- [x] City box number Materials Lab (x)
- [x] Title/cover page w/the following info:
  - [x] Company (author) name
  - [x] Report Date
  - [x] Project name
  - [x] Company's job number
  - [ ] City DCLU project number (7-digit number)
  - [ ] City Permit number (6-digit number)
  - [ ] Kroll map index number (3-digit number, w?/E,W,N,S)
  - [ ] Green label
  - [ ] Site address (may be on 1st or 2nd page of text)
- [x] Executive Summary and associated figures
- [x] Table of Contents
- [x] Project Location Plan/Map or Vicinity Map
- [x] Site Plans, Boring Location Plans, or Exploration Plans
- [ ] Survey
- [ ] Geologic Maps
- [ ] Cross Sections/Subsurface Profiles
- [ ] Fill or Peat Thickness Maps and Contour Maps
- [x] Boring Logs
- [ ] Geology Text (if no logs)
- [x] Soil Classification Key/Boring Log Key
- [ ] Probe Logs
- [ ] Test Pit Logs
- [ ] Monitoring Well Logs
- [ ] Cone Penetrometer Logs
- [ ] Shear Wave Velocity Measurements
- [ ] Groundwater Maps
- [ ] GW Elevation Tables/Data
- [ ] Soils Lab Testing (Geotechnical) Summary Tables
  - [x] Grain Size Analyses/Hydrometer Analyses
  - [ ] Atterberg Limits
  - [ ] Strength tests: Triaxial, Unconfined, Direct Shear
  - [ ] Organic Content
  - [ ] ^{14}C or Radiocarbon Testing
  - [ ] Other Plasticity Chart
- [x] Soil Chemical Analytical Testing Summary Tables
- [ ] Water/Groundwater Chemical Analytical Summary Tables
- [ ] Comments

3396

- [x] Date Copied 9/15/00 By Suzanne

2/9/99

11320

DRAFT
SUBJECT TO REVISION
DATE AUG 29 1989

3396

16/16

HARTCROWSER

Earth and Environmental Technologies

Microfilmed

Environmental Site Assessment and Geotechnical Engineering Report Diagonal Avenue South CSO Project Seattle, Washington

Prepared for
Kramer, Chin & Mayo, Inc.

August 29, 1989
J-2456

1910 Fairview Avenue East Seattle, Washington 98102-3699 206.324.9530

CONTENTS

	Page
INTRODUCTION	1
SUMMARY	2
GENERAL SITE DESCRIPTION	3
Soils	3
Groundwater	4
Site History	4
Potential Soil and Groundwater Contamination	6
SUBSURFACE CONDITIONS	6
Subbasin A	
East Marginal Way and South Idaho Street	8
Subbasin B	
Ohio Avenue South and South Alaska Street	9
Subbasin C	
Denver Avenue South and Connecting Lines	11
Subbasin D	
First Avenue South and South Andover Street	13
Subbasin G	
Airport Way South and South Edmunds Street	15
Subbasin H	
Tenth Avenue South Detention Facility	16
DESIGN AND CONSTRUCTION RECOMMENDATIONS	17
General Construction Considerations	17
Demolition	18
Contamination Potential	19
Remediation/Disposal of Contaminated Soil	22
Pipe Design	23
Dewatering	24
Trench Side Slopes	33
Pipe Bedding and Backfill	36
Control Structure Foundations	40
Foundation Construction	41
Pavement Replacement	42
Vibration Limitation Along First Avenue	44
RECOMMENDATIONS FOR ADDITIONAL GEOTECHNICAL ENGINEERING SERVICES	44

Page

TABLES

1	Boring Locations by Subbasin
2	Dewatering Drawdown
3	Consolidation Settlement Due to Dewatering
4	Recommended Soil Parameters for Design of Temporary Shoring
5	Pavement Replacement

FIGURES

1	Vicinity Map Site and Exploration Plans
2	Subbasin A - East Marginal Way and South Idaho Street
3	Subbasin B - Ohio Avenue South and South Alaska Street
4	Subbasin C - Denver Avenue South and Connecting Lines
5	Subbasin D - First Avenue South and South Andover Street
6	Subbasin G - Airport Way South and South Edmunds Street, and Part of Subbasin H - Tenth Avenue South Detention Facility
7 through 12	Pipe Load Curves - Subbasins A through H

APPENDIX A A-1
FIELD EXPLORATIONS

Explorations and Their Location A-1
The Use of Auger Borings A-2
Standard Penetration Test (SPT) Procedures A-2
Monitoring Well Installation and Development A-3
Water Level Measurements A-3
Slug Test Analysis A-4

FIGURES

A-1	Key to Exploration Logs
A-2 through A-17	Boring Log B-1/B-1A through B-16

Page

APPENDIX B B-1
LABORATORY TESTING PROGRAM

Soil Classification B-1
Water Content Determinations B-1
Atterberg Limits (AL) B-1
Grain Size Analysis (GS) B-2
200-Wash B-2
Chemical Testing B-2
Data Quality Review B-3
Chemical Screening Analyses B-4
Soil Chemical Confirmation Analyses B-5
Water Chemical Analyses B-6

TABLES

B-1 Analytical Methods Used by ATI for Chemical Confirmation Analyses of Soil and Water
B-2 Screening Data for Diagonal/CSO Soil Samples
B-3 Chemical Results for Diagonal/CSO Soil Samples - Analytical Technologies, Inc.
B-4 Chemical Results for Diagonal/CSO Water Samples - Analytical Technologies, Inc.

FIGURES

B-1 Unified Soil Classification (USC) System
B-2 Plasticity Chart
B-3 Grain Size Classification

APPENDIX C
SITE BACKGROUND REVIEW C-1

Sources Consulted C-1

TABLES

C-1 Subbasin A - Locations Where Reported Site Use Could Have Resulted in Potential Contamination
C-2 Subbasin B - Locations Where Reported Site Use Could Have Resulted in Potential Contamination
C-3 Subbasin C - Locations Where Reported Site Use Could Have Resulted in Potential Contamination

Page

TABLES

C-4 Subbasin D - Locations Where Reported Site Use Could Have Resulted in Potential Contamination
C-5 Subbasin G - Locations Where Reported Site Use Could Have Resulted in Potential Contamination

