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PRE-DESIGN INVESTIGATION
TASK S-2
STABILITY OF HIDE PILES
INTERIM FINAL REPORT

INDUSTRI-PLEX SITE
WOBURN, MASSACHUSETTS

Prepared for:

Industri-Plex Site Remedial Trust
800 North Linbergh Boulevard
St. Louis, Missouri 63167

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September 1990 Project No.: 893-6255

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Golder Associates Inc.
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September 21, 1990 Project No. 893-6255

United States Environmental Protection Agency, Region 1
Waste Management Division
J.F.K. Federal Building HRS-CAN-3
Boston, Massachusetts 02203-2211

Attn: Joseph DeCola
Remedial Project Manager

RE: INDUSTRI-PLEX SITE PRE-DESIGN INVESTIGATION
TASK S-2 STABILITY OF HIDE PILES
INTERIM FINAL REPORT

Gentlemen:

On behalf of the Industri-Plex Site Remedial Trust, we are submitting the attached Stability of Hide Piles Interim Final Report for the Industri-Plex Site in Woburn, Massachusetts. This report is being submitted in accordance with the Pre-Design Investigation Work Plan (PDI) Task S-2 reporting requirements (PDI Sections 3.2.4.6 and 3.8.1.1.2, p. 46 and 127).

Please contact us if you have any questions.

Very truly yours,

GOLDER ASSOCIATES INC.

Kenneth R. Moser, Associate
Project Manager

KRM/krm
C:6255S2CL

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1.0 INTRODUCTION

This report is submitted in fulfillment of the Interim Final Report deliverable for the Pre-Design Investigation (PDI) Task S-2, Evaluate Stability of Hide Piles, as specified in Sections 3.2.4.6 (p. 46) and 3.8.1.1.2 (p. 127) of the PDI Work Plan.

1.1 Purpose

The purpose of this interim final report is to provide the stratigraphy and geotechnical parameters to enable the slope stability of the East and West Hide Piles to be assessed before and after remediation.

This report discusses the background and requirements set forth in various governing documents for the sampling and testing of the hide piles and underlying soils; the sampling and laboratory testing protocols used in the investigation; the test results obtained; and provides recommendations for geotechnical parameters to be used in the assessment of the hide piles' slope stability.

1.2 Consent Decree Objectives

On April 24, 1989, a Consent Decree was entered between the Industri-Plex Site Remedial Trust (ISRT), the United States Environmental Protection Agency (USEPA), and the Massachusetts Department of Environmental Protection (MDEP), which defines the scope of the remediation at the Industri-Plex Site in Woburn, Massachusetts. The objective of the remediation is stated in the Record of Decision (ROD), prepared by the USEPA in September 1986, page 27:

> "...the objective of the remedial alternatives addressing contaminated soils and sludges is to prevent the public from coming into direct contact with these materials."

The Consent Decree incorporates the Remedial Design/Action Plan (RDAP) which outlines various remedial requirements. As stated in the RDAP:

> (p.1) "The remedial action for soils, sediments, and sludges contaminated with Hazardous Substances, other than those emitting odors (the East Hide Pile), shall include site grading, capping with a permeable soil cover, excavation, dredging, and/or consolidation for all areas containing Hazardous Substances at concentrations above established action levels (300 ppm = arsenic, 600 ppm = lead, 1000 ppm = chromium...)"
>
> (p.7) "The remedial action shall consist of stabilizing the side slopes of the East Hide Pile, installing a gas collection layer, capping with a synthetic membrane liner to establish impermeability, and soil cover in accordance with Attachment A..."

The RDAP requires the execution of a Pre-Design Investigation (PDI) which includes the determination of geotechnical information to evaluate the stability of the hide piles. Specifically, the RDAP states that :

> "(b) An investigation including additional soil borings and monitoring wells in the vicinity of the East and West Hide Piles. This additional effort is intended to identify the requirements necessary to establish a firm base at the toes of the East and West Hide Piles to minimize the possibility of the slope failure. This additional information is to be used to ensure that impacts to the wetlands are kept to an absolute minimum."

This interim final report constitutes the results of the Hide Pile investigation, which has been conducted to meet the requirements set forth in the RDAP and PDI Work Plan.

1.3 Scope of Report

As specified in Sections 3.2.4.6 and 3.8.1.1.2 of the PDI Work Plan, the scope of this report includes:

- Description of the investigation
- Location of the borings
- Classification of the soils and hide residues
- Results of the laboratory tests
- Confirmation that enough data has been collected to support the design of the hide pile remedy.

All the information indicated above is included in this report. Confirmation that enough data has been collected is addressed by the presentation of the idealized cross-sections to be used for the slope stability analyses of the current conditions and for the remedial design.

2.0 PROJECT REQUIREMENTS

As defined in the Consent Decree, the West, South, and East-Central Hide Piles will be remediated using a permeable cover, and the East Hide Pile will be remediated with a Flexible Membrane Liner cover. The ROD requires additional investigation, supplementing that of the Remedial Investigation Feasibility Study (RI/FS), to address design parameters necessary to ensure that the remediated hide piles are stable in order to protect the wetlands. The general requirements were given the following specific interpretation in the PDI Work Plan and formed the detailed objectives for the site investigation described in this report:

1. Clarification of the lateral and vertical extent of the hide residues, and the location and nature of the underlying natural soils; this information is intended to supplement that already available from the RI/FS.

2. Geotechnical characterization of the hide pile materials and the underlying and adjacent soils in accordance with the Unified Soils Classification System (USCS). In addition to visual description of the materials, this requires gradation and Atterberg limit determinations to be carried out in the laboratory. Characterization information would be used in the interpretation of the more specific geotechnical tests.

3. Installation and monitoring of surface settlement markers to observe if local surface sloughing of the hide piles is occurring.

4. Installation of monitoring wells in the vicinity of the East and West Hide Piles to observe groundwater elevations and obtain water samples.

5. Determination of the stratigraphy and geotechnical parameters necessary to conduct analyses of the current slope stability of the hide piles using the PCSTABL5M version of the STABL program developed by Purdue University. The required parameters are unit weights, appropriate shear strengths and groundwater conditions.

6. Determination of the stratigraphy and geotechnical parameters necessary to design the remedial works to stabilize the slopes of the hide piles, possibly including retaining structures at the toes of the hide piles, to make the existing slopes flatter, (i.e., appropriate shear strength and consolidation characteristics, and groundwater conditions).

7. Determination of hide pile materials' consolidation characteristics in order to facilitate evaluation of the settlement characteristics of the hide piles under increased loads due to the caps being placed.

The detailed information satisfying these objectives is presented in the following sections of this report:

Item 1	Stratigraphy - Section 5.1
Item 2	Geotechnical Characterization - Section 5.2
Item 3	Surface Settlement Markers - Section 4.3
Item 4	Monitoring Wells - Section 4.1.3
Items 5-7	Geotechnical Parameters for Design - Sections 5.1, 5.3, 6.0 and 7.0.

3.0 ORIGIN OF HIDE RESIDUES

The site history is described in the Summary of Remedial Alternatives Selection (USEPA, 1986) which includes the following information on the origin of the hide materials:

- Animal hide glue was manufactured on the site between March 1935 and mid 1969.
- The glue manufacturing process involved cooking animal tissue in hot water followed by concentration of the extracted protein. The raw materials included hides, hide fleshings and leather scraps from various sources. The solid residue left after the cooking process (called tankage) was disposed of on site and included raw materials and wood shavings.
- Disposal practices were uncontrolled and involved on site burial of tankage together with other solids and the sludge from the primary waste water settling lagoon. Over the 35 years of operations, the waste deposits accumulated such that large piles of hide residues and other wastes rising 40 to 50 feet above grade covered a number of acres to the east and southeast of the site.
- In 1968 the site was purchased by a developer and in 1975 excavation of the glue process wastes began. Excavated materials were stockpiled at the northern end of the site to form the present East and West Hide piles.

The hide pile materials presently existing therefore originate from a process of burial of the waste materials, re-excavation, transport, and placement. As a result, there is likely to have been significant mixing of the waste materials with natural soils and any preferred structure will have been destroyed. In order to reflect the composition and origin of the hide pile materials, the designation "Fill and Hide Residue" is subsequently used in this report.

4.0 GEOTECHNICAL INVESTIGATION

4.1 Fieldwork

4.1.1 Introduction

The field investigation was conducted between April 16 and May 29, 1990 during which period a total of 17 boreholes (Nos. 1 through 17) were drilled. All the boreholes were sampled and monitoring wells were installed in two of them on completion. The drilling and sampling were carried out by Geologic Inc. of Watertown, Massachusetts under the full-time supervision of Golder Associates' personnel. A Mobile B-57 ATV rubber-tired drill rig equipped with hollow stem augers was used for all the boreholes. The internal diameter (ID) of the auger stem was 4.25 inch in all cases except for the monitoring wells (Borehole Nos. 6 and 14), which were drilled using 6.625 inch ID augers.

The drill rig, drilling equipment and tools were steam cleaned upon arrival at the site, prior to the drilling and installation of each monitoring well and before leaving the site.

Air monitoring was conducted during the drilling of each borehole using an MSA 361 Combustible Gas Indicator and an Hnu or Organic Vapor Analyzer (OVA). Monitoring was conducted in the breathing zone above the boreholes, by means of spot readings taken each time the holes were advanced approximately 5-feet of depth. When any reading exceeded the action levels established in the Project Health and Safety Plan, work was temporarily suspended while the borehole was either allowed to vent or was purged with carbon dioxide gas. Drilling was suspended on a total of three occasions, once in Borehole No. 1 at 10 feet drilled depth, and twice in Borehole No. 9 at drilled depths of 15 feet and 25 feet. Drilling was resumed once

measurements confirmed that gas concentrations were below action levels.

Eight of the borings were drilled in the area of the West Hide Pile and included two holes drilled from the crest through the entire thickness of Fill and Hide Residue. The remaining nine borings covered the East Hide Pile area, with four drilled from the crest through to natural ground.

A borehole location plan, based on an as-built survey of the boring positions, is presented as Figure 1.

Boreholes were field located using Figure 19 of the PDI Work Plan as a guide. Several boreholes required relocation based on field conditions as described below. Borehole Nos. 12 and 13 were originally located on a plateau below the summit of the East Hide Pile within the Boston Edison powerline right-of-way 14. The existence of the overhead power lines precluded the drilling at the original locations due to insufficient clearance. The boreholes were therefore relocated to the summit of the East Hide Pile. The objectives of the boreholes remained the same, that is, to determine the thickness of the Fill and Hide Residue and underlying soils; to obtain good quality samples to study the composition and geotechnical properties of the Fill and Hide Residue; to perform in-situ tests to estimate the strength of the Fill and Hide Residue and soils; and to provide information in appropriate locations to construct cross-sections to be used for slope stability analysis and remedial design. The relocation was approved by the USEPA/MDEP in a letter to ISRT dated July 17, 1990 which responded to a PDI addendum submitted by Golder Associates on May 7, 1990 (see Appendix E).

The boreholes in the hide piles were advanced at least to the depth of the original natural ground surface to define the vertical extent of the Fill and Hide Residue. Typically, the depths were within +/- 5 feet of the estimate provided in the PDI Work Plan. Boreholes along the toe of the hide piles were advanced to the minimum depth prescribed in the PDI Work Plan or to auger refusal, if this occurred at shallower depth. Anticipated borehole depths were established in Table 5 of the PDI Work Plan, which is included in Appendix D as a reference. Actual and anticipated borehole depths are compared in Table 1.

The materials encountered in the borings were described using the Golder Associates logging system which is based on the Unified Soils Classification System (USCS). The geotechnical borehole logs are presented in Appendix A together with an outline of the logging system.

The boreholes were decommissioned by backfilling with the cuttings generated from the drilling process. The completed borings were staked and flagged for subsequent surveying. Borehole Nos. 6 and 14 were completed as monitoring wells as described below.

4.1.2 Sampling and Standard Penetration Testing

Undisturbed Shelby tube samples, collected in accordance with American Society for Testing and Materials (ASTM) Standard D1587, were recovered from the borings together with disturbed samples. Undisturbed samples were obtained by pushing 3 inch diameter Shelby tubes a total of 2 feet using steady downward pressure from the drill rig. Each tube was left in place for a period of approximately 10 minutes prior to withdrawal to allow for excess pore pressure dissipation. The tube was extracted from the borehole by first shearing the soil at the base by manual

rotation of the tube and then pulling upward with a steady pressure. Both ends of the tube were waxed, capped, and taped. Each tube was labelled with the borehole number, sample number (using "ST" as a prefix), depth, recovery, date, vertical orientation, Golder job number, and location.

Shelby tube sampling was very difficult in the hide piles and toe borings due to the variability of the soils. Shelby tubes were attempted at the frequency specified in the PDI Work Plan; however, modifications were necessary based on local field conditions as anticipated in the PDI Work Plan Table 5 (see Appendix D). Sampling frequencies were increased where unique conditions were encountered and when a previous sampling attempt had yielded low recovery. Generally, poor recovery was the result of the Shelby tube bending when a cobble or boulder was encountered or a piece of wood became wedged in the tube. Where ground conditions did not permit sample recovery (i.e granular, and/or dense soils) sampling frequencies were lower than envisaged in the PDI Work Plan Table 5 (Appendix D). Table 1 includes a comparison of the actual and envisaged sampling in each borehole and shows that 21 Shelby tubes were attempted compared to 19 envisaged in the PDI Work Plan. Only 13 tubes achieved sufficient recovery for laboratory test purposes; the detailed conditions in particular borings are discussed in the following paragraphs.

In four boreholes (Nos. 1, 7, 9, and 17) fewer Shelby tubes than envisaged in the PDI Work Plan were attempted. In Borehole No. 1, two rather than three Shelby tubes were attempted because natural ground was encountered at a higher elevation than anticipated. In Borehole No. 7 no Shelby tubes were attempted because coarse fill (bricks, cobbles, etc.) was found overlying dense sand and till. In

Borehole No. 9 only two rather than three tubes were attempted due to frequent cobbles and high SPT "N" values through the bottom 17 feet of the boring. Borehole No. 17 encountered dense, granular soils, in which Shelby tube sampling was not appropriate.

In four boreholes (Nos. 8, 10, 12, and 13) more Shelby tubes than envisaged in the PDI Work Plan were attempted. In Borehole No. 8 two Shelby tubes were attempted, although none had been specified. No recovery was achieved in either tube due to the presence of very soft saturated soils. An additional Shelby tube was attempted in Borehole No. 10 because two previous tubes had been bent due to the presence of cobbles/boulders and wood. Two additional tubes were attempted in Borehole No. 12 and one additional tube in Borehole No. 13 in order to collect more sample to properly characterize the materials.

Standard Penetration Tests (SPT) were conducted in accordance with ASTM D1586 in all boreholes at an average of 5-foot intervals of depth. A 1.375-inch internal diameter split spoon was typically driven 2-feet recording blow counts for each 6-inch increment of penetration. The blow counts from 6 to 18 inches of penetration were added to determine the Standard Penetration resistance (N-value). Representative soil samples were collected from the split spoon sampler and placed in glass jars for laboratory testing and archive. The jars were labelled with borehole number, sample number, date, depth, N-value, Golder job number, and location code. Table 1 includes a comparison of the actual and envisaged sampling in each borehole and shows that overall 93 disturbed samples were recovered which corresponds to the number envisaged in the PDI Work Plan.

A total of eight bulk disturbed samples of the auger cuttings were also recovered. These samples were preserved in sealed plastic buckets and labelled with the borehole number, date, approximate depth range, Golder job number, and location code. These samples were additional to the requirements set out in the PDI Work Plan.

4.1.3 Monitoring Wells

Borehole Nos. 6 and 14 were completed as monitoring wells and denoted as OW-31 and OW-32, respectively. Continuous split spoon samples were taken in these holes, which were drilled using 6.625 inch diameter hollow stem augers as noted previously. Well installation logs are presented in Appendix B. Borehole No. 6 (OW-31) was drilled to 14 feet depth compared to the envisaged 10 feet. In the case of Borehole No. 14 (OW-32), auger and spoon refusal was encountered at 7.5 feet. A second borehole, designated No. 14A, was drilled approximately 9 feet from the original location and refusal occurred again at 8.3 feet; the observation well was therefore completed to this depth rather than the 15 feet envisaged in the PDI Work Plan. Both monitoring wells were constructed with 4-inch PVC riser and #10 slotted screen. The well screens extended from 8.4 to 14.0 feet depth in OW-31 and from 5.5 to 8.0 feet depth in OW-32. A sand pack, consisting of uniformly graded fine to medium sand (Mystic White sand), was extended a minimum of 2 feet above the well screens. The top seal of 1 foot minimum thickness was constructed above the sand pack using "Peltonite" bentonite pellets. A 6-inch diameter, 6 foot long steel protective casing was installed at a minimum of 2.5 feet into the ground and secured with concrete to complete the installation.

The monitoring wells were developed using a 2-inch stainless steel bailer. A total of 35 gallons of water was removed from OW-32 and 100 gallons from OW-31. The bail water was placed in 5-gallon buckets and disposed of at the decontamination pad. Specific conductivity, pH, and temperature readings were taken at a minimum of every 5-gallons bailed. The wells were bailed until readings stabilized; final values are included on the well installation logs in Appendix B. Both wells remained turbid throughout development.

The wells were subsequently sampled by Roux Associates as described in the PDI Task GW-1 Plume Delineation Phase I Interim Report.

4.2 Laboratory Testing

A comprehensive laboratory testing program was conducted to assist in the characterization of the various materials encountered and to evaluate geotechnical parameters for design purposes. Testing was conducted at Golder Associates' Geotechnical Laboratory in Mt. Laurel, New Jersey and was performed on undisturbed and disturbed samples collected from the borings as discussed in Section 4.1.2. The testing program was designed to meet the objectives set forth in Table 5 of the PDI Work Plan and the Data Quality Objectives (DQO) presented in Table 16 of the PDI Work Plan; these tables are included in Appendix D. Table 2 compares the testing program conducted with the schedule envisaged in the PDI Work Plan. The number of tests performed corresponded to or exceeded that envisaged in the PDI Work Plan although, on occasions, the distribution of tests between the East and West Hide Piles varied slightly from the PDI Work Plan as a result of the sampling and materials encountered, as discussed in Section 4.1.2.

The following paragraphs discuss the types of tests conducted, the methodology used and the samples tested.

1. Natural moisture content was determined on a total of 64 samples which were the subject of other tests to determine hydraulic or mechanical properties. The samples were tested in accordance with American Society for Testing and Materials (ASTM) Standard D2217-85.

2. Mechanical grain size distribution tests were conducted on a total of 46 samples. Hydrometer tests were also conducted on the same samples except where the fines content was less than 5%. The tests were performed in accordance with ASTM Standards D421, D422, and C136.

3. Atterberg limits (liquid and plastic limits) were conducted on a total of 39 samples. The tests were performed in accordance with ASTM Standard D4318-84.

4. Specific gravity was determined for those samples on which Modified Proctor and/or consolidation tests were conducted. A total of 18 tests were run in accordance with ASTM Standard D854-83.

5. Organic content determinations were made on a total of 28 samples which were the subject of other tests to determine hydraulic or mechanical properties. The tests were performed using the loss-on-ignition method in accordance with ASTM Standard D2974.

6. Modified Proctor tests were conducted on 4 samples of the Fill and Hide Residue to establish moisture/density relationships. The tests were performed according to ASTM Standard D1557.

7. Permeability tests were conducted on 3 samples of Fill and Hide Residue; two from undisturbed samples and one on a sample recompacted to field water content and density. The tests were conducted in accordance with Army Corps of Engineers EM-1110-2-1906.

8. Triaxial strength tests were carried out on a total of 14 samples, one of the outwash sand, one of surficial material and the remainder of Fill and Hide Residue. The granular nature of the outwash sand determined the use of a drained test on specimens consolidated to confining pressures of 12, 18, and 24 pounds per square inch (psi). In view of the heterogeneous nature of the Fill and Hide Residue a program of 6 consolidated undrained triaxial tests with pore pressure measurement and 6 consolidated drained triaxial tests was undertaken.

   The nature of the Fill and Hide Residue was such that the preparation of undisturbed triaxial specimens from Shelby tube samples presented severe practical problems. A total of 14 undisturbed specimens were successfully prepared from Shelby tubes and the remaining tests were carried out on specimens remolded to field water content and density. In view of the origin of the Fill and Hide Residue (Section 3.0) leading to the absence of any preferred structure, its mechanical and hydraulic properties can be properly evaluated from remolded specimens prepared to resemble field conditions. Confining pressures were chosen to approximately correspond with the in-situ effective stress and to provide a suitable stress range to permit construction of the failure envelope. The tests were conducted in accordance with Army Corps of Engineers EM-1110-2-1906, Appendix 10 (with recent updates).

9. One-dimensional consolidation tests were conducted on 8 samples of the Fill and Hide Residue on which triaxial tests were also performed. Six of the tests were carried out on undisturbed samples and two on material remolded to field water content and density. The tests were performed in accordance with ASTM Standard D2435-80.

The soils laboratory test results are summarized in Table 4 and the detailed information is included as Appendix C.

Tests on water samples are presented in the PDI Task GW-1 Plume Delineation Phase I Interim Report.

4.3 Surface Settlement Monitoring

Topographic features indicating possible previous shallow surface sloughing of slopes were observed during the course of the investigation particularly on the lower slopes of the East Hide Pile. No evidence of recent slope instability was apparent.

Twelve surface settlement markers were installed on the East Hide Pile in May 1990; several within areas of possible previous movement. Each marker consists of a 5 foot long, 1-inch diameter smooth steel rod driven 4 feet into the ground and spray painted for visibility. The elevations and locations of each marker were surveyed initially on May 18, 1990 and the positions are shown in Figure 1. The markers are surveyed at monthly intervals in order to define any changes in elevations or locations from the initial survey. The results of the settlement monitoring to date are presented in Table 3. It will be noted that very small heave movements have been recorded, however, the apparent movements involved are very small and comparable with likely survey closing errors. The survey data also indicates no significant change in lateral position of the markers to date and it is therefore concluded that no ground surface movement has occurred in the vicinity of the monitoring points.

5.0 GROUND CONDITIONS

5.1 Stratigraphy

Details of the various strata encountered are presented on the borehole logs in Appendix A, which also includes the logs of relevant borings which were carried out as part of the RI/FS. A downward succession of the following strata was recognized in the present investigation and can be inferred from the descriptions in the RI/FS boreholes:

Surficial Materials: Undifferentiated variable surface sediments up to 7.5 feet in thickness. These are generally considered to be fill materials, although portions may be of natural origin along the margins of the wetlands.

Fill and Hide Residue: Mixture of hide residue and naturally occurring materials placed as fill. In visual description this strata was distinguished from the Surficial Materials by the presence of hair.

Outwash Sand: Undisturbed natural ground of glacial origin. Visually distinguished from the overlying Fill and Hide Residue by the absence of hair and usually a color change.

Glacial Till: Undisturbed natural ground visually distinguished from the Outwash Sand by virtue of gradation.

Geotechnical cross-sections through the hide piles are presented as Figures 3 and 4 in which the lateral and vertical extent of the various strata are delineated. Section locations are indicated in Figure 2 and were selected both to delineate stratigraphy and provide the necessary geometry information for slope stability analysis of critical sections. The Fill and Hide Residue is generally underlain by approximately 10 feet of Outwash Sand which in turn overlies Glacial Till. In the western portion of the West Hide Pile, Outwash Sand is not present and the Fill and Hide Residue overlies Glacial Till directly. To the east of the East Hide Pile both the

Outwash Sand and Glacial Till thin out and Fill and Hide Residue overlies bedrock.

5.2 Material Characterization

5.2.1 Surficial Materials

The Surficial Materials generally comprise loose or very soft SILT and fine SAND; a grading envelope based on 5 test results is presented as Figure 5. In the vicinity of the West Hide Pile, the finer fraction is somewhat greater and the material is classified as ML under the USCS. Surficial Materials occur less frequently around the East Hide Pile and are slightly coarser leading to a classification of SM under the USCS. Based on two Atterberg limit tests on material from borings along the wetland margins, the Surficial Materials are classified as non-plastic and have organic contents of up to 8.1 percent. The material is locally different in Borehole No. 7 where it comprises a compact coarse to fine SAND with some fine gravel and a little clayey silt.

5.2.2 Fill and Hide Residue

The Fill and Hide Residue generally comprises medium to fine SAND with a little to some silt, up to a little fine gravel and variable quantities of organic matter and hair (hide residue). Occasional cobbles and wood fragments are also present. The material is relatively uniform between the East and West Hide Piles and a grading envelope, based on 20 samples, is presented in Figure 6. The material is classified as SM or SP-SM under the USCS. From the gradation information it appears that these materials were formed by mixing the naturally occurring Outwash Sand with hide residues which have probably subsequently undergone some decomposition. Comparison of the gradation of the Fill and Hide Residue with that of the Outwash Sand indicates that the Hide Residue effectively comprises a

well graded sand with some silt and a trace of fine gravel. The Fill and Hide Residue material is non-plastic and organic contents range from 0.6 percent to 19.1 percent with an average value of 7 percent for 22 tests.

In certain of the RI/FS boreholes a thin (approximately 1 foot thick) layer designated as "peat" was recognized at the base of the Fill and Hide Residue. The sample descriptions indicate that this material is a variably clayey sand and includes root matter; it is probable that this material corresponds to original topsoil left in place when the fill and hide residue was deposited. The classification "peat" does not seem appropriate and this material has been reclassified as clayey sand with organic inclusions. Bearing in mind the thin nature of this layer and the fact that the present investigation shows that it is laterally discontinuous, it will not be described separately.

5.2.3 Outwash Sand

The Outwash Sand is essentially a clean fine to medium SAND. The material is very homogeneous and a grading envelope, based on 7 samples, is presented in Figure 7. The material is non-plastic and classified as SP or SP-SM under the USCS.

5.2.4 Glacial Till

The Glacial Till generally comprises a fine to coarse SAND with some fine gravel and a little silt. The material is relatively homogeneous between the East and West Hide Piles and a grading envelope, based on 3 samples, is presented in Figure 8. The material is non-plastic and classified as SW or SM under the USCS.

5.3 Groundwater Conditions

Groundwater was noted in all of the borings; observations during drilling generally indicated groundwater elevations from zero to 3 feet below that of standing water in the wetlands. In Borehole Nos. 12 and 13, located on the crest of the East Hide Pile, groundwater was noted within the Fill and Hide Residue materials at elevations above that of the wetlands. Borehole No. 12 was left open for a period of two days after which time the water level had risen to 11.5 feet above that of standing water in the wetlands. The water level observed during drilling of Borehole No. 13 was 1.5 feet above that of the wetlands. Visual assessment of the moisture content of samples recovered from Borehole No. 9, located on the crest of the East Hide Pile, also suggests the presence of perched water tables higher up within the Fill and Hide Residue materials. Groundwater levels measured in Monitoring Wells OW-31 and OW-32 twenty-four hours after development correspond with the standing water level in the adjacent wetland.

The above observations indicate that groundwater conditions are primarily controlled by standing water levels in the wetlands, bearing in mind that water levels observed during drilling are generally lower than true water levels due to the action of the drilling process. There is however limited evidence of some "mounding" of the groundwater table within the hide piles and of perched water tables at shallow depth. The presence of perched water tables within the Fill and Hide Residue could be expected on the basis of the heterogeneity of these materials and a further indication of their presence is provided by measurements of the degree of saturation of Shelby tube samples as shown in Figure 12. Perched water tables of this nature are likely to be of limited lateral extent and cannot be mapped with any confidence. It seems likely that the perched water

tables have a controlling influence on local slope stability leading to the variable steepness of the hide piles. Where perched water tables are not present, slopes will stand at high angles as a result of capillarity; the presence of perched water tables eliminates the apparent cohesion induced by the capillarity effect and results in shallow sloughing of the slope to much flatter angles of repose.

6.0 GEOTECHNICAL PARAMETERS

6.1 Introduction

The determination of geotechnical parameters for slope stability analysis, retaining structures design and hide pile settlement behavior forms part of the objectives of this report. The following sections address these requirements for each of the strata in turn providing unit weight, shear strength and consolidation data.

Since no geotechnical information was known to Golder Associates regarding properties and behavior of Fill and Hide Residues, a library search for published material on relevant properties was conducted using computerized database interrogation methods; a comprehensive study was carried out but located no sources of relevant information. It was concluded that geotechnical information regarding Fill and Hide Residue properties has not been published to date.

6.2 Surficial Materials

As noted previously, the Surficial Materials are of limited thickness and assessed parameters can be inferred from index tests and SPT 'N' values. The material is essentially a non-plastic silt and fine sand (see section 5.2.1) which is expected to be cohesionless when saturated. The SPT results are plotted against depth in Figure 9 and indicate 'N' values between 1 between 14. Using the work of Schmertmann (1975) an effective angle of shearing resistance of 25 degrees is assessed on this basis. Typical saturated unit weights for such materials are on the order of 100 pounds per cubic foot (pcf) and this value is suggested for design purposes. The generally low density of this material infers a relatively high compressibility, and a compression index (C_C) of 0.5 is assessed using the work of Nishida (1956).

6.3 Fill and Hide Residue

Unit weights determined from undisturbed Shelby tube samples of Fill and Hide Residue prior to extrusion are presented in Figure 12. A range of values of 65 to 130 pcf is apparent reflecting variations in the degree of saturation associated with perched water tables (see section 5.3). A conservative value should be used in analyses; depending upon the design situation this may be either a low or a high unit weight within the range quoted above. In assessing the value for a particular design case it is important to consider if the material can become saturated (and therefore increase in unit weight) whether under normal or failure conditions.

Shear strength parameters may be assessed from the results of the triaxial tests. For heterogeneous materials of this nature the most reliable strength parameters are obtained by considering all of the test results together to define a single failure envelope rather than by assessing distinct values for each test from the Mohr circles. A large number of results can be conveniently assessed in this way by plotting the failure points on a p'-q plot where:

$$p' = \frac{\sigma_1' + \sigma_3'}{2} \qquad q = \frac{\sigma_1' - \sigma_3'}{2}$$

σ_1' and σ_3' being the major and minor principal effective stresses at failure. The conventional Mohr-Coulomb failure parameters c' and ϕ' are related to the slope (ψ) and intercept (d) of the p'-q plot as follows:

$$\sin \phi' = \tan \psi$$

$$c' = \frac{d}{\cos \phi'}$$

A p'-q plot for the Fill and Hide Residue is presented as Figure 13. The data is reasonably consistent, both between consolidated undrained tests with pore pressure measurement and consolidated drained tests, for both undisturbed samples and specimens remolded at field water content and density. A "best fit" line through the data gives an effective angle of friction of 37 degrees and an effective cohesion of 2 psi.

Shear strength parameters may also be estimated from the SPT 'N' values. The SPT results for Fill and Hide Residue are plotted against depth in Figure 10. The data shows a range of values, as would be expected for a heterogeneous material of this nature, with a clear trend of increasing 'N' value with depth. Using the work of Schmertmann (1975) to account for overburden effects and noting low 'N' values which are likely to have been affected by piping, suggests an effective angle of shearing resistance of 35 degrees.

It is considered unwise to rely on a cohesive strength component for such a heterogeneous material and a prudent allowance should also be made for possible future degradation of material properties as a result of continuing anaerobic decomposition of the hide materials. Considering this and the above discussions, effective shear strength parameters of zero cohesion and 34 degrees friction angle are suggested for design purposes.

Some further "confirmation" of the general order of these parameters can be derived by considering the origins of the material; as noted in Section 5.2.2 Outwash Sand forms a major component with which hide residue has been mixed. The Outwash Sand is a naturally occurring material with a relatively high friction angle (see below) to which has been added a material with a gradation corresponding to a

well graded sand with some silt and a trace of fine gravel. It is therefore anticipated that the Fill and Hide Residue would have a friction angle comparable to, or less than, that of the Outwash Sand.

The compressibility of the Fill and Hide Residue has been estimated from the results of the one-dimensional consolidation tests presented in Appendix C. A range of compression index (C_c) from 0.07 to 0.34 is apparent and a value of 0.3 is recommended for design purposes.

6.4 Outwash Sand

The Outwash Sand is a medium to dense clean fine to medium sand which is present below the water table and is therefore expected to be saturated. A typical unit weight of 120 pcf is suggested for design purposes on this basis. A single consolidated drained triaxial test on this material indicates an effective angle of shearing resistance of 38 degrees and zero effective cohesion. SPT 'N' values, plotted against elevation for ease of comparison, are presented in Figure 11. Based on the work of Schmertmann (1975) an effective friction angle on the order of 37 degrees has been calculated. An effective angle of shearing resistance of 36 degrees is recommended for undisturbed material in design; if the material is disturbed or may pipe as a result of any construction process a lower friction angle on the order of 33 degrees should be adopted.

The density of this material in-situ is such that its compressibility, if undisturbed, will be low. Settlements of this material can be estimated from empirical relationships with SPT 'N' values available in the literature.

6.5 Glacial Till

The envisaged engineering design and construction is unlikely to be contingent upon the properties of the glacial till to any significant degree. SPT 'N' values indicate that the Till occurs in a dense condition and the following parameters are recommended for design purposes:

Unit weight:	125 pcf
Effective friction angle:	37 degrees
Effective cohesion:	zero
Compressibility:	negligible

7.0 STABILITY ANALYSIS MODEL

The cross-sections presented in Figures 3 and 4 provide appropriate models for slope stability analysis using the PCSTABL5M version of the STABL program developed by Purdue University. The section lines were selected to include the critical portions of the slope and the groundwater conditions are considered to represent long term conditions. As noted in Section 5.3, the current surface stability is affected by shallow sloughing, which in turn is probably controlled by local perched water tables that cannot be reliably predicted. Remedial design analyses should consider the possible existence of these perched water tables. Soil parameters for use with the cross-section models are discussed in Section 6 of this report and summarized in Figures 3 and 4.

8.0 REFERENCES

American Society for Testing and Materials, Annual Book of ASTM Standards, Concrete and Aggregates, 1990, Volume 04.02, 804p.

C 136-84a Sieve Analysis of Fine and Coarse Aggregates, pp. 76-79.

American Society for Testing and Materials, Annual Book of ASTM Standards, Soil and Rock, Building, Stones, Geotextiles, 1990, Volume 04.08, 1092p.

D2217-85 Wet Preparation of Soil Samples for Particle Size Analysis and Determination of Soil Constants, pp. 277-279.

D421-85 Dry Preparation of Soil Samples for Particle Size Analysis and Determination of Soil Constants, pp. 89-90.

D422-63 Particle Size Analysis of Soils, pp. 91-97.

D4318-84 Liquid Limit, Plastic Limit, and Plasticity Index of Soils, pp. 591-600.

D854-83 Specific Gravity of Soils, pp. 168-170.

D1587-83 Practice for Thin-Walled Tube Sampling of Soils, pp. 233-235.

D1586-84 Method for Penetration Test and Split-Barrel Sampling of Soils, pp. 228-232.

D2435-80 Test Method for One-Dimensional Consolidation Properties of Soils pp. 290-294.

D1557-78 Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10-lb. (4.54-Kg) Rammer and 18-in. (457-mm) Drop, pp. 217-221.

D2974-87 Moisture, Ash,, and Organic Matter of Peat and Other Organic soils pp. 369-371.

Golder Associates Inc., December 1989, Pre-Design Work Plan, Industri-Plex Site, Woburn, Massachusetts, prepared for Industri-Plex Site Remedial Trust, 134p.

Nishida, Y., 1956, A Brief Note on Compression Index of Soil. Journal of the Soil Mechanics and Foundation Division, Proc. ASCE, 82, No. SM3, p. 1027-1 to 1027-14.

Schmertmann, J.H., 1975, The Measurement of In-Situ Shear Strength. 6th PSC, ASCE, Vol. 2, pp. 57-138.

Stauffer Chemical Company, 1983, Woburn Environmental Studies Phase I Report, Environmental Assessments, Industri-Plex Site, Woburn, MA, April 1983. (RI/FS)

Stauffer Chemical Company, 1984, Woburn Environmental Studies, Phase II Report, Industri-Plex Site, Woburn, MA.

U.S. Environmental Protection Agency, 1986, Record of Decision, Industri-Plex Site, Woburn, MA, September 1986.

United States Army Corps of Engineers, 1970, Engineering and Design Laboratory Soils Testing (with updates), EM-1110-2-1906.

C:HIDEREF

TABLE 1
Borehole Depth and Sampling Summary

Borehole	Depth		Disturbed Samples		Undisturbed Samples			Remarks
	Anticipated	Actual	Anticipated	Actual	Anticipated	Attempted	Recovered	
1	35	32.0	8	7	3	2	2	Natural ground higher than anticipated
2	32	32.0	7	7	3	3	3	
3	15	14.2	4	4	1	1	0	Very soft ground, no recovery
4	10	12.0	3	3	0	0	0	
5	10	12.0	3	3	1	1	0	Poor recovery, rocks encountered
6	10	14.0	3	7	0	0	0	Monitoring well- cont. sampling
7	15	17.0	4	4	1	0	0	Fill overlying sand and till
8	20	8.4	5	4	0	2	0	Very soft ground, no recovery
9	45	40.0	10	8	3	2	1	Difficult drilling bottom 17 ft.
10	45	40.5	10	8	3	4	2	Poor recovery, rocks and wood recovered
11	25	22.0	6	5	1	1	1	
12	25	37.3	6	8	0	2	2	Hole relocated to top of hide pile
13	35	37.0	8	8	1	2	1	Hole relocated to top of hide pile
14	15	8.0	4	5	0	0	0	Monitoring well- cont. sampling
15	15	17.0	4	4	1	1	1	
16	15	17.0	4	4	0	0	0	
17	15	17.0	4	4	1	0	0	Dense soils encountered
Total	380.0	377.4	93	93	19	21	13	

TABLE 2
Laboratory Test Requirements Summary

Type of Test	Required Number of Tests		Completed Number of Tests	
	East Hide Pile	West Hide Pile	East Hide Pile	West Hide Pile
Standard Penetration Test	56	37	56	38
Grain Size Analysis	14	16	25	21
Atterberg Limits	14	16	21	18
Triaxial Strength Test				
Consolidated/Undrained	4	3	4	3
Consolidated/Drained	4	3	5	2
Consolidation	4	4	4	4
Modified Proctor	2	2	2	2
Permeability	2	1	3	0
Organic Content	8	7	19	10

Note: Requirements based on Table 5 of PDI Work Plan (see Appendix D).

TABLE 3
EAST HIDE PILE SETTLEMENT MONITORING

Settlement Monitoring Point

	SM-1	SM-2	SM-3	SM-4	SM-5	SM-6	SM-7	SM-8	SM-9	SM-10	SM-11	SM-12
EL.(May 18,1990)	79.90	101.68	87.13	97.75	83.74	109.78	109.96	110.64	85.78	108.19	90.32	107.86
SETTLEMENT TO:												
June 21,1990	-0.03	-0.02	-0.03	-0.02	-0.03	-0.01	-0.01	0.00	-0.03	-0.01	0.00	-0.01
July 16,1990	0.00	0.02	0.00	0.02	0.01	0.01	-0.02	0.00	0.00	0.00	0.02	0.00
August 15,1990	-0.02	-0.02	-0.01	-0.01	-0.03	-0.01	-0.02	-0.04	-0.02	-0.01	-0.02	-0.01

Note: Negative sign (-) denotes an increase in elevation from May 1990 survey.

TABLE 4
HIDE PILE
LABORATORY TEST RESULTS SUMMARY
ISRT SITE WOBURN, MA

BOREHOLE NO.	DEPTH (FT-BGS)	SAMPLE NO.	SAMPLE TYPE	NATURAL WATER CONT.(%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTIC INDEX	ORGANIC CONT.(%)	% PASSING 200 SIEVE	GRAIN SIZE: SIEVE ANALYSIS	GRAIN SIZE: HYDROMETER TEST	SPECIFIC GRAVITY	MODIFIED PROCTOR: UNIT WT.(PCF)	MODIFIED PROCTOR: MAX. D.D. (PCF)	MODIFIED PROCTOR: OPT. MOIST. CONTENT	HYDRAULIC CONDUCTIVITY (cm/sec)	SHEAR STRENGTH	CONSOLIDATION	USCS CLASS.	MATERIAL TYPE
1	0-2	S-1	DO	45.6	-	-	-	-	53.9	*	*	-	-	-	-	-	-	-	SM-ML	SURFICIAL
1	5-7	S-2	DO	23.2	NP	NP	NP	3.5	-	-	-	-	-	-	-	-	-	-	-	FILL & HIDE
1	10-12	S-3	DO	19.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	FILL & HIDE
1	13-15	ST-1	TO	18.1	NP	NP	NP	-	10.9	*	*	2.69	92.0	-	-	-	-	#	SP	FILL & HIDE
1	15-17	S-4	DO	20.5	-	-	-	-	12.0	*	*	-	-	-	-	-	-	-	SP-SM	FILL & HIDE
1	20-22	ST-2	TO	18.1	NP	NP	NP	2.2	-	*	*	2.82	125.6	-	-	-	X	-	SP	FILL & HIDE
1	22-24	S-5	DO	15.8	NP	NP	NP	0.6	-	-	-	-	-	-	-	-	-	-	-	FILL & HIDE
1	25-27	S-6	DO	28.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	OUTWASH SAND
1	30-32	S-7	DO	20.6	NP	NP	NP	-	5.1	*	*	-	-	-	-	-	-	-	SP	OUTWASH SAND
1	0-5	-	BULK	37.2	NP	NP	NP	-	48	*	*	2.61	-	-	-	-	X	-	SM-ML	SURFICIAL
2	0-2	S-1	DO	25.2	-	-	-	-	75.1	*	*	-	-	-	-	-	-	-	ML	SURFICIAL
2	5-7	S-2	DO	25.9	NP	NP	NP	-	-	-	-	-	-	-	-	-	-	-	-	SURFICIAL
2	8-10	ST-1	TO	36.2	NP	NP	NP	9.6	23.5	*	*	2.96	83.0	-	-	-	-	#	SP-SM	FILL & HIDE
2	10-12	S-3	DO	22.8	-	-	-	-	19.0	*	*	-	-	-	-	-	-	-	SM	FILL & HIDE
2	15-17	S-4	DO	25.7	NP	NP	NP	8.8	-	-	-	-	-	-	-	-	-	-	-	FILL & HIDE
2	19-21	ST-2	TO	32.8	NP	NP	NP	12	18.6	*	*	3.0	85.8	-	-	-	X	#	SM	FILL & HIDE
2	21-23	S-6	DO	36.7	-	-	-	-	16.3	*	*	-	-	-	-	-	-	-	SM	FILL & HIDE
2	25-27	S-6	DO	20.5	NP	NP	NP	5.6	-	-	-	-	-	-	-	-	-	-	-	F&H/OUTWASH SAND
2	28-30	ST-3	TO	12.8	NP	NP	NP	0.8	1.4	*	*	2.75	-	-	-	-	X	#	SP	OUTWASH SAND
2	30-32	S-7	DO	15.2	-	-	-	-	4.8	*	*	-	-	-	-	-	-	-	-	OUTWASH SAND
3	0-2	S-1	DO	41.7	NP	NP	NP	7.0	60.0	*	*	-	-	-	-	-	-	-	ML	SURFICIAL

* Test performed. See grain size distribution curves for results.

X Test performed. See Mohr circles and p-q plot for results.

Test performed. See e-log p curves for results.

TABLE 4

HIDE PILE

LABORATORY TEST RESULTS SUMMARY

ISRT SITE WOBURN, MA

893-6255

BOREHOLE NO.	DEPTH (FT-BGS)	SAMPLE NO.	SAMPLE TYPE	NATURAL WATER CONT.(%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTIC INDEX	ORGANIC CONT.(%)	GRAIN SIZE: % PASSING 200 SIEVE	GRAIN SIZE: SIEVE ANALYSIS	GRAIN SIZE: HYDROMETER TEST	SPECIFIC GRAVITY	UNIT WT.(PCF)	MODIFIED PROCTOR: MAX. D.D. (PCF)	MODIFIED PROCTOR: OPT. MOIST. CONTENT	HYDRAULIC CONDUCTIVITY (cm/sec)	SHEAR STRENGTH	CONSOLIDATION	USCS CLASS.	MATERIAL TYPE
3	5-7	S-2	DO	22.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	OUTWASH SAND
3	10-12	S-3A	DO	23.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	OUTWASH SAND/GLACIAL TILL
3	12.7-14.2	S-4	DO	13.0	-	-	-	-	5.7	*	*	-	-	-	-	-	-	-	SP-SM	GLACIAL TILL
3	0-5	-	BULK	27.8	NP	NP	NP	-	16.2	*	*	2.72	-	-	-	-	X	#	SM	FILL & HIDE
5	5-7	S-2	DO	58.1	NP	NP	NP	8.1	68.1	*	*	-	-	-	-	-	-	-	ML	SURFICIAL
5	10-12	S-3	DO	26.9	-	-	-	-	0.2	*	*	-	-	-	-	-	-	-	SP	OUTWASH SAND
7	10-11.5	S-3	DO	18.1	-	-	-	-	3.3	*	*	-	-	-	-	-	-	-	SP	OUTWASH SAND
7	15-17	S-4	DO	8.9	NP	NP	NP	-	13.6	*	*	-	-	-	-	-	-	-	SW	GLACIAL TILL
8	0-2	S-1	DO	77.0	NP	NP	NP	-	-	-	-	-	-	-	-	-	-	-	-	OUTWASH SAND
8	5.5-7.5	S-3	DO	27.0	-	-	-	-	3.8	*	*	-	-	-	-	-	-	-	SP	OUTWASH SAND
9	0-2	S-1	DO	17.5	-	-	-	-	23.4	*	*	-	-	-	-	-	-	-	SM	FILL & HIDE
9	5-7	S-2	DO	45.6	NP	NP	NP	11.6	23.6	*	*	-	-	-	-	-	-	-	SM	FILL & HIDE
9	10-12	S-3	DO	53.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	FILL & HIDE
9	15-17	S-4	DO	21.0	NP	NP	NP	-	20.2	*	*	-	-	-	-	-	-	-	SM	FILL & HIDE
9	18-20	ST-2	TO	21.2	NP	NP	NP	3.9	12.7	*	*	2.95	101.8	-	-	-	X	#	SP	FILL & HIDE
9	20-22	S-5	DO	31.9	-	-	-	5.0	-	-	-	-	-	-	-	-	-	-	-	FILL & HIDE
9	25-27	S-6	DO	30.3	NP	NP	NP	-	-	-	-	-	-	-	-	-	-	-	-	FILL & HIDE
9	31-32.5	S-7	DO	37.2	-	-	-	7.7	21.6	*	*	-	-	-	-	-	-	-	SM	FILL & HIDE
9	-	-	BULK	-	-	-	-	-	-	-	-	-	-	-	-	4.5xE-7	X	#	-	FILL & HIDE

* Test performed. See grain size distribution curves for results.

X Test performed. See Mohr circles and p-q plot for results.

Test performed. See e-log p curves for results.

TABLE 4

HIDE PILE

LABORATORY TEST RESULTS SUMMARY

ISRT SITE WOBURN, MA

893-6255

BOREHOLE NO.	DEPTH (FT-BGS)	SAMPLE NO.	SAMPLE TYPE	NATURAL WATER CONT.(%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTIC INDEX	ORGANIC CONT.(%)	GRAIN SIZE: % PASSING 200 SIEVE	GRAIN SIZE: SIEVE ANALYSIS	GRAIN SIZE: HYDROMETER TEST	SPECIFIC GRAVITY	MODIFIED PROCTOR: UNIT WT.(PCF)	MODIFIED PROCTOR: MAX. D.D. (PCF)	MODIFIED PROCTOR: OPT. MOIST. CONTENT	HYDRAULIC CONDUCTIVITY (cm/sec)	SHEAR STRENGTH	CONSOLIDATION	USCS CLASS.	MATERIAL TYPE
10	0-2	S-1	DO	14.3	NP	NP	NP	4.6	20.5	*	*	-	-	-	-	-	-	-	SM	FILL & HIDE
10	5-7	S-2	DO	26.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	FILL & HIDE
10	15-17	ST-3	TO	22.6	NP	NP	NP	3.3	11.1	*	*	2.61	131.7	-	-	-	X	-	SP	FILL & HIDE
10	17-19	S-4	DO	45.0	-	-	-	6.4	35.6	*	*	-	-	-	-	-	-	-	SM	FILL & HIDE
10	22-24	S-5	DO	25.8	-	-	-	-	18.3	*	*	-	-	-	-	-	-	-	SM	FILL & HIDE
10	30-32	S-7	DO	17.2	NP	NP	NP	-	-	-	-	-	-	-	-	-	-	-	-	FILL & HIDE
10	33-35	ST-4	TO	26.0	NP	NP	NP	6.9	14.9	*	*	2.51	97.4	-	-	4.5xE-6	X	#	SP	FILL & HIDE
10	35-37	S-8	DO	30.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	FILL & HIDE
10	-	-	BULK	23.4	NP	NP	NP	5.5	14.9	*	*	2.66	-	111.5	12	-	X	-	SM	FILL & HIDE
11	0-2	S-1	DO	22.9	NP	NP	NP	-	35.3	*	*	-	-	-	-	-	-	-	SM	FILL & HIDE
11	3-5	ST-1	TO	33.9	NP	NP	NP	12.8	35.8	*	*	2.66	96.0	-	-	2XE-6	X	#	SM	FILL & HIDE
11	5-7	S-2	DO	37.9	-	-	-	8.2	-	-	-	-	-	-	-	-	-	-	-	FILL & HIDE
11	10-12	S-3	DO	38.5	NP	NP	NP	-	35.7	*	*	-	-	-	-	-	-	-	SM	FILL & HIDE
11	15-17	S-4	DO	42.6	-	-	-	9.2	-	-	-	-	-	-	-	-	-	-	-	FILL & HIDE
11	20-22	S-5	DO	31.0	NP	NP	NP	-	8.0	*	*	-	-	-	-	-	-	-	SP-SM	OUTWASH SAND
12	3-5	ST-1	TO	14.4	NP	NP	NP	3.5	6.5	*	*	2.58	94.9	-	-	-	X	-	SP	FILL & HIDE
12	18-20	ST-2	TO	23.3	NP	NP	NP	4.2	14.2	*	*	2.78	94.6	-	-	-	X	-	SP-SM	FILL & HIDE
13	0-2	S-1	DO	18.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	FILL & HIDE
13	5-7	S-2	DO	24.9	-	-	-	-	20.6	*	*	-	-	-	-	-	-	-	SM	FILL & HIDE
13	18-20	ST-2	TO	15.7	NP	NP	NP	19.1	19.1	*	*	2.49	83.9	-	-	-	X	-	SM	FILL & HIDE
13	25-27	S-6	DO	28.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	FILL & HIDE
13	35.5-37	S-8	DO	22.9	NP	NP	NP	-	3.8	*	*	-	-	-	-	-	-	-	SP	OUTWASH SAND

* Test performed. See grain size distribution curves for results.

X Test performed. See Mohr circles and p-q plot for results.

\# Test performed. See e-log p curves for results.

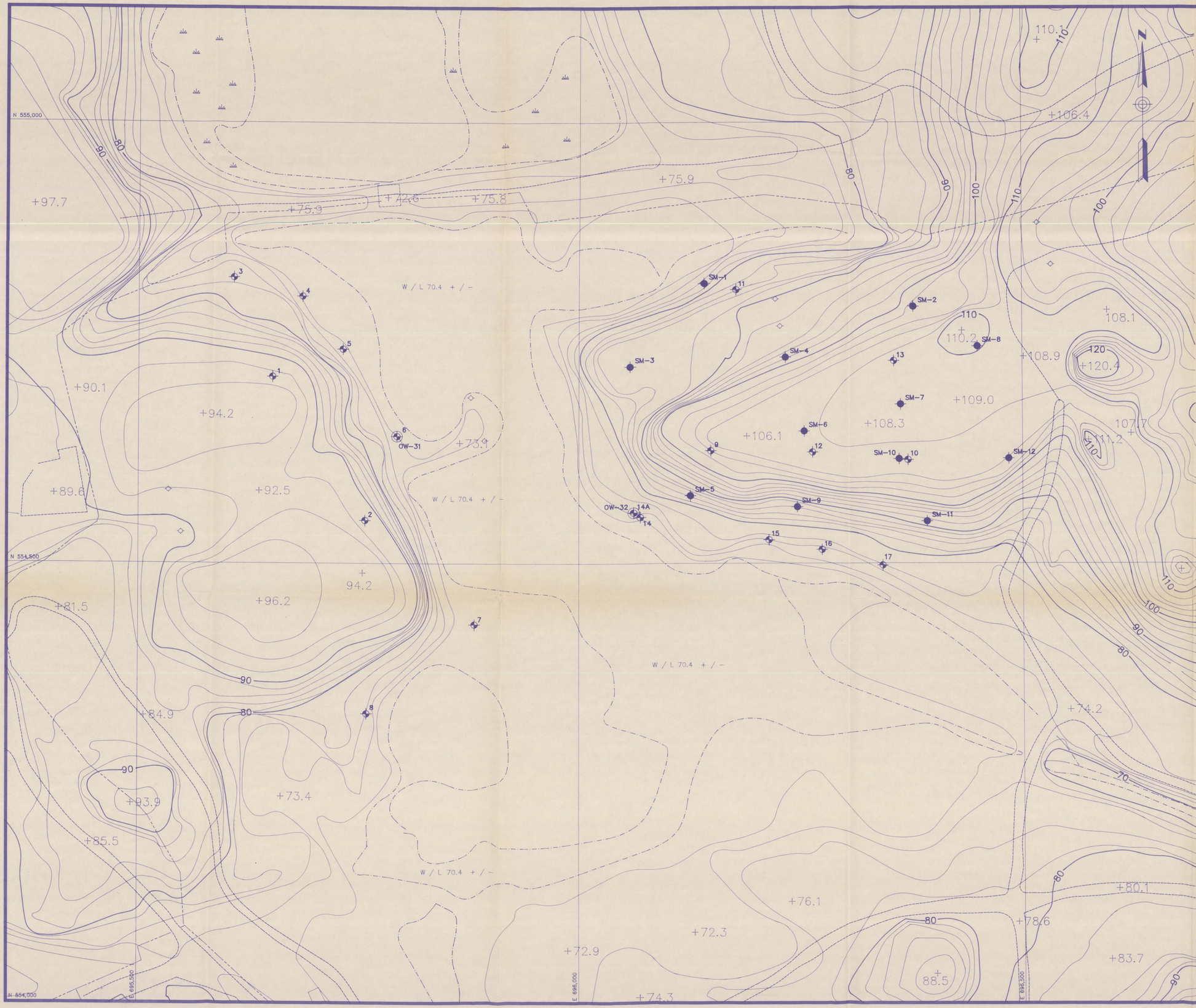
TABLE 4
HIDE PILE
LABORATORY TEST RESULTS SUMMARY
ISRT SITE WOBURN, MA

BOREHOLE NO.	DEPTH (FT-BGS)	SAMPLE NO.	SAMPLE TYPE	NATURAL WATER CONT.(%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTIC INDEX	ORGANIC CONT.(%)	GRAIN SIZE: % PASSING 200 SIEVE	GRAIN SIZE: SIEVE ANALYSIS	GRAIN SIZE: HYDROMETER TEST	SPECIFIC GRAVITY	UNIT WT.(PCF)	MODIFIED PROCTOR: MAX. D.D. (PCF)	MODIFIED PROCTOR: OPT. MOIST. CONTENT	HYDRAULIC CONDUCTIVITY (cm/sec)	SHEAR STRENGTH	CONSOLIDATION	USCS CLASS.	MATERIAL TYPE
13	–	–	BULK	17.6	NP	NP	NP	19.1	3.7	*	*	2.63	–	94.5	18	–	–	–	SP	FILL & HIDE
15	8–10	ST-1	TO	20.1	NP	NP	NP	3.3	7	*	*	2.64	–	–	–	–	–	–	SP	FILL & HIDE
15	–	–	BULK	16.5	NP	NP	NP	2.1	7.1	*	*	2.65	–	114	11.5	–	X	–	SP-SM	FILL & HIDE
16	0–2	S-1	DO	44.1	–	–	–	–	13.4	*	*	–	–	–	–	–			SM	SURFICIAL
16	15–17	S-4	DO	13.2	NP	NP	NP	0.4	18.5	*	*	–	–	–	–	–			SM	GLACIAL TILL
WHP	–	–	BULK	–	NP	NP	NP	–	–	–	–	–	–	106.5	13.4	–	–	–	–	–

* Test performed. See grain size distribution curves for results.

X Test performed. See Mohr circles and p–q plot for results.

Test performed. See e–log p curves for results.



LEGEND

1	TASK S-2 BOREHOLE
OW-32 14A	TASK S-2 BOREHOLE AND MONITORING WELL
SM-1	SETTLEMENT MARKERS
	POWER POLE
	STREAM OR WATERCOURSE
	EDGE OF ROADWAY
	FENCES
120	CONTOUR
	MARSH

NOTES

1.) TOPOGRAPHIC MAP COMPILED BY SAIC ENGINEERING, INC., APRIL 15,1990.

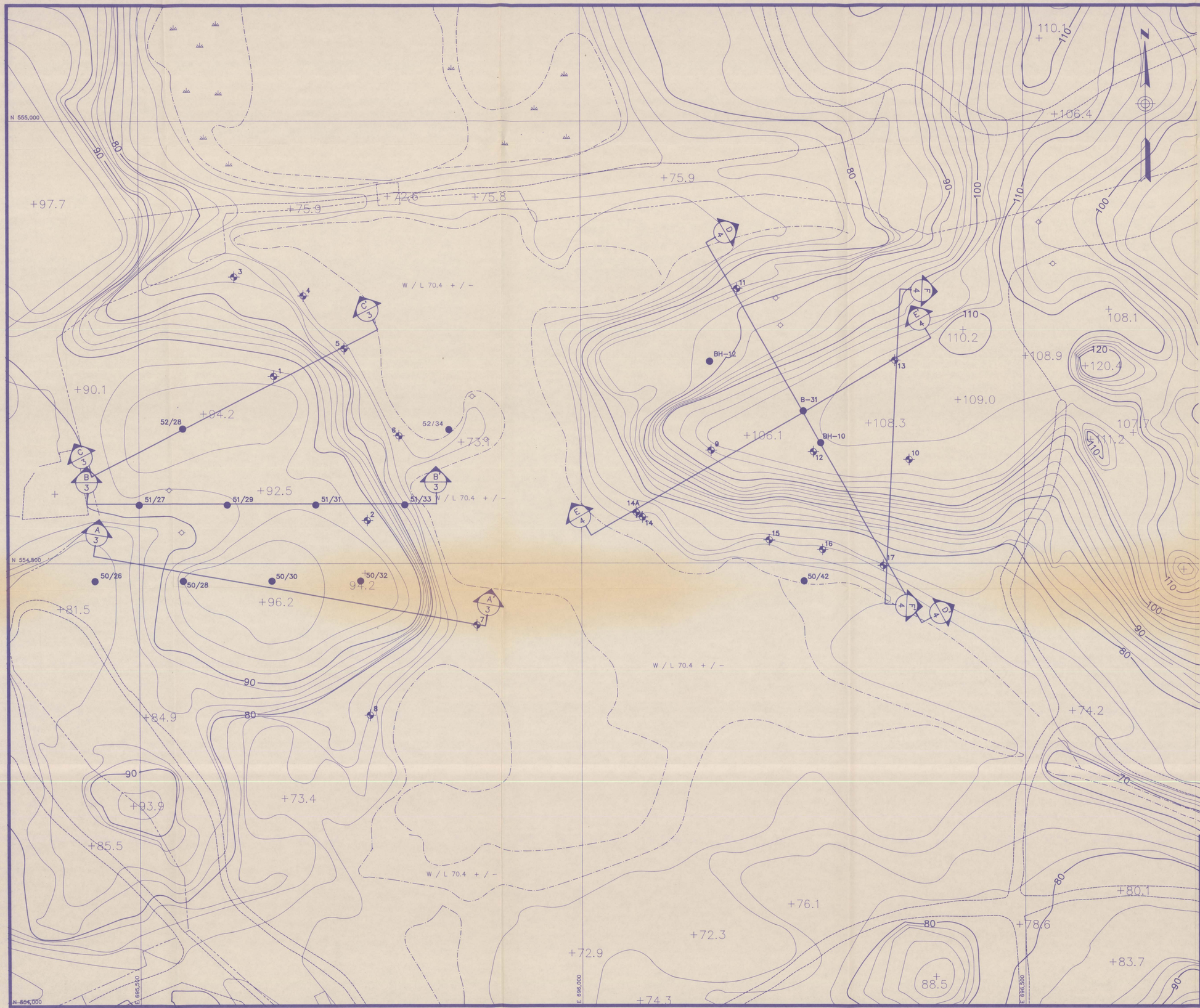
2.) TASK S-2 BOREHOLE AND SETTLEMENT MARKER LOCATIONS SURVEYED BY SAIC ENGINEERING, INC., MAY 1990.

SEP 21 1990

50 0 50 100
scale feet

REV	DATE	DESCRIPTION	DR BY	RVW BY

SCALE: AS SHOWN		PROJECT: INDUSTRI-PLEX SITE REMEDIAL TRUST WOBURN, MASSACHUSETTS
PROJECT No. 893-6255		
DES BY	RAC	08/21/90
DR BY	JSG	08/21/90
CHK BY		9/21/90
RVW BY		9/21/90
SHEET TITLE: TASK S-2 BOREHOLE LOCATIONS		
Golder Associates Mt. Laurel, New Jersey		SHEET OF
		DRAWING No. MA01-108
		FIGURE 1



LEGEND

- TASK S-2 BOREHOLE
- BOREHOLE TAKEN FROM RI/FS
- POWER POLE
- STREAM OR WATERCOURSE
- EDGE OF ROADWAY
- FENCES
- 120 CONTOUR
- MARSH
- A / 3 — CROSS SECTION IDENTIFIER / FIGURE NO. WHERE SECTION IS SHOWN

NOTES

1.) TOPOGRAPHIC MAP COMPILED BY SAIC ENGINEERING, INC., APRIL 15,1990.

2.) TASK S-2 BOREHOLES SURVEYED BY SAIC ENGINEERING, INC., MAY 1990.

3.) RI/FS BOREHOLE LOCATIONS TAKEN FROM FIGURE 21 ENTITLED "LOCATIONS OF DETAILED CROSS SECTIONS" DATED MARCH, 1984 BY ROUX ASSOCIATES INC.

4.) CROSS SECTIONS PRESENTED AS FIGURES 3 AND 4.

