Subsurface Conditions Data Report
Phase 3 Fill
Third Runway Embankment
Sea-Tac International Airport

HARTCROWSER
Delivering smarter solutions

Prepared for HNTB and
The Port of Seattle

November 12, 1999
J-4978-16

CONTENTS

FIGURES

CONTENTS

AR 043138

SUBSURFACE CONDITIONS DATA REPORT
PHASE 3 FILL
THIRD RUNWAY EMBANKMENT
SEA-TAC INTERNATIONAL AIRPORT

INTRODUCTION

This data report presents information on subsurface conditions, based on geotechnical and hydrogeologic field testing and laboratory testing to support the Phase 3 Fill (Y2000) construction for the Third Runway Embankment Project at the Sea-Tac International Airport. The companion document to this data report is the Phase 3 Engineering Report, which provides discussion of our engineering analyses and geotechnical recommendations for the plans and specifications.

The site is located at the Sea-Tac International Airport, in SeaTac, Washington (refer to Figure 1, Vicinity Map). Figure 1 shows the area where we performed explorations for this study. The shaded area of Figure 1 is presented on Figure 2, Site and Exploration Plan, showing exploration locations. Cross sections showing inferred geologic conditions are provided on Figures 3 and 4. Figure 5 shows "dry season" or late summer, groundwater elevation contours for the Shallow Regional Aquifer. Late spring or "wet season" groundwater elevation contours are shown in the 404 Permit Support Subsurface Conditions Data Report (Hart Crowser, 1999b).

We have organized this report into several sections. The main text begins with a summary of the geologic units we encountered followed by a more detailed discussion of subsurface conditions. This is followed by a discussion of the hydrogeologic conditions and testing information we have obtained from our explorations to date. Appendices A and B follow the main text and present results of our subsurface explorations and laboratory testing, respectively.

An errata sheet is included in Appendix A to document corrections to the boring logs previously presented in the 404 Permit Support Subsurface Conditions Data Report (Hart Crowser, 1999b) and the Borrow Areas 1, 3, and 4 Subsurface Conditions Data Report (Hart Crowser, 1999c).

PURPOSE AND SCOPE

This report provides information on subsurface soil and groundwater conditions for the planned Phase 3 Fill for the Third Runway based on explorations within the areas noted. The Phase 3 Fill, as used in this report, includes two areas (north and south of South 156th Way) as well as continued filling in the North Safety Area (NSA) soil stockpile area, which was started in 1999. The information presented herein provides the basis for geotechnical engineering analyses and recommendations presented elsewhere.

Information presented herein was obtained in general accordance with Task 5.0 - Explorations and Tests presented in our proposal dated August 23, 1999. This report has been prepared for the use of HNTB and the Port of Seattle for the site and project described herein. We completed the work according to generally accepted geotechnical engineering practices in the same or similar localities, related to the nature of the work accomplished, at the time the services were accomplished. We make no other warranty, express or implied.

GENERALIZED GEOLOGIC DESCRIPTION AND SUBSURFACE SOIL CONDITIONS

This section provides a description of the geologic and subsurface soil conditions within the Phase 3 Fill and NSA Stockpile areas, shown on Figure 2, based on our recent explorations at the site and explorations by others.

Generalized Geologic Conditions

The 404 Permit Support Subsurface Conditions Data Report (Hart Crowser, 1999b) describes the generalized geologic conditions for areas at the north end of the proposed runway and along part of the west side, including part of the area covered by this report. In summary, the following geologic units have been identified at the Third Runway project site:

- Fill (loose to medium dense, locally dense, variably graded, silt, sand, and gravel);
- Alluvium (primarily soft to stiff, peat, clay, and silt; and very loose to medium dense, fine to medium sand);
- Recessional Outwash (primarily medium dense to dense, silty sand and gravel, and/or medium stiff to hard, sandy silt and/or sandy clay);
- Glacial Till (dense to very dense, silty sand and gravel);

- Advance Outwash (dense to very dense, non-silty to silty sand and gravel); and

- Lawton Clay (very stiff to hard silt and clay).

Subsurface Conditions

Subsurface soil conditions interpreted from materials encountered in explorations at the site and soil properties inferred from laboratory tests formed the basis for the information contained in this report. Variations between explorations occur due to the variability in gradation, moisture content, and density/consistency of soils at the site. The nature and extent of these variations may not become evident until construction. If variations become evident, it will be necessary to re-evaluate our interpretation of the soil conditions at the site, as well as any recommendations based on those interpretations.

The subsurface conditions beneath the Phase 3 North Fill (north of South 156th Street), the Phase 3 South Fill (south of South 156th Street), and the NSA Stockpile (northeast corner of the site) were evaluated separately. Descriptions of the subsurface conditions for each area follow.

Phase 3 North Fill Area

Generalized subsurface conditions for the Phase 3 North Fill area are shown on Cross Section A-A', see Figure 3. The following soil materials were observed in this area.

Loose to Medium Dense, Slightly Gravelly, Silty SAND with Organic Material. These sands were encountered in most explorations at the ground surface in a loose to medium dense condition. Roots and other organic materials were observed to a couple feet depth. This unit extended from the ground surface to an average depth of 3 feet.

Stiff to Hard, Slightly Gravelly, Sandy SILT. One or two thin layers of stiff to hard silt was observed in the current study test pits (HC99-TP14, HC99-TP26, HC99-TP28, and HC99-TP30) in the Phase 3 North Fill area. The unit thickness ranged from about 0.5 to 3.5 feet and was encountered within the upper 12 feet of the test pits.

Medium Dense, Sandy GRAVEL. A thin layer of gravel was present in some of the explorations (HC99-TP14, HC99-TP26, and HC99-TP28). This soil unit was medium dense, less than about 3 feet thick, and located 6 to 12 feet below the ground surface.

Very Soft to Medium Stiff, Slightly Sandy, Silty CLAY. A 3-foot-thick layer of very soft to medium stiff clay was observed in three of the explorations (HC99-TP26, HC99-TP28, and HC99-B61) in the Phase 3 North Fill area. This unit was encountered between 10 and 15 feet depth in these explorations. Atterberg limits tests (Figures B-3 and B-4) on these samples identified the unit as low plasticity, sandy and silty clay. It plots as CL to CL-ML based on the USC System.

Dense to Very Dense, Silty, Gravelly SAND, Silty SAND, and Gravelly SAND. These sands were located at the base of the test pits (except HC99-TP36) recently completed for the Phase 3 North Fill area. In most cases, the sand was very dense and it contained varying degrees of silt and gravel.

Phase 3 South Fill Area

Subsurface conditions in the Phase 3 South Fill area consist of density compacted fill that was placed in 1998. This fill is similar in gradation to the borrow materials to be used in Phase 3.

NSA Stockpile Area

Generalized subsurface conditions in the NSA Stockpile area are shown on Cross Section C-C', see Figure 5. The following soil materials were observed in this area.

Loose to Medium Dense, Slightly Gravelly, Silty SAND with Organic Material. These sands were encountered in both borings (HC99-B63 and HC99-B65) at the ground surface in a loose to medium dense condition. Roots and other organic materials were observed to a few feet depth. This unit extended from the ground surface to a depth of 3 to 5 feet.

Stiff, Sandy SILT. A thin, 1-foot-thick layer of sand silt was observed at 6 feet depth in one test pit (HC99-TP40). This is a very minor unit based on the observations from the current set of explorations.

Dense to Very Dense SAND, Silty, Gravelly SAND, and Silty SAND. This is the primary unit that was observed below the NSA Stockpile area. These sands extended from less than 10 feet depth to more than 30 feet depth in the two borings (HC99-B63 and HC99-B65) in the area. Heave was observed in drilling HC99-B63, as described in the following section.

Hydrogeologic Conditions

Groundwater Occurrence

Groundwater was encountered in the borings during drilling for this phase of work. The water levels observed in the open borings at the time of drilling (ADT) and prior to monitoring well installation and development are shown on the boring logs (Appendix A). Heaving conditions were encountered at depth in the fine to medium sands during drilling in HC99-B63. This boring was drilled in the general area of earlier wells (e.g., HC99-B43a) where artesian groundwater conditions had been observed.

Groundwater Monitoring

Groundwater elevation data are being collected monthly from 28 wells on the site to gain a better understanding of seasonal fluctuations in groundwater elevations and flow patterns in the Phase 3 Fill area. The most recent set of depth to water measurements was collected on October 13, 1999. The available data are compiled and presented in Table 1. The seasonal flux throughout the site, as observed in our monitoring well program from March through October 1999, indicates an average increase in groundwater level of less than 3 feet during the monitoring period.

Four new wells were installed in September 1999 to provide additional data. Three of the wells, HC99-B61, HC99-B71, and HC99-B73, were installed between 12th Avenue South and Miller Creek, in an area where no other monitoring wells were available. The fourth, HC99-B65, was installed to the east of 12th Avenue South. The locations of these wells are shown on Figure 2 and 6.

Groundwater Flow Mapping

Shallow groundwater elevations as observed in October 1999 are contoured on Figure 6. These groundwater levels represent dry-season conditions, with elevations that are typically 2 to 3 feet lower than levels observed in March 1999, at the height of the wet season. Groundwater flow patterns are apparently unchanged by seasonal water level variations, with flow generally toward Miller Creek from the higher ground of the airport. This is consistent with conceptual

models of the local hydrogeology, where recharge occurs on the higher ground of the airport, and water moves down into the Shallow Regional Aquifer before discharging to the creek. The artesian conditions indicate an upward hydraulic gradient, consistent with the regional discharge of groundwater to the creek drainage basin.

The pattern of groundwater flow is broadly consistent with the implied occurrence of significant recharge beneath the existing airport. However, not all water levels are necessarily reflective of conditions in the Shallow Regional Aquifer, since perched zones can occur above the main water table, especially in the till. Consequently, observed water levels may not necessarily reflect the main water table in the Shallow Regional Aquifer, due to the presence of perching layers.

Groundwater Seepage at Proposed Pond Location

Figure 4 shows generalized subsurface soil conditions at the proposed locations of Ponds C and G, including location and depth where seepage was observed in test pits.

Three test pits were advanced within the footprint of Pond C (the north detention pond) to about elevation 267 to 269 feet, corresponding to proposed pond bottom elevations that vary from about 268 to 273 feet. All the test pits encountered interlayered slightly silty sand to very silty sand and silt, with varying amounts of gravel. Seepage was encountered in all 3 test pits as follows:

- "Slight to moderate" seepage was reported in test pit HC99-TP19 at depths between 4 to 8 feet, corresponding to elevations between about 282 to 278 feet;
- Seepage was encountered at a depth of about 7 feet in HC99-TP21, corresponding to about elevation 271. Note no observation was recorded of the seepage rate in this test pit, which typically suggests it was slight; and
- "Slight" seepage was reported in HC99-TP39 at a depth of 12 feet, corresponding to an elevation of about 269 feet.

No infiltration was noted in tests accomplished in test pits HC99-TP19 and HC99-TP21, apparently due to seepage from the ground into the test pits during the tests. While the higher elevation seepage noted in HC99-TP19 probably reflects local perched zones, seepage in the other two test pits corresponds closely with the our estimate of 275 feet for the elevation of the Shallow Regional Aquifer, based on extrapolation from Miller Creek and observation wells located to the west.

Three test pits were also advanced within the footprint of Pond G (the south detention pond) to about elevation 245 to 250 feet, corresponding to a proposed pond bottom elevation of about 252 feet. All the test pits encountered interlayered slightly silty sand to very silty sand, with varying amounts of gravel. Seepage was encountered in two of the test pits as follows:

- "Slight" seepage was reported in test pit HC99-TP41 at a depth of about 13 feet, corresponding to an elevation of about 251 feet; and
- "Slight" seepage was reported in HC99-TP37 at a depth of about 13 feet, corresponding to an elevation of about 247 feet.

No infiltration was noted over a 90-minute period during an attempted test in test pit HC99-TP41, which was terminated when the side of the test pit sloughed. The observed seepage in these test pits corresponds closely with the our estimate of 250 feet for the elevation of the Shallow Regional Aquifer, based on extrapolation from Miller Creek and observation wells located to the west.

Typical wet weather water level contours are presented on Figure 7 of Hart Crowser's data report dated July 1999. The enclosed Figure 6 shows typical dry season water levels. Seasonal water level fluctuations of up to about 3 feet have been noted in wells east of the proposed detention ponds, but seasonal flux would probably be less near Miller Creek. Water level contours are similar in the pond areas for the two maps referenced above, but this is due at least partly to not having much data (i.e. wells) in the immediate vicinity.

Infiltration Testing

Double-ring infiltrometer testing was performed to provide input into detention pond design. The tests were performed in test pits HC99-TP19, HC99-TP21, and HC99-TP36D.

One infiltration test was performed in test pit HC99-TP36D in an area identified as a proposed infiltration pond in a fax received from HNTB dated July 24, 1999. This area is not currently considered as a potential pond location. The gravelly nature of the soils in this test pit prevented driving the rings further than about 3 inches. The rate of infiltration could not be assessed due to negligible infiltration during the test duration.

Two infiltration tests, in test pits HC99-TP19 and HC99-TP21, were performed in the area of the proposed Pond C. No infiltration was observed in these tests due to the shallow groundwater table encountered at the proposed pond bottoms (about 7 to 10 feet below grade). Test pit logs for HC99-TP19 and HC99-TP21

were shown in the 404 Permit Support Subsurface Conditions Data Report (Hart Crowser, 1999b).

An infiltration test was proposed but not performed in the area of the proposed Pond G in test pit HC99-TP37, because this test pit encountered silty, low permeability soils at the anticipated pond bottom (about 8 feet below grade). One or two additional test pits will be located in the vicinity of the proposed south pond during work in November 1999, to further assess potential for infiltration in this area.

CLOSING

Hart Crowser appreciates the opportunity to provide this information. Please call if you have any questions.

Sincerely,

HART CROWSER, INC.

Douglas D. Lindquist

DOUGLAS D. LINDQUIST
Staff Geotechnical Engineer

James R Beaver

JAMES R. BEAVER
Project Geotechnical Engineer

MICHAEL J. BAILEY
STATE OF WASHINGTON
22484
REGISTERED
PROFESSIONAL ENGINEER
EXPIRES 12/12/01

MICHAEL J. BAILEY, P.E.
Project Manager

F:\Docs\Jobs\497816\data(rpt).doc

AR 043146

REFERENCES

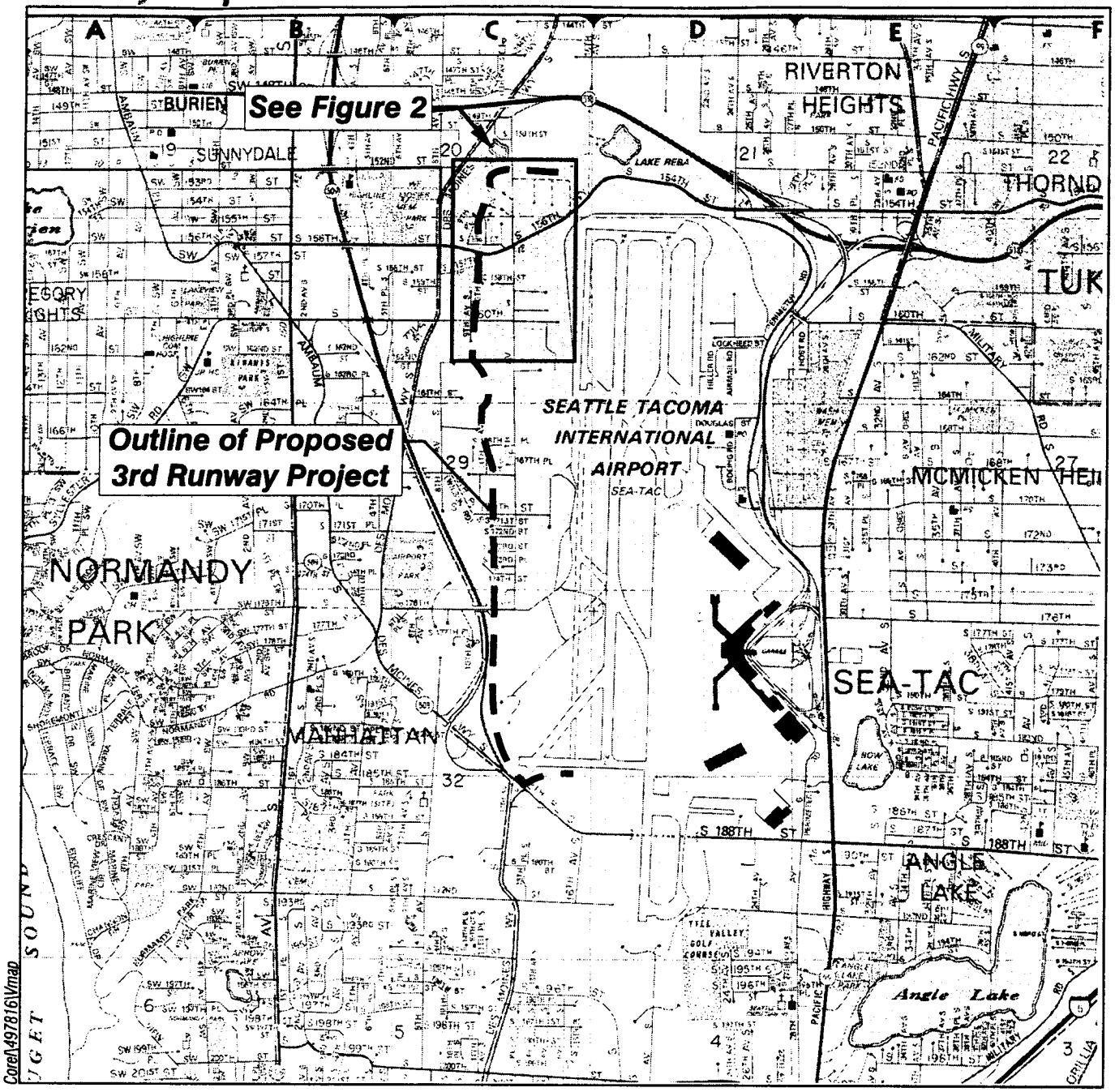
Hart Crowser, 1999a. Draft Memorandum: Additional Explorations, Watermain Relocation Project, Sea-Tac International Airport, SeaTac, Washington, June 23, 1999.

Hart Crowser, 1999b. Subsurface Conditions Data Report, 404 Permit Support, Third Runway Embankment, Sea-Tac International Airport, SeaTac, Washington, July 9, 1999.

Hart Crowser, 1999c. Subsurface Conditions Data Report, Borrow Areas 1, 3, and 4, Sea-Tac Airport Third Runway, September 24, 1999.