APPENDIX D
ENVIRONMENTAL HEALTH AND SAFETY

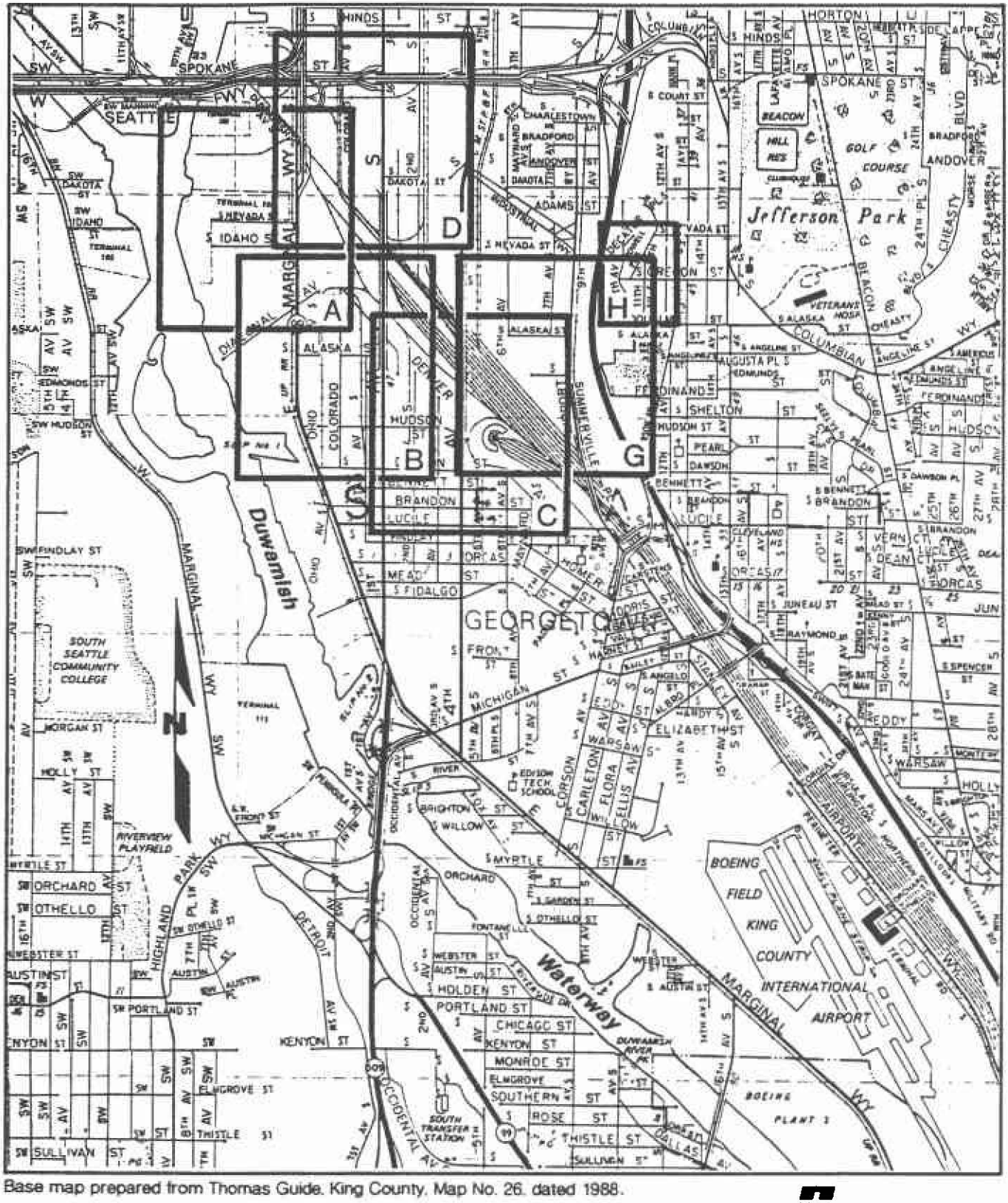
Health and Safety Plan Model Specification D-1
Contingency Response Plan D-6
County Landfill Disposal of Petroleum Contaminated Soils D-7
Disposal of Designated Hazardous Waste Contaminated Soil D-8

TABLE

D-1 Common Sense Criteria for Identification of Suspect Soil or Groundwater Contamination

Form 2

Vicinity Map



Base map prepared from Thomas Guide, King County, Map No. 26, dated 1988.

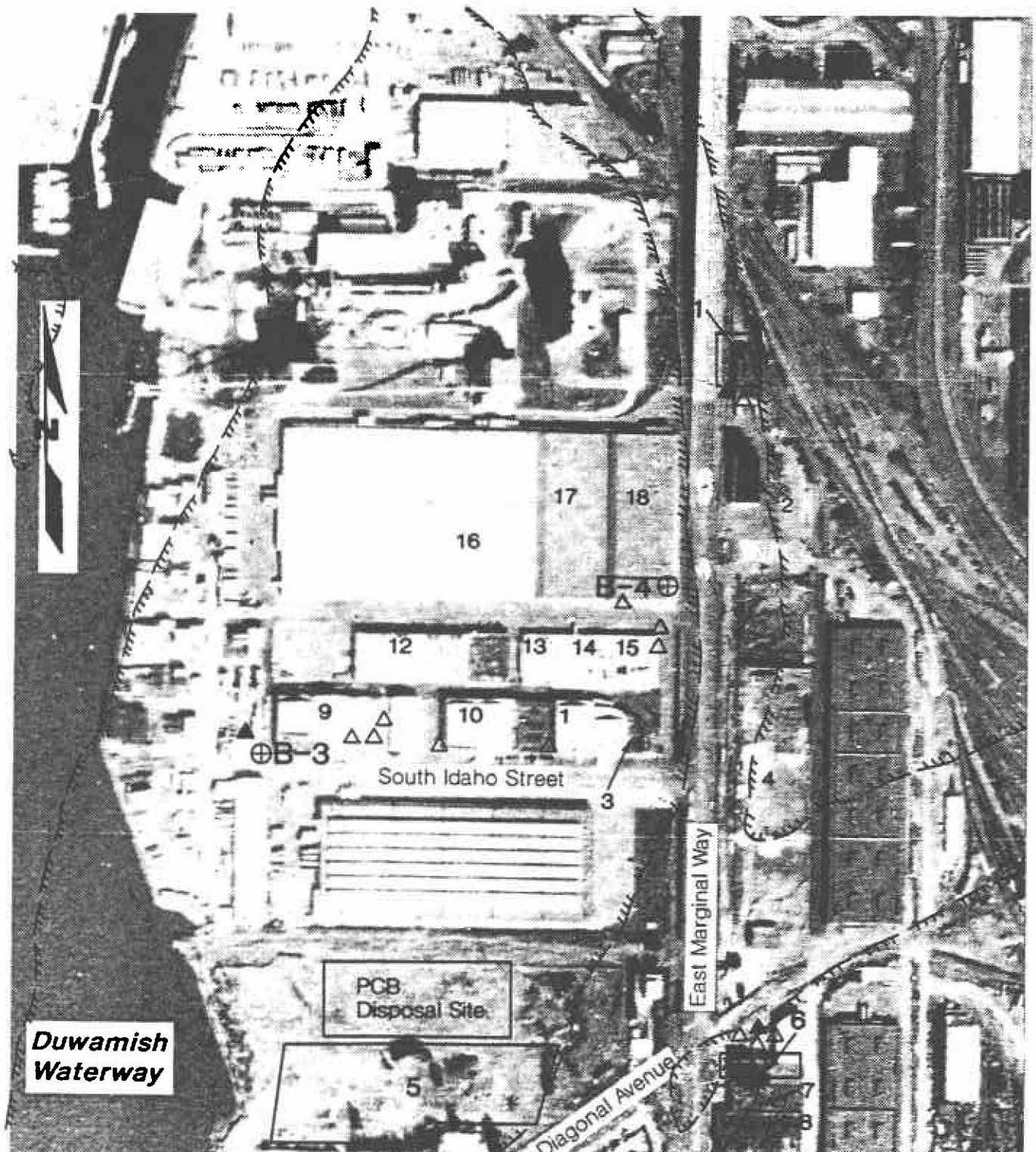
B Subbasin Location and Designation

0 2000 4000
Scale in Feet

HARTCROWSER
J-2456 6/89
Figure 1

Site and Exploration Plan

Subbasin A –East Marginal Way and South Idaho Street



Base map prepared from aerial photograph provided by Walker & Associates. Photo No. 12-20/13-27.