50 0 50 100
scale feet

SEP 21 1990

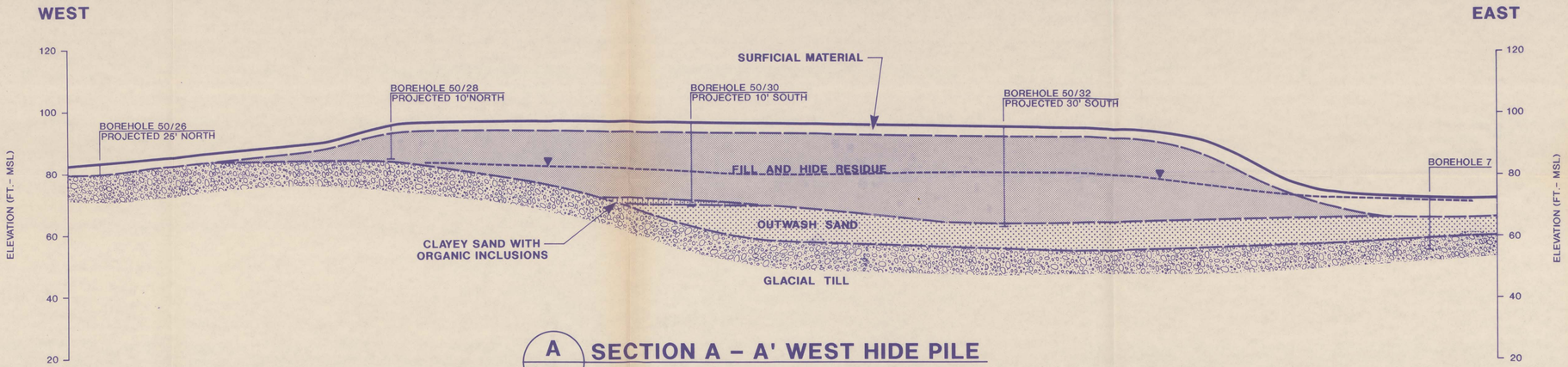
REV	DATE	DESCRIPTION	DR BY	RVW BY

SCALE: AS SHOWN		PROJECT: INDUSTRI-PLEX SITE REMEDIAL TRUST WOBURN, MASSACHUSETTS
PROJECT No. 893-6255		
DES BY	RAC	08/21/90
DR BY	JSG	08/21/90
CHK BY	RSF	8/21/90
RVW BY	[illegible]	8/21/90
SHEET TITLE: CROSS SECTION LOCATION PLAN EAST AND WEST HIDE PILES		

Golder Associates
Mt. Laurel, New Jersey

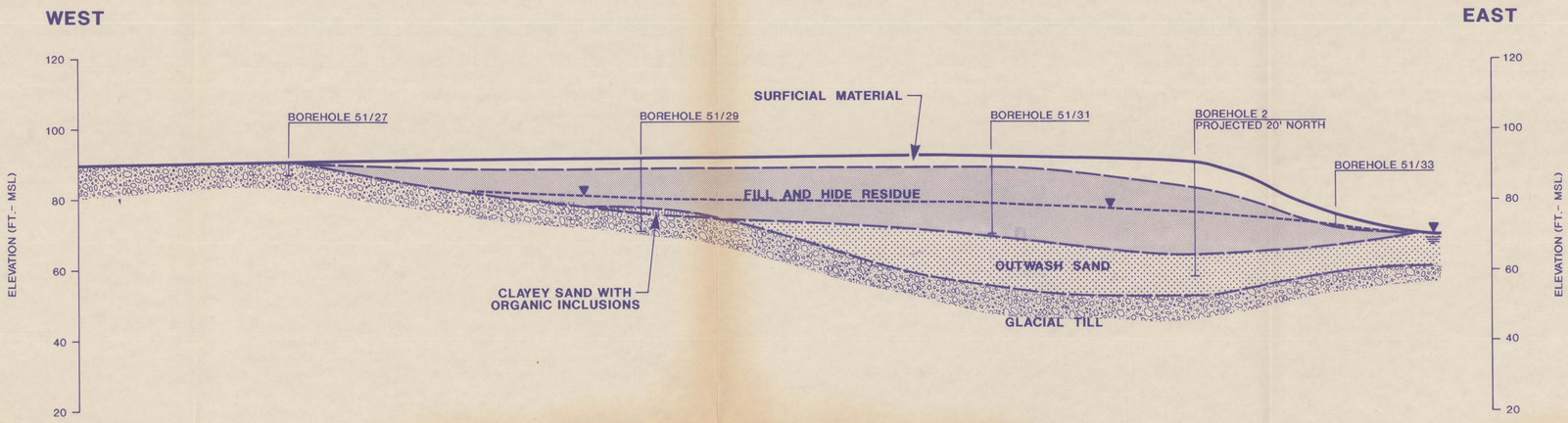
SHEET OF
DRAWING No. MA01-107

FIGURE 2



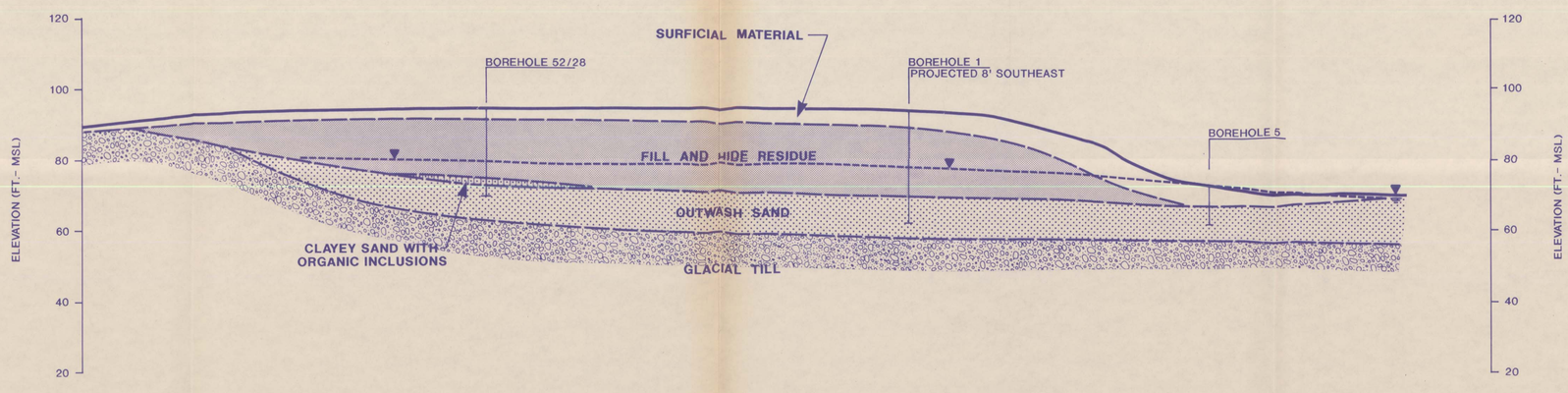
A/3 SECTION A – A' WEST HIDE PILE

20 0 20 40
scale feet



B/3 SECTION B – B' WEST HIDE PILE

20 0 20 40
scale feet



C/3 SECTION C – C' WEST HIDE PILE

20 0 20 40
scale feet

NOTES

1.) CROSS SECTION LOCATIONS PRESENTED ON FIGURE 2.

2.) ▼ DENOTES TENTATIVE LONG TERM GROUNDWATER LEVEL.
SEE REPORT TEXT FOR FULL DISCUSSION OF GROUNDWATER CONDITIONS.

3.) PARAMETERS FOR STABILITY ANALYSES :

SURFICIAL MATERIALS :	UNIT WEIGHT 100 pcf	C' = O Ø' = 25°
FILL AND HIDE RESIDUE :	UNIT WEIGHT 125 pcf	C' = O Ø' = 34°
OUTWASH SAND :	UNIT WEIGHT 120 pcf	C' = O Ø' = 36°
GLACIAL TILL :	UNIT WEIGHT 125 pcf	C' = O Ø' = 37°

SEP 2 1 1990

REV	DATE	DESCRIPTION	DR BY	RVW BY

SCALE: AS SHOWN
PROJECT No. 893-6255

DES BY	RJI	09/13/90
DR BY	RDT	09/13/90
CHK BY	RJI	9/21/90
RVW BY	[illegible]	9/21/90

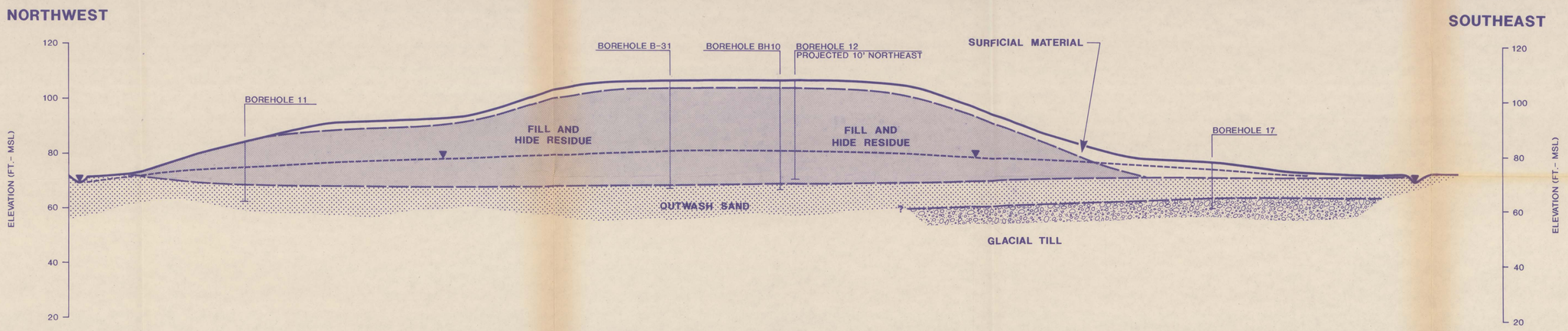
PROJECT:
INDUSTRI-PLEX SITE REMEDIAL
TRUST WOBURN, MASSACHUSETTS

SHEET TITLE:
GEOTECHNICAL CROSS
SECTIONS WEST HIDE PILE

Golder Associates
Mt. Laurel, New Jersey

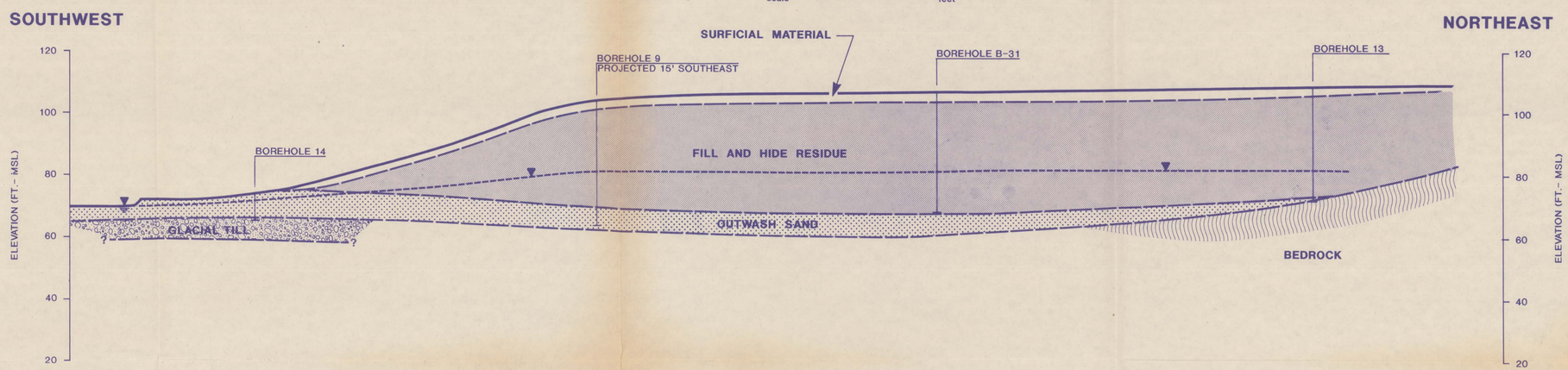
SHEET OF
DRAWING No. MA01-109

FIGURE 3



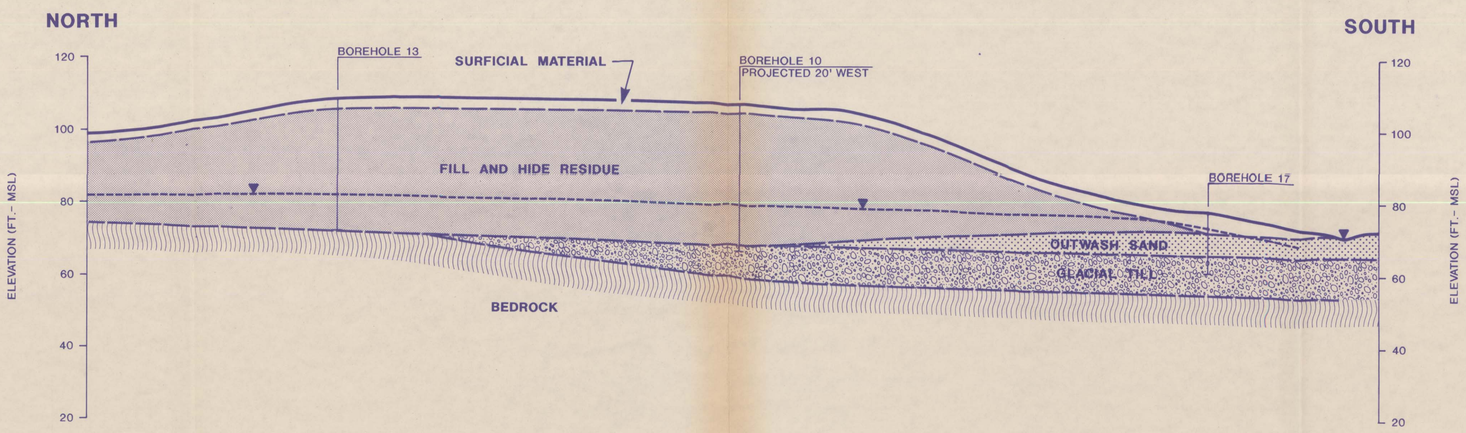
D/4 SECTION D – D' EAST HIDE PILE

20 0 20 40
scale feet



E/4 SECTION E – E' EAST HIDE PILE

20 0 20 40
scale feet



F/4 SECTION F – F' EAST HIDE PILE

20 0 20 40
scale feet

NOTES

1.) CROSS SECTION LOCATIONS PRESENTED ON FIGURE 2.

2.) ▼ DENOTES TENTATIVE LONG TERM GROUNDWATER LEVEL. SEE REPORT TEXT FOR FULL DISCUSSION OF GROUNDWATER CONDITIONS.

3.) PARAMETERS FOR STABILITY ANALYSES :

SURFICIAL MATERIALS :	UNIT WEIGHT 100 pcf	
	C' = O	Ø' = 25°
FILL AND HIDE RESIDUE :	UNIT WEIGHT 125 pcf	
	C' = O	Ø' = 34°
OUTWASH SAND :	UNIT WEIGHT 120 pcf	
	C' = O	Ø' = 36°
GLACIAL TILL :	UNIT WEIGHT 125 pcf	
	C' = O	Ø' = 37°

SEP 21 1990

REV	DATE	DESCRIPTION	DR BY	RVW BY

SCALE: AS SHOWN		PROJECT: INDUSTRI-PLEX SITE REMEDIAL TRUST WOBURN, MASSACHUSETTS
PROJECT No. 893-6255		
DES BY	RJI	09/13/90
DR BY	RDT	09/13/90
CHK BY	RJI	9/21/90
RVW BY	[illegible]	9/21/90
SHEET TITLE: GEOTECHNICAL CROSS SECTIONS EAST HIDE PILE		

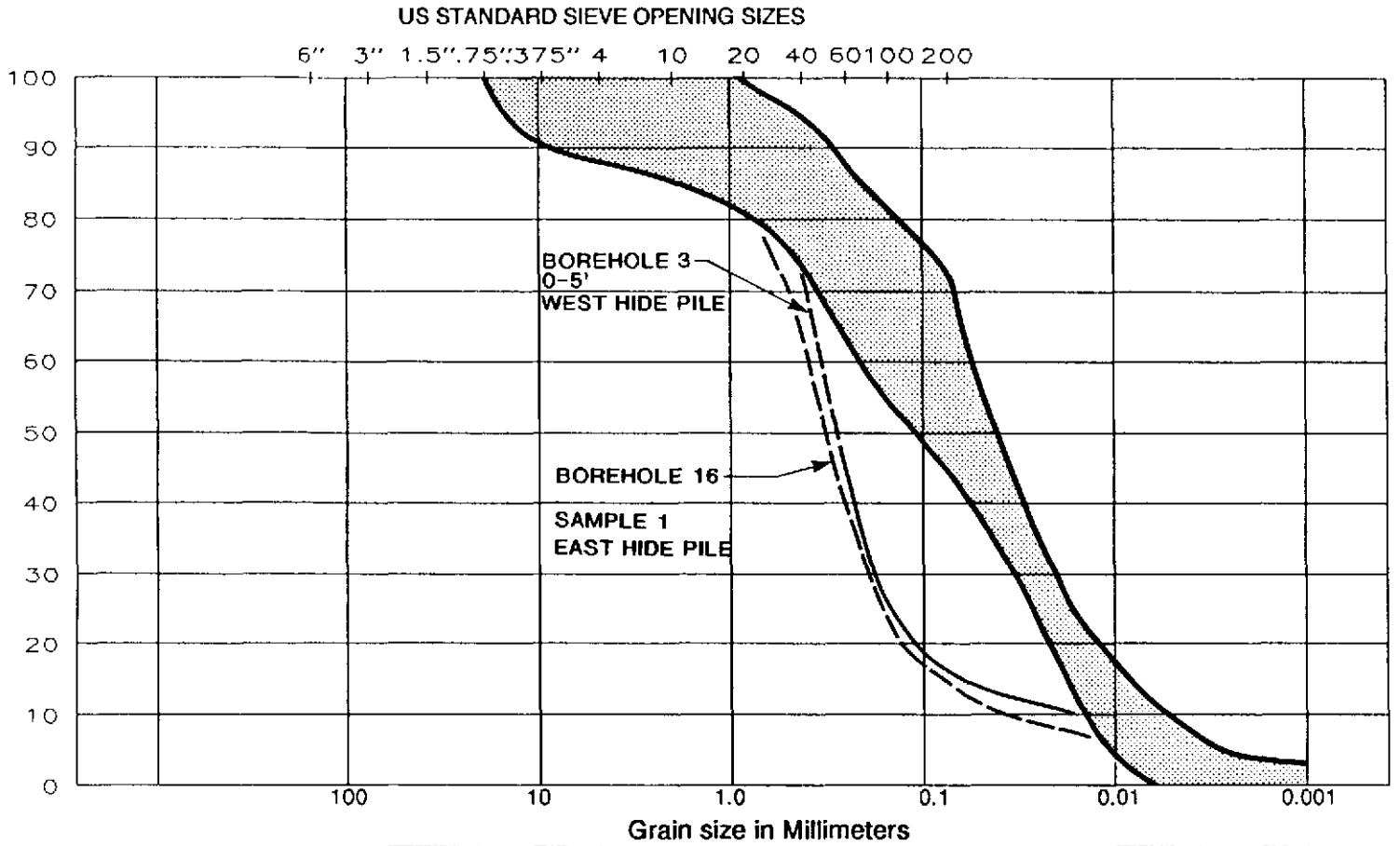
Golder Associates
Mt. Laurel, New Jersey

SHEET OF
DRAWING No. MA01-110

FIGURE 4

158696

PARTICLE SIZE DISTRIBUTION ASTM D-421 AND 422



COBBLES	GRAVEL coarse	GRAVEL fine	SAND c	SAND med	SAND fine	SILT	CLAY

SAMPLE ID	W%	LL	PL	PI	Other	DESCRIPTION
						SURFICIAL MATERIALS 1 SAMPLE EAST HIDE PILE 6 SAMPLES WEST HIDE PILE

Sample Type: Date Tested: USDA:

JOB No.:	893-6255
DRAWN:	TLF
CHECKED:	MAC
SCALE:	N/A
DATE:	09/14/90
DWG. No.:	MA01-148

Golder Associates

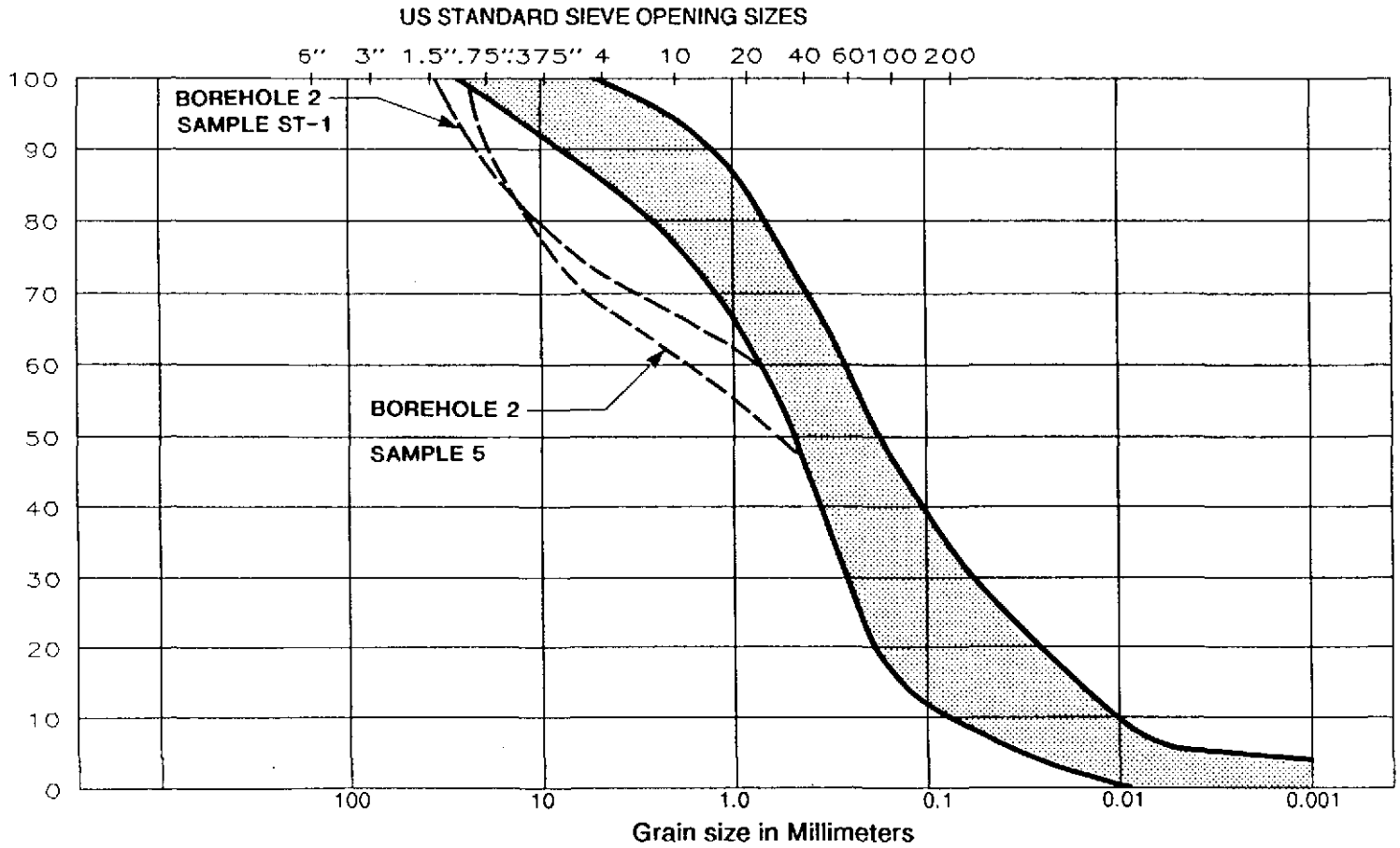
ISRT/WOBURN/MA

GRAIN SIZE ENVELOPE
SURFICIAL MATERIALS

FIGURE 5

158696

PARTICLE SIZE DISTRIBUTION ASTM D-421 AND 422



COBBLES	GRAVEL coarse	GRAVEL fine	SAND c	SAND med	SAND fine	SILT	CLAY

SAMPLE ID	W%	LL	PL	PI	Other	DESCRIPTION
						FILL AND HIDE RESIDUE 14 SAMPLES EAST HIDE PILE 6 SAMPLES WEST HIDE PILE

Sample Type: Date Tested: USDA:

Golder Associates

ISRT/WOBURN/MA

GRAIN SIZE ENVELOPE
FILL AND HIDE RESIDUE

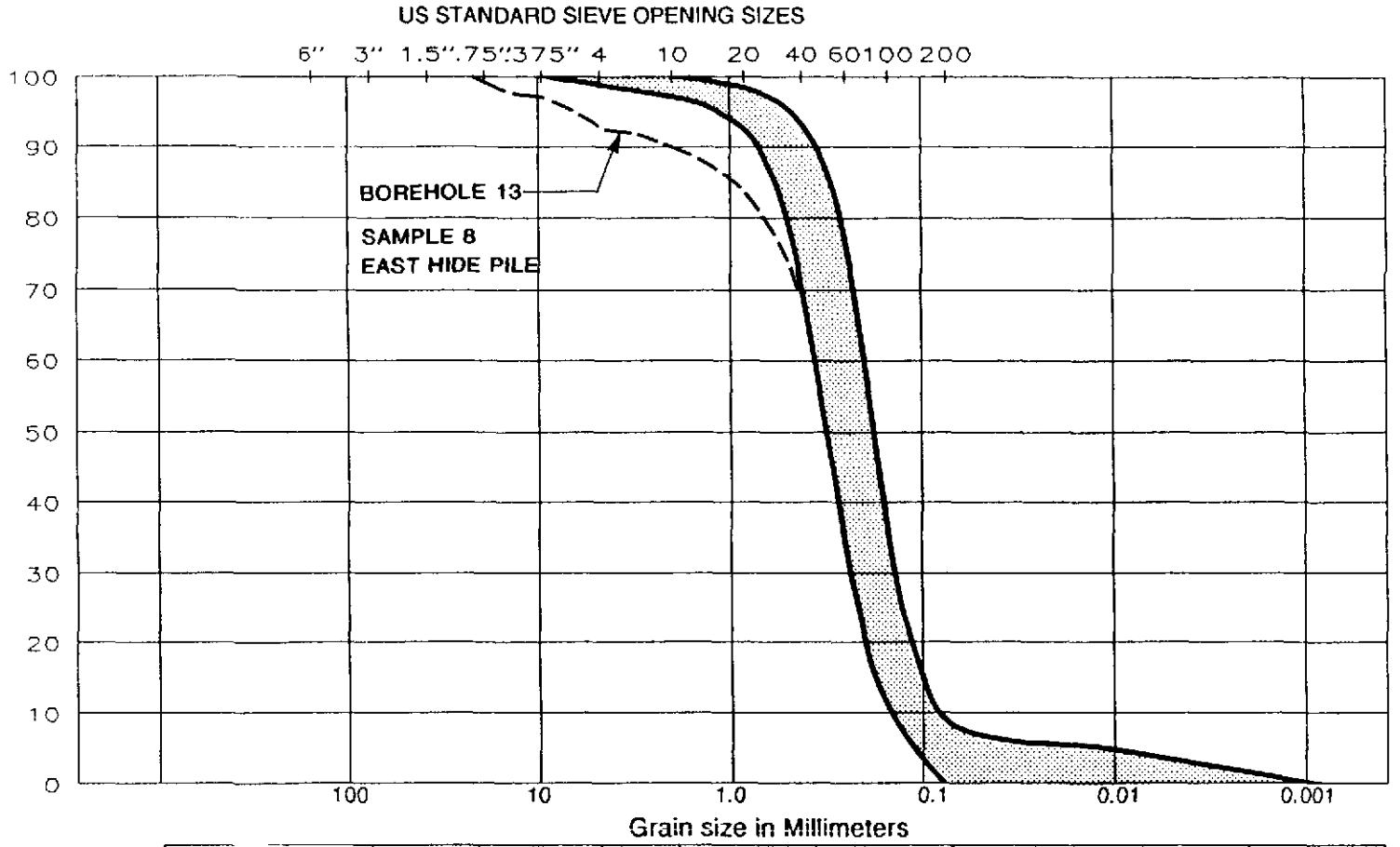
JOB No.:	DRAWN:	CHECKED:
893-6255	TLF	RAC

SCALE:	DATE:	DWG. No.:
N/A	09/14/90	MA01-149

FIGURE 6

158696

PARTICLE SIZE DISTRIBUTION ASTM D-421 AND 422



COBBLES	GRAVEL coarse	GRAVEL fine	SAND c	SAND med	SAND fine	SILT	CLAY

SAMPLE ID	W%	LL	PL	PI	Other	DESCRIPTION
						OUTWASH SAND 6 SAMPLES WEST HIDE PILE 1 SAMPLE EAST HIDE PILE

Sample Type: Date Tested: USDA:

JOB No.:	893-6255
DRAWN:	TLF
CHECKED:	RAC
SCALE:	N/A
DATE:	09/12/90
DWG. No.:	MA01-150

Golder Associates

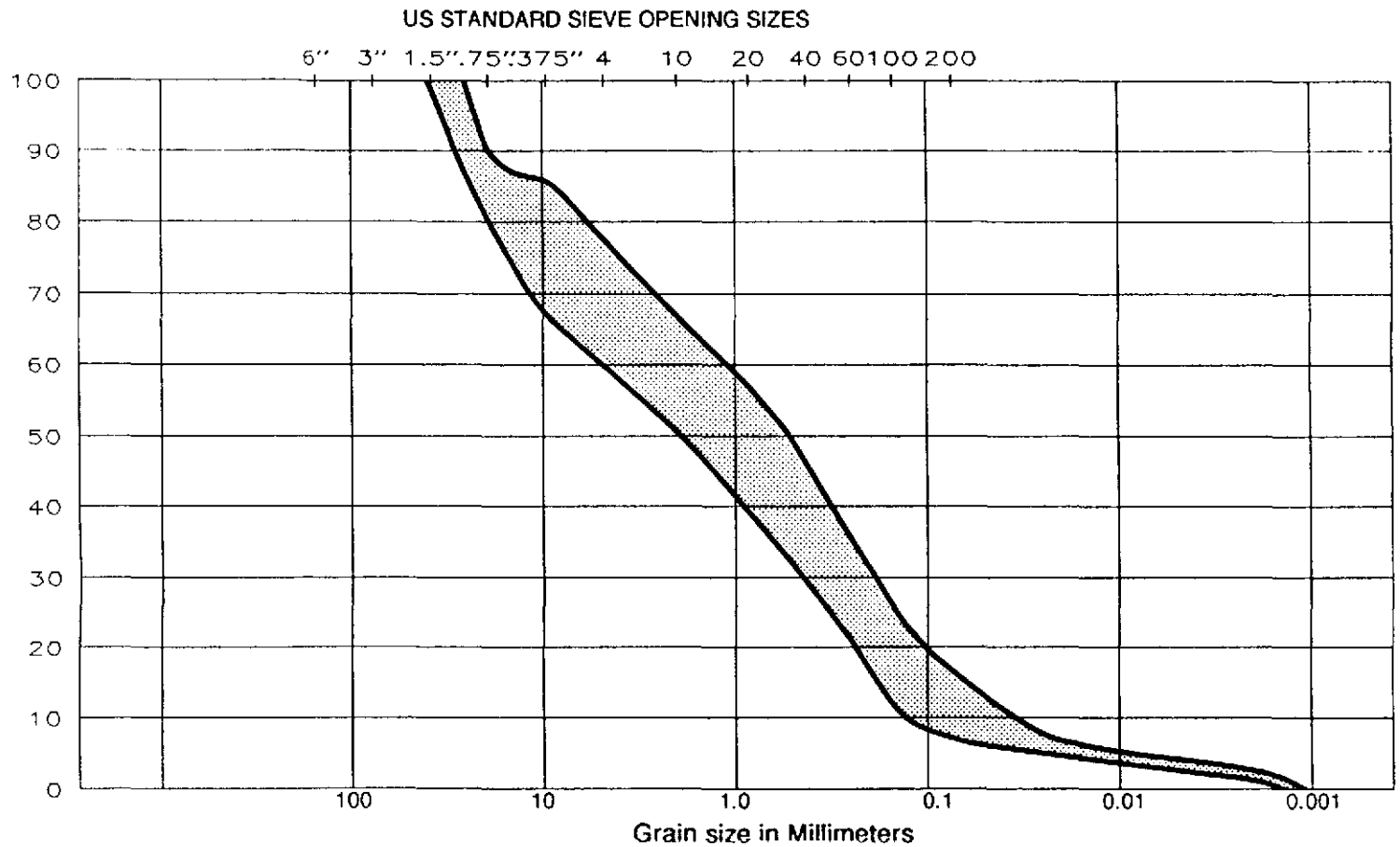
ISRT/WOBURN/MA

GRAIN SIZE ENVELOPE
OUTWASH SAND

FIGURE 7

158696

PARTICLE SIZE DISTRIBUTION ASTM D-421 AND 422



COBBLES	GRAVEL coarse	GRAVEL fine	SAND c	SAND med	SAND fine	SILT	CLAY

SAMPLE ID	W%	LL	PL	PI	Other	DESCRIPTION
						GLACIAL TILL 2 SAMPLES WEST HIDE PILE 1 SAMPLE EASTHIDE PILE

Sample Type: Date Tested: USDA:

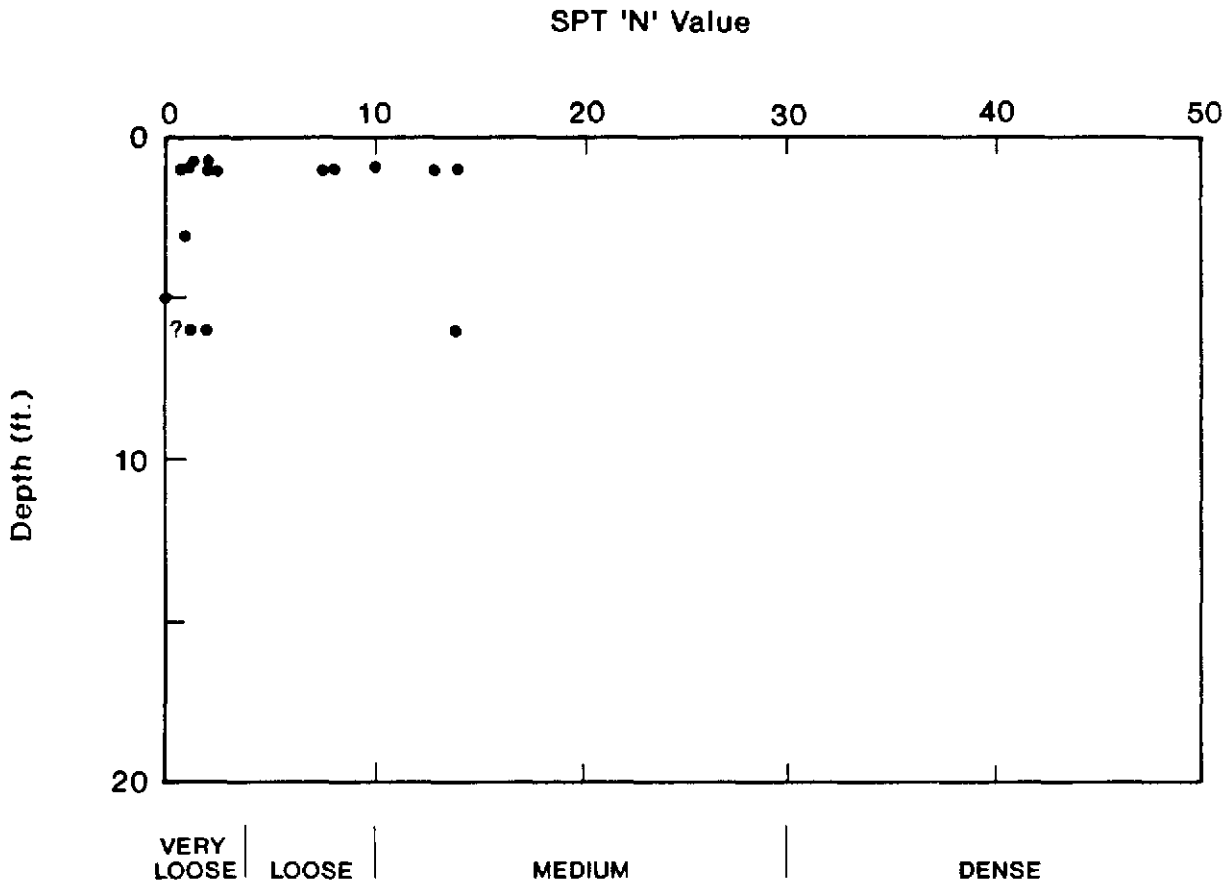
JOB No.:	893-6255
DRAWN:	TLF
CHECKED:	RAC
SCALE:	N/A
DATE:	09/14/90
DWG. No.:	MA01-151

Golder Associates

ISRT/WOBURN/MA

GRAIN SIZE ENVELOPE GLACIAL TILL

FIGURE 3



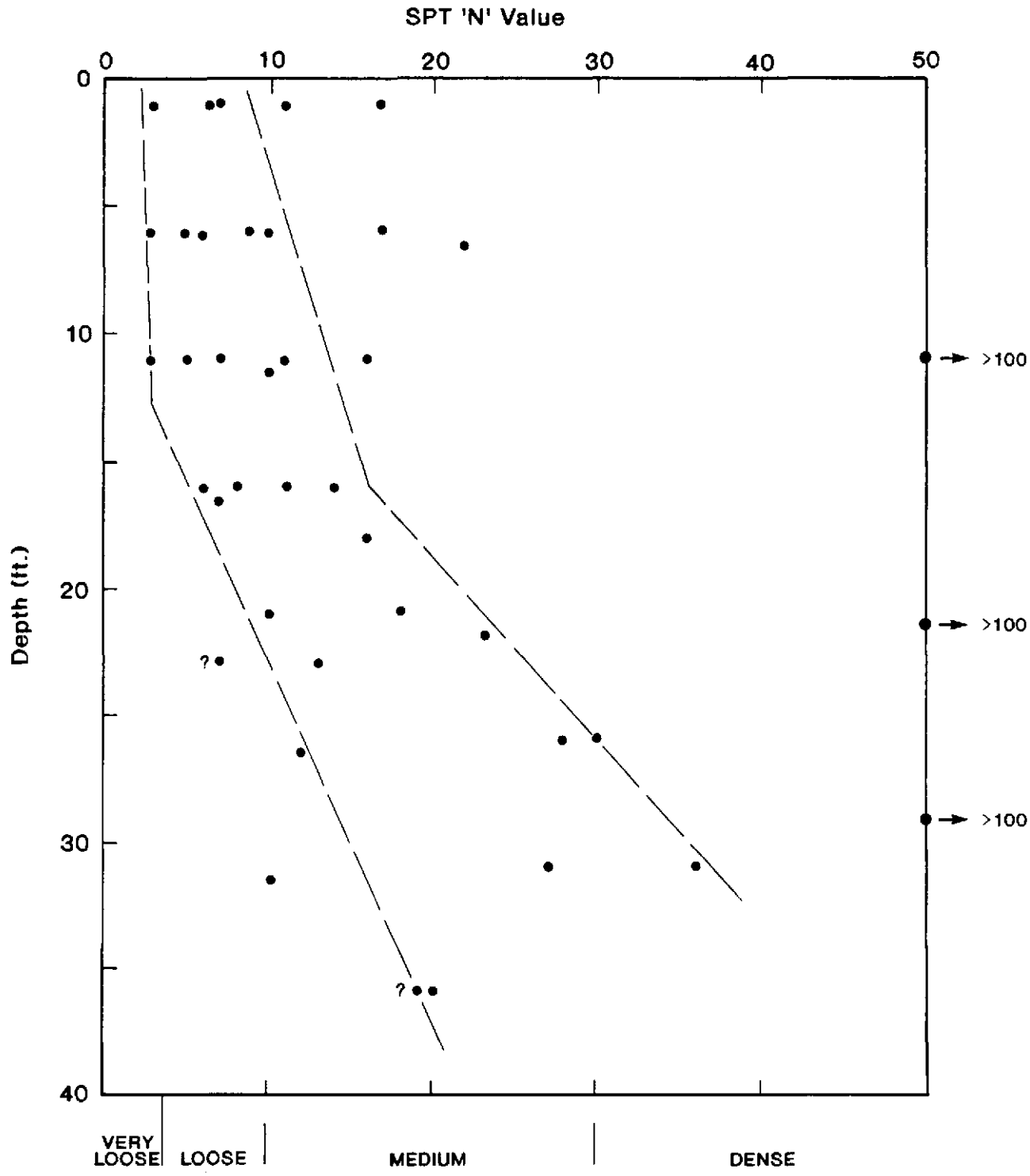
NOTES :

1.) ? RESULT POSSIBLY AFFECTED BY PIPING.

2.) 'N' VALUES NOT CORRECTED FOR DEPTH EFFECTS.

JOB No.: 893-6255	SCALE: AS SHOWN	**SPT 'N' VALUES : SURFICIAL MATERIALS**	
DRAWN: RDT	DATE: 09/12/90		
CHECKED: RAC	DWG. No.: MA01-152		
Golder Associates		ISRT/WOBURN/MA	FIGURE 9

158696



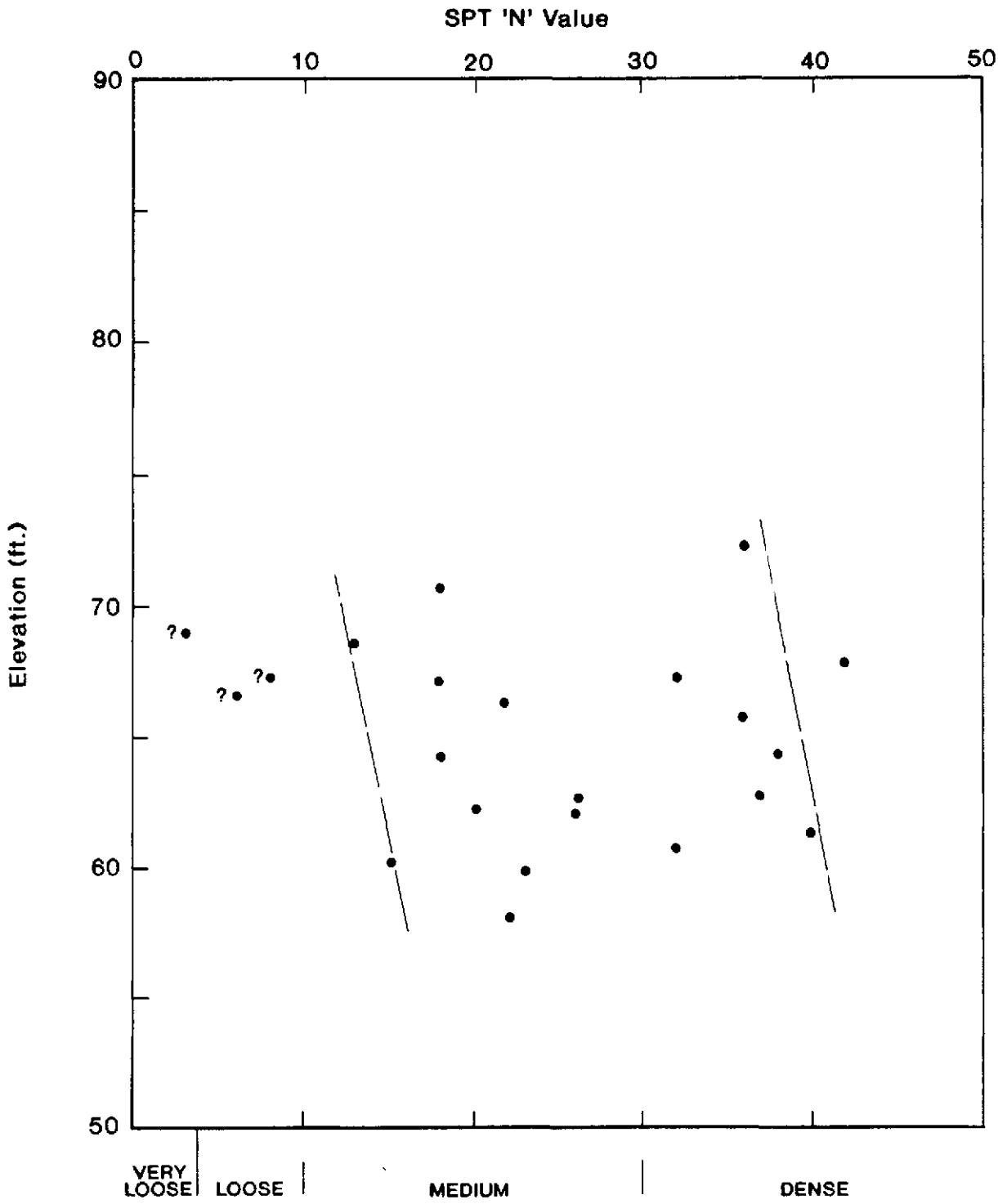
NOTES :

1.) ? RESULTS POSSIBLY AFFECTED BY PIPING.

2.) 'N' VALUES NOT CORRECTED FOR DEPTH EFFECTS.

JOB No.: 893-6255	SCALE: AS SHOWN	**SPT 'N' VALUES : FILL AND HIDE RESIDUE**	
DRAWN: RDT	DATE: 09/12/90		
CHECKED: RAC	DWG. No.: MA01-153		
Golder Associates		ISRT/WOBURN/MA	FIGURE **10**

158696



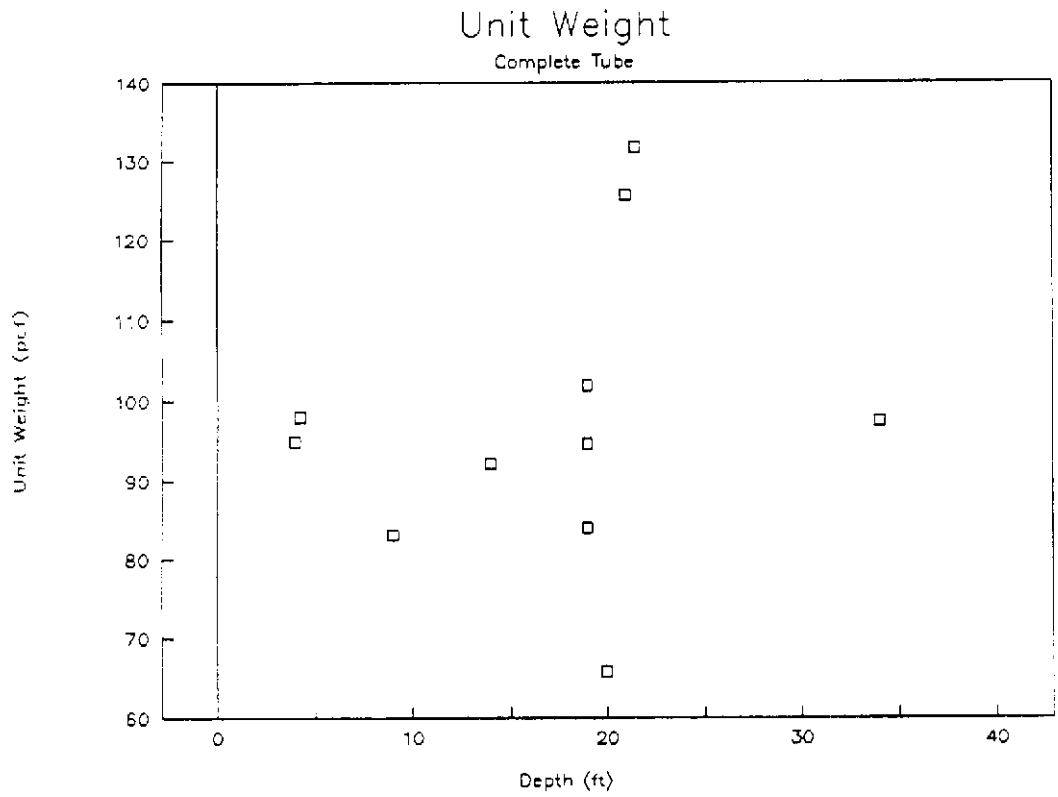
NOTES :

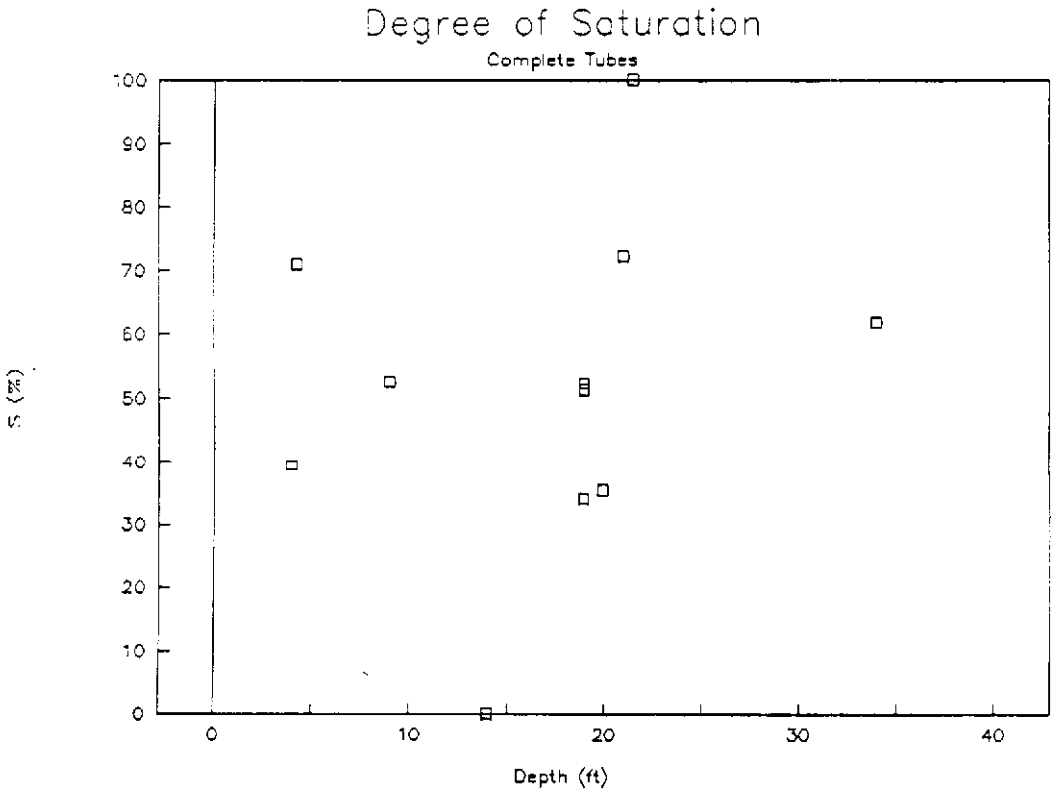
1.) ? RESULT POSSIBLY AFFECTED BY PIPING.

2.) 'N' VALUES NOT CORRECTED FOR DEPTH EFFECT

JOB No.: 893-6255	SCALE: AS SHOWN	**SPT 'N' VALUES : OUTWASH SAND**	
DRAWN: RDT	DATE: 09/12/90		
CHECKED: GAC	DWG. No.: MA01-154		
Golder Associates		ISRT/WOBURN/MA	FIGURE **11**

158696





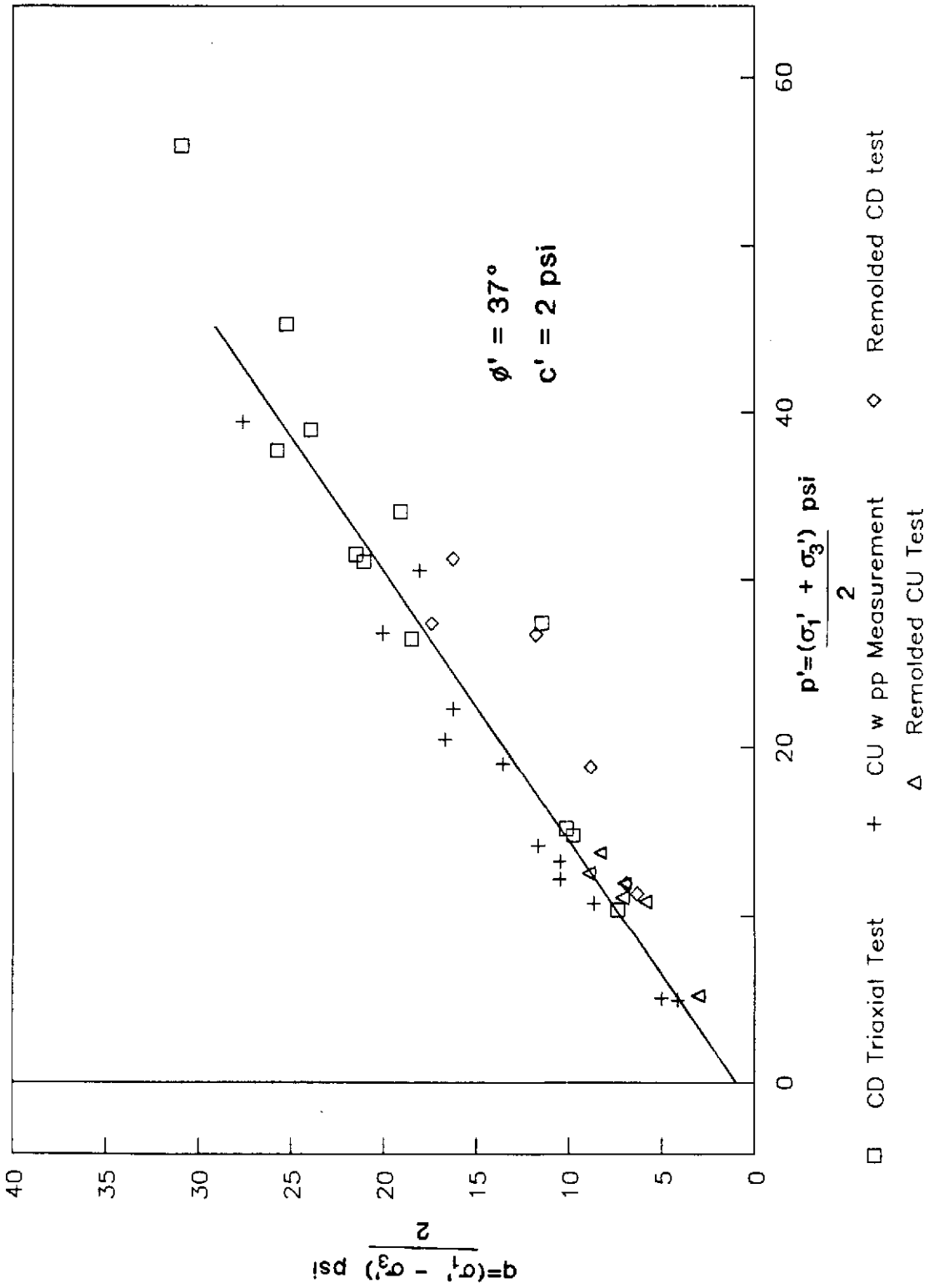
NOTES

1. UNIT WEIGHTS BASED ON SHELBY TUBE VOLUMES PRIOR TO EXTRUSION.

2. DEGREE OF SATURATION BASED ON AVERAGE MOISTURE CONTENTS AND MEASURED SPECIFIC GRAVITIES.

JOB No.: 893-6255	SCALE: AS SHOWN	UNIT WEIGHT AND DEGREE OF SATURATION FILL AND HIDE RESIDUE		
DRAWN: TLF	DATE: 09/12/90			
CHECKED: GAC	DWG. No.: MA01-155			
Golder Associates		ISRT/WOBURN/MA	FIGURE 12	

158696



JOB No.: 893-6255	SCALE: N/A	**SHEAR STRENGTH p'-q PLOT FILL AND HIDE RESIDUE**	
DRAWN: MRM	DATE: 09/14/90		
CHECKED: GAC	DWG. No.: MAO1-156		
Golder Associates		ISRT/WOBURN/MA	FIGURE 13

158896

APPENDIX A

Borehole Logs

Task S-2 Borehole Logs

Unified Soil Classification System

Criteria for Assigning Group Symbols and Names			Soil Classification Generalized Group Descriptions	
COARSE-GRAINED SOILS More than 50% retained on No. 200 sieve	GRAVELS More than 50% of coarse fraction retained on No. 4 Sieve	CLEAN GRAVELS Less than 5% fines	GW	Well-graded Gravels
			GP	Poorly-graded gravels
		GRAVELS WITH FINES More than 12% fines	GM	Gravel and Silt Mixtures
			GC	Gravel and Clay Mixtures
	SANDS 50% or more of coarse fraction passes No. 4 Sieve	CLEAN SANDS Less than 5% fines	SW	Well-graded Sands
			SP	Poorly-graded Sands
		SANDS WITH FINES More than 12% fines	SM	Sand and Silt Mixtures
			SC	Sand and Clay Mixtures
FINE-GRAINED SOILS 50% or more passes the No. 200 sieve	SILTS AND CLAYS Liquid limit less than 50	INORGANIC	CL	Low-plasticity Clays
			ML	Non-plastic and Low-Plasticity Silts
		ORGANIC	OL	Non-plastic and Low-Plasticity Organic Clays Non-plastic and Low-Plasticity Organic Silts
	SILTS AND CLAYS Liquid limit greater than 50	INORGANIC	CH	High-plasticity Clays
			MH	High-plasticity Silts
		ORGANIC	OH	High-plasticity Organic Clays High-plasticity Organic Silts
HIGHLY ORGANIC SOILS	Primarily organic matter, dark in color, and organic odor		PT	Peat

Component Definitions by Gradation

Component	Size Range
Boulders	Above 12 in.
Cobbles	3 in. to 12 in.
Gravel	3 in. to No. 4 (4.76mm)
Coarse gravel	3 in. to 3/4 in.
Fine gravel	3/4 in. to No. 4 (4.76mm)
Sand	No. 4 (4.76mm) to No. 200 (0.074mm)
Coarse sand	No 4 (4.76mm) to No. 10 (2.0mm)
Medium sand	No. 10 (2.0mm) to No. 40 (0.42mm)
Fine sand	No. 40 (0.42mm) to No. 200 (0.074mm)
Silt and Clay	Smaller than No. 200 (0.074mm)

Samples

SS	SPT Sampler (2.0" OD)
HD	Heavy Duty Split Spoon
SH	Shelby Tube
P	Pitcher Sampler
B	Bulk
C	Cored

Unless otherwise noted, drive samples advanced with 140 lb. hammer with 30 in. drop.

Relative Density or Consistency Utilizing Standard Penetration Test Values

Cohesionless Soils (a)			Cohesive Soils (b)		
Density (c)	N, blows/ft. (c)	Relative Density (%)	Consistency	N, blows/ft. (c)	Undrained Shear Strength (d) (psf)
Very loose	0 to 4	0 – 15	Very soft	0 to 2	<250
Loose	4 to 10	15 – 35	Soft	2 to 4	250–500
Compact	10 to 30	35 – 65	Firm	4 to 8	500–1000
Dense	30 to 50	65 – 85	Stiff	8 to 15	1000–2000
Very Dense	over 50	>85	Very Stiff	15 to 30	2000–4000
			Hard	over 30	>4000

(a) Soils consisting of gravel, sand, and silt, either separately or in combination, possessing no characteristics of plasticity, and exhibiting drained behavior.

(b) Soils possessing the characteristics of plasticity, and exhibiting undrained behavior.

(c) Refer to text of ASTM D 1586-84 for a definition of N; in normally consolidated cohesionless soils Relative Density terms are based on N values corrected for overburden pressures.

(d) Undrained shear strength = 1/2 unconfined compression strength.

Laboratory Tests

Test	Designation
Moisture	(1)
Density	D
Grain Size	G
Hydrometer	H
Atterberg Limits	(1)
Consolidation	C
Unconfined	U
UU Triax	UU
CU Triax	CU
CD Triax	CD
Permeability	P

(1) Moisture and Atterberg Limits plotted on log.

Descriptive Terminology Denoting Component Proportions

Descriptive Terms	Range of Proportion
Trace	0–5%
Little	5–12%
Some or Adjective (a)	12–30%
And	30–50%

(a) Use Gravelly, Sandy or Silty as appropriate.

Silt and Clay Descriptions

Description	Typical Unified Designation
Silt	ML (non-plastic)
Clayey Silt	CL–ML (low plasticity)
Silty Clay	CL
Clay	CH
Plastic Silt	MH
Organic Soils	OL, OH, Pt

Golder Associates

SOIL CLASSIFICATION/LEGEND

PROJECT: INDUSTRI-PLEX

PROJECT LOCATION: WOBURN

PROJECT NUMBER: 893-6255

RECORD OF BOREHOLE 1

BORING DATE: 04/23/90

BORING LOCATION: N: 554,712
E: 695,655

SHEET: 1 OF 1

DATUM: MSL

DEPTH SCALE FEET	BORING METHOD	SOIL PROFILE DESCRIPTION	USCS	GRAPHIC LOG	ELEV / DEPTH	SAMPLES NUMBER	TYPE	BLOWS / 6 in	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT ■ (10 20 30 40 50 60 70 80 90) / WATER CONTENT, PERCENT Wp W Wl (10 20 30 40 50 60 70 80 90)	PIEZOMETER OR STANDPIPE INSTALLATION
0					82.30							
		0.00-5.0 ft. Loose, moderate brown to yellowish-orange, SILT and m-f SAND, few roots, some pockets of white clayey silt, (SM-ML). FILL.	SM-ML		0.00	1	DO	2,4,4,6	8	45		
5					87.30							
		5.0-23.7 ft. Loose to compact, black, m-f SAND, little to some silt, few hairs, occasional micas, some roots (SP-SM). FILL AND HIDE RESIDUE.	SP-SM		5.00	2	DO	10,13,9,9	22	30		
10						3	DO	5,8,8,9	16	80		
						ST-1	TO	SHELBY TUBE		100		
15						4	DO	2,3,3,4	6	85		
20						ST-2	TO	SHELBY TUBE		100		
						5	DO	4,3,4,7	7	95		
					68.60							
		23.7-32.0 ft. Compact becoming dense, black becoming olive-gray, f-SAND, little silt, few micas (SP). OUTWASH SAND. Water encountered at approximately 23.7 ft.	SP		23.70	6	DO	6,9,13,18	22	90		
30						7	DO	13,20,20,30	40	100		
					60.30							
		BOREHOLE TERMINATED AT 32.0 FT. BELOW GROUND SURFACE.			32.00							
35												
40												

DRILL RIG: Mobile B-57 ATV

DRILLING CONTRACTOR: Geologic

DRILLER: T. Paquette

Golder Associates

LOGGED: RJI

CHECKED: JEW

DATE: 05/29/90

PROJECT: INDUSTRI-PLEX

PROJECT LOCATION: WOBURN

PROJECT NUMBER: 893-6255

RECORD OF BOREHOLE 2

BORING DATE: 04/22/90

BORING LOCATION: N: 554,550
E: 695,759

SHEET: 1 OF 1

DATUM: MSL

DEPTH SCALE FEET	BORING METHOD	SOIL PROFILE DESCRIPTION	USCS	GRAPHIC LOG	ELEV / DEPTH	SAMPLES NUMBER	TYPE	BLOWS / 6 in	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT ■ (10 20 30 40 50 60 70 80 90) / WATER CONTENT, PERCENT Wp W Wl (10 20 30 40 50 60 70 80 90)	PIEZOMETER OR STANDPIPE INSTALLATION
					93.20							
0		0.00-7.5 ft. Firm to very dense, moderate brown to dark gray, SILT, some f-sand, slight organic odor. Frequent pockets of white clayey silt, roots present, (ML). FILL	ML		0.00	1	DO	1,6,7,10	13	100		
5						2	DO	10,26,28,28	54	100		
					85.70							
		7.5-25.8 ft. Loose to compact, black, f-m SAND, some silt, hair and hair clumps, occasional roots, frequent pockets of white clayey silt, few micas, (SM). FILL AND HIDE RESIDUE. Water at approximately 24.8 ft. at completion of drilling.	SM		7.50	ST-1	TO	SHELBY TUBE		65		
10						3	DO	5,2,5,8	7	75		
15						4	DO	4,3,8,5	11	40		
20						ST-2	TO	SHELBY TUBE		85		
						5	DO	4,15,8,9	23	65		
25					67.40							
		25.8-32.0 ft. Loose becoming very dense, black to light olive gray, m-f SAND, trace silt, few roots (SP). OUTWASH SAND.	SP		25.80	6	DO	3,5,3,3	8	100		
						ST-3	TO	SHELBY TUBE		100		
30						7	DO	10,19,32,48	51	100		
					61.20							
		BORING TERMINATED AT 32 FT. BELOW GROUND SURFACE.			32.00							
35												
40												

DRILL RIG: Mobile B-57 ATV

DRILLING CONTRACTOR: Geologic

DRILLER: T. Paquette

Golder Associates

LOGGED: RJI

CHECKED: JEW

DATE: 05/29/90

PROJECT: INDUSTRI-PLEX

PROJECT LOCATION: WOBURN

PROJECT NUMBER: 893-6255

RECORD OF BOREHOLE 3

BORING DATE: 04/24/90

BORING LOCATION: N: 554,825
E: 696,610

SHEET: 1 OF 1

DATUM: MSL

DEPTH SCALE FEET	BORING METHOD	SOIL PROFILE DESCRIPTION	USCS	GRAPHIC LOG	ELEV / DEPTH	SAMPLES NUMBER	TYPE	BLOWS / 6 in	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT ■ (10 20 30 40 50 60 70 80 90) / WATER CONTENT, PERCENT (Wp ○W Wl)	PIEZOMETER OR STANDPIPE INSTALLATION
					73.10							
0		0.0-5.0 ft. Very soft, reddish brown with pockets of black, SILT, and m-f SAND, increasing with depth, frequent roots, organic odor, possible hairs, (ML).	ML		0.00	1	DO	1,1,1,2	2	100		
						ST-1	TO	SHELBY TUBE		20		
5		5.0-11.0 ft. Compact, olive gray, m-f SAND, little silt, (SP-SM). OUTWASH SAND. Water encountered at approximately 5.0 ft.	SP-SM		68.10 5.00	2	DO	1,7,11,15	18	100		
10					62.10	3	DO	12,21,31,41	52	70		
		11.0-14.2 ft. Very dense, olive to medium gray, m-f SAND and c-f GRAVEL, little silt, (SP-SM). GLACIAL TILL.	SP-SM		11.00	4	DO	60,65,100	165	53		
15		BORING TERMINATED AT 14.2 FT. BELOW GROUND SURFACE.			58.90 14.20							
20												
25												
30												
35												
40												

NOTES:
1.) Recovered shelby tube sample placed in jar.