F:\docs\jobs\497816\data(rpt).doc

Vicinity Map



CorelJ497816Vmap

0 2000 4000

Scale in Feet

N

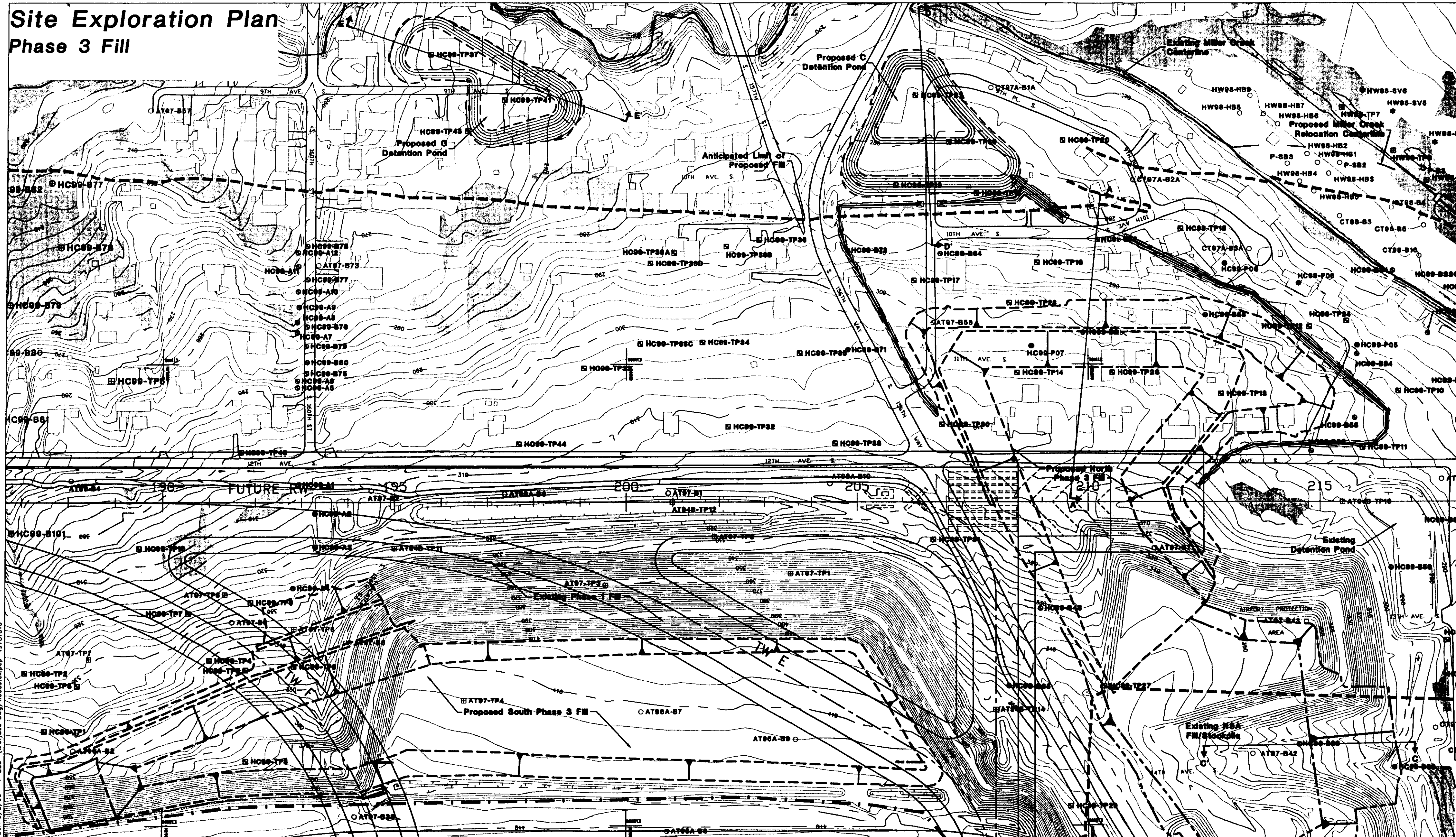
AR 043148

HARTCROWSER

J-4978-16 11/99

Figure 1

Site Exploration Plan
Phase 3 Fill



Note: Base map prepared from drawing provided by HNTB entitled "Topo_Full.dwg", dated October 4, 1999.

DJH 3/2/00 1=200 (xref)See Dwg/Woodstck.pcp 49781610

HC99-B50 ⊕ Exploration Location and Designation. See reference list for explorations not included in this report.

Wetlands

A A' Cross Section Location and Designation

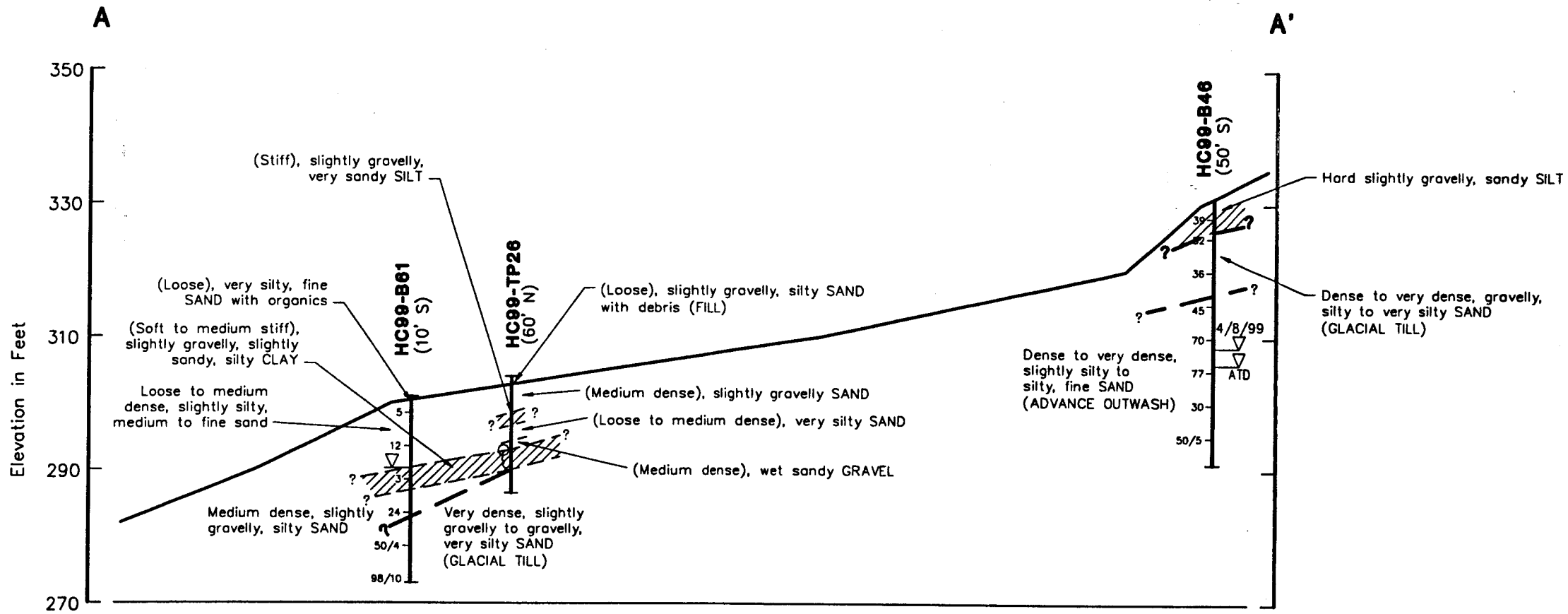
0 200 400
Scale in Feet

HARTCROWSER
J-4978-16 3/00
Figure 2

AR 043149

Generalized Geologic Cross Section A-A' (North Phase 3 Fill Area)

Looking North



HC99-B61 (10' S) Exploration Number (Offset Distance and Direction)

Exploration Location

5 N Value

ATD Water Level

Seep Location

– – – – Inferred Geologic Contact (Minor Unit)

—— —— Inferred Geologic Contact (Major Unit)

Horizontal Scale in Feet
0 100 200
0 20 40
Vertical Scale in Feet
Vertical Exaggeration x 5

Note: Contacts between soil units are based upon interpolation between explorations and represent our interpretation of subsurface conditions based on currently available data.

C:\0 11/5/99 1=100 wastk.pc2
4978160\

AR 043150

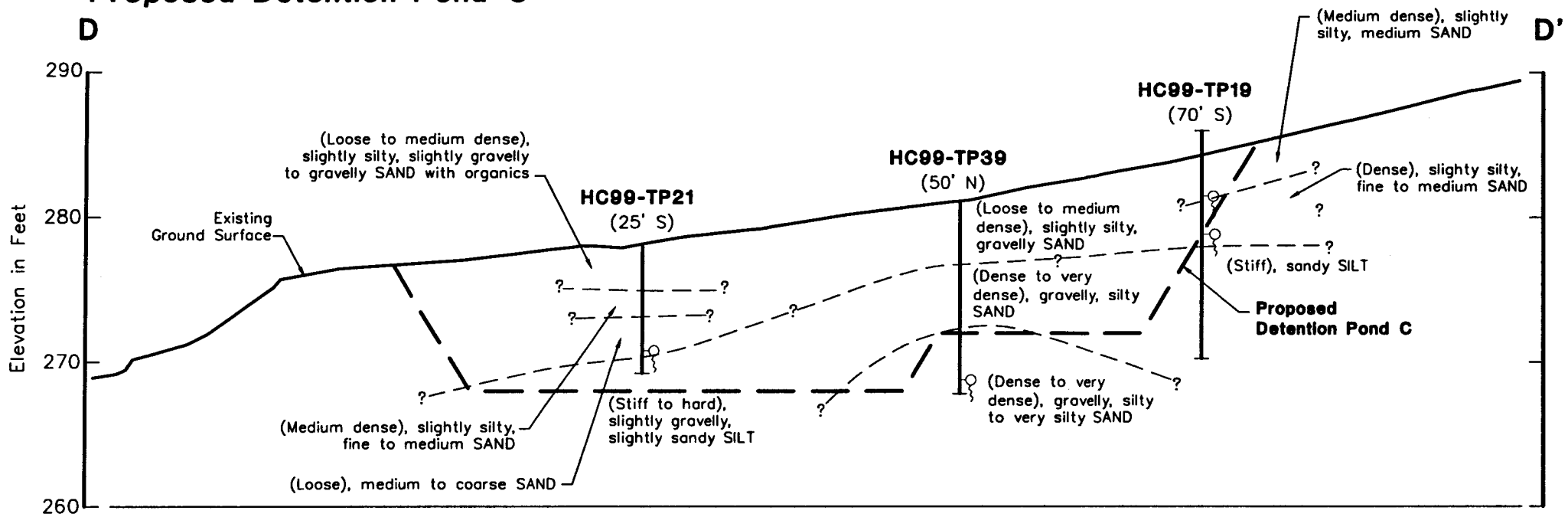
HARTCROWSER

J-4978-16 11/99

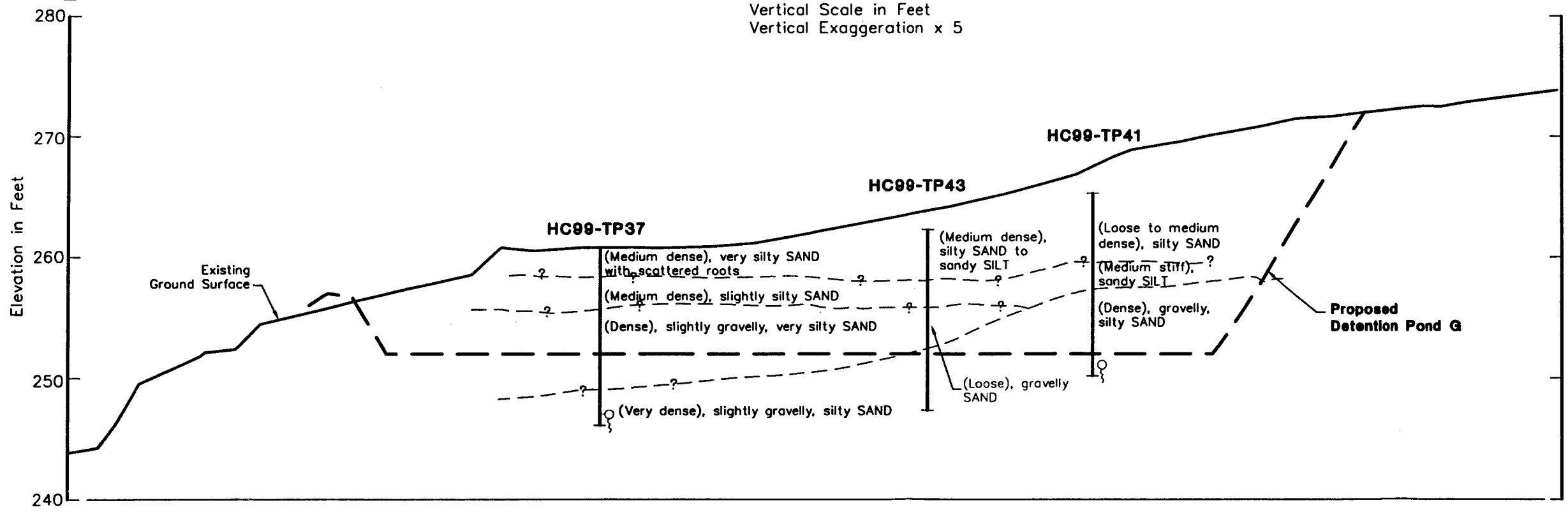
Figure 3

Cross Sections D-D' and E-E'

Proposed Detention Pond C



Proposed Detention Pond G



HC99-TP-21 (25' S) Test Pit (Offset Distance and Direction)

Test Pit Location

Seep Location

– – – – Inferred Geologic Contact

Note: Contacts between soil units are based upon interpolation between explorations and represent our interpretation of subsurface conditions based on currently available data.

DJH 3/3/00 1=50 wdatk.pc2
49781611

AR 043151

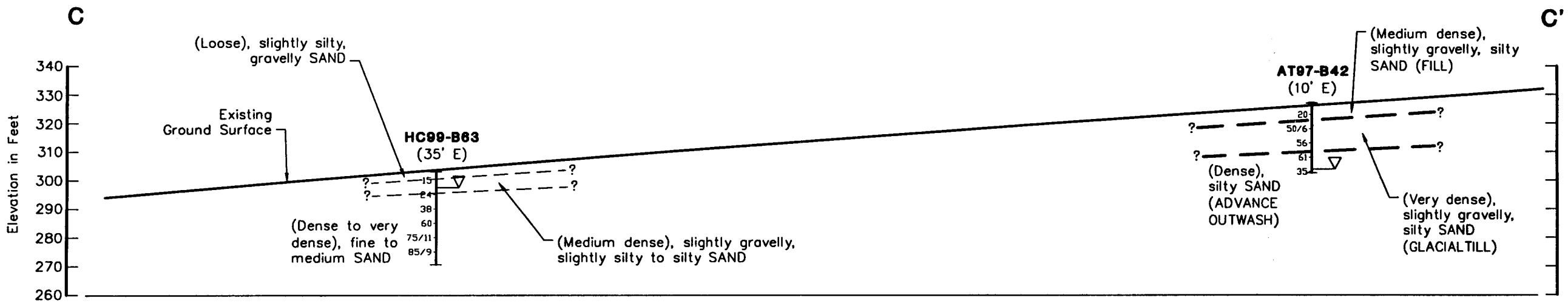
HARTCROWSER

J-4978-16 3/00

Figure 4

Generalized Geologic Cross Section C-C' (NSA Stockpile Area)

Looking East



HC99-B63 Exploration Number
(35' E) (Offset Distance and Direction)

Exploration Location

38 N Value

Water Level

Seep Location

– – – – Inferred Geologic Contact (Minor Unit)

—— —— Inferred Geologic Contact (Major Unit)

0 40 80
Scale in Feet

Note: Contacts between soil units are based upon interpolation between explorations and represent our interpretation of subsurface conditions based on currently available data.

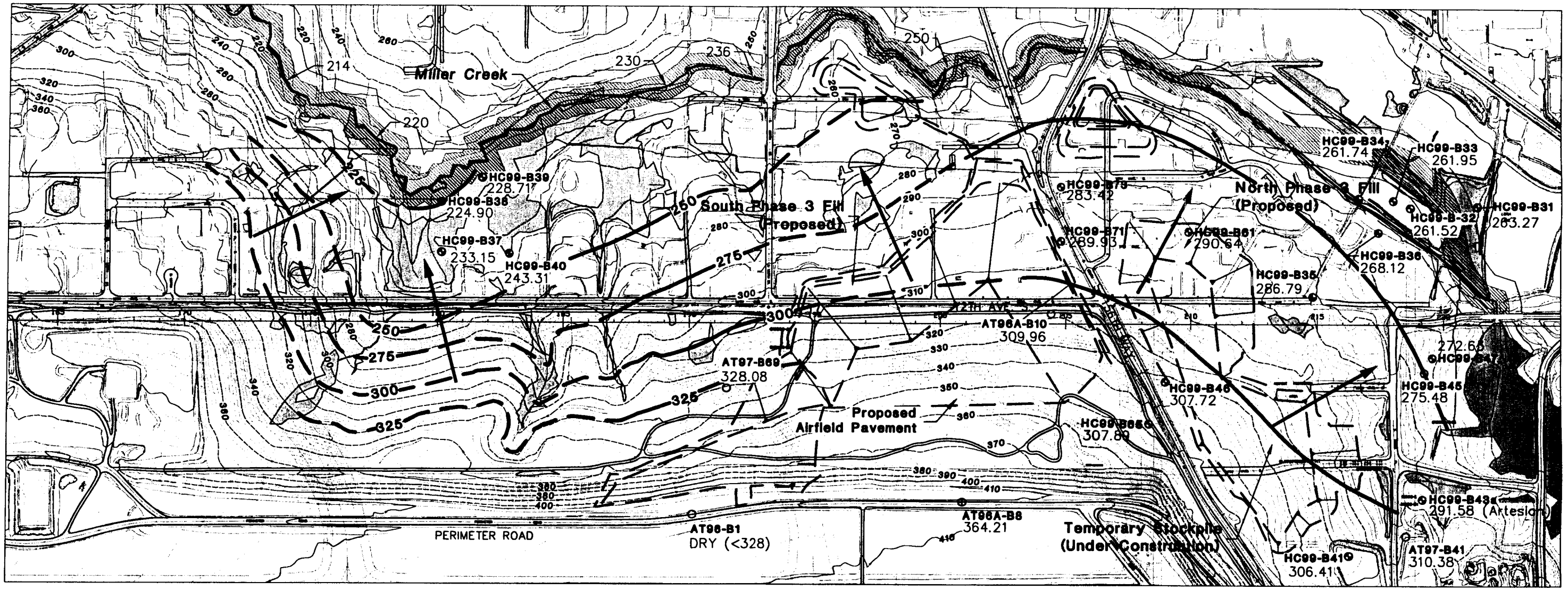
AR 043152

HARTCROWSER
J-4978-16 3/00
Figure 5

DJH 3/3/00 1=40 wdsk.pc2
49781609

Groundwater Elevation Contour Map

Dry Season (October 13, 1999)



Note: Base map prepared from drawing provided by HNTB entitled, "SthBase.dwg", dated August, 1998. Wetland locations based on drawing provided by Parametrix entitled, "w_050799.dwg," dated May 7, 1999.

