPE

TIP LENGTH ______ FT. DEPTH ______ FT.

d = ______ IN. t = ______ FT.

SURROUND MATERIAL

SEAL

BACKFILL

SURFACE SEAL

☐ INCLINOMETER CASING (BUTT JOINTS)

DIA. ______ IN. LENGTH ______ FT.

BACKFILL

STICKUP ______ FT. FIRST JOINT AT ______ FT.

GROUNDWATER

☐ NO FREE GROUNDWATER OBSERVED

GROUNDWATER HIT AT ______ FT.
(DRILLER ESTIMATE)

☐ TIME CHARGES BY DRILLER

DETAILS

Landslide Technology

10250 SW Greenburg Road
Portland, Oregon 97223

REPORT OF EXPLORATION

JOB NO. 1507

JOB Kellogg Creek

CLIENT US COE PDX

FIELD OBSERVER J. Harris

DRILL CONTRACTOR Crux

DRILL RIG Burley 2000

DRILLING METHOD HQ core / casing

DRILL BIT rock bit

BORING NO. DH-3

SHT. 2/4

LOCATION ON SITE NE Corner

GROUND ELEVATION

CIRCULATION: ☒ MUD light ez-mud. ☐ WATER ☐ AIR ☐ NONE

DATE 7-15-03

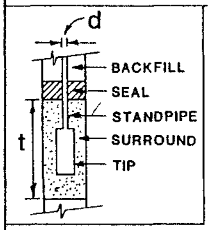
SAMPLE DATA

SAMPLE NO.	TYPE OF SAMPLE	DEPTH OF SAMPLE (FT.)		DRIVING RESISTANCE BLOWS/6 IN.	LENGTH SAMPLE (FT.)	FIELD DESCRIPTION
		FROM	TO			
S-5	SPT	14^{8}	16^{3}	6/15/21 ㊱	1^{3}	gray/brown, DENSE, sl. clayey, silty gravelly SAND, highly weathered BASALT?
~~S-6~~	~~SPT~~	~~17^{3}~~				—driller — harder drilling — @16½ but not rock hard just less soft
S-6	SPT	17^{3}	18^{8}	18/30/49 (79)	1^{3}	V. Dense, gravelly, silty SAND, relic rock struct, weathered BASALT, <15% fines
S-7	SPT	19^{8}	21^{3}	25/31/33 (64)	1^{2}	Gray/Brown, silty gravelly SAND, relic rock struct. <20% fines v. highly weathered BASALT
S-8	SPT	22^{3}	23^{8}	14/17/23 ㊵	1^{2}	Gray/Brown, silty gravelly SAND <20% fines, v. highly weath. BASALT
7-16-03 S-9	SPT	24^{5}	26^{-}	21/26/50/3½	1^{1}	Brown, clayey silty gravelly Sand to sandy clayey silt tr gravel, V. Dense. small rock in shoe → weath. BASALT.

SUMMARY FIELD BORING LOG

DEPTH (FT.)		
FROM	TO	

FIELD INSTRUMENTATION



☐ PIEZOMETER ☐ OBSERVATION WELL

TIP TYPE

TIP LENGTH ____ FT. DEPTH ____ FT.

d = ____ IN. t = ____ FT.

SURROUND MATERIAL

SEAL

BACKFILL

SURFACE SEAL

☐ INCLINOMETER CASING (BUTT JOINTS)

DIA. ____ IN. LENGTH ____ FT.

BACKFILL

STICKUP ____ FT. FIRST JOINT AT ____ FT.

GROUNDWATER

☐ NO FREE GROUNDWATER OBSERVED

GROUNDWATER HIT AT ____ FT. (DRILLER ESTIMATE)

☐ TIME CHARGES BY DRILLER

DETAILS

Cornforth Consultants, Inc.
10250 SW Greenburg Road
Portland, Oregon 97223

REPORT OF EXPLORATION

JOB NO. 1507

JOB Kellogg Creek

CLIENT USA COE PDX

FIELD OBSERVER J. Harris

DRILL CONTRACTOR Crux

BORING NO. DH-3

SHT. 3 / 4

DRILL RIG Blurley 2000

LOCATION ON SITE SE Corner

DRILLING METHOD HQ core / SPT samples

DRILL BIT HQ rock core bit

GROUND ELEVATION Conc. Slab

CIRCULATION: ☒ MUD Bentez mud ☐ WATER ☐ AIR ☐ NONE

DATE 7-16-03

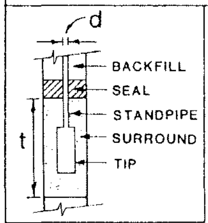
SAMPLE DATA

SAMPLE NO.	TYPE OF SAMPLE	DEPTH OF SAMPLE (FT.)		DRIVING RESISTANCE BLOWS/6 IN.	LENGTH SAMPLE (FT.)	FIELD DESCRIPTION
		FROM	TO			
S-10	SPT	25	26	50/1/4"	0	no recovery
	BOH 26'					