DRILL RIG: Mobile B-57 ATV

DRILLING CONTRACTOR: Geologic

DRILLER: T. Paquette

Golder Associates

LOGGED: RJI

CHECKED: JEW

DATE: 05/29/90

PROJECT: INDUSTRI-PLEX

PROJECT LOCATION: WOBURN

PROJECT NUMBER: 893-6255

RECORD OF BOREHOLE 4

BORING DATE: 04/23/90

BORING LOCATION: N: 554,804
E: 695,688

SHEET: 1 OF 1

DATUM: MSL

DEPTH SCALE FEET	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 6 in	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT ■ (10 20 30 40 50 60 70 80 90) / WATER CONTENT, PERCENT (Wp ○ W Wl, 10 20 30 40 50 60 70 80 90)	PIEZOMETER OR STANDPIPE INSTALLATION
0					73.30							
		0.0-3.5 ft. Very soft, moderate brown, CLAYEY SILT, some f-sand, few roots, (ML). PROBABLE FILL. Boulder from 2.0 to 3.0 ft.	ML		0.00	1	DO	1,0,1,0	1	95		
					69.80							
		3.5-7.5 ft. Very loose, black with brown pockets, f-SAND, some silt, wet, possible hairs and root mass from 6.6-7.0 ft. (SM). PROBABLE FILL. Water encountered at approximately 5.0 ft.	SM		3.50	2	DO	3,1,1,1	2	100		
					65.80							
		7.5-12.0 ft. Compact, light olive gray, m-f SAND, little silt, quartz and micas, wet, (SP-SM). OUTWASH SAND.	SP-SM		7.50	3	DO	11,14,12,14	26	85		
					61.30							
		BORING TERMINATED AT 12.0 FT. BELOW GROUND SURFACE.			12.00							

DRILL RIG: Mobile B-57 ATV

DRILLING CONTRACTOR: Geologic

DRILLER: T. Paquette

Golder Associates

LOGGED: RJI

CHECKED: JEW

DATE: 05/29/90

PROJECT: INDUSTRI-PLEX

PROJECT LOCATION: WOBURN

PROJECT NUMBER: 893-6255

RECORD OF BOREHOLE 5

BORING DATE: 05/25/90

BORING LOCATION: N: 554,743
E: 695,734

SHEET: 1 OF 1

DATUM: MSL

DEPTH SCALE FEET	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 6 in	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT ■ (10 20 30 40 50 60 70 80 90) / WATER CONTENT, PERCENT (Wp, W, Wl)	PIEZOMETER OR STANDPIPE INSTALLATION
					73.80							
0		0.0-7.5 ft. Very soft, dark reddish-brown to dark gray, SILT, and f-SAND, slight organic odor, (ML). Water encountered at approximately 3.0 ft.	ML		0.00	1	DO	1,0,2,4	2	65		
						ST-1	TO	SHELBY TUBE		50		
5						2	DO	1,0,1,1	1	70		
					66.30							
		7.5-12.0 ft. Compact, medium-gray, m-f SAND, little silt, slight H2S odor, possible hairs in zone from10.5-10.6 ft., (SP). OUTWASH SAND.	SP		7.50							
10						3	DO	8,12,14,16	26	100		
					61.80							
		BORING TERMINATED AT 12.0 FT. BELOW GROUND SURFACE.			12.00							
15		NOTES: 1.) Odor in sample at 5.0-7.0 ft. and 10.0-12.0 FT. 2.) HNu readings up to 22ppm and OVA readings up to 100ppm. 3.) Recovered shelby tube sample placed in jar.										
20												
25												
30												
35												
40												

DRILL RIG: Mobile B-57 ATV

DRILLING CONTRACTOR: Geologic

DRILLER: T. Paquette

Golder Associates

LOGGED: RJI

CHECKED: JEW

DATE: 05/31/90

PROJECT: INDUSTRI-PLEX

PROJECT LOCATION: WOBURN

PROJECT NUMBER: 893-6255

RECORD OF BOREHOLE 6 (OW-31)

BORING DATE: 05/24/90

BORING LOCATION. N: 554,645
E: 695,795

SHEET: 1 OF 1

DATUM: MSL

DEPTH SCALE FEET	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 6 in	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT ■ (10 20 30 40 50 60 70 80 90) / WATER CONTENT, PERCENT (Wp, W, Wl; 10 20 30 40 50 60 70 80 90)	PIEZOMETER OR STANDPIPE INSTALLATION
0					71.30 / 0.00							
		0.0-6.0 ft. Very soft, dark gray, CLAYEY SILT, some f-sand, slight organic odor, possible hairs at 0.0-2.0 ft., (ML to OL). Water encountered at approximately 2.0 ft.	ML to OL			1	DO	1,0,1,0	1	45		
						2	DO	1,0,1,0	1	50		
5						3	DO	1,0,0,0	0	0		
					65.30 / 6.00							
		6.0-14.0 ft. Compact, olive to medium gray, m-f SAND, little silt, (SP-SM). OUTWASH SAND.	SP-SM			4	DO	5,7,11,13	18	70		
						5	DO	4,9,11,12	20	65		
10						6	DO	3,7,8,11	15	65		
						7	DO	7,10,12,15	22	50		
					57.30 / 14.00							
15		BORING TERMINATED AT 14.0 FT. BELOW GROUND SURFACE.										
20												
25												
30												
35												
40												

DRILL RIG: Mobile B-57 ATV

DRILLING CONTRACTOR: Geologic

DRILLER: T. Paquette

Golder Associates

LOGGED: RJI

CHECKED: JEW

DATE: 05/31/90

PROJECT: INDUSTRI-PLEX

PROJECT LOCATION: WOBURN

PROJECT NUMBER: 893-6255

RECORD OF BOREHOLE 7

BORING DATE: 04/25/90

BORING LOCATION: N: 554,431
E: 695,882

SHEET: 1 OF 1

DATUM: MSL

DEPTH SCALE FEET	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 6 in	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT ■ (10 20 30 40 50 60 70 80 90) / WATER CONTENT, PERCENT (Wp W Wl)	PIEZOMETER OR STANDPIPE INSTALLATION
0					70.80							
		0.0-6.5 ft. Compact, medium gray to medium brown, c-f SAND, some f-gravel, little clayey silt, some roots, few pieces of red brick, (SW). FILL. Water encountered at approximately 1.2 ft. Difficult drilling at 0.0-5.0 ft.	SW		0.00	1	DO	3,4,6,6	10	40		
5					64.30	2	DO	7,8,6,1	14	20		
		6.5-7.5 ft. Very soft, black, CLAYEY SILT, some m-f sand, organic odor, (ML).	ML		6.50 / 63.30							
		7.5-12.5 ft. Compact, medium gray becoming grayish orange, m-f SAND, trace silt, trace f-gravel, (SP). OUTWASH SAND.	SP		7.50	3	DO	5,7,16	23	80		
					58.30							
		12.5-17.0 ft. Very dense, olive gray, c-f SAND and c-f GRAVEL, little silt, (SW), GLACIAL TILL.	SW		12.50	4	DO	26,26,32,36	58	75		
					53.80							
		BORING TERMINATED AT 17.0 FT. BELOW GROUND SURFACE.			17.00							
10												
15												
20												
25												
30												
35												
40												

DRILL RIG: Mobile B-57 ATV

DRILLING CONTRACTOR: Geologic

DRILLER: T. Paquette

Golder Associates

LOGGED: RJI

CHECKED: JEW

DATE: 05/29/90

PROJECT: INDUSTRI-PLEX

PROJECT LOCATION: WOBURN

PROJECT NUMBER: 893-6255

RECORD OF BOREHOLE 8

BORING DATE: 04/24/90

BORING LOCATION: N: 554,330
E: 695,762

SHEET: 1 OF 1

DATUM: MSL

DEPTH SCALE FEET	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 6 in	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT ■ (10 20 30 40 50 60 70 80 90) / WATER CONTENT, PERCENT Wp ○W Wl (10 20 30 40 50 60 70 80 90)	PIEZOMETER OR STANDPIPE INSTALLATION
0					71.00							
		0.0-4.0 ft. Very soft, reddish brown to black, CLAYEY SILT, some f-sand, few roots, (ML to CL). Water encountered at approximately 3.5 ft.	ML to CL		0.00	1	DO	0,1,1,4	2	75		
					67.00							
5		4.0-8.4 ft. Dense, moderately brown to yellowish orange, m-f SAND, trace silt, (SP). OUTWASH SAND.	SP		4.00	2	DO	N/A		75		
						3	DO	1,14,24,22	38	100		
					62.60	4	DO	100/0	100	0		
		AUGER REFUSAL AT 8.4 FT. BELOW GROUND SURFACE.			8.40							
10		NOTES: 1.) A shelby tube was attempted from 3.50-5.50 ft. No recovery was obtained. A split spoon was then driven in this interval. 2.) A second shelby tube attempted from 1.0-3.0 ft. by moving rig up after completion of borehole. No recovery was obtained.										
15												
20												
25												
30												
35												
40												

DRILL RIG: Mobile B-57 ATV

DRILLING CONTRACTOR: Geologic

DRILLER: T. Paquette

Golder Associates

LOGGED: RJI

CHECKED: JEW

DATE: 05/29/90

PROJECT: INDUSTRI-PLEX

PROJECT LOCATION: WOBURN

PROJECT NUMBER: 893-6255

RECORD OF BOREHOLE 9

BORING DATE: 04/19/90

BORING LOCATION: N: 554,629
E: 696,148

SHEET: 1 OF 1

DATUM: MSL

DEPTH SCALE FEET	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 6 in	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT ■ (10 20 30 40 50 60 70 80 90) / WATER CONTENT, PERCENT (Wp W Wl)	PIEZOMETER OR STANDPIPE INSTALLATION
					103.70							
0		0.0-34.0 ft. Loose to compact, black, m-f SAND, some silt, little c-f gravel, hair and hair clumps, occasional wood fragments, few micas, (SM). FILL AND HIDE RESIDUE. Soil moist to wet throughout drilling.			0.00	1	DO	2,3,4,3	7	75		
5						2	DO	1,0,6,2	6	55		
						ST-1	TO	SHELBY TUBE		0		
10						3	DO	4,2,3,4	5	15		
15			SM			4	DO	2,4,4,3	8	35		
						ST-2	TO	SHELBY TUBE		63		
20						5	DO	12,9,11,11	18	20		
25						6	DO	31,15,15,16	30	80		
30						7	DO	10,22,38	60	93		
					69.70							
35		34.0-40.0 ft. Very dense, black, f-SAND, little silt, few micas, wet, (SP-SM). OUTWASH SAND. Water encountered at approximately 35.5 ft. after completion of drilling.	SP-SM		34.00	8	DO	10,22,40,58	62	75		
40		BORING TERMINATED AT 40.0 FT. BELOW GROUND SURFACE.				9	DO	50/1"	100	0		

DRILL RIG: Mobile B-57 ATV

DRILLING CONTRACTOR: Geologic

DRILLER: T. Paquette

Golder Associates

LOGGED: RJI

CHECKED: JEW

DATE: 05/29/90

PROJECT: INDUSTRI-PLEX

PROJECT LOCATION: WOBURN

PROJECT NUMBER: 893-6255

RECORD OF BOREHOLE 10

BORING DATE: 04/17/90

BORING LOCATION: N: 554,619
E: 696,372

SHEET: 1 OF 1

DATUM: MSL

DEPTH SCALE FEET	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 6 in	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT ■ (10 20 30 40 50 60 70 80 90) / WATER CONTENT, PERCENT (Wp ○W Wl)	PIEZOMETER OR STANDPIPE INSTALLATION
					107.20							
0		0.0-38.5 ft. Compact, black, m-f SAND, some silt, little f- gravel, moist, hair and hair clumps, occasional wood fragment and fiber, few micas, (SM). FILL AND HIDE RESIDUE. Water encountered at approximately 37.30 ft.			0.00	1	DO	1,2,9,10	11	75		
						ST-1	TO	SHELBY TUBE		25		
5						2	DO	3,2,3,3	5	40		
						ST-2	TO	SHELBY TUBE		25		
10						3	DO	9,4,7,9	11	0		
15						ST-3	TO	SHELBY TUBE		92		
						4	DO	10,7,9,30	16	35		
20			SM									
						5	DO	9,6,7,7	13	30		
25		NOTES: 1.) Recovered shelby tube samples in TO-1 and TO-2 placed in jar.				6	DO	60,108/5"	>100	0		
30						7	DO	13,18,18,20	36	85		
						ST-4	TO	SHELBY TUBE		100		
35						8	DO	5,9,11,14	20	100		
		38.5-40.5 ft. Very dense, black to grayish green, c-f SAND, some silty clay, some f-gravel, wet, (SC). GLACIAL TILL.			68.70							
		BORING TERMINATED AT 40.5 FT. BELOW GROUND SURFACE.	SC		38.50	9	DO	100/1"	>100	100		
40												

DRILL RIG: Mobile B-57 ATV

DRILLING CONTRACTOR: Geologic

DRILLER: T. Paquette

LOGGED: RJI

CHECKED: JEW

DATE: 05/29/90

Golder Associates

PROJECT: INDUSTRI-PLEX

PROJECT LOCATION: WOBURN

PROJECT NUMBER: 893-6255

RECORD OF BOREHOLE 11

BORING DATE: 04/20/90

BORING LOCATION: N: 554,811
E: 696,177

SHEET: 1 OF 1

DATUM: MSL

DEPTH SCALE FEET	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 6 in	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT ■ (10 20 30 40 50 60 70 80 90) / WATER CONTENT, PERCENT (Wp, W, Wl)	PIEZOMETER OR STANDPIPE INSTALLATION
					85.00							
0		0.0-16.0 ft. Very loose, black, m-f SAND and SILT, hair and hair clumps, few micas, (SM). FILL AND HIDE RESIDUE.	SM		0.00	1	DO	1,4,3,3	7	40		
						ST-1	TO	SHELBY TUBE		75		
5						2	DO	1,1,2,3	3	65		
10						3	DO	3,1,2,2	3	85		
15					69.00	4	DO	0,1,2,2	3	75		
		16.0-22.0 ft. Very dense, black, m-f SAND, trace silt, few micas, (SP-SM). OUTWASH SAND. Water encountered at approximately 16.50 ft.	SP-SM		16.00							
20						5	DO	14,27,40,35	67	75		
					63.00							
		BORING TERMINATED AT 22.0 FT. BELOW GROUND SURFACE.			22.00							
25												
30												
35												
40												

DRILL RIG: Mobile B-57 ATV

DRILLING CONTRACTOR: Geologic

DRILLER: T. Paquette

Golder Associates

LOGGED: RJI

CHECKED: JEW

DATE: 05/29/90

PROJECT: INDUSTRI-PLEX

PROJECT LOCATION: WOBURN

PROJECT NUMBER: 893-6255

RECORD OF BOREHOLE 12

BORING DATE: 05/25/90

BORING LOCATION: N: 554,627
E: 696,263

SHEET: 1 OF 1

DATUM: MSL

DEPTH SCALE FEET	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 6 in	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT ■ (10 20 30 40 50 60 70 80 90) / WATER CONTENT, PERCENT (Wp W Wl)	PIEZOMETER OR STANDPIPE INSTALLATION
					108.10							
0		0.0-2.5 ft. Compact, moderate to dusky brown, f-SAND, some silt, few roots, possible hairs, (SM). FILL.	SM		0.00	1	DO	2,5,9,5	14	70	■	
					105.60							
		2.5-36.9 ft. Compact, black with occasional light-gray patches, m-f SAND, little to some silt to clayey silt, hair and hair clumps, few micas, occasional clumps of root mass, (SM to SP-SM). FILL AND HIDE RESIDUE. Sample saturated at 30.5 ft. Water level at approximately 26.0 ft. after hole stood for 2 days.			2.50	ST-1	TO	SHELBY TUBE		90	■	
5						2	DO	4,5,4,4	9	80	■	
10						3	DO	5,5,5,6	10	100	■	
15						4	DO	2,3,4,4	7	100	■	
						ST-2	TO	SHELBY TUBE		100	■	
20						5	DO	6,5,5,5	10	90	■	
25						6	DO	27,5,7,7	12	25	■	
30						7	DO	2,4,6,8	10	100	■	
35						8	DO	7,8,11,21	19	75	■	
		OUTWASH SAND			71.20							
					70.80							
		AUGER REFUSAL AT 37.3 FT. BELOW GROUND SURFACE.			37.30							
40												

DRILL RIG: Mobile B-57 ATV

DRILLING CONTRACTOR: Geologic

DRILLER: T. Paquette

Golder Associates

LOGGED: RJI

CHECKED: JEW

DATE: 05/31/90

PROJECT: INDUSTRI-PLEX

PROJECT LOCATION: WOBURN

PROJECT NUMBER: 893-6255

RECORD OF BOREHOLE 13

BORING DATE: 05/29/90

BORING LOCATION: N: 554,730
E: 696,356

SHEET: 1 OF 1

DATUM: MSL

DEPTH SCALE FEET	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 6 in	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT ■ (10 20 30 40 50 60 70 80 90) / WATER CONTENT, PERCENT (Wp, W, Wl)	PIEZOMETER OR STANDPIPE INSTALLATION
					109.10							
0		0.0-35.5 ft. Compact, black with occasional light-gray pockets, f-SAND, little to some silt to clayey silt, few cobbles and f-gravel, hair and hair clumps, occasional clumps of root mass, (SM to SP-SM). FILL AND HIDE RESIDUE. Water encountered at approximately 37.0 ft. at end of drilling.	SM to SP-SM		0.00	1	DO	2,7,10,21	17	75	■	
5						2	DO	6,9,8,7	17	80	■	
						ST-1	TO	SHELBY TUBE		30	■	
10						3	DO	6,100/.1'	>100	83	■	
15						4	DO	5,7,7,7	14	70	■	
						ST-2	TO	SHELBY TUBE		80	■	
20						5	DO	100/0'	>100	0	■	
25						6	DO	11,13,15,20	28	50	■	
30						7	DO	9,14,13,23	27	100	■	
		NOTES: 1.) Recovered shelby tube sample placed in jar to TO-1.										
35		35.5-36.2 ft. Dense, black, m-f SAND, little f-gravel, trace silt, possible few hairs, (SP). OUTWASH SAND ?	SP		73.60 / 35.50 / 72.90	8	DO	18,60,125	185	100		
		36.2-37.0 ft. Weathered bedrock.			36.20 / 72.10							
		BORING TERMINATED AT 37.0 FT. BELOW GROUND SURFACE.			37.00							
40												

DRILL RIG: Mobile B-57 ATV

DRILLING CONTRACTOR: Geologic

DRILLER: T. Paquette

Golder Associates

LOGGED: RJI

CHECKED: JEW

DATE: 05/31/90

PROJECT: INDUSTRI-PLEX

PROJECT LOCATION: WOBURN

PROJECT NUMBER: 893-6255

RECORD OF BOREHOLE 14 (OW-32)

BORING DATE: 05/23/90

BORING LOCATION: N: 554,559
E: 696,063

SHEET: 1 OF 1

DATUM: MSL

DEPTH SCALE FEET	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 6 in	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT ■ (10 20 30 40 50 60 70 80 90) / WATER CONTENT, PERCENT (Wp W Wl)	PIEZOMETER OR STANDPIPE INSTALLATION
0					71.70							
		0.0-6.0 ft. Loose to dense, dark yellowish-brown becoming dark gray, c-f SAND, trace f-gravel, little to some silt, (SW). OUTWASH SAND. Slight organic odor at 4 to 6 ft. Water encountered at approximately 2.0 ft.	SW		0.00	1	DO	5,10,8,5	18	45		
						2	DO	5,6,7,10	13	15		
5					65.70	3	DO	5,4,2,4	6	85		
		6.0-8.3 ft. Dense, grey, f-GRAVEL and m-f SAND, little silt, (GP-SP). GLACIAL TILL	GP-SP		6.00	4	DO	3,14,17,100	31	60		
		BORING TERMINATED AT 8.3 FT. BELOW GROUND SURFACE.			63.40 8.30	5	DO	100/.3'	>100	20		
10												
15												
20												
25												
30												
35												
40												

NOTES:
1.) Auger refusal was encountered at 7.5 ft. depth. The drill rig was moved 9.0 ft. and the borehole redrilled to 8.3 ft. depth, where spoon refusal occurred.

DRILL RIG: Mobile B-57 ATV

DRILLING CONTRACTOR: Geologic

DRILLER: T. Paquette

Golder Associates

LOGGED: RJI

CHECKED: JEW

DATE: 05/31/90

PROJECT: INDUSTRI-PLEX

PROJECT LOCATION: WOBURN

PROJECT NUMBER: 893-6255

RECORD OF BOREHOLE 15

BORING DATE: 04/21/90

BORING LOCATION: N: 554,528
E: 696,213

SHEET: 1 OF 1

DATUM: MSL

DEPTH SCALE FEET	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 6 in	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT ■ (10 20 30 40 50 60 70 80 90) / WATER CONTENT, PERCENT (Wp W Wl, 10 20 30 40 50 60 70 80 90)	PIEZOMETER OR STANDPIPE INSTALLATION
					76.90							
0		0.0-10.0 ft. Very loose to loose, black, f-SAND, some silt, hairs, few micas, roots, (SM). FILL AND HIDE RESIDUE.	SM		0.00	1	DO	1,2,1,2	3	35		
5						2	DO	2,4,6,6	10	35		
						ST-1	TO	SHELBY TUBE		75		
10		10.0-17.0 ft. Dense, black grading to olive gray, m-f SAND, little silt, few micas, (SP-SM). OUTWASH SAND. Water at 13.2 ft. depth after completion of drilling.	SP-SM		66.90 10.00	3	DO	7,13,23,32	36	100		
15						4	DO	11,16,16,17	32	70		
		BORING TERMINATED AT 17.0 FT. BELOW GROUND SURFACE.			59.90 17.00							
20												
25												
30												
35												
40												

DRILL RIG: Mobile B-57 ATV

DRILLING CONTRACTOR: Geologic

DRILLER: T. Paquette

Golder Associates

LOGGED: RJI

CHECKED: JEW

DATE: 05/30/90

PROJECT: INDUSTRI-PLEX

PROJECT LOCATION: WOBURN

PROJECT NUMBER: 893-6255

RECORD OF BOREHOLE 16

BORING DATE: 04/17/90

BORING LOCATION: N: 554,517
E: 696,273

SHEET: 1 OF 1

DATUM: MSL

DEPTH SCALE FEET	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 6 in	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT ■ (10 20 30 40 50 60 70 80 90) / WATER CONTENT, PERCENT (Wp, W, Wl) (10 20 30 40 50 60 70 80 90)	PIEZOMETER OR STANDPIPE INSTALLATION
					73.50							
0		0.0-5.0 ft. Very loose, light brown to black, m-f SAND, some silt, little roots, (SM).	SM		0.00	1	DO	1,0,1,1	1	33		
					68.50							
5		5.0-13.0 ft. Dense, yellow-brown to black, f-SAND, trace silt, (SM). OUTWASH SAND.	SM		5.00	2	DO	4,18,18,24	36	67		
10						3	DO	8,15,17,27	32	75		
					60.50							
		13.0-17.0 ft. Dense, light olive gray to dark green-gray, m-f SAND, some c-f gravel, some clayey silt, (SM). GLACIAL TILL.	SM		13.00							
15						4	DO	12,20,16,21	38	75		
					56.50							
		BORING TERMINATED AT 17.0 FT. BELOW GROUND SURFACE.			17.00							
20												
25												
30												
35												
40												

DRILL RIG: Mobile B-57 ATV

DRILLING CONTRACTOR: Geologic

DRILLER: T. Paquette

Golder Associates

LOGGED: JEW

CHECKED: JEW

DATE: 05/30/90

PROJECT: INDUSTRI-PLEX

PROJECT LOCATION: WOBURN

PROJECT NUMBER: 893-6255

RECORD OF BOREHOLE 17

BORING DATE: 04/17/90

BORING LOCATION: N: 554,499
E: 696,342

SHEET: 1 OF 1

DATUM: MSL

DEPTH SCALE FEET	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 6 in	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT ■ (10 20 30 40 50 60 70 80 90) / WATER CONTENT, PERCENT (Wp W Wl)	PIEZOMETER OR STANDPIPE INSTALLATION
					74.30							
0		0.0-5.0 ft. Loose, brown to black, m-f SAND, some silt, little roots. (SM)	SM		0.00	1	DO	1,2,6,8	8	100	■	
					69.30							
5		5.0-12.0 ft. Dense, green-gray to black, m-f SAND, trace silt, (SM). OUTWASH SAND.	SM		5.00	2	DO	10,19,23,27	42	92	■	
10						3	DO	9,16,21,34	37	83	■	
					62.30							
		12.0-17.0 ft. Dense, gray, c-f SAND and GRAVEL, some clayey silt, (SM). GLACIAL TILL.	SM		12.00							
15						4	DO	14,12,26,23	38	33	■	
					57.30							
		BORING TERMINATED AT 17.0 FT. BELOW GROUND SURFACE.			17.00							
20												
25												
30												
35												
40												

DRILL RIG: Mobile B-57 ATV

DRILLING CONTRACTOR: Geologic

DRILLER: T. Paquette

Golder Associates

LOGGED: JEW

CHECKED: JEW

DATE: 05/30/90

RI/FS Borehole Logs

CONSULTING GROUND-WATER GEOLOGISTS
ROUX ASSOCIATES INC

WELL LOG

Project: Woburn
Client: Stauffer Chemical Company
Page 1 Of 1
Date Prepared 10/25/83 By A. Jaroszewski
Owner:
Well No. 50/26
Loc. West of west hide pile
M.P. Elevation:
Drilling Started 9/12/83, Ended 9/12/83
Driller: Parratt Wolff
Type Of Rig: Hollow Stem Auger

WELL DATA

Hole Diam. 6.0"
Final Depth 3.1'
Casing Diam.:
Casing Length:
Screen Setting:
Screen Slot & Type:
Well Status:

G-W READINGS

Date	DTW MP	Elev.W.T.

SAMPLER

Type Split Spoon
Hammer 140 lb.
Fall 30 inches

DEVELOPMENT

Depth in ft.	SAMPLE No.	Rec.	Depth	Blows 6	Strta Chg. & Gen. Desc.	SAMPLE DESCRIPTION
	1	8"	0 - 2'	17,12,24,18	Fill (A)	Brown silty sand Multi-colored p.s. m-c sand, granules, occasional pebble
2	2	12"	2 - 3.1'	9,27,50-1	Till (R)	Same as last unit Brown sandy silt Subangular gabbro-dioritic & rounded granitic pebbles and cobbles in gray cohesive clayey p.s. sand
4						
6						
8						
10						
12						
14						
16						

REMARKS:

DOF - 3.0'

CONSULTING GROUND-WATER GEOLOGISTS
ROUX ASSOCIATES INC

WELL LOG

Project	Woburn
Client	Stauffer Chemical Company
Page	1 Of 1
Date Prepared	11/8/83 By A. Jaroszewski
Owner	
Well No.	50/28
Loc.	West Hide Pile
M.P. Elevation	
Drilling Started	10/12/83, Ended 10/12/83
Driller	Parratt Wolff
Type Of Rig	Hollow Stem Auger

WELL DATA

Hole Diam.	6.0"
Final Depth	10.5'
Casing Diam.	
Casing Length	
Screen Setting	
Screen Slot & Type	
Well Status	

G-W READINGS

Date	DTW MP	Elev.W.T.

SAMPLER

Type	Split Spoon
Hammer	140 lb.
Fall	30 inches

DEVELOPMENT

Depth in ft.	SAMPLE No.	Rec.	Depth	Blows 6	Strta Chg. & Gen. Desc.	SAMPLE DESCRIPTION
	1	15"	0 - 2'	2,2,2,2	(A)	Brown sandy loam roots, pebbles Black sandy hide residue
5	2	24"	5 - 7'	14,18,15,10	(A)	Black silty sand hide residue, hairs, wood, cobbles
10	3	24"	10 - 10.5'	30,50 - 0'	Till (A)	Black sandy hide residue Brown cobbles in sandy matrix Refusal 10.5'
15						
20						
25						
30						

REMARKS: DOF - 10.0'

CONSULTING GROUND-WATER GEOLOGISTS
ROUX ASSOCIATES INC

WELL LOG

Project: Woburn
Client: Stauffer Chemical Company
Page 1 Of 1
Date Prepared 11/1/83 By S. Sucharski
Owner:
Well No. 50/30
Loc. West Hide Pile
M.P. Elevation:
Drilling Started 10/5/83, Ended 10/5/83
Driller: Parratt Wolff
Type Of Rig: Hollow Stem Auger

WELL DATA
Hole Diam. 6"
Final Depth 27'
Casing Diam.:
Casing Length:
Screen Setting:
Screen Slot & Type:
Well Status:

G-W READINGS

Date	DTW MP	Elev.W.T.

SAMPLER
Type Split Spoon
Hammer 140 lb.
Fall 30 inches

DEVELOPMENT

Depth in ft.	SAMPLE No.	Rec.	Depth	Blows 6	Strta Chg. & Gen. Desc.	SAMPLE DESCRIPTION
	1	12"	0 - 2'	11,7,8	Fill (A)	Brown sandy loam White-brown silty material (dry, friable) with brown sandy silt horizons throughout
5	2	12'	5 - 7'	4,3,2,3	(R)	Black & gray fine sand, silt, clay, & hair; with occasional granules. at 9' difficult drilling-wood: cobbles
10	3	6"	10 - 12'	18,10,8,6	(R)	Black & gray sand, silt, clay, hair & wood-odoriferous
15	4	24"	15 - 17'	10,6,6,8	(A)	Black & gray fine sand, silt, pebbles, and hair. At approx. 15.4'-wood & brown sand
20	5	24"	20 - 22'	4,4,3,4	(R)	Black, gray, fine sand, silt, pebbles small cobbles, and hair
25	6	24"	25 - 27'	5,6,7,10	Fill (A) Peat Sand	Black f-m sand, silt, clay, hair, and roots Brown f-m sand, silt, clay, and roots Gray-brown f-m sand - moist
30						

REMARKS: DOF - 26.6'

CONSULTING GROUND-WATER GEOLOGISTS
ROUX ASSOCIATES INC

WELL LOG

Project	Woburn
Client	Stauffer Chemical Company
Page	1 Of 1
Date Prepared	11/1/83 By S. Sucharski
Owner	
Well No.	50/32
Loc.	West Hide Pile
M.P. Elevation	
Drilling Started	10/4/83, Ended 10/4/83
Driller	Parratt Wolff
Type Of Rig	Hollow Stem Auger

WELL DATA

Hole Diam.	6.0"
Final Depth	32.0'
Casing Diam.	
Casing Length	
Screen Setting	
Screen Slot & Type	
Well Status	

G-W READINGS

Date	DTW MP	Elev.W.T.

SAMPLER

Type	Split Spoon
Hammer	140 lb.
Fall	30 inches

DEVELOPMENT

Depth in ft.	SAMPLE No.	Rec.	Depth	Blows 6	Strta Chg. & Gen. Desc.	SAMPLE DESCRIPTION
	1	12"	0 - 2'	1,5,10,9	Fill (A)	Brown sandy loam & pebbles with small lenses of white (hard) clay material disseminated throughout
5	2	24"	5 - 7'	3,2,1,2	(R)	Black sand silt, granules, & hair Green & white pasty material (strong odor) Black-brown silt, sand, and wood
10	3	2"	10 - 12'	3,9,8,4	(R)	Moist-black & gray sandy clay material (strong odor-not H_2S)
15	4	6"	15 - 17'		(R)	Black stained f-m sand, wood, hair, with a greasy sheen
20	5	12"	20 - 22'	3,7,8,14	(A)	Black sandy silt, clay, hair, and cobbles
25	6	24"	25 - 27'	12,14,12,13	(R)	Black sand, silt, clay, hair, and roots, Gray in some places
30	7	24"	30 - 32'	5,13,18,31	Fill (A)	Black sand, silt, clay, hair, & pebbles (strong odor)
					Sand	Brown f-m sand-wet Gray f-m sand

REMARKS: DOF - 31.5'

CONSULTING GROUND-WATER GEOLOGISTS
ROUX ASSOCIATES INC

WELL LOG

Project: Woburn
Client: Stauffer Chemical Company
Page 1 Of 1
Date Prepared 10/25/83 By A. Jaroszewski
Owner:
Well No. 51/27
Loc. West edge of W. Hide Pile
M.P. Elevation:
Drilling Started: , Ended:
Driller: Parratt Wolff
Type Of Rig: Hollow Stem Auger

WELL DATA

Hole Diam. 6.0"
Final Depth 1.5'
Casing Diam.:
Casing Length:
Screen Setting:
Screen Slot & Type:
Well Status:

G-W READINGS

Date	DTW MP	Elev.W.T.

SAMPLER

Type Split Spoon
Hammer 140 lb.
Fall 30 inches

DEVELOPMENT

Depth in ft.	SAMPLE No.	Rec.	Depth	Blows 6	Strta Chg. & Gen. Desc.	SAMPLE DESCRIPTION
	1	8"	0 - 1.5'	9,30,50	Till (A)	Brown sandy loam Black-brown sand, silt, roots Gray p.s. sand, silt, cobbles Refusal at 1.5'
2						
4						
6						
8						
10						
12						
14						
16						

REMARKS:

DOF - 0.0'

CONSULTING GROUND-WATER GEOLOGISTS
ROUX ASSOCIATES INC

WELL LOG

Project	Woburn
Client	Stauffer Chemical Company
Page	1 Of 1
Date Prepared	10/26/83 By A. Jaroszewski
Owner	
Well No.	51/29
Loc.	West Hide Pile
M.P. Elevation	
Drilling Started	9/12/83, Ended 9/12/83
Driller	Parratt Wolff
Type Of Rig	Hollow Stem Auger

WELL DATA

Hole Diam.	6.0"
Final Depth	20.5'
Casing Diam.	2.0"
Casing Length	21.5'
Screen Setting	16.5 - 21.5'
Screen Slot & Type	
Well Status	Piezometer

G-W READINGS

Date	DTW MP	Elev.W.T.

SAMPLER

Type	Split Spoon
Hammer	140 lb.
Fall	30 inches

DEVELOPMENT

Depth in ft.	SAMPLE No.	Rec.	Depth	Blows 6	Strta Chg. & Gen. Desc.	SAMPLE DESCRIPTION
	1	15"	0 - 2'	2,4,8,9	Fill (A)	Brown silty organic soil. White chalky substance with brown silty laminations
5	2	24"	5 - 7'	8,9,10,13	(A)	Black silty f sand, few hairs, stems, scattered pebbles (hide odor)
10	3	8"	10 - 12'	8,8,5,10	(A)	Same as above. Black silty p.s. sand, stems, scattered pebbles, pieces of wood
15	4	24"	15 -16.5'	8,15,23,50-1	Till (A)	Black silty to f sandy peat. Brown m-c sand, pebbles, cobbles, densely packed
20	5	6"	20 - 20.5'	58 - 6"		Subangular gabbro-dioritic and rounded granitic pebbles and cobbles in moist gray cohesive clayey p.s. sand
25						
30						

REMARKS:

CONSULTING GROUND-WATER GEOLOGISTS
ROUX ASSOCIATES INC

WELL LOG

Project	Woburn
Client	Stauffer Chemical Company
Page	1 of 1
Date Prepared	10/26/83 By A. Jaroszewski
Owner	
Well No.	51/31
Loc.	West Hide Pile
M.P. Elevation	
Drilling Started	9/12/83 Ended 9/12/83
Driller	Parratt Wolff
Type Of Rig	Hollow Stem Auger

WELL DATA

Hole Diam.	6.0"
Final Depth	22.0'
Casing Diam.	
Casing Length	
Screen Setting	
Screen Slot & Type	
Well Status	

G-W READINGS

Date	DTW MP	Elev.W.T.

SAMPLER

Type	Split Spoon
Hammer	140 lb.
Fall	30 inches

DEVELOPMENT

Depth in ft.	SAMPLE No.	Rec.	Depth	Blows 6	Strta Chg. & Gen. Desc.	SAMPLE DESCRIPTION
	1	12"	0 - 2'	2,5,6,3	Fill (A)	Brown p.s. f-c sand, granules, silt, trace of Bauxite, roots Gray sandy hide residue
5	2	24"	5 - 7'	5,4,3,2	(R)	Black p.s. sand, abundant hairs, cobbles
10	3	12"	10 - 12'	2,2,3,4	(A)	Black fine sand, abundant hairs
15	4	12"	15 - 17'	4,4,5,5	(R)	Same as above, patches of gray clayey substance, pieces of wood
20	5	12"	20 - 22'	8,13,19,15	Fill (A)	Black f sand, pebbles and cobbles (densely packed) hairs Black p.s. sand, pieces of wood
					Sand	Brown w.s. f-m sand
25						
30						

REMARKS: DOF - 21.0'

CONSULTING GROUND-WATER GEOLOGISTS
ROUX ASSOCIATES INC

WELL LOG

Project: Woburn
Client: Stauffer Chemical Company
Page 1 Of 1
Date Prepared 11/1/83 By S. Sucharski
Owner:
Well No. 51/33
Loc. East of West Hide Pile
M.P. Elevation:
Drilling Started 10/5/83, Ended 10/5/83
Driller: Parratt Wolff
Type Of Rig:

WELL DATA

Hole Diam. 2.0"
Final Depth 4.0'
Casing Diam.:
Casing Length:
Screen Setting:
Screen Slot & Type:
Well Status:

G-W READINGS

Date	DTW MP	Elev.W.T.

SAMPLER

Type Split Spoon
Hammer ____ lb.
Fall:

DEVELOPMENT

Depth in ft.	SAMPLE No.	Rec.	Depth	Blows 6	Strta Chg. & Gen. Desc.	SAMPLE DESCRIPTION
	1	4"	0 - 2'	Sledge Hammer	Fill (A)	Black fine sand, silt, hair, and roots overlain by brown silt, sand, roots-wet
2	2	8"	2 - 4'	Sledge Hammer	Fill (A) Sand	Black sand, silt, roots, and hair Dark gray silt, fine sand, roots
4						
6						
8						
10						
12						
14						
16						

REMARKS: DOF - 2.4'

CONSULTING GROUND-WATER GEOLOGISTS
ROUX ASSOCIATES INC

WELL LOG

Project	Woburn
Client	Stauffer Chemical Company
Page	1 Of 1
Date Prepared	11/1/83 By S. Sucharski
Owner	
Well No.	52/28
Loc.	West Hide Pile
M.P. Elevation	
Drilling Started	10/5/83, Ended 10/5/83
Driller	Parratt Wolff
Type Of Rig	Hollow Stem Auger

WELL DATA

Hole Diam.	6.0"
Final Depth	24.0'
Casing Diam.	
Casing Length	
Screen Setting	
Screen Slot & Type	
Well Status	

G-W READINGS

Date	DTW MP	Elev.W.T.

SAMPLER

Type	Split Spoon
Hammer	140 lb.
Fall	30 inches

DEVELOPMENT

Depth in ft.	SAMPLE No.	Rec.	Depth	Blows 6	Strta Chg. & Gen. Desc.	SAMPLE DESCRIPTION
	1	12"	0 - 2'	1,2,4,5	Fill (A)	Brown sandy loam Poorly sorted-brown & gray sand, granules, pebbles, and silt with roots disseminated throughout, trace of maroon staining at approx .5'
5	2	12"	5 - 7'	4,10,8,13	(R)	Black & gray stained silt, sand and hair at 2.0' Black sand, silt, & hair-strong odor Blue dense material -(hard cemented) Black-brown fine sand & silt (cohesive) wood at 7' Black-brown fine sand,silt,wood
10	3	10"	10 - 12"	6,11,14,14	(A)	Black fine sand, silt, & hair (alternating layers of hair & sand)
15	4	24"	15 - 17'	5,5,6,7	(R)	Black & gray sand, silt, pebbles, & hair (cohesive) Black stained f-m sand, pebbles, small cobbles, less than 10% hair
20	5	24"	20 - 22'	7,8,9,13	Fill (A) Peat Sand	Black sand, silt, and hair Brown-black silt, clay, roots Black fine sand & silt
	6	18"	22 - 24'	10,9,14,22		Gray poorly sorted f-c sand -moist
25						
30						

REMARKS: DOF - 21.5'

CONSULTING GROUND-WATER GEOLOGISTS
ROUX ASSOCIATES INC

WELL LOG

Project: Woburn
Client: Stauffer Chemical Company
Page 1 Of 1
Date Prepared 10/27/83 By A. Jaroszewski
Owner:
Well No. AS-10 (BH-10)
Loc. East Hide Pile
M.P. Elevation:
Drilling Started 8/23/83, Ended 8/23/83
Driller: Parratt Wolff
Type Of Rig: Hollow Stem Auger

WELL DATA

Hole Diam. 6.0"
Final Depth 40.0'
Casing Diam. 4"
Casing Length 10'
Screen Setting 0 - 8'
Screen Slot & Type:
Well Status: Air Monitoring Well

G-W READINGS

Date	DTW MP	Elev.W.T.

SAMPLER

Type:
Hammer: lb.
Fall:

DEVELOPMENT

Depth in ft.	SAMPLE No.	Rec.	Depth	Blows 6	Strta Chg. & Gen. Desc.	SAMPLE DESCRIPTION
			0 - 2'		Fill	Brown p.s. sand, pebbles, cobbles
2			2 - 4			Black-gray hide residue, abundant hairs, pods of clayey gray material, scattered pebbles
4						Same to BOB - 40.0'

REMARKS:

P. M. ROUX & ASSOCIATES, INC.
Consulting Ground-Water Geologists

WELL LOG

PROJECT Woburn
CLIENT Stauffer Chemical Co.
DATE PREPARED 8/24/82 BY MS

DEPTH, ft	DESCRIPTION
0	Dry light brown f-sand fill
	Dry dark brown to black silt, f-sand, clay with plant stems; less clay with depth (odorous)
2	Moist black silt & f-sand with organic clay & hair, some pebbles (odorous)
4	
6	
8	
10	Moist light gray clay, silt, f-sand with some hair or root fibers
	Wood
12	Dry black f-sand, silt, clay
14	Wood
	Dry brown poorly sorted sandy silt with clay, plant fibers; loosely packed
16	

OWNER SCC
WELL NO. B-31
LOCATION Top of newest waste pile
TOPO SETTING
GROUND ELEV.

DRILLING STARTED 8/5/82
DRILLING COMPLETED 8/5/82
DRILLER Parratt-Wolff
TYPE OF RIG H.S.A.

WELL DATA

HOLE DIAM. 6"
FINAL DEPTH 39'
CASING DIAM.
CASING LENGTH
SCREEN DIAM.
SCREEN SETTING
SCREEN SLOT & TYPE
WELL STATUS

DEVELOPMENT

REMARKS

Samples Taken

0.5'-2.5' - Retain
2.5'-4.5' - Analyze
7.0'-9.0' - Retain
10.0'-11.5' - Retain
13.0'-19.0' - Retain
21.0'-31.0' - Retain

T. H. ROUX & ASSOCIATES, INC.
Consulting Ground-Water Geologists

WELL LOG

PROJECT Woburn
CLIENT Stauffer Chemical Co.
DATE PREPARED 8/24/82 BY MS

DEPTH, ft	DESCRIPTION
16	Dry black, silty f-sand with gray layers
	Dry black poorly sorted clay, silt, f-m sand with green wood and thick clumps of hair
18	
	Dry black silty sand & hair
20	
	Dry black silty sand with hair
22	Wood
	Dry gray c-sand with hair, silty f-m sand
	Moist black poorly sorted silty f-sand & pebbles with hair disseminated throughout; gray silty clay layer with some wood fibers
24	
26	
28	
30	
32	

OWNER SCC
WELL NO. B-31
LOCATION See Page 1

TOPO SETTING
GROUND ELEV.

DRILLING STARTED See Page 1
DRILLING COMPLETED
DRILLER
TYPE OF RIG

WELL DATA

HOLE DIAM. 6"
FINAL DEPTH 39'
CASING DIAM.
CASING LENGTH
SCREEN DIAM.
SCREEN SETTING
SCREEN SLOT & TYPE
WELL STATUS

DEVELOPMENT

REMARKS

F. M. ROOA & ASSOCIATES, INC.
Consulting Ground-Water Geologists

WELL LOG

PROJECT Woburn
CLIENT Stauffer Chemical Co.
DATE PREPARED 8/24/82 BY MS

DEPTH, ft	DESCRIPTION
32	
34	
	Occasional, gray coarse sand layers
36	
	Moist black fine-coarse sand with hide/hair disseminated throughout
38	Moist dark brown soil horizon of f-m sand & roots
	Moist light brown f-m sand
	Moist dark gray, black & gray layers of fine-med. sand
	BOB
40	

OWNER SCC
WELL NO. B-31
LOCATION See Page 1

TOPO SETTING
GROUND ELEV.

DRILLING STARTED
DRILLING COMPLETED
DRILLER
TYPE OF RIG

WELL DATA

HOLE DIAM. 6"
FINAL DEPTH 39'
CASING DIAM.
CASING LENGTH
SCREEN DIAM.
SCREEN SETTING
SCREEN SLOT & TYPE
WELL STATUS

DEVELOPMENT

REMARKS

Samples Taken

35.0'-39.0'

CONSULTING GROUND-WATER GEOLOGISTS
ROUX ASSOCIATES INC

WELL LOG

Project	Woburn
Client	Stauffer Chemical Company
Page	1 Of 1
Date Prepared	10/27/83 By A. Jaroszewski
Owner	
Well No.	AS-10 (BH-10)
Loc.	East Hide Pile
M.P. Elevation	
Drilling Started	8/23/83, Ended 8/23/83
Driller	Parratt Wolff
Type Of Rig	Hollow Stem Auger

WELL DATA

Hole Diam.	6.0"
Final Depth	40.0'
Casing Diam.	4"
Casing Length	10'
Screen Setting	0 - 8'
Screen Slot & Type	
Well Status	Air Monitoring Well

G-W READINGS

Date	DTW MP	Elev.W.T.

SAMPLER

Type	
Hammer	lb.
Fall	

DEVELOPMENT

Depth in ft.	SAMPLE No.	Rec.	Depth	Blows 6	Strata Chg. & Gen. Desc.	SAMPLE DESCRIPTION
			0 - 2'		Fill	Brown p.s. sand, pebbles, cobbles
2			2 - 4			Black-gray hide residue, abundant hairs, pods of clayey gray material, scattered pebbles
4						Same to BOB - 40.0'

REMARKS:

APPENDIX B

Monitoring Well Details

MONITORING WELL INSTALLATION LOG

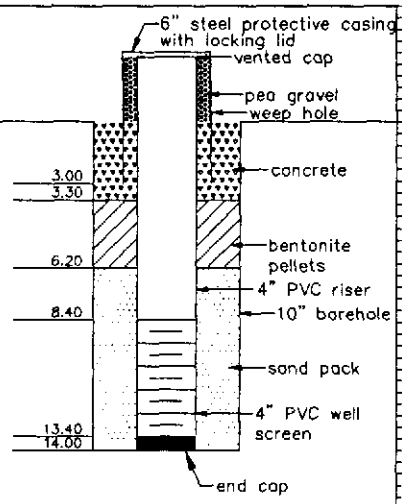
JOB NO. 893-6255 PROJECT ISRT/WOBURN/MASS WELL NO. 6 (OW-31) SHEET 1 OF 1
GA INSP. RJI DRILLING METHOD H.S.A. 6-5/8" I.D. GROUND ELEV. 71.3 WATER DEPTH 1.1' (BGS)
WEATHER SUNNY DRILLING COMPANY GEOLOGIC COLLAR ELEV. 0 DATE/TIME 5-25-90/0930
TEMP. 65 F DRILL RIG MOBILE-B-57 ATV DRILLER T. PAQUETTE STARTED 1230/5-24-90 (TIME / DATE) COMPLETED 1630/5-24-90 (TIME / DATE)
LOCATION / COORDINATES N554643.87 E695793.79

MATERIALS INVENTORY

WELL CASING 4 in. dia. 11.2 l.f. WELL SCREEN 4 in. dia. 5 l.f. BENTONITE SEAL (1) 5 GAL BUCKET
CASING TYPE SCH 40 PVC SCREEN TYPE SCH 40 PVC, MACHINE SLOTTED INSTALLATION METHOD HAND
JOINT TYPE TEFLON WRAPPED, FLUSH THREADED SLOT SIZE .010" FILTER PACK QTY. 200 lbs.
GROUT QUANTITY N/A CENTRALIZERS NOT USED FILTER PACK TYPE MYSTIC WHITE SAND
GROUT TYPE N/A DRILLING MUD TYPE NOT USED INSTALLATION METHOD HAND

ELEV./DEPTH	SOIL/ROCK DESCRIPTION
	GROUND SURFACE
0.0	Very soft, dark gray, CLAYEY SILT, some fine sand, slight organic odor, possible hairs 0'-2' (ML to OL) Water encountered at approximately 2'
6.00	Compact, olive to med-gray, m-f SAND, little silt (SP-SM) OUTWASH SAND
14.00	End of borehole

WELL SKETCH



INSTALLATION NOTES

WELL DEVELOPMENT NOTES

Well developed on 5/25/90.
A total of 100 gallons were purged using a 2 inch stainless steel bailer. Water remained turbid. Conductivity and pH stabalized.

Conductivity = 5400 umho/cm
pH = 6.67

MONITORING WELL INSTALLATION LOG

JOB NO. 893-6255 PROJECT ISRT/WOBURN/MASS WELL NO. 14 (OW-32) SHEET 1 OF 1
GA INSP. RJI DRILLING METHOD H.S.A. 6-5/8" I.D. GROUND ELEV. 71.7 WATER DEPTH 1.3' BGS
WEATHER CLOUDY DRILLING COMPANY GEOLOGIC COLLAR ELEV. 0 DATE/TIME 5-24-90/0900
TEMP. 60 F DRILL RIG MOBILE-B-57 ATV DRILLER T. PAQUETTE STARTED 1315/5-23-90 (TIME / DATE) COMPLETED 1530/5-23-90 (TIME / DATE)
LOCATION / COORDINATES N554557.70 E696061.60

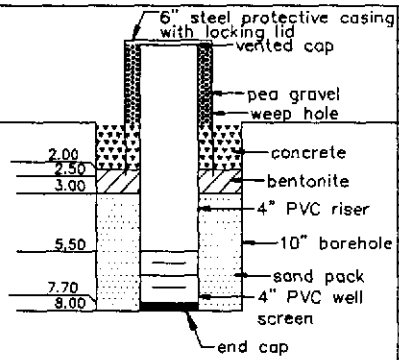
MATERIALS INVENTORY

WELL CASING 4 in. dia. 8.8 l.f. WELL SCREEN 4 in. dia. 2.2 l.f. BENTONITE SEAL (1/2) 5 GAL BUCKET
CASING TYPE SCH 40 PVC SCREEN TYPE SCH 40 PVC, MACHINE SLOTTED INSTALLATION METHOD HAND
JOINT TYPE TEFLON WRAPPED, FLUSH THREADED SLOT SIZE .010" FILTER PACK QTY. 100 lbs.
GROUT QUANTITY N/A CENTRALIZERS NOT USED FILTER PACK TYPE MYSTIC WHITE SAND
GROUT TYPE N/A DRILLING MUD TYPE NOT USED INSTALLATION METHOD HAND

ELEV./DEPTH	SOIL/ROCK DESCRIPTION
	GROUND SURFACE
0.0	Loose to dense, dark yellowish-brown becoming dark gray, c-f SAND, trace f-gravel, little to some silt, (SW). OUTWASH SAND. Slight organic odor at 4 to 6 ft. Water encountered at approximately 2 ft.
6.00	
8.30	Dense, gray, f-GRAVEL and m-f SAND, little silt, (GP-SP). GLACIAL TILL.
	BORING TERMINATED AT 8.3 FT. BELOW GROUND SURFACE.

NOTES:
1.) Auger refusal was encountered at 7.5 ft. depth. The drill rig was moved 9 ft. and the borehole redrilled to 8.3 ft. depth, where spoon refusal occurred.

WELL SKETCH



INSTALLATION NOTES

Running sand resulted in difficulty installing sand pack and contributed to sand pack going 2.5' above top of screen.

WELL DEVELOPMENT NOTES

Well developed on 5/30/90. A total of 35 gallons were purged using a 2" stainless steel bailer. Water remained very turbid. Conductivity and pH stabalized.

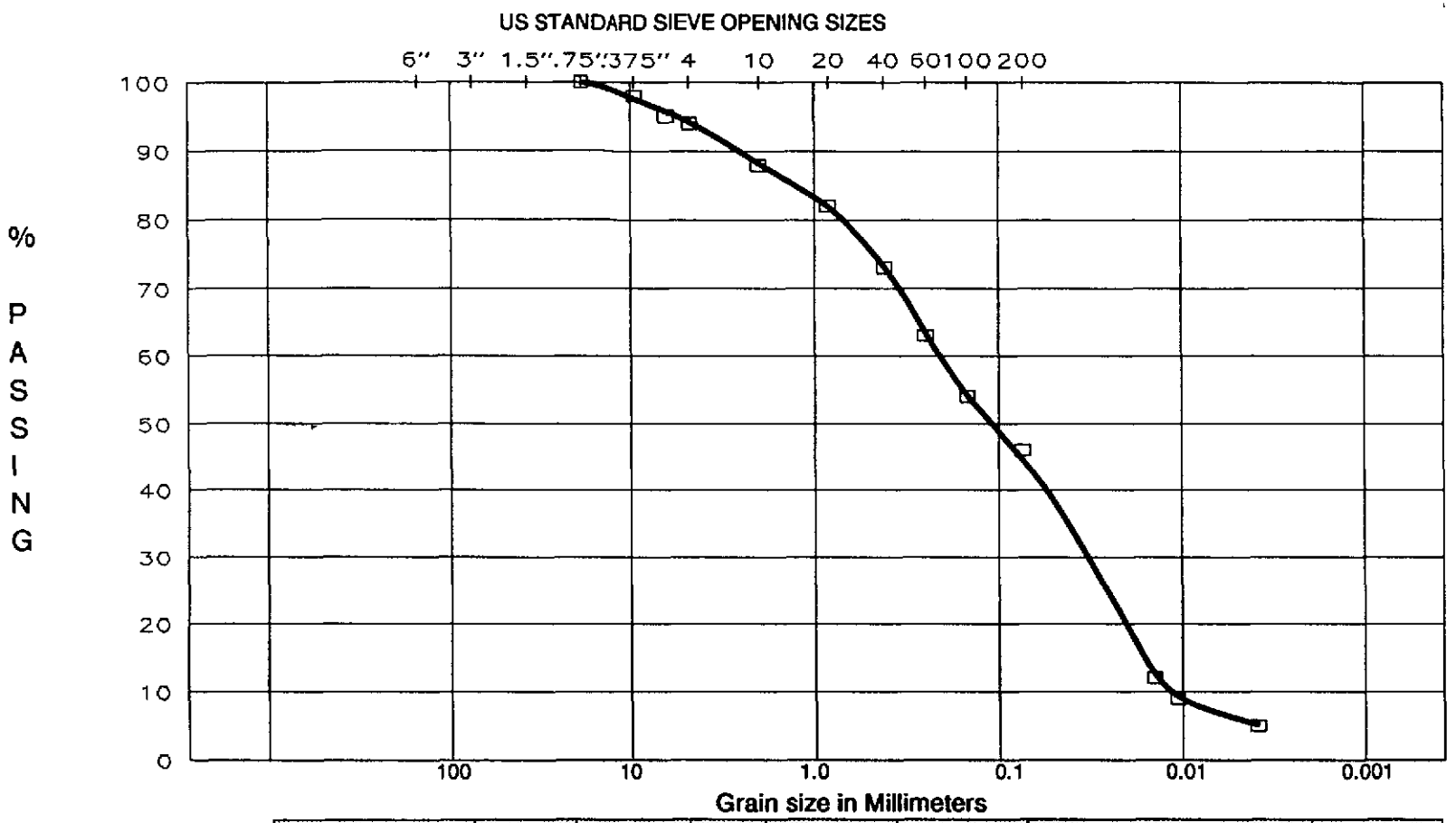
Conductivity = 2300 umho/cm
pH = 6.93

APPENDIX C

Soils Laboratory Test Results

Grain Size Analysis

PARTICLE SIZE DISTRIBUTION ASTM D-421 AND 422



COBBLES	GRAVEL coarse	GRAVEL fine	SAND c	SAND med	SAND fine	SILT	CLAY

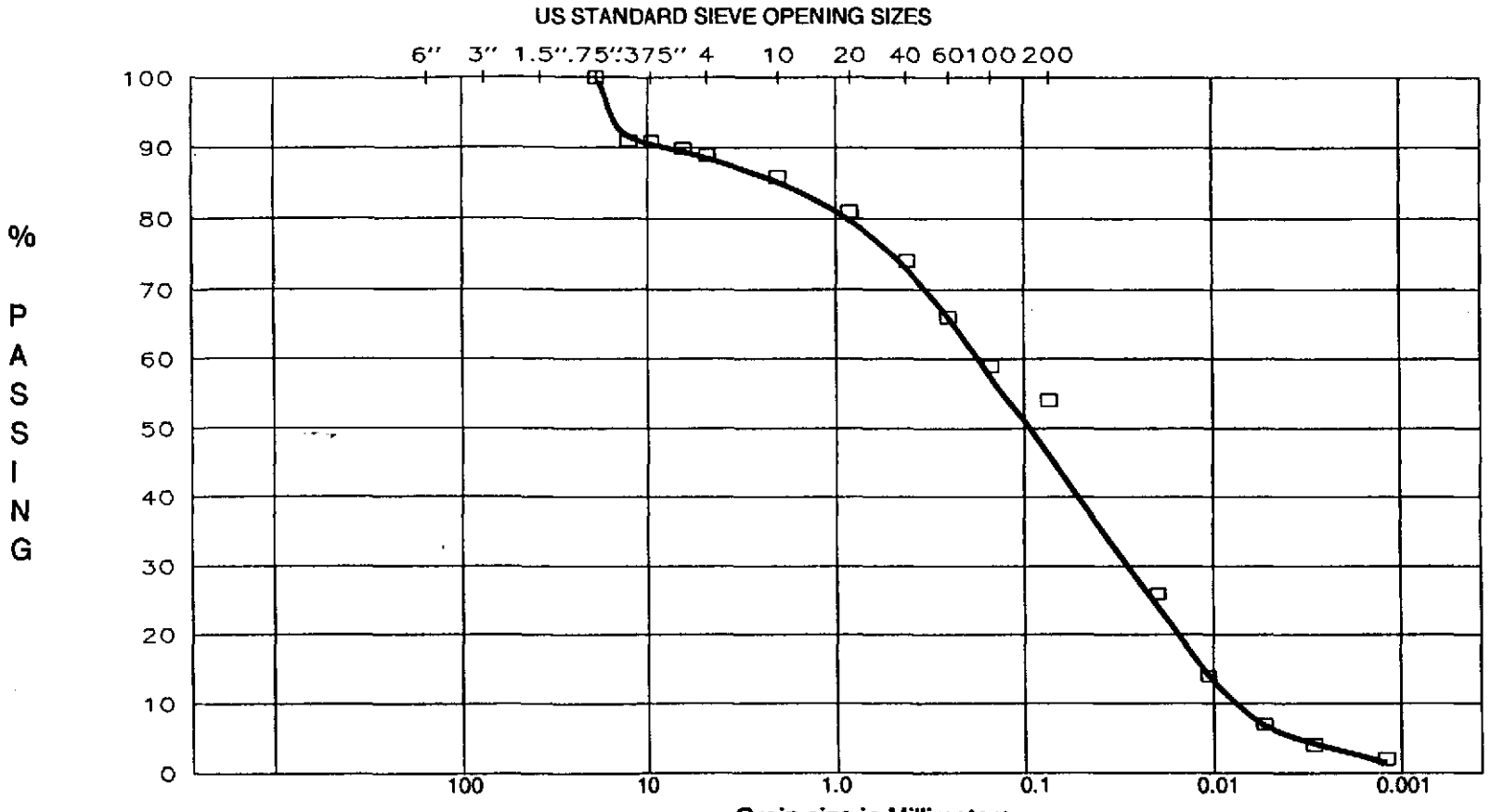
SAMPLE ID	W%	LL	PL	PI	Other	DESCRIPTION
BH-1,WHP 0-5'	37.2	NP	NP	NP		Moderate brown m-f SAND and FINES little f gravel(SM-ML)
Sample Type:	Bulk	Date Tested:	9/19/90			

ISRT/WOBURN/MA

893-6255

GOLDER ASSOCIATES INC.
Consulting Engineers

PARTICLE SIZE DISTRIBUTION ASTM D-421 AND 422



COBBLES	GRAVEL coarse	GRAVEL fine	SAND c	SAND med	SAND fine	SILT	CLAY

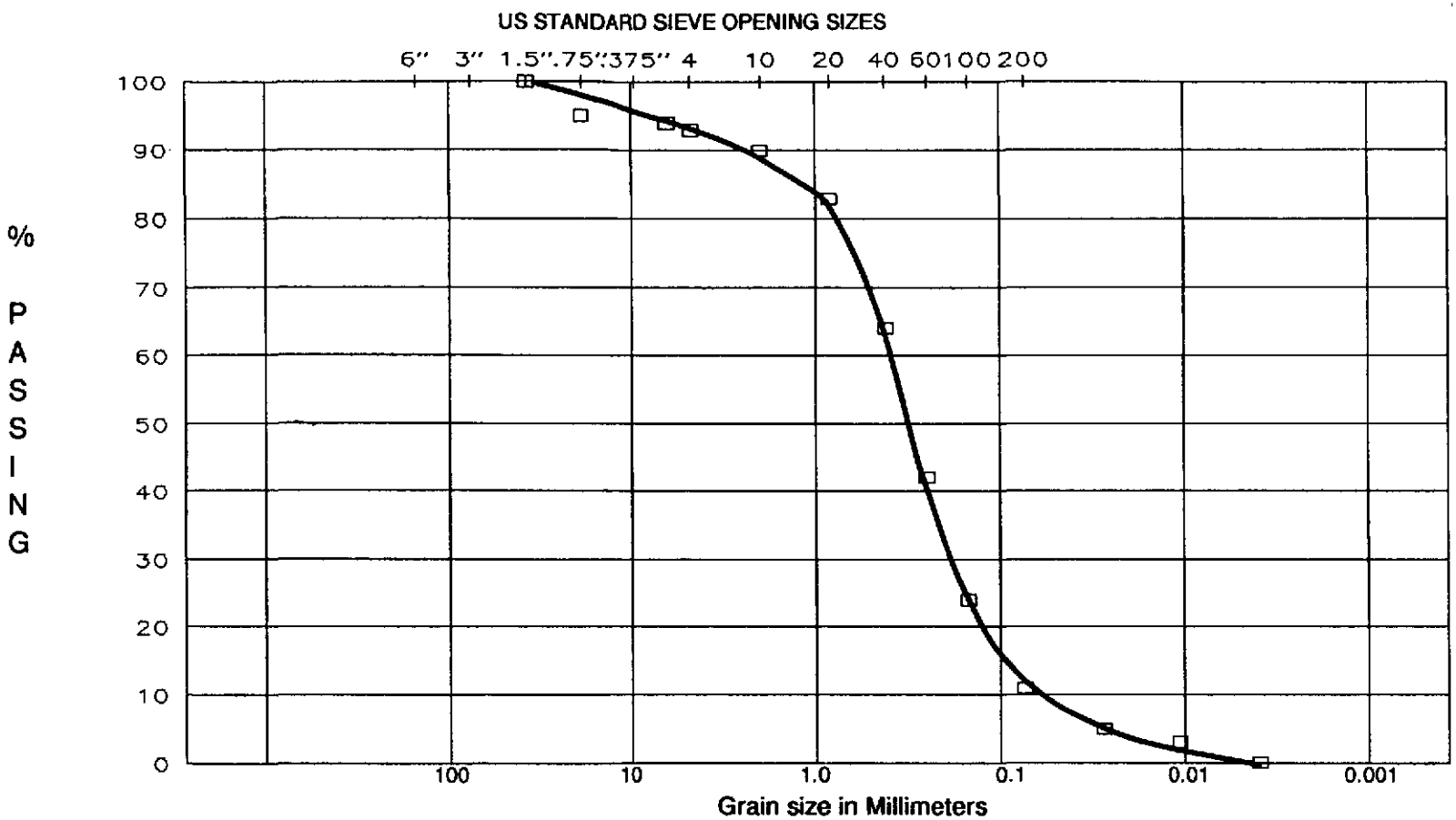
SAMPLE ID	W%	LL	PL	PI	Other	DESCRIPTION
#1,S-1 WHP	45.6					Moderate to brownish black SILT and m-f SAND, little f gravel (SM-ML)
Sample Type: SPLIT SPOON				Date Tested: 6/23/90		