250	Groundwater Elevation Contour in Feet (Dashed Where Inferred)
HC99-B35	Monitoring Well Location and Number
286.79	Groundwater Elevation in Feet (October 13, 1999)
(Artesian)	Water Level above Ground Surface
	Inferred Groundwater Flow Direction
175	Runway Stationing
	Wetland

N

0 400 800

Scale in Feet

RC 11/12/99 1=400 (xref)sse drawing file/woodstick.pc2
49781603

HARTCROWSER

J-4978-16 10/99

Figure 6

AR 043153

APPENDIX A
FIELD EXPLORATIONS METHODS AND ANALYSIS

APPENDIX A
FIELD EXPLORATIONS METHODS AND ANALYSIS

This appendix documents the processes Hart Crowser used in determining the nature of the soils underlying the project site addressed by this report. The discussion includes information on the following subjects:

- Explorations and Their Location;
- The Use of Auger Borings;
- Standard Penetration Test (SPT) Procedures;
- Excavation of Test Pits;
- Double-Ring Infiltrometer Test;
- Water Level Measurement;
- Pocket Penetrometer (PP); and
- Errata.

Explorations and Their Location

Subsurface explorations for this project include the following:

- **Borings**
  HC99-B61, HC99-B63, HC99-B65, HC99-B71, and HC99-B73.

- **Test Pits**
  HC99-TP26 through HC99-TP40, HC99TP44, HC99-TP36A, HC99-TP36B, HC99-TP36C, and HC99-TP36D.

The exploration logs within this appendix show our interpretation of the material encountered based on drilling (or excavation), sampling, and testing data. They indicate the depth where the soils change. Note that the change may be gradual. In the field, we classified the samples taken from the explorations according to the methods presented on Figure A-1 - Key to Exploration Logs. This figure also provides a legend explaining the symbols and abbreviations used in the logs.

Location of Explorations. Figure 2 shows the location of explorations. In the field, borings and test pits were located using GPS survey by Hart Crowser on October 1, 1999. Port of Seattle surveyors performed x, y, z survey for all wells on October 13, 1999, which replaced the GPS locations. GPS coordinates were used for the test pits. The ground surface elevations of the test pits can be interpreted from the aerial survey topography shown on Figure 2. The method used determines the accuracy of the location and elevation of the explorations.

The Use of Auger Borings

With depths ranging from 17.9 to 43.5 feet below the ground surface, five hollow-stem auger borings, designated HC99-B61, HC99-B63, HC99-B65, HC99-B71, and HC99-B73, were drilled from September 27 through 29, 1999. The borings used a 3-3/8-inch inside diameter hollow-stem auger and were advanced with a truck-mounted drill rig subcontracted by Hart Crowser. The drilling was continuously observed by an engineering geologist from Hart Crowser. Detailed field logs were prepared of each boring. Using the Standard Penetration Test (SPT), we obtained samples at 2-1/2- to 5-foot-depth intervals.

Groundwater level in the borings were noted at the time of drilling (ATD) and following installation and development of observation wells where noted on the boring logs and shown in Table A-1. A monitoring well was not installed in boring HC99-B63 because of excessive heave.

The borings logs are presented on Figures A-2 through A-6 at the end of this appendix.

Standard Penetration Test (SPT) Procedures

This test is an approximate measure of soil density and consistency. To be useful, the results must be used with engineering judgment in conjunction with other tests. The SPT (as described in ASTM D 1587) was used to obtain disturbed samples. This test employs a standard 2-inch outside diameter split-spoon sampler. Using a 140-pound hammer, free falling 30 inches, the sampler is driven into the soil for 18 inches. The number of blows (N value) required to drive the sampler the last 12 inches only is the Standard Penetration Resistance. This resistance, or blow count, measures the relative density of granular soils and the consistency of cohesive soils. The blow counts are plotted on the boring logs at their respective sample depths.

Soil samples are recovered from the split-barrel sampler, field classified, and placed into water tight jars. They are then taken to Hart Crowser's laboratory for further testing.

Some instances of "heave" are noted on boring logs. Heave is a phenomenon that occurs typically within a sand soil where there is excess seepage pressure at the bottom of the auger (i.e., water within the augers is at a lower elevation than the groundwater level surrounding the boring). A sufficient difference in water levels will cause the sandy soils to be displace upward into the auger, thereby disturbing the soil formation. Therefore, the corresponding SPT N values do not

accurately indicate density. Heave is typically controlled by sustaining the water level within the auger at or near the surrounding groundwater level, no drilling mud was used in the explorations described in this report.

In the Event of Hard Driving

Occasionally very dense materials or the presence of gravel and/or cobbles prevented driving the total 18-inch sample. When this happens, the penetration resistance is entered on logs as follows:

Penetration less than six inches. The log indicates the total number of blows over the number of inches of penetration.

Penetration greater than six inches. The blow count noted on the log is the sum of the total number of blows completed after the first 6 inches of penetration. This sum is expressed over the number of inches driven that exceed the first 6 inches. The number of blows needed to drive the first 6 inches is not reported. For example, a blow count series of 12 blows for 6 inches, 30 blows for 6 inches, and 50 (the maximum number of blows counted within a 6-inch increment for SPT) for 3 inches would be recorded as 80/9.

Excavation of Test Pits

Twenty test pits, designated HC99-TP-26 through HC99-TP40, HC99-TP44, HC99-TP36A, HC99-TP36B, HC99-TP36C, and HC99-TP36D, were excavated across the site with a tractor-mounted backhoe provided by Port Construction Services (PCS). The test pits were excavated on September 28 through October 1, 1999. The sides of these excavated pits offer direct observation of the subgrade soils. The test pits were located by and excavated under the direction of an engineering geologist from Hart Crowser. The geologist observed the soil exposed in the test pits and reported the findings on a field log. Our geologist took representative samples of soil types for testing at Hart Crowser's laboratory. He noted groundwater levels or seepage during excavation. The density/consistency of the soils (as presented parenthetically on the test pit logs to indicate their having been estimated) is based on visual observation only, as disturbed soils cannot be measured for in-place density.

The test pit logs are presented on Figures A-7 through A-16.

Double-Ring Infiltrometer Test

The double-ring infiltrometer test, based on ASTM D 3385, was used to measure infiltration in selected test pits. The rings were driven into the ground about 6

inches. Bentonite was placed around the outside of the outer ring, to prevent water from coming out around the ring. The rings were filled with water, and the levels were maintained for a while before beginning the test, to obtain a saturated infiltration rate. Readings were recorded on field forms. Results of the infiltration tests were presented in the main text.

Water Level Measurement

Water levels were measured using a Solinst water level probe, graduated in 0.01-foot increments. Depth to water was measured below the top of casing, and recorded to the nearest hundredth of a foot. Depth to water was converted to groundwater elevation using survey information for the top of casing in the wells. Depth to water data and groundwater elevations are summarized in Table A-1.

Pocket Penetrometer (PP)

The pocket penetrometer procedure provides a quick approximate test of the consistency (undrained shear strength) of a cohesive soil sample. The device consists of a calibrated spring mechanism, which measures penetration resistance of a 1/4-inch-diameter steel tip over a given distance. The penetration resistance is correlated to the unconfined compressive strength of the soil, which is typically twice the undrained shear strength of a saturated, cohesive soil. The exploration logs show the results of the pocket penetrometer tests.

Errata

This section summarizes errata that have been identified in previous Hart Crowser data reports for the Third Runway project. The correct information does not affect any previous engineering analyses or recommendations but an errata sheet or corrections should be included as part of any data reports referred to in construction contract documents. The header identifies the report, which is followed by the corrected information.

404 Permit Support Subsurface Conditions Data Report

This report was prepared by Hart Crowser (1999b) for HNTB and dated July 9, 1999. The following corrections should be made to boring logs of Appendix A of this report:

- The northing and easting coordinates are switched on the boring logs. These should be reversed.

Borrow Areas 1, 3, and 4 Subsurface Conditions Data Report

This report was prepared by Hart Crowser (1999c) for HNTB and dated September 24, 1999. The following corrections should be made to boring logs in Appendix A of this report:

- Boring Log A1-B13-99 ground surface elevation should read 288.6 feet instead of 288.5 feet.

- Boring Log A3-B13-99 ground surface elevation should read 286.66 feet instead of 286.35 feet.

F:\data\jobs\497816\data(rpt).doc

Table A-1 - Water Level Data

East of 12th	AT96-B1		AT97-B69		AT96A-B8		AT96A-B10		AT97-B41		AT97-B42	
	Depth* in Feet	Elevation in Feet	Depth* in Feet	Elevation in Feet	Depth* in Feet	Elevation in Feet	Depth* in Feet	Elevation in Feet	Depth* in Feet	Elevation in Feet	Depth* in Feet	Elevation in Feet
Measuring Point	0.00	*407.7*	0.00	*337.2*	0.00	*412.7*	0.00	*319.7*	0.00	*312.2*	0.00	*325.2*
Ground Level*	*-0.3*	*408*	3.2	*334*	*-0.3*	*413*	*-0.3*	*320*	3.2	*309*	3.2	*322*
Top of Screen*	*77.7*	*330*	*27.7*	*310*	*49.7*	*363*	*23.7*	*296*	*81.2*	*231*	*22.7*	*303*
Bottom of Screen*	*87.7*	*320*	*29.7*	*308*	*60.7*	*352*	*33.7*	*286*	*83.2*	*229*	*27.7*	*298*
Date: 3/8/1999	-	-	-	-	-	-	-	-	Flowing	>312	21.21	303.94
3/10/1999	dry	dry	6.18	331.02	-	-	8.15	311.55	-	-	-	-
4/5/1999	dry	dry	6.59	330.61	-	-	8.11	311.59	Flowing	>312	21.59	303.56
5/4/1999	dry	dry	7.43	329.77	-	-	8.35	311.35	0.91	311.24	22.17	302.98
5/15/1999	-	-	-	-	-	-	-	-	-	-	22.22	302.93
6/14/1999	dry	dry	8.08	329.12	47.86	364.84	8.74	310.96	1.27	310.88	22.58	302.57
7/13/1999	dry	dry	8.41	328.79	48.87	363.83	8.81	310.89	1.41	310.74	Abandoned	
8/13/1999	dry	dry	8.83	328.37	48.10	364.60	9.06	310.64	1.57	310.58	Abandoned	
9/14/1999	dry	dry	9.16	328.04	48.26	364.44	9.44	310.26	1.73	310.42	Abandoned	
10/13/1999	dry	dry	9.12	328.08	48.49	364.21	9.74	309.96	1.77	310.38	Abandoned	

West of 12th	AT97-B57		HC99-B31		HC99-B32		HC99-B33		HC99-B34		HC99-B35	
	Depth* in Feet	Elevation in Feet	Depth* in Feet	Elevation in Feet	Depth* in Feet	Elevation in Feet	Depth* in Feet	Elevation in Feet	Depth* in Feet	Elevation in Feet	Depth* in Feet	Elevation in Feet
Measuring Point	0.00	*235.7*	0.00	266.24	0.00	266.29	0.00	265.65	0.00	267.63	0.00	294.58
Ground Level*	*-0.3*	*236*	2.5	263.7	3.1	263.2	2.9	262.8	2.4	265.2	2.0	292.6
Top of Screen*	*13*	*395*	17.5	248.7	13.1	253.2	11.9	253.8	7.4	260.2	15.0	279.6
Bottom of Screen*	*23*	*385*	27.5	238.7	23.1	243.2	21.9	243.8	17.4	250.2	25.0	269.6
Date: 3/8/1999	-	-	2.38	263.86	3.55	262.74	2.71	262.94	4.72	262.91	4.69	289.89
4/5/1999	-	-	2.41	263.83	3.51	262.78	2.64	263.01	4.68	262.95	5.13	289.45
5/4/1999	-	-	2.58	263.66	4.14	262.15	3.19	262.46	5.44	262.19	5.58	289.00
6/14/1999	2.11	233.59	2.93	263.31	4.75	261.54	2.61	263.04	5.88	261.75	6.48	288.10
7/13/1999	-	-	2.98	263.26	4.83	261.46	3.72	261.93	5.86	261.77	6.79	287.79
8/13/1999	3.10	232.60	3.11	263.13	5.05	261.24	3.90	261.75	6.12	261.51	7.29	287.29
9/14/1999	3.61	232.09	3.30	262.94	5.21	261.08	4.09	261.56	6.16	261.47	7.76	286.82
10/13/1999	3.72	231.98	2.97	263.27	4.77	261.52	3.70	261.95	5.89	261.74	7.79	286.79

Italics = Estimated

Depth* All depths are below measuring point (NOT below the ground surface)

- Indicates data not available.

497816\SeaTacWaterLevels.xls

Table A-1 - Water Level Data

East of 12th	HC99-B41		HC99-B43A		HC99-B45		HC99-B46		HC99-B47	
	Depth* in Feet	Elevation in Feet	Depth* in Feet	Elevation in Feet	Depth* in Feet	Elevation in Feet	Depth* in Feet	Elevation in Feet	Depth* in Feet	Elevation in Feet
Measuring Point	0.00	330.7	0.00	295.58	0.00	285.29	0.00	332.93	0.00	281.22
Ground Level*	*3*	328	*3*	*293*	3.1	282.2	2.1	330.8	2.4	278.8
Top of Screen*	28	302.7	27.0	268.6	8.1	277.2	30.1	302.8	7.4	273.8
Bottom of Screen*	38	292.7	37.0	258.6	13.1	272.2	40.1	292.8	12.4	268.8
Date: 3/8/1999	31.87	308.86	–	–	6.70	278.59	22.01	310.81	–	–
3/10/1999	–	–	–	–	–	–	–	–	–	–
4/5/1999	32.57	308.16	Under Pressure		7.50	277.79	22.48	310.34	–	–
5/4/1999	33.17	307.56	-10.1	306	7.93	277.36	23.09	309.73	6.26	274.96
5/15/1999	33.24	307.49	–	–	–	–	–	–	–	–
6/14/1999	33.56	307.17	-9.2	304.81	8.99	276.30	23.75	309.07	7.44	273.78
7/13/1999	33.77	306.96	-9.5	305.04	9.00	276.29	24.17	308.65	6.99	274.23
8/13/1999	33.97	306.76	-10.4	305.96	9.43	275.86	24.53	308.29	7.56	273.66
9/14/1999	24.18	306.52	-9.2	304.81	11.09	274.20	24.84	307.98	9.03	272.19
10/13/1999	24.29	306.41	-9.5	305.04	9.81	275.48	25.21	307.72	8.59	272.63

West of 12th	HC99-B36		HC99-B37		HC99-B38		HC99-B39		HC99-B40	
	Depth* in Feet	Elevation in Feet	Depth* in Feet	Elevation in Feet	Depth* in Feet	Elevation in Feet	Depth* in Feet	Elevation in Feet	Depth* in Feet	Elevation in Feet
Measuring Point	0.00	275.03	0.00	237.65	0.00	230.88	0.00	230.80	0.00	250.63
Ground Level*	2.4	272.6	3.1	234.6	3.3	227.6	*-0.3*	*231.1*	2.0	248.6
Top of Screen*	6.4	268.6	9.1	228.6	12.3	218.6	4.7	226.1	14.0	236.6
Bottom of Screen*	10.4	264.6	19.1	218.6	22.3	208.6	14.7	216.1	24.0	226.6
Date: 3/8/1999	4.73	270.30	3.52	234.13	4.40	226.48	0.69	230.11	4.88	245.75
4/5/1999	5.01	270.02	3.58	234.07	4.41	226.47	0.74	230.06	5.26	245.37
5/4/1999	5.83	269.20	3.82	233.83	4.60	226.28	0.86	229.94	5.75	244.88
6/14/1999	6.23	268.80	5.12	232.53	5.90	224.98	1.68	229.12	6.89	243.74
7/13/1999	6.42	268.61	4.72	232.93	5.93	224.95	2.05	228.75	7.18	243.45
8/13/1999	6.68	268.35	5.70	231.95	6.08	224.80	2.18	228.62	7.13	243.50
9/14/1999	7.85	267.18	6.47	231.18	6.48	224.40	2.51	228.29	7.67	242.96
10/13/1999	6.91	268.12	4.50	233.15	5.98	224.90	2.09	228.71	7.32	243.31

Italics = Estimated

Depth* All depths are below measuring point (NOT below the ground surface)

– Indicates data not available.

Table A-1 - Water Level Data

East of 12th		HC99-B65 Depth* in Feet	HC99-B65 Elevation in Feet
Measuring Point		0.00	348.12
Ground Level*		2.5	345.6
Top of Screen*		34.5	313.6
Bottom of Screen*		44.5	303.6
Date:	3/8/1999	–	–
	3/10/1999	–	–
	4/5/1999	–	–
	5/4/1999	–	–
	5/15/1999	–	–
	6/14/1999	–	–
	7/13/1999	–	–
	8/13/1999	–	–
	9/14/1999	–	–
	10/13/1999	40.23	307.89

West of 12th		HC99-B61 Depth* in Feet	HC99-B61 Elevation in Feet	HC99-B71 Depth* in Feet	HC99-B71 Elevation in Feet	HC99-B73 Depth* in Feet	HC99-B73 Elevation in Feet
Measuring Point		0.00	303.94	0.00	304.46	0.00	293.80
Ground Level*		2.1	301.8	2.5	302.0	2.1	291.7
Top of Screen*		9.1	294.8	9.5	295.0	14.1	279.7
Bottom of Screen*		14.1	289.8	19.5	285.0	24.1	269.7
Date:	3/8/1999	–	–	–	–	–	–
	4/5/1999	–	–	–	–	–	–
	5/4/1999	–	–	–	–	–	–
	6/14/1999	–	–	–	–	–	–
	7/13/1999	–	–	–	–	–	–
	8/13/1999	–	–	–	–	–	–
	9/14/1999	–	–	–	–	–	–
	10/13/1999	13.30	290.64	14.53	289.93	10.38	283.42

Italics = Estimated

Depth* All depths are below measuring point (NOT below the ground surface)

– Indicates data not available.

Key to Exploration Logs

Sample Description

Classification of soils in this report is based on visual field and laboratory observations which include density/consistency, moisture condition, grain size, and plasticity estimates and should not be construed to imply field nor laboratory testing unless presented herein. Visual–manual classification methods of ASTM D 2488 were used as an identification guide.

Soil descriptions consist of the following:
Density/consistency, moisture, color, minor constituents, MAJOR CONSTITUENT, additional remarks.

Density/Consistency

Soil density/consistency in borings is related primarily to the Standard Penetration Resistance.
Soil density/consistency in test pits is estimated based on visual observation and is presented parenthetically on the test pit logs.