SUMMARY FIELD BORING LOG

DEPTH (FT.)		
FROM	TO	

FIELD INSTRUMENTATION



☐ PIEZOMETER ☐ OBSERVATION WELL

TIP TYPE

TIP LENGTH FT. DEPTH FT.

d = IN. t = FT.

SURROUND MATERIAL

SEAL

BACKFILL

SURFACE SEAL

☐ INCLINOMETER CASING (BUTT JOINTS)

DIA. IN. LENGTH FT.

BACKFILL

STICKUP FT. FIRST JOINT AT FT.

GROUNDWATER

☐ NO FREE GROUNDWATER OBSERVED

GROUNDWATER HIT AT FT.
(DRILLER ESTIMATE)

☐ TIME CHARGES BY DRILLER

DETAILS

Hole No.

DRILLING LOG

DIVISION

INSTALLATION DH-3

SHEET 4 OF 4 SHEETS

1. PROJECT Kellogg Creek
2. LOCATION (Coordinates or Station) NE corner of slab
3. DRILLING AGENCY Crux
4. HOLE NO. (As shown on drawing title and file number) —
5. NAME OF DRILLER Christopher Brown
6. DIRECTION OF HOLE ☑ VERTICAL ☐ INCLINED ______ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN 14^{5}
8. DEPTH DRILLED INTO ROCK 10^{0}
9. TOTAL DEPTH OF HOLE 24^{5}
10. SIZE AND TYPE OF BIT
11. DATUM FOR ELEVATION SHOWN (TBM or MSL) Conc. Slab.
12. MANUFACTURER'S DESIGNATION OF DRILL Burley 2000
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN DISTURBED 10 UNDISTURBED —
14. TOTAL NUMBER CORE BOXES 1
15. ELEVATION GROUND WATER artesian (slight)
16. DATE HOLE STARTED 7-15-03 COMPLETED 7-15-03
17. ELEVATION TOP OF HOLE —
18. TOTAL CORE RECOVERY FOR BORING 100 %
19. SIGNATURE OF INSPECTOR

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	21^{3}		(R2) SOFT very highly weath, BASALT, v highly fract,	100%	Box 1 Run 1	10/10 0
	22^{3}	SPT	S-8 SPT 14/17/23			
			R0 Extremely SOFT to R1 SOFT ROCK, clayey SILT w/ ~~gravel~~ rounded gravel & weathered Basalt (frag.)	100%	Run 2	02/03 0
	24^{5}	SPT	S-9 SPT 21/20/50/3½"			
	25					
	26		S-10 SPT 50 fo ¼"			

Cornforth Consultants, Inc.

10250 SW Greenburg Road
Portland, Oregon 97223

REPORT OF EXPLORATION

JOB NO. 1507

JOB Kellogg Creek

CLIENT US COE PDX

FIELD OBSERVER J. Harris

DRILL CONTRACTOR Crux

BORING NO. DH-4

SHT. 1 / 4

DRILL RIG Burley 2000

LOCATION ON SITE center of slab.