ISRT/WOBURN/MA

893-6255.5

GOLDER ASSOCIATES INC.
Consulting Engineers

PARTICLE SIZE DISTRIBUTION ASTM D-421 AND 422



COBBLES	GRAVEL coarse	GRAVEL fine	SAND c	SAND med	SAND fine	SILT	CLAY

SAMPLE ID	W%	LL	PL	PI	Other	DESCRIPTION
#1,ST-1 WHP	19.9	NP	NP	NP		Black m-f SAND,little c-f gravel little silt(SP)
Sample Type:	Shelby	Date Tested:	9/05/90			

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893-6255.5

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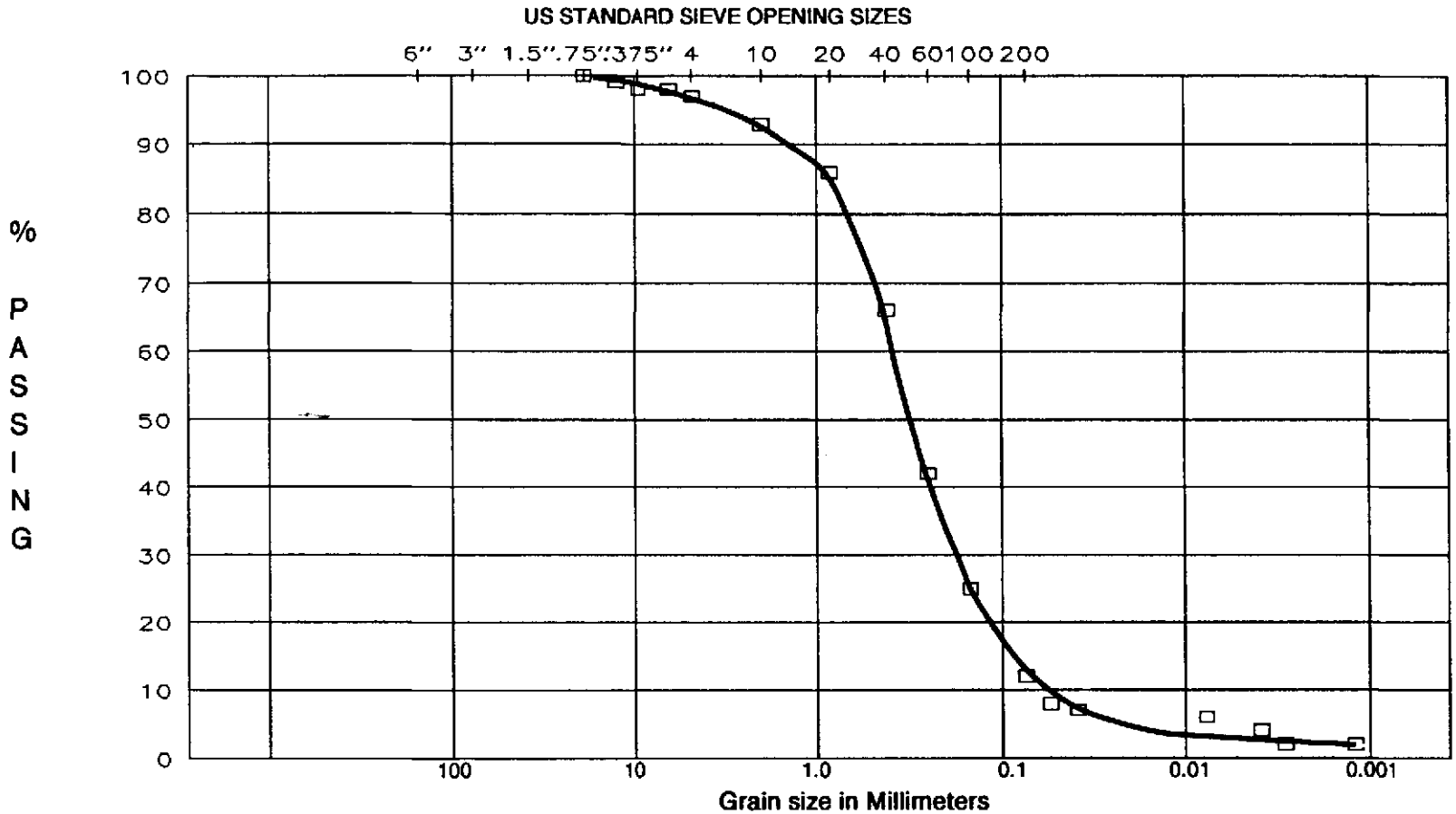
PARTICLE SIZE DISTRIBUTION ASTM D-421 AND 422



COBBLES	GRAVEL coarse	GRAVEL fine	SAND c	SAND med	SAND fine	SILT	CLAY

SAMPLE ID	W%	LL	PL	PI	Other	DESCRIPTION
#1,S-4 WHP	20.5					Moderate to brownish black m-f SAND. little silt trace f gravel (SP-SM)

Sample Type: SPLIT SPOON Date Tested: 6/23/90

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893-6255.5

GOLDER ASSOCIATES INC.
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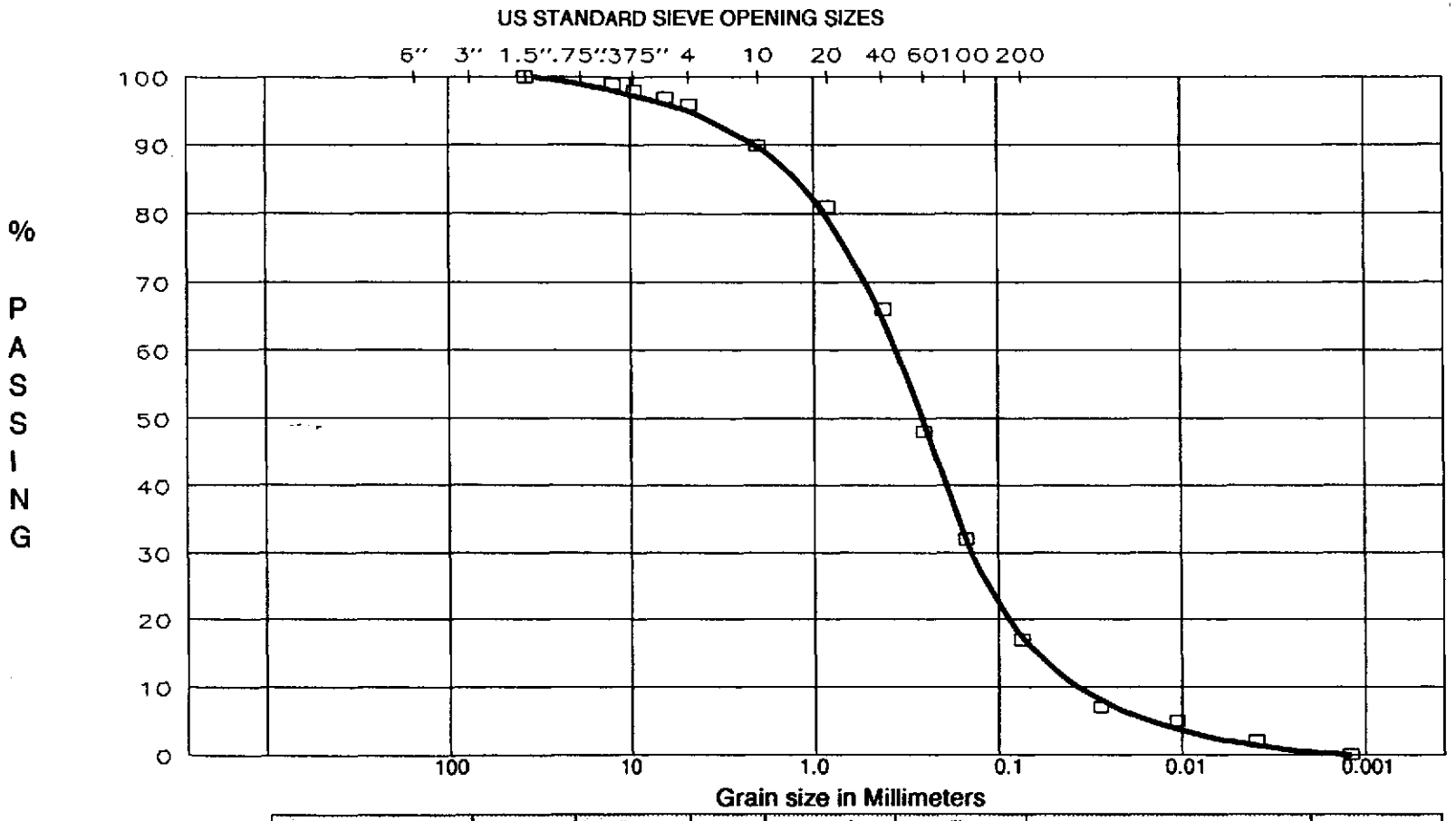
PARTICLE SIZE DISTRIBUTION ASTM D-421 AND 422



COBBLES	GRAVEL coarse	GRAVEL fine	SAND c	SAND med	SAND fine	SILT	CLAY

SAMPLE ID	W%	LL	PL	PI	Other	DESCRIPTION
#1,ST-2 WHP	20.7	NP	NP	NP		Grayish brown m-f SAND,some fines trace f gravel(SP)
Sample Type:	Shelby	Date Tested:	9/08/90			

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893-6255.5

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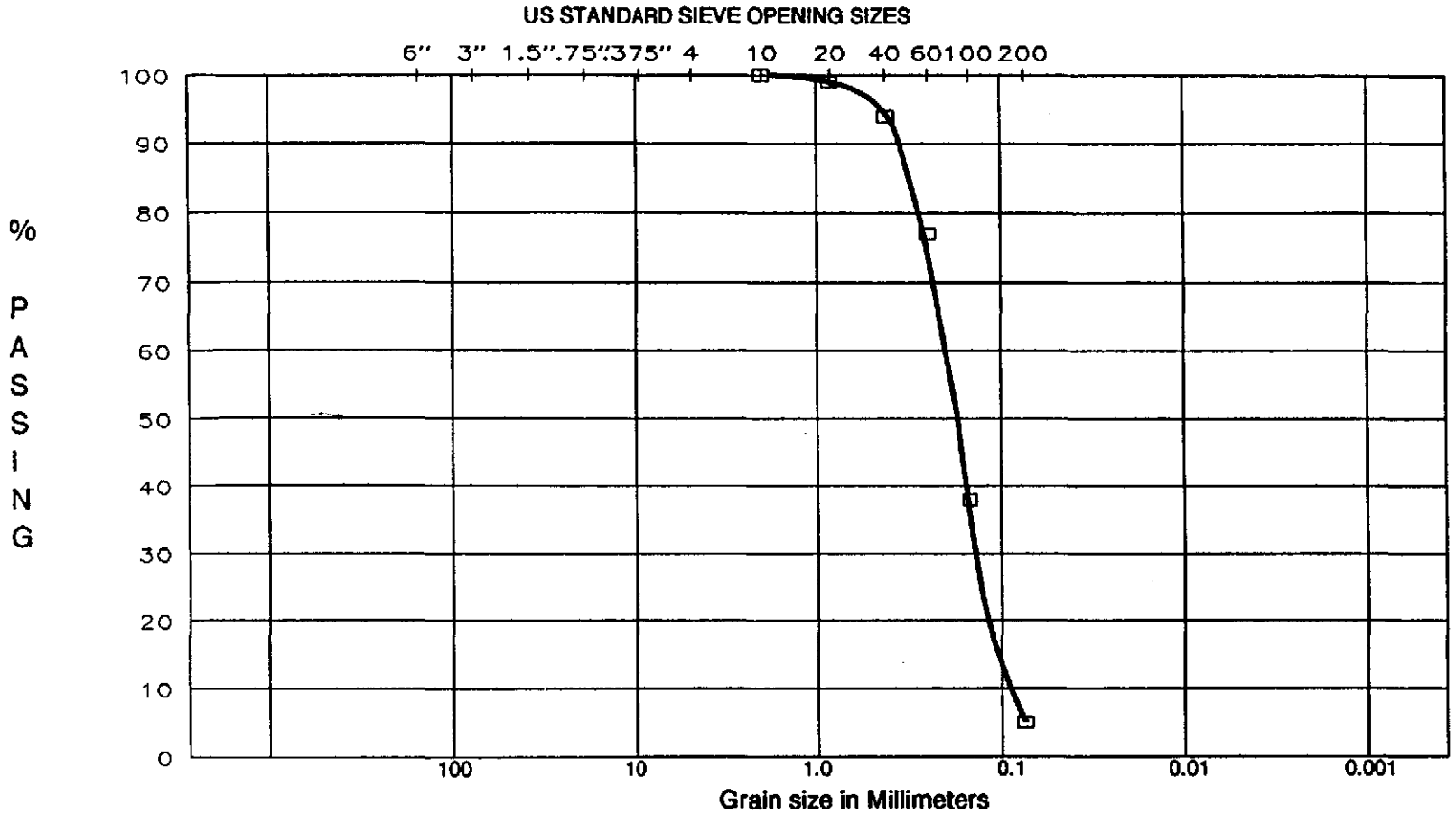
Consulting Engineers

PARTICLE SIZE DISTRIBUTION ASTM D-421 AND 422



COBBLES	GRAVEL coarse	GRAVEL fine	SAND c	SAND med	SAND fine	SILT	CLAY

SAMPLE ID	W%	LL	PL	PI	Other	DESCRIPTION
#1,S-7 WHP	20.6	NP	NP	NP		Moderate to brownish black f SAND, trace silt (SP)

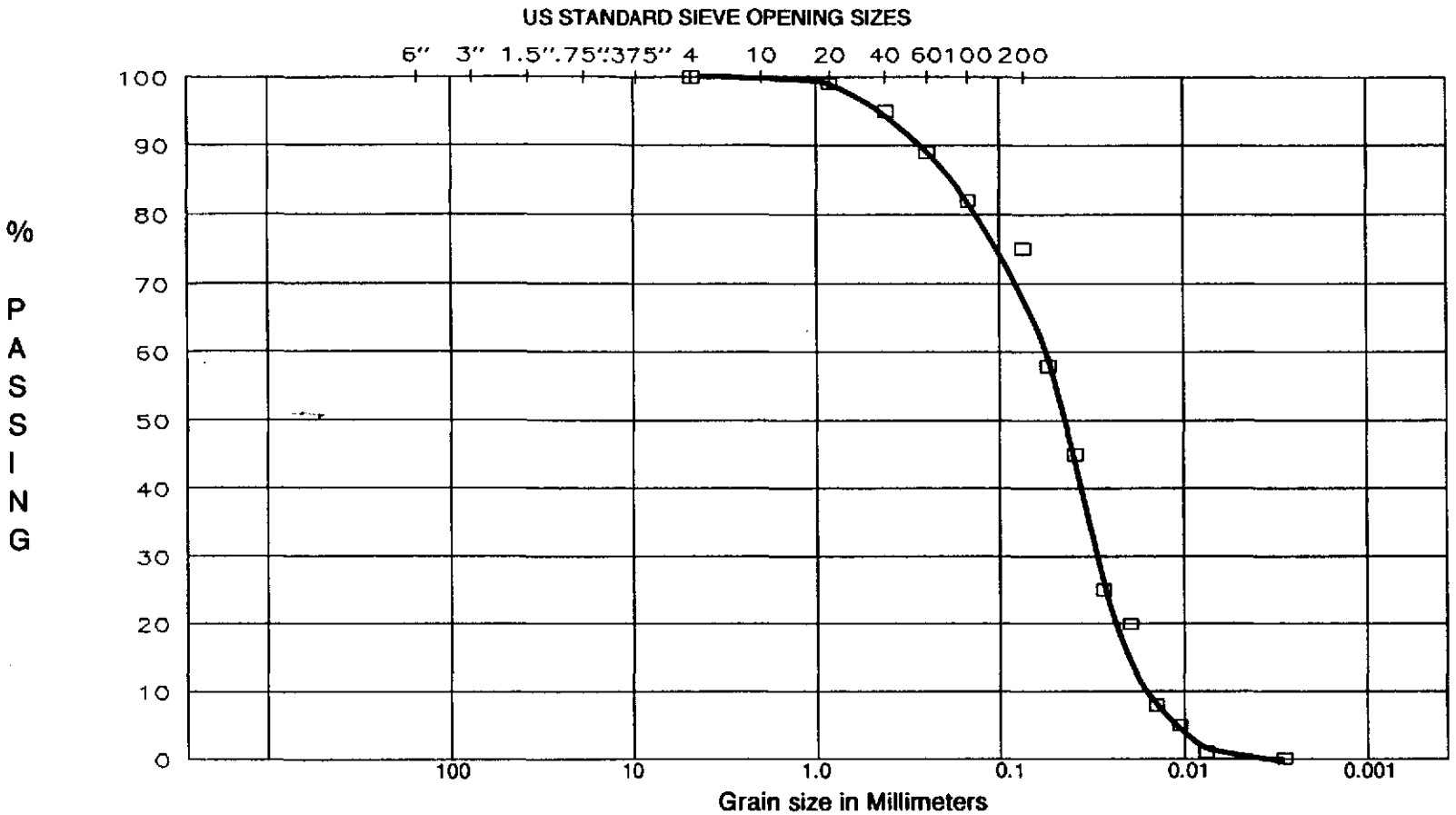
Sample Type: SPLIT SPOON Date Tested: 6/26/90

ISRT/WOBURN/MA

893-6255.5

GOLDER ASSOCIATES INC.
Consulting Engineers

PARTICLE SIZE DISTRIBUTION ASTM D-421 AND 422



COBBLES	GRAVEL coarse	GRAVEL fine	SAND c	SAND med	SAND fine	SILT	CLAY

SAMPLE ID	W%	LL	PL	PI	Other	DESCRIPTION
#2,S-1 WHP	25.2					Medium to dark brown black SILT, some f sand (ML)

Sample Type: SPLIT SPOON Date Tested: 6/23/90

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893-6255.5

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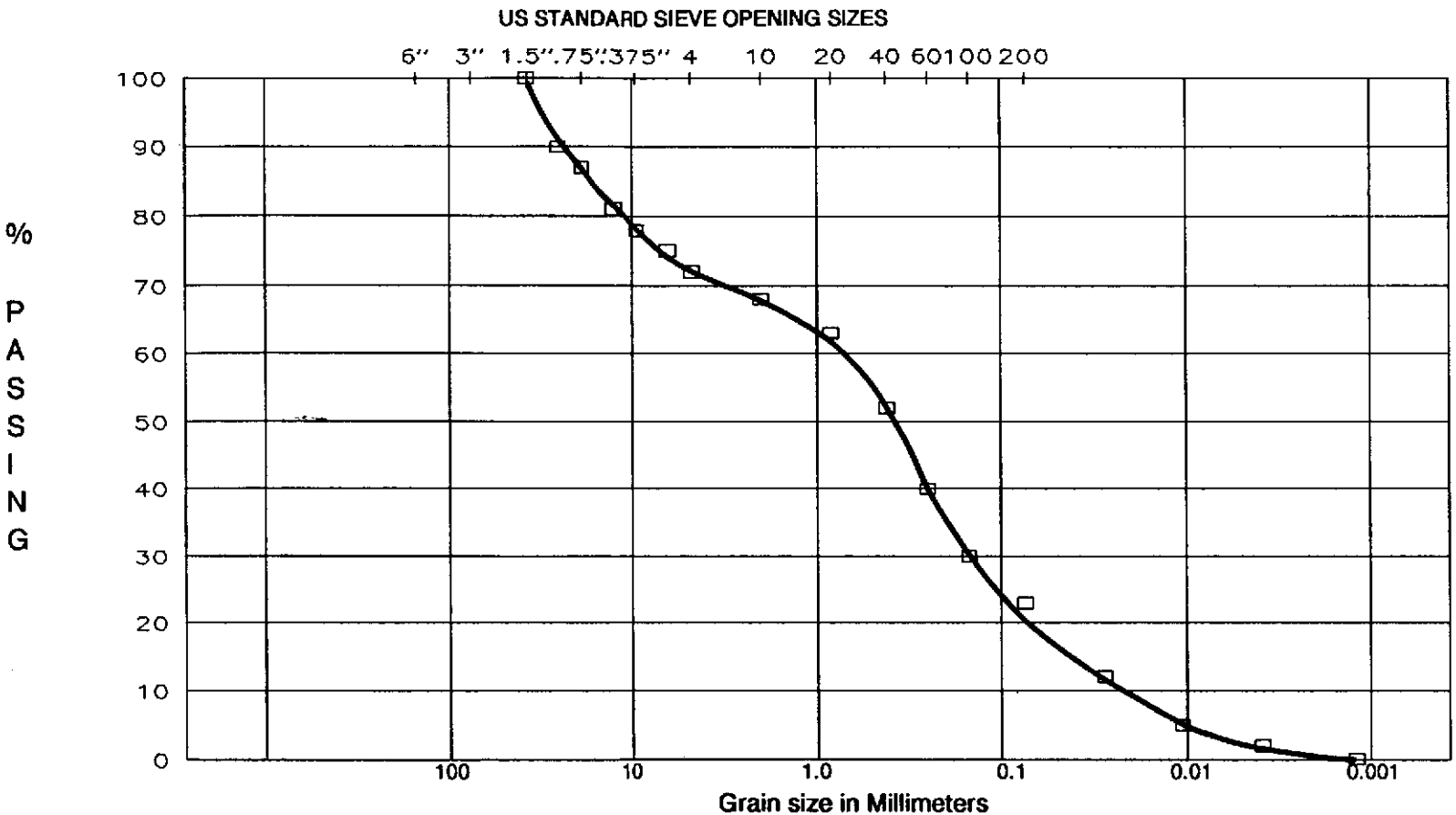
PARTICLE SIZE DISTRIBUTION ASTM D-421 AND 422



COBBLES	GRAVEL coarse	GRAVEL fine	SAND c	SAND med	SAND fine	SILT	CLAY

SAMPLE ID	W%	LL	PL	PI	Other	DESCRIPTION
#2,ST-1 WHP	25.6	NP	NP	NP		Dark brownish orange m-f SAND,some c-f gravel some silt(SP-SM)
Sample Type:	Shelby	Date Tested:	9/05/90			

ISRT/WOBURN/MA

893-6255.5

GOLDER ASSOCIATES INC.
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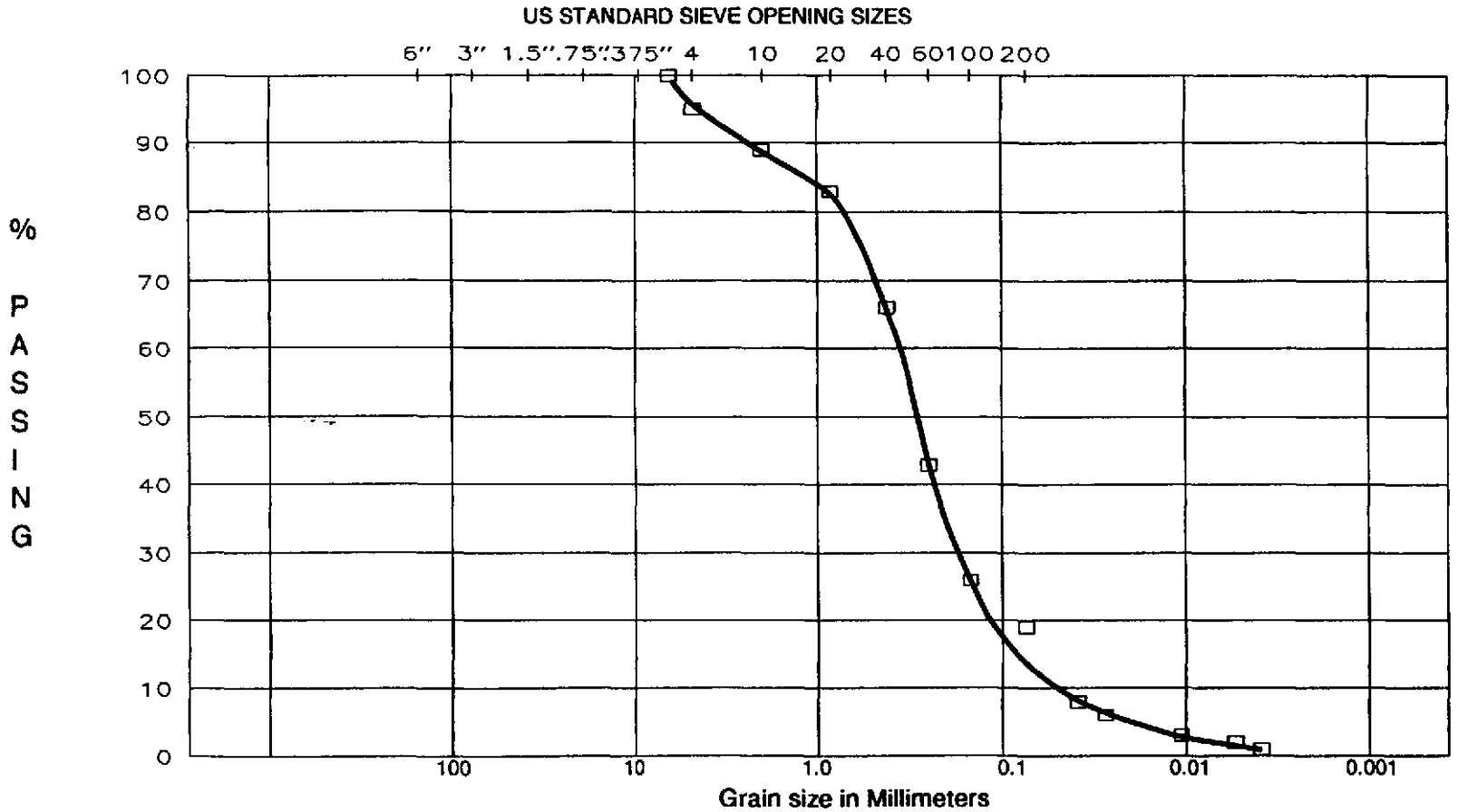
PARTICLE SIZE DISTRIBUTION ASTM D-421 AND 422



COBBLES	coarse	fine	c	med	fine	SILT	CLAY
	GRAVEL		SAND				

SAMPLE ID	W%	LL	PL	PI	Other	DESCRIPTION
#2,S-3 WHP	22.8					Moderate to brownish black f-m SAND,some silt trace gravel (SM)

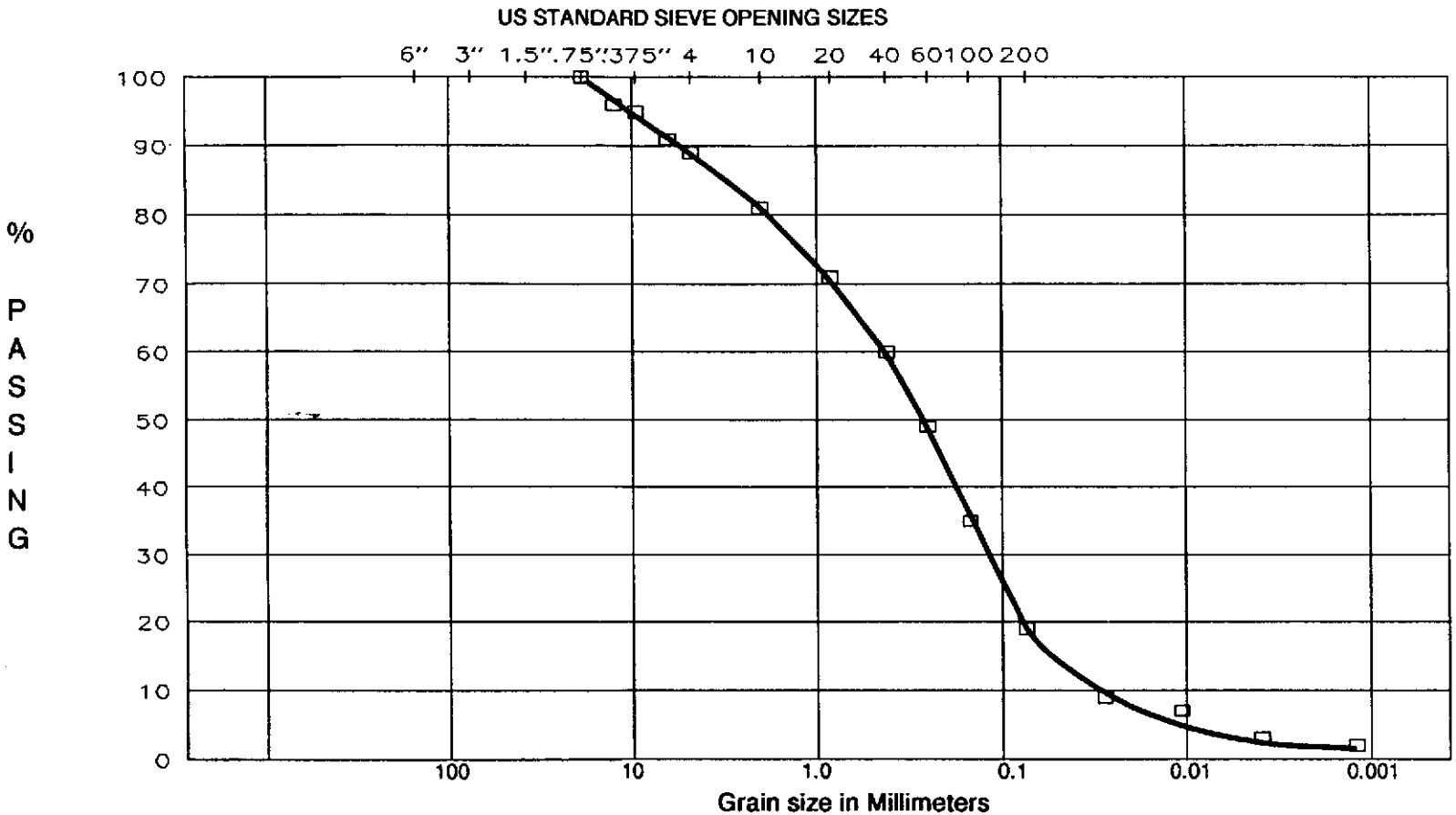
Sample Type: SPLIT SPOON Date Tested: 6/27/90

ISRT/WOBURN/MA

893-6255.5

GOLDER ASSOCIATES INC.
Consulting Engineers

PARTICLE SIZE DISTRIBUTION ASTM D-421 AND 422



COBBLES	coarse	fine	c	med	fine	SILT	CLAY
	GRAVEL		SAND				

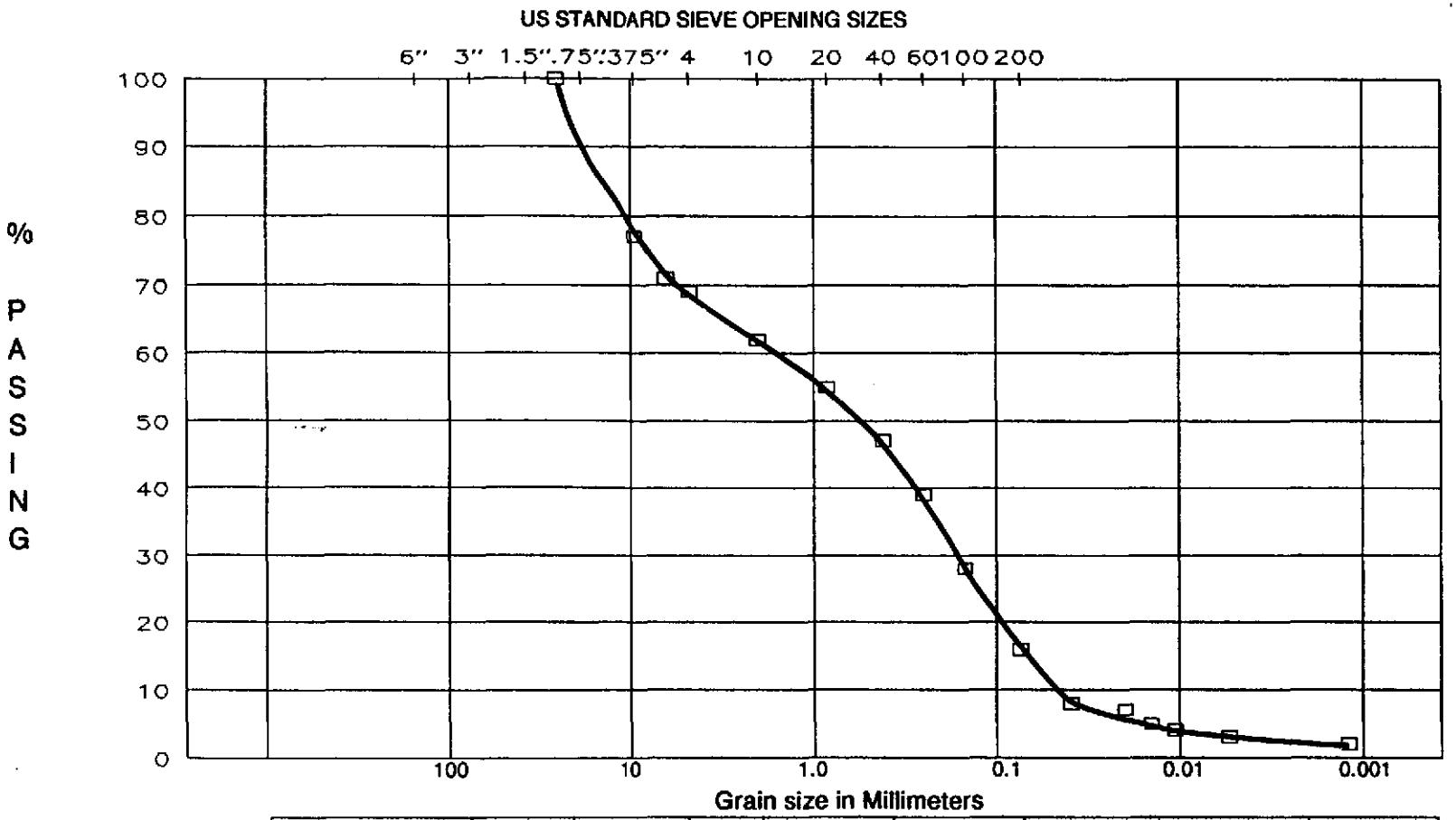
SAMPLE ID	W%	LL	PL	PI	Other	DESCRIPTION
#2,ST-2 WHP	26.9	NP	NP	NP		Moderate yellowish brown m-f SAND,some silt little f gravel(SM)
Sample Type:	Shelby	Date Tested:	9/08/90			

ISRT/WOBURN/MA

893-6255.5

GOLDER ASSOCIATES INC.
Consulting Engineers

PARTICLE SIZE DISTRIBUTION ASTM D-421 AND 422



COBBLES	GRAVEL coarse	GRAVEL fine	SAND c	SAND med	SAND fine	SILT	CLAY

SAMPLE ID	W%	LL	PL	PI	Other	DESCRIPTION
#2,S-5 WHP	36.7					Moderate to brownish black m-f SAND and c-f GRAVEL some silt (SM)

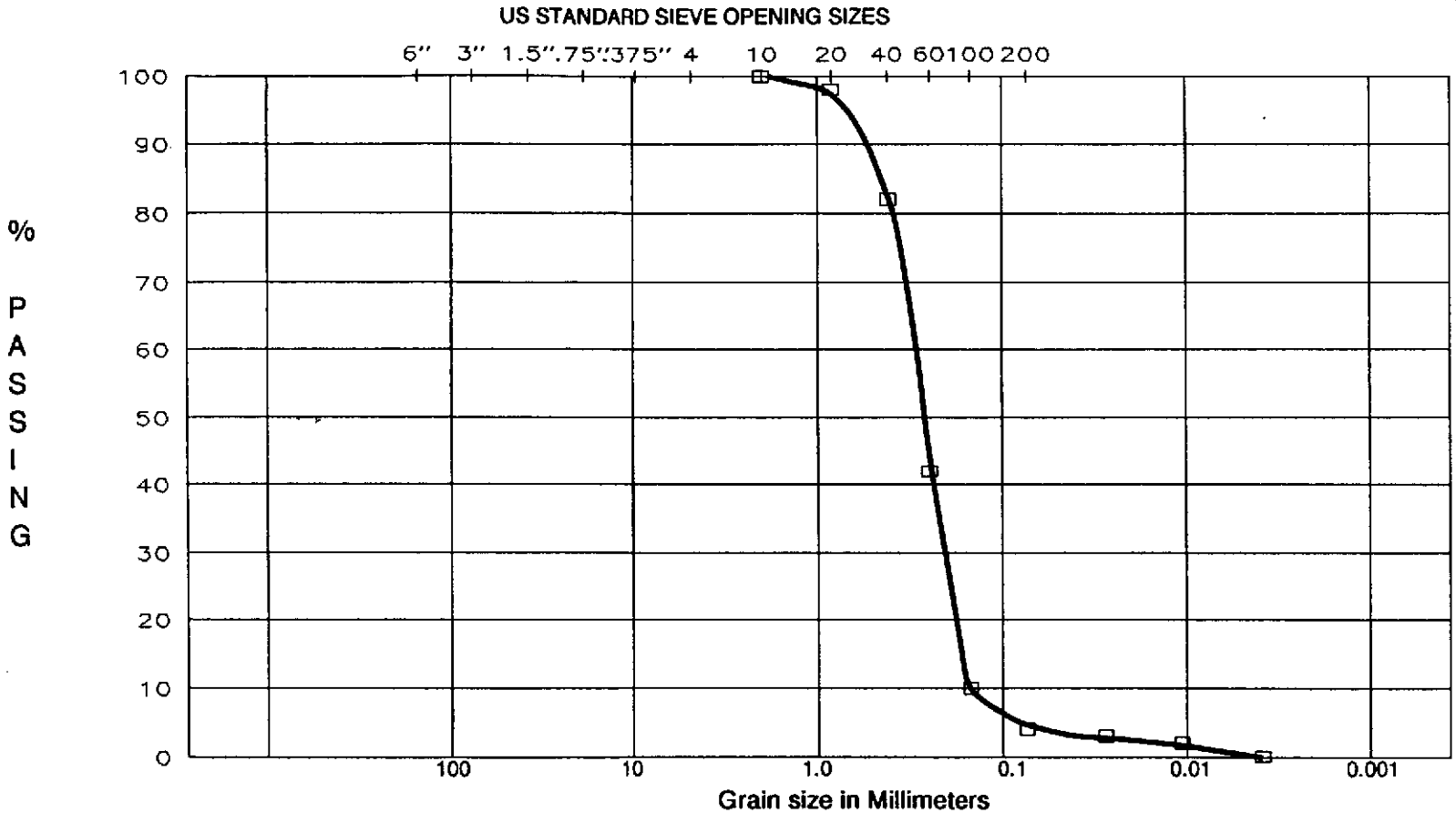
Sample Type: SPLIT SPOON Date Tested: 6/27/90

ISRT/WOBURN/MA

893-6255.5

GOLDER ASSOCIATES INC.
Consulting Engineers

PARTICLE SIZE DISTRIBUTION ASTM D-421 AND 422



COBBLES	GRAVEL coarse	GRAVEL fine	SAND c	SAND med	SAND fine	SILT	CLAY

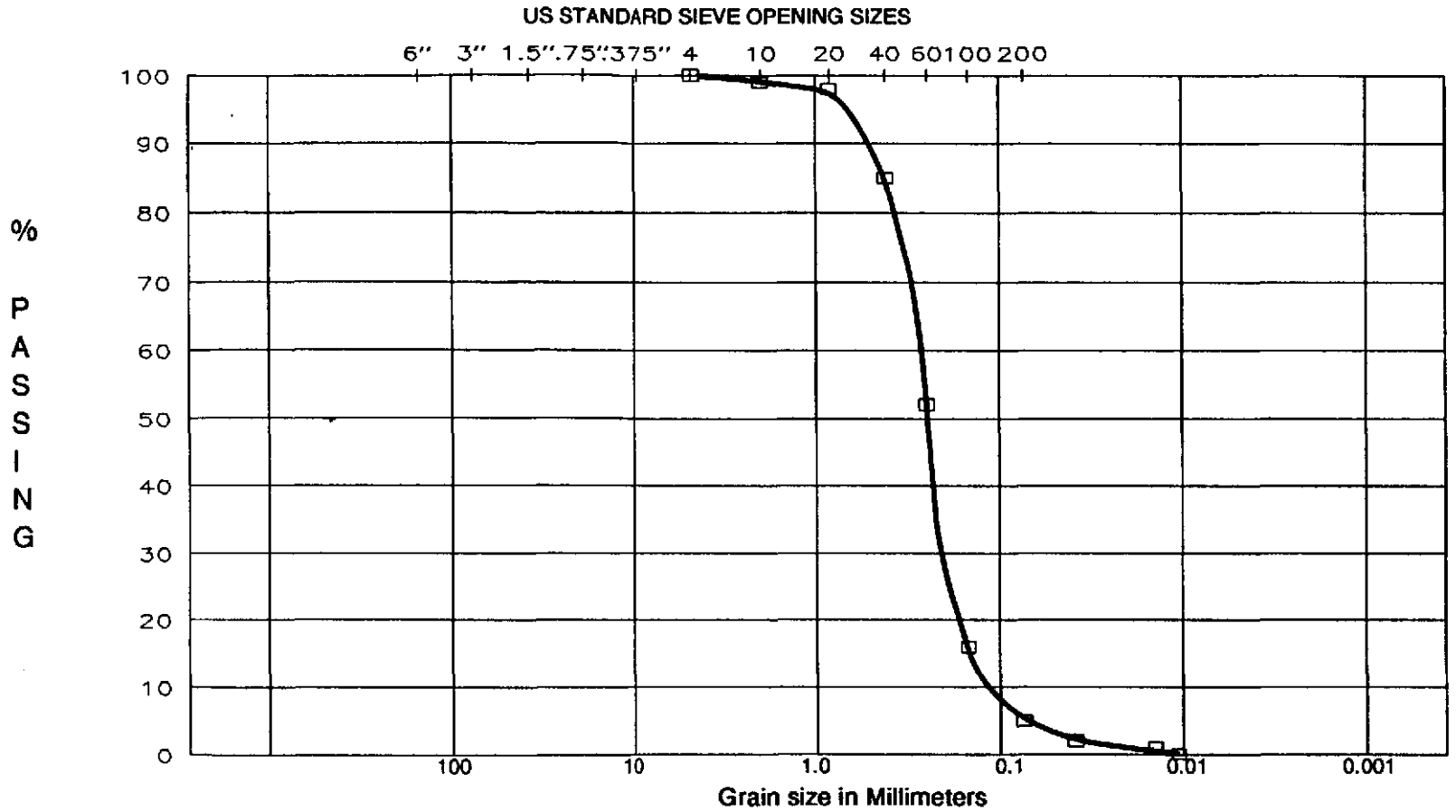
SAMPLE ID	W%	LL	PL	PI	Other	DESCRIPTION
#2,ST-3 WHP	12.8	NP	NP	NP		Moderate yellowish brown m-f SAND trace silt(SP)
Sample Type:	Shelby	Date Tested:	9/05/90			

ISRT/WOBURN/MA

893-6255.5

GOLDER ASSOCIATES INC.
Consulting Engineers

PARTICLE SIZE DISTRIBUTION ASTM D-421 AND 422



COBBLES	GRAVEL (coarse, fine)	SAND (c, med, fine)	SILT	CLAY

SAMPLE ID	W%	LL	PL	PI	Other	DESCRIPTION
#2,S-7 WHP	15.2					Medium to dark brown black m-f SAND , trace silt (SP)

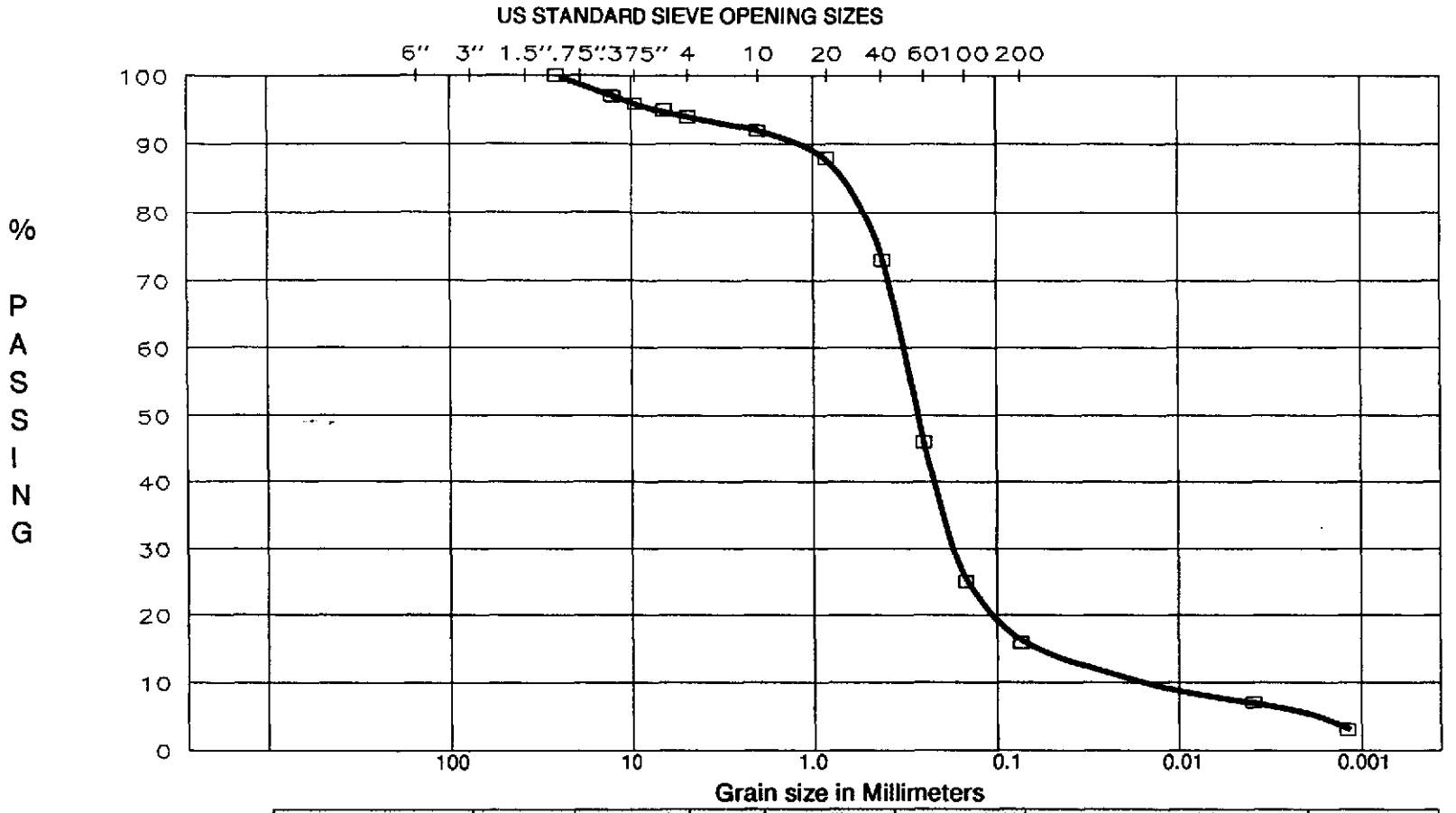
Sample Type: SPLIT SPOON Date Tested: 6/27/90

ISRT/WOBURN/MA

893-6255.5

GOLDER ASSOCIATES INC.
Consulting Engineers

PARTICLE SIZE DISTRIBUTION ASTM D-421 AND 422



COBBLES	GRAVEL coarse	GRAVEL fine	SAND c	SAND med	SAND fine	SILT	CLAY

SAMPLE ID	W%	LL	PL	PI	Other	DESCRIPTION
BH-3,WHP 0-5'	27.8	NP	NP	NP		Dusky brown m-f SAND,some fines little f gravel(SM)

Sample Type: Bulk Date Tested: 9/19/90

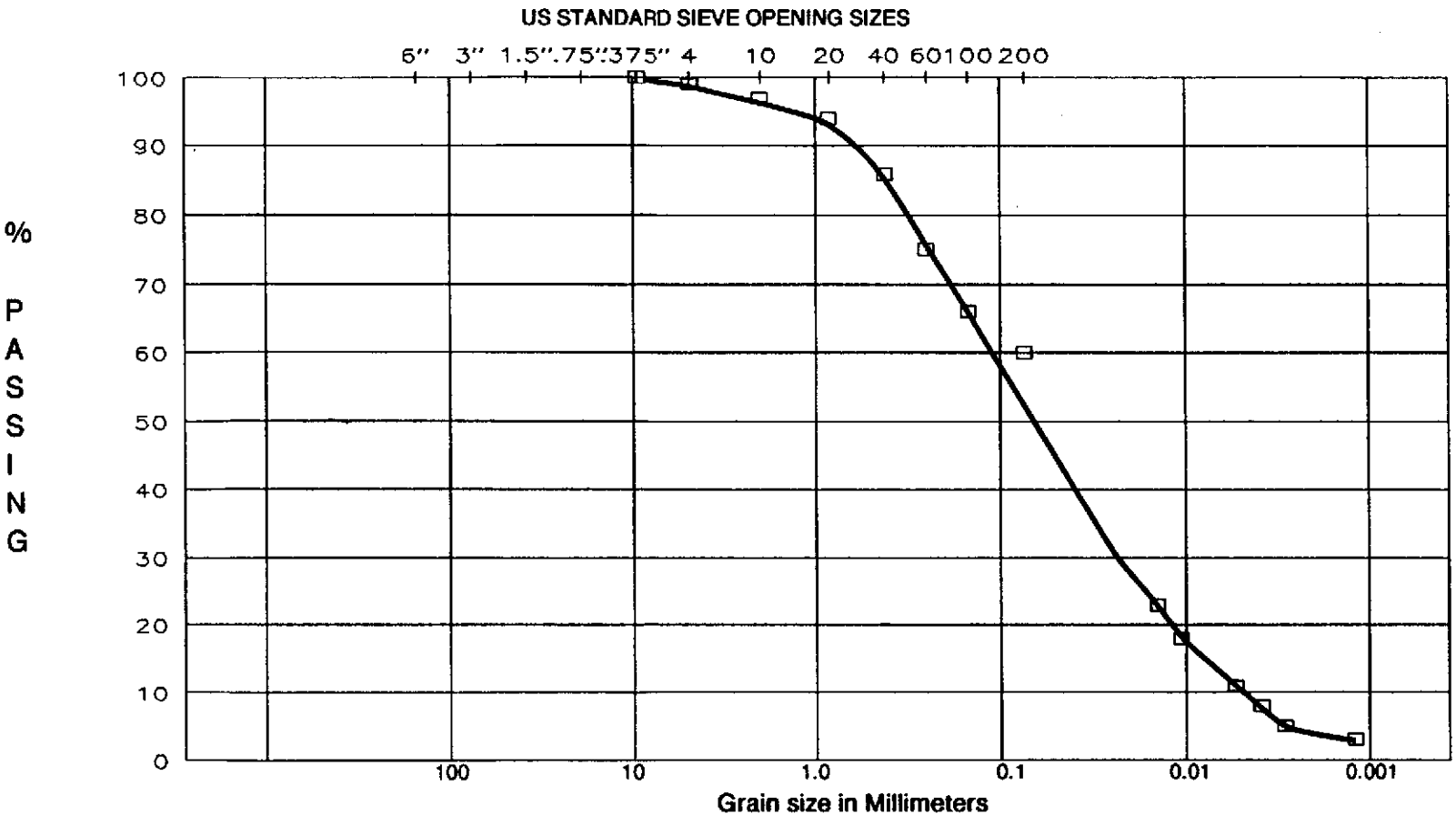
ISRT/WOBURN/MA

893-6255

GOLDER ASSOCIATES INC.

Consulting Engineers

PARTICLE SIZE DISTRIBUTION ASTM D-421 AND 422



COBBLES	GRAVEL coarse	GRAVEL fine	SAND c	SAND med	SAND fine	SILT	CLAY

SAMPLE ID	W%	LL	PL	PI	Other	DESCRIPTION
#3,S-1 WHP	41.7	NP	NP	NP		Medium to dark brown black SILT and m-f SAND trace f gravel (ML)

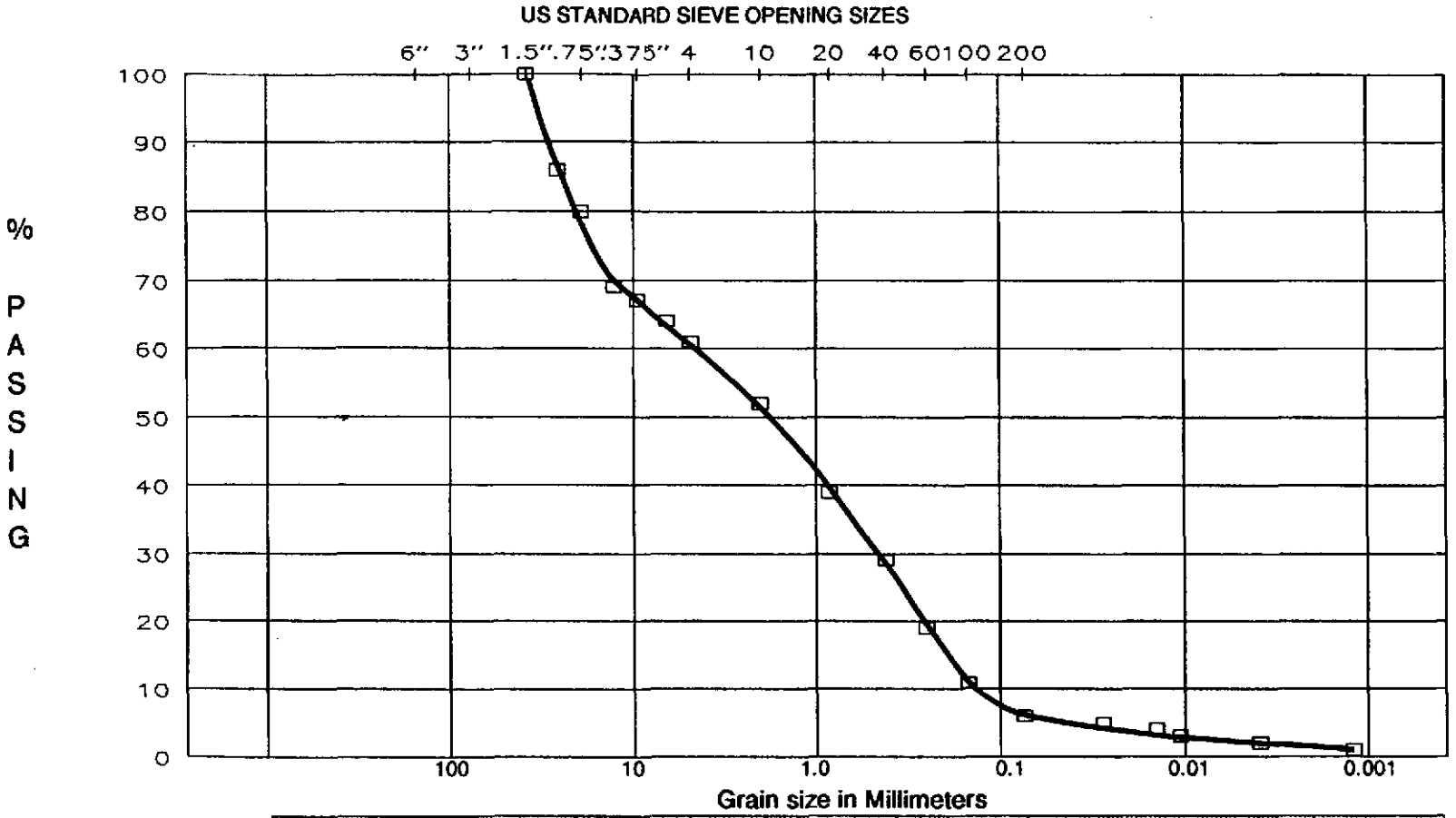
Sample Type: SPLIT SPOON Date Tested: 6/28/90

ISRT/WOBURN/MA

893-6255.5

GOLDER ASSOCIATES INC.
Consulting Engineers

PARTICLE SIZE DISTRIBUTION ASTM D-421 AND 422



COBBLES	GRAVEL coarse	GRAVEL fine	SAND c	SAND med	SAND fine	SILT	CLAY

SAMPLE ID	W%	LL	PL	PI	Other	DESCRIPTION
#3,S-4 WHP	13					Medium to dark brown black m-f SAND and c-f GRAVEL little silt (SP-SM)

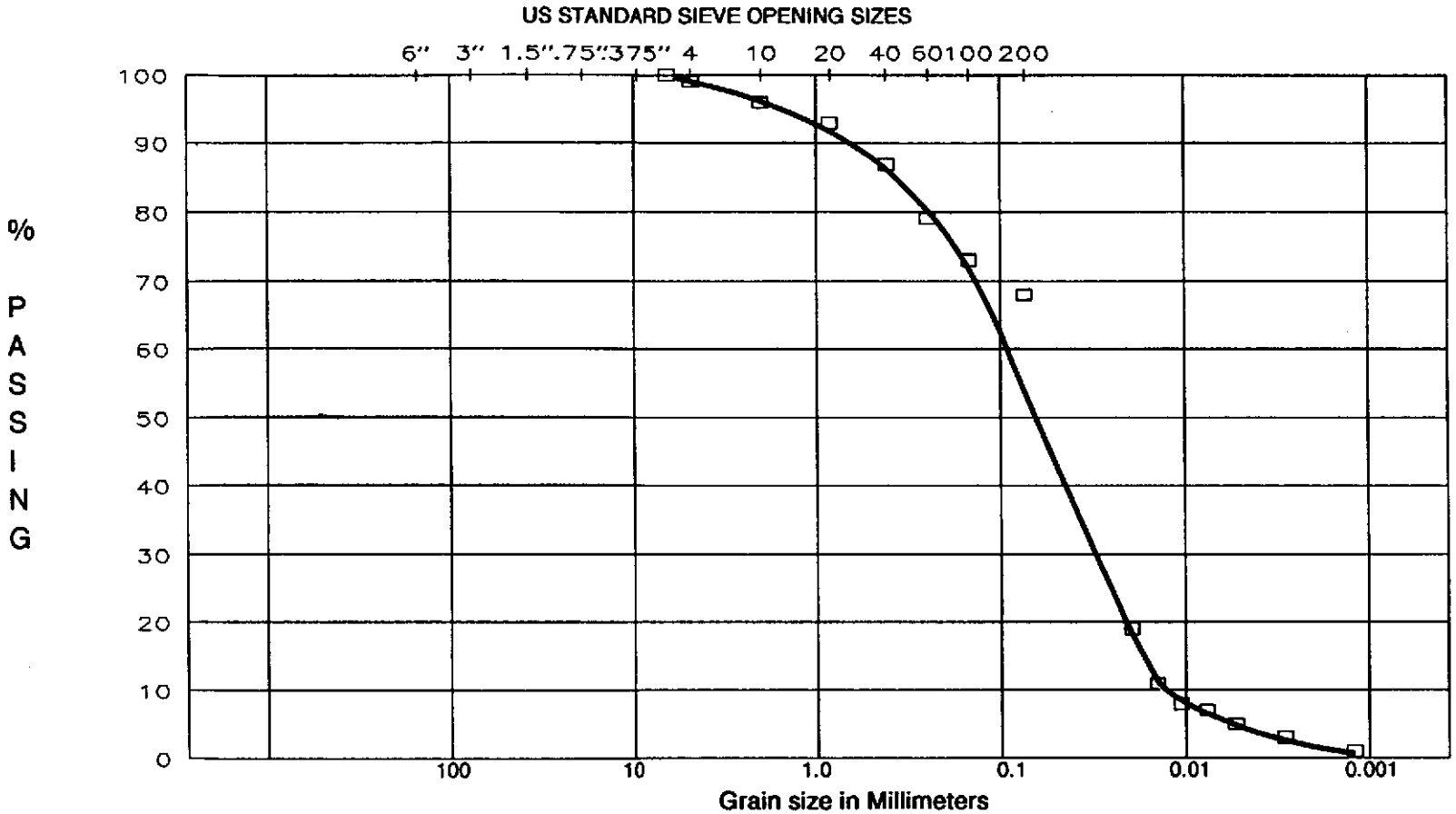
Sample Type: SPLIT SPOON Date Tested: 6/23/90

ISRT/WOBURN/MA

893-6255.5

GOLDER ASSOCIATES INC.
Consulting Engineers

PARTICLE SIZE DISTRIBUTION ASTM D-421 AND 422



COBBLES	GRAVEL coarse	GRAVEL fine	SAND c	SAND med	SAND fine	SILT	CLAY

SAMPLE ID	W%	LL	PL	PI	Other	DESCRIPTION
#5,S-2 WHP	56.1	NP	NP	NP		Medium to dark brown black SILT and f SAND trace f gravel (ML)

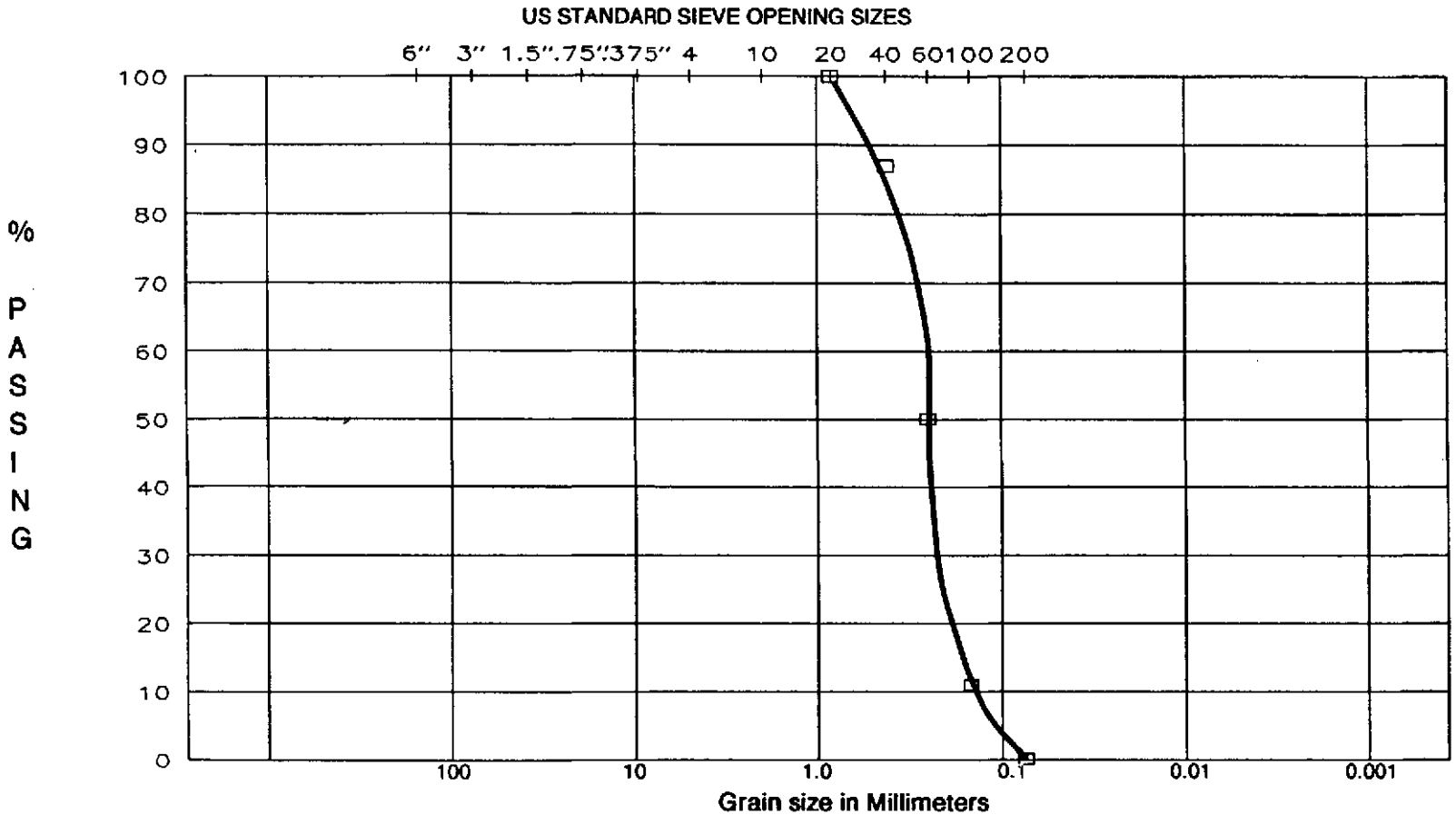
Sample Type: SPLIT SPOON Date Tested: 6/28/90