SAND or GRAVEL Density	Standard Penetration Resistance (N) in Blows/Foot	SILT or CLAY Consistency	Standard Penetration Resistance (N) in Blows/Foot	Approximate Shear Strength in TSF
Very loose	0 – 4	Very soft	0 – 2	<0.125
Loose	4 – 10	Soft	2 – 4	0.125 – 0.25
Medium dense	10 – 30	Medium stiff	4 – 8	0.25 – 0.5
Dense	30 – 50	Stiff	8 – 15	0.5 – 1.0
Very dense	>50	Very stiff	15 – 30	1.0 – 2.0
		Hard	>30	>2.0

Moisture

Dry	Little perceptable moisture
Damp	Some perceptable moisture, probably below optimum
Moist	Probably near optimum moisture content
Wet	Much perceptable moisture, probably above optimum

Minor Constituents

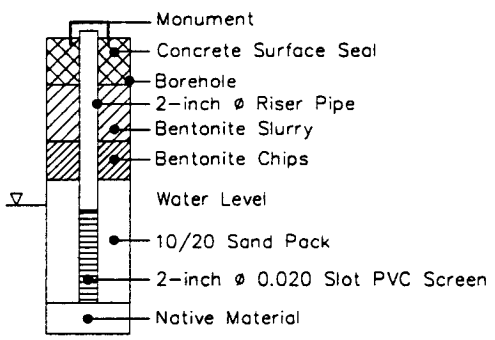
	Estimated Percentage
Not identified in description	0 – 5
Slightly (clayey, silty, etc.)	5 – 12
Clayey, silty, sandy, gravelly	12 – 30
Very (clayey, silty, etc.)	30 – 50

Legends

Sampling Test Symbols

BORING SAMPLES		TEST PIT SAMPLES	
☒	Split Spoon	☒	Grab (Jar)
▨	Shelby Tube	▨	Bag
▥	Cuttings	▨	Shelby Tube
▯	Core Run	⧓	Bucket Sample
*	No Sample Recovery		
P	Tube Pushed, Not Driven		

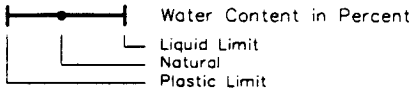
Groundwater Observations



497816\RAISED_MON 1=1

Test Symbols

GS	Grain Size Classification
P_{200}	Percent Fines Classification
CN	Consolidation
TUU	Triaxial Unconsolidated Undrained
TCU	Triaxial Consolidated Undrained
TCD	Triaxial Consolidated Drained
QU	QU
DS	Direct Shear
K	Permeability
PP	Pocket Penetrometer Approximate Compressive Strength in TSF
TV	Torvane Approximate Shear Strength in TSF
CBR	California Bearing Ratio
MD	Moisture Density Relationship
AL	Atterberg Limits