DRILLING METHOD HWT w/ casing shoe 4 7/8" dia

DRILL BIT Casing Shoe

GROUND ELEVATION

light ex-mud

CIRCULATION: ☒ MUD ☐ WATER ☐ AIR ☐ NONE

DATE 7-16-03

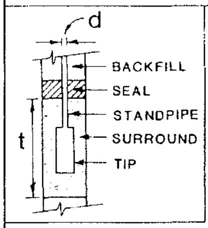
SAMPLE DATA

SAMPLE NO.	TYPE OF SAMPLE	DEPTH OF SAMPLE (FT.)		DRIVING RESISTANCE BLOWS/6 IN.	LENGTH SAMPLE (FT.)	FIELD DESCRIPTION start 9:00 AM
		FROM	TO			
						concrete 0-6"
						driller notes that matl. below slab is very gravelly & cobbley - likely w/ sand to about 2½ feet deep,
						switch to AQ @ 2½' / HQ to $4^{\underline{5}}$
S-1	SPT	$4^{\underline{5}}$	$6^{\underline{0}}$	10/17/16 ㉝	$1^{\underline{5}}$	brown & gray, silty gravelly sand tr. clay, relic rock struct., DENSE weath. BASALT ??
						driller — lost return $7^{\underline{5}}$' to $8^{\underline{5}}$' back @ $8^{\underline{5}}$
S-2	SPT	$7^{\underline{0}}$	$8^{\underline{5}}$	5/15/24 ㊴	$1^{\underline{5}}$	Ⓐ 7-$7^{\underline{5}}$, M. SOFT, RED, silty clay, 50% fines, relic mudstone or Interbed matl
						Ⓑ $7^{\underline{5}}$ $8^{\underline{5}}$, DENSE, Brown-gray ~~St clay~~ silty gravelley ~~ro~~ Sand relic rock, weath BASALT

SUMMARY FIELD BORING LOG

DEPTH (FT.)		
FROM	TO	

FIELD INSTRUMENTATION



☐ PIEZOMETER ☐ OBSERVATION WELL

TIP TYPE

TIP LENGTH FT. DEPTH FT.

d = IN. t = FT.

SURROUND MATERIAL

SEAL

BACKFILL

SURFACE SEAL

☐ INCLINOMETER CASING (BUTT JOINTS)

DIA. IN. LENGTH FT.

BACKFILL

STICKUP FT. FIRST JOINT AT FT.

GROUNDWATER

☐ NO FREE GROUNDWATER OBSERVED

GROUNDWATER HIT AT FT.
(DRILLER ESTIMATE)

☐ TIME CHARGES BY DRILLER

DETAILS

Cornforth Consultants, Inc.
10250 SW Greenburg Road
Portland, Oregon 97223

REPORT OF EXPLORATION

JOB NO. 1507
JOB Kellogg Creek
CLIENT US COE
BORING NO. DH-4
SHT. 2 / 4
LOCATION ON SITE Control Slab
GROUND ELEVATION
DATE 7-16-03

FIELD OBSERVER J. Harris
DRILL CONTRACTOR Crux
DRILL RIG Burley 2000
DRILLING METHOD HQ Core
DRILL BIT HQ Rock Coring bit
CIRCULATION: ☒ MUD light eze-mud ☐ WATER ☐ AIR ☐ NONE

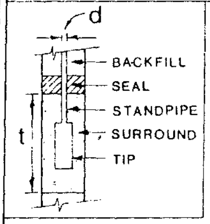
SAMPLE DATA

SAMPLE NO.	TYPE OF SAMPLE	DEPTH OF SAMPLE (FT.)		DRIVING RESISTANCE BLOWS/6 IN.	LENGTH SAMPLE (FT.)	FIELD DESCRIPTION
		FROM	TO			
S-3	SPT	$9^{\underline{5}}$	11-	$29/\frac{50}{4\frac{1}{2}}$	$1^{\underline{5}}$	V. DENSE, gravelly-silty sand grading to silty sand gravell, relic rock, v. highly weathered BASALT, R2 rock in shoe
						gray/brown more rocky - little harder - smoother to drill off & on
S-4	SPT	12-	$13^{\underline{5}}$	$22/14/\frac{50}{5\frac{1}{2}}$	$1^{\underline{5}}$	V. DENSE, silty gravelly sand, gray & brown weather BASALT.
						-switchback to HWT - ream to 10½" ream HQ to $14^{\underline{5}}$ → Clayey zone 13½ to $14^{\underline{5}}$ feet and above squeezing casing -
S-5	SPT	$14^{\underline{5}}$	16-	$18/15/\frac{50}{5\frac{1}{2}}$	$1^{\underline{0}}$	V. Dense, silty gravelly sand, weathered rock, <10% fines, relic rock texture
						-Basalt in matrix of soft clay may be on vertical fracture of rock?
~~S-6~~	~~SPT~~	~~17~~				AQ to $16^{\underline{2}}$ → cannot get past vert. fract. in rock bit moving around.

SUMMARY FIELD BORING LOG

DEPTH (FT.)		
FROM	TO	

FIELD INSTRUMENTATION



☐ PIEZOMETER ☐ OBSERVATION WELL

TIP TYPE
TIP LENGTH ____ FT. DEPTH ____ FT.
d = ____ IN. t = ____ FT.

SURROUND MATERIAL
SEAL
BACKFILL
SURFACE SEAL

☐ INCLINOMETER CASING (BUTT JOINTS)

DIA. ____ IN. LENGTH ____ FT.
BACKFILL
STICKUP ____ FT. FIRST JOINT AT ____ FT.