Former Duwamish River Channel

⊕ B-3 Boring Location and Number

0 400 800

Scale in Feet

△ Existing Underground Storage Tank

▲ Historical Underground Storage Tank

12 Facility Identification Number

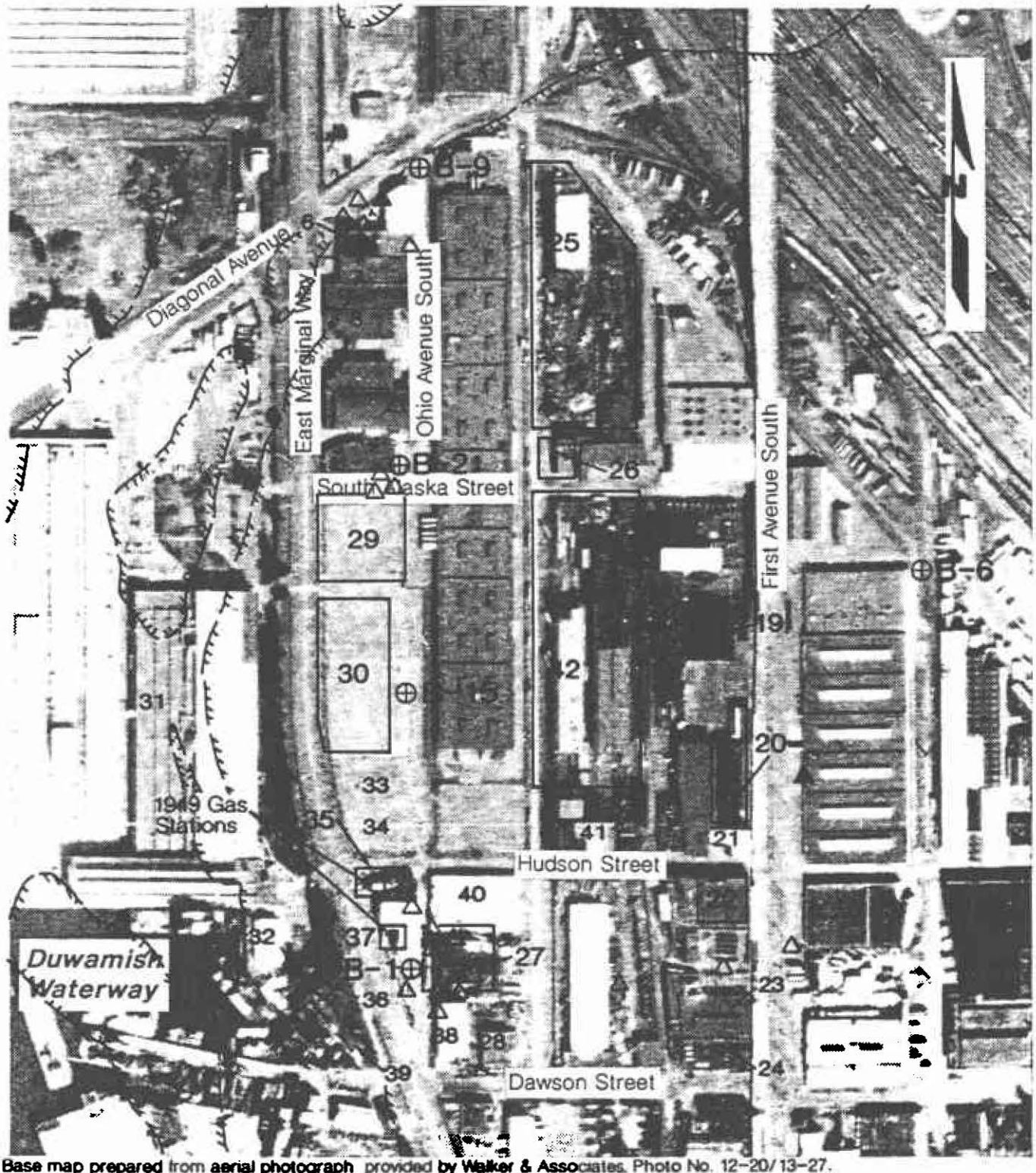
HARTCROWSER

J-2456 6/89

Figure 2

Site and Exploration Plan

Subbasin B – Ohio Avenue South and South Alaska Street



Base map prepared from aerial photograph provided by Walker & Associates. Photo No. 12-20/13-27.

Former Duwamish River Channel

⊕B-9 Boring Location and Number

0 400 800

Scale in Feet

△ Existing Underground Storage Tank

▲ Historical Underground Storage Tank

5 Facility Identification Number

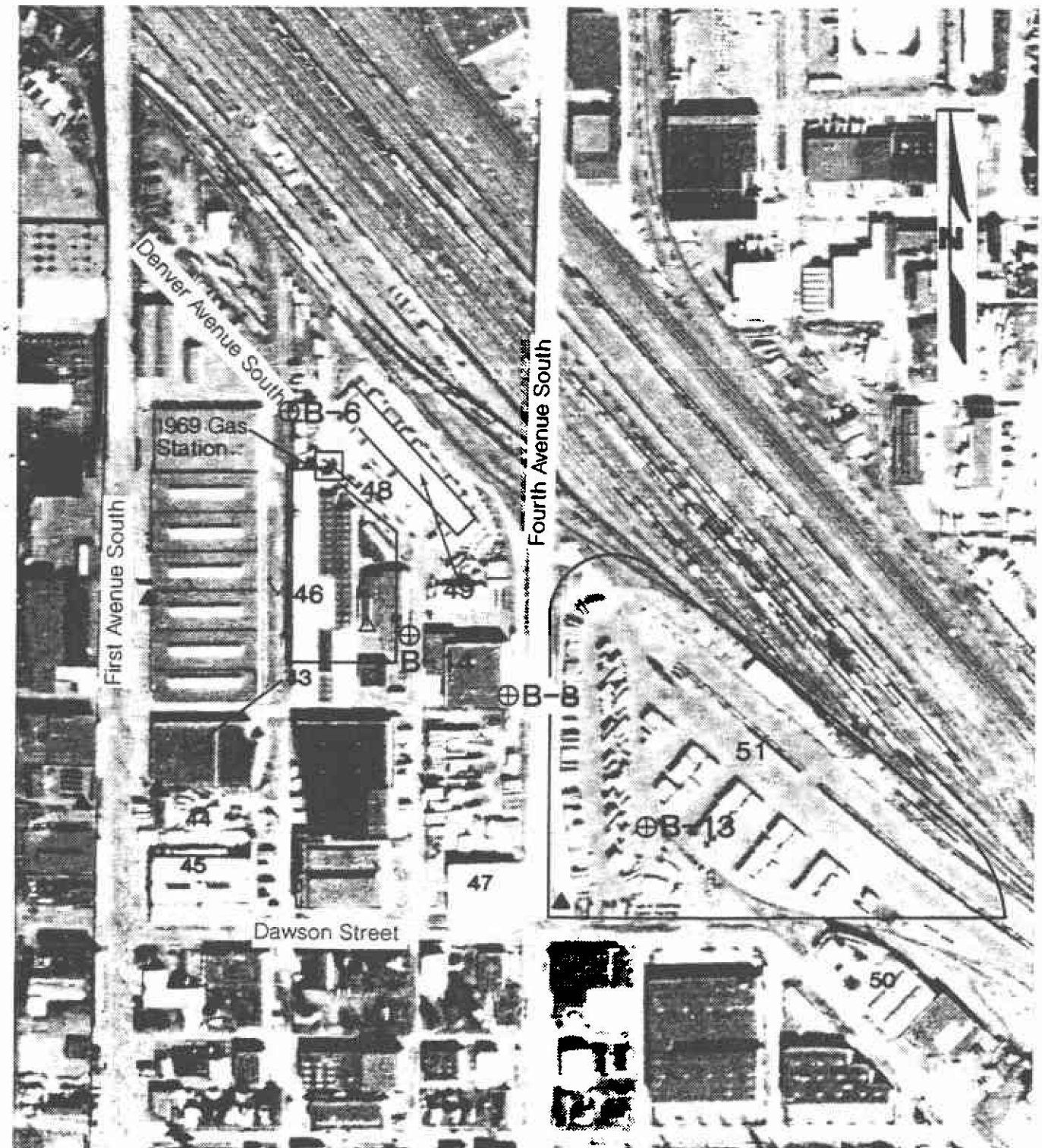
HARTCROWSER

J-2456 6/89

Figure 3

Site and Exploration Plan

Subbasin C–Denver Avenue South and Connecting Lines



Base map prepared from aerial photograph provided by Walker & Associates, Photo No. 12-20/13-27.