HARTCROWSER

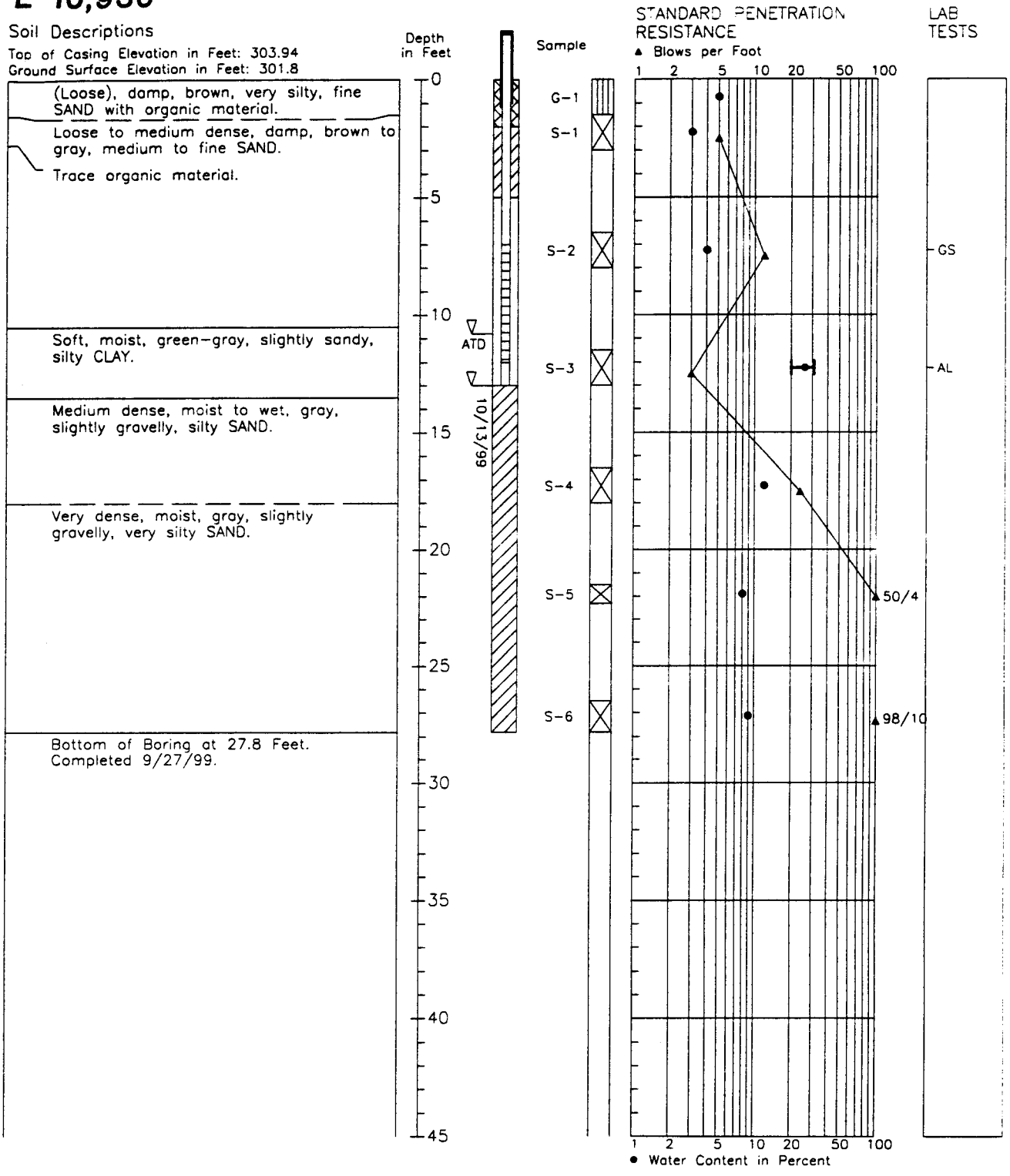
J-4978-16 11/99

Figure A-1

AR 043163

Boring Log HC99-B61

N 20,989
E 10,930



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

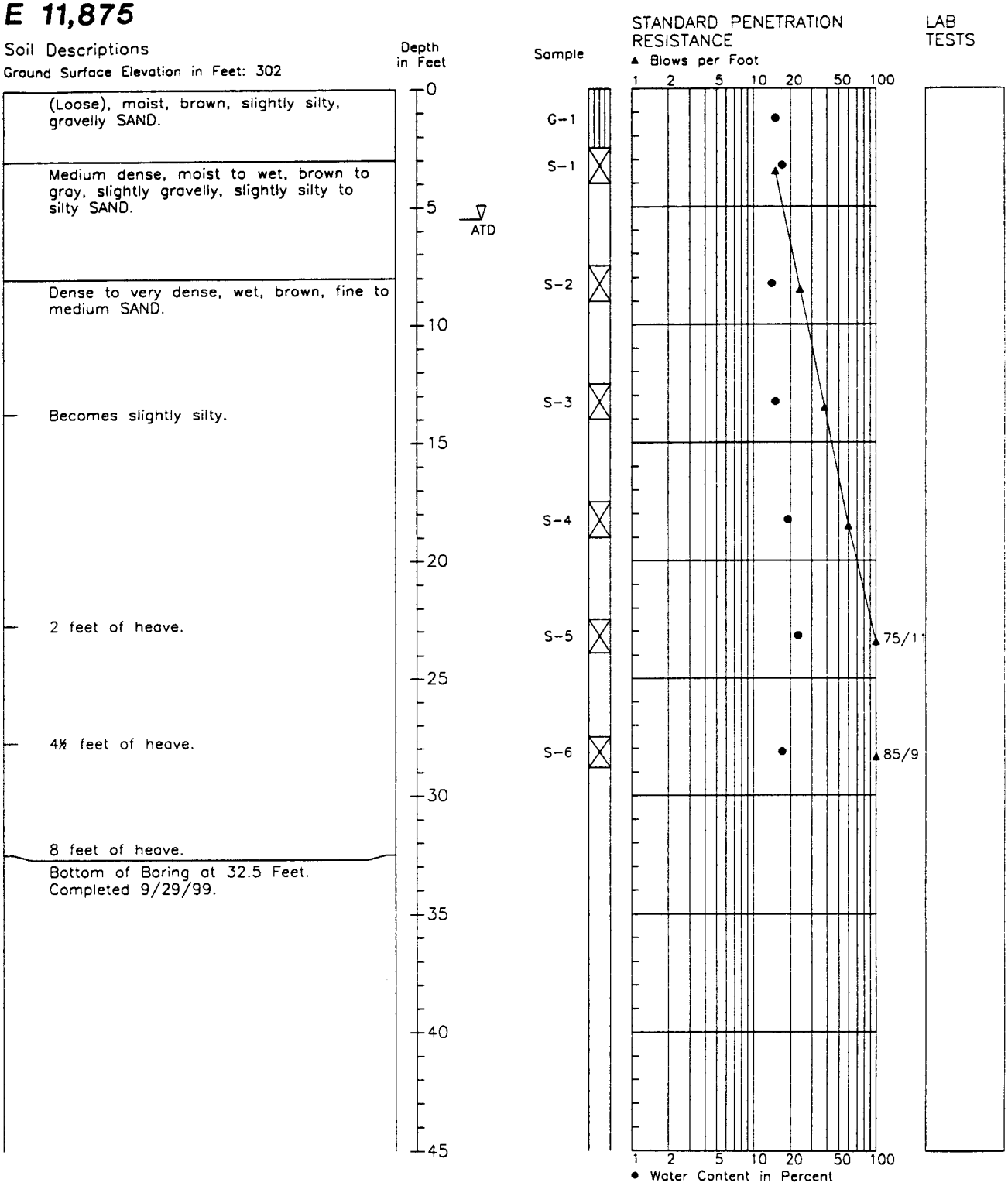
HARTCROWSER
J-4978-16 9/99
Figure A-2

AR 043164

CVD 11/12/99 1=1 woodstock-8.pc2
497816 BORING

Boring Log HC99-B63

N 21,660
E 11,875



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

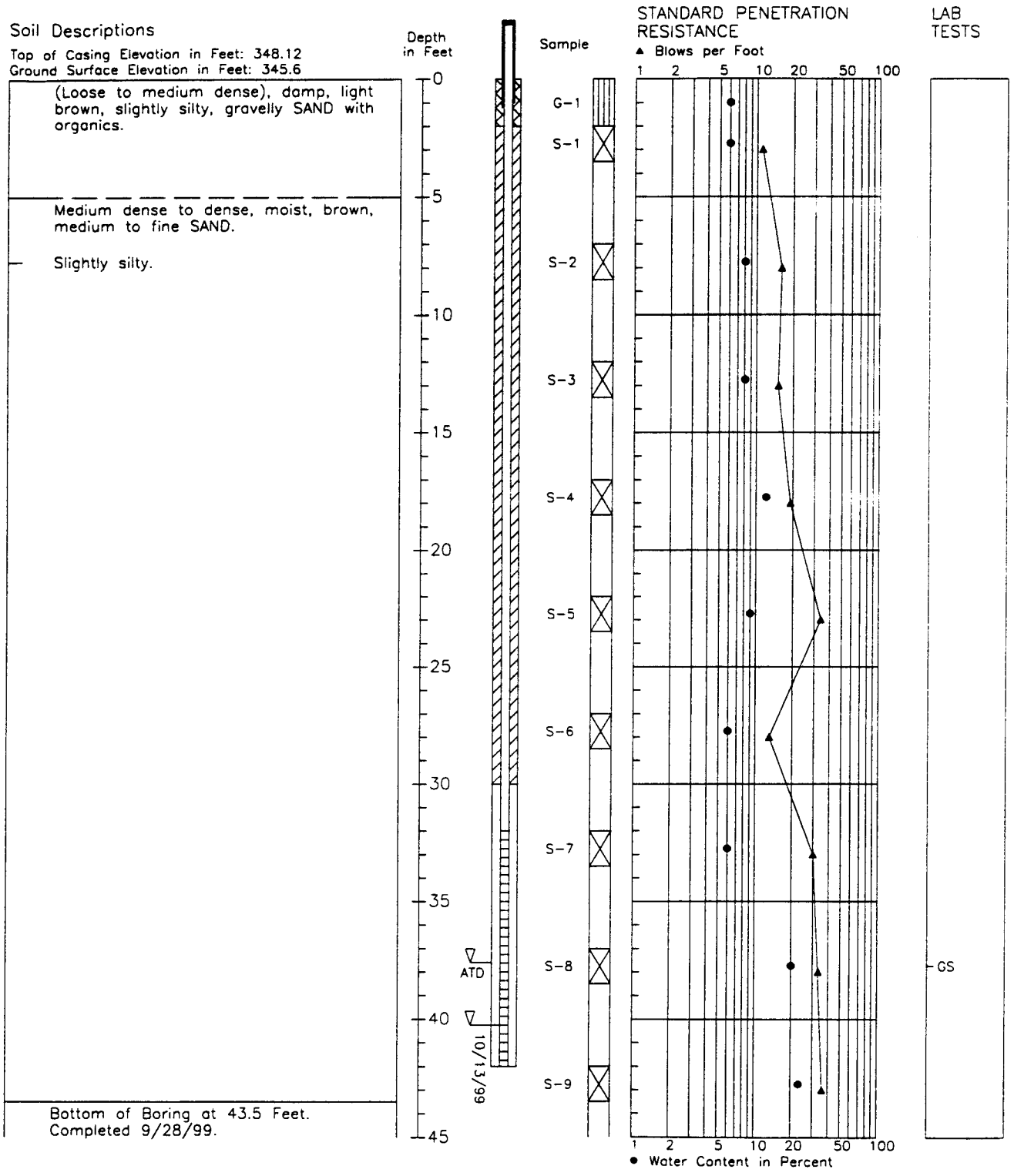
HARTCROWSER
J-4978-16 9/99
Figure A-3

AR 043165

CVD 11/12/99 1=1 woodstock-B.pc2
497818 BORING

Boring Log HC99-B65

N 20,829
E 11,969



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

AR 043166

HARTCROWSER

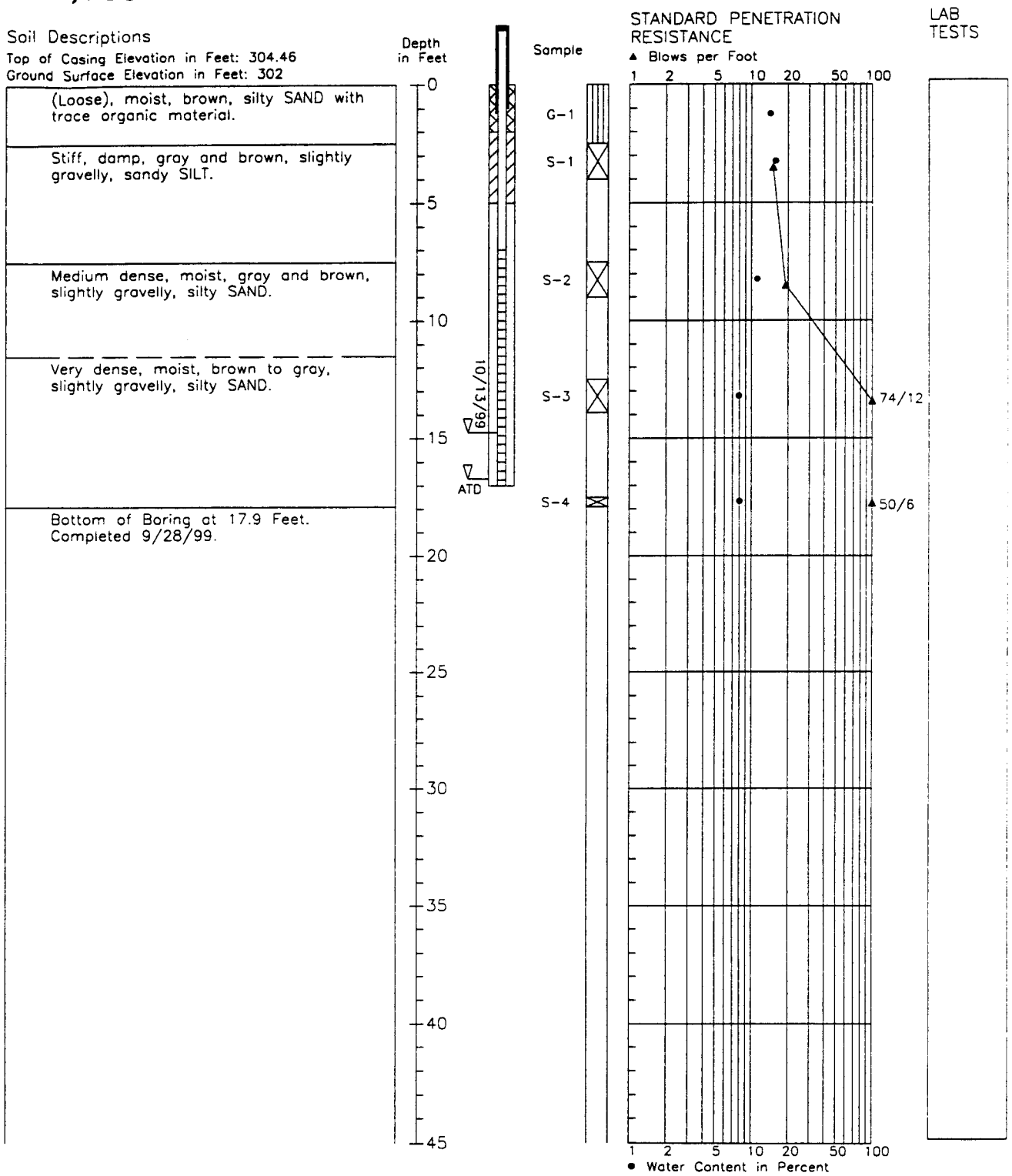
J-4978-16 9/99

Figure A-4

CVD 11/12/99 1=1 woodstock-B.pc2
497816 BORING

Boring Log HC99-B71

N 20,479
E 10,969



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

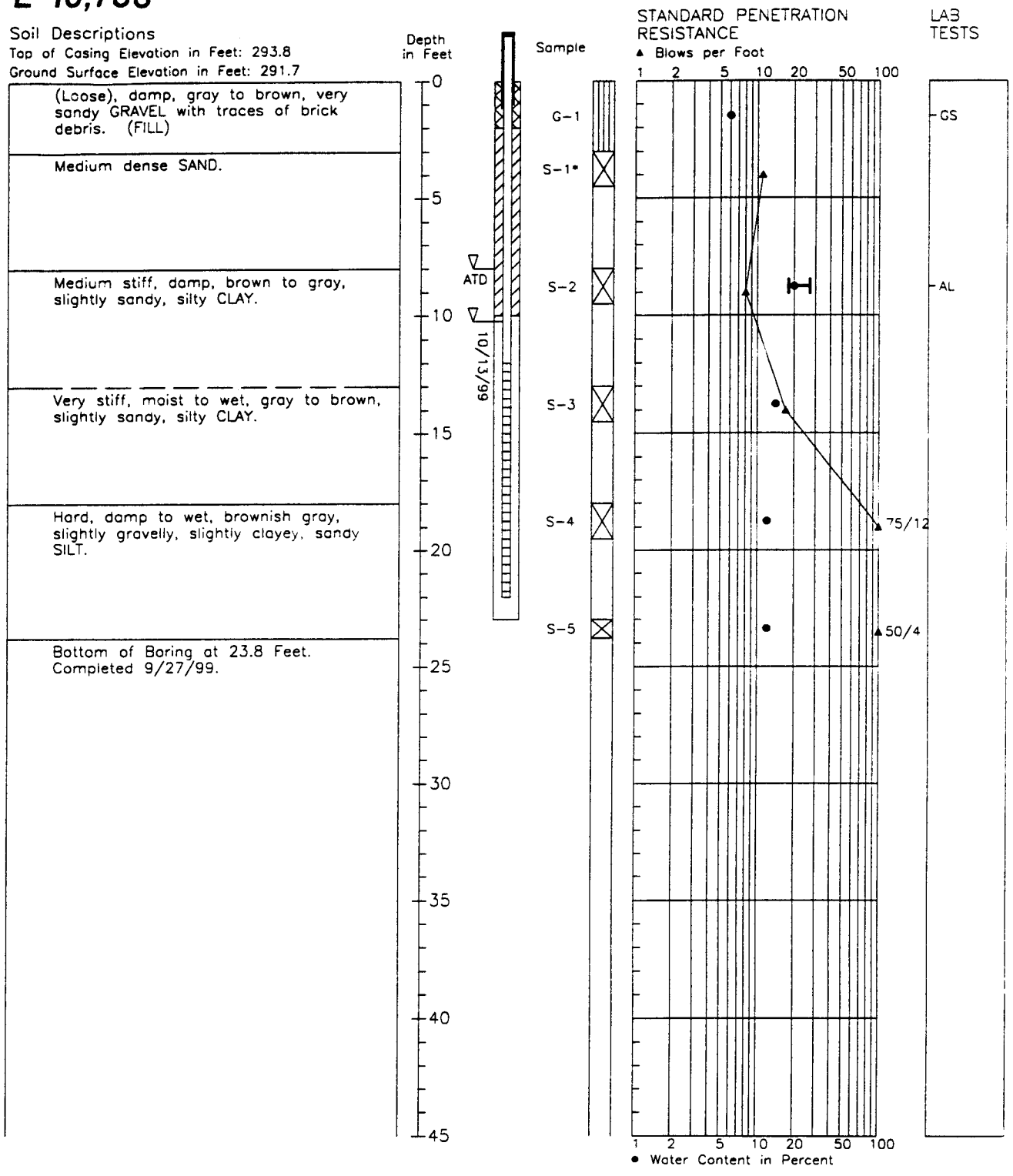
AR 043167

HARTCROWSER
J-4978-16 9/99
Figure A-5

CVD 11/12/99 1=1 woodstock-B.pc2
497816 BORING

Boring Log HC99-B73

N 20,478
E 10,753



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

AR 043168

HARTCROWSER

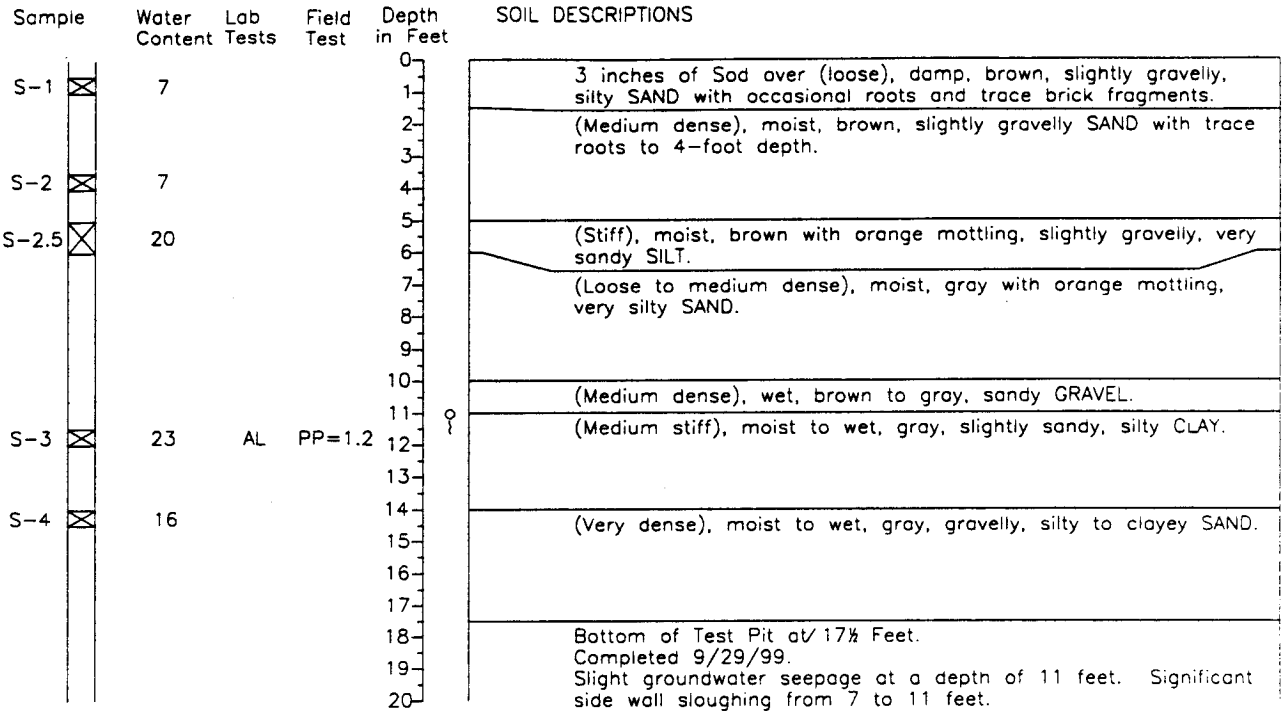
J-4978-16 9/99

Figure A-6

CVD 11/12/99 1=1 woodstock-8.pc2
497816 BORING

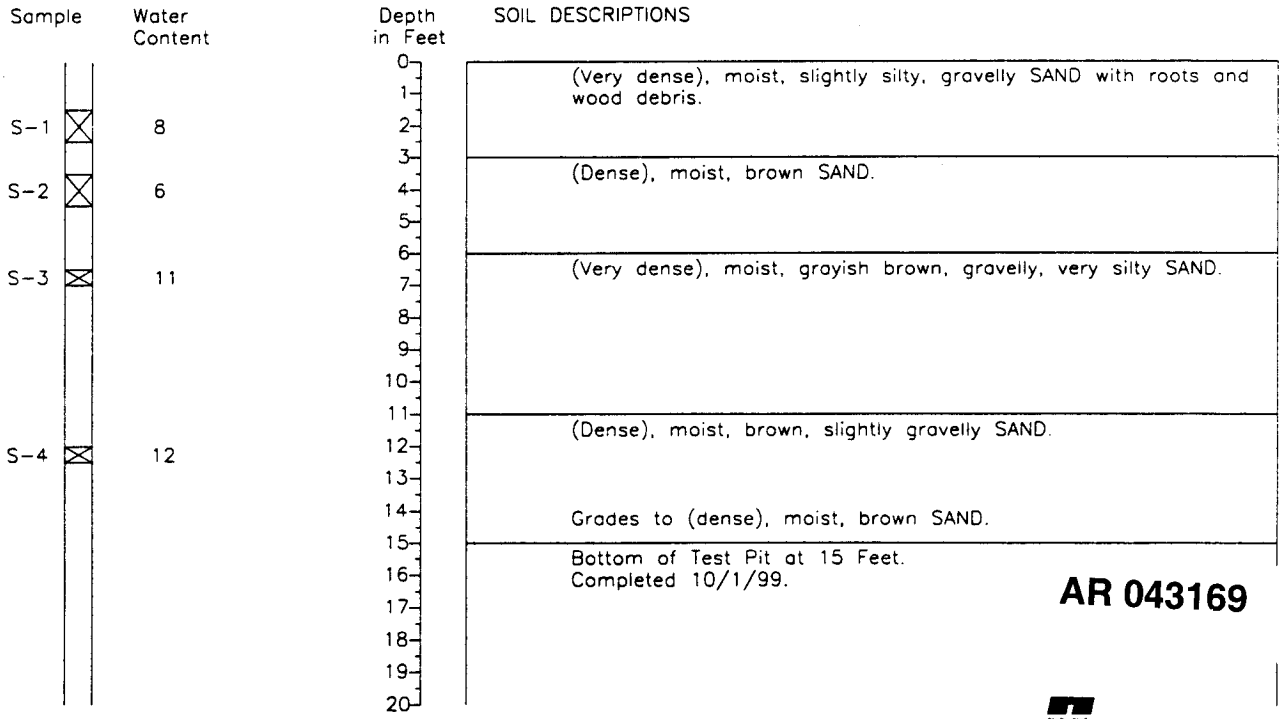
Test Pit Log HC99-TP26

N 21,054
E 11,018



Test Pit Log HC99-TP27

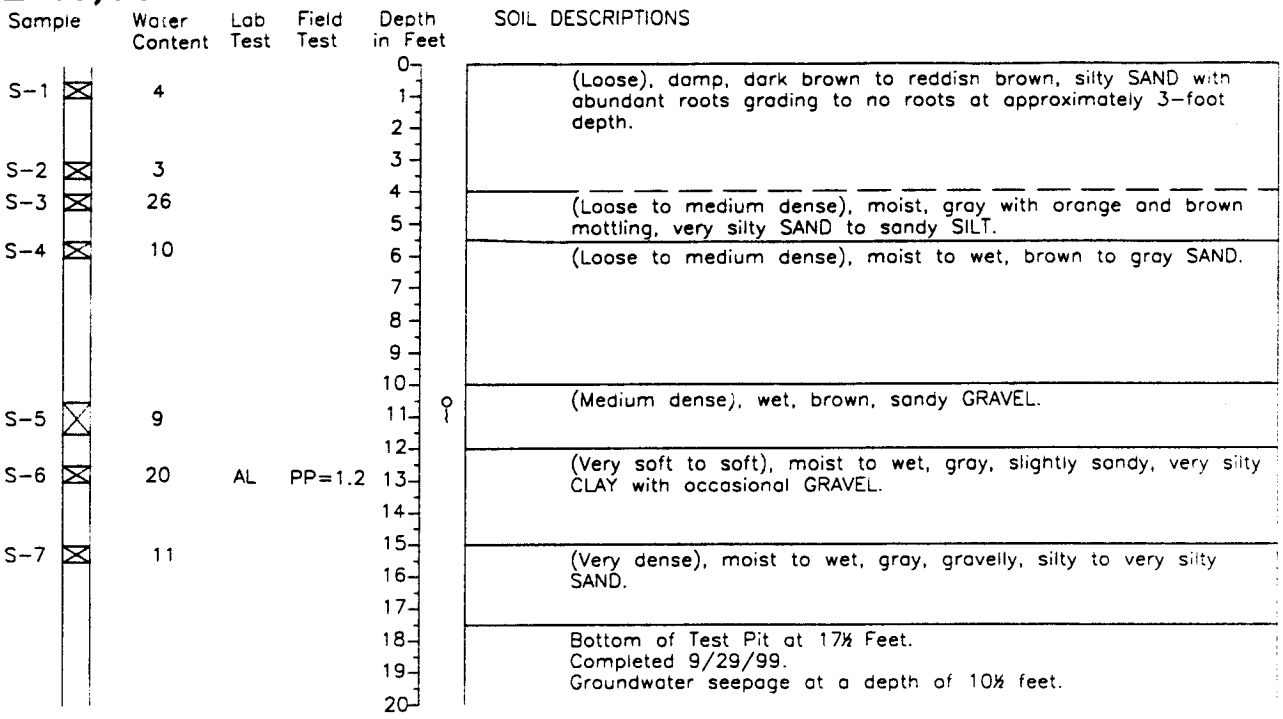
N 21,036
E 11,700



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Groundwater conditions, if indicated, are at the time of excavation. Conditions may vary with time.

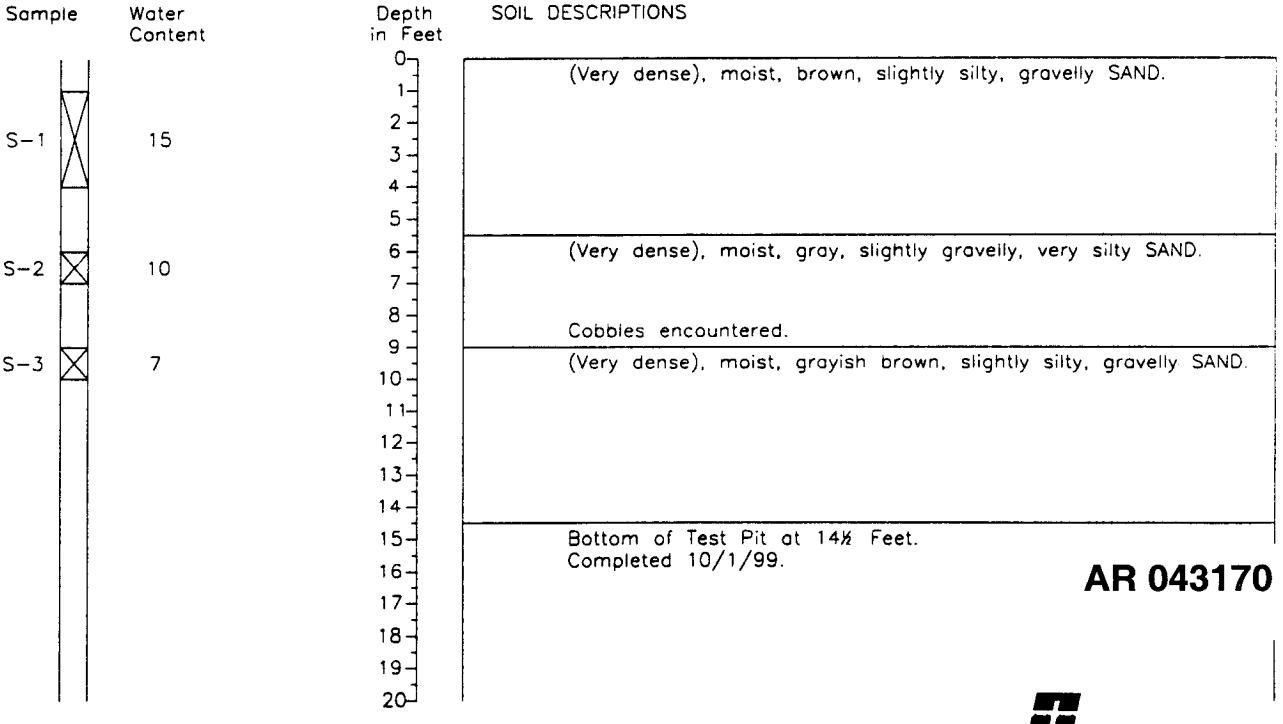
Test Pit Log HC99-TP28

N 20,830
E 10,867



Test Pit Log HC99-TP29

N 20,962
E 11,959



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Groundwater conditions, if indicated, are at the time of excavation. Conditions may vary with time.

AR 043170

HARTCROWSER

J-4978-16 9/99

Figure A-8

CVD 11/12/99 1=1 woodstock-8.pc2
497816 TEST PITS

Test Pit Log HC99-TP30

N 20,684
E 11,131

Sample	Water Content	Field Test	Depth in Feet	SOIL DESCRIPTIONS
S-1			0–2	3 inches of Sod over (loose to medium dense), damp, brown, gravelly, silty SAND with scattered roots.
S-2	10		2–5	(Medium dense), damp to moist, brown to gray, silty to very silty SAND. Encountered 4-inch-diameter abandoned drainpipe with drain rock in west side of pit at a depth of 3 feet.
S-3	23		5–9	(Medium dense), damp, brown SAND with trace gravel.
S-4	17	PP=1.5	9–13	(Stiff), moist, gray with orange mottling, sandy SILT with occasional gravel.
S-5	10		13–15	(Medium dense to dense), moist to wet, gray, slightly gravelly, silty SAND.
S-6	12		15–15½	(Very dense), moist, gray, slightly silty to silty, gravelly SAND.
			15½	Bottom of Test Pit at 15½ Feet. Completed 9/28/99. Encountered 4-inch-diameter abandoned drainpipe with drain rock in west side of test pit.

Test Pit Log HC99-TP31

N 20,666
E 11,382

Sample	Water Content	Depth in Feet	SOIL DESCRIPTIONS
S-1	6	0–6½	(Medium dense to dense), damp, light brown, gravelly, silty SAND with occasional organic material to 4½-foot depth.
S-2	6		
S-3	9	6½–7	(Very dense), damp, gray, slightly gravelly, silty SAND.
S-4	9	7–15	(Very dense), moist, gray, slightly silty SAND.
		15	Bottom of Test Pit at 15 Feet. Completed 10/1/99.

AR 043171

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Groundwater conditions, if indicated, are at the time of excavation. Conditions may vary with time.

HARTCROWSER

J-4978-16 9/99

Figure A-9

CVD 11/12/99 1=1 woodstock-8.pc2
497816 TEST PITS

Test Pit Log HC99-TP32

N 20,220
E 11,136

Sample	Water Content	Lab Tests	Field Test	Depth in Feet	SOIL DESCRIPTIONS
S-1	7			0–4	(Medium dense), damp to moist, reddish brown, slightly gravelly SAND with occasional cobbles.
S-2	6			4–6	(Medium dense to dense), moist, brown to gray SAND.
S-3	10			6–12	(Very stiff), moist, gray with orange mottling, sandy, clayey SILT.
S-4	23	AL	PP=1.7		
S-5	11			12–13	(Very dense), moist to wet, gray, silty, gravelly to very gravelly SAND.
				13–20	Bottom of Test Pit at 12½ Feet. Completed 10/1/99. Slight groundwater seepage at a depth of 12 feet.

Test Pit Log HC99-TP33

N 19,908
E 11,009

Sample	Water Content	Depth in Feet	SOIL DESCRIPTIONS
S-1	6	0–3	(Medium dense), damp, light brown, slightly silty, slightly gravelly, fine SAND.
S-2	10	3–4	(Stiff), damp, light brown, slightly gravelly, sandy SILT.
S-3	5	4–5	(Dense), moist, brown, slightly gravelly SAND.
S-4	4	5–7	(Medium dense), moist, gray, slightly silty SAND.
S-5	17	7–10	(Very stiff), moist, gray with orange mottling, slightly gravelly, sandy SILT.
S-6	13	10–15	(Dense), moist, gray, slightly silty, gravelly SAND with occasional cobbles.
		15–20	Bottom of Test Pit at 15 Feet. Completed 10/1/99.