GROUNDWATER

☐ NO FREE GROUNDWATER OBSERVED

GROUNDWATER HIT AT ____ FT. (DRILLER ESTIMATE)

☐ TIME CHARGES BY DRILLER

DETAILS

Cornforth Consultants, Inc.
10250 SW Greenburg Road
Portland, Oregon 97223

REPORT OF EXPLORATION

JOB NO. 1507

JOB Kellogg Creek

CLIENT US COE

BORING NO. DH-4

SHT. 3 / 4

FIELD OBSERVER J. Harris

DRILL CONTRACTOR Crux

DRILL RIG Burley2000

DRILLING METHOD HWT Casing Adv / & HQ3 Coring

DRILL BIT 4 7/8" Casing Adv / HQ 3 3/4 coring bit

LOCATION ON SITE

GROUND ELEVATION Conc, Slab

CIRCULATION: ☒ MUD ez mud ☐ WATER ☐ AIR ☐ NONE

DATE 7-17

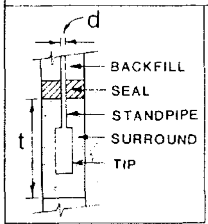
SAMPLE DATA

SAMPLE NO.	TYPE OF SAMPLE	DEPTH OF SAMPLE (FT.)		DRIVING RESISTANCE BLOWS/6 IN.	LENGTH SAMPLE (FT.)	FIELD DESCRIPTION
		FROM	TO			
						- Start with HWT casing adv from $10^{\underline{3}}$ to $15^{\underline{2}}$ - HQ $15^{\underline{2}}$ to $19^{\underline{5}}$
S-6	SPT	$19^{\underline{5}}$	$20^{\underline{3}}$	50/5½ | 50/4"	$0^{\underline{7}}$	gray, silty sandy gravel, V. DENSE – highly weath. BASALT, iron staining
		BOH $20^{\underline{3}}$				

SUMMARY FIELD BORING LOG

DEPTH (FT.)		
FROM	TO	

FIELD INSTRUMENTATION



☐ PIEZOMETER ☐ OBSERVATION WELL

TIP TYPE

TIP LENGTH FT. DEPTH FT.

d = IN. t = FT.

SURROUND MATERIAL

SEAL

BACKFILL

SURFACE SEAL

☐ INCLINOMETER CASING (BUTT JOINTS)

DIA. IN. LENGTH FT.

BACKFILL

STICKUP FT. FIRST JOINT AT FT.

GROUNDWATER

☐ NO FREE GROUNDWATER OBSERVED

GROUNDWATER HIT AT FT.
(DRILLER ESTIMATE)

☐ TIME CHARGES BY DRILLER

DETAILS

Hole No.

DRILLING LOG

DIVISION

INSTALLATION DA-4

SHEET 4 OF 4 SHEETS

1. PROJECT Kellog Creek
2. LOCATION (Coordinates or Station) Portland, OR
3. DRILLING AGENCY Crux
4. HOLE NO. (As shown on drawing title and file number) —
5. NAME OF DRILLER Christopher Brown
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED ______ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN
8. DEPTH DRILLED INTO ROCK 3^{3}
9. TOTAL DEPTH OF HOLE 20^{3}
10. SIZE AND TYPE OF BIT
11. DATUM FOR ELEVATION SHOWN (TBM or MSL) Conc. Slab
12. MANUFACTURER'S DESIGNATION OF DRILL Burley 2000
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN DISTURBED 6 UNDISTURBED —
14. TOTAL NUMBER CORE BOXES 1
15. ELEVATION GROUND WATER 5-10'
16. DATE HOLE STARTED 7-16-03 COMPLETED 7-17-03
17. ELEVATION TOP OF HOLE —
18. TOTAL CORE RECOVERY FOR BORING 100 %
19. SIGNATURE OF INSPECTOR

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	16^{2}		(R4) HARD, highly weath. BASALT in a matrix of RO-extremely soft (clay) for ~30% of volume. vesicular Basalt Very difficult coring -Very small amount of return	100	BOX 1 RUN 1	3^{3} 3^{3} 0
	19^{5}	SPT	S-6 50/5½			
	20^{3}					

Cornforth Consultants, Inc.
10250 SW Greenburg Road
Portland, Oregon 97223

REPORT OF EXPLORATION

JOB NO. 1507

JOB Kellogg Creek

CLIENT US COE

FIELD OBSERVER J. Harris

DRILL CONTRACTOR Crux

BORING NO. DH-5

SHT. 1 / 3

DRILL RIG Burley 2000

LOCATION ON SITE NW Slab area

DRILLING METHOD HWT Casing Adv / HQ3 core

DRILL BIT $4\frac{7}{8}$ casing shoe / rock bit

GROUND ELEVATION Conc. Slab.