ISRT/WOBURN/MA

893-6255.5

GOLDER ASSOCIATES INC.
Consulting Engineers

PARTICLE SIZE DISTRIBUTION ASTM D-421 AND 422



COBBLES	GRAVEL coarse	GRAVEL fine	SAND c	SAND med	SAND fine	SILT	CLAY

SAMPLE ID	W%	LL	PL	PI	Other	DESCRIPTION
#5,S-3 WHP	26.9					Medium to dark brown black m-f SAND (SP) trace organics

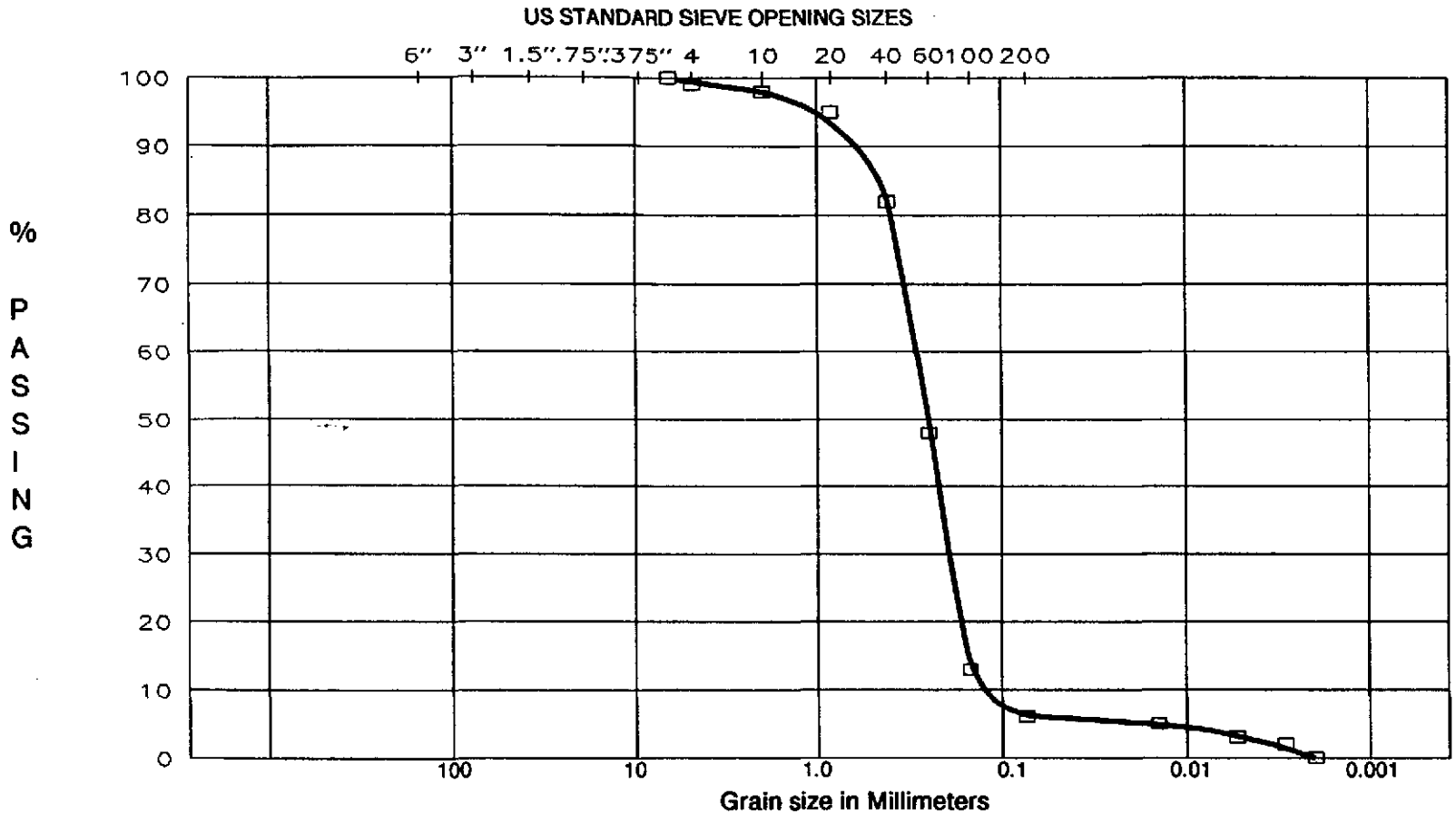
Sample Type: SPLIT SPOON Date Tested: 6/28/90

ISRT/WOBURN/MA

893-6255.5

GOLDER ASSOCIATES INC.
Consulting Engineers

PARTICLE SIZE DISTRIBUTION ASTM D-421 AND 422



COBBLES	GRAVEL coarse	GRAVEL fine	SAND c	SAND med	SAND fine	SILT	CLAY

SAMPLE ID	W%	LL	PL	PI	Other	DESCRIPTION
#7,S-3 WHP	18.1					Medium to dark brown black m-f SAND, trace silt trace f gravel (SP)

Sample Type: SPLIT SPOON Date Tested: 6/28/90

ISRT/WOBURN/MA

893-6255.5

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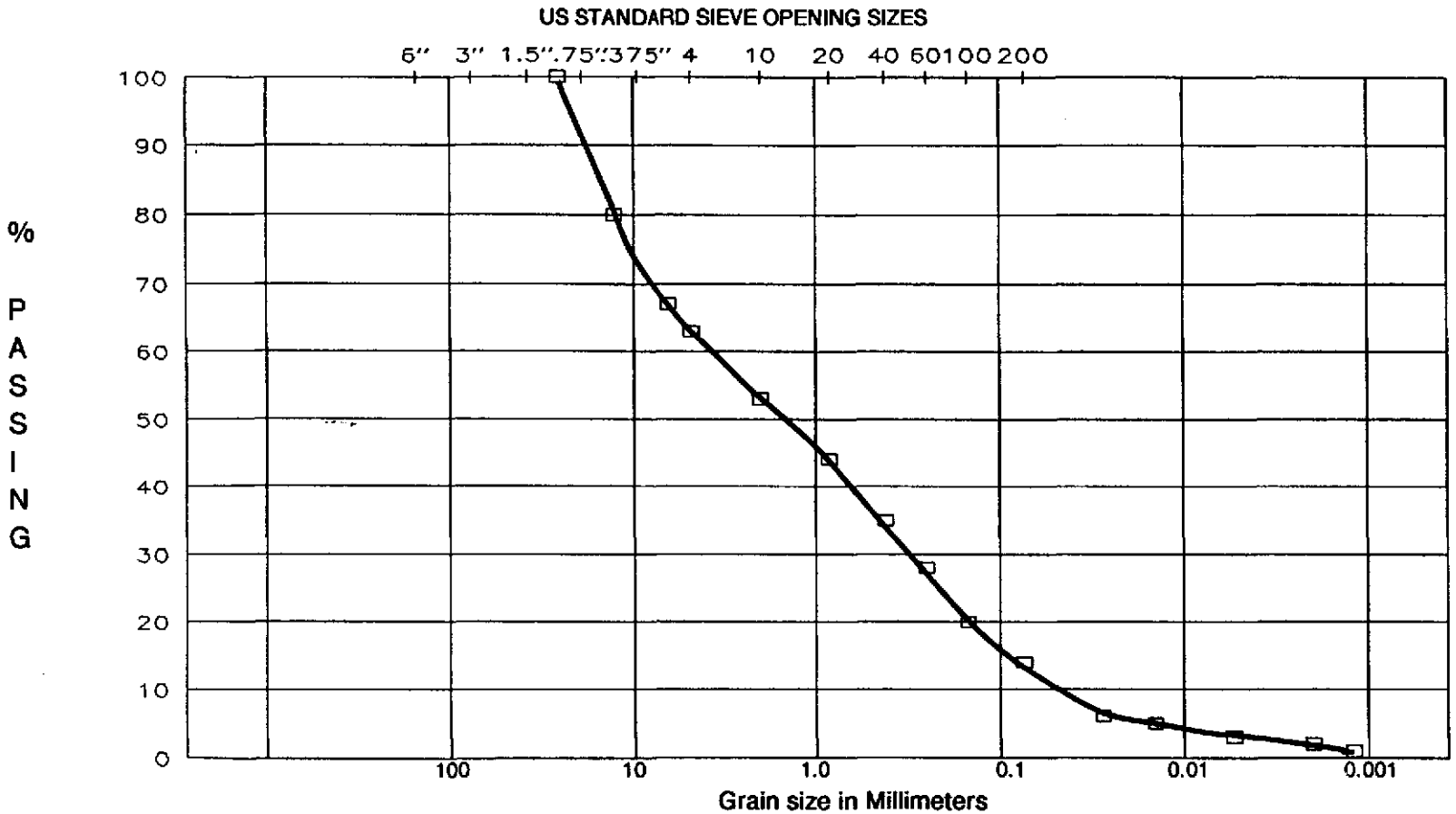
PARTICLE SIZE DISTRIBUTION ASTM D-421 AND 422



COBBLES	GRAVEL coarse	GRAVEL fine	SAND c	SAND med	SAND fine	SILT	CLAY

SAMPLE ID	W%	LL	PL	PI	Other	DESCRIPTION
#7,S-4 WHP	8.9	NP	NP	NP		Moderate to brownish black c-f SAND and c-f GRAVEL little silt (SW)

Sample Type: Split Spoon Date Tested: 6/23/90

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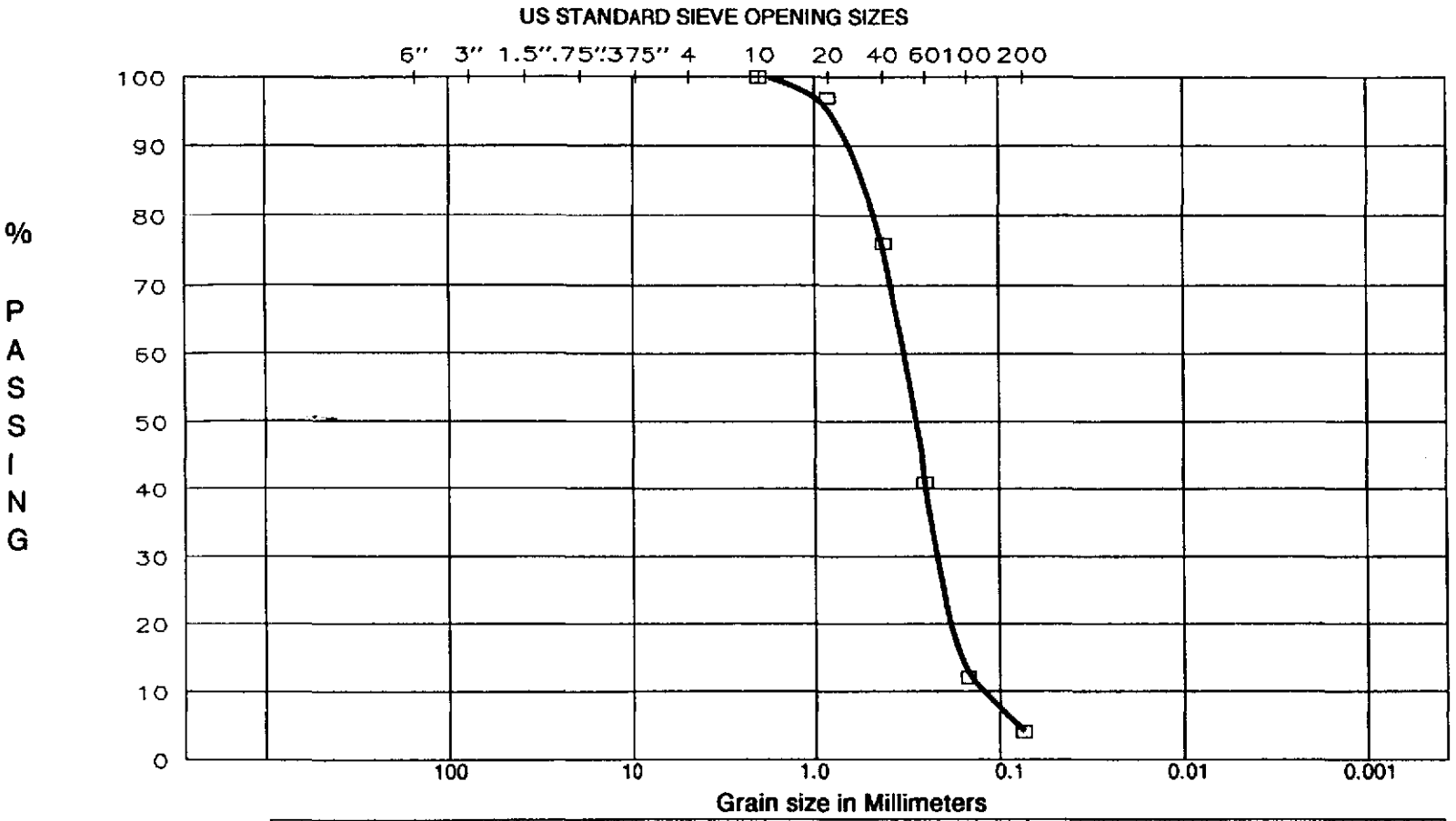
PARTICLE SIZE DISTRIBUTION ASTM D-421 AND 422



COBBLES	coarse	fine	c	med	fine	SILT	CLAY
	GRAVEL		SAND				

SAMPLE ID	W%	LL	PL	PI	Other	DESCRIPTION
#8,S-3 WHP	27					Medium to dark brown black m-f SAND, trace silt (SP)

Sample Type: SPLIT SPOON Date Tested: 6/28/90

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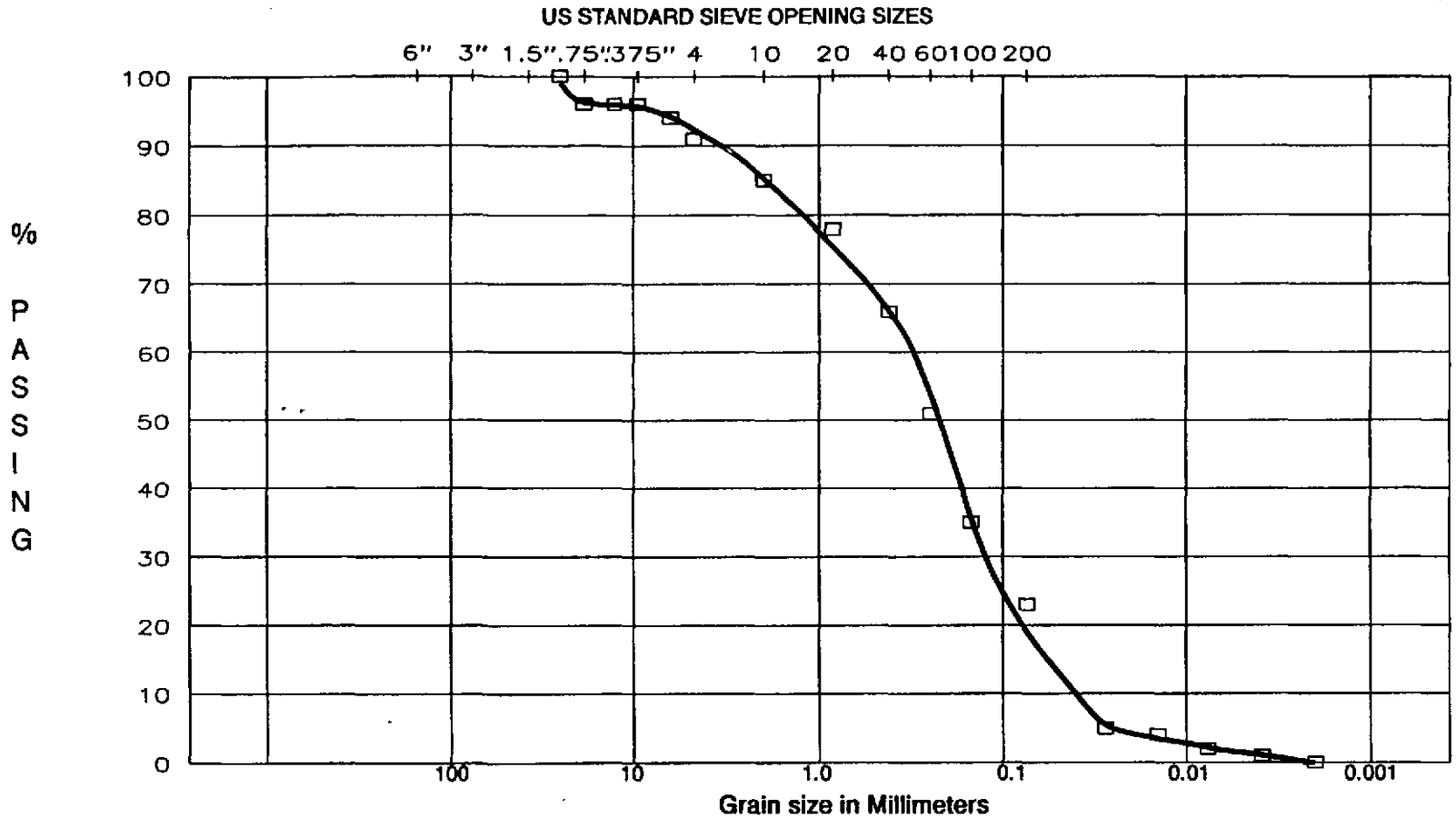
PARTICLE SIZE DISTRIBUTION ASTM D-421 AND 422



COBBLES	GRAVEL coarse	GRAVEL fine	SAND c	SAND med	SAND fine	SILT	CLAY

SAMPLE ID	W%	LL	PL	PI	Other	DESCRIPTION
#9,S-1 EHP	17.5					Medium to dark brown black m-f SAND,some silt,little c-f gravel (SM)

Sample Type: Split Spoon Date Tested: 6/23/90

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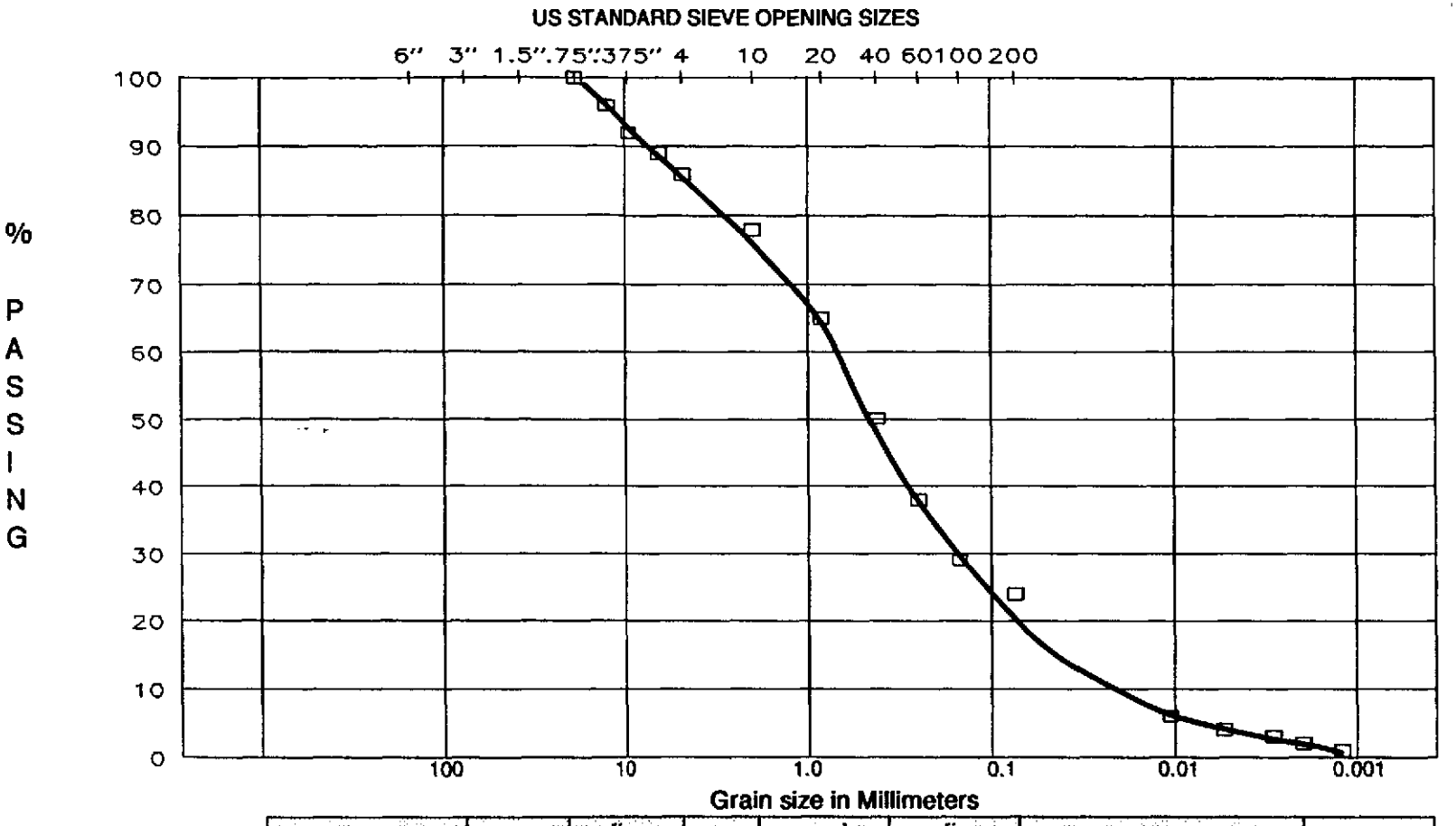
PARTICLE SIZE DISTRIBUTION ASTM D-421 AND 422



COBBLES	GRAVEL coarse	GRAVEL fine	SAND c	SAND med	SAND fine	SILT	CLAY

SAMPLE ID	W%	LL	PL	PI	Other	DESCRIPTION
#9,S-2 EHP	45.8	NP	NP	NP		Medium to dark brown black m-f SAND,some silt little f gravel (SM)

Sample Type: Split Spoon Date Tested: 6/23/90

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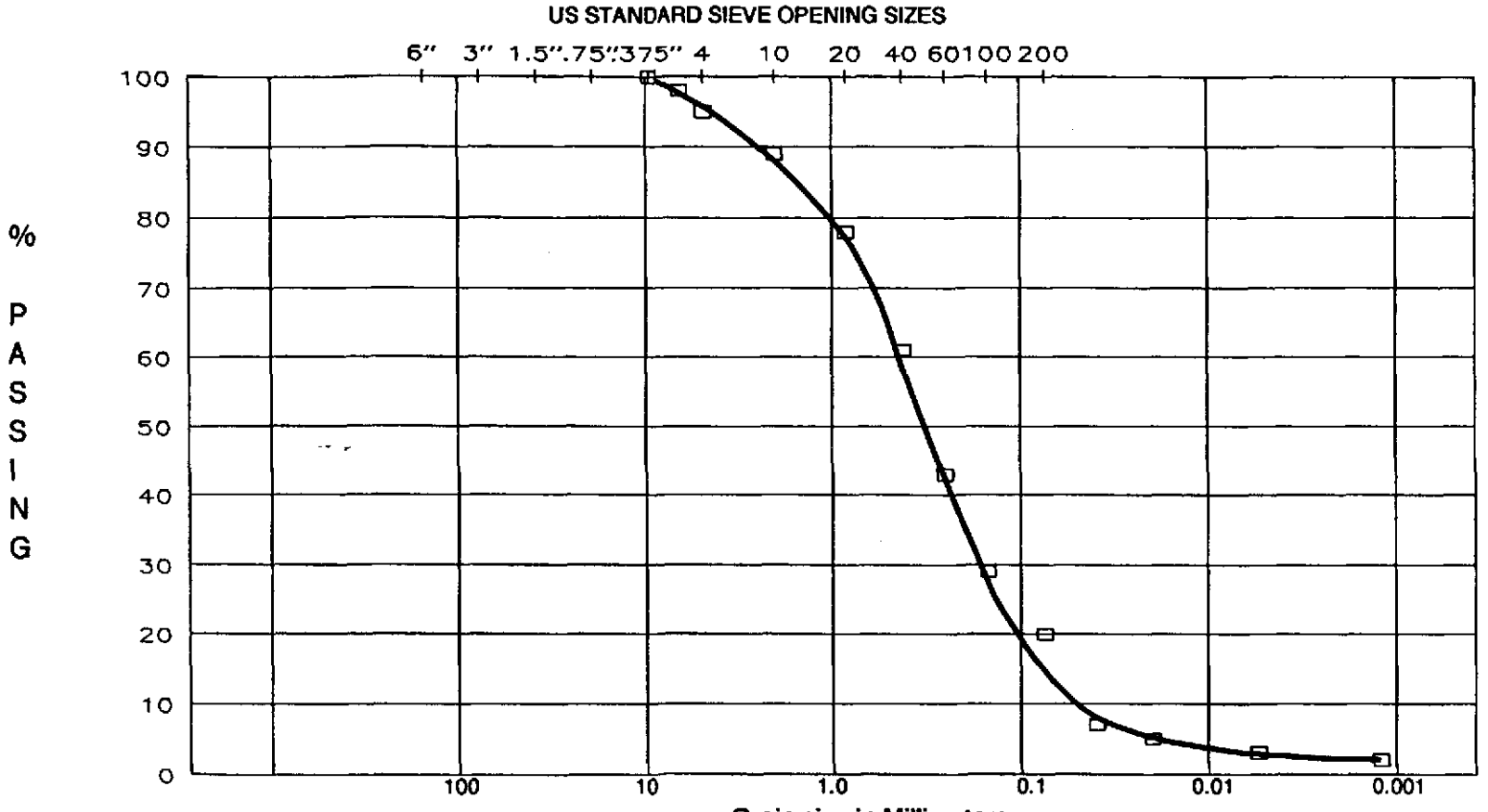
PARTICLE SIZE DISTRIBUTION ASTM D-421 AND 422



COBBLES	GRAVEL coarse	GRAVEL fine	SAND c	SAND med	SAND fine	SILT	CLAY

SAMPLE ID	W%	LL	PL	PI	Other	DESCRIPTION
#9,S-4 EHP	21	NP	NP	NP		Medium to dark brown black m-f SAND,some fines trace f gravel (SM)

Sample Type: Split Spoon Date Tested: 7/2/90

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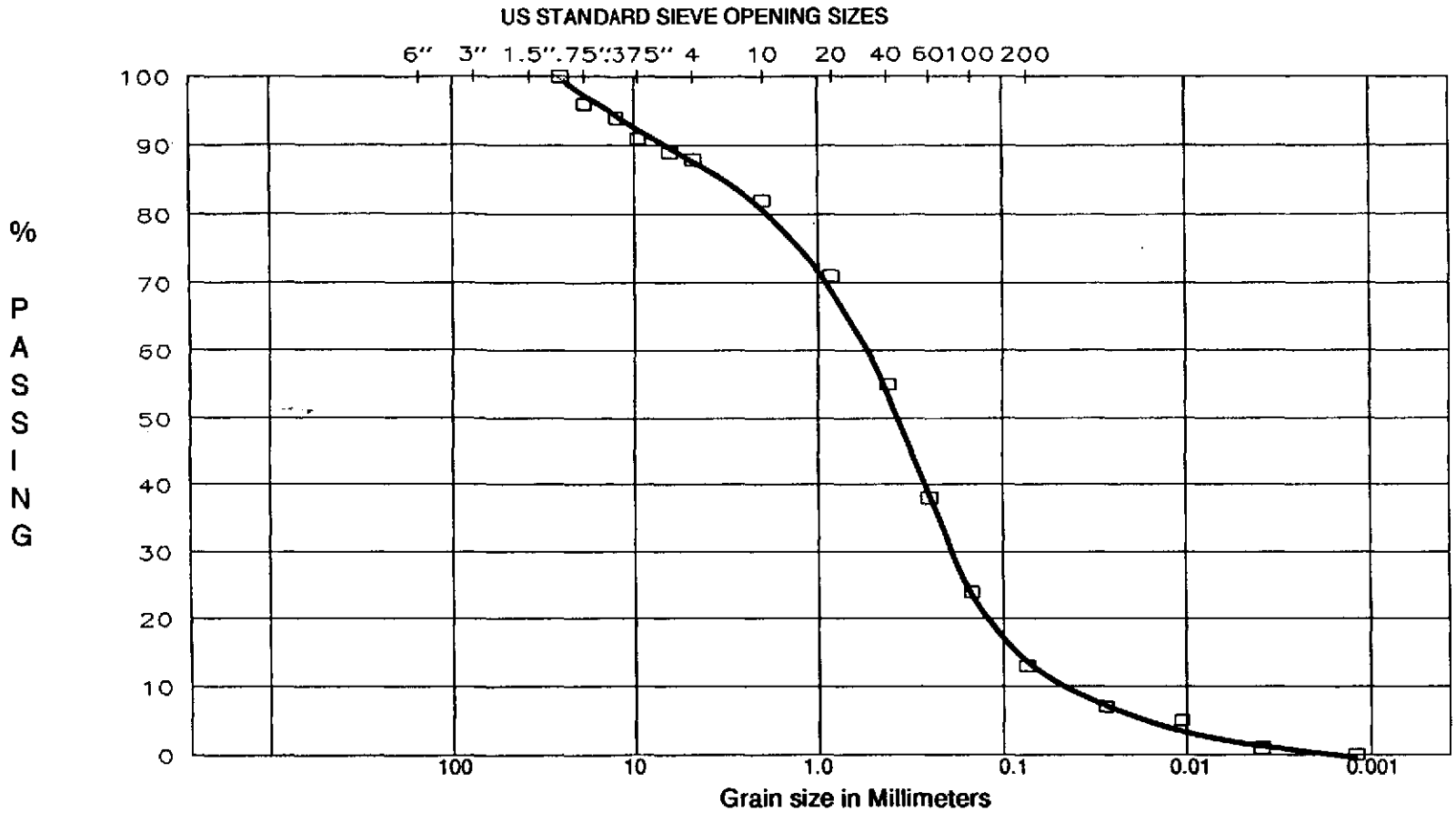
PARTICLE SIZE DISTRIBUTION ASTM D-421 AND 422



COBBLES	GRAVEL coarse	GRAVEL fine	SAND c	SAND med	SAND fine	SILT	CLAY

SAMPLE ID	W%	LL	PL	PI	Other	DESCRIPTION
#9,ST-2 EHP	21.4	NP	NP	NP		Medium brownish black m-f SAND,little c-f gravel little silt(SP)
Sample Type:	Shelby	Date Tested:	9/13/90			

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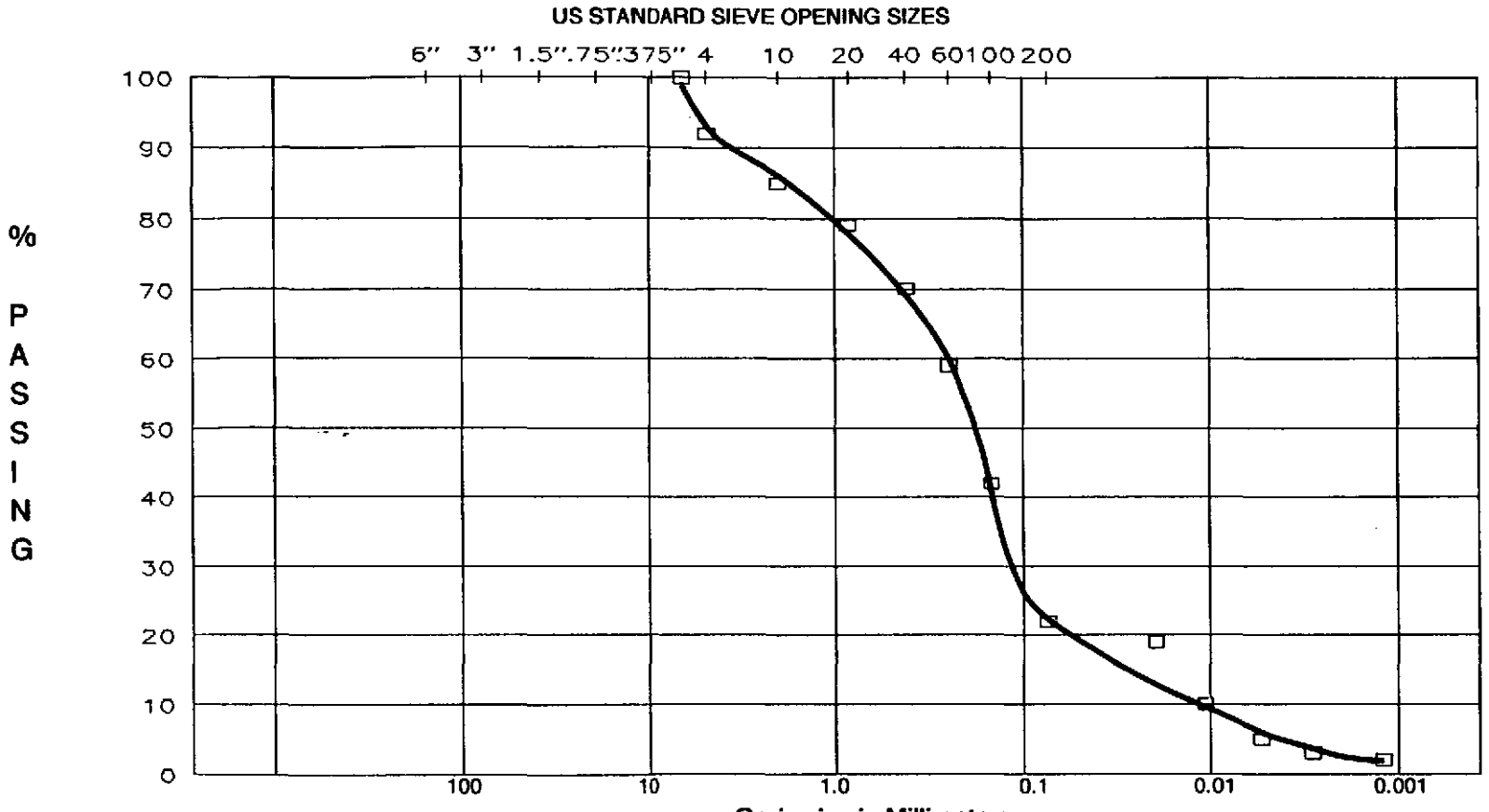

COBBLES	GRAVEL coarse	GRAVEL fine	SAND c	SAND med	SAND fine	SILT	CLAY

SAMPLE ID	W%	LL	PL	PI	Other	DESCRIPTION
#9,S-7 EHP	37.2					Medium to dark brown black f-m SAND,some silt, little f gravel (SM)

Sample Type: Split Spoon Date Tested: 6/28/90

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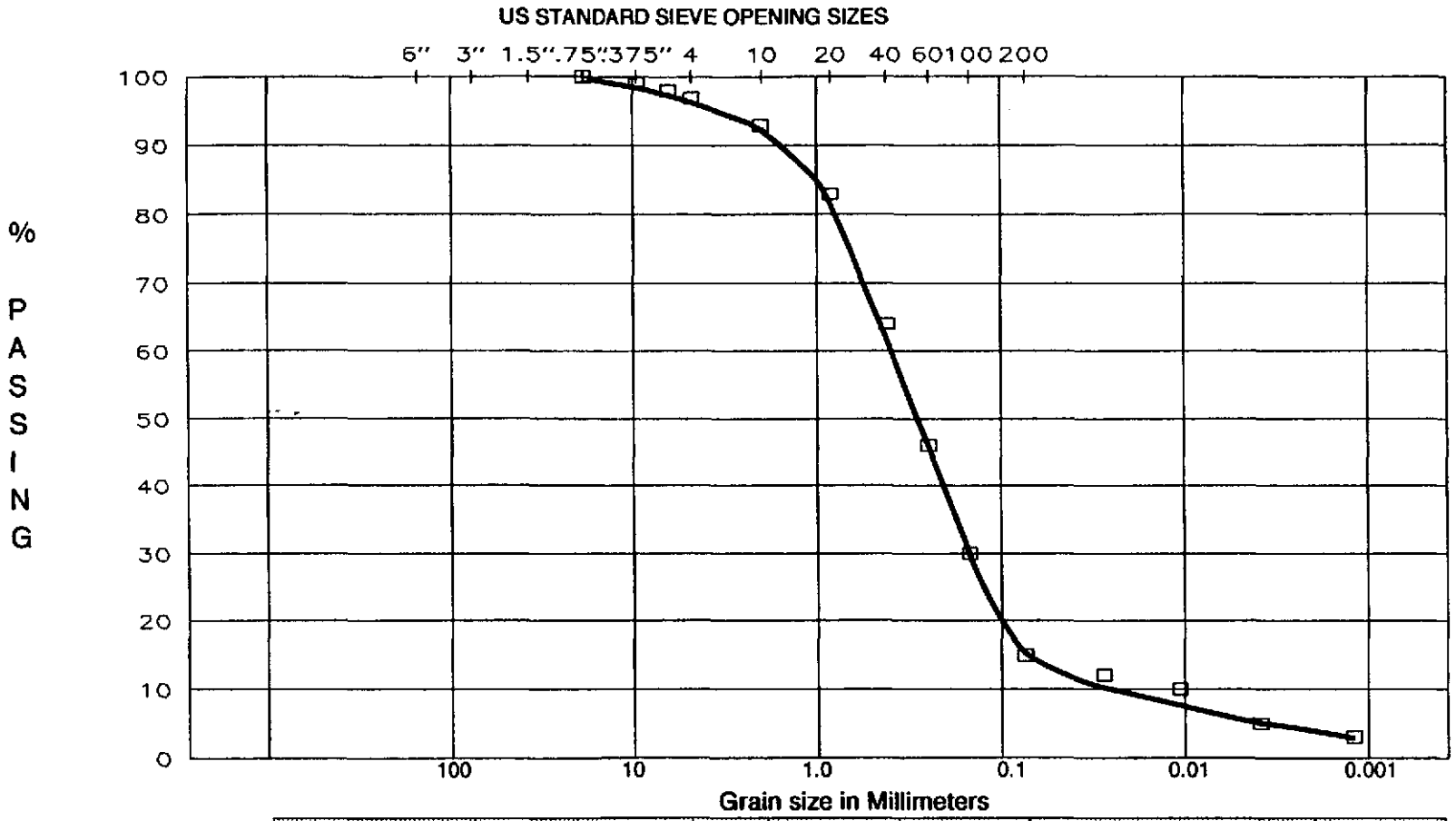

COBBLES	coarse	fine	c	med	fine	SILT	CLAY
	GRAVEL		SAND				

SAMPLE ID	W%	LL	PL	PI	Other	DESCRIPTION
#10,BULK EHP	23.4	NP	NP	NP		Dark gray m-f SAND,some silt trace f gravel (SM)
Sample Type:	Shelby	Date Tested:	9/10/90			

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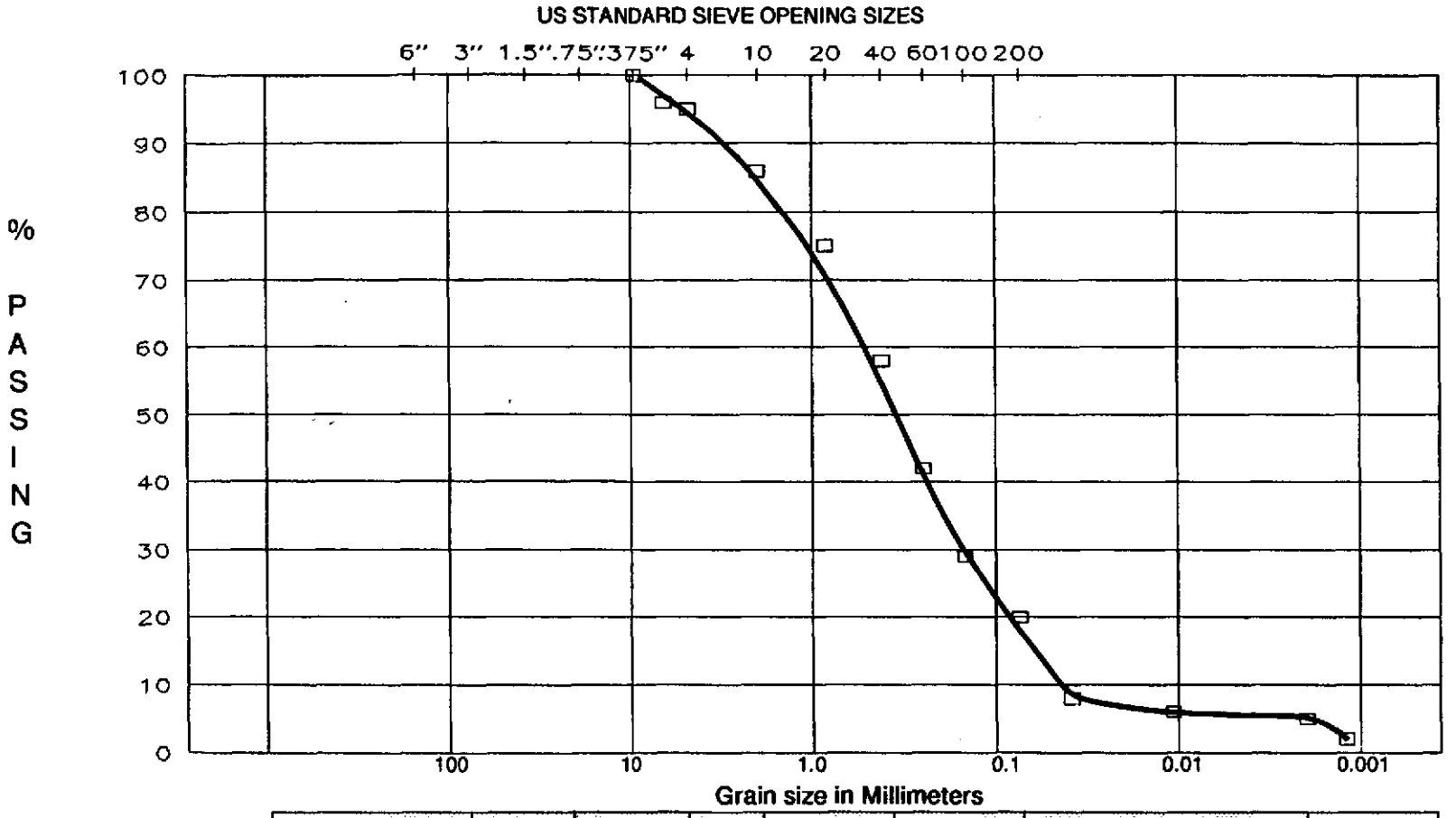

COBBLES	coarse	fine	c	med	fine	SILT	CLAY
	GRAVEL		SAND				

SAMPLE ID	W%	LL	PL	PI	Other	DESCRIPTION
#10,S-1 EHP	14.3	NP	NP	NP		Medium to dark brown black m-f SAND,some silt little f gravel (SM)

Sample Type: Split Spoon Date Tested: 7/2/90

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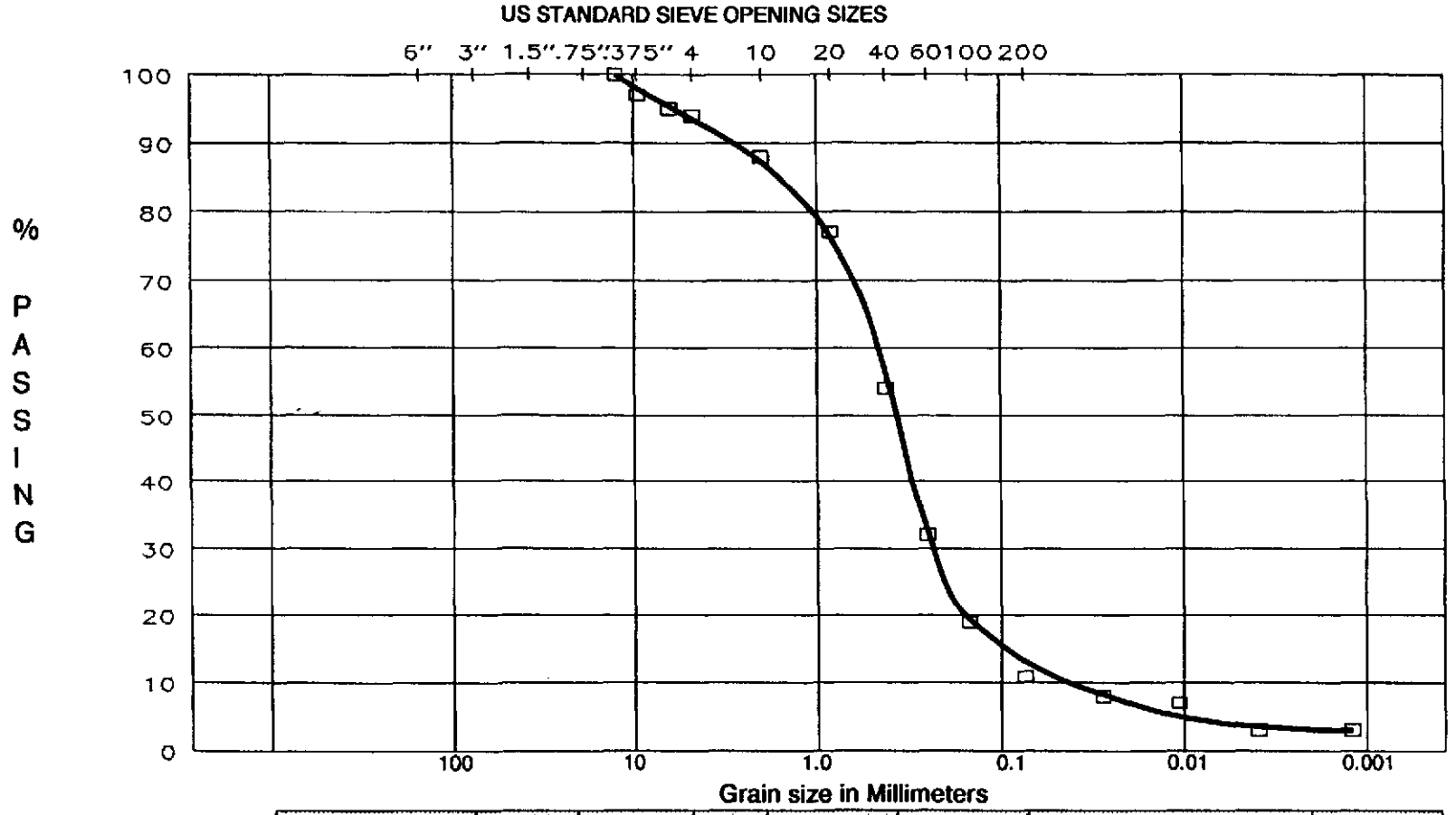

COBBLES	GRAVEL coarse	GRAVEL fine	SAND c	SAND med	SAND fine	SILT	CLAY

SAMPLE ID	W%	LL	PL	PI	Other	DESCRIPTION
#10,ST-3 EHP	23.6	NP	NP	NP		Medium brown m-f SAND,little silt little f gravel(SP)
Sample Type:	Shelby	Date Tested:	9/05/90			

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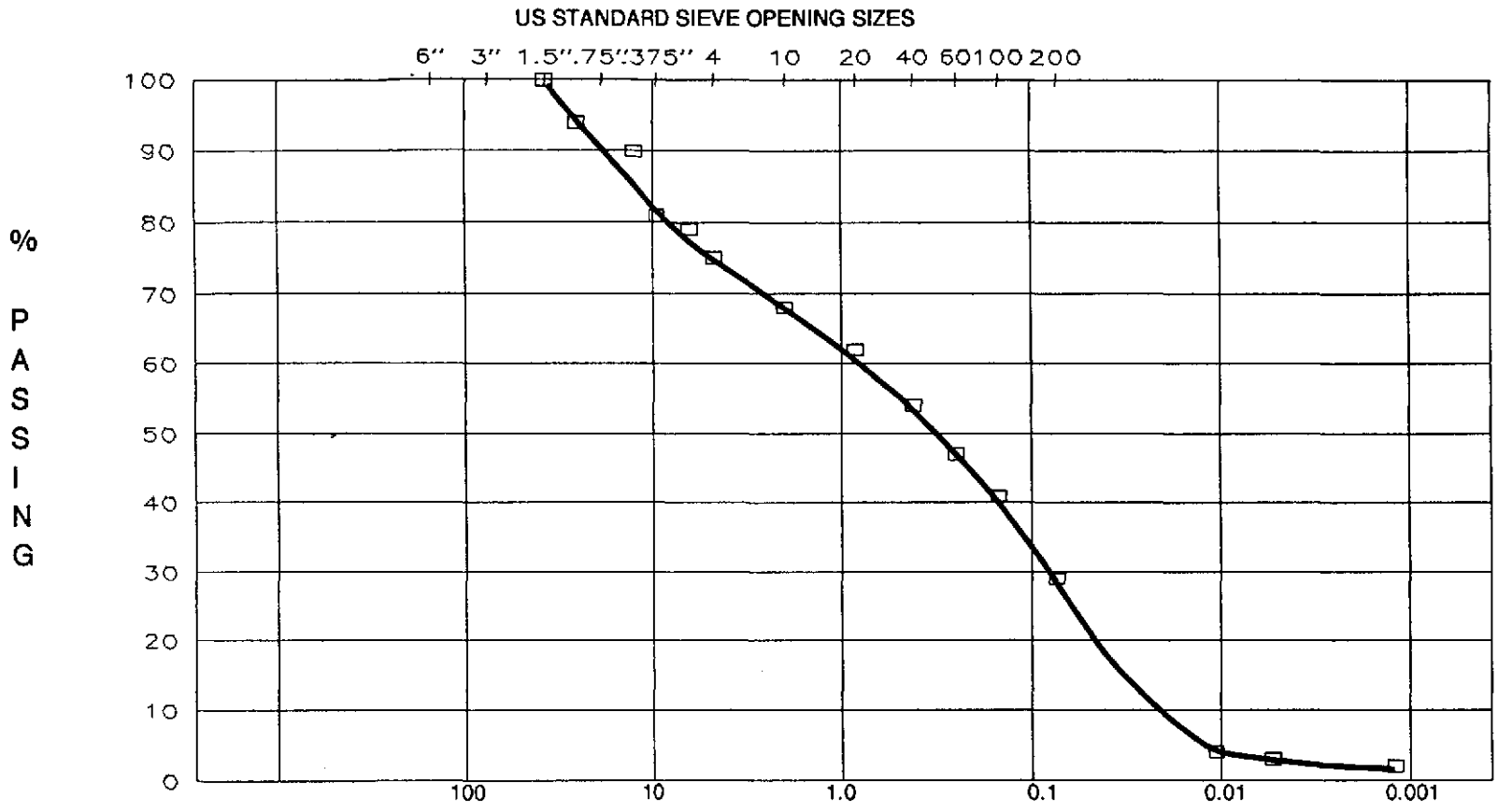

COBBLES	coarse	fine	c	med	fine	SILT	CLAY
	GRAVEL		SAND				

SAMPLE ID	W%	LL	PL	PI	Other	DESCRIPTION
#10-S4 EHP	45					Medium to dark brown black m-f SAND,some silt some f gravel(SM)
Sample Type:	DO	Date Tested:	7/02/90	USDA:		

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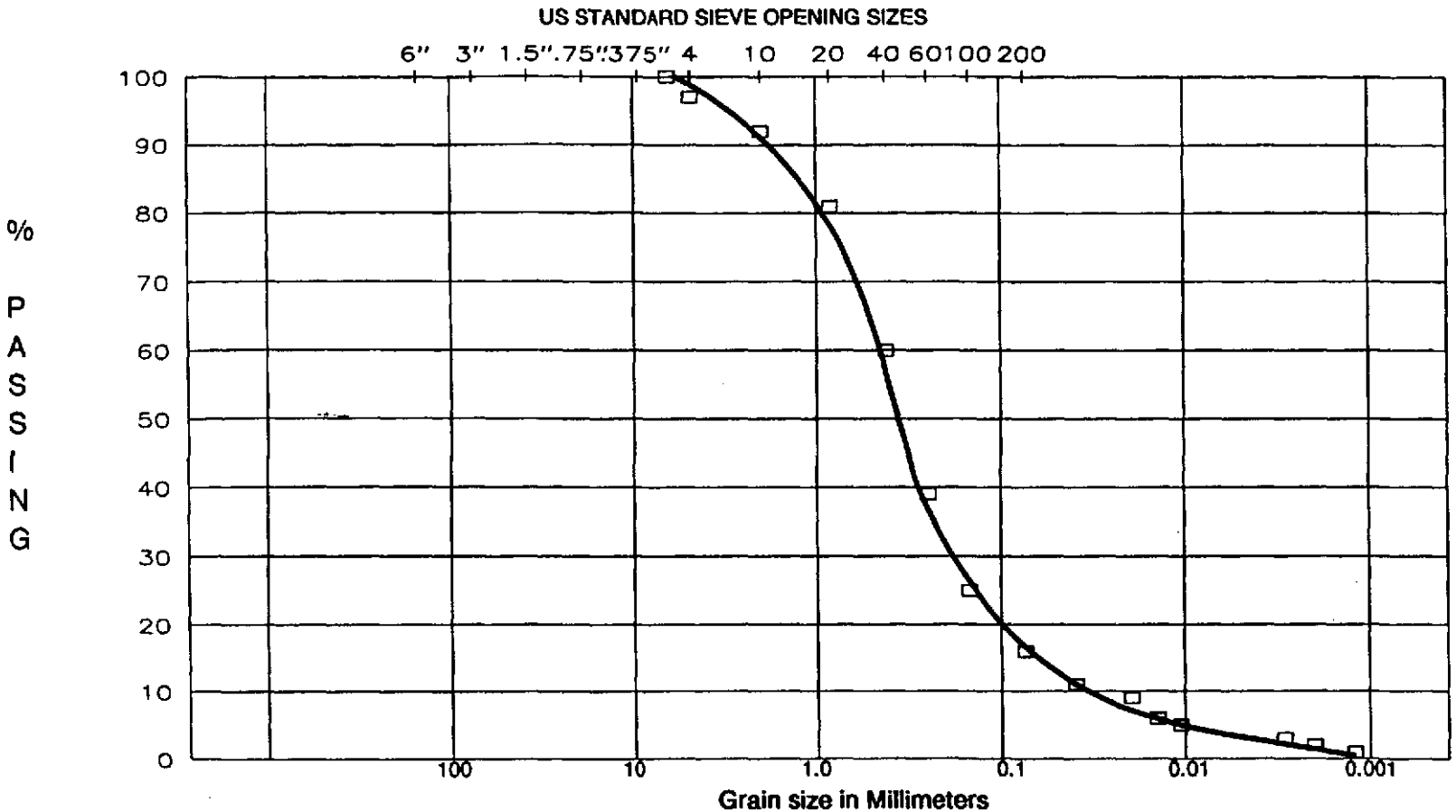

COBBLES	GRAVEL coarse	GRAVEL fine	SAND c	SAND med	SAND fine	SILT	CLAY

SAMPLE ID	W%	LL	PL	PI	Other	DESCRIPTION
#10,S-5 EHP	25.8					Moderate yellowish brown m-f SAND, some silt trace f gravel (SM)

Sample Type: SPLIT SPOON Date Tested: 7/2/90

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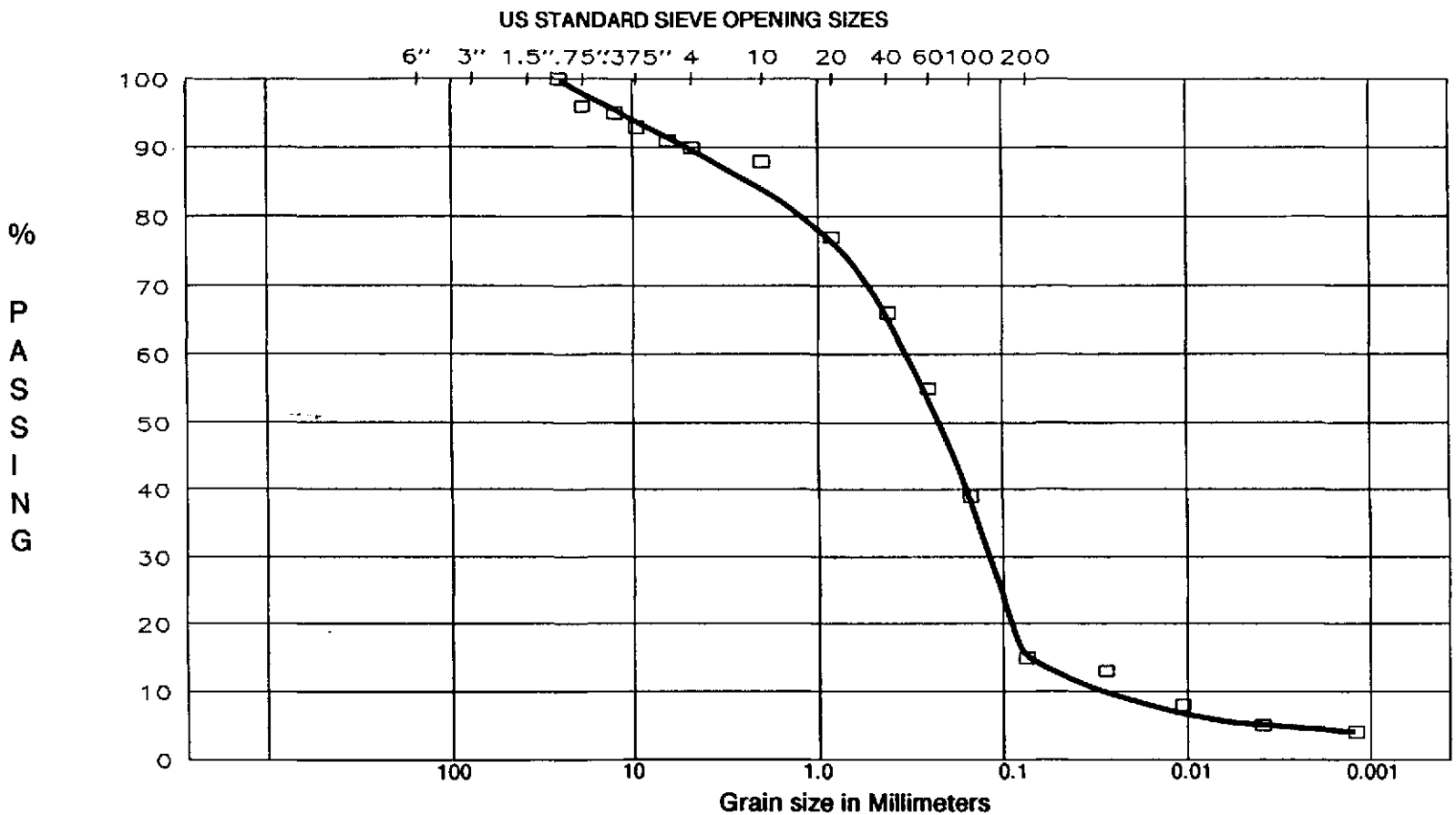

COBBLES	coarse	fine	c	med	fine	SILT	CLAY
	GRAVEL		SAND				

SAMPLE ID	W%	LL	PL	PI	Other	DESCRIPTION
#10,ST-4 EHP	20.3	NP	NP	NP		Black/light olive gray m-f SAND,little c-f gravel little silt(SP)
Sample Type:	Shelby	Date Tested:	9/05/90			

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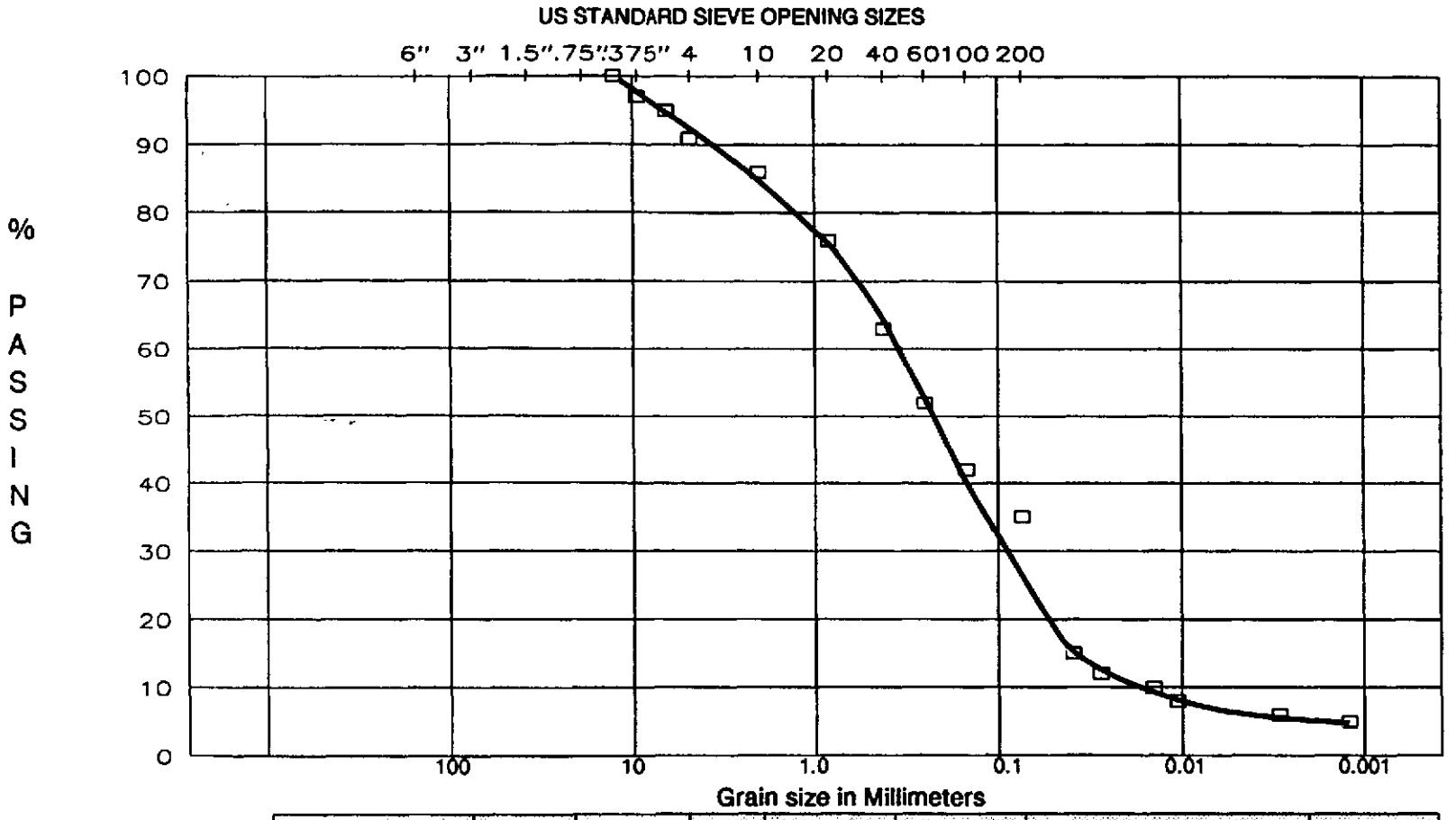

COBBLES	GRAVEL coarse	GRAVEL fine	SAND c	SAND med	SAND fine	SILT	CLAY

SAMPLE ID	W%	LL	PL	PI	Other	DESCRIPTION
#11,S-1 EHP	22.9	NP	NP	NP		Moderate yellowish brown m-f SAND and SILT little f gravel (SM)