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Groundwater conditions, if indicated, are at the time of excavation. Conditions may vary with time.

AR 043172

HARTCROWSER

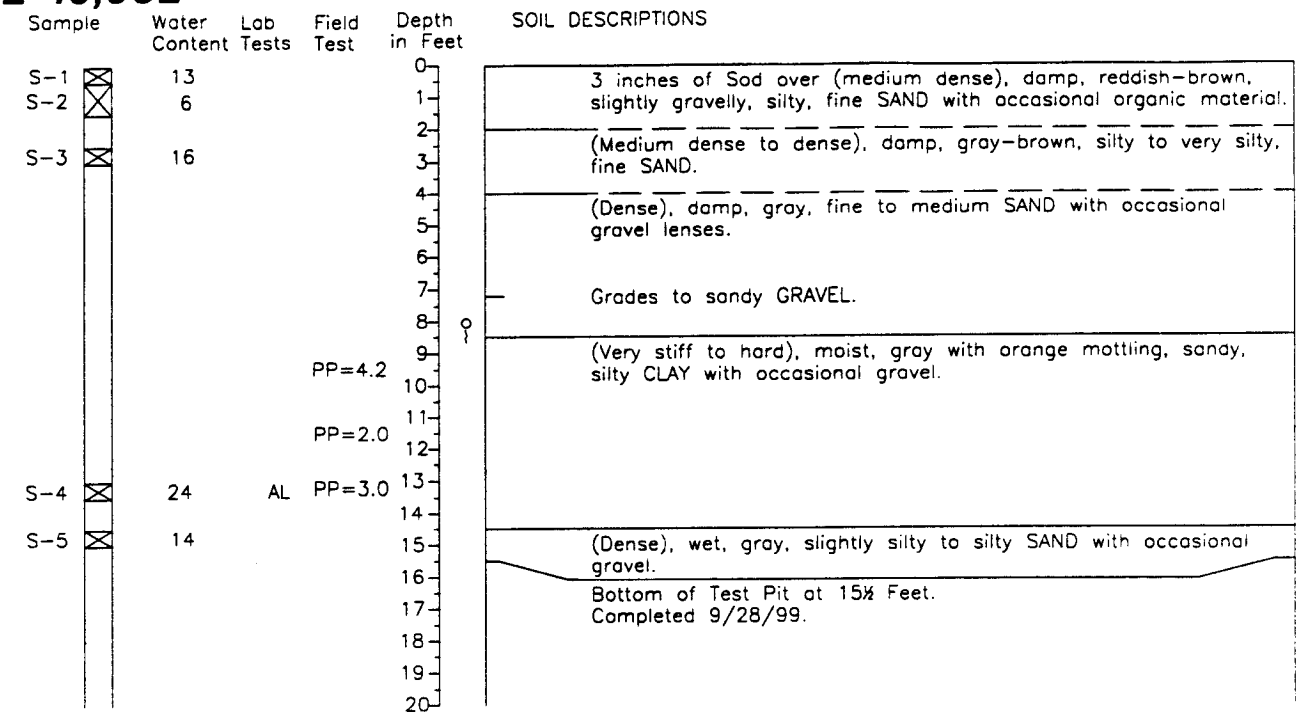
J-4978-16 9/99

Figure A-10

CVD 11/12/99 1=1 woodstock-B.pc2
497816 TEST PITS

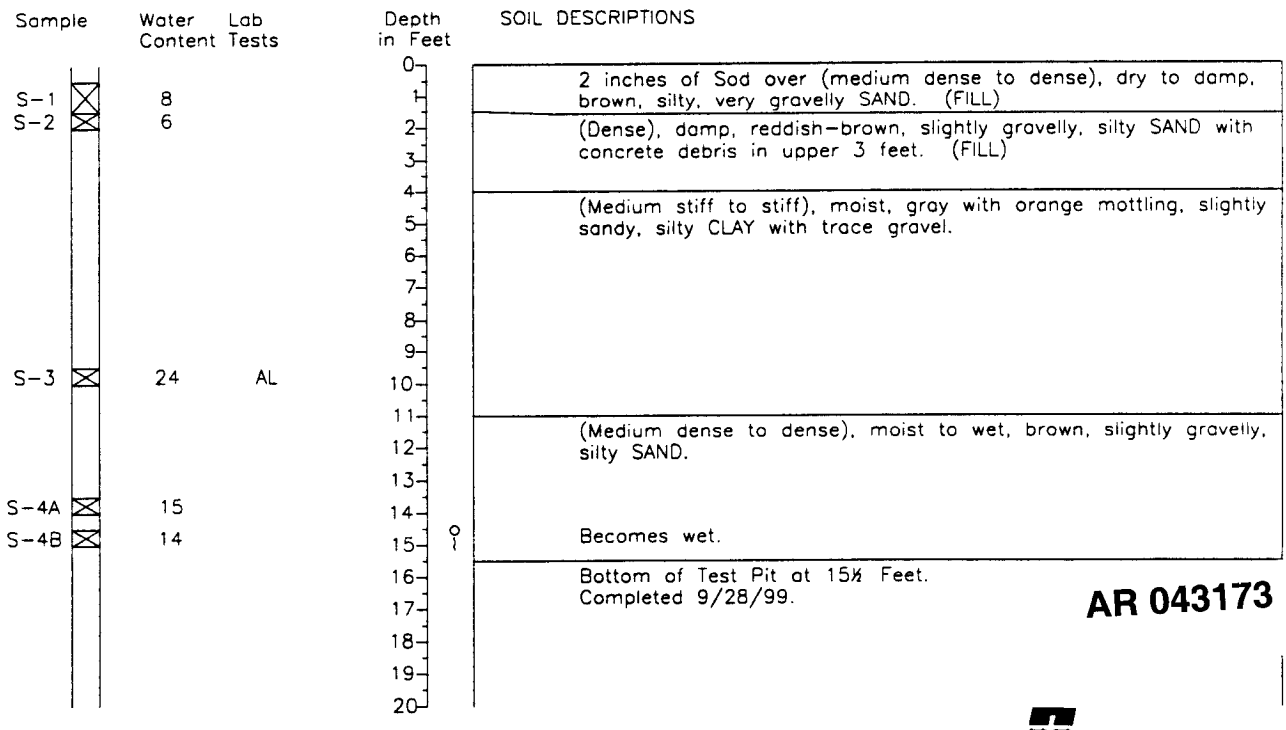
Test Pit Log HC99-TP34

N 20,164
E 10,952



Test Pit Log HC99-TP35

N 20,374
E 10,976



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Groundwater conditions, if indicated, are at the time of excavation. Conditions may vary with time.

AR 043173

HARTCROWSER

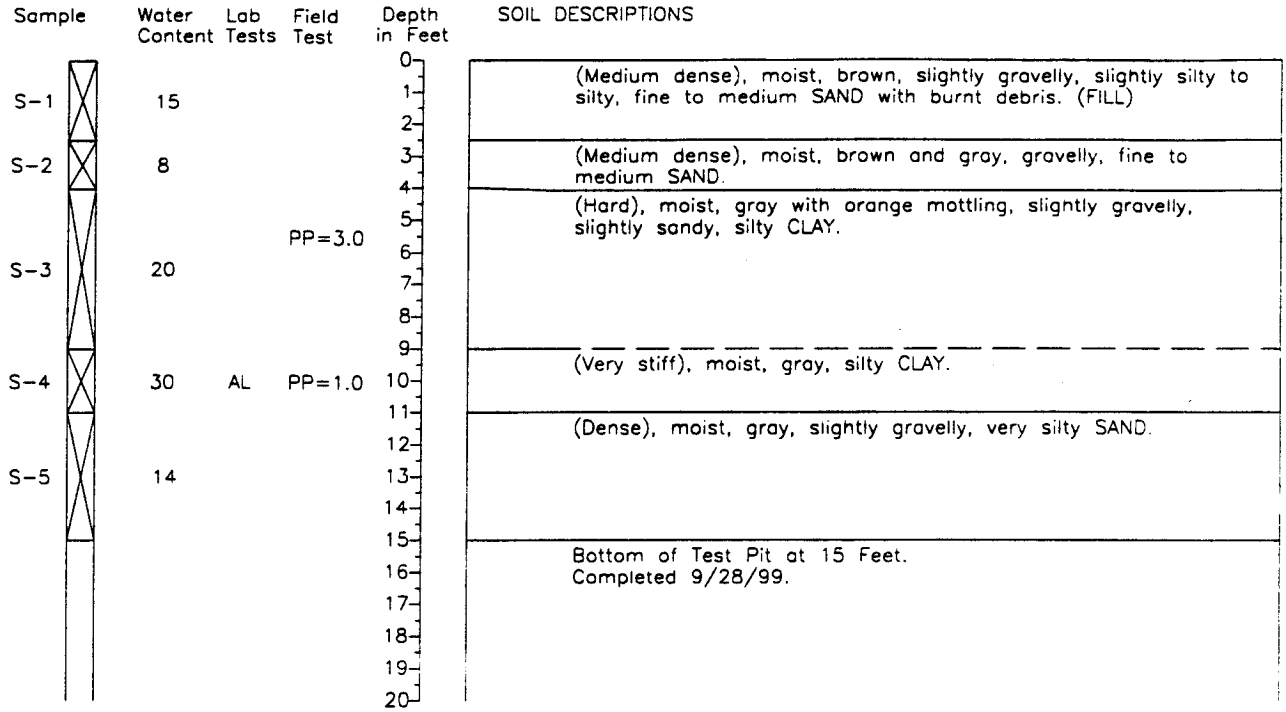
J-4978-16 9/99

Figure A-11

CVD 11/12/99 1=1 woodstock-8.pc2
497816 TEST PITS

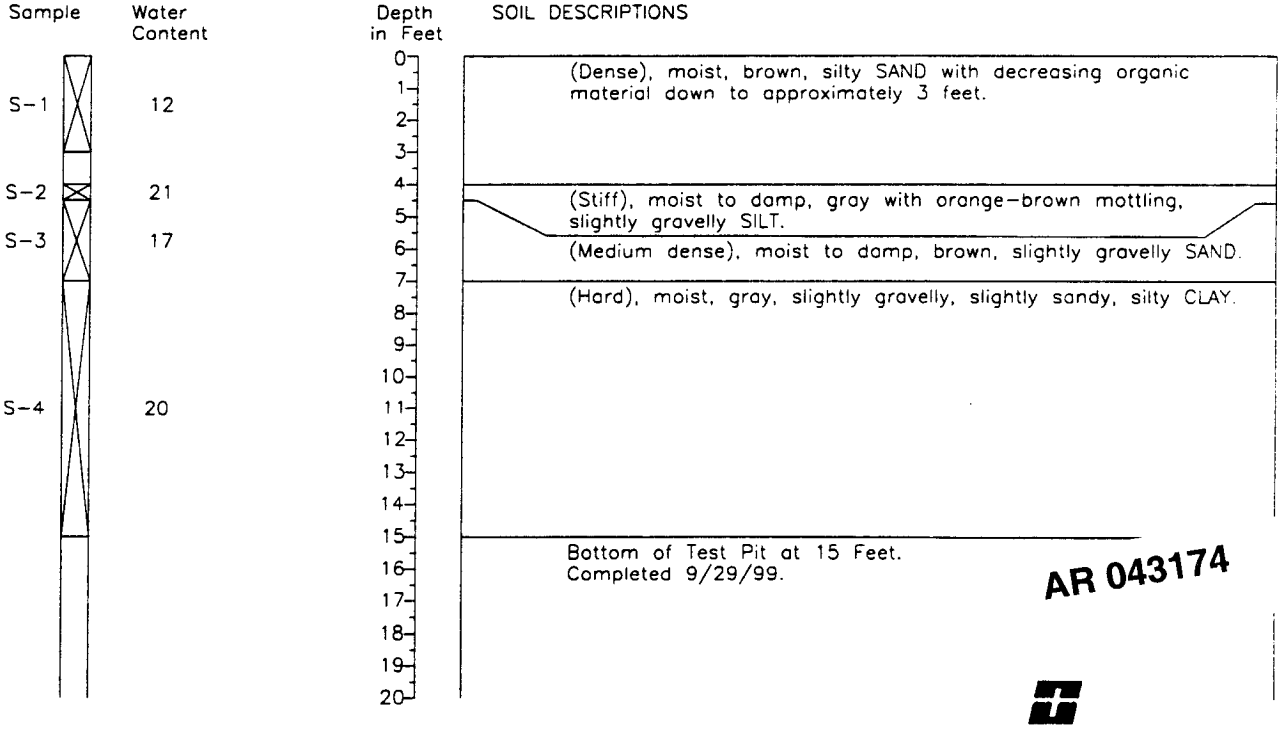
Test Pit Log HC99-TP36

N 20,287
E 10,730



Test Pit Log HC99-TP36A

N 20,102
E 10,759



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Groundwater conditions, if indicated, are at the time of excavation. Conditions may vary with time.