CIRCULATION: ☒ MUD ex-mud ☐ WATER ☐ AIR ☐ NONE

DATE 7-17-03 / 7-18-03

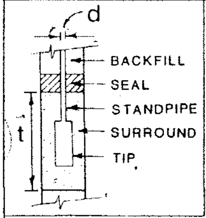
SAMPLE DATA

SAMPLE NO.	TYPE OF SAMPLE	DEPTH OF SAMPLE (FT.) FROM	DEPTH OF SAMPLE (FT.) TO	DRIVING RESISTANCE BLOWS/6 IN.	LENGTH SAMPLE (FT.)	FIELD DESCRIPTION
						0-6" concrete / No return since ~1' HWT 0-2^{2} switch HQ casing 2^{2} to
S-1	SPT	4^{0}	5^{5}	20/45/50/3"	1^{5}	V. DENSE, sl. gravelly silty f. sand, 10% fines relic rock structure, grey-brown (w/ green & yellow) (V. highly weath. BASALT?)
						return back @ 5^{5} → on about 20% / wood fragments encounted ~6 feet
S-2	SPT	7^{3}	8^{8}	26/36/50	1^{5}	V. DENSE, gravelly silty fine Sand, weather rock, relic rock, ~~wood fragments~~, 10-15% fines
7 S-3	SPT	9^{8}	11^{3}	22/41/44	1^{5}	V. DENSE, silty gravelly f-m SAND, <10% fines, v.h. weath. BASALT?
18 S-4	SPT	12^{3}	13^{3}	31/50/5½	0^{8}	V. DENSE silty gravelly f-m SAND, 10% fines, v.h. weath. BASALT?
						slight return <20%
						very diff zone 13-14^{5}

SUMMARY FIELD BORING LOG

DEPTH (FT.) FROM	DEPTH (FT.) TO	

FIELD INSTRUMENTATION



☐ PIEZOMETER ☐ OBSERVATION WELL

TIP TYPE

TIP LENGTH ______ FT. DEPTH ______ FT.

d = ______ IN. t = ______ FT.

SURROUND MATERIAL

SEAL

BACKFILL

SURFACE SEAL

☐ INCLINOMETER CASING (BUTT JOINTS)

DIA. ______ IN. LENGTH ______ FT.

BACKFILL

STICKUP ______ FT. FIRST JOINT AT ______ FT.

GROUNDWATER

☐ NO FREE GROUNDWATER OBSERVED

GROUNDWATER HIT AT ______ FT. (DRILLER ESTIMATE)

☐ TIME CHARGES BY DRILLER

DETAILS

Cornforth Consultants, Inc.
10250 SW Greenburg Road
Portland, Oregon 97223

REPORT OF EXPLORATION

JOB NO. 1507

JOB Kellogg Creek

CLIENT US COE

FIELD OBSERVER J. Harris

BORING NO. DH-5   SHT. 2 / 3

DRILL CONTRACTOR Crux

DRILL RIG Burley 2000

LOCATION ON SITE NW Corner

DRILLING METHOD HQ3 Casing / Coring

DRILL BIT Std. rock Core bit

GROUND ELEVATION Conc. Slab

CIRCULATION: slight ez-mud. ☒ MUD ☐ WATER ☐ AIR ☐ NONE

DATE 7-18-03

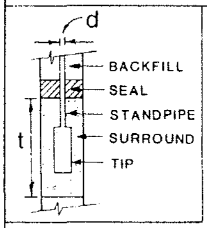
SAMPLE DATA

SAMPLE NO.	TYPE OF SAMPLE	DEPTH OF SAMPLE (FT.)		DRIVING RESISTANCE BLOWS/6 IN.	LENGTH SAMPLE (FT.)	FIELD DESCRIPTION
		FROM	TO			
5-5	SPT	~~14.8~~	~~16.3~~	12/18/50/5½		First two blows (ie 12") were slough from casing run.
		13.8	15.3			driller –
	1.2'	slough hole				hit solid BASALT @ 15.8
						Switch to HQ logging @ 15.8

SUMMARY FIELD BORING LOG

DEPTH (FT.)		
FROM	TO	

FIELD INSTRUMENTATION



☐ PIEZOMETER ☐ OBSERVATION WELL

TIP TYPE

TIP LENGTH ____ FT. DEPTH ____ FT.

d = ____ IN. t = ____ FT.