Sample Type: SPLIT SPOON Date Tested: 7/2/90

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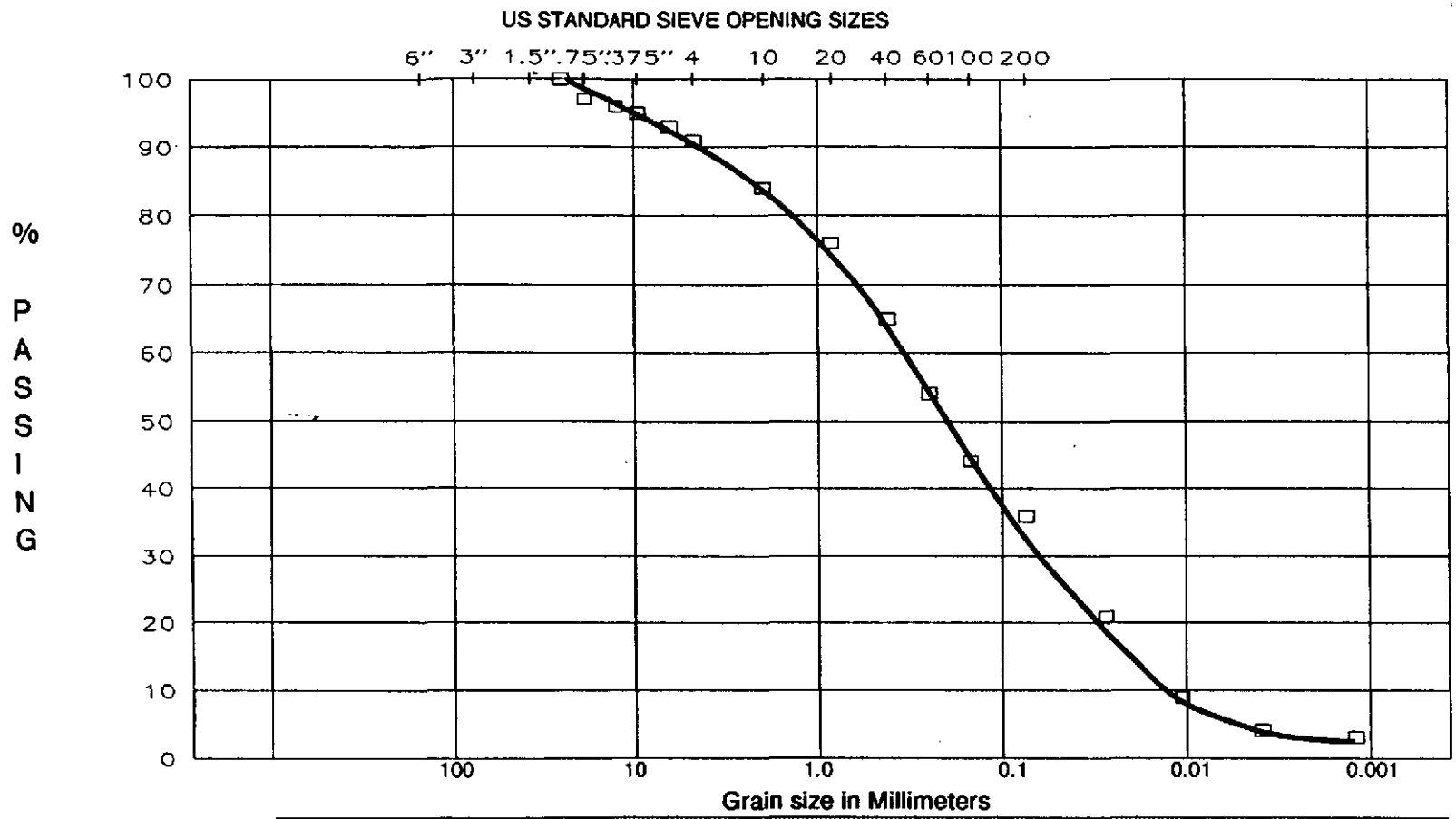

COBBLES	GRAVEL coarse	GRAVEL fine	SAND c	SAND med	SAND fine	SILT	CLAY

SAMPLE ID	W%	LL	PL	PI	Other	DESCRIPTION
#11,ST-1 EHP	36.2	NP	NP	NP		Dark yellowish brown m-f SAND and SILT little c-f gravel(SM)
Sample Type:	Shelby	Date Tested:	9/08/90			

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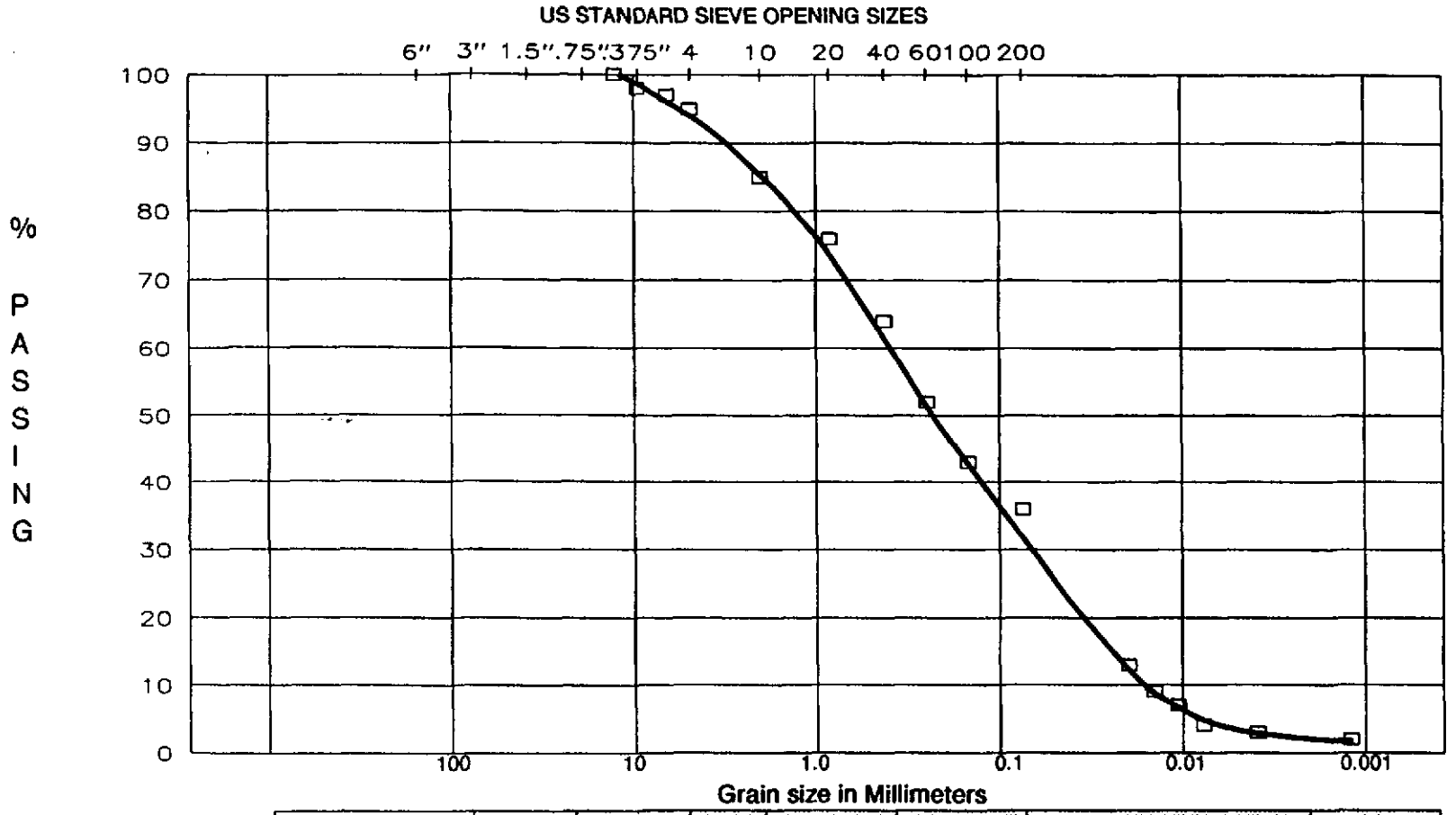

COBBLES	GRAVEL coarse	GRAVEL fine	SAND c	SAND med	SAND fine	SILT	CLAY

SAMPLE ID	W%	LL	PL	PI	Other	DESCRIPTION
#11,S-3 EHP	38.5	NP	NP	NP		Moderate yellowish brown c-f SAND and SILT trace f gravel (SM)

Sample Type: SPLIT SPOON Date Tested: 7/2/90

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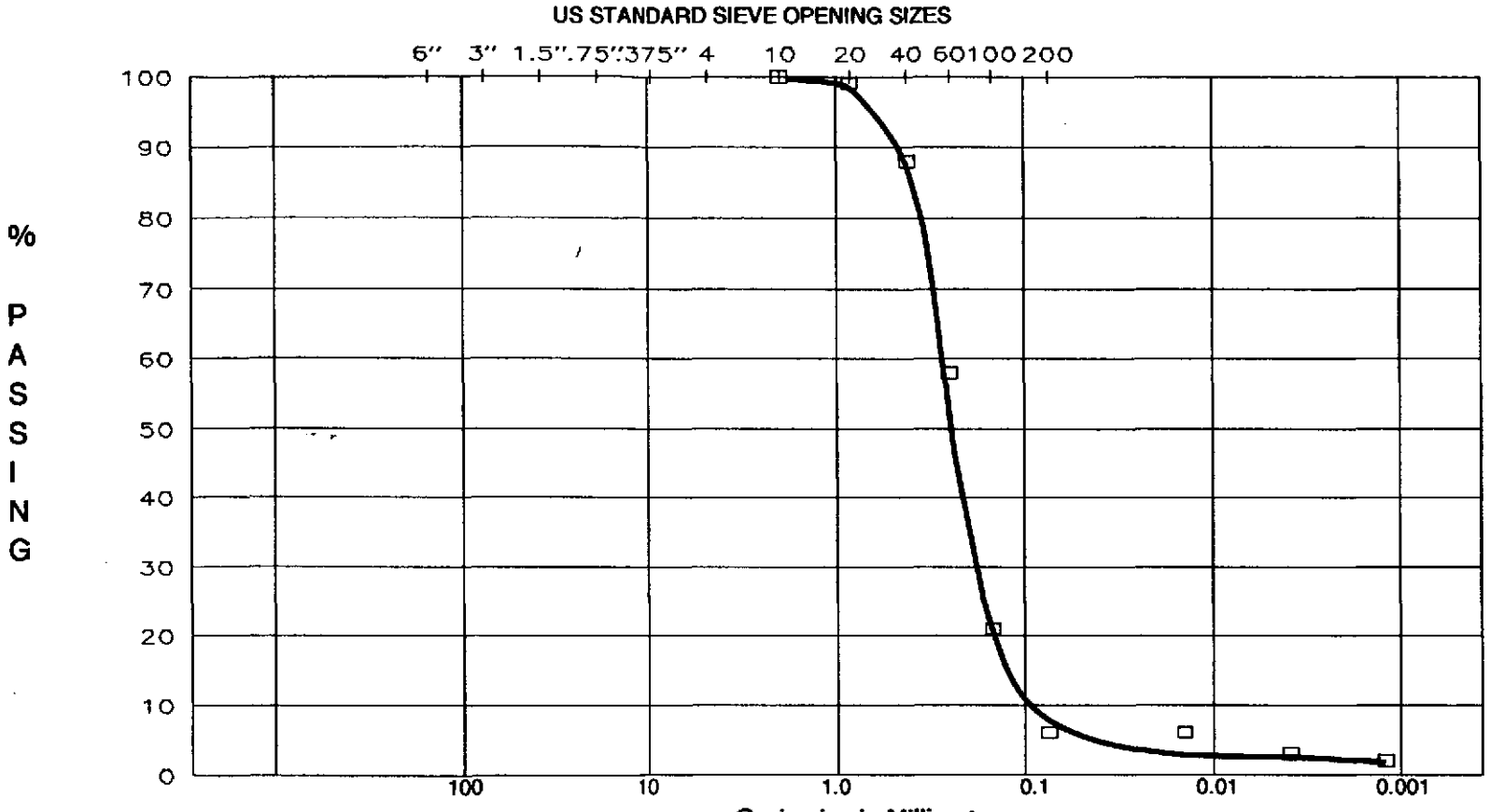
PARTICLE SIZE DISTRIBUTION ASTM D-421 AND 422



COBBLES	coarse	fine	c	med	fine	SILT	CLAY
	GRAVEL		SAND				

SAMPLE ID	W%	LL	PL	PI	Other	DESCRIPTION
#11,S-5 EHP	31	NP	NP	NP		Medium to dark brown black m-f SAND,trace silt (SP-SM)

Sample Type: Split Spoon Date Tested: 6/23/90

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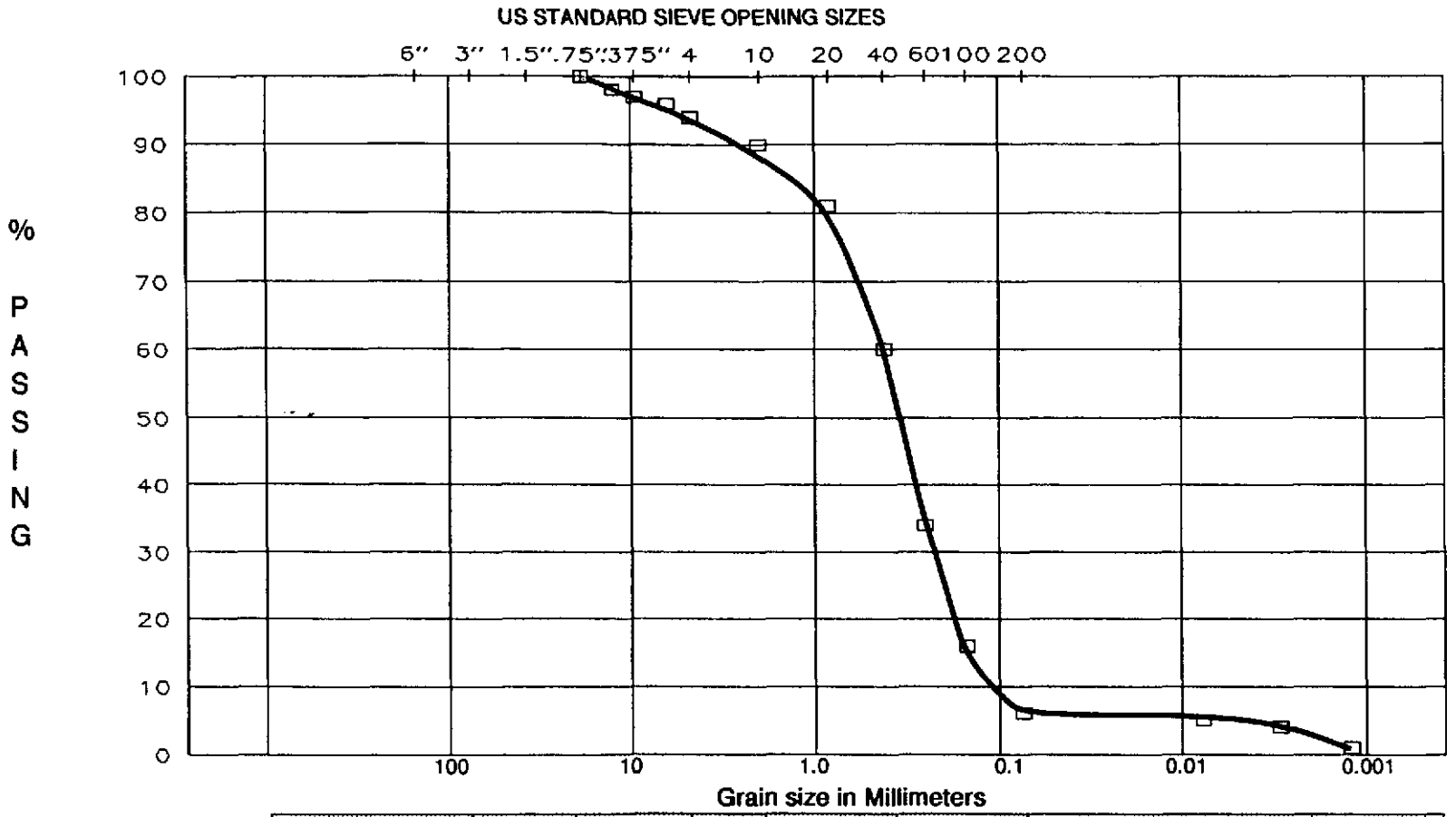

COBBLES	GRAVEL coarse	GRAVEL fine	SAND c	SAND med	SAND fine	SILT	CLAY

SAMPLE ID	W%	LL	PL	PI	Other	DESCRIPTION
#12,ST-1 EHP	21.9	NP	NP	NP		Moderate yellowish brown m-f SAND,little f gravel trace silt (SP)
Sample Type:	Shelby	Date Tested:	9/08/90			

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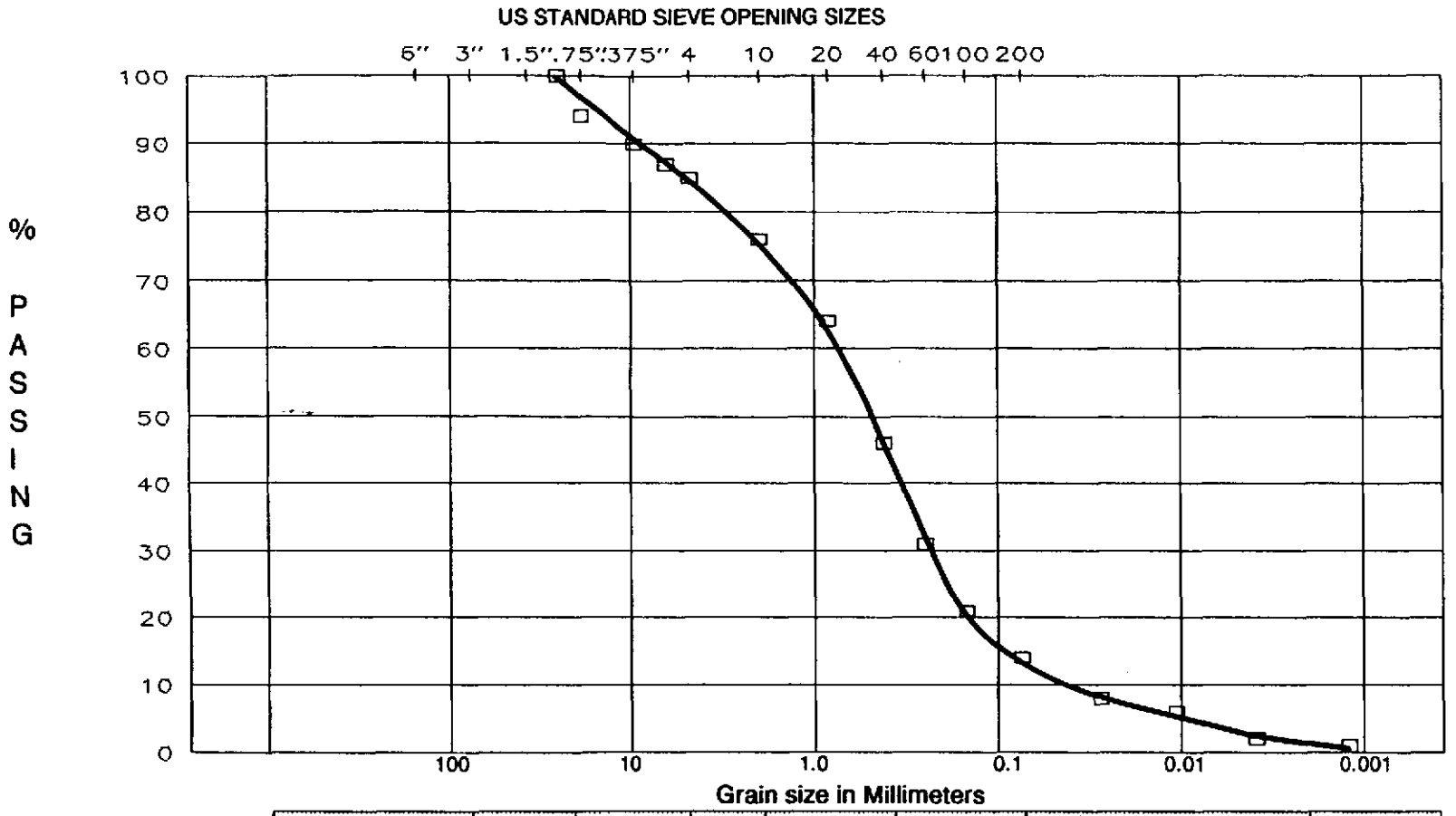
PARTICLE SIZE DISTRIBUTION ASTM D-421 AND 422



COBBLES	GRAVEL coarse	GRAVEL fine	SAND c	SAND med	SAND fine	SILT	CLAY

SAMPLE ID	W%	LL	PL	PI	Other	DESCRIPTION
#12,ST-2 EHP	24.1	NP	NP	NP		Moderate brown m-f SAND,some c-f gravel some silt(SP-SM)
Sample Type:	Shelby	Date Tested:	9/08/90			

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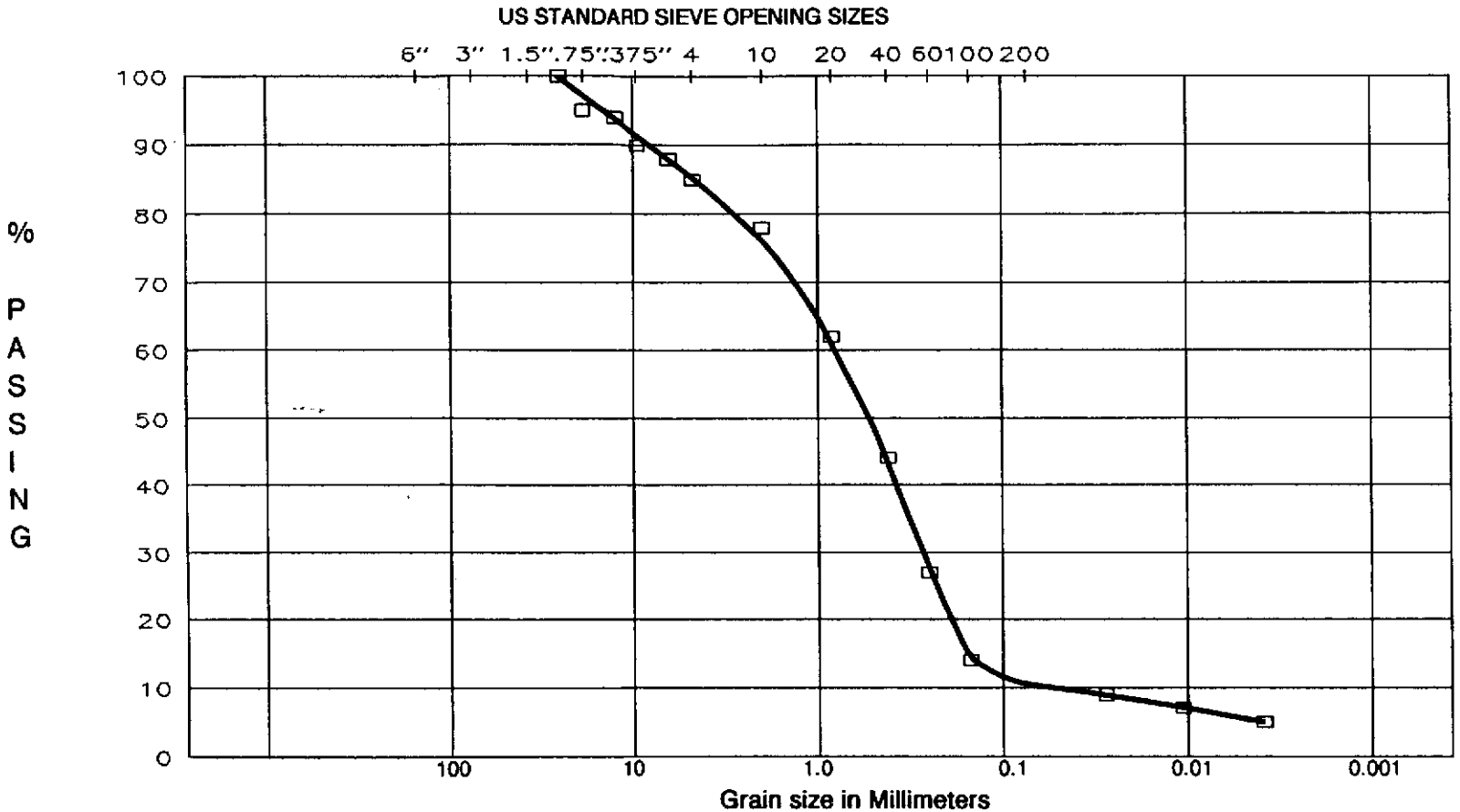

COBBLES	coarse	fine	c	med	fine	SILT	CLAY
	GRAVEL		SAND				

SAMPLE ID	W%	LL	PL	PI	Other	DESCRIPTION
BH-13 BULK	17.5	NP	NP	NP		Moderate yellowish brown m-f SAND,some c-f gravel trace silt(SP)
Sample Type:	Shelby	Date Tested:	9/10/90			

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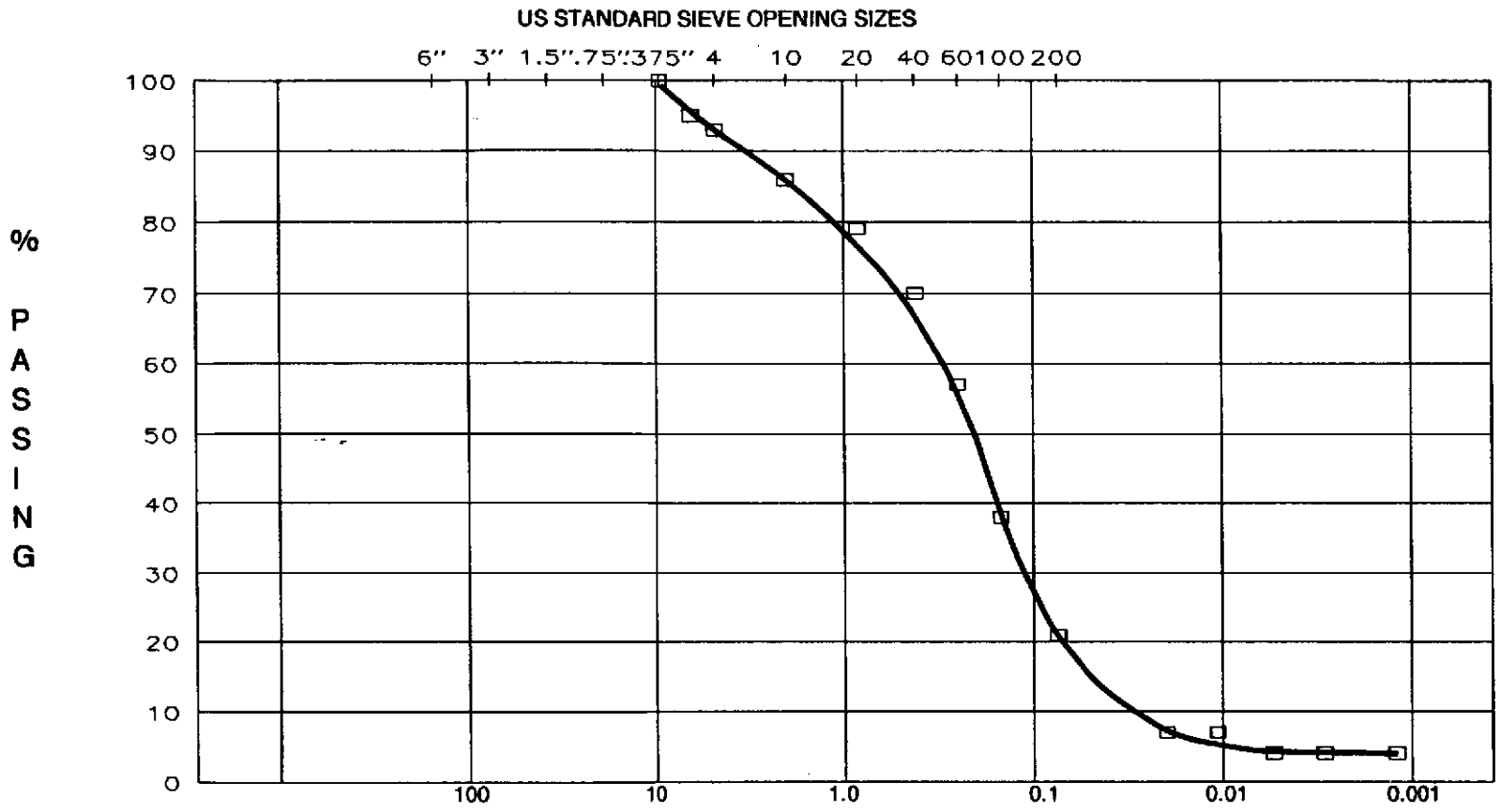

COBBLES	coarse	fine	c	med	fine	SILT	CLAY
	GRAVEL		SAND				

SAMPLE ID	W%	LL	PL	PI	Other	DESCRIPTION
#13,S-2 EHP	24.9					Medium to dark brown black f SAND,some silt, little f gravel (SM)
Sample Type:		Split Spoon		Date Tested:		6/23/90

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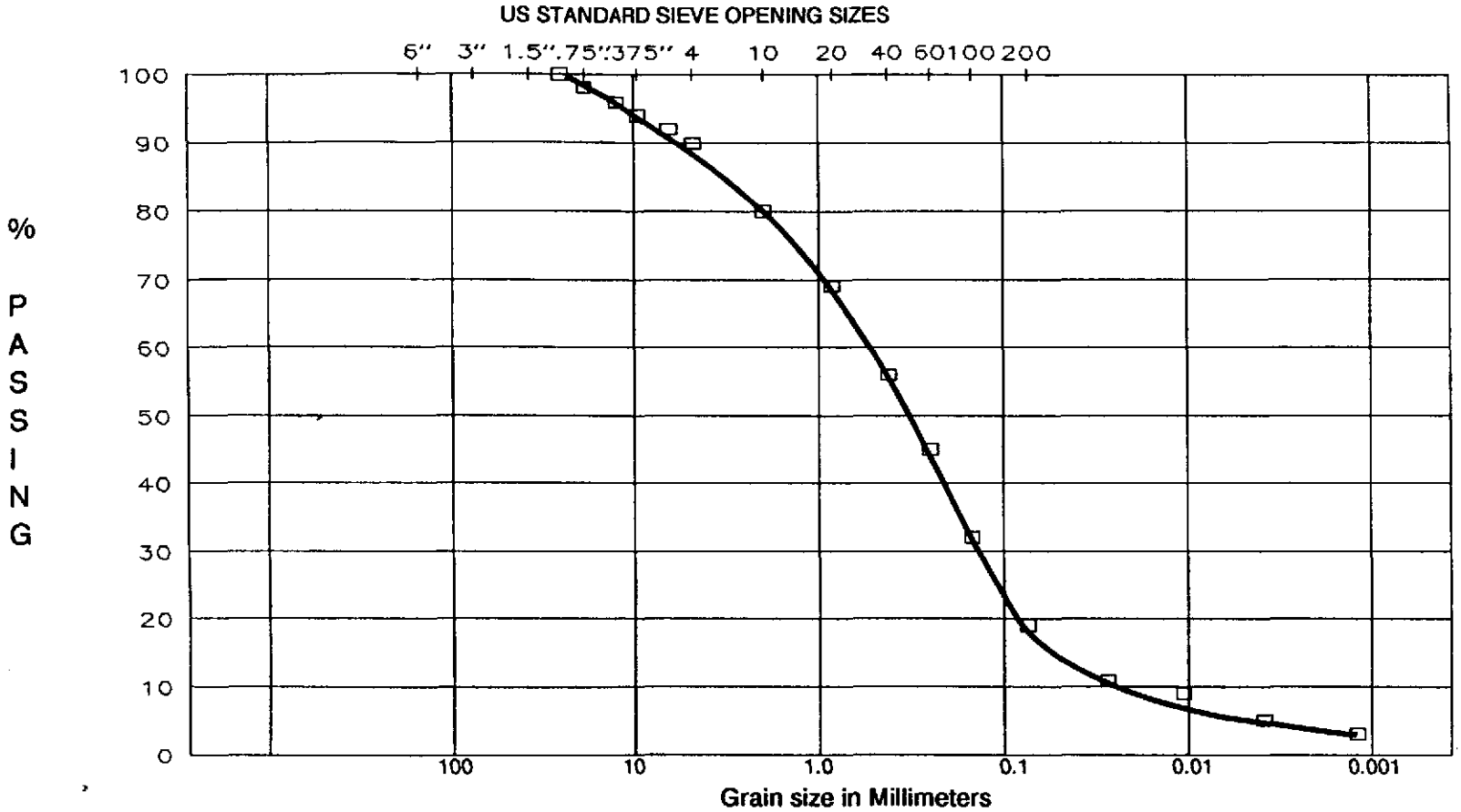

COBBLES	coarse	fine	c	med	fine	SILT	CLAY
	GRAVEL		SAND				

SAMPLE ID	W%	LL	PL	PI	Other	DESCRIPTION
#13,ST-2 EHP	30.0	NP	NP	NP		Moderate brown m-f SAND,some silt little f gravel(SM)
Sample Type:	Shelby	Date Tested:	9/08/90			

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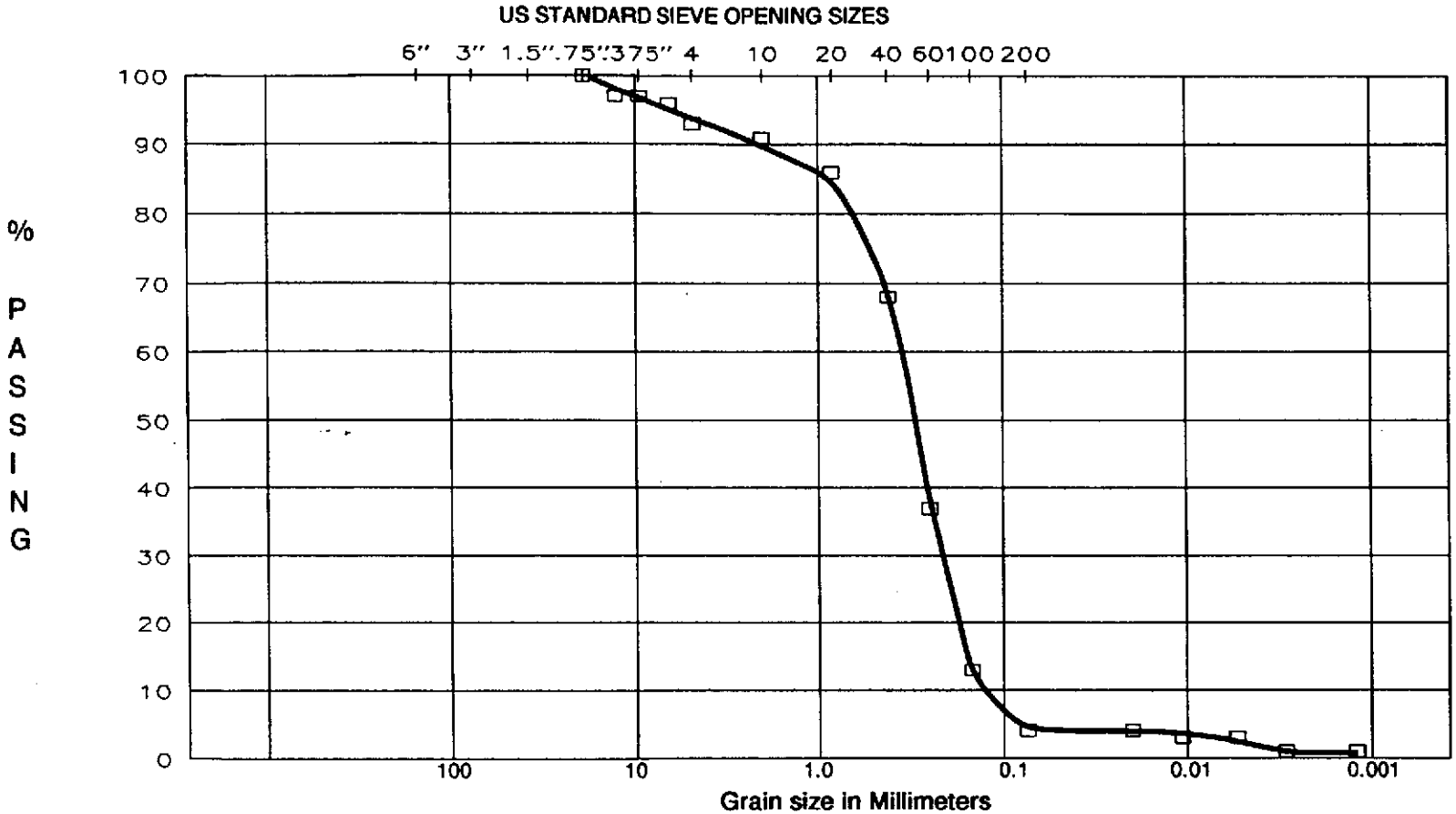

COBBLES	coarse	fine	c	med	fine	SILT	CLAY
	GRAVEL		SAND				

SAMPLE ID	W%	LL	PL	PI	Other	DESCRIPTION
#13,S-8 EHP	22.9	NP	NP	NP		Medium to dark brown black m-f SAND,little f gravel, trace silt (SP)
Sample Type:		Split Spoon		Date Tested:		6/23/90

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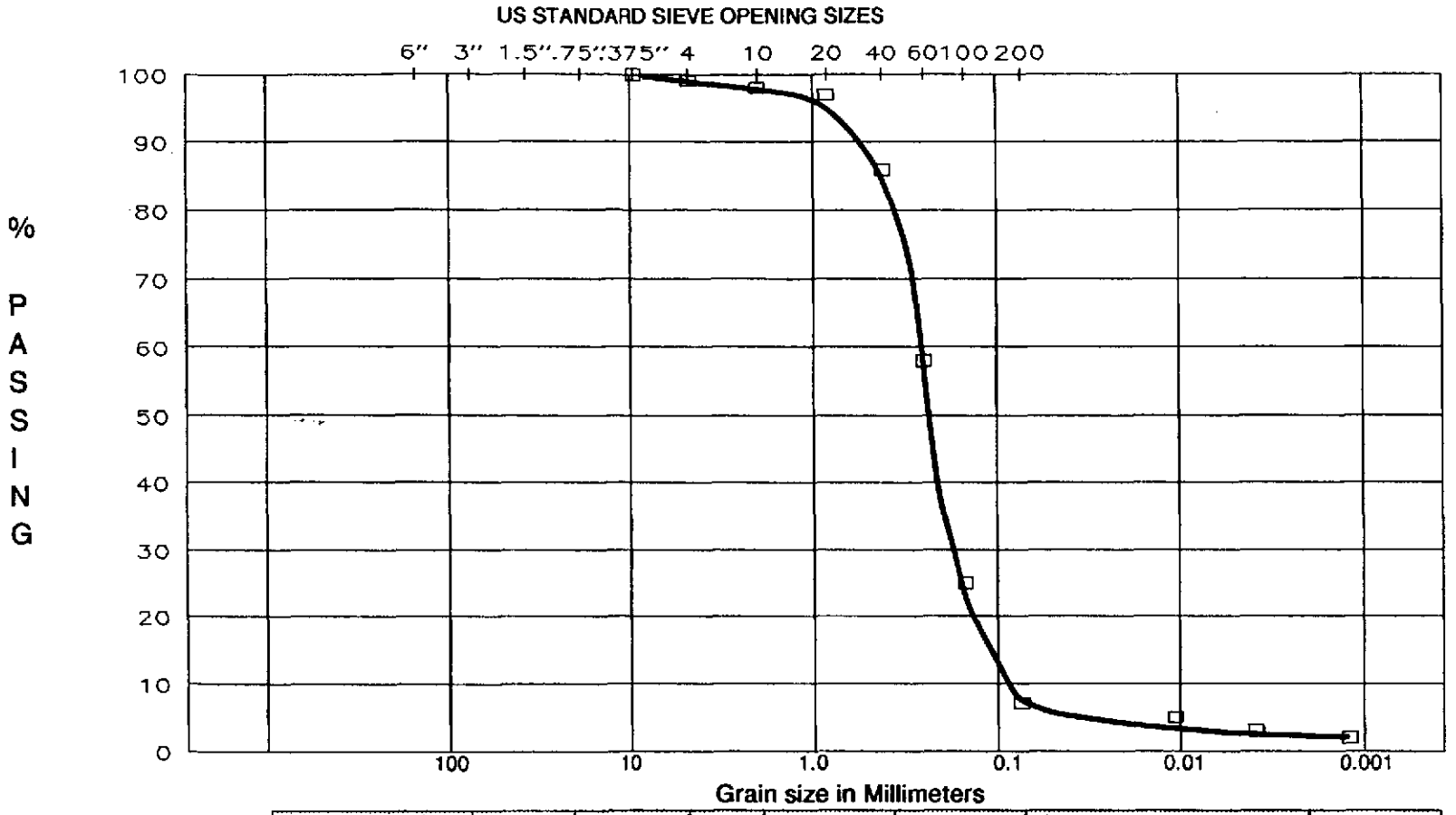

COBBLES	GRAVEL coarse	GRAVEL fine	SAND c	SAND med	SAND fine	SILT	CLAY

SAMPLE ID	W%	LL	PL	PI	Other	DESCRIPTION
#15,BULK EHP	19.5	NP	NP	NP		Grayish black f SAND,trace silt trace f gravel (SP-SM)
Sample Type:	Shelby	Date Tested:	9/10/90			

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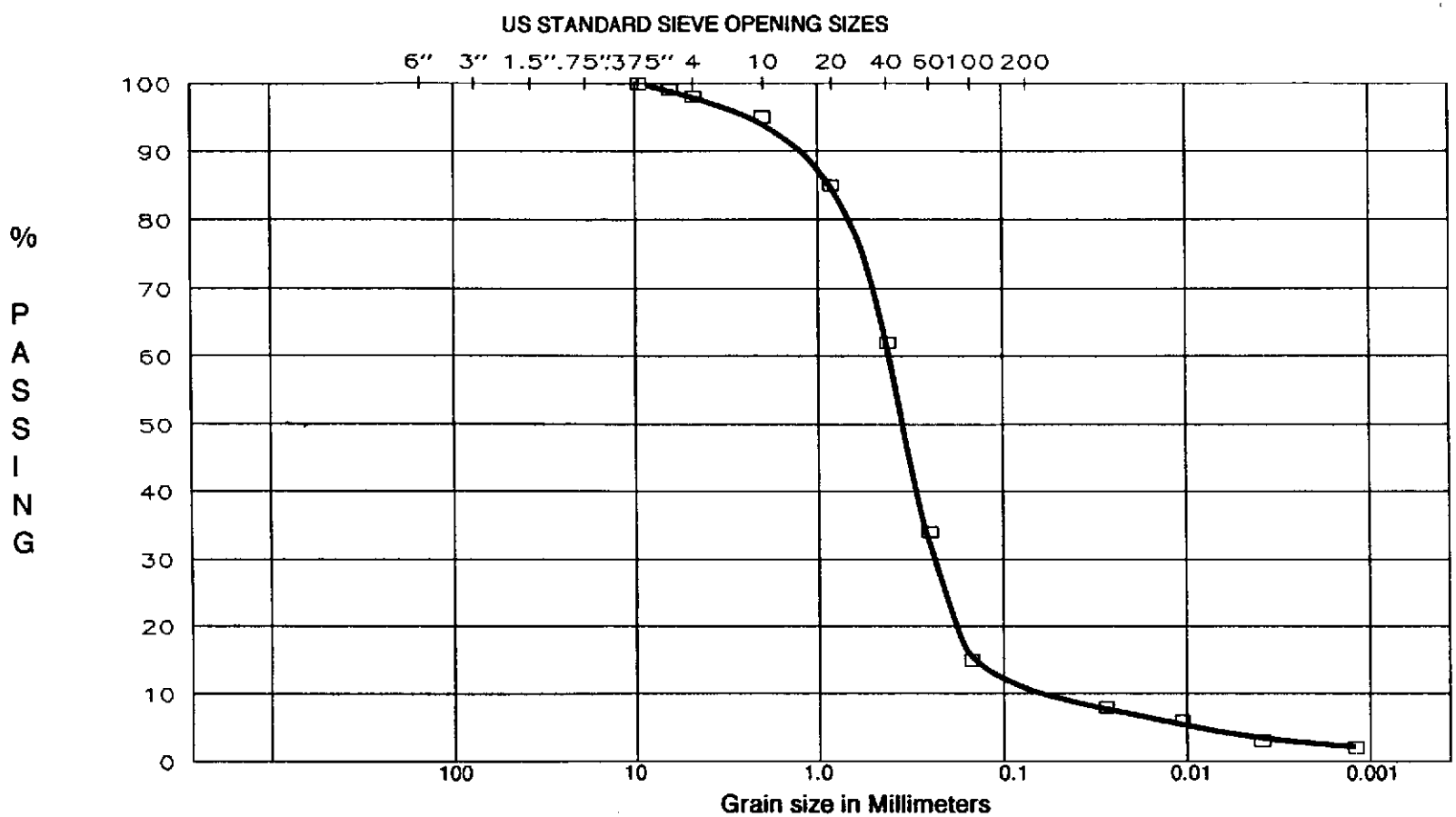

COBBLES	coarse	fine	c	med	fine	SILT	CLAY
	GRAVEL		SAND				

SAMPLE ID	W%	LL	PL	PI	Other	DESCRIPTION
#15,ST-1 EHP	20.1	NP	NP	NP		Dark yellowish brown m-f SAND,little silt trace f gravel(SP)
Sample Type:	Shelby	Date Tested:	9/08/90			

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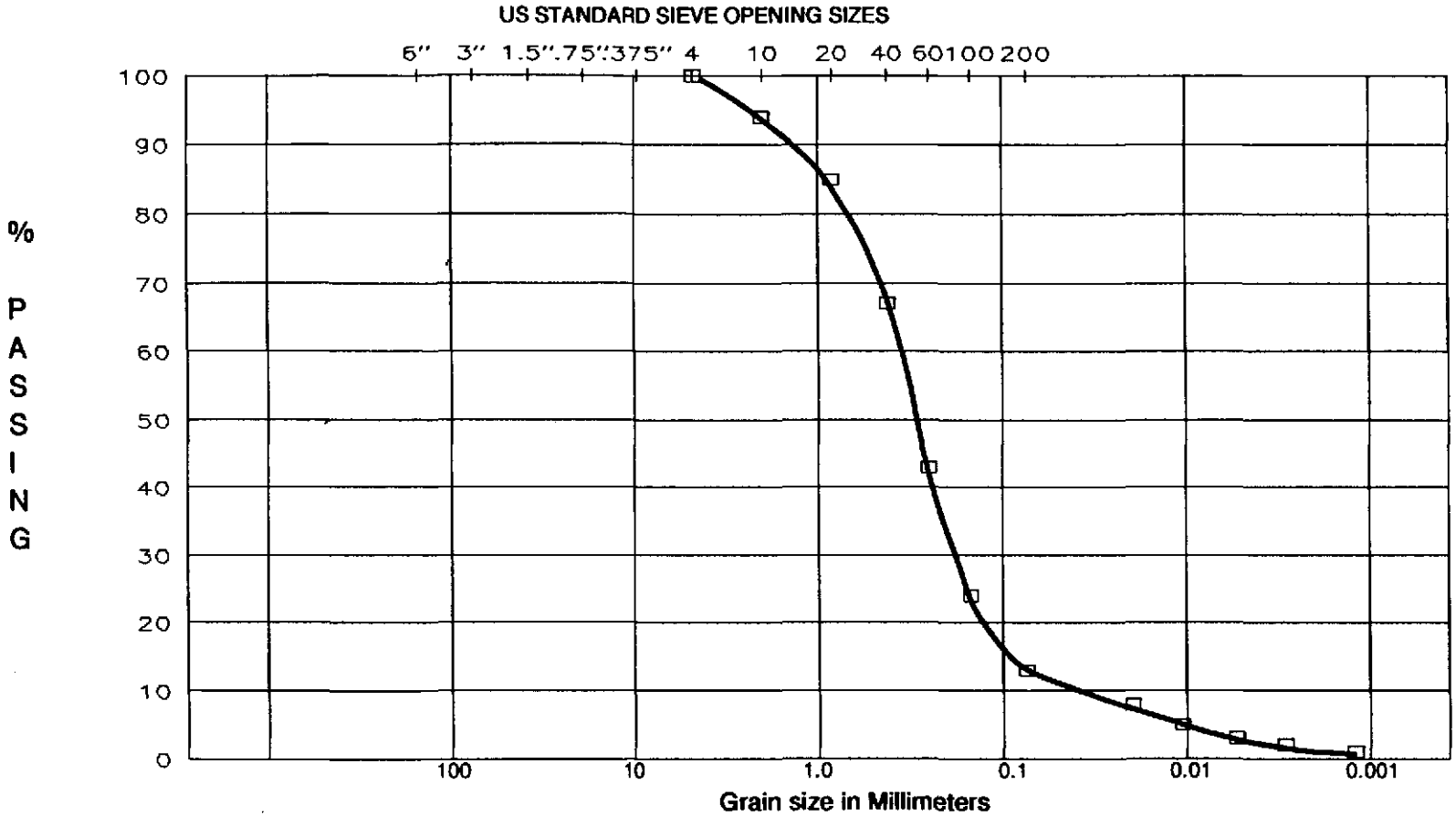

COBBLES	GRAVEL coarse	GRAVEL fine	SAND c	SAND med	SAND fine	SILT	CLAY

SAMPLE ID	W%	LL	PL	PI	Other	DESCRIPTION
#16,S-1 EHP	44.1					Medium to dark brown black m-f SAND,some silt (SM)

Sample Type: Split Spoon Date Tested: 6/23/90

ISRT/WOBURN/MA

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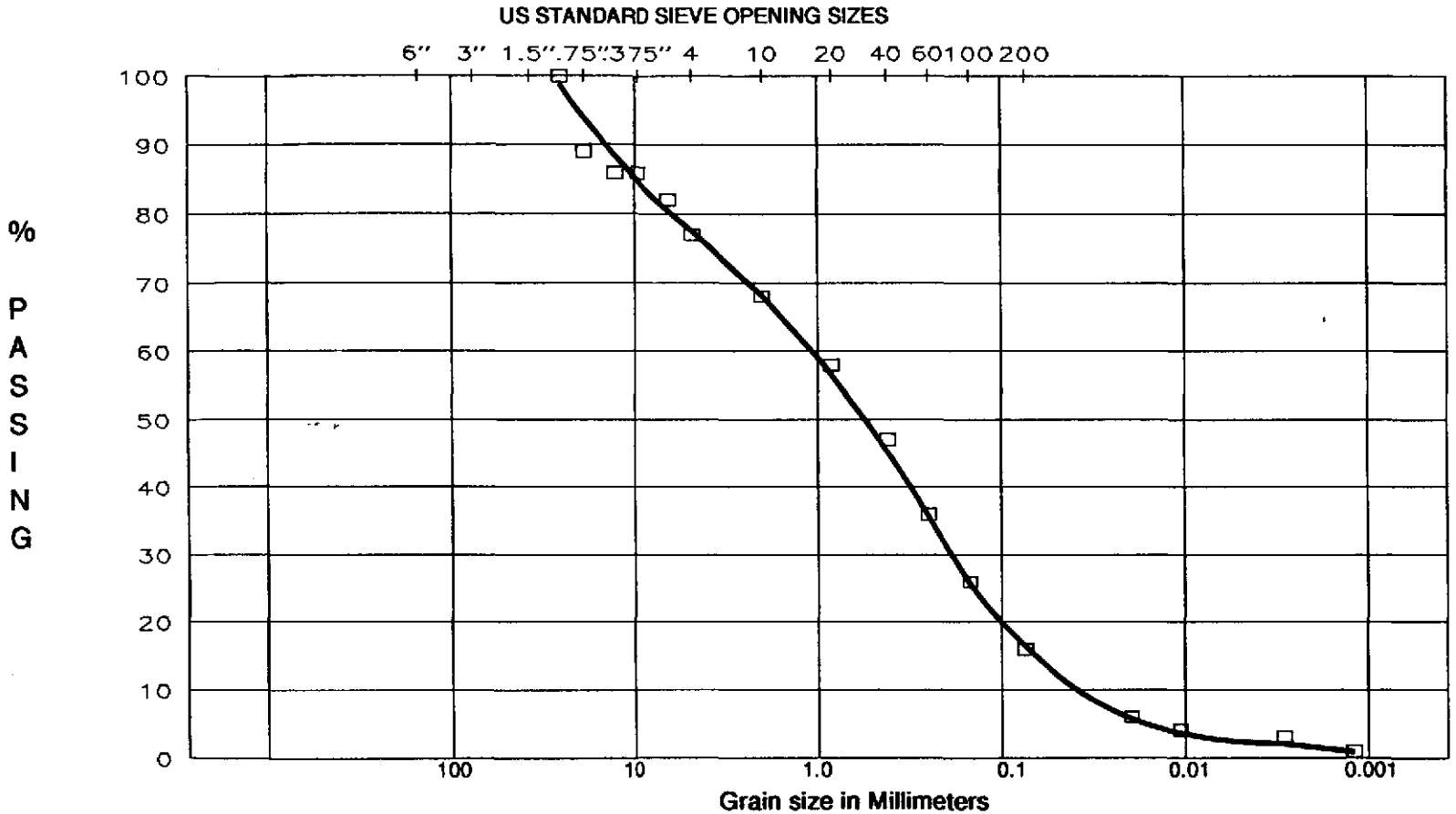
PARTICLE SIZE DISTRIBUTION ASTM D-421 AND 422



COBBLES	GRAVEL coarse	GRAVEL fine	SAND c	SAND med	SAND fine	SILT	CLAY

SAMPLE ID	W%	LL	PL	PI	Other	DESCRIPTION
#16,S-4 EHP	13.2	NP	NP	NP		Medium to dark brown black m-f SAND,some c-f gravel, some silt (SM)
Sample Type:		Split Spoon		Date Tested:		6/23/90

ISRT/WOBURN/MA

893-6255.5

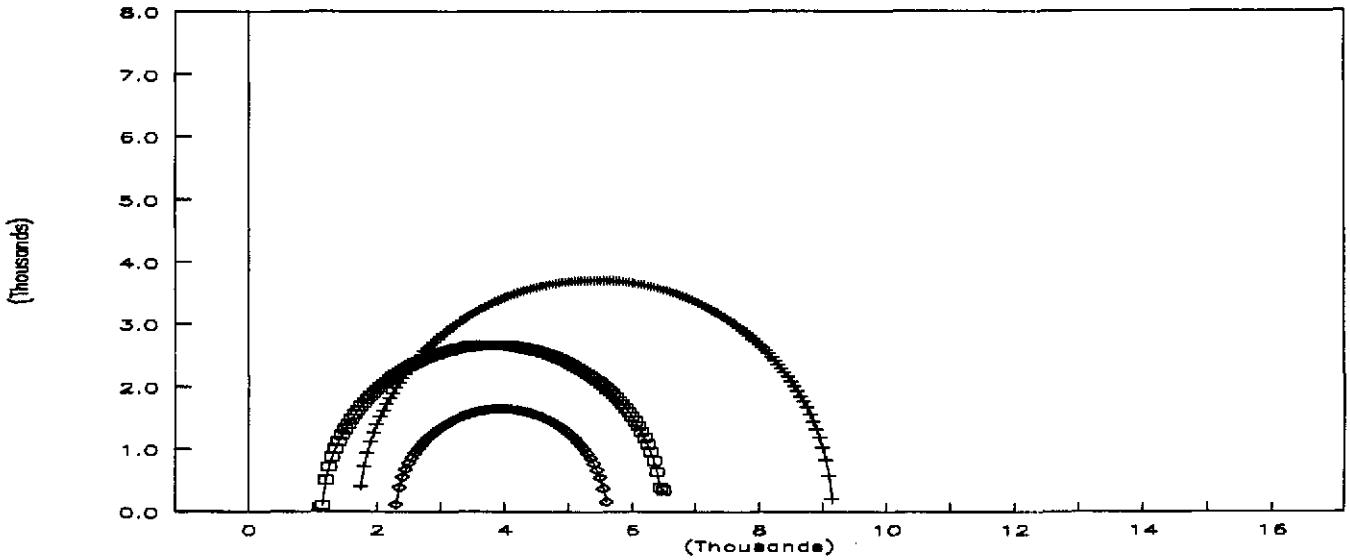
GOLDER ASSOCIATES INC.

Consulting Engineers

Triaxial Test

TRIAXIAL COMPRESSION STRENGTH TEST
CONSOLIDATED/DRAINED
BH1 ST-2

EFFECTIVE STRESS MOHR'S STRENGTH CIRCLES (in psf)



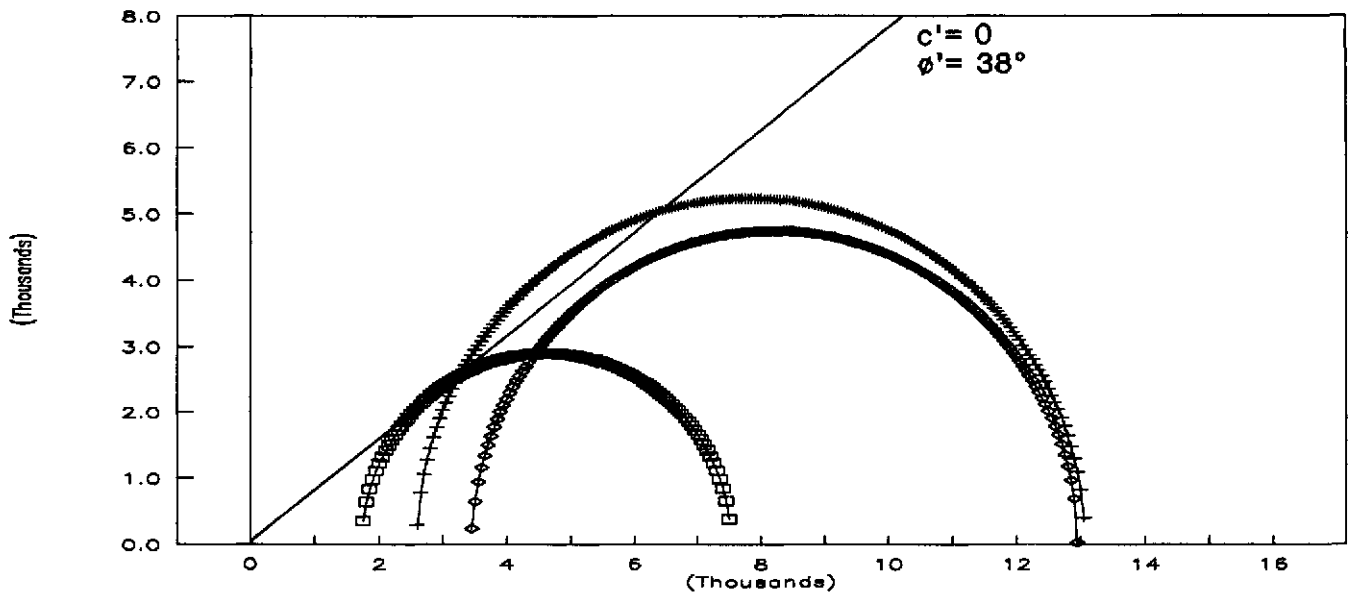
Consolidation Pressure	Initial Moisture	Initial Moist Density
(psi)	(%)	(pcf)
8	16.8	125
12	16.8	121
16	16.8	123

ISRT/WOBURN/MA
893-6255.5

GOLDER ASSOCIATES INC.
MT. LAUREL, N.J.

TRIAXIAL COMPRESSION STRENGTH TEST
CONSOLIDATED/DRAINED
BH2 ST-3

EFFECTIVE STRESS MOHR'S STRENGTH CIRCLES (in psf)



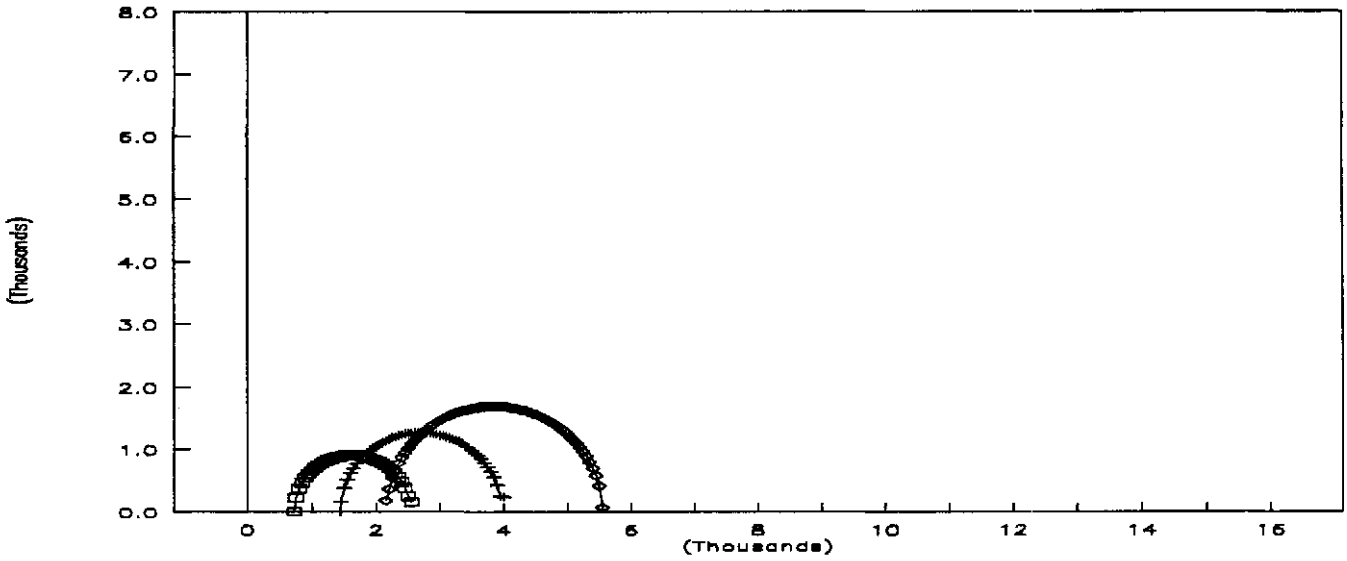
Consolidation Pressure	Initial Moisture	Initial Moist Density
(psi)	(%)	(pcf)
12	11.8	107
18	11.8	112
24	8.2	113

ISRT/WOBURN/MA
893-6255.5

GOLDER ASSOCIATES INC.
MT. LAUREL, N.J.

TRIAXIAL COMPRESSION STRENGTH TEST
CONSOLIDATED/DRAINED
BH 10 BULK

EFFECTIVE STRESS MOHR'S STRENGTH CIRCLES (in psf)



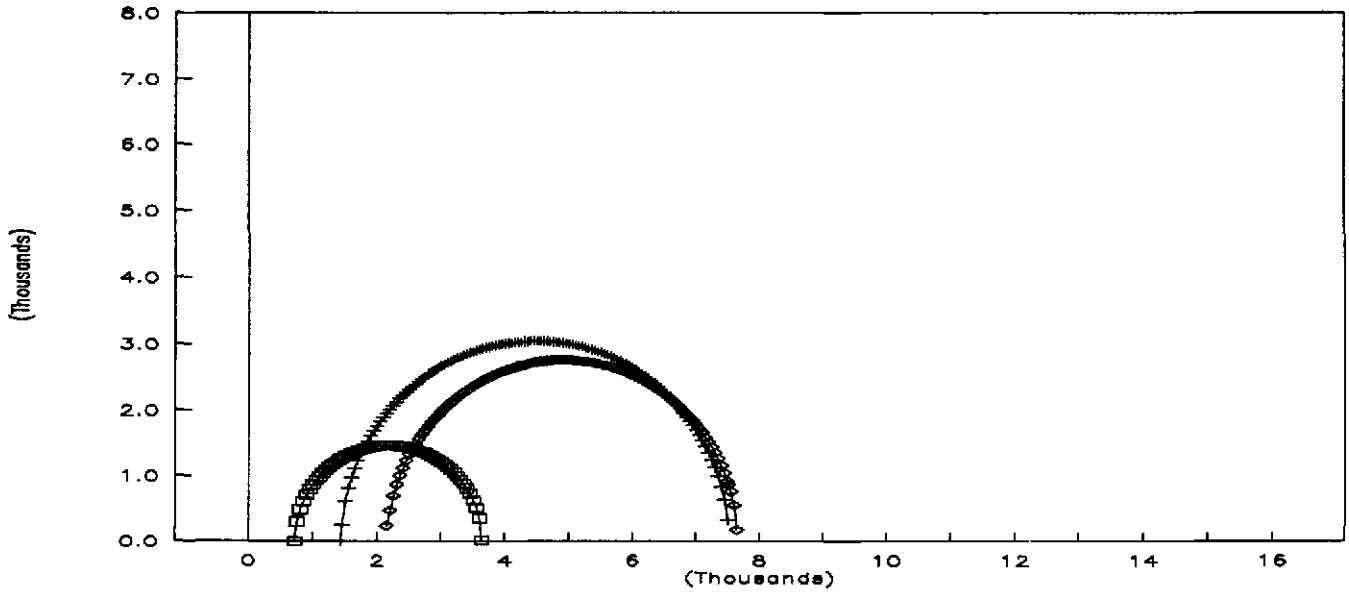
Consolidation Pressure	Initial Moisture	Initial Moist Density
(psi)	(%)	(pcf)
5	24.6	96.0
10	23.3	96.0
15	19.7	96.0

ISRT/WOBURN/MA
893-6255.5

GOLDER ASSOCIATES INC.
MT. LAUREL, N.J.