⊕B-6 Boring Location and Number

0 400 800

Scale in Feet

△ Existing Underground Storage Tank

▲ Historical Underground Storage Tank

50 Facility Identification Number

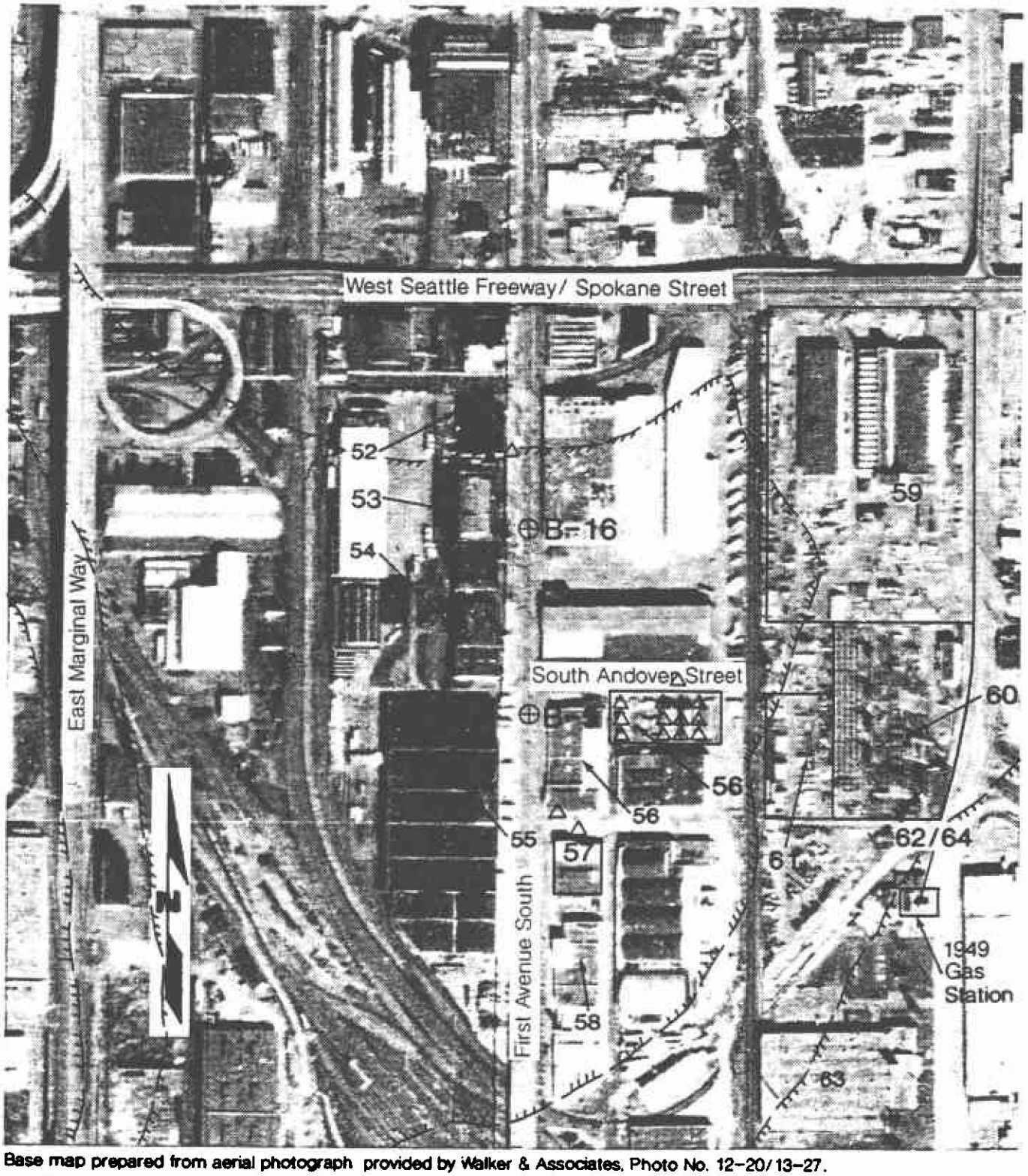
HARTCROWSER

J-2456 6/89

Figure 4

Site and Exploration Plan

Subbasin D–First Avenue South and South Andover Street



Base map prepared from aerial photograph provided by Walker & Associates, Photo No. 12-20/13-27.

Former Duwamish River Channel

⊕B-5 Boring Location and Number

0 400 800

Scale in Feet

△ Existing Underground Storage Tank

▲ Historical Underground Storage Tank

58 Facility Identification Number

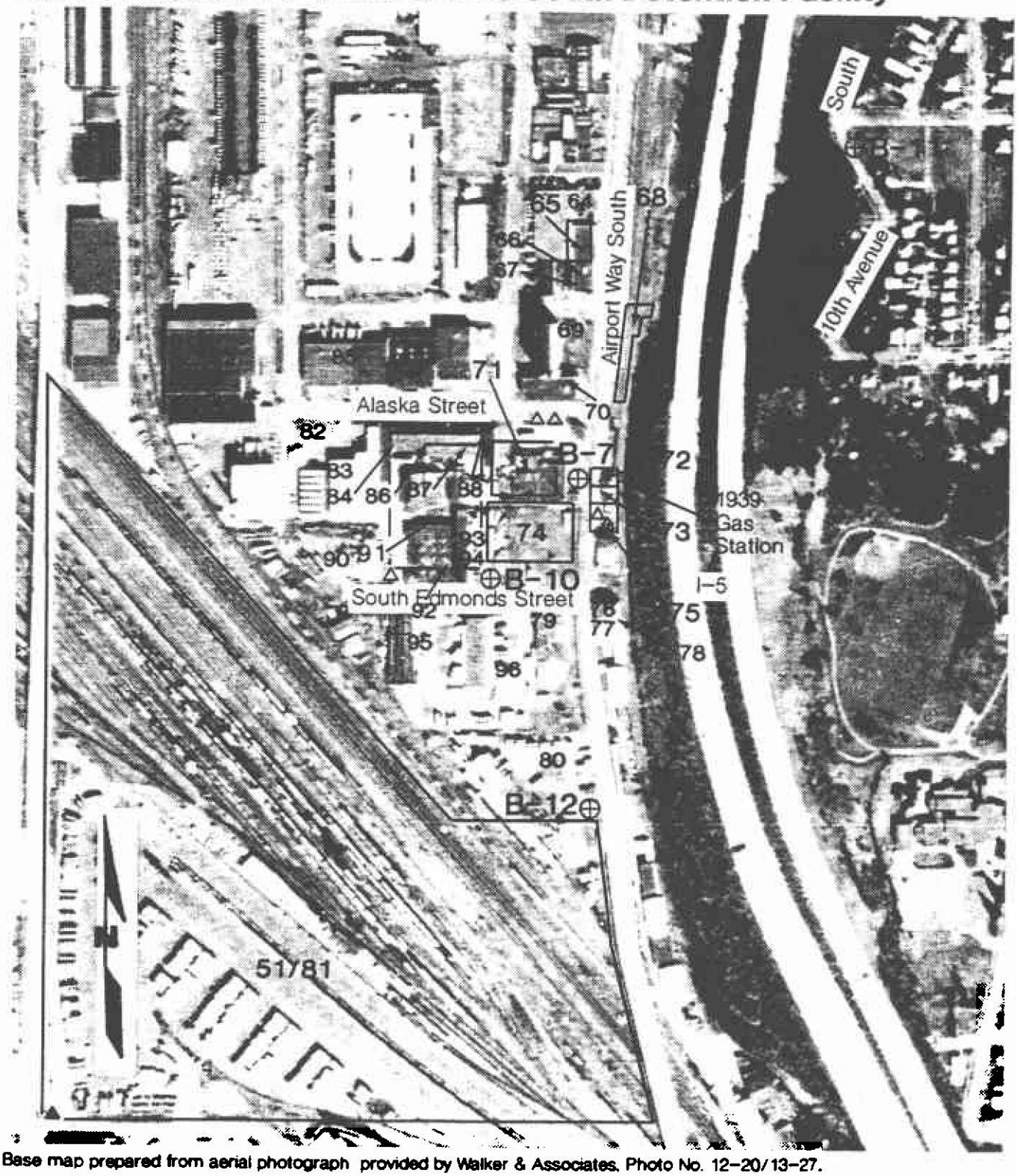
HARTCROWSER

J-2456 6/89

Figure 5

Site and Exploration Plan

Subbasin G–Airport Way South and South Edmonds Street and Part of Subbasin H–Tenth Avenue South Detention Facility



Base map prepared from aerial photograph provided by Walker & Associates, Photo No. 12–20/13–27.