SURROUND MATERIAL

SEAL

BACKFILL

SURFACE SEAL

☐ INCLINOMETER CASING (BUTT JOINTS)

DIA. ____ IN. LENGTH ____ FT.

BACKFILL

STICKUP ____ FT. FIRST JOINT AT ____ FT.

GROUNDWATER

☐ NO FREE GROUNDWATER OBSERVED

GROUNDWATER HIT AT ____ FT. (DRILLER ESTIMATE)

☐ TIME CHARGES BY DRILLER

DETAILS

Hole No.

DRILLING LOG

DIVISION

INSTALLATION

SHEET 3 OF 3 SHEETS

1. PROJECT Kellogg Creek
2. LOCATION (Coordinates or Station) —
3. DRILLING AGENCY Crux
4. HOLE NO. (As shown on drawing title and file number) DH-5
5. NAME OF DRILLER Christopher Brown
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED ______ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN —
8. DEPTH DRILLED INTO ROCK —
9. TOTAL DEPTH OF HOLE
10. SIZE AND TYPE OF BIT HQ rock core
11. DATUM FOR ELEVATION SHOWN (TBM or MSL) Concrete Slab
12. MANUFACTURER'S DESIGNATION OF DRILL Burley 2000
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN DISTURBED 5 UNDISTURBED —
14. TOTAL NUMBER CORE BOXES 1
15. ELEVATION GROUND WATER 10-15'
16. DATE HOLE STARTED 7-17 COMPLETED 7-18-03
17. ELEVATION TOP OF HOLE conc. slab
18. TOTAL CORE RECOVERY FOR BORING 100% %
19. SIGNATURE OF INSPECTOR

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	15^{8}		RY, HARD, slightly weath. BASALT, V.h. to highly jointed, Gray, w/ yellow-green, mineralization on some joints	100%	BOX 1 RUN 1	$D=1^{\underline{0}}$ $C=1^{0}$ $Q=04$
	17^{3}		RY, HARD, sl. weath. BASALT Very highly jointed, Gray, w/ some clay infilling of joints ~≤40% of vol.	100%	RUN 2	$D\ 2^{\underline{7}}$ $C\ 2^{\underline{7}}$ $Q\ 0^{\underline{9}}$
	20^{0}				BOH@	20^{0}