TRIAXIAL COMPRESSION STRENGTH TEST
CONSOLIDATED/DRAINED
BH 10 ST-3

EFFECTIVE STRESS MOHR'S STRENGTH CIRCLES (in psf)



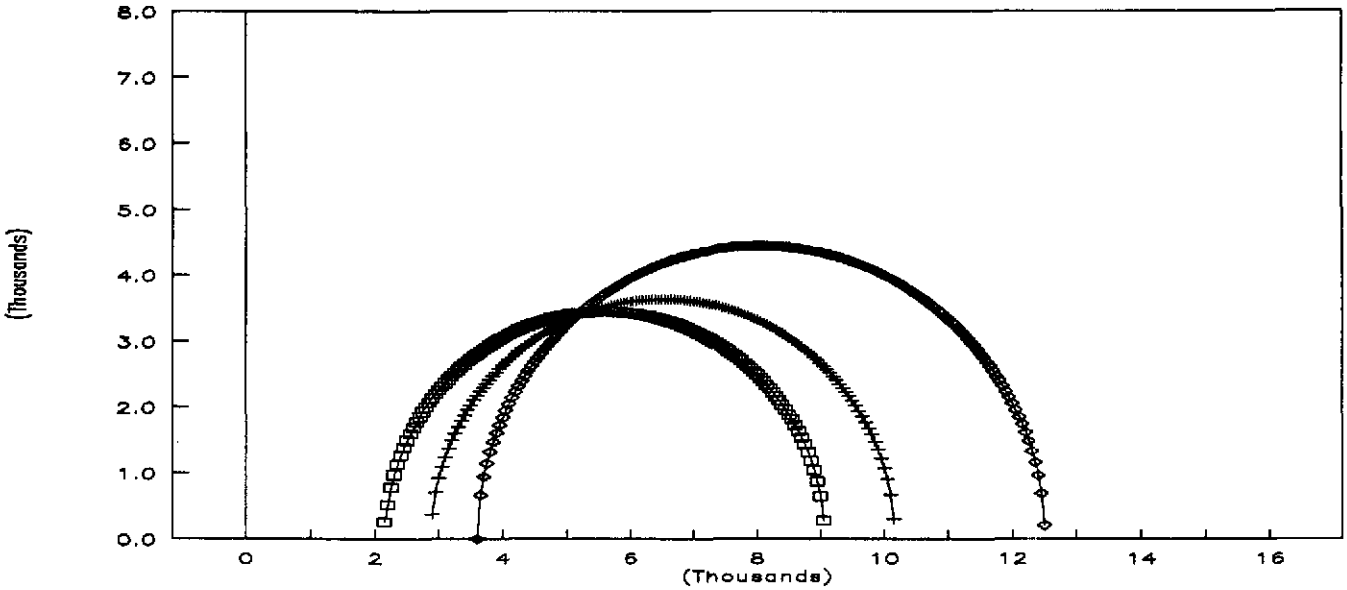
Consolidation Pressure	Initial Moisture	Initial Moist Density
(psi)	(%)	(pcf)
5	22.6	122
10	21.9	125
15	19.1	114

ISRT/WOBURN/MA
893-6255.5

GOLDER ASSOCIATES INC.
MT. LAUREL, N.J.

TRIAXIAL COMPRESSION STRENGTH TEST
CONSOLIDATED/DRAINED
BH 10 ST-4

EFFECTIVE STRESS MOHR'S STRENGTH CIRCLES (in psf)



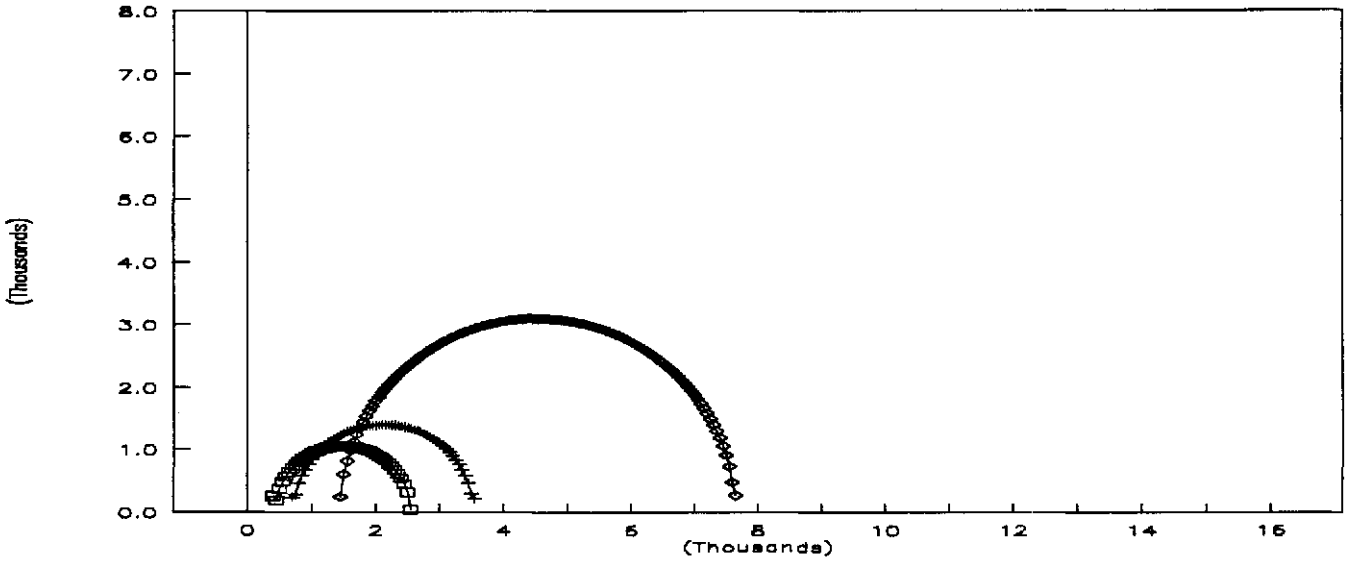
Consolidation Pressure	Initial Moisture	Initial Moist Density
(psi)	(%)	(pcf)
15	15.2	107
20	15.2	100
25	15.2	99

ISRT/WOBURN/MA
893-6255.5

GOLDER ASSOCIATES INC.
MT. LAUREL, N.J.

TRIAXIAL COMPRESSION STRENGTH TEST
CONSOLIDATED/DRAINED
BH12 ST-1

EFFECTIVE STRESS MOHR'S STRENGTH CIRCLES (in psf)



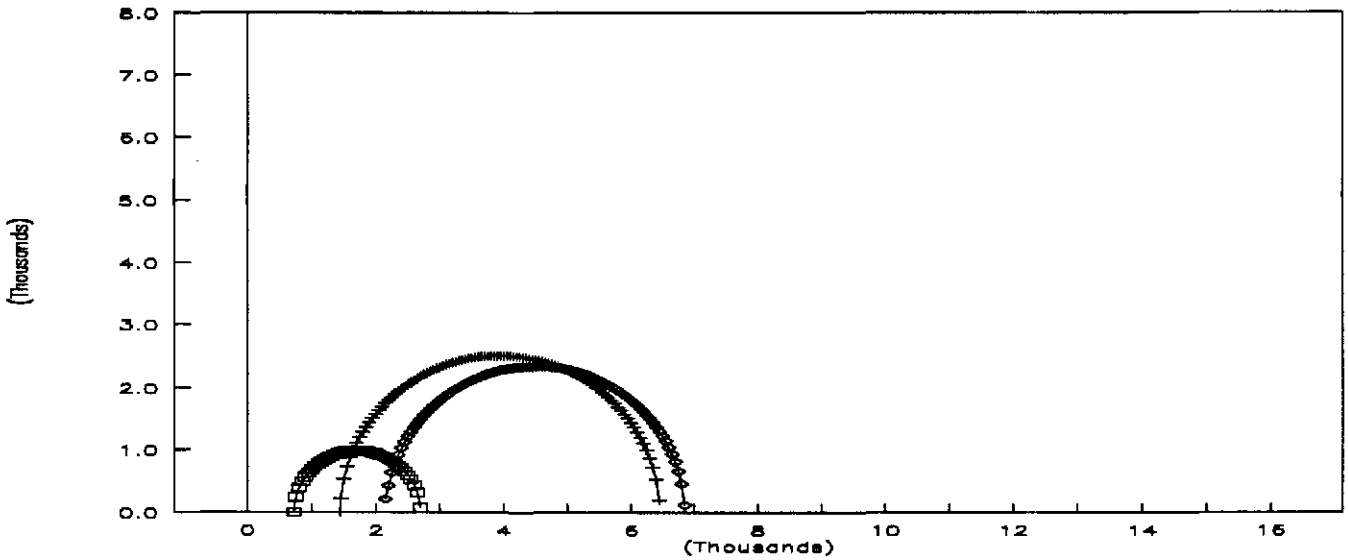
Consolidation Pressure	Initial Moisture	Initial Moist Density
(psi)	(%)	(pcf)
3	3.7	103
5	44.6	101
10	44.6	112

ISRT/WOBURN/MA
893-6255.5

GOLDER ASSOCIATES INC.
MT. LAUREL, N.J.

TRIAXIAL COMPRESSION STRENGTH TEST
CONSOLIDATED/DRAINED
BH 15 BULK

EFFECTIVE STRESS MOHR'S STRENGTH CIRCLES (in psf)



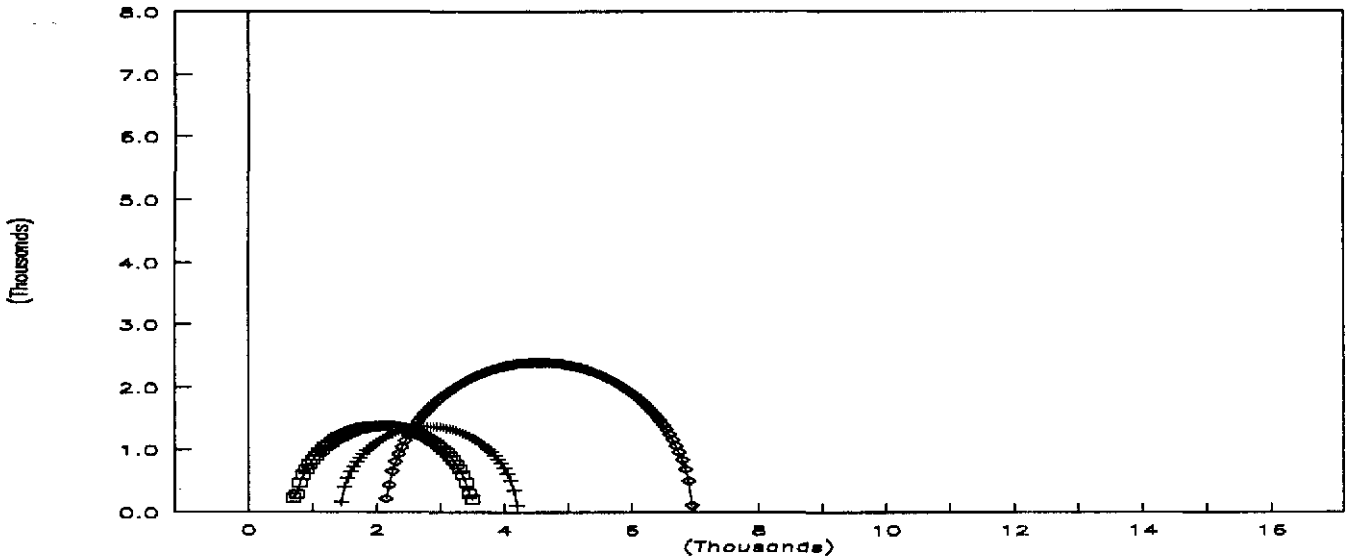
Consolidation Pressure	Initial Moisture	Initial Moist Density
(psi)	(%)	(pcf)
5	24.1	96.0
10	21.6	96.0
15	23.0	96.0

ISRT/WOBURN/MA
893-6255.5

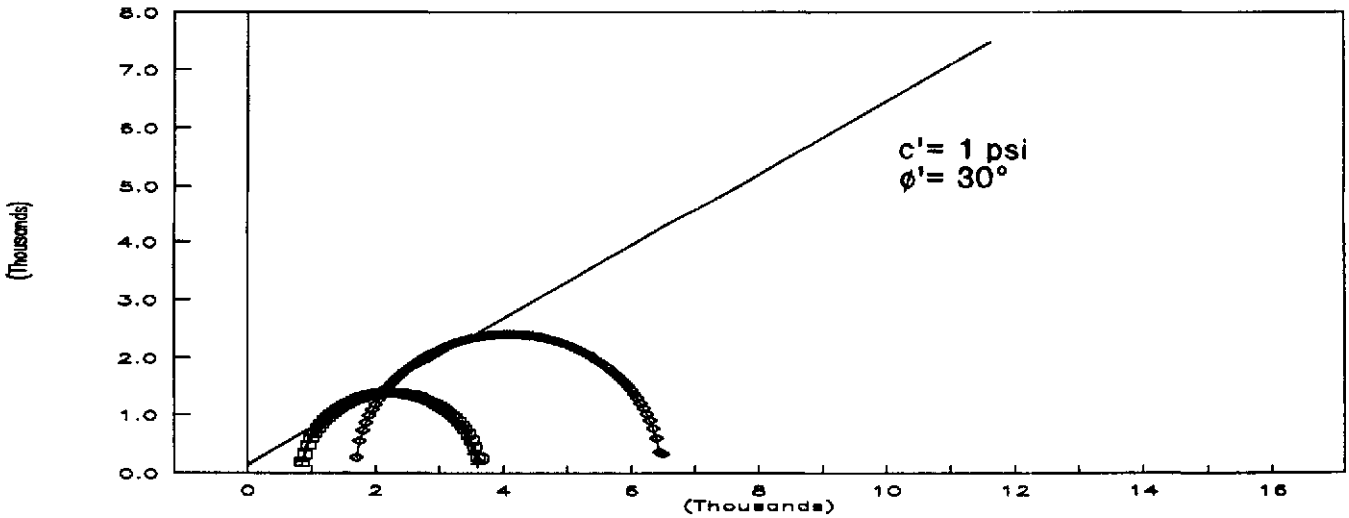
GOLDER ASSOCIATES INC.
MT. LAUREL, N.J.

TRIAXIAL COMPRESSION STRENGTH TEST
CONSOLIDATED/UNDRAINED WITH PORE PRESSURE MEASUREMENT
BH1 BULK (0' -5')

TOTAL STRESS MOHR'S STRENGTH CIRCLES (in psf)



EFFECTIVE STRESS MOHR'S STRENGTH CIRCLES (in psf)



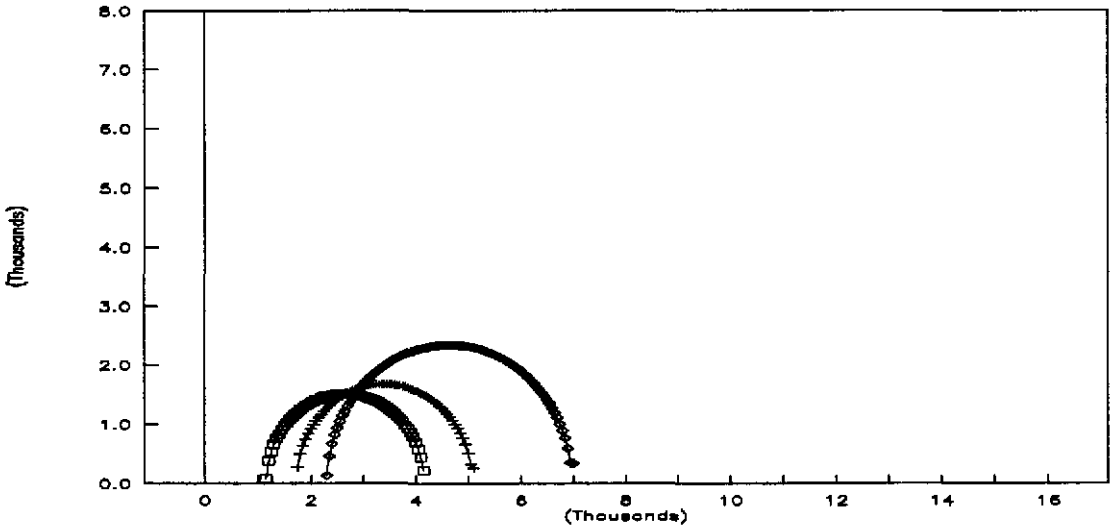
Consolidation Pressure	Initial Moisture	Initial Moist Density
(psi)	(%)	(pcf)
5	35.4	100
10	35.4	100
15	35.4	100

ISRT/WOBURN/MA
893-6255.5

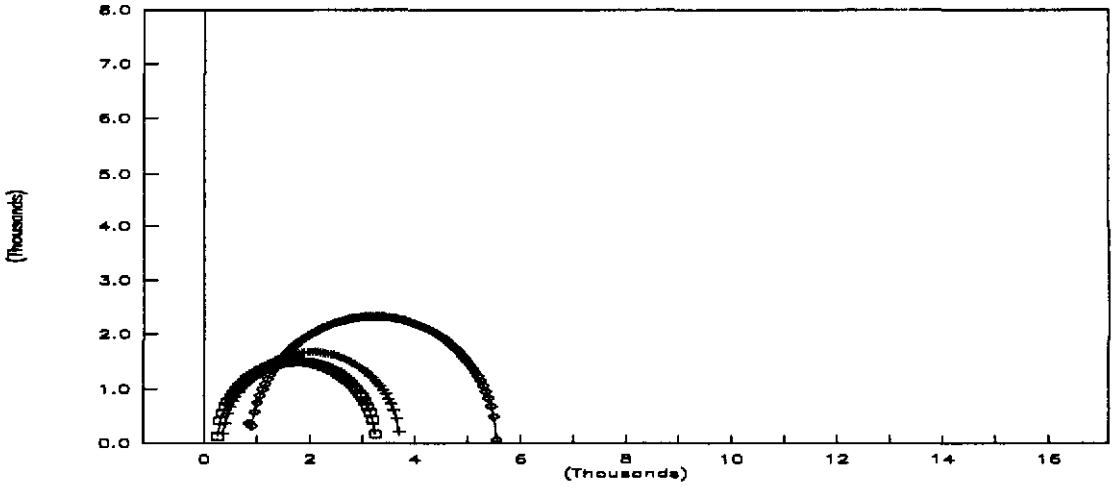
GOLDER ASSOCIATES INC.
MT. LAUREL, N.J.

TRIAXIAL COMPRESSION STRENGTH TEST
CONSOLIDATED/UNDRAINED WITH PORE PRESSURE MEASUREMENT
BH2 ST-2

TOTAL STRESS MOHR'S STRENGTH CIRCLES (in psf)



EFFECTIVE STRESS MOHR'S STRENGTH CIRCLES (in psf)



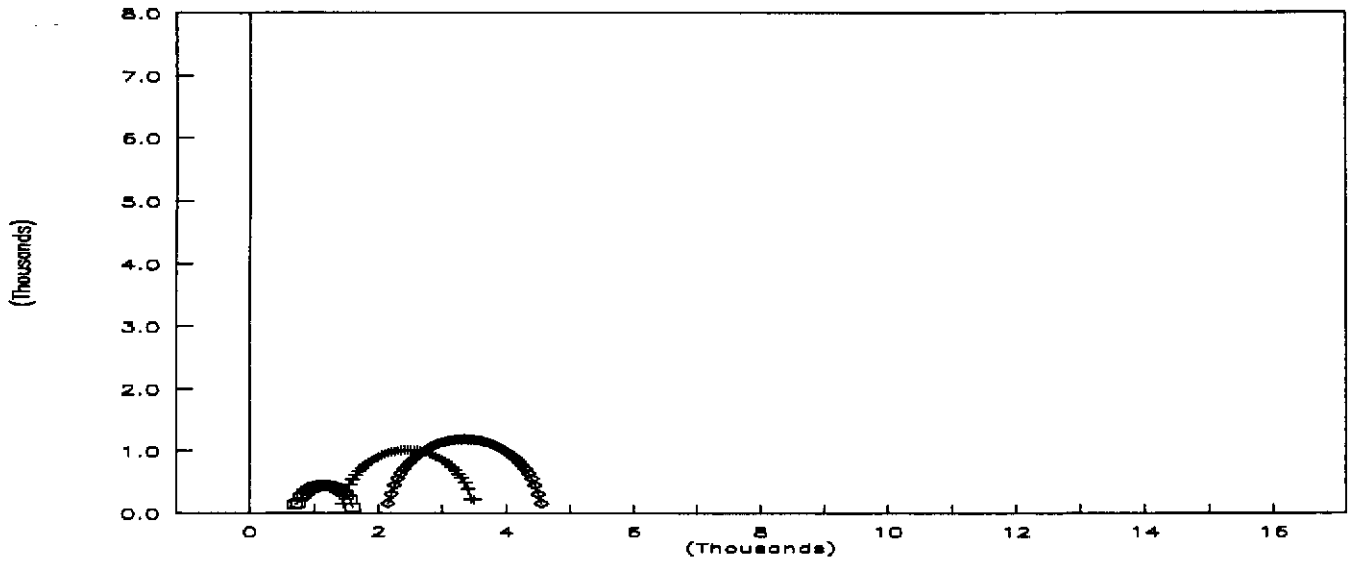
Consolidation Pressure	Initial Moisture	Initial Moist Density
(psi)	(%)	(pcf)
8	23.7	95
12	26.2	102
16	23.7	112

ISRT/WOBURN/MA
893-6255.5

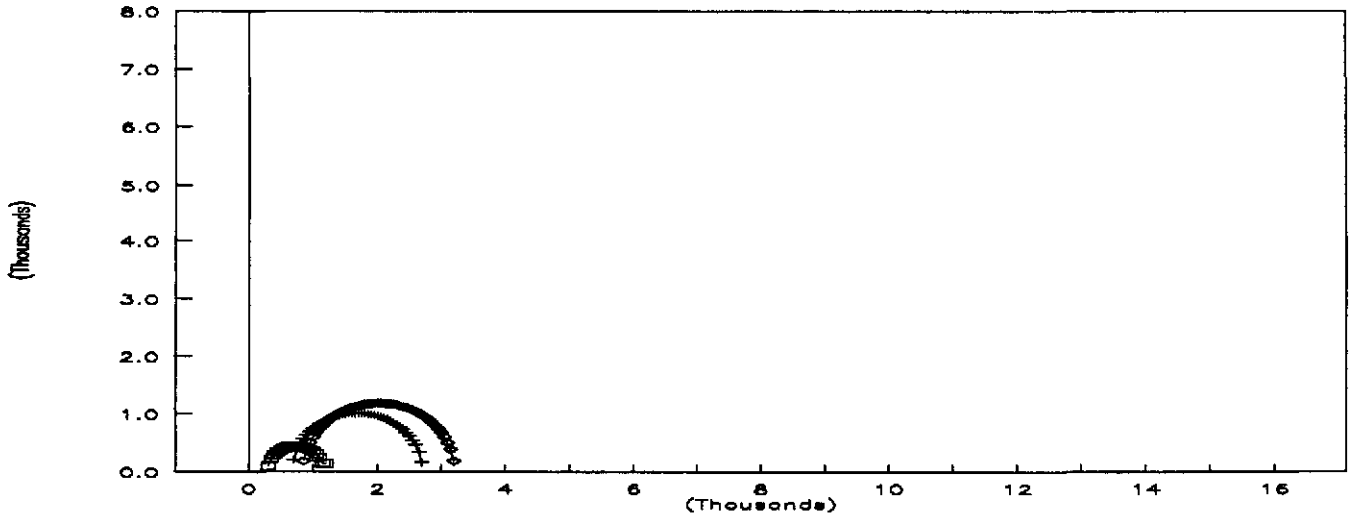
GOLDER ASSOCIATES INC.
MT. LAUREL, N.J.

TRIAXIAL COMPRESSION STRENGTH TEST
CONSOLIDATED/UNDRAINED WITH PORE PRESSURE MEASUREMENT
BH3 BULK (0' – 5')

TOTAL STRESS MOHR'S STRENGTH CIRCLES (in psf)



EFFECTIVE STRESS MOHR'S STRENGTH CIRCLES (in psf)



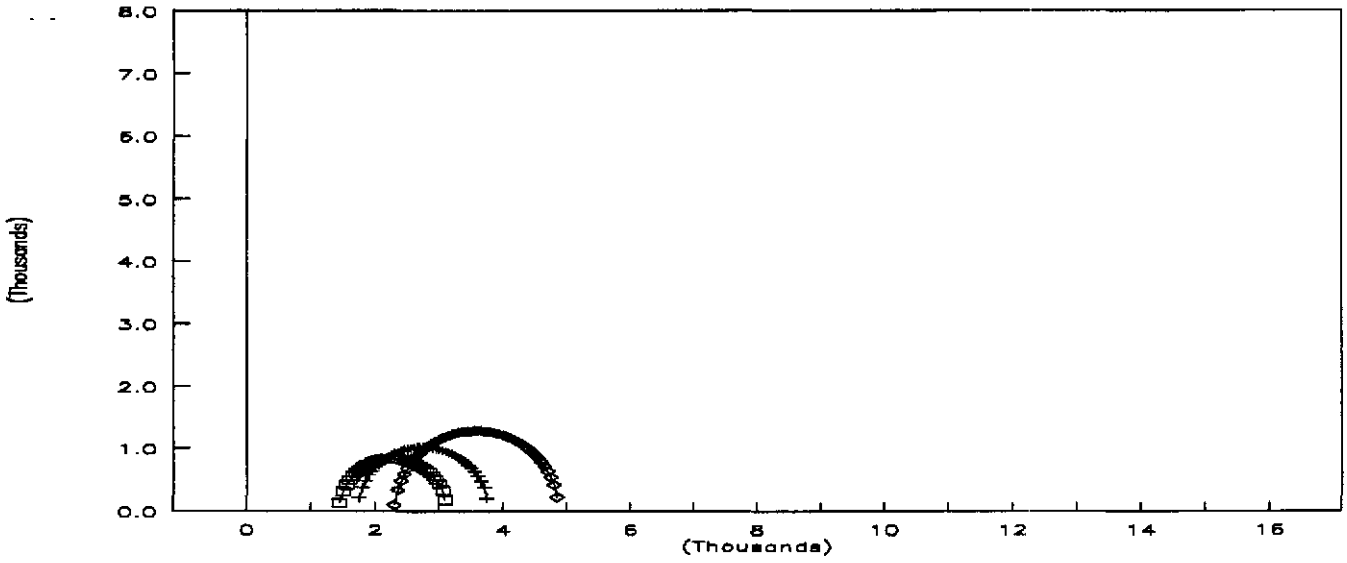
Consolidation Pressure	Initial Moisture	Initial Moist Density
(psi)	(%)	(pcf)
5	29.5	100
10	29.1	100
15	29.5	100

ISRT/WOBURN/MA
893-6255.5

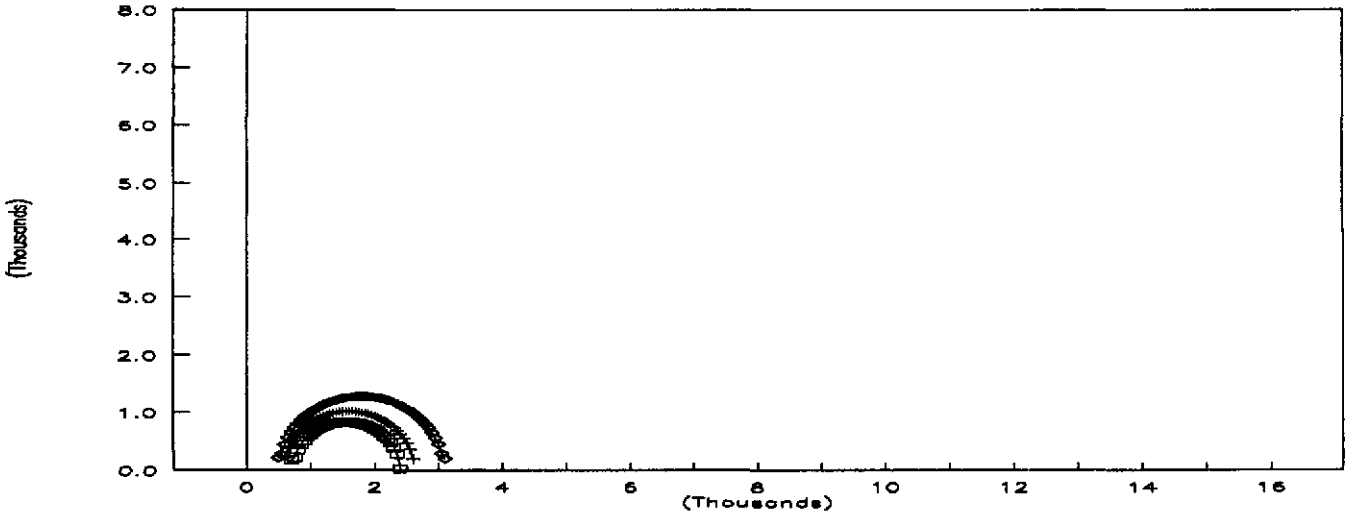
GOLDER ASSOCIATES INC.
MT. LAUREL, N.J.

TRIAXIAL COMPRESSION STRENGTH TEST
CONSOLIDATED/UNDRAINED WITH PORE PRESSURE MEASUREMENT
BH9 BULK

TOTAL STRESS MOHR'S STRENGTH CIRCLES (in psf)



EFFECTIVE STRESS MOHR'S STRENGTH CIRCLES (in psf)



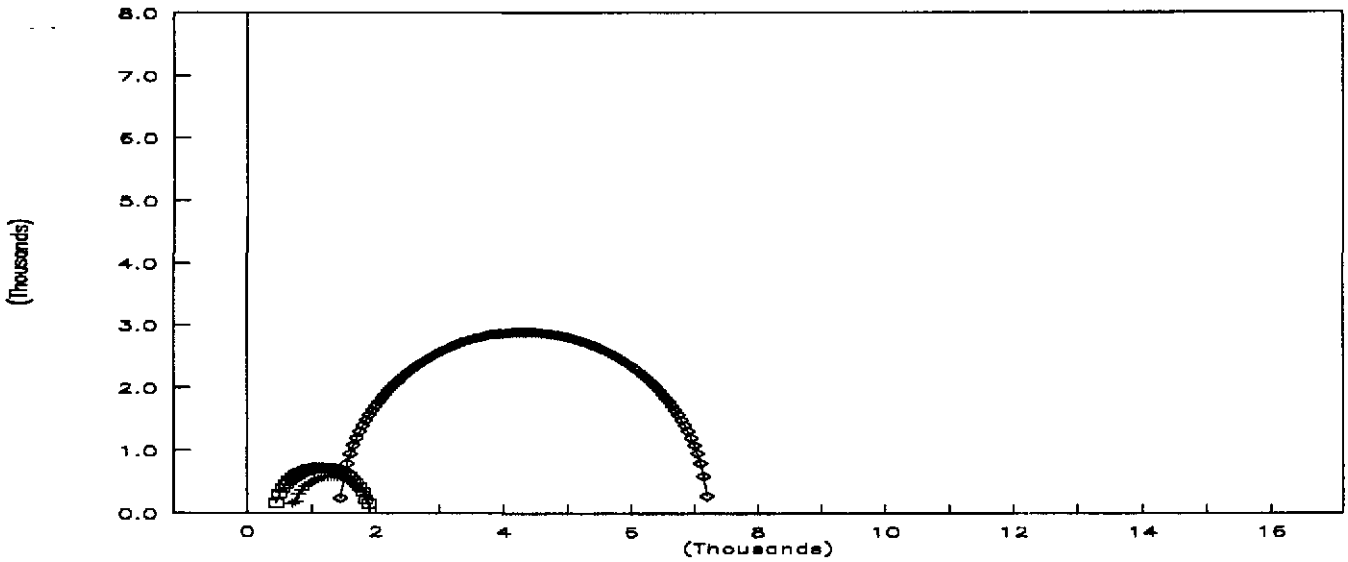
Consolidation Pressure	Initial Moisture	Initial Moist Density
(psi)	(%)	(pcf)
3	20	96
6	20	96
9	20	96

ISRT/WOBURN/MA
893-6255.5

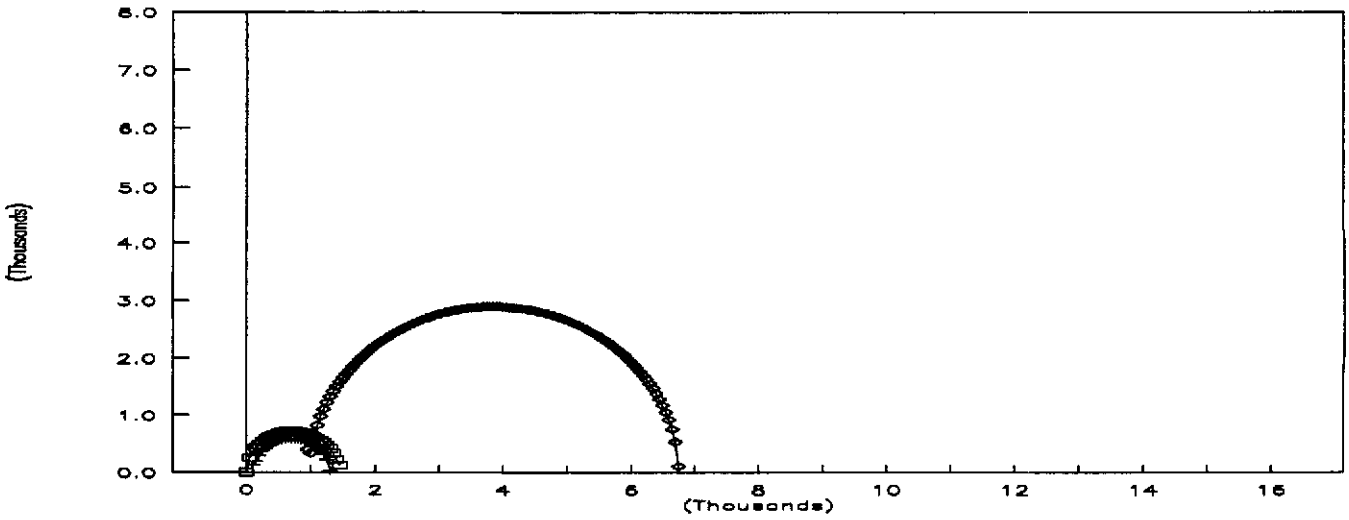
GOLDER ASSOCIATES INC.
MT. LAUREL, N.J.

TRIAXIAL COMPRESSION STRENGTH TEST
CONSOLIDATED/UNDRAINED WITH PORE PRESSURE MEASUREMENT
BH11 ST-1

TOTAL STRESS MOHR'S STRENGTH CIRCLES (in psf)



EFFECTIVE STRESS MOHR'S STRENGTH CIRCLES (in psf)



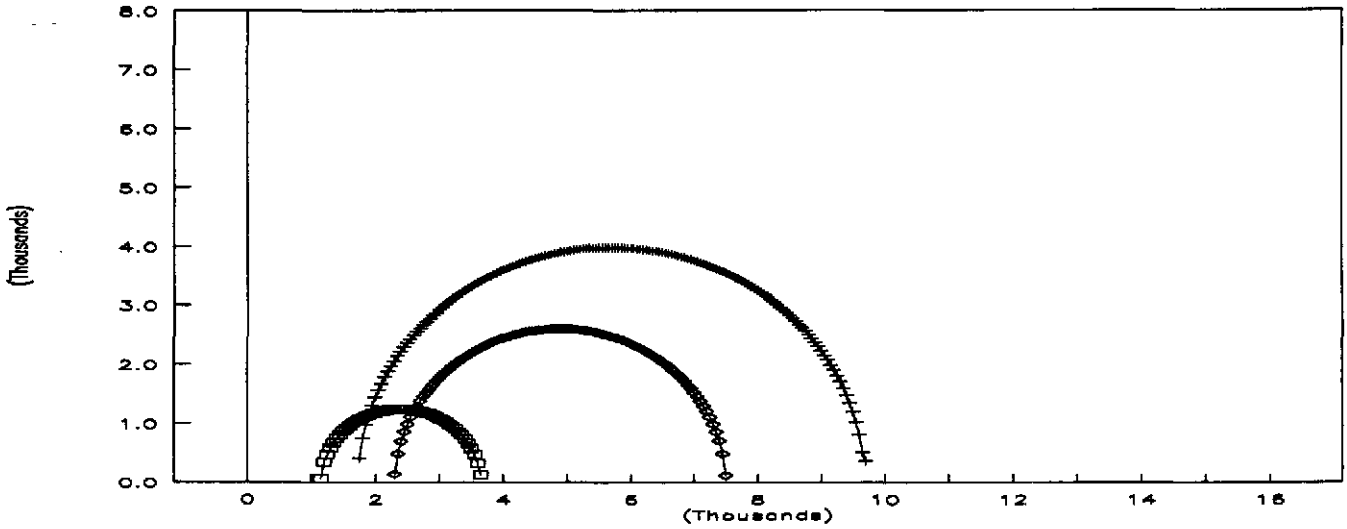
Consolidation Pressure	Initial Moisture	Initial Moist Density
(psi)	(%)	(pcf)
3	33.9	89
5	27.6	93
10	33.9	80

ISRT/WOBURN/MA
893-6255.5

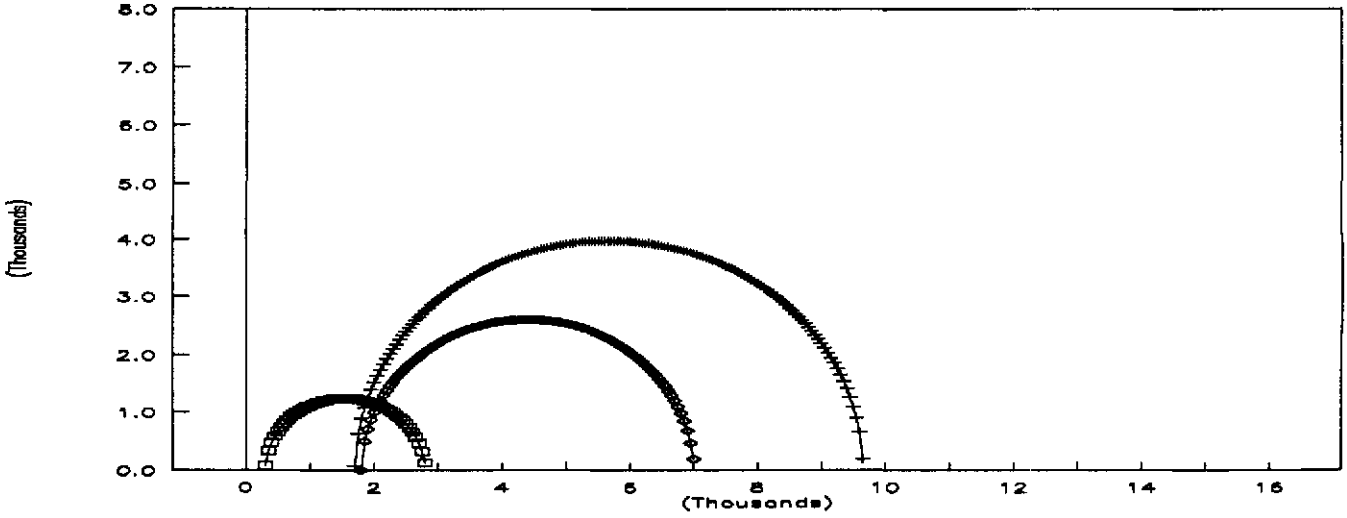
GOLDER ASSOCIATES INC.
MT. LAUREL, N.J.

TRIAXIAL COMPRESSION STRENGTH TEST
CONSOLIDATED/UNDRAINED WITH PORE PRESSURE MEASUREMENT
BH12 ST-2

TOTAL STRESS MOHR'S STRENGTH CIRCLES (in psf)



EFFECTIVE STRESS MOHR'S STRENGTH CIRCLES (in psf)



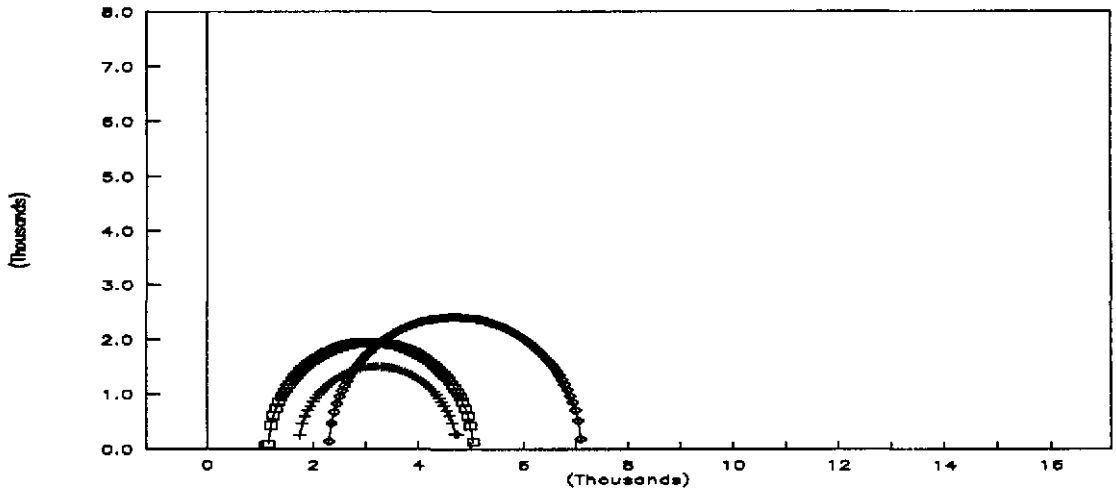
Consolidation Pressure	Initial Moisture	Initial Moist Density
(psi)	(%)	(pcf)
8	22.7	105
12	22.7	105
16	23.2	110

ISRT/WOBURN/MA
893-6255.5

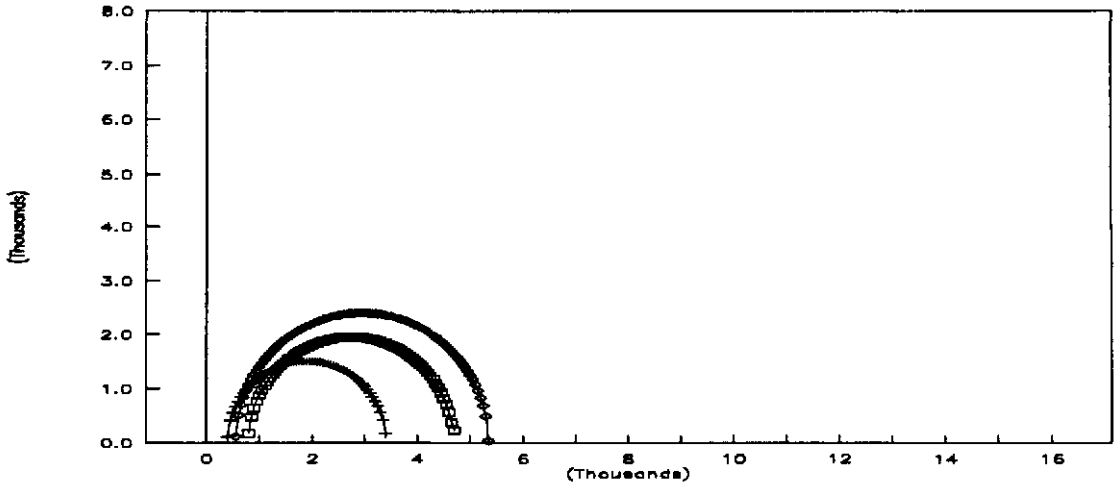
GOLDER ASSOCIATES INC.
MT. LAUREL, N.J.

TRIAXIAL COMPRESSION STRENGTH TEST
CONSOLIDATED/UNDRAINED WITH PORE PRESSURE MEASUREMENT
BH13 ST-2

TOTAL STRESS MOHR'S STRENGTH CIRCLES (in psf)



EFFECTIVE STRESS MOHR'S STRENGTH CIRCLES (in psf)



Consolidation Pressure	Initial Moisture	Initial Moist Density
(psi)	(%)	(pcf)
8	28.6	107
12	28.6	99
16	28.6	106

ISRT/WOBURN/MA
893-6255.5

GOLDER ASSOCIATES INC.
MT. LAUREL, N.J.

One-Dimensional Consolidation Test

CONSOLIDATION TEST

FIGURE

PROJECT ISRT/WOBURN/MA

BORING NO. 2 SAMPLE NO. ST-1 DEPTH 8-10 FT. ELEV. 85.2-83.2 MSL

DESCRIPTION

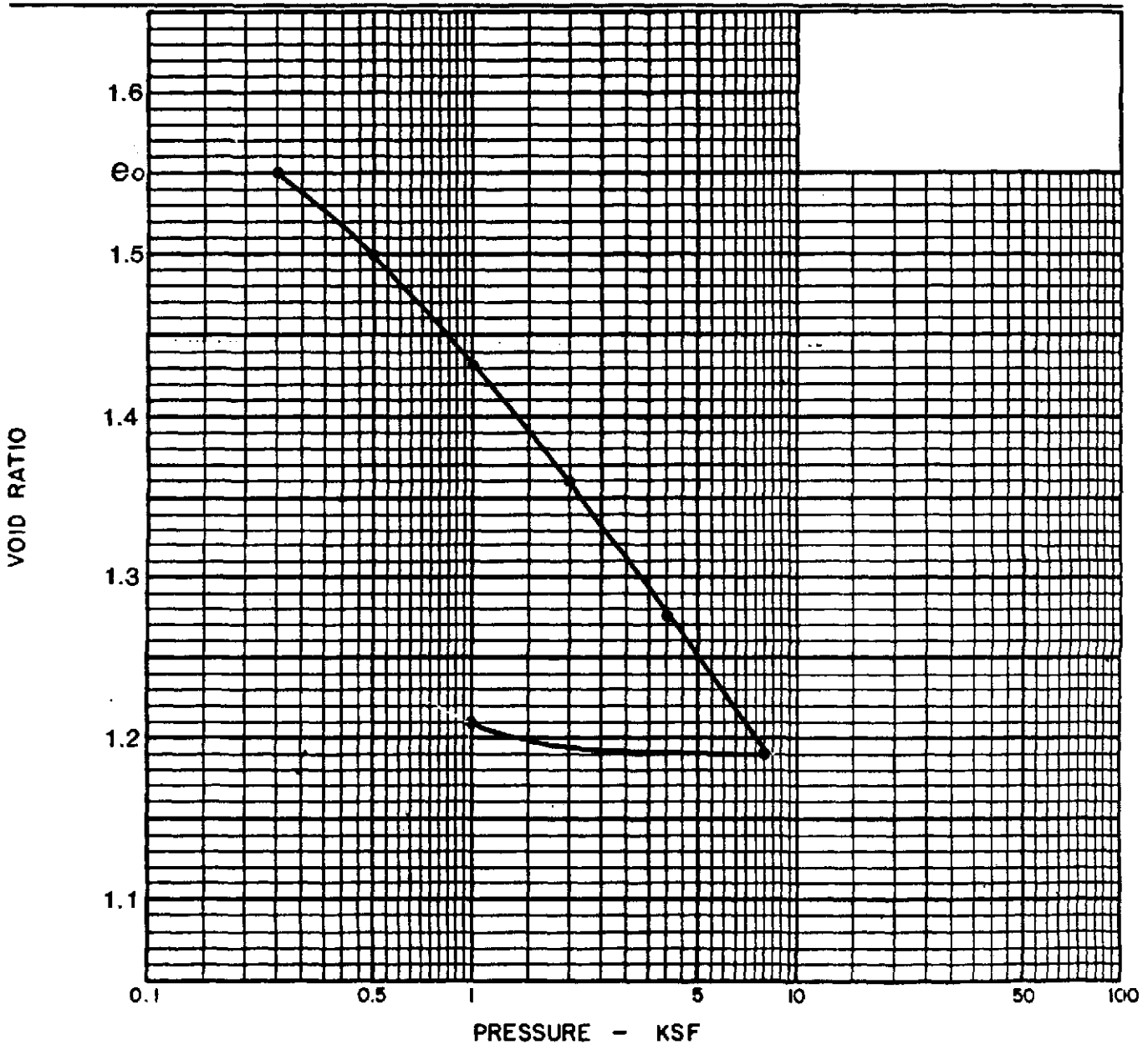
INITIAL SAMPLE HEIGHT 0.747 IN. SAMPLE AREA 4.886 SQ. IN. SPECIFIC GRAVITY 2.98

INITIAL MOISTURE CONTENT 30.3 % INITIAL BULK DENSITY 95.0 PCF INITIAL DRY DENSITY 72.9 PCF

INITIAL VOID RATIO 1.551 INITIAL SATURATION 58.2 % FINAL SATURATION 100.0 %

ATTERBERG LIMITS: L_w NP % I_w NP % P_w NP %

REMARKS:



Scale AS SHOWN

Date 9/14/90

Job No. 893-6255.5

Golder Associates

Drawn RDT

Checked

Reviewed

CONSOLIDATION TEST

FIGURE

PROJECT ISRT/WOBURN/MA

BORING NO. 2 SAMPLE NO. ST-2 DEPTH 19-21 FT. ELEV. 74.2-72.2 MSL

DESCRIPTION

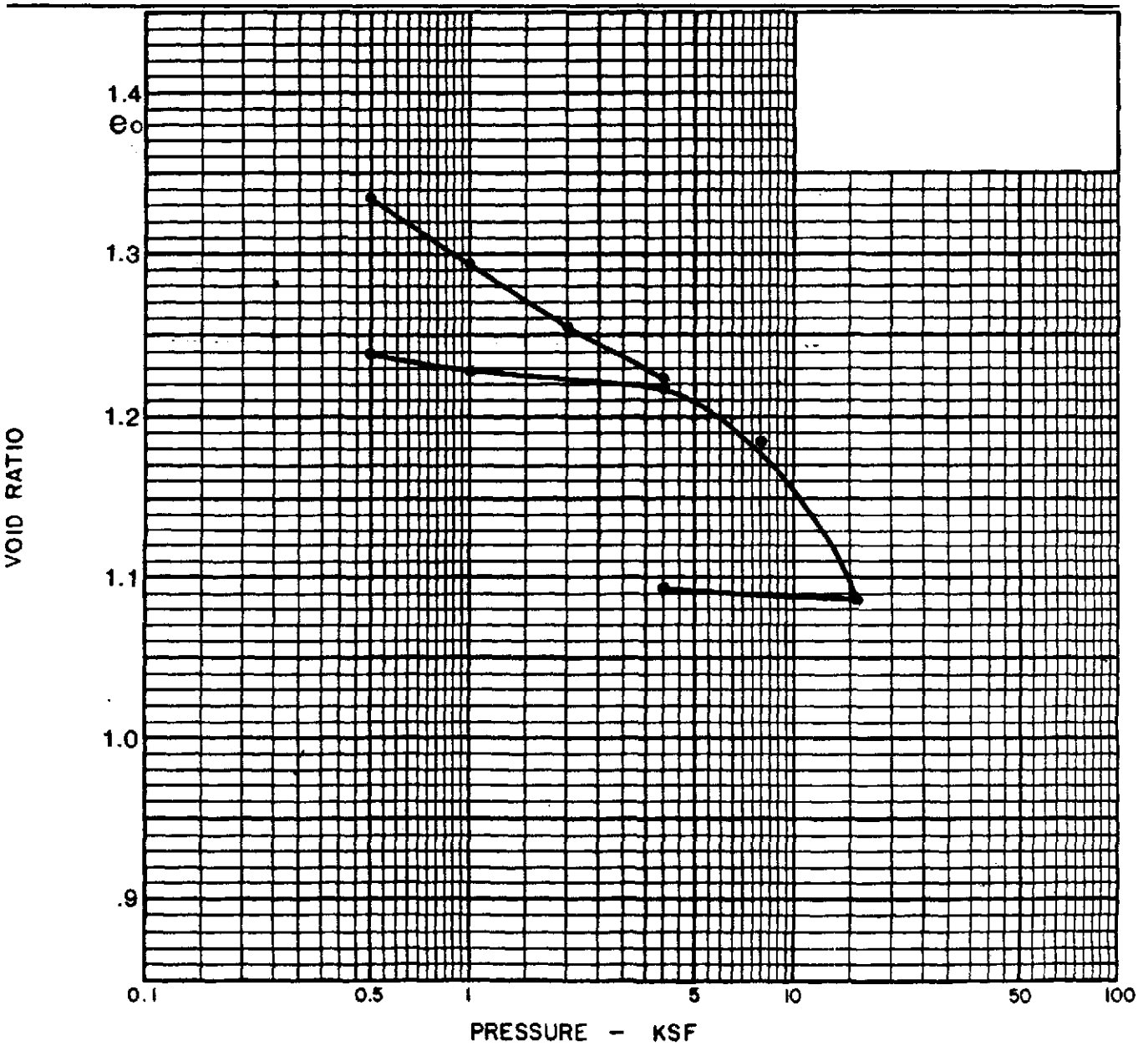
INITIAL SAMPLE HEIGHT 0.755 IN. SAMPLE AREA 4.893 SQ. IN. SPECIFIC GRAVITY 3.00

INITIAL MOISTURE CONTENT 29.7 % INITIAL BULK DENSITY 101.9 PCF INITIAL DRY DENSITY 78.6 PCF

INITIAL VOID RATIO 1.382 INITIAL SATURATION 64.5 % FINAL SATURATION 100.0 %

ATTERBERG LIMITS: L_w NP % I_w NP % P_w NP %

REMARKS:



Scale AS SHOWN

Date 9/14/90

Job No. 893-6255.5

Golder Associates

Drawn RDT

Checked

Reviewed

CONSOLIDATION TEST

FIGURE

PROJECT ISRT/WOBURN/MA

BORING NO. 2 SAMPLE NO. ST-3 DEPTH 28-30 FT. ELEV. 65.2-63.2 MSL

DESCRIPTION

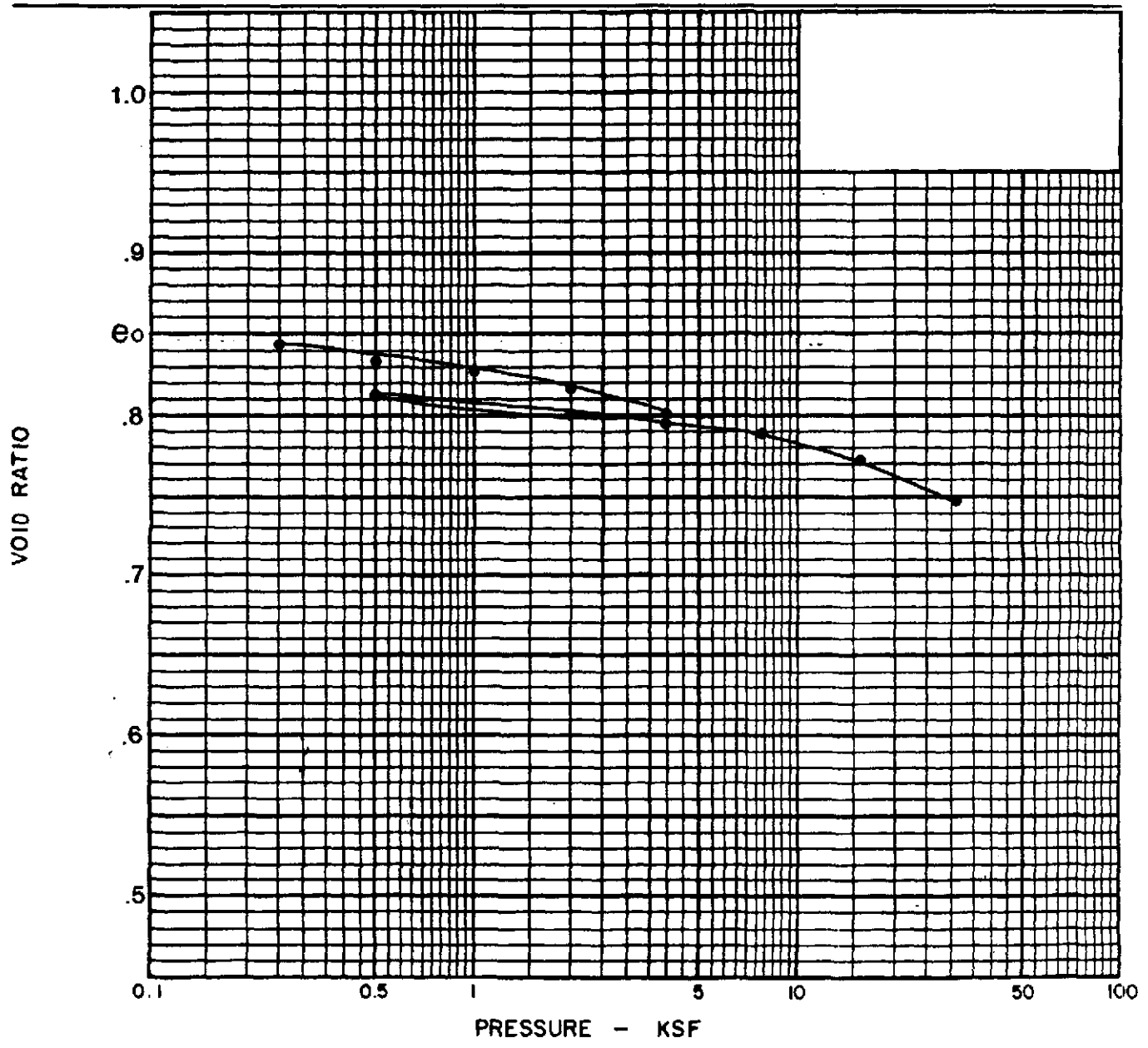
INITIAL SAMPLE HEIGHT 0.769 IN. SAMPLE AREA 4.896 SQ. IN. SPECIFIC GRAVITY 2.75

INITIAL MOISTURE CONTENT 13.0 % INITIAL BULK DENSITY 104.9 PCF INITIAL DRY DENSITY 92.8 PCF

INITIAL VOID RATIO 0.848 INITIAL SATURATION 42.4 % FINAL SATURATION 100.0 %

ATTERBERG LIMITS: L_w NP % I_w NP % P_w NP %

REMARKS:



Scale AS SHOWN

Date 9/14/90

Job No. 893-6255.5

Golder Associates

Drawn RDT

Checked

Reviewed

CONSOLIDATION TEST

FIGURE

PROJECT ISRT/WOBURN/MA.

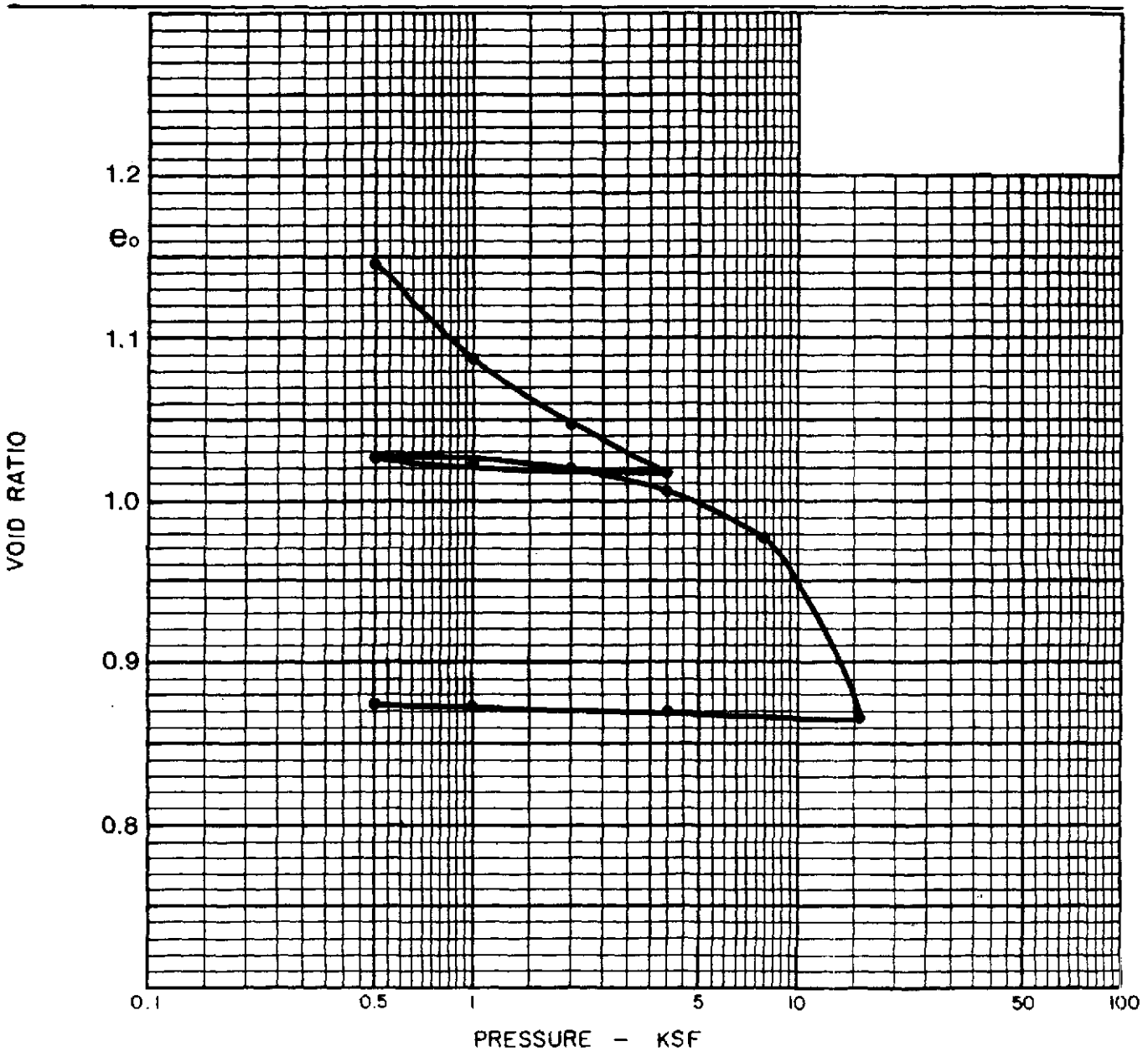
BORING NO. 3 SAMPLE NO. BULK DEPTH 0 - 5' ELEV.