⊕ B–7 Boring Location and Number

0 400 800

Scale in Feet

△ Existing Underground Storage Tank

▲ Historical Underground Storage Tank

80 Facility Identification Number

HARTCROWSER

J–2456 6/89

Figure 6

Key to Exploration Logs

Sample Descriptions

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

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

Density/Consistency

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

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

Moisture

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

Minor Constituents

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

Legends

Sampling

BORING SAMPLES

- ⊠ Split Spoon
- ⊠ Shelby Tube
- ▥ Cuttings
- ◫ Core Run
- * No Sample Recovery
- P Tube Pushed, Not Driven

TEST PIT SAMPLES

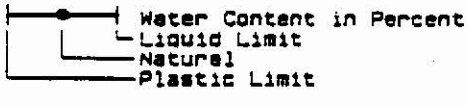
- ⊠ Grab (Jar)
- ⊠ Bag
- ⊠ Shelby Tube

Ground Water Observations

- Surface Seal
- Ground Water Level on Date (ATD) At Time of Drilling
- Observation Well Tip or Slotted Section
- Ground Water Seepage (Test Pits)

Test Symbols

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



HARTCROWSER

J-2456 6/89

Figure A-1

Boring Log B-1/B-1A

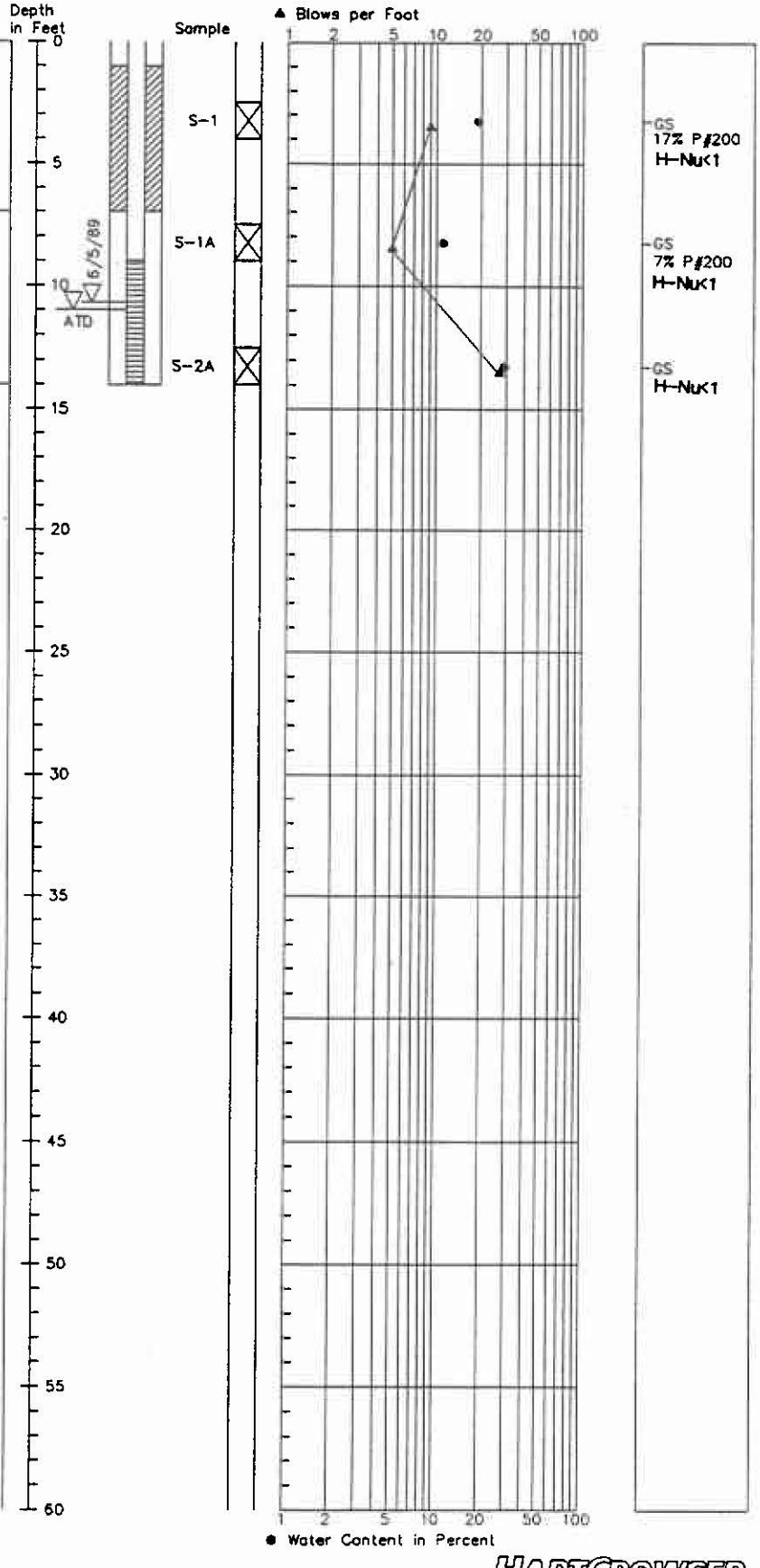
Soil Descriptions

Ground Surface Elevation in Feet 8.2

3 inches ASPHALT over medium to dense, damp, black, very silty SAND and sandy SILT with debris. (FILL)

Loose to medium dense, damp to wet, black, clean to slightly silty, fine to medium SAND.

Bottom of Boring at 14.0 Feet.
Completed 5/15/89.
Note: Boring B-1 abandoned due to debris between approx. 5-1/2 to 8 feet in depth. Boring B-1A redrilled 2 feet to north.



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

HARTCROWSER
J-2456 5/89
Figure A-2 1/1

Boring Log B-2

Soil Descriptions

Ground Surface Elevation in Feet 6.6

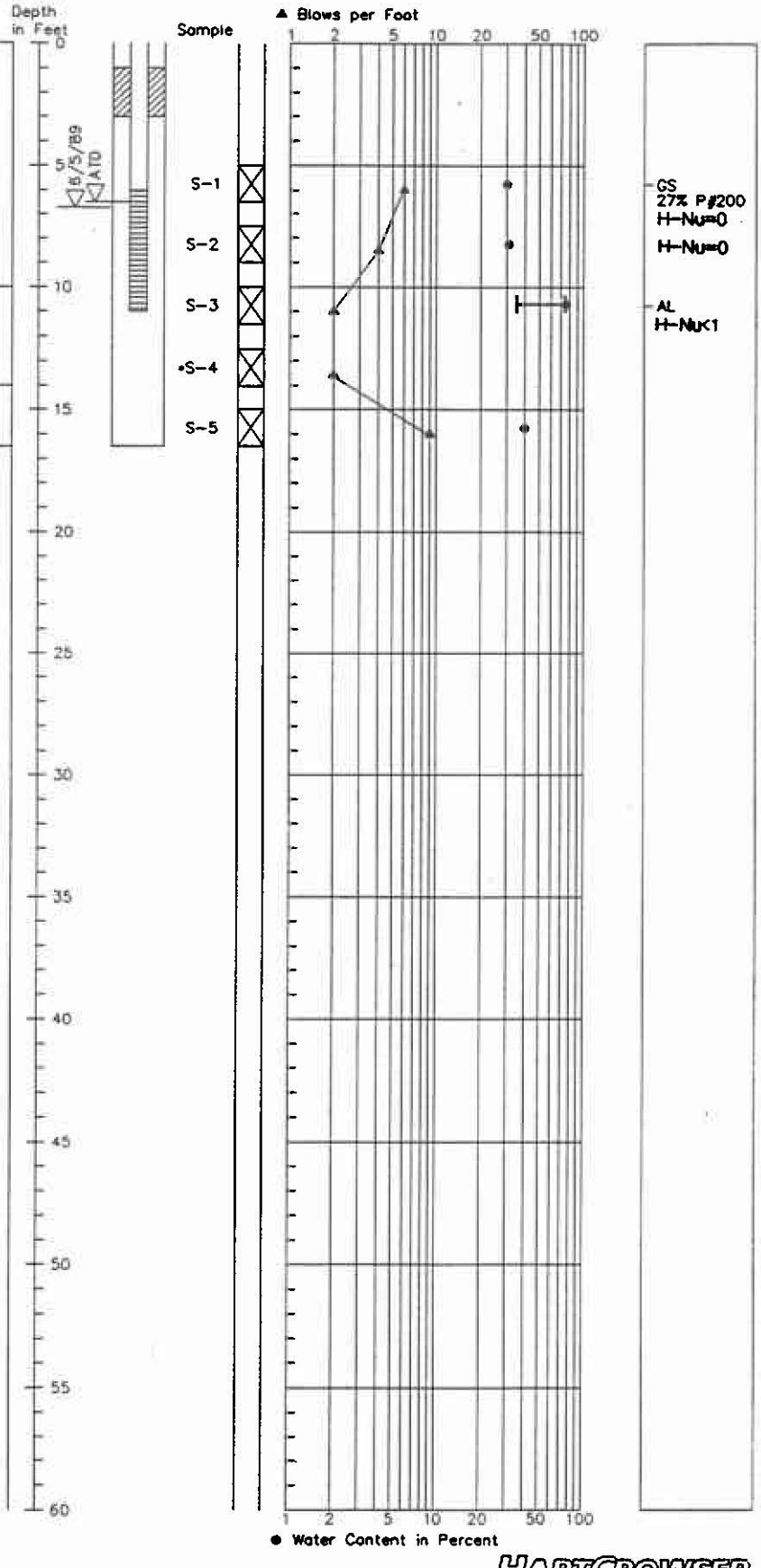
4 inches ASPHALT over loose to very loose, moist to wet, brown, silty SAND. (Possible FILL)

1 foot of heave.