AR 043174

HARTCROWSER

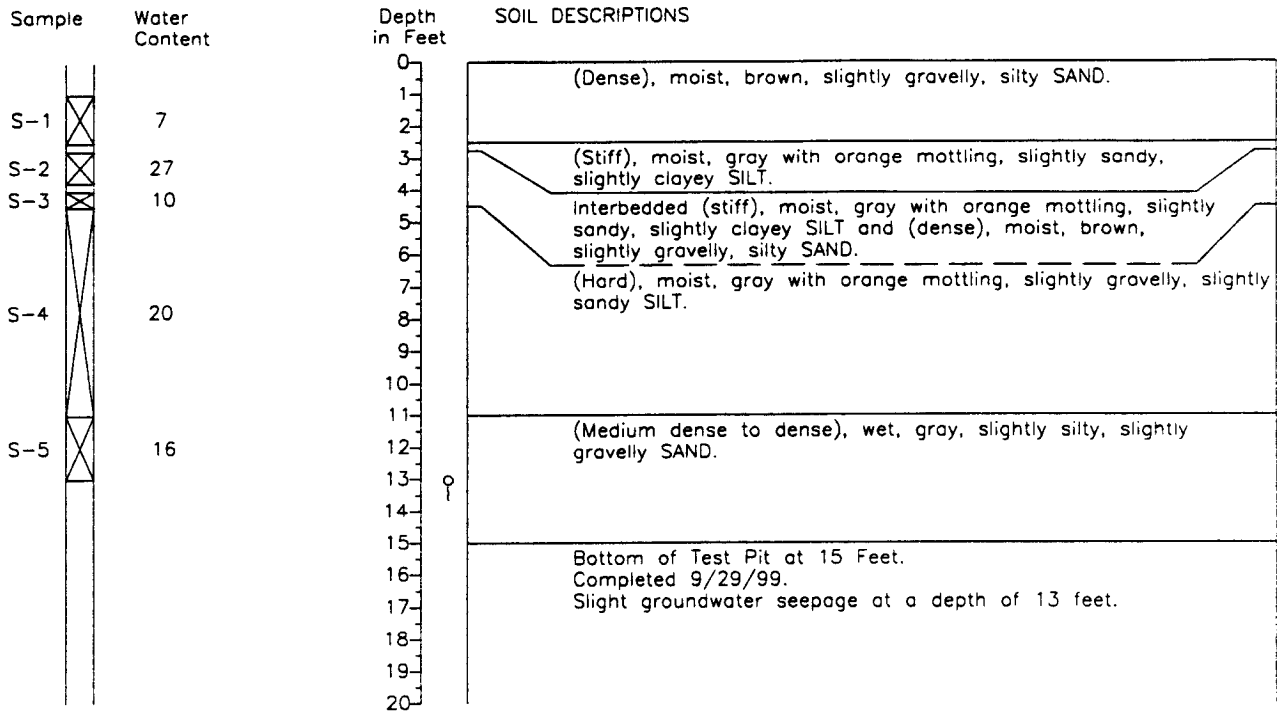
J-4978-16 9/99

Figure A-12

CVD 11/12/99 1=1 woodstock-8.pc2
4978\16 TEST PITS

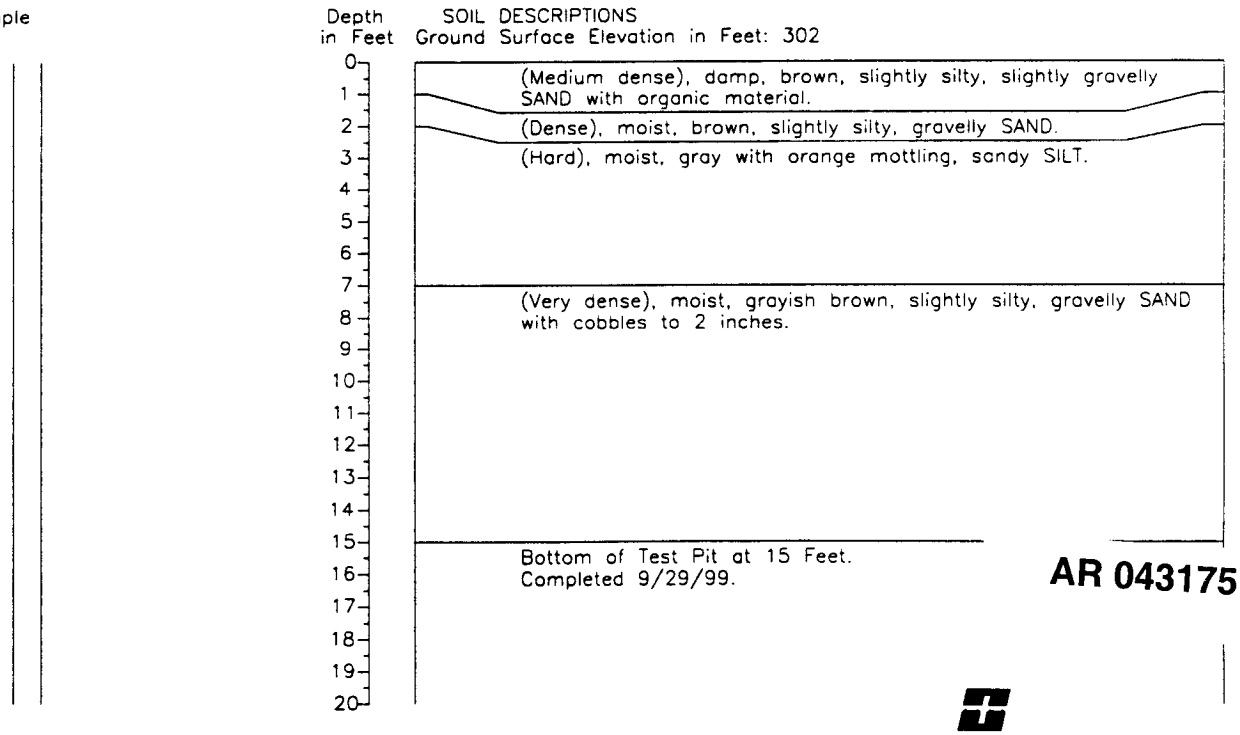
Test Pit Log HC99-TP36B

N 20,215
E 10,744



Test Pit Log HC99-TP36C

N 20,030
E 10,956

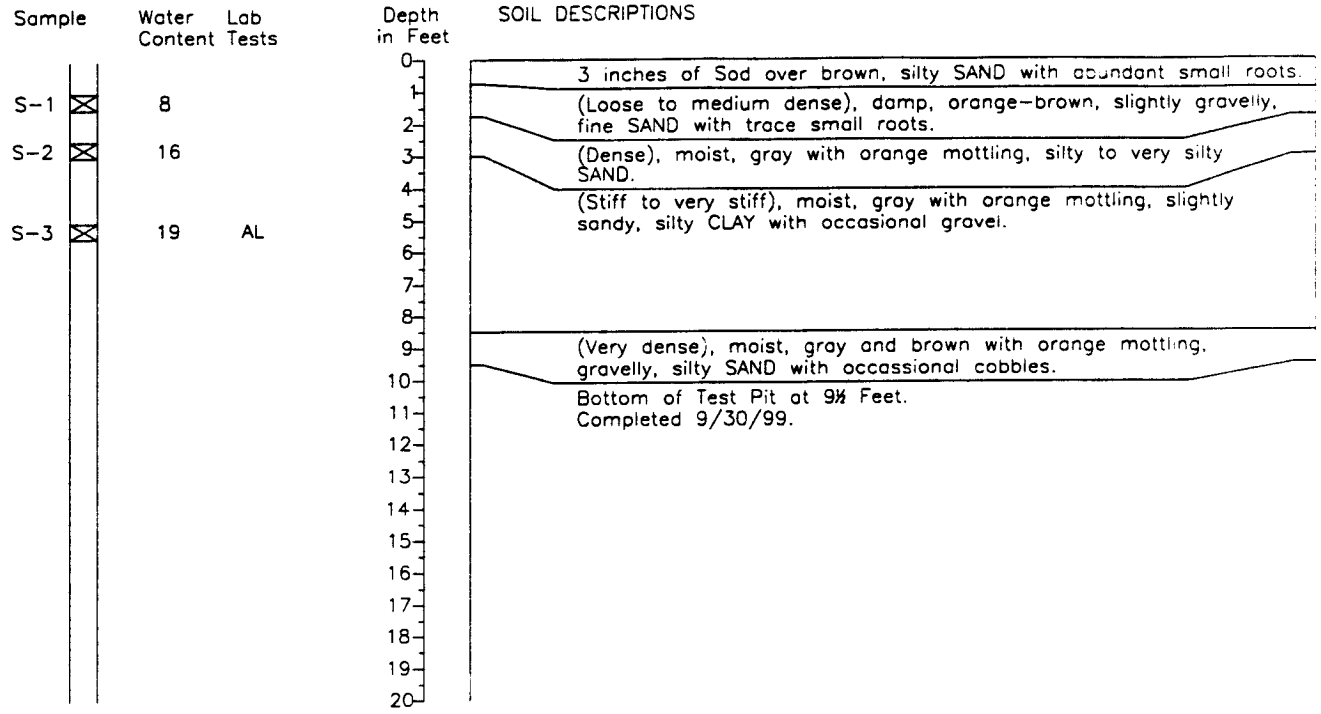


1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Groundwater conditions, if indicated, are at the time of excavation. Conditions may vary with time.

HARTCROWSER
J-4978-16 9/99
Figure A-13

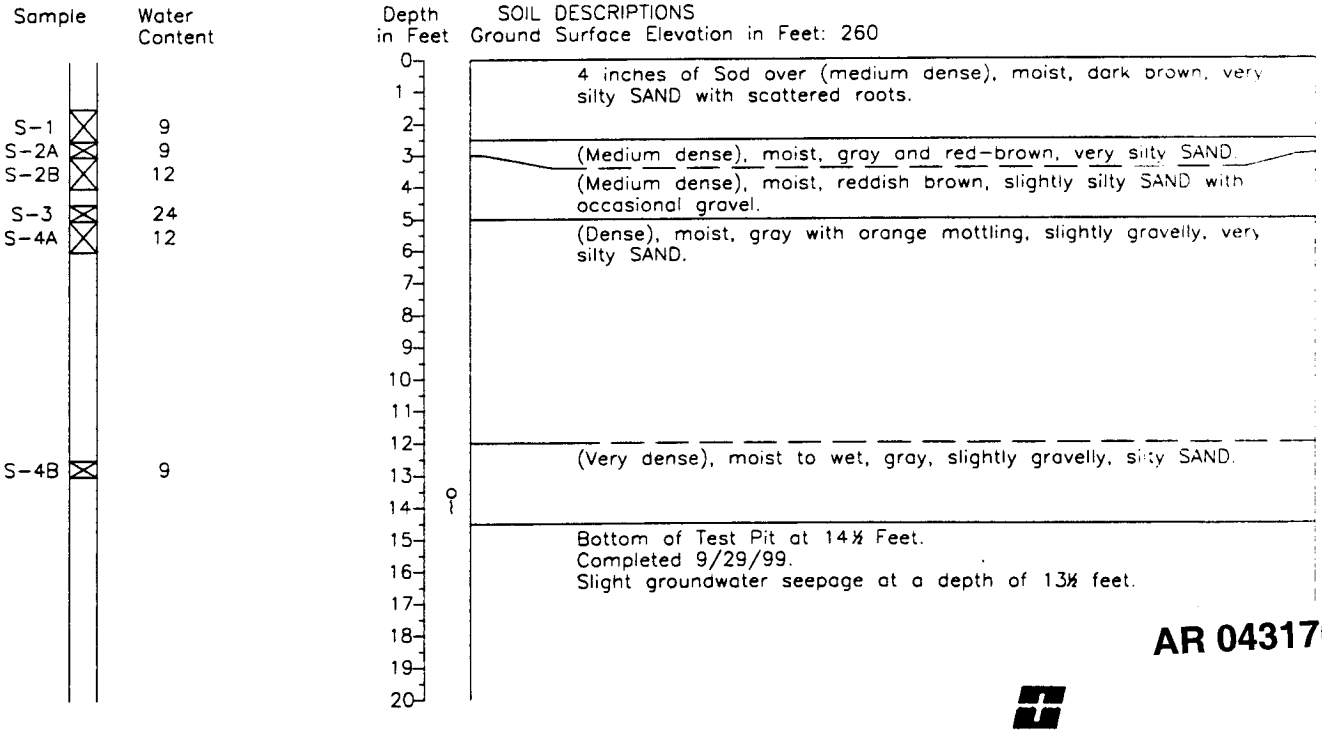
Test Pit Log HC99-TP36D

N 20,051
E 10,781



Test Pit Log HC99-TP37

N 19,575
E 10,328



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Groundwater conditions, if indicated, are at the time of excavation. Conditions may vary with time.

AR 043176

HARTCROWSER

J-4978-16 9/99

Figure A-14

CVD 11/12/99 1=1 woodstock-8.pc2
497816 TEST PITS

Test Pit Log HC99-TP38

N 20,450
E 11,172

Sample	Water Content	Field Test	Depth in Feet	SOIL DESCRIPTIONS
S-1	4		0–1	3 inches of Sod over (loose), damp, brown, silty, gravelly SAND.
S-2	5		1–3	(Medium dense), damp, brown, slightly silty to silty, gravelly, fine to medium SAND with roots.
S-3	3		3–7	(Medium dense to dense), moist, brown SAND. Grades to very gravelly.
S-4	21	PP=2.7	7–10	(Very stiff to hard), moist, gray with orange mottling, slightly gravelly, sandy SILT.
S-5	18		10–12	(Medium dense to dense), wet, grayish brown, slightly silty, slightly gravelly SAND.
S-6	11		12–12½	(Very dense), moist, gray, gravelly, silty to very silty SAND.
			12½	Bottom of Test Pit at 12½ Feet. Completed 9/28/99. Note: Minor sloughing between 2– and 4–foot depths. Slight groundwater seepage at a depth of 10 feet.

Test Pit Log HC99-TP39

N 20,700
E 10,518

Sample	Water Content	Depth in Feet	SOIL DESCRIPTIONS Ground Surface Elevation in Feet: 280
S-1	6	0–2	2 inches of Sod over (loose), damp, dark brown, gravelly, silty SAND with occasional brick and concrete debris.
S-2	4	2–4	(Medium dense), damp, brown, slightly gravelly SAND.
S-3	20	4–9	(Medium stiff to stiff), damp, gray with orange–brown mottling, slightly gravelly, sandy SILT.
S-4	13	9–13	(Dense to very dense), moist to wet, gray, gravelly, silty to very silty SAND with occasional cobbles.
S-5	7	13	Bottom of Test Pit at 13½ Feet. Completed 9/28/99. Slight groundwater seepage at a depth of 12½ feet.

1. Refer to Figure A–1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Groundwater conditions, if indicated, are at the time of excavation. Conditions may vary with time.

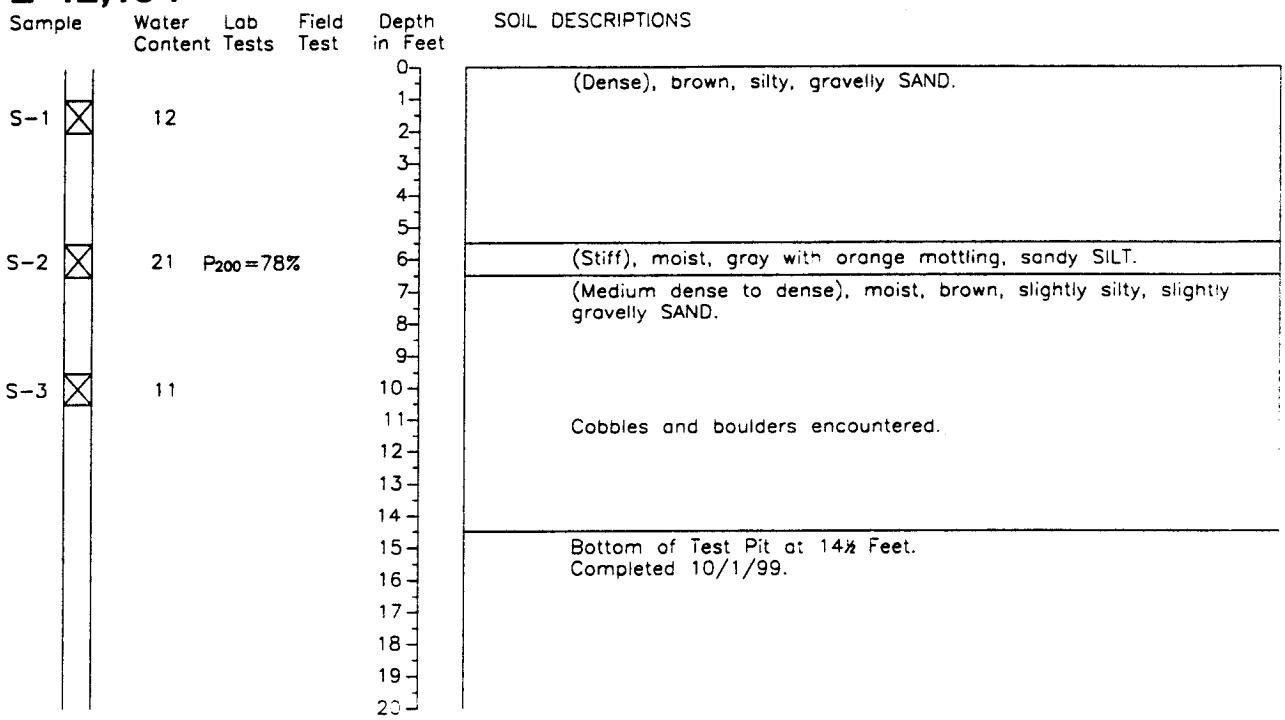
HARTCROWSER
J-4978-16 9/99
Figure A-15

AR 043177

CVD 11/12/99 1=1 woodstock-B.pc2
497816 TEST PITS

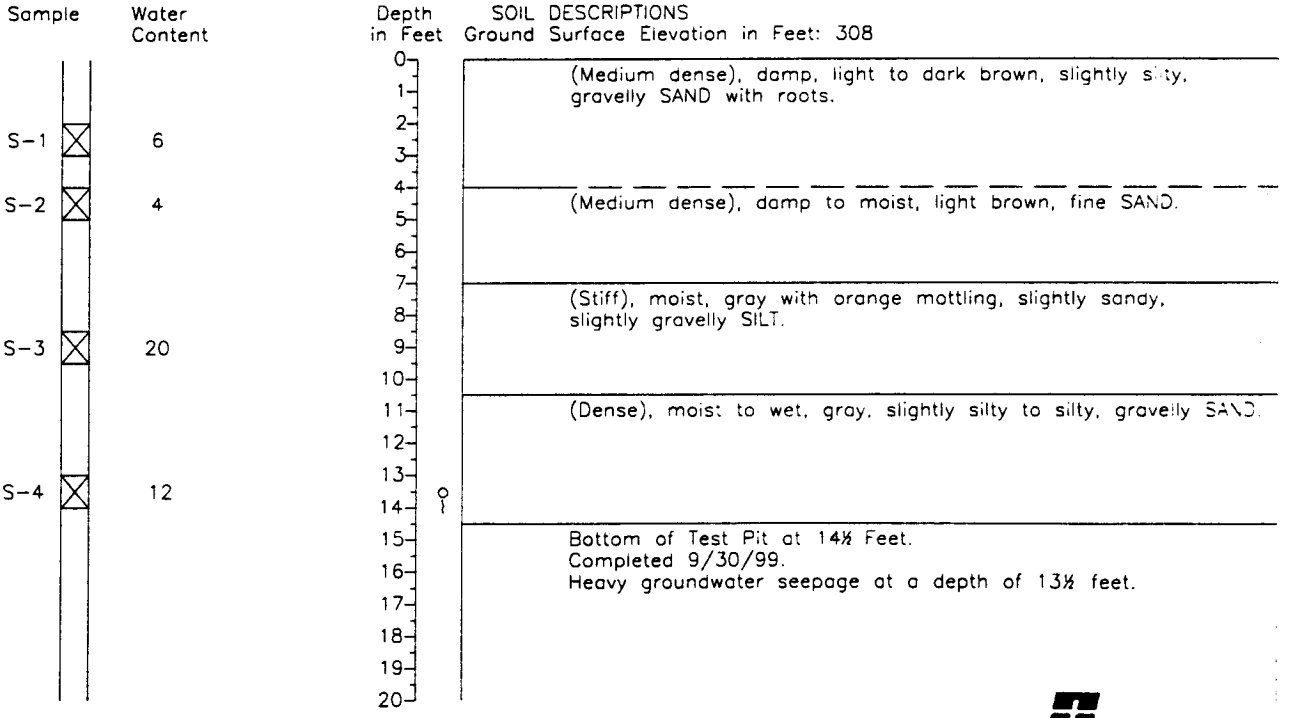
Test Pit Log HC99-TP40

N 21,533
E 12,134



Test Pit Log HC99-TP44

N 19,768
E 11,173



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Groundwater conditions, if indicated, are at the time of excavation. Conditions may vary with time.

HARTCROWSER

J-4978-16 9/99

Figure A-16

APPENDIX B
LABORATORY TESTING PROGRAM

APPENDIX B
LABORATORY TESTING PROGRAM

A laboratory testing program was performed for this study to evaluate the basic index and geotechnical engineering properties of the site soils. Disturbed samples were tested. The tests performed and the procedures followed are outlined below.

Soil Classification

Field Observation and Laboratory Analysis. Soil samples from the explorations were visually classified in the field and then taken to our laboratory where the classifications were verified in a relatively controlled laboratory environment. Field and laboratory observations include density/consistency, moisture condition, and grain size and plasticity estimates.

The classifications of selected samples were checked by laboratory tests such as Atterberg limits determinations and grain size analyses. Classifications were made in general accordance with the Unified Soil Classification (USC) System, ASTM D 2487, as presented on Figure B-1.

Note that the terms "with" and "trace" used on exploration logs generally indicate a material within the soil matrix that constitutes a relatively small fraction by weight of the total soil. The usage of this term in not associated with the ASTM simplified classification procedure.

Water Content Determinations

Water contents were determined for most samples recovered in the explorations in general accordance with ASTM D 2216, as soon as possible following their arrival in our laboratory. The results of these tests are plotted or recorded at the respective sample depth on the exploration logs. In addition, water contents are routinely determined for samples subjected to other testing. These are also presented on the exploration logs.

Grain Size Analysis (GS)

Grain size distribution was analyzed on representative samples in general accordance with ASTM D 422. Wet sieve analysis was used to determine the size distribution greater than the U.S. No. 200 mesh sieve. The results of the tests are presented as curves on Figure B-2 plotting percent finer by weight versus grain size.

200-Wash

One sample was subjected to a modified grain size classification known as a 200-wash. The sample was "washed" through the No. 200 mesh sieve to determine the relative percentages of coarse- and fine-grained material in the samples. The test was performed in general accordance with ASTM D 1140. This was performed for sample S-2 from test pit HC99-TP40 at a depth interval between 5.8 and 6.5 feet. The results indicated 78 percent passing the No. 200 sieve; therefore, this soil sample is classified as sandy silt.

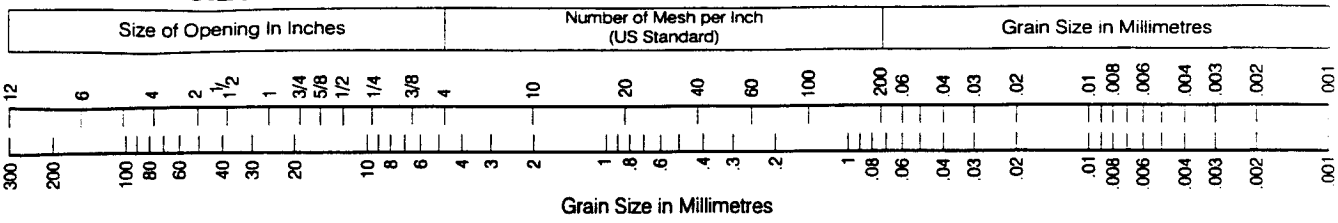
Atterberg Limits (AL)

We determined Atterberg limits for selected fine-grained soil samples. The liquid limit and plastic limit were determined in general accordance with ASTM D 4318-84. The results of the Atterberg Limits analyses and the plasticity characteristics are summarized in the Liquid and Plastic Limits Test Report, Figures B-3 and B-4. This relates the plasticity index (liquid limit minus the plastic limit) to the liquid limit. The results of the Atterberg limits tests are also shown graphically on the boring logs.