Appendix B

Unconfined Compression Test Results on Selected Cores

UNCONFINED COMPRESSIVE STRENGTH of INTACT ROCK CORE

ASTM D 2938-95

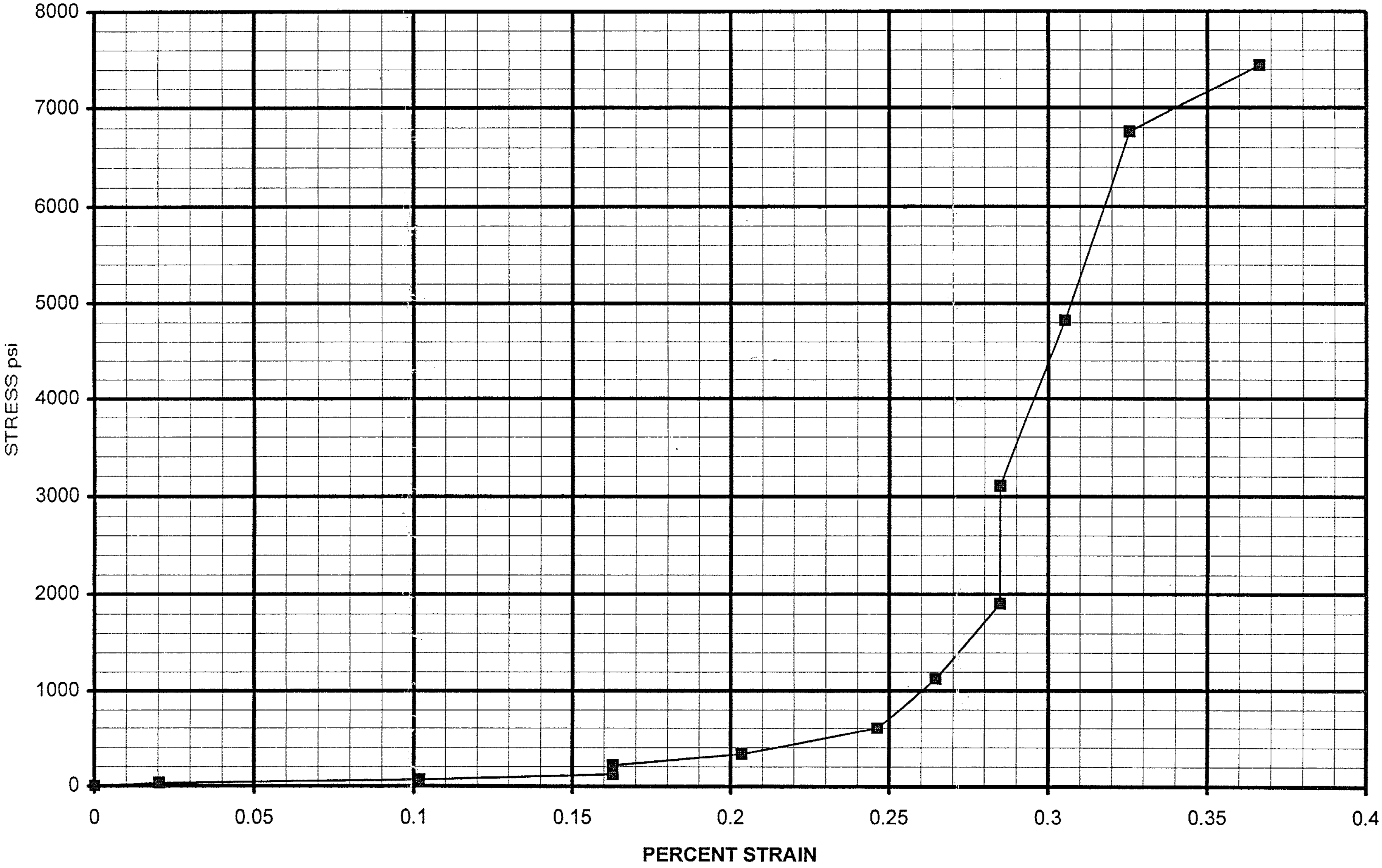
PROJECT	Kellogg Creek	**LAB NUMBER**	03-3636
SAMPLE #	DH-1	**DEPTH**	22.7'-23.7'
HEIGHTin	4.9135	**INITIAL WET WT. g**	967.20
DIAMETER in	2.3928	**FINAL DRY WT. g**	925.04
AREA in^2	4.497	**MOISTURE %**	4.6
***Length to Diameter (L/D) ratio =**	2.053	**WET DENSITY lb/ft^3**	166.8
Maximum Stress= 7442 psi	**%STRAIN RATE=0.122%/Min**		

TIME min	LOAD lb	DIAL READING in	% STRAIN	STRESS psi
0	0.0	0	0	0
0.25	141.5	0.001	0.0	31
0.5	298.5	0.005	0.1	66
0.75	555.6	0.008	0.2	124
1	967.5	0.008	0.2	215
1.25	1479.0	0.01	0.2	329
1.5	2695.0	0.0121	0.2	599
1.75	5062.0	0.013	0.3	1126
2	8570.0	0.014	0.3	1906
2.25	13970.0	0.014	0.3	3107
2.5	21695.0	0.015	0.3	4825
2.75	30400.0	0.016	0.3	6761
3	33465.5	0.018	0.4	7442
3.25				
3.5				
3.75				
4				
4.25				
4.5				
4.75				
5				
5.25				
5.5				
5.75				
6				
6.25				
6.5				
6.75				
7				
7.25				
7.5				
7.75				
8				
8.25				
8.5				
8.75				
9				
9.25				
9.5				
9.75				

LAB # 03-3636
DH-1
22.7'-23.7'

PAGE 3 OF 3

UNCONFINED COMPRESSIVE STRENGTH



PEAK STRESS 13.255 psi

UNCONFINED COMPRESSIVE STRENGTH of INTACT ROCK CORE

ASTM D 2938-95

PROJECT	Kellogg Creek	**LAB NUMBER**	03-3635
SAMPLE #	DH-~~1~~ 2	**DEPTH**	17.6-18.3
HEIGHTin	4.9595	**INITIAL WET WT. g**	952.10
DIAMETER in	2.4020	**FINAL DRY WT. g**	899.22
AREA in^2	4.531	**MOISTURE %**	5.9
***Length to Diameter (L/D) ratio =**	2.065	**WET DENSITY lb/ft^3**	161.4