Very soft, wet, brownish gray, silty CLAY.

Medium stiff, wet, dark gray, fine sandy SILT and silty, fine SAND.

Bottom of Boring at 16.5 Feet. Completed 5/15/89.



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

HARTCROWSER

J-2456 5/89

Figure A-3 1/1

Boring Log B-3

Soil Descriptions

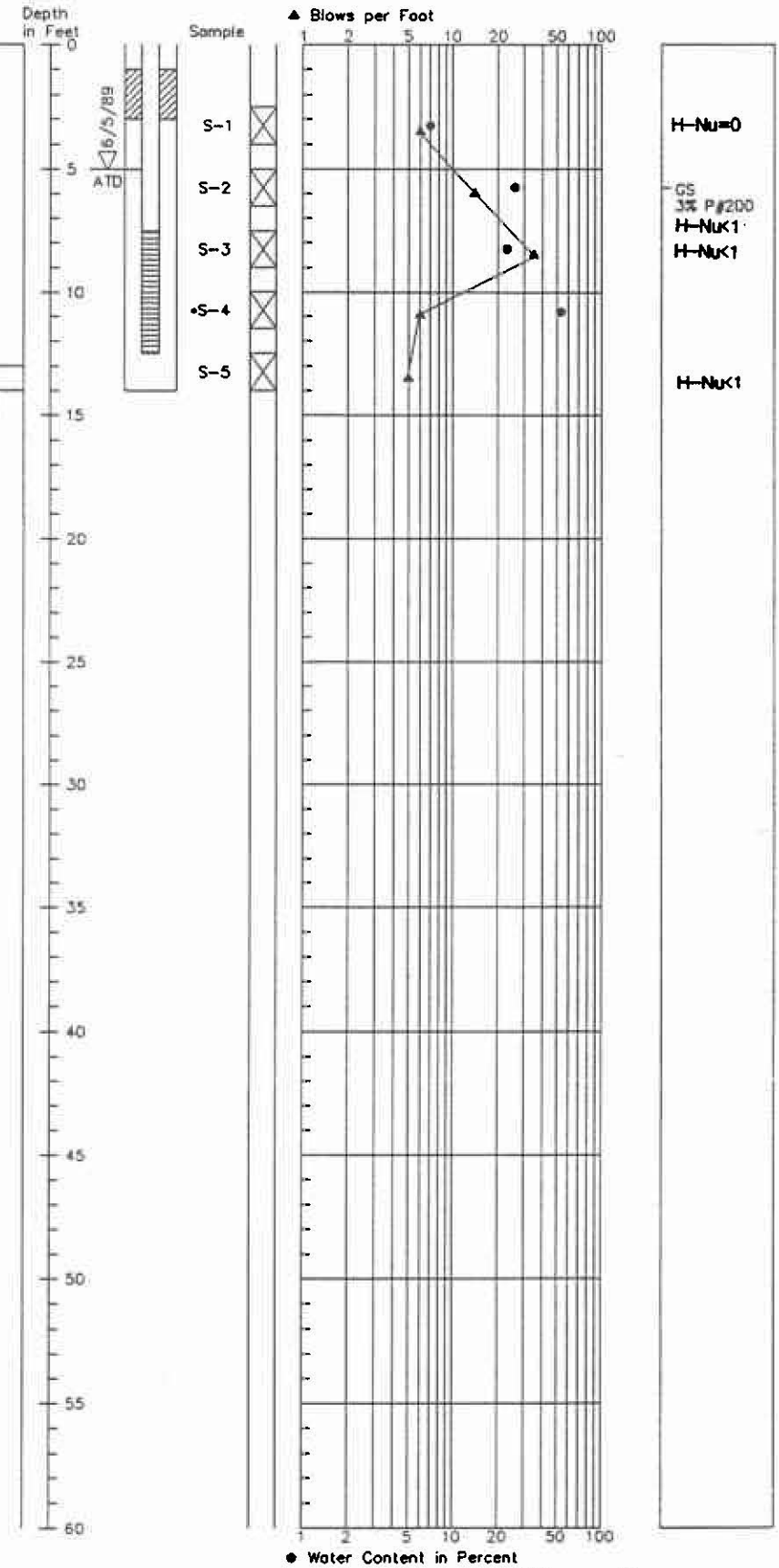
Ground Surface Elevation in Feet 6.1

3 inches ASPHALT over loose to dense, dry to wet, brown SAND.

Becomes silty.

Medium stiff, wet, gray, SILT with abundant organics and sand interbeds.

Bottom of Boring at 14 Feet.
Completed 5/15/89.



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

HARTCROWSER

J-2456 5/89

Figure A-4 1/1

Boring Log B-4

Soil Descriptions

Ground Surface Elevation in Feet 7.1

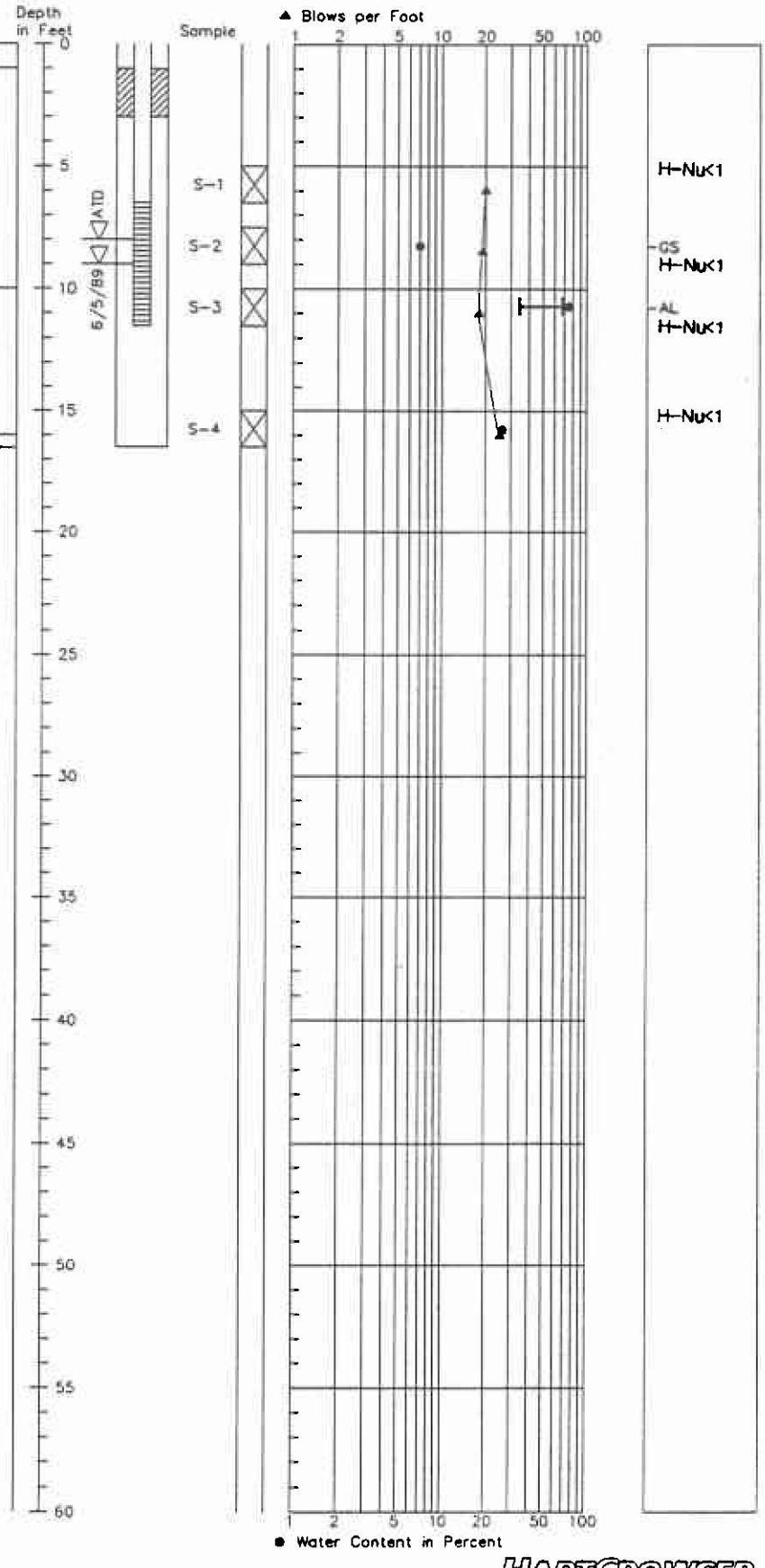
Dry, dark brown, very gravelly SAND.