DESCRIPTION

INITIAL SAMPLE HEIGHT	0.75 IN.	SAMPLE AREA	4.909 SQ. IN.	SPECIFIC GRAVITY	2.72
INITIAL MOISTURE CONTENT	27.4 %	INITIAL BULK DENSITY	100.0 PCF	INITIAL DRY DENSITY	78.5 PCF
INITIAL VOID RATIO	1.161	INITIAL SATURATION	64.1 %	FINAL SATURATION	100 %

ATTERBERG LIMITS: L_w NP % I_w NP % P_w NP %

REMARKS:



Scale AS SHOWN

Date 09/21/90

Job No. 893-6255

Golder Associates

Drawn RDT

Checked

Reviewed

CONSOLIDATION TEST

FIGURE

PROJECT ISRT/WOBURN/MA

BORING NO. 9 SAMPLE NO. BULK DEPTH _____ ELEV. _____

DESCRIPTION _____

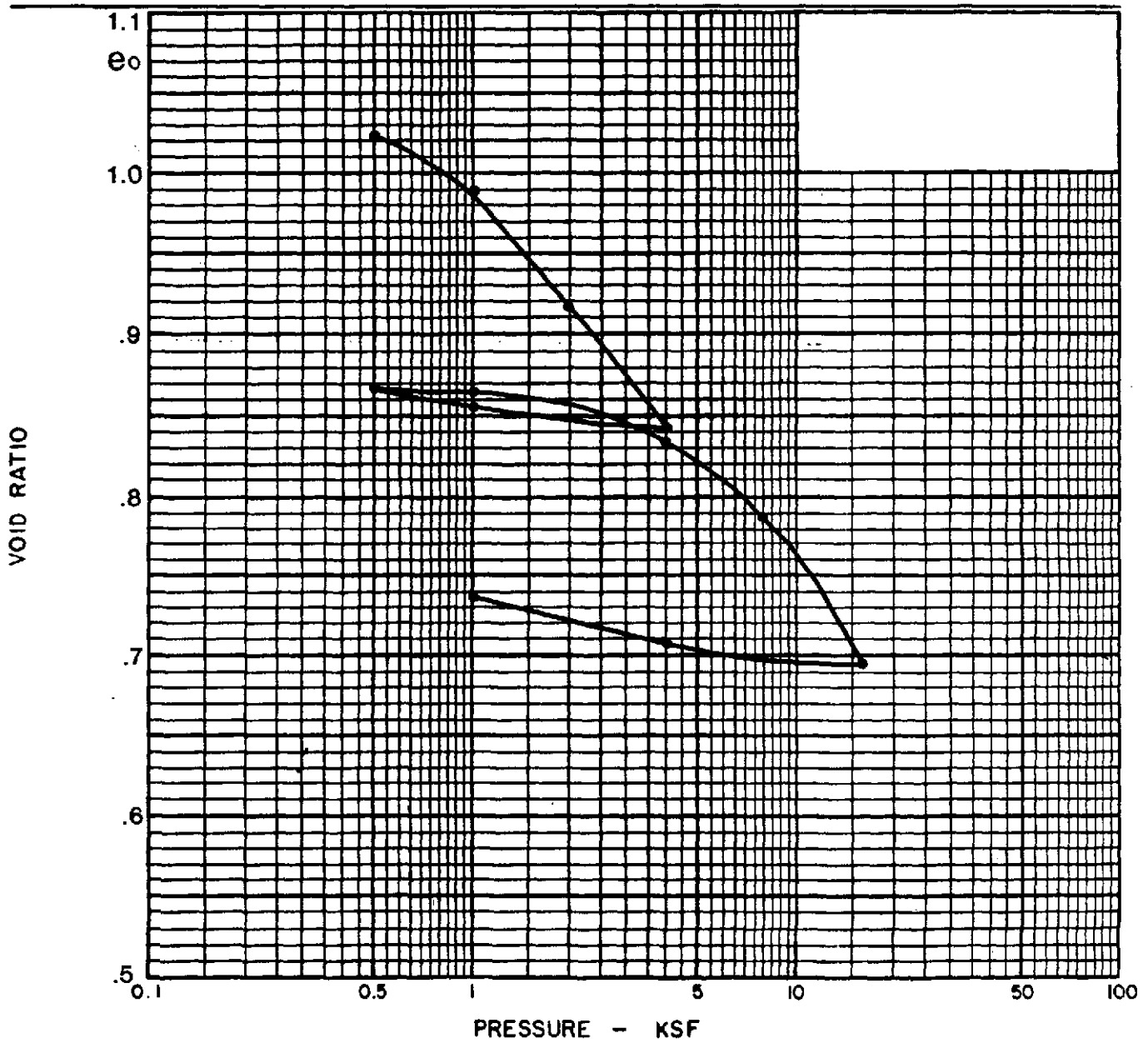
INITIAL SAMPLE HEIGHT 0.756 IN. SAMPLE AREA 4.909 SQ. IN. SPECIFIC GRAVITY 2.55

INITIAL MOISTURE CONTENT 30.1 % INITIAL BULK DENSITY 100.0 PCF INITIAL DRY DENSITY 76.9 PCF

INITIAL VOID RATIO 1.069 INITIAL SATURATION 71.7 % FINAL SATURATION 100.0 %

ATTERBERG LIMITS: L_w _____ % I_w _____ % P_w _____ %

REMARKS: _____



Scale AS SHOWN

Date 9/14/90

Job No. 893-6255.5

Golder Associates

Drawn RDT

Checked

Reviewed

CONSOLIDATION TEST

FIGURE

PROJECT ISRT/WOBURN/MA

BORING NO. 9 SAMPLE NO. ST 2 DEPTH 18-20 FT. ELEV. 85.7-83.7 MSL

DESCRIPTION

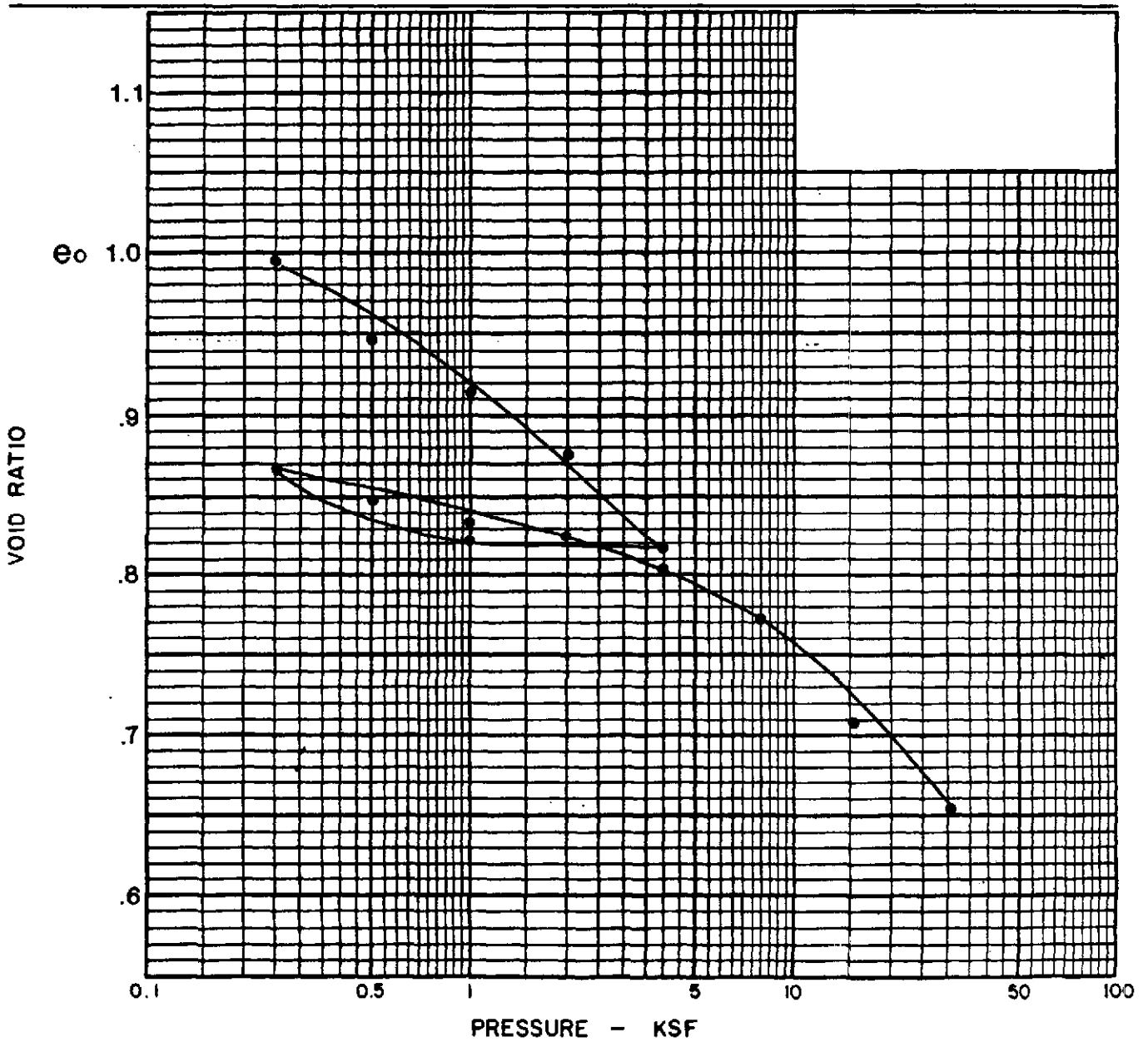
INITIAL SAMPLE HEIGHT 0.480 IN. SAMPLE AREA 4.892 SQ. IN. SPECIFIC GRAVITY 2.95

INITIAL MOISTURE CONTENT 24.8 % INITIAL BULK DENSITY 113.2 PCF INITIAL DRY DENSITY 90.8 PCF

INITIAL VOID RATIO 1.028 INITIAL SATURATION 71.10 % FINAL SATURATION 100.0 %

ATTERBERG LIMITS: L_w NP % I_w NP % P_w NP %

REMARKS:



Scale AS SHOWN

Date 9/14/90

Job No. 893-6255.5

Golder Associates

Drawn RDT

Checked

Reviewed

CONSOLIDATION TEST

FIGURE

PROJECT ISRT/WOBURN/MA

BORING NO. 10 SAMPLE NO. ST4 DEPTH 33-35 FT. ELEV. 74.2-72.2 MSL

DESCRIPTION

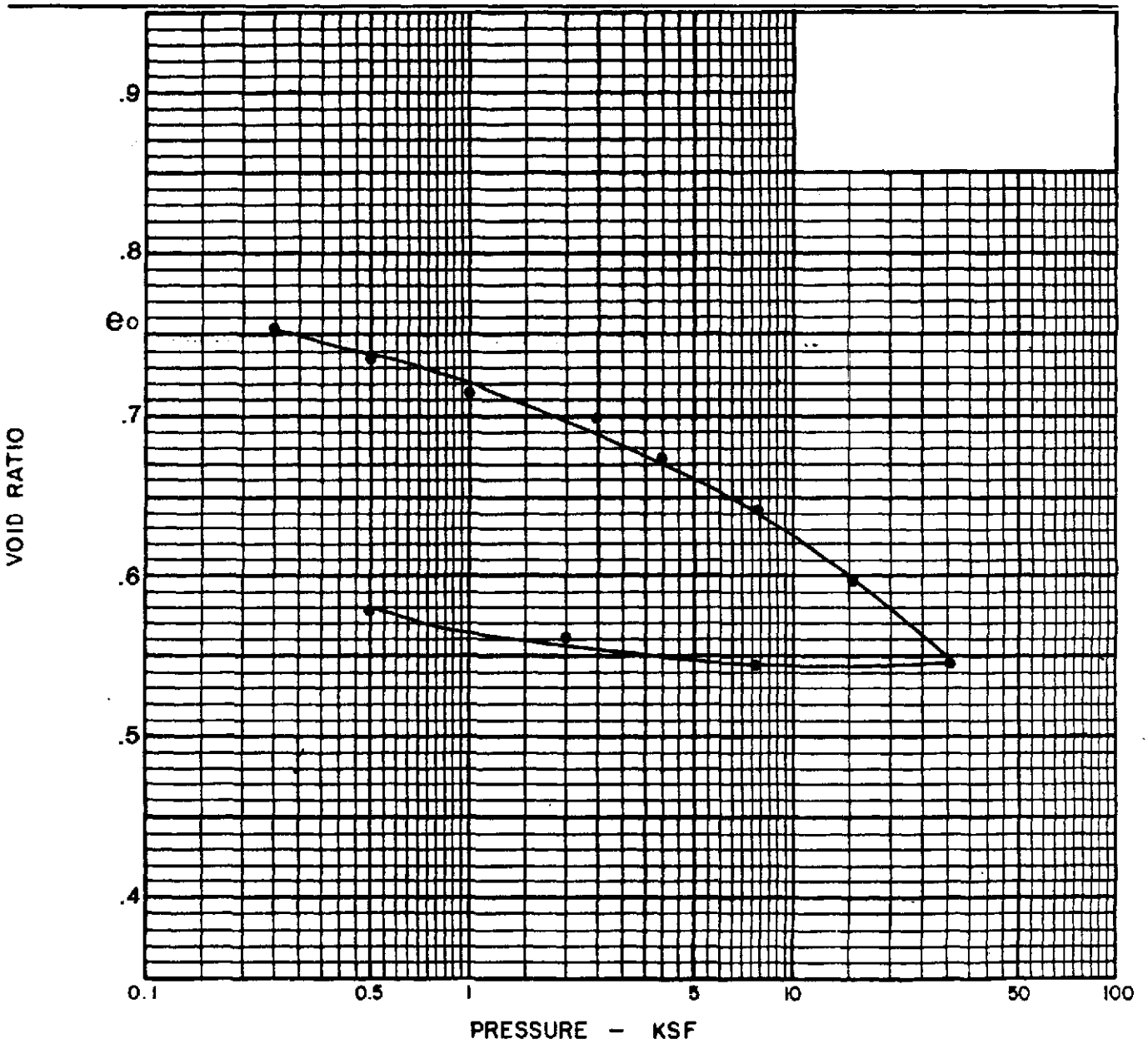
INITIAL SAMPLE HEIGHT 0.902 IN. SAMPLE AREA 4.892 SQ. IN. SPECIFIC GRAVITY 2.51

INITIAL MOISTURE CONTENT 29.8 % INITIAL BULK DENSITY 115.6 PCF INITIAL DRY DENSITY 89.1 PCF

INITIAL VOID RATIO 0.759 INITIAL SATURATION 98.5 % FINAL SATURATION 100.0 %

ATTERBERG LIMITS: L_w NP % I_w NP % P_w NP %

REMARKS:



Scale AS SHOWN

Date 9/14/90

Job No. 893-6255.5

Golder Associates

Drawn RDT

Checked

Reviewed

CONSOLIDATION TEST

FIGURE

PROJECT ISRT/WOBURN/MA

BORING NO. 11 SAMPLE NO. ST-1 DEPTH 3-5 FT. ELEV. 82.0-80.0 MSL

DESCRIPTION

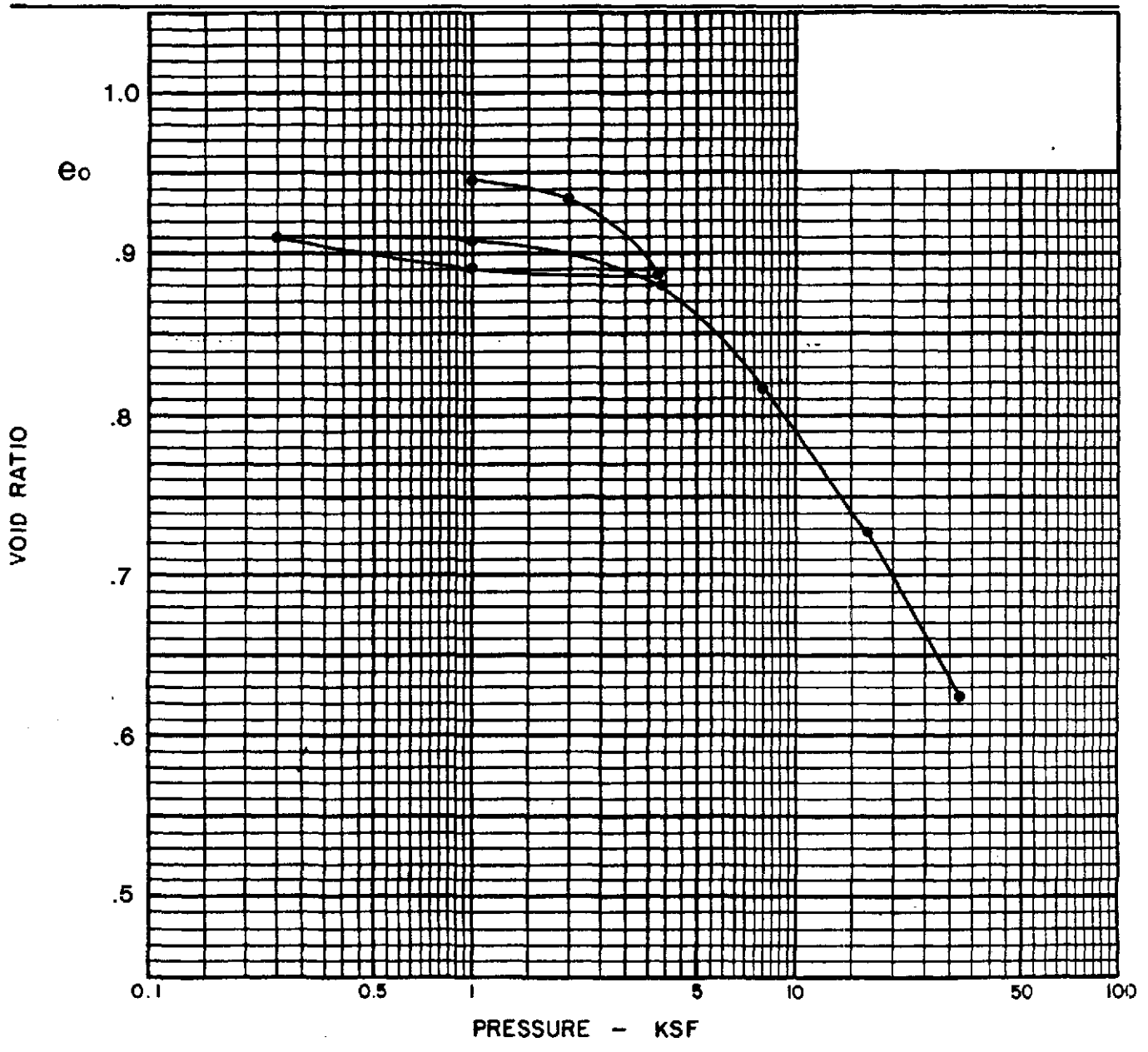
INITIAL SAMPLE HEIGHT 0.835 IN. SAMPLE AREA 4.90 SQ. IN. SPECIFIC GRAVITY 2.66

INITIAL MOISTURE CONTENT 31.0 % INITIAL BULK DENSITY 111.80 PCF INITIAL DRY DENSITY 85.40 PCF

INITIAL VOID RATIO 0.951 INITIAL SATURATION 87.0 % FINAL SATURATION 100.0 %

ATTERBERG LIMITS: L_w NP % I_w NP % P_w NP %

REMARKS:



Scale AS SHOWN

Date 9/14/90

Job No. 893-6255.5

Golder Associates

Drawn RDT

Checked

Reviewed

Permeability

BH-9
cond12cpi

FLEXIBLE WALL TRXIAL PERMEABILITY
COE EM 1110-2-19 APPENDIX VII

PROJECT TITLE: ISRT/WOBURN/MA
PROJECT NO.: 893-6255.5
TYPE TEST: PRODUCTION / MODIFIED COE / STANDARD COE / FLOW PUMP

SAMPLE ID: BH-9
TYPE: BULK/REMOLDED

TECH: TMS
DATE: 9/15/90

CHECKED: [illegible]
DATE: 9/21/90

****

Sample Data

ID	BH-9	USCS	NP	B-Value,f	0.99	
Height (cm)	5.46	Wt.,i (g)	347.70	Cell Pres	100.00	psi
Diameter (cm)	7.11	Wt,.f (g)	339.30	Top Pres	90.00	psi
Nom. Area (cm2)	39.70	Wt.,f,dry	266.48	Bot Pres	95.00	psi
Volume,i (cc)	216.77	%Moist,i	30.5%	Head,psi	5.00	psi
Spec. Grav.		%Moist,f	27.3%	Head,in	138.50	inches
		Gradient:	64.38	Head,cm	351.50	cm

SAMPLE PREPARATION:
undisturbed y/n shelby tube 3.0" OD 2.0" OD Other:
remolded y/n 4"in Proctor Mold Hammer #5.5/#10.0
y/n 6"in Proctor Mold Hammer #5.5/#10.0
y/n Other Method
Moisture Conditioning;water added y/n
dried y/n
oven/air

****

Calculation Constant: 3.91E-04 Dervied from Q=kia where Q is flow,k is permeability,i is gradient and a is x-sectional area.

CONDITIONS BEFORE SATURATION
Initial volume(cc) 216.77 cc
WET DENSITY (pcf) 100.09 pcf
DRY DENSITY (pcf) 76.71 pcf
MOISTURE CONTENT 30.48 %
Volume of Solids cc
Volume of Voids cc
VOID RATIO
Saturation (%) %

CONDITIONS AFTER TESTING
Final Volume (cc) 215.77 cc
WET DENSITY (pcf) 98.12 pcf
DRY DENSITY (pcf) 77.06 pcf
MOISTURE CONTENT 27.33 %
Volume of Solids cc
Volume of Voids cc
VOID RATIO
Saturation (%) %

COMMENTS; Specific gravity value is an assumed number, as such related values will reflect deviations associated with this assumption.

WATER CONTENTS	"Trimmings" initial	"Sample" final
Tare No.	D-024	D-02
Wt soil&tare,i (g)	54.4	449.6
Wt soil&tare,f (g)	49.3	376.8
Wt Tare (g)	34.0	110.3
Wt Moisture Lost (g)	5.1	72.8
Wt Dry Soil (g)	15.3	266.5
WATER CONTENT (%)	33.7%	27.3%

Total volume change during back pressure saturation and consolidation cc A positive value in dicates shrinkage and a negative value indicates swelling.

DATE	TIME FUNCTION,SECONDS DAY	HOUR	MIN	dt (min)	dt,acc (min)	dt (sec)	dt,acc (sec)	rdng (cc)	INFLOW d,vol (cc)	tot,vol (cc)	rdng (cc)	OUTFLOW d,vol (cc)	tot,vol (cc)	PERMEABILITY PERM,INC (cm/sec)	PERM,ACC (cm/sec)
9/18/90	33134	12	2	0	0.00	0	0	14.30	0.00	0.00	35.10	0.00	0.00	0.0	0.0
9/18/90	33134	12	59	57	57.00	3420	3420	18.30	4.00	4.00	31.00	4.10	4.10	4.69E-07	4.69E-07
9/18/90	33134	14	46	107	164.00	6420	9840	25.60	7.30	11.30	23.80	7.20	11.30	4.39E-07	4.49E-07
9/18/90	33134	16	44	118	282.00	7080	16920	33.00	7.40	18.70	16.40	7.40	18.70	4.09E-07	4.32E-07
9/19/90	33135	7	46	0	282.00	0	16920	0.20	0.00	18.70	49.00	0.00	18.70		
9/19/90	33135	16	30	524	806.00	31440	48360	37.30	37.10	55.80	12.00	37.00	55.70	4.60E-07	4.51E-07

****

*TRANSCRIBED FROM ORIGINAL DATA SHEETS

Number of pore volumes passed thru 0.47 vols
Estimated time for one pore volume 1.19 days

k(total inflow) 4.51E-07
k(total outflow)4.51E-07
k(ave,total) 4.51E-07

PERMEABILITY REPORTED AS ** 4.5E-07 *********
BASED ON ACCUMULATED OUTFLOW VALUES
GOLDER ASSOCIATES,MOUNT LAUREL,NEW JERSEY
20000 HORIZON WAY, SUITE 500
1-609-273-1110

FLEXIBLE WALL TRXIAL PERMEABILITY
COE EM 1110-2-19 APPENDIX VII

cond12cpi

PROJECT TITLE: ISRT/WOBURN/MA
PROJECT NO.: 893-6255.5

SAMPLE ID: BH-10, ST-4
TYPE: 3" SHELBY TUBE

TECH: CLL
DATE: 7/10/90

CHECKED:
DATE:

****

SAMPLE DATA

ID	BH10ST4	USCS	B-Value,f	1.00	
Height (cm)	9.31	Wt.,i (g)	665.95	Cell Pres	101.50 psi
Diameter (cm)	7.30	Wt,.f (g)	696.95	Top Pres	93.00 psi
Nom. Area (cm2)	41.89	Wt.,f,dry	523.95	Bot Pres	95.00 psi
Volume,i (cc)	389.97	%Moist,i	27.1%	Head,psi	2.00 psi
Spec. Grav.	2.51	%Moist,f	33.0%	Head,in	55.40 inches
		Gradient:	15.10	Head,cm	140.60 cm

SAMPLE PREPARATION:

undisturbed	y/n	shelby tube 3.0" OD 2.0" OD Other:
remolded	y/n	4"in Proctor Mold Hammer #5.5/#10.0
	y/n	6"in Proctor Mold Hammer #5.5/#10.0
	y/n	Other Method
		Moisture Conditioning;water added y/n
		dried y/n
		oven/air

****

Calculation Constant: 1.58E-03 Dervied from Q=kia where Q is flow,k is permeability,i is gradient and a is x-sectional area.

CONDITIONS BEFORE SATURATION

Initial volume(cc)	389.97	cc
WET DENSITY (pcf)	106.56	pcf
DRY DENSITY (pcf)	83.84	pcf
MOISTURE CONTENT	27.10	%
Volume of Solids	208.75	cc
Volume of Voids	181.22	cc
VOID RATIO	0.87	
Saturation (%)	78.4	%

CONDITIONS AFTER TESTING

Final Volume (cc)	381.77	cc
WET DENSITY (pcf)	113.92	pcf
DRY DENSITY (pcf)	85.64	pcf
MOISTURE CONTENT	33.02	%
Volume of Solids	208.75	cc
Volume of Voids	173.02	cc
VOID RATIO	0.83	
Saturation (%)	100.0	%

COMMENTS; Specific gravity value is an assumed number, as such related values will reflect deviations associated with this assumption.

WATER CONTENTS	"Trimmings" initial	"Sample" final
Tare No.	I-29	D-22
Wt soil&tare,i (g)	44.1	730.6
Wt soil&tare,f (g)	38.1	557.6
Wt Tare (g)	16.0	33.7
Wt Moisture Lost (g)	6.0	173.0
Wt Dry Soil (g)	22.2	524.0
WATER CONTENT (%)	27.1%	33.0%

Total volume change during back pressure saturation and consolidation 8.20 cc A positive value in dicates shrinkage and a negative value indicates swelling.

DATE	TIME FUNCTION,SECONDS DAY	HOUR	MIN	dt (min)	dt,acc (min)	dt (sec)	dt,acc (sec)	rdng (cc)	INFLOW d,vol (cc)	tot,vol (cc)	rdng (cc)	OUTFLOW d,vol (cc)	tot,vol (cc)	PERMEABILITY PERM,INC (cm/sec)	PERM,ACC (cm/sec)
7/3/90	33057	10	16	0	0.00	0	0	-2.70	0.00	0.00	47.10	0.00	0.00	0.0	0.0
7/3/90	33057	13	32	196	196.00	11760	11760	18.40	21.10	21.10	-2.70	49.80	49.80	6.69E-06	6.69E-06
7/9/90	33063	14	32	0	196.00	0	11760	1.20	0.00	21.10	39.50	0.00	49.80		
7/9/90	33063	18	10	218	414.00	13080	24840	37.50	36.30	57.40	2.30	37.20	87.00	4.50E-06	5.54E-06
7/10/90	33064	6	48	0	414.00	0	24840	4.40	0.00	57.40	48.70	0.00	87.00		
7/10/90	33064	8	55	127	541.00	7620	32460	24.90	20.50	77.90	27.60	21.10	108.10	4.38E-06	5.26E-06
7/10/90	33064	10	25	90	631.00	5400	37860	35.80	10.90	88.80	16.20	11.40	119.50	3.34E-06	4.99E-06
7/10/90	33064	10	55	30	661.00	1800	39660	38.90	3.10	91.90	12.90	3.30	122.80	2.90E-06	4.89E-06
7/10/90	33064	11	30	35	696.00	2100	41760	42.30	3.40	95.30	9.30	3.60	126.40	2.71E-06	4.78E-06
7/10/90	33064	12	1	31	727.00	1860	43620	45.20	2.90	98.20	6.20	3.10	129.50	2.63E-06	4.69E-06
7/10/90	33064	12	30	0	727.00	0	43620	-0.20	0.00	98.20	49.90	0.00	129.50		
7/10/90	33064	13	0	30	757.00	1800	45420	5.40	5.60	103.80	44.10	5.80	135.30	5.09E-06	4.71E-06
7/10/90	33064	13	30	30	787.00	1800	47220	10.50	5.10	108.90	38.80	5.30	140.60	4.65E-06	4.71E-06
7/10/90	33064	14	5	35	822.00	2100	49320	16.00	5.50	114.40	33.00	5.80	146.40	4.37E-06	4.69E-06
7/10/90	33064	14	35	30	852.00	1800	51120	20.40	4.40	118.80	28.50	4.50	150.90	3.95E-06	4.67E-06
7/10/90	33064	15	5	30	882.00	1800	52920	25.50	5.10	123.90	23.20	5.30	156.20	4.65E-06	4.67E-06
7/10/90	33064	15	35	30	912.00	1800	54720	30.30	4.80	128.70	18.30	4.90	161.10	4.30E-06	4.65E-06
7/10/90	33064	16	2	27	939.00	1620	56340	34.30	4.00	132.70	14.10	4.20	165.30	4.10E-06	4.64E-06
7/10/90	33064	16	30	28	967.00	1680	58020	38.30	4.00	136.70	10.00	4.10	169.40	3.86E-06	4.62E-06

****

*TRANSCRIBED FROM ORIGINAL DATA SHEETS

Number of pore volumes passed thru 0.93 vols
Estimated time for one pore volume 7.49 days

k(total inflow) 3.72E-06
k(total outflow)4.62E-06
k(ave,total) 4.17E-06

PERMEABILITY REPORTED AS **4.62E-06 cm/sec***
BASED ON ACCUMULATED OUTFLOW VALUES
GOLDER ASSOCIATES,MOUNT LAUREL,NEW JERSEY
20000 HORIZON WAY, SUITE 500

1-609-273-1110

BH1ST1L
cond12cpi

FLEXIBLE WALL TRXIAL PERMEABILITY
COE EM 1110-2-19 APPENDIX VII

PROJECT TITLE: ISRT/WOBURN/MA
PROJECT NO.: 893-6255.5

SAMPLE ID: BH-11;ST-1
TYPE: 3" SHELBY TUBE

TECH: CLL
DATE: 7/5/90

CHECKED:
DATE:

****

SAMPLE DATA

ID	BH11ST1	USCS		B-Value,f	0.94	
Height (cm)	15.52	Wt.,i (g)	1091.77	Cell Pres	101.50	psi
Diameter (cm)	7.21	Wt,.f (g)	1058.33	Top Pres	93.00	psi
Nom. Area (cm2)	40.87	Wt.,f,dry	780.56	Bot Pres	95.00	psi
Volume,i (cc)	634.34	%Moist,i	39.9%	Head,psi	2.00	psi
Spec. Grav.	2.66	%Moist,f	35.6%	Head,in	55.40	inches
		Gradient:	9.06	Head,cm	140.60	cm

SAMPLE PREPARATION:

undisturbed	y/n	shelby tube 3.0" OD 2.0" OD Other:
remolded	y/n	4"in Proctor Mold Hammer #5.5/#10.0
	y/n	6"in Proctor Mold Hammer #5.5/#10.0
	y/n	Other Method
		Moisture Conditioning;water added y/n
		dried y/n
		oven/air

****

Calculation Constant: 2.70E-03 Dervied from Q=kia where Q is flow,k is permeability,i is gradient and a is x-sectional area.

CONDITIONS BEFORE SATURATION

Initial volume(cc)	634.34	cc
WET DENSITY (pcf)	107.40	pcf
DRY DENSITY (pcf)	76.78	pcf
MOISTURE CONTENT	39.87	%
Volume of Solids	293.44	cc
Volume of Voids	340.89	cc
VOID RATIO	1.16	
Saturation (%)	91.29	%

CONDITIONS AFTER TESTING

Final Volume (cc)	571.21	cc
WET DENSITY (pcf)	115.61	pcf
DRY DENSITY (pcf)	85.27	pcf
MOISTURE CONTENT	35.59	%
Volume of Solids	293.44	cc
Volume of Voids	277.76	cc
VOID RATIO	0.95	
Saturation (%)	100.00	%

COMMENTS; Specific gravity value is an assumed number, as such related values will reflect deviations associated with this assumption.

WATER CONTENTS	"Trimmings" initial	"Sample" final
Tare No.	I-53	ID-27
Wt soil&tare,i (g)	54.1	1091.8
Wt soil&tare,f (g)	45.6	814.0
Wt Tare (g)	20.7	33.4
Wt Moisture Lost (g)	8.5	277.8
Wt Dry Soil (g)	24.9	780.6
WATER CONTENT (%)	33.9%	35.6%

Total volume change during back pressure saturation and consolidation 63.13 cc A positive value in dicates shrinkage and a negative value indicates swelling.

TIME FUNCTION,SECONDS DATE	DAY	HOUR	MIN	dt (min)	dt,acc (min)	dt (sec)	dt,acc (sec)	rdng (cc)	INFLOW d,vol (cc)	tot,vol (cc)	rdng (cc)	OUTFLOW d,vol (cc)	tot,vol (cc)	PERMEABILITY PERM,INC (cm/sec)	PERM,ACC (cm/sec)
6/30/90	33054	9	9	0	0.00	0	0	0.70	0.00	0.00	49.50	0.00	0.00	0.0	0.0
6/30/90	33054	13	29	260	260.00	15600	15600	10.50	9.80	9.80	39.40	10.10	10.10	1.75E-06	1.75E-06
7/2/90	33056	6	55	0	260.00	0	15600	11.10	0.00	9.80	39.20	0.00	10.10		
7/2/90	33056	16	47	592	852.00	35520	51120	30.70	19.60	29.40	18.50	20.70	30.80	1.57E-06	1.63E-06
7/3/90	33057	6	55	0	852.00	0	51120	30.60	0.00	29.40	18.30	0.00	30.80		
7/3/90	33057	16	18	563	1415.00	33780	84900	46.10	15.50	44.90	2.10	16.20	47.00	1.30E-06	1.50E-06
7/5/90	33059	7	14	0	1415.00	0	84900	0.20	0.00	44.90	49.10	0.00	47.00		
7/5/90	33059	15	37	503	1918.00	30180	115080	22.70	22.50	67.40	25.50	23.60	70.60	2.11E-06	1.66E-06

****

*TRANSCRIBED FROM ORIGINAL DATA SHEETS

Number of pore volumes passed thru 0.21 vols
Estimated time for one pore volume 24.14 days

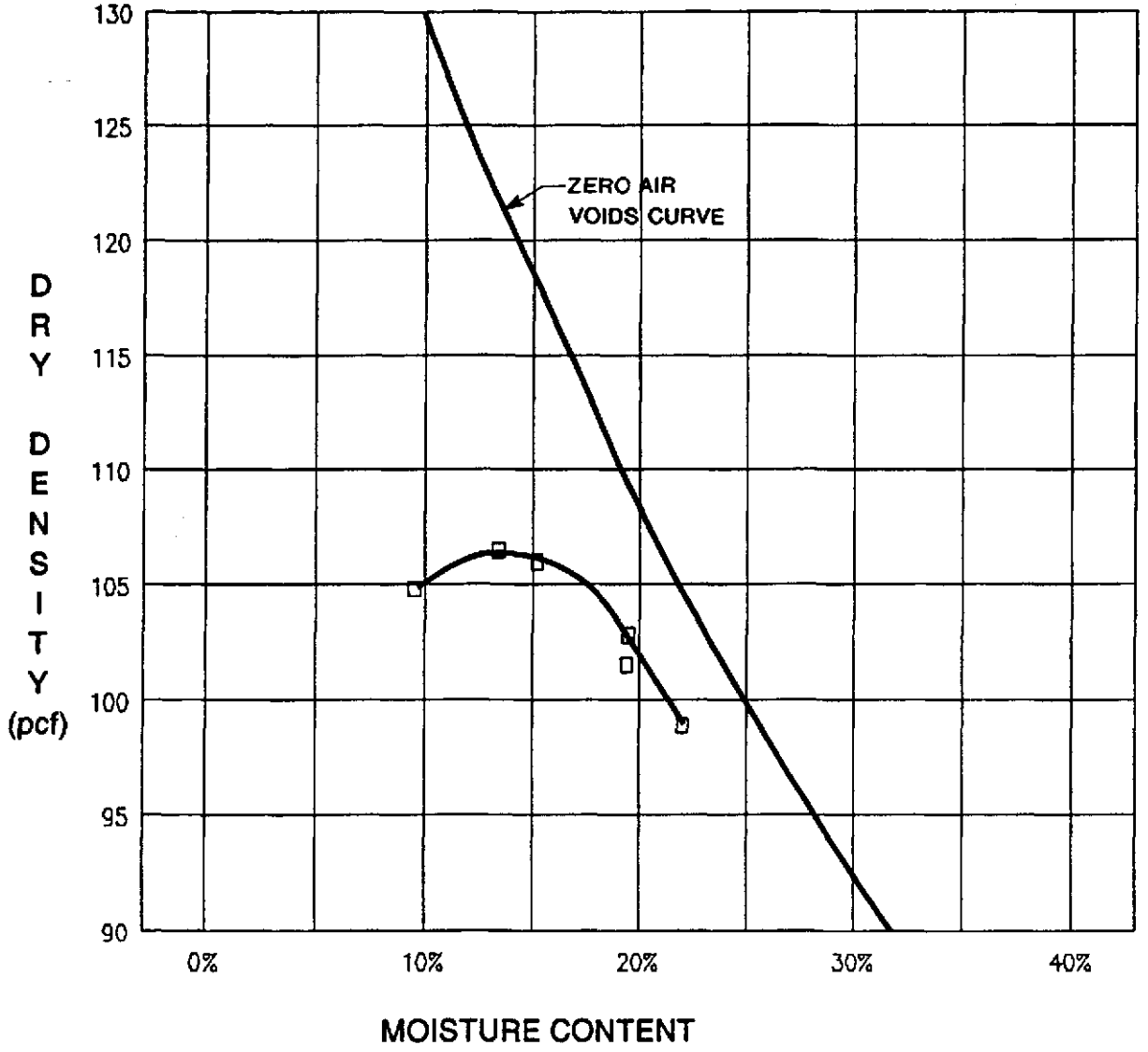
k(total inflow) 1.58E-06
k(total outflow)1.66E-06
k(ave,total) 1.62E-06

PERMEABILITY REPORTED AS **1.66E-06 cm/sec***
BASED ON ACCUMULATED OUTFLOW VALUES
GOLDER ASSOCIATES,MOUNT LAUREL,NEW JERSEY
20000 HORIZON WAY, SUITE 500
1-609-273-1110

Moisture-Density Test

MOISTURE/DRY DENSITY CURVE

ASTM D-1557



SAMPLE IDENTITY	Wn%	WL	WP	IP	DESCRIPTION
WHP	22.0%	NP	NP	NP	
	MAXIMUM DRY DENSITY (pcf)			106.5	
	OPTIMUM MOISTURE (%)			13.4%	
SAMPLE TYPE	Bulk		DATE TESTED	8/31/90	

ISRT/WOBURN/MA

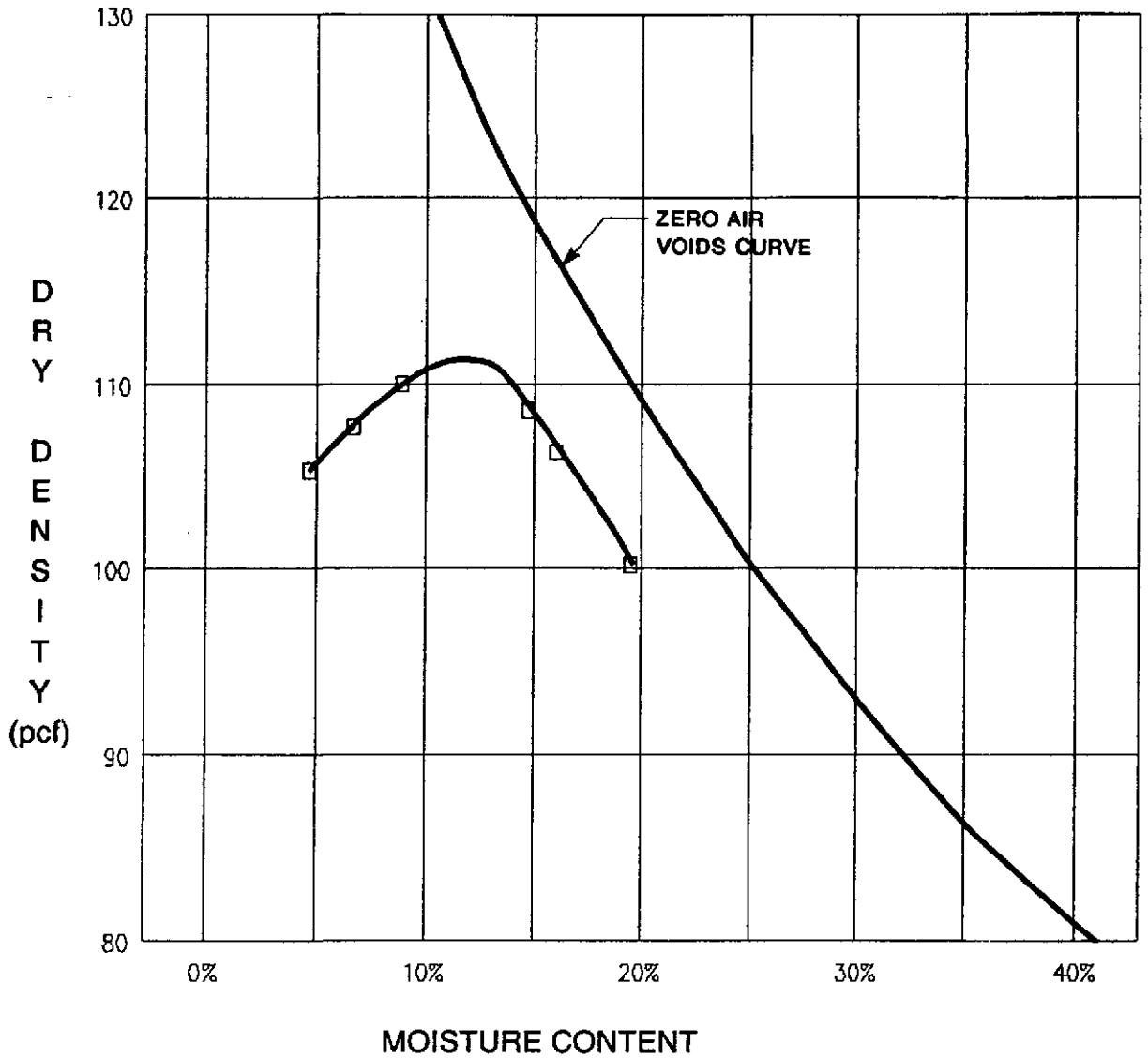
893-6255

GOLDER ASSOCIATES,INC

Consulting Engineers

MOISTURE/DRY DENSITY CURVE

ASTM D-1557



SAMPLE IDENTITY	Wn%	WL	WP	IP	DESCRIPTION
BH-10 EHP	22.4%	NP	NP	NP	Dark gray m-f SAND,some silt trace f gravel(SM)
	MAXIMUM DRY DENSITY (pcf)			111.5	
	OPTIMUM MOISTURE (%)			12%	
SAMPLE TYPE	Bulk		DATE TESTED	9/14/90	

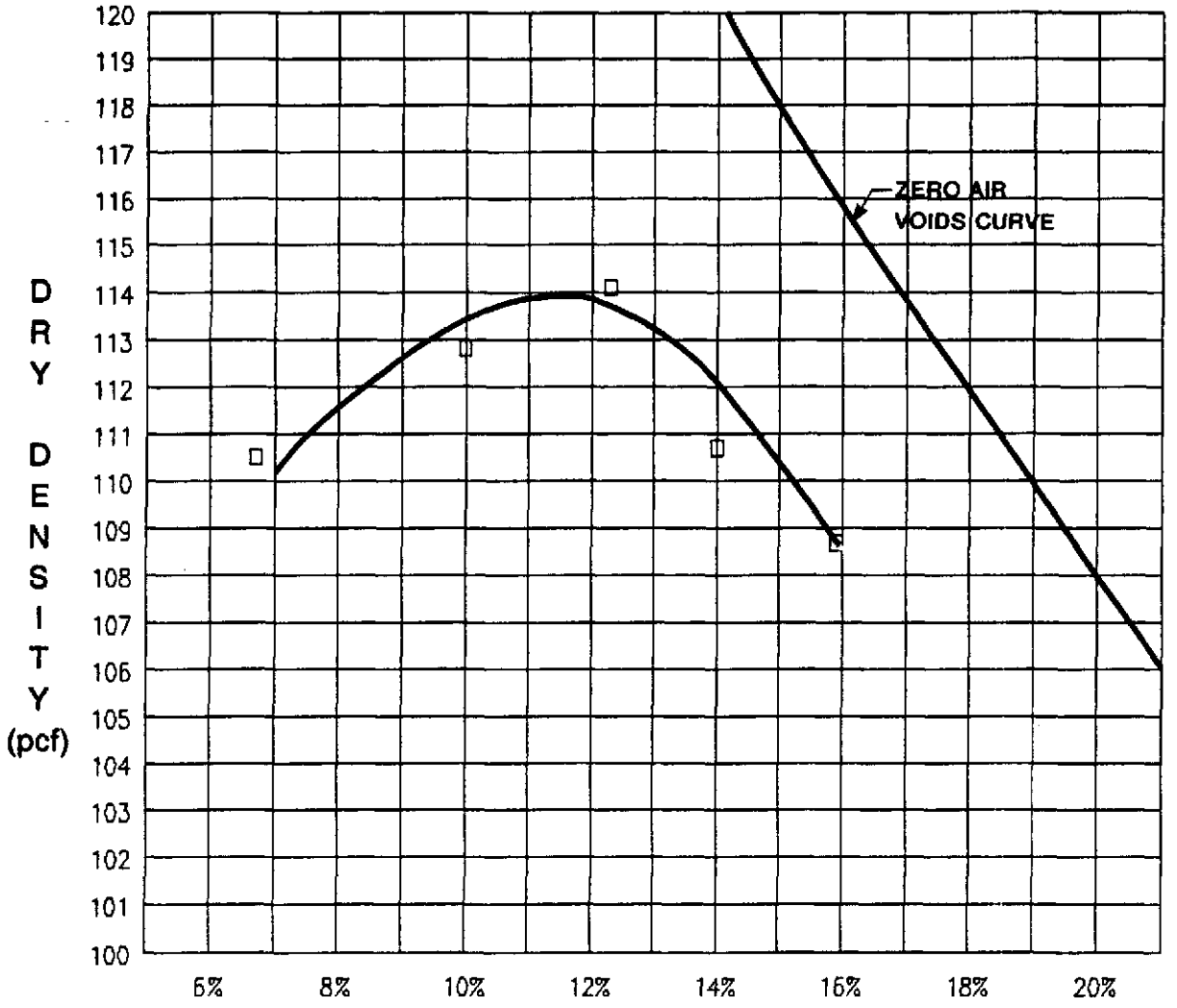
ISRT/WOBURN/MA

893-6255

GOLDER ASSOCIATES,INC

Consulting Engineers

MOISTURE/DRY DENSITY CURVE
ASTM D-1557



SAMPLE IDENTITY	Wn%	WL	WP	IP	DESCRIPTION
BH-15	7.1%	NP	NP	NP	Grayish black f SAND,trace fines trace f gravel
	MAXIMUM DRY DENSITY (pcf)			114.0	
	OPTIMUM MOISTURE (%)			11.5%	
SAMPLE TYPE	Bulk		DATE TESTED	9/10/90	

ISRT/WOBURN/MA

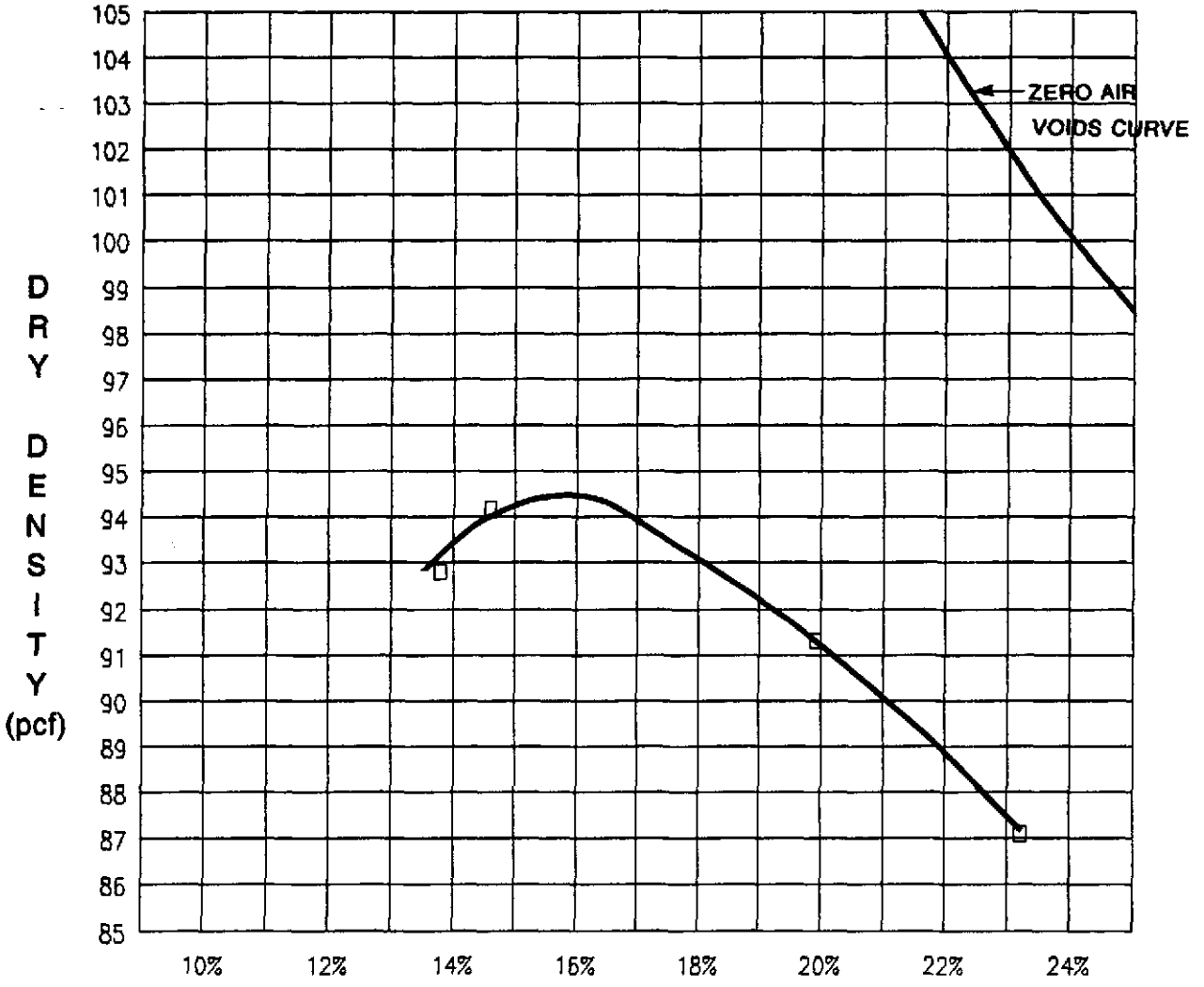
893-6255

GOLDER ASSOCIATES,INC

Consulting Engineers

MOISTURE/DRY DENSITY CURVE

ASTM D-1557



SAMPLE IDENTITY	Wn%	WL	WP	IP	DESCRIPTION
BH-13	22.0%	NP	NP	NP	Moderate yellowish brown f-m SAND,some c-f gravel trace fines
	MAXIMUM DRY DENSITY (pcf)			94.5	
	OPTIMUM MOISTURE (%)			16.0%	
SAMPLE TYPE	Bulk		DATE TESTED	9/11/90	

ISRT/WOBURN/MA

893-6255

GOLDER ASSOCIATES,INC

Consulting Engineers

APPENDIX D

PDI Work Plan Objectives

TABLE 5

Drilling and Testing Requirements

Task S-2, Stability of Hide Piles

DRILLING

Borehole Depth and Sample Distribution

Hole Number	Approx. Top Elev.	Approx Base Elev.	Length (ft)	Number of Disturbed Samples	Number of Undisturbed Samples
West Pile:					
1	95	60	35	8	3
2	90	60	30	7	3
3	75	60	15	4	1
4	70	60	10	3	0
5	70	60	10	3	1
6 *	70	60	10	3	0
7	75	60	15	4	1
8	80	60	20	5	0
East Pile:					
9	100	65	45	10	3
10	100	65	45	10	3
11	85	65	25	6	1
12	90	65	25	6	0
13	85	65	35	8	1
14 *	80	65	15	4	0
15	80	65	15	4	1
16	80	65	15	4	0
17	80	65	15	4	1

* Hole designated to be a monitoring well.

Note: Actual borehole depths and sample locations may be varied in the field with the agreement of the Project Manager, dependent upon field conditions.

TABLE 5 (continued)

Drilling and Testing Requirements

Task S-2, Stability of Hide Piles

TESTING

Test	No. Tests East Pile	No. Tests West Pile
Index Tests	14	16
Triaxial CU Shear Strength (on clays/silts)	4	3
Triaxial CD Shear Strength (on sands)	4	3
Consolidation Test	4	4
Proctor (Modified)	2	2
Permeability (Standpipe/Rigid Wall)	2	1
Organic Content	8	7
Standard Penetration Tests	56	37

Actual testing will depend on soil types.

TABLE 16 (Cont.)
DATA QUALITY OBJECTIVE SUMMARY

MEDIA	CONSENT DECREE OBJECTIVE	DATA NEEDS	ANALYSES	NUMBER OF SAMPLES	ANALYTICAL LEVEL	ANALYTICAL METHOD	RATIONALE
Soil	b) Stability of Hide Piles – Identify the requirements necessary to establish a firm base at the toes of the East and West Hide Piles to minimize the possibility of slope failure ... to ensure that impacts to the wetlands are kept to a minimum. (Task S-2)	Soil borings (9) to determine East Hide Pile content	Standard Penetration Test	56	N/A	ASTM-D1586	The soil investigation and lab testing program will determine the geotechnical characteristics of the East Hide Pile and underlying soils to allow determination of slope stability, bearing capacity and settlement potential.
			Grain size distribution	14	N/A	ASTM-D422	
			Atterberg limit	14	N/A	ASTM-D4318	
			Shear strength	8	N/A	COE EM 1110-2-1906	
			Consolidation	4	N/A	ASTM-D2435	
			Proctor density	2	N/A	ASTM-D1557	
			Permeability	2	N/A	COE EM 1110-2-1906	
			Organic content	8	N/A	ASTM-D2974	
		Soil borings (8) to determine West Hide Pile content	Standard Penetration Test	37	N/A	ASTM-D1586	The soil investigation and lab testing program will determine the geotechnical characteristics of the West Hide Pile and underlying soils to allow determination of slope stability, bearing capacity and settlement potential.
			Grain size distribution	16	N/A	ASTM-D422	
			Atterberg limit	16	N/A	ASTM-D4318	
			Shear strength	6	N/A	COE EM 1110-2-1906	
			Consolidation	4	N/A	ASTM-D2435	
			Proctor density	2	N/A	ASTM-D1557	
			Permeability	1	N/A	COE EM 1110-2-1906	
			Organic content	7	N/A	ASTM-D2974	

TABLE 16 (Cont.)
DATA QUALITY OBJECTIVE SUMMARY

MEDIA	CONSENT DECREE OBJECTIVE	DATA NEEDS	ANALYSES	NUMBER OF SAMPLES	ANALYTICAL LEVEL	ANALYTICAL METHOD	RATIONALE
Soil	b)The installation of the monitoring network shall be designed to provide a ground water quality ... data base to allow post-closure monitoring in areas of the east and West Hide Piles adjacent to the wetlands. (Task S-2)	Groundwater quality adjacent to East and West Hide Piles	TCL/TAL	2	IV	CLP-RAS	Two wells located between the hide piles and the wetlands will be used to assess shallow groundwater quality and provide monitoring points for O&M monitoring
	Evaluate sources of cap materials for their ability to meet technical design requirements as specified in the Consent Decree. (Task S-3)	Permeable cover fill material	Grain size distribution	4	N/A	ASTM-D422	Samples from each potential borrow source will be tested to determine material gradation, USC classification, consolidation, compaction, organic content, acidity and grain specific gravity for suitability as fill
			Atterberg limit	4	N/A	ASTM-D4318	
			Shear strength	4	N/A	COE EM 1110-2-1906	
			Consolidation	4	N/A	ASTM-D2435	
			Proctor density	4	N/A	ASTM-D1557	
			Organic content	4	N/A	ASTM-D2974	
			Soil pH	4	N/A	ASTM-G51	
			Soil Grain Specific Gravity	4	N/A	ASTM-D854	
		East Hide Pile Cover topsoil	Grain size distribution	5	N/A	ASTM-D422	Samples from each potential topsoil borrow source will be tested to determine material gradation for USDA and UCS classification and to determine the nutrients required to establish vegetation.
			Atterberg limit	5	N/A	ASTM-D4318	
			Organic content	5	N/A	ASTM-D2974	
			Soil fertility	5	N/A	Baker Test	

APPENDIX E

PDI Addendum

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION I
J.F. KENNEDY FEDERAL BUILDING, BOSTON, MASSACHUSETTS 02203-2211

July 17, 1990

Warren Smull
Industri-Plex Site Remedial Trust
Monsanto Company
800 N. Lindbergh Blvd. G4WM
St. Louis, MO 63167

Re: Addenda 3 through 6 to the Industri-Plex PDI Work Plan.

Dear Warren:

This acknowledges receipt of the following proposed addenda to the Pre-Design Investigation (PDI) Work Plan:

- Addendum 3, contained in your letter dated May 7, 1990, proposing to relocate geotechnical borings 12 and 13;
- Addendum 4, contained in your letters dated May 9, 1990 and June 14, 1990, proposing to relocate observation wells OW-23 and OW-26;
- Addendum 5, contained in your letter dated May 15, 1990, proposing modification of the method for determining background concentrations of hazardous substances, and
- Addendum 6, contained in your letter dated June 27, 1990, proposing modification of the quality assurance plan.

Please be advised that EPA in consultation with the Commonwealth accepts and approves these four addenda as written. These addenda are incorporated into the PDI Work Plan effective immediately, and are enforceable under the terms of the consent decree.

Regards,

Marilyn M. Wade, P.E.
Remedial Project Manager

cc: J. Naparstek - MADEP
A. Ostrofsky - NUS

PRINTED ON RECYCLED PAPER

INDUSTRI-PLEX SITE REMEDIAL TRUST

Woburn, Massachusetts

RECEIVED
MAY - 8 1990
GOLDER - NJ

Reply to:
Industri-Plex Site Remedial Trust
800 North Lindbergh Boulevard, G4WM
Saint Louis, MO 63167
(314) 694-1617
FAX (314) 694-6262

May 7, 1990

Marilyn M. Wade, P. E.
Remedial Project Manager
USEPA-I
J. F. K. Federal Bldg., HRS-CAN-3
Boston, MA 02203-2211

Dear Marilyn:

Attached is a proposal for relocating geotechnical boreholes 12 and 13 on the East Hide Pile which are part of the Pre-Design Investigation (PDI) Work Plan. We propose these adjustments in the PDI Work Plan for your acceptance and will incorporate this attachment as Addendum 3 subject to it being agreeable to the Agencies.

Sincerely,

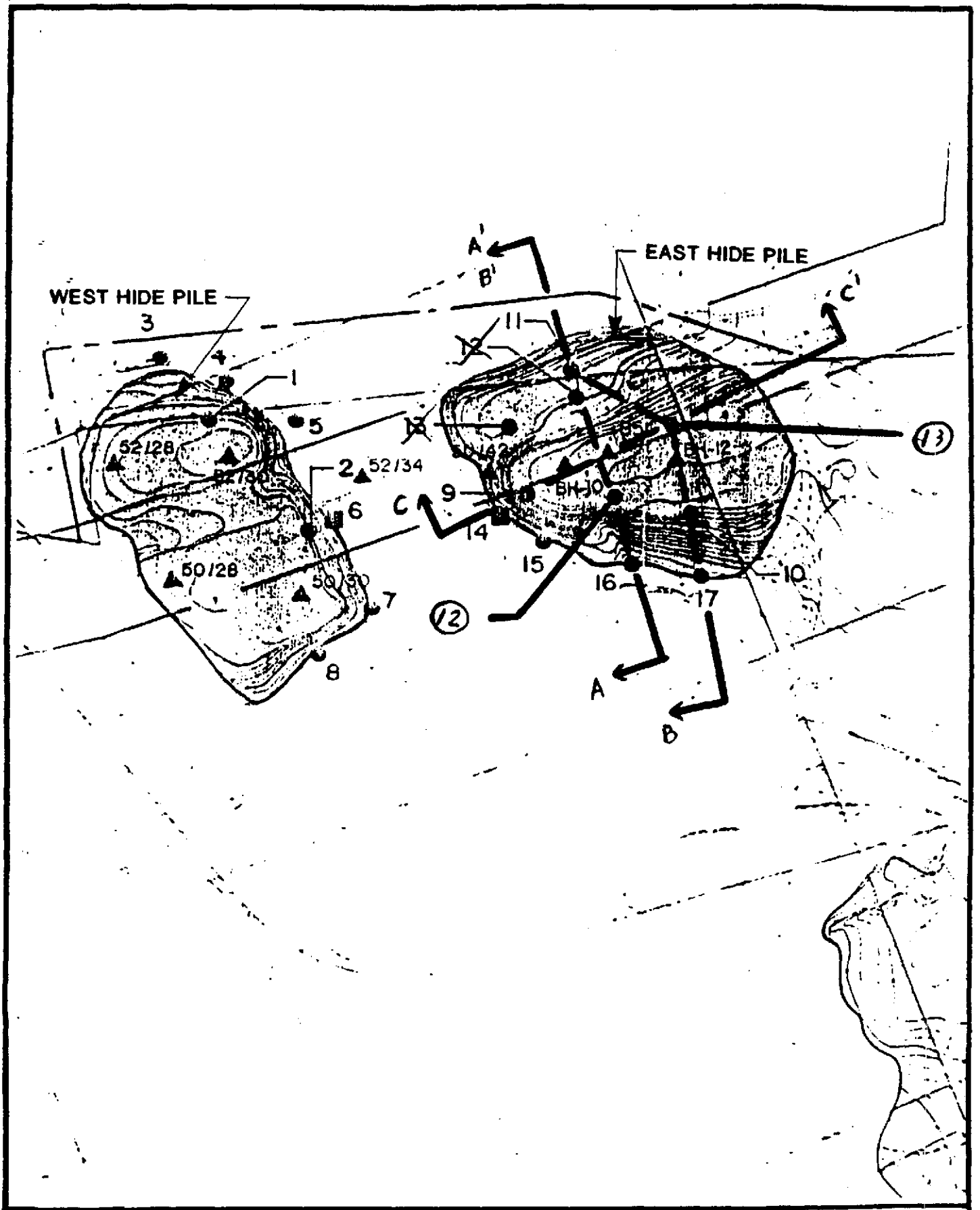
Warren L. Smull
Coordinator

cc: J. E. Baker - Golder
C. P. Devine - ISRT
Jay Naparstek - MDEP
W. W. Varnado - G4WM
K. P. Winkler - F3WB
B. S. Yare - F2WJ
G. R. Zell - F3WB

PROPOSED REVISION
INDUSTRI-PLEX SITE REMEDIAL TRUST
PRE-DESIGN INVESTIGATION
WOBURN, MASSACHUSETTS

This proposed revision to the Pre-Design Investigation Work Plan addresses modifications to Task S-2 - Stability of Hide Piles. As presented on the Pre-Design Investigation Work Plan (PDIWP) Figure 19, boreholes 12 and 13 were located on a plateau below the summit of the East Hide Pile within the Boston-Edison Right of Way. The existence of the overhead power lines, however, precluded the possibility of setting up a drill rig at the original locations, due to the 30 foot horizontal clearance specified by ISRT. The proposed new locations of boreholes 12 and 13 will be selected to satisfy the main objective of the DQO's; that is, to determine the composition and geotechnical properties of the hide residues. Boreholes 12 and 13 will be relocated to areas where the vertical extent of hide residue is expected to be about the same as the original locations, and the same number of disturbed and undisturbed samples will be obtained. Similar laboratory tests will be run on these samples to determine the soil parameters established in the DQO. In addition, the proposed locations allow construction of the appropriate cross sections for slope stability analysis, i.e., they represent the highest and steepest East Hide Pile slopes:

Section A-A' (north) = 38 foot change in elevation
Section A-A' (south) = 37 foot change in elevation
Section B-B' (south) = 32 foot change in elevation



JOB NO. 893-6255	SCALE N.T.S.	EAST HIDE PILE SECTIONS AND RELOCATION OF BOREHOLES 12 AND 13	
DRAWN LAS	DATE 05/02/90		
CHECKED JEW	DWG. NO.		
Golder Associates		ISRT/WOBURN/MA	FIGURE

152978