Maximum Stress= 8611 psi **%STRAIN RATE=0.661%/Min**

TIME min	LOAD lb	DIAL READING in	% STRAIN	STRESS psi
0	0.0	0	0	0
0.25	477.0	0.004	0.1	105
0.5	2390.0	0.01	0.2	527
0.75	9700.0	0.023	0.5	2141
1	25008.0	0.035	0.7	5519
1.25	39020.5	0.041	0.8	8611
1.5				
1.75				
2				
2.25				
2.5				
2.75				
3				
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3.75				
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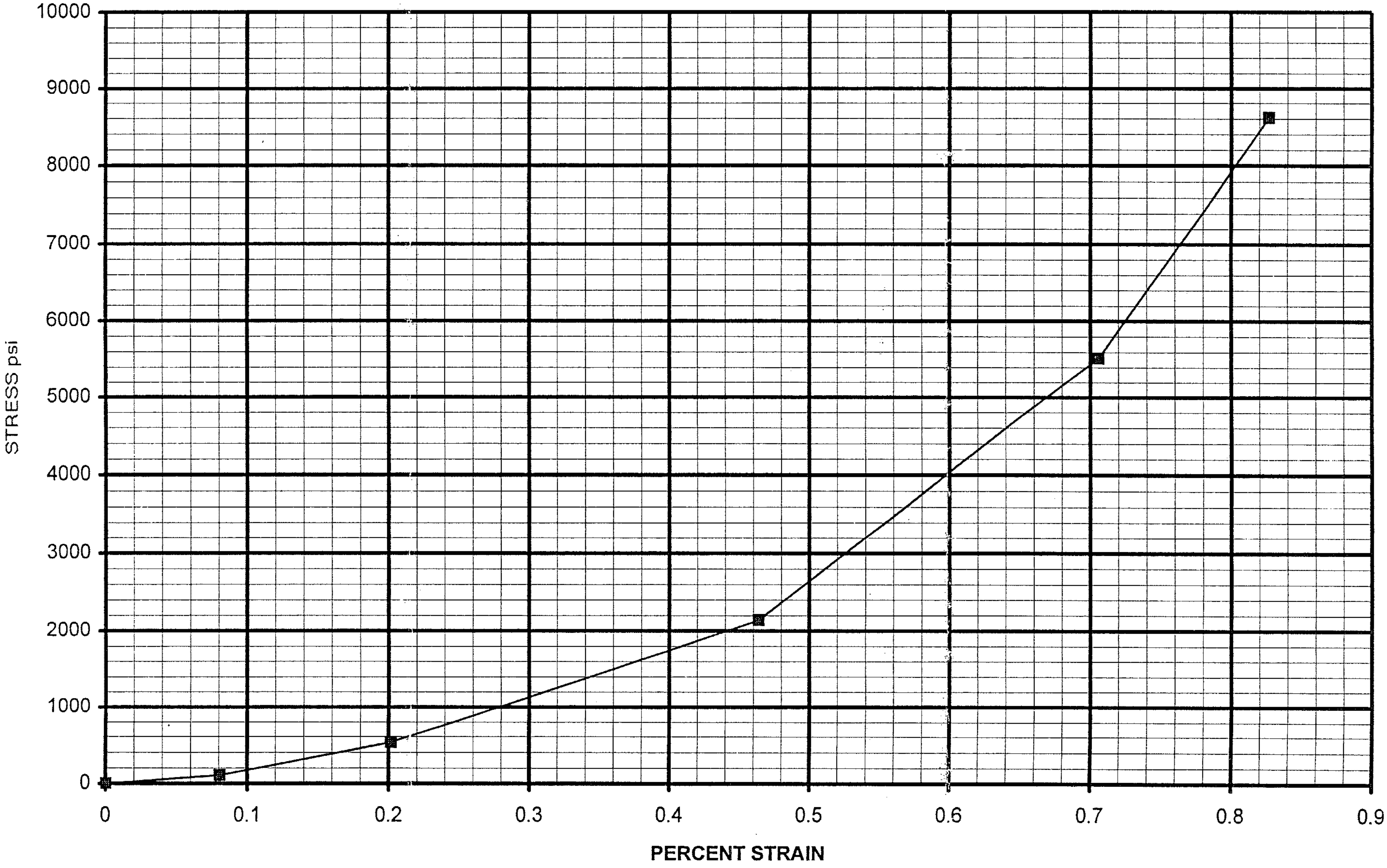
LAB # 03-3635

DH-~~1~~2

PAGE 3 OF 3

17.6'-18.3'

UNCONFINED COMPRESSIVE STRENGTH



PEAK STRESS 13.255 psi