F:\data\jobs\497816\data(rpt).doc

Unified Soil Classification (USC) System

Soil Grain Size



COBBLES	GRAVEL	SAND	SILT and CLAY
Coarse-Grained Soils			Fine-Grained Soils

Coarse-Grained Soils

G W	G P	G M	G C	S W	S P	S M	S C
Clean GRAVEL <5% fines	*	GRAVEL with >12% fines		Clean SAND <5% fines	*	SAND with >12% fines	
GRAVEL >50% coarse fraction larger than No. 4				SAND >50% coarse fraction smaller than No. 4			
Coarse-Grained Soils >50% larger than No. 200 sieve							

G W and S W $\left(\frac{D_{60}}{D_{10}}\right)$ >4 for G W, >6 for S W & $1 \leq \left(\frac{(D_{30})^2}{D_{10} \times D_{60}}\right) \leq 3$

G P and S P Clean GRAVEL or SAND not meeting requirements for G W and S W

G M and S M Atterberg limits below A line with PI <4

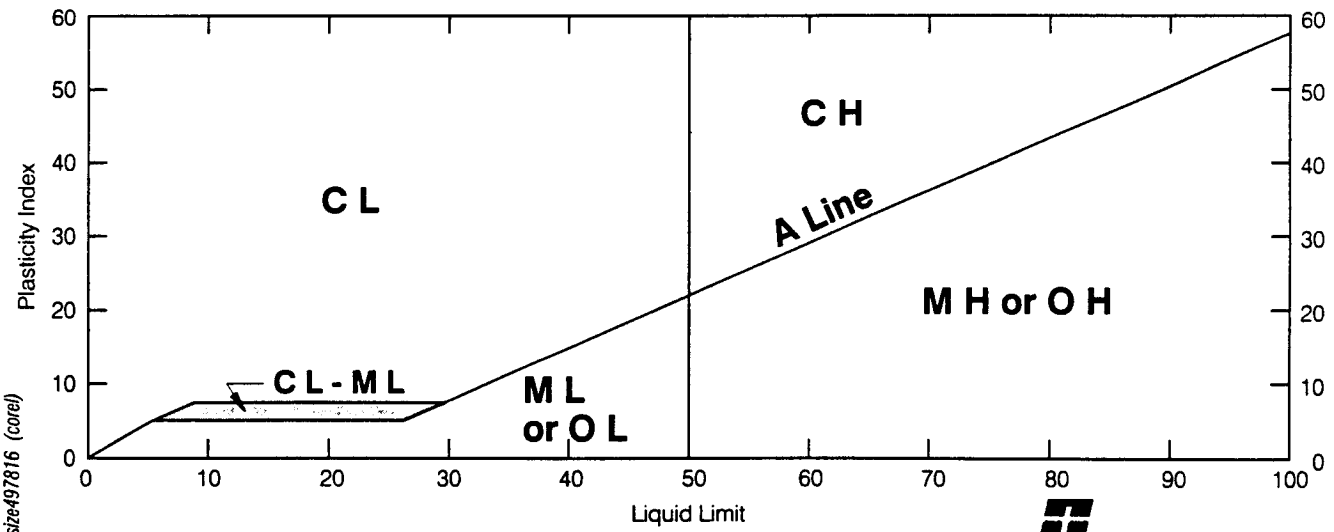
G C and S C Atterberg limits above A Line with PI >7

* Coarse-grained soils with percentage of fines between 5 and 12 are considered borderline cases required use of dual symbols

D_{10}, D_{30}, and D_{60} are the particles diameter of which 10, 30, and 60 percent, respectively, of the soil weight are finer.

Fine-Grained Soils

M L	C L	O L	M H	C H	O H	Pt
SILT	CLAY	Organic	SILT	CLAY	Organic	Highly Organic Soils
Soils with Liquid Limit <50%			Soils with Liquid Limit >50%			
Fine-Grained Soils >50% smaller than No. 200 sieve						



497816\Gr_size497816 (corel)

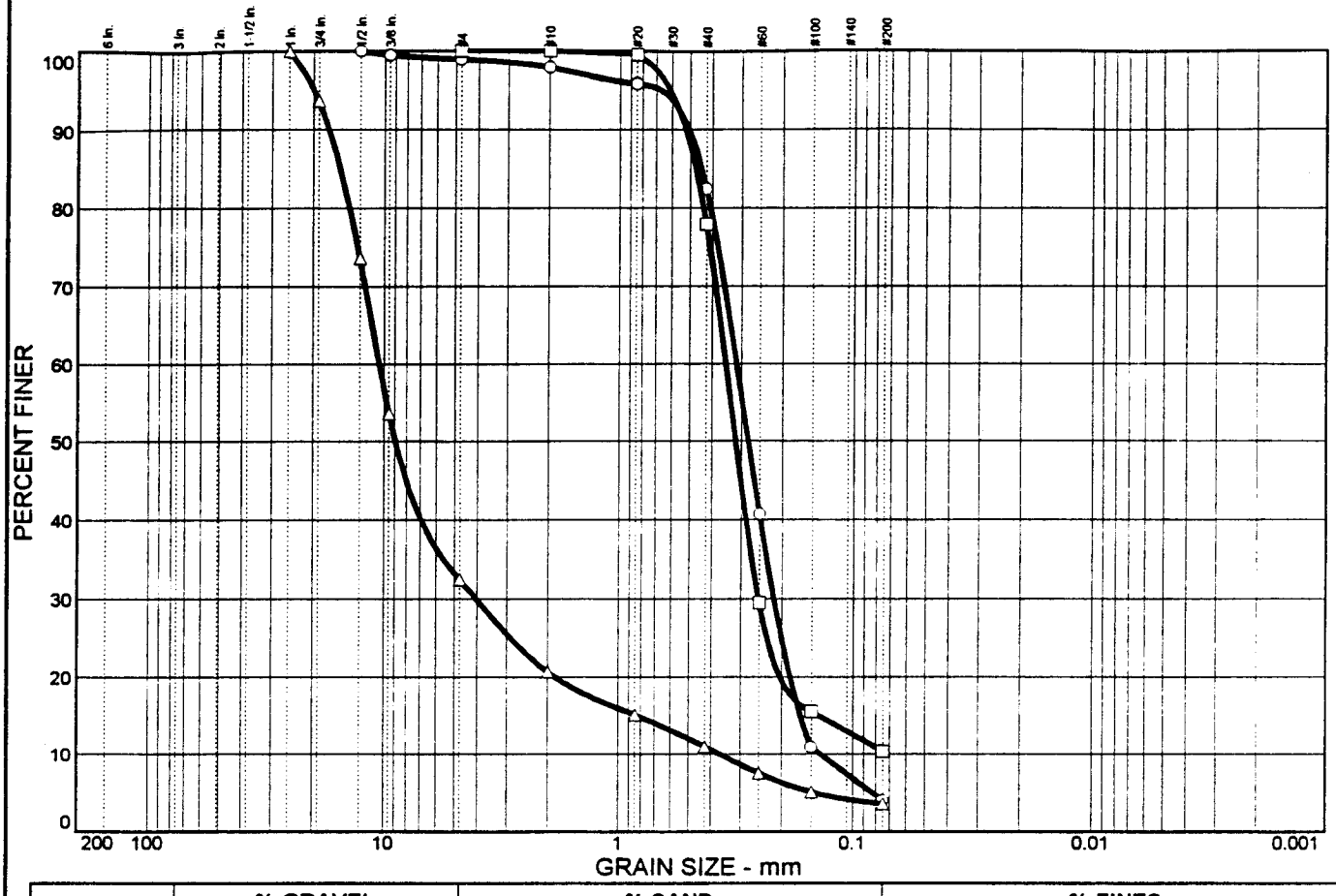
HARTCROWSER

J-7033-03 11/99

Figure B-1

AR 043182

PARTICLE SIZE DISTRIBUTION TEST REPORT



	% + 3"	% GRAVEL		% SAND			% FINES	
		CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
○	0.0	0.0	1.1	1.0	15.4	78.4	4.1	
□	0.0	0.0	0.0	0.0	22.1	67.5	10.4	
△	0.0	6.3	61.2	11.8	9.7	7.4	3.6	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_C	C_u
○			0.446	0.314	0.280	0.217	0.166	0.137	1.09	2.29
□			0.472	0.349	0.316	0.252	0.138			
△			15.4	10.5	8.92	4.04	0.819	0.365	4.26	28.68

MATERIAL DESCRIPTION	USCS	NAT. MOIST.
○ Medium to fine SAND	SP	4%
□ Slightly silty, medium to fine SAND	SP-SM	20%
△ Very sandy GRAVEL	GP	6%

Remarks:

○

□

△

Project: Third Runway Embankment

Client: The Port of Seattle

○ **Source:** HC99-B61 **Sample No.:** S-2

□ **Source:** HC99-B65 **Sample No.:** S-8

△ **Source:** HC99-B73 **Sample No.:** G-1

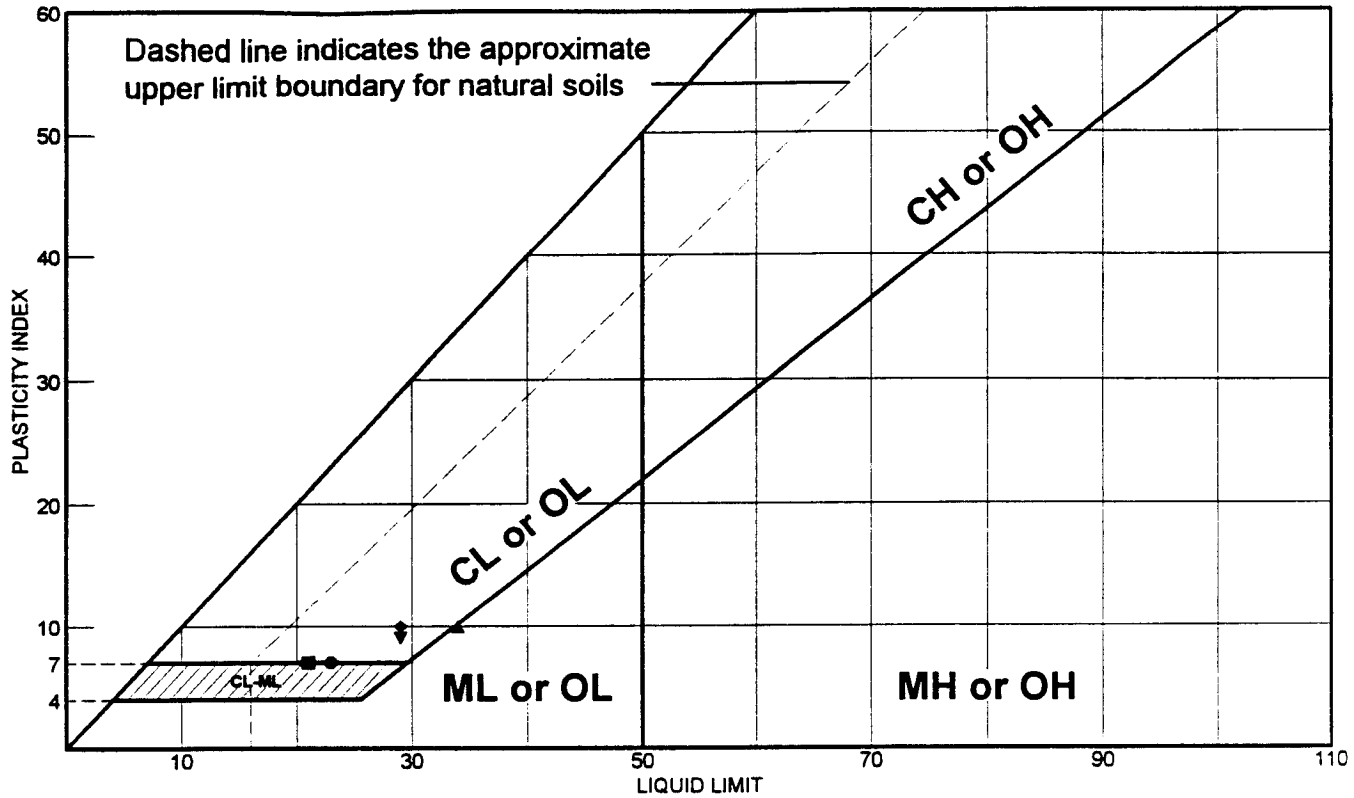
HARTCROWSER

J-4978-16 11/3/99

Figure No. B-2

AR 043183

LIQUID AND PLASTIC LIMITS TEST REPORT



Location + Description	LL	PL	PI	-200	USC
● Source: HC99-TP26 Sample No.: S-3 Slightly sandy, silty CLAY	23	16	7		CL-ML
■ Source: HC99-TP28 Sample No.: S-6 Slightly sandy, very silty CLAY	21	14	7		CL-ML
▲ Source: HC99-TP32 Sample No.: S-4 Sandy, clayey SILT	34	24	10		ML
◆ Source: HC99-TP34 Sample No.: S-4 Sandy, silty CLAY	29	19	10		CL
▼ Source: HC99-TP35 Sample No.: S-3 Slightly sandy, silty CLAY	29	20	9		CL

Remarks:

●

■

▲

◆

▼

Project: Third Runway Embankment

Client: The Port of Seattle

Location: Sea-Tac International Airport

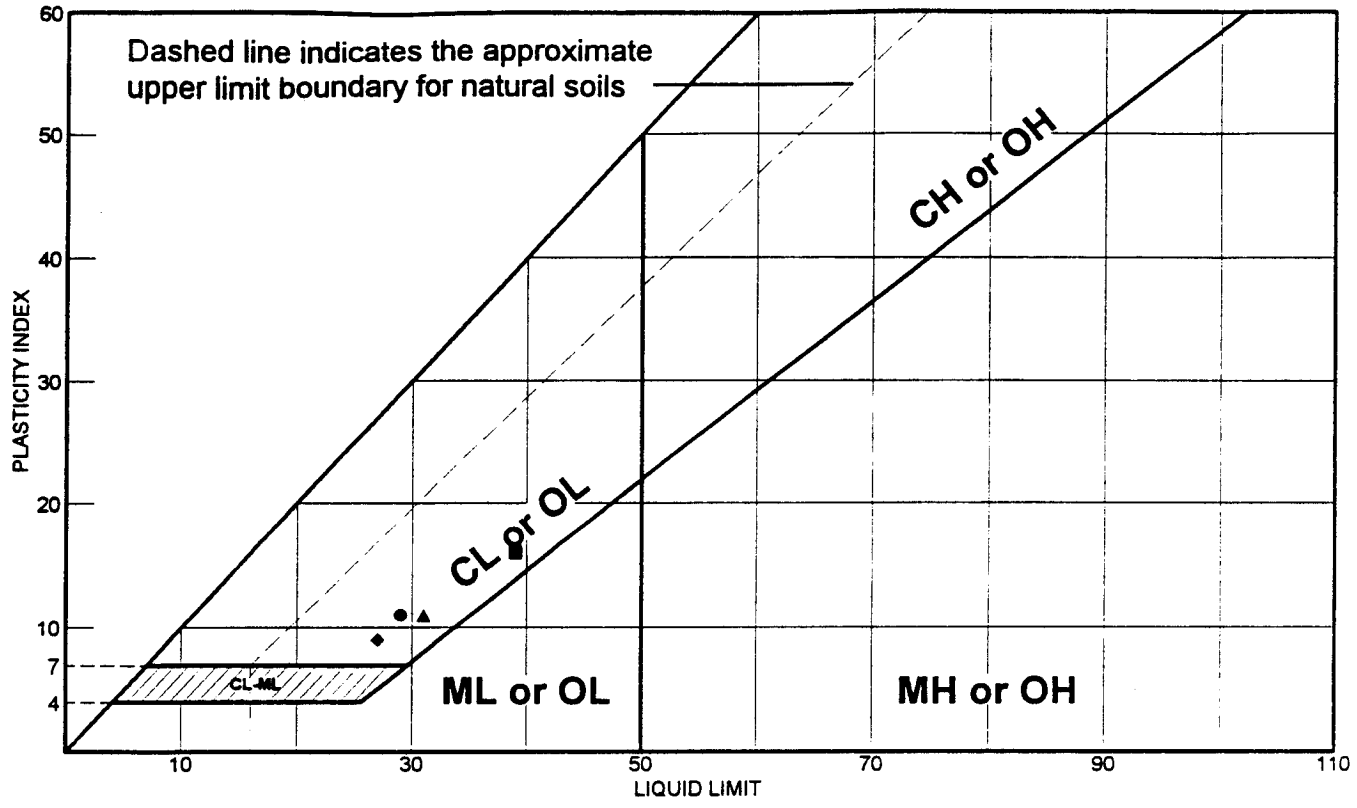
HARTCROWSER

J-4978-16 11/3/99

Figure No. B-3

AR 043184

LIQUID AND PLASTIC LIMITS TEST REPORT



Location + Description	LL	PL	PI	-200	USC
● Source: HC99-TP36 Sample No.: S-4 Silty CLAY	29	18	11		CL
■ Source: HC99-TP36D Sample No.: S-3 Slightly sandy, silty CLAY	39	23	16		CL
▲ Source: HC99-B61 Sample No.: S-3 Slightly sandy, silty CLAY	31	20	11		CL
◆ Source: HC99-B73 Sample No.: S-2 Slightly sandy, silty CLAY	27	18	9		CL

Remarks:

●

■

▲

◆

Project: Third Runway Embankment

Client: The Port of Seattle

Location: Sea-Tac International Airport

HARTCROWSER

J-4978-16 11/12/99

Figure No. B-4

AR 043185

Anchorage
2550 Denali Street, Suite 705
Anchorage, Alaska 99503-2737
Fax 907.276.2104
Tel 907.276.7475

Boston
100 Cummings Center, Suite 331G
Beverly, Massachusetts 01915-6123
Fax 978.921.8164
Tel 978.921.8163

Chicago
333 West Wacker Drive, Suite 700
Chicago, Illinois 60606-1225
Fax 312.750.4507
Tel 312.444.2991

Denver
274 Union Boulevard, Suite 200
Lakewood, Colorado 80228-1835
Fax 303.987.8907
Tel 303.986.6950

Fairbanks
1896 Marika Street, Unit 1
Fairbanks, Alaska 99709-5545
Fax 907.451.6056
Tel 907.451.4496

Jersey City
75 Montgomery Street, Fifth Floor
Jersey City, New Jersey 07302-3726
Fax 201.985.8182
Tel 201.985.8100

Juneau
319 Seward Street, Suite 1
Juneau, Alaska 99801-1173
Fax 907.586.1071
Tel 907.586.6534

Long Beach
One World Trade Center, Suite 2460
Long Beach, California 90831-2460
Fax 562.495.6361
Tel 562.495.6360

Portland
Five Centerpointe Drive, Suite 240
Lake Oswego, Oregon 97035-8652
Fax 503.620.6918
Tel 503.620.7284

Seattle
1910 Fairview Avenue East
Seattle, Washington 98102-3699
Fax 206.328.5581
Tel 206.324.9530

www.hartcrowser.com