Medium dense, moist to wet, brown SAND.

Very stiff to stiff, wet, brown SILT with abundant organic and wood fragments. (PEAT)

Medium dense, wet, dark gray, fine SAND.

Bottom of Boring at 16.5 Feet.
Completed 5/15/89.



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

HARTCROWSER

J-2456 5/89

Figure A-5 1/1

Boring Log B-5

Soil Descriptions

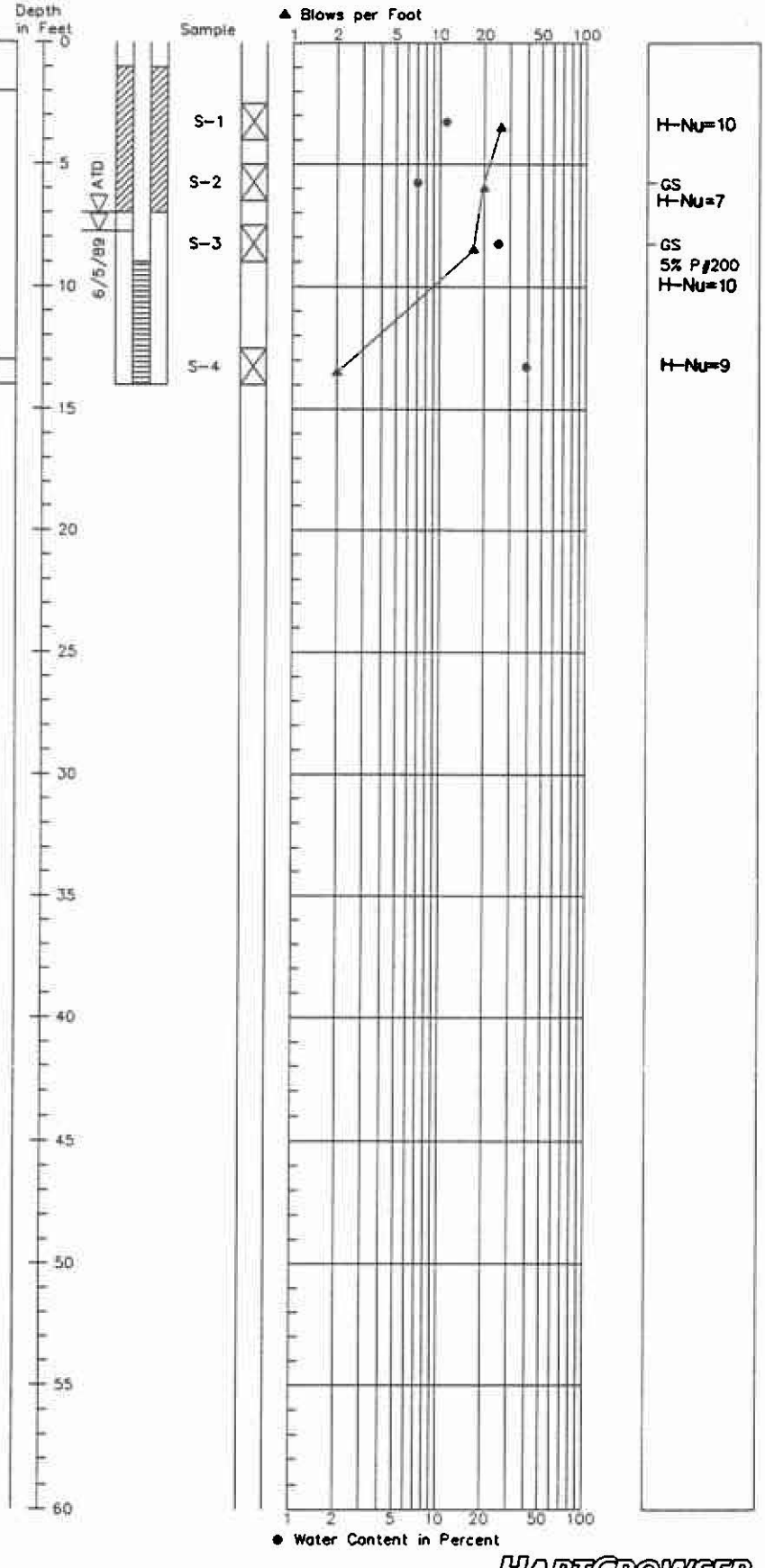
Ground Surface Elevation in Feet 9.5

Concrete with railroad ties.

Loose to medium dense, damp to moist, slightly silty SAND with debris (FILL).

Very soft, slightly sandy SILT with wood fragments and other debris (FILL).

Bottom of Boring at 14 Feet.
Completed 5/16/89.



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

HARTCROWSER

J-2456 5/89

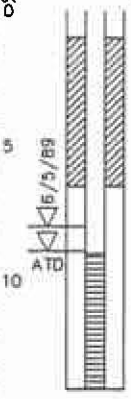
Figure A-6 1/1

Boring Log B-6

Soil Descriptions

Ground Surface Elevation in Feet 7.7

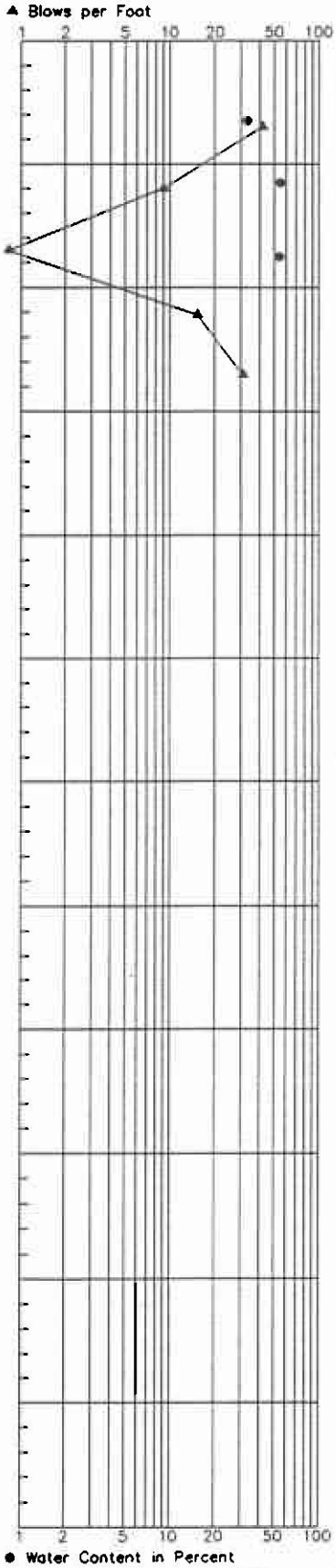
Soil Descriptions	Depth in Feet
Hard, damp, black SILT and silty, fine SAND and wood fragments (FILL).	0
Stiff to very soft, damp, black SILT with SAND interbeds.	5
Medium dense to dense, wet, black, silty to slightly silty SAND.	10
Bottom of Boring at 14.0 Feet. Completed 5/15/89.	15



Sample: S-1, S-2, S-3, *S-4, S-5

STANDARD PENETRATION RESISTANCE

▲ Blows per Foot



● Water Content in Percent

TESTS

H-Nu<1
H-Nu<1
H-Nu<1
H-Nu<1

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

HARTCROWSER

J-2456 5/89

Figure A-7 1/1

Boring Log B-7

Soil Descriptions

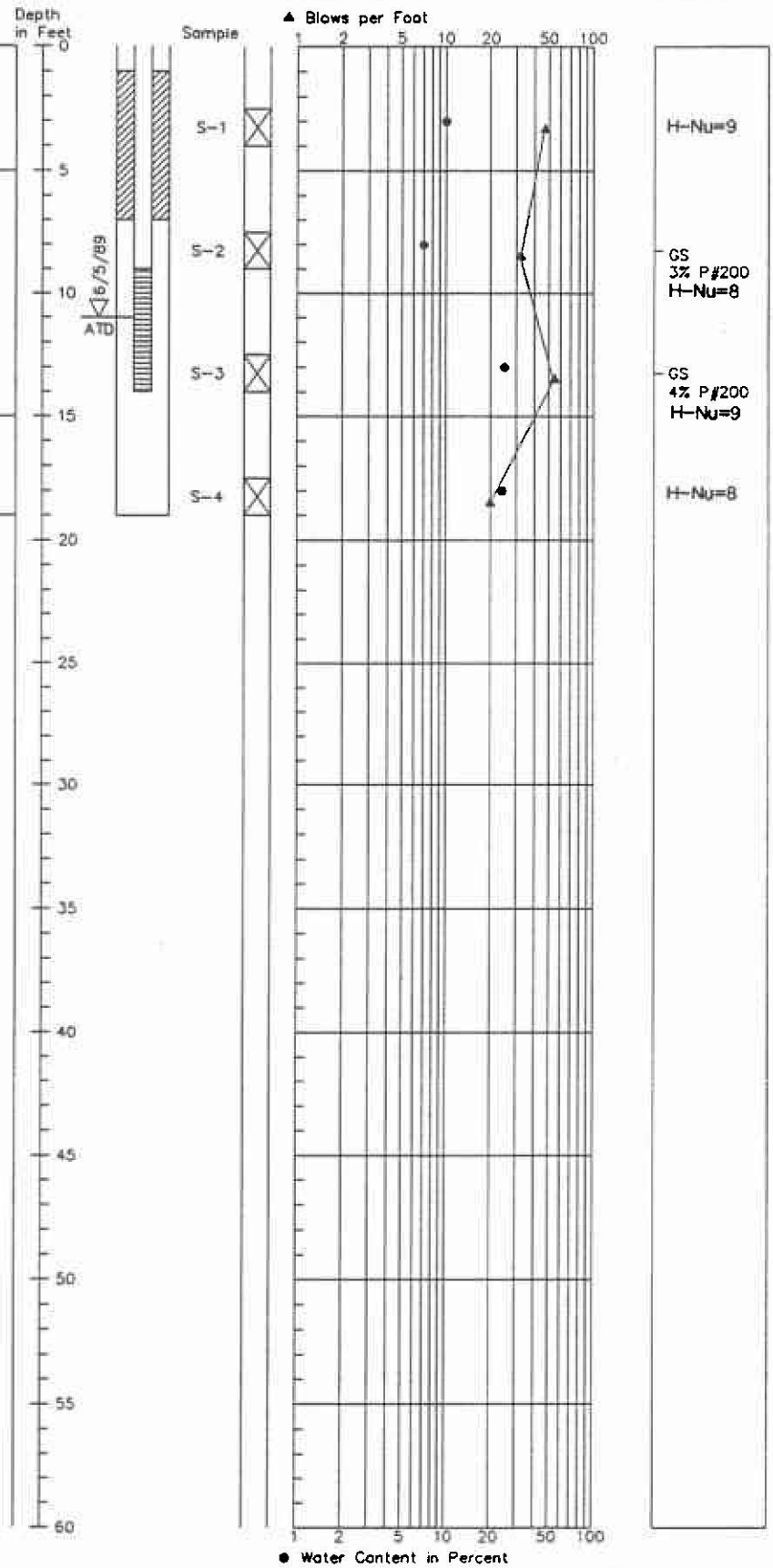
Ground Surface Elevation in Feet 12.9

Dense, brown, moist, silty, gravelly SAND (FILL).

Dense to very dense, damp to wet, black, clean SAND.

Medium dense, wet, gray, very silty SAND with shell fragments.

Bottom of Boring at 19 Feet.
Completed 5/16/89.



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

HARTCROWSER

J-2456 5/89

Figure A-8 1/1

Boring Log B-8

Soil Descriptions

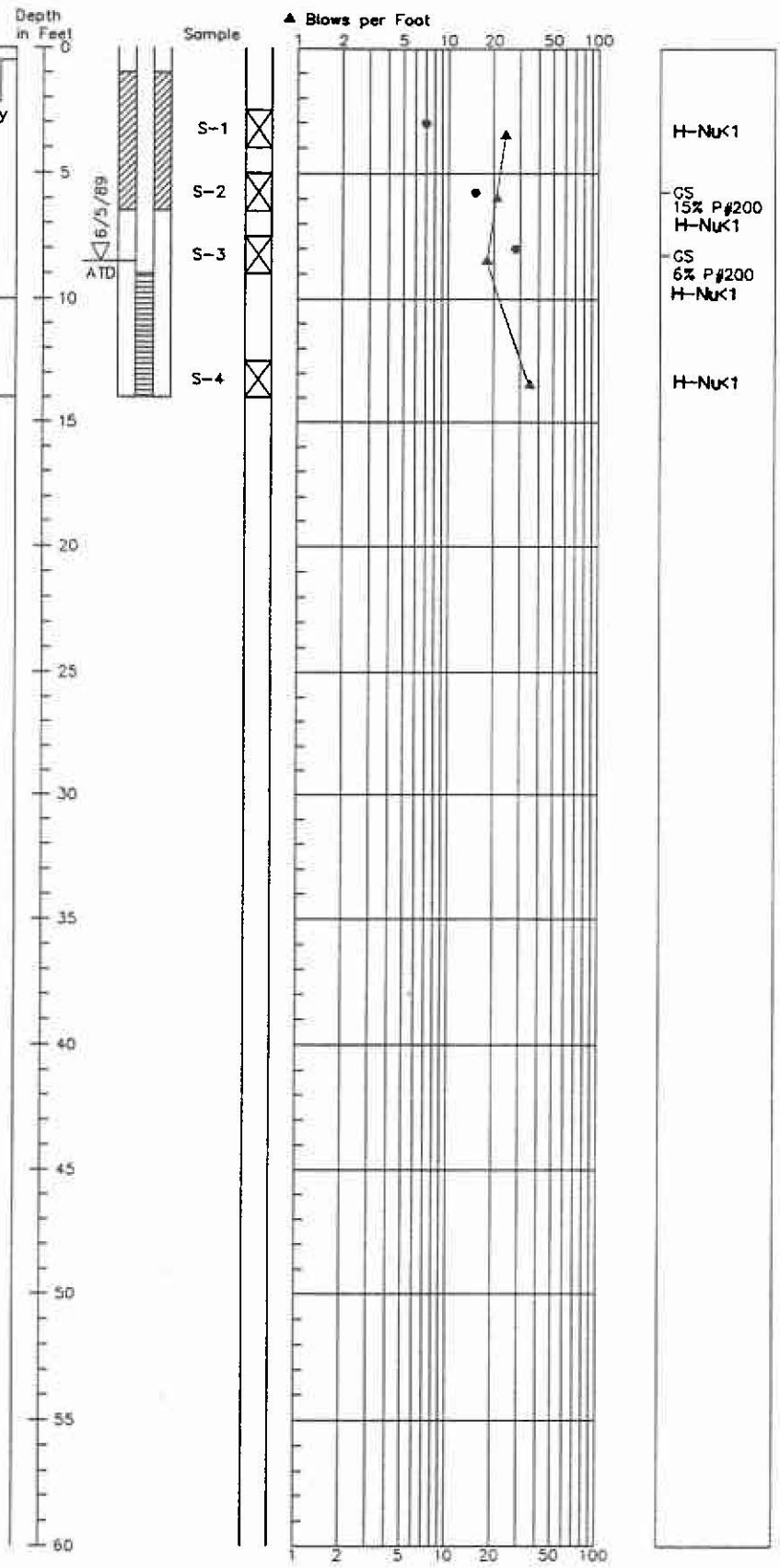
Ground Surface Elevation in Feet 9.2

2 inches of ASPHALT over 4 inches of slightly silty, gravelly SAND.

Medium dense, damp to moist, black, slightly silty to silty SAND.

Dense, wet, black, SAND.

Bottom of Boring at 14 Feet.
Completed 5/15/89.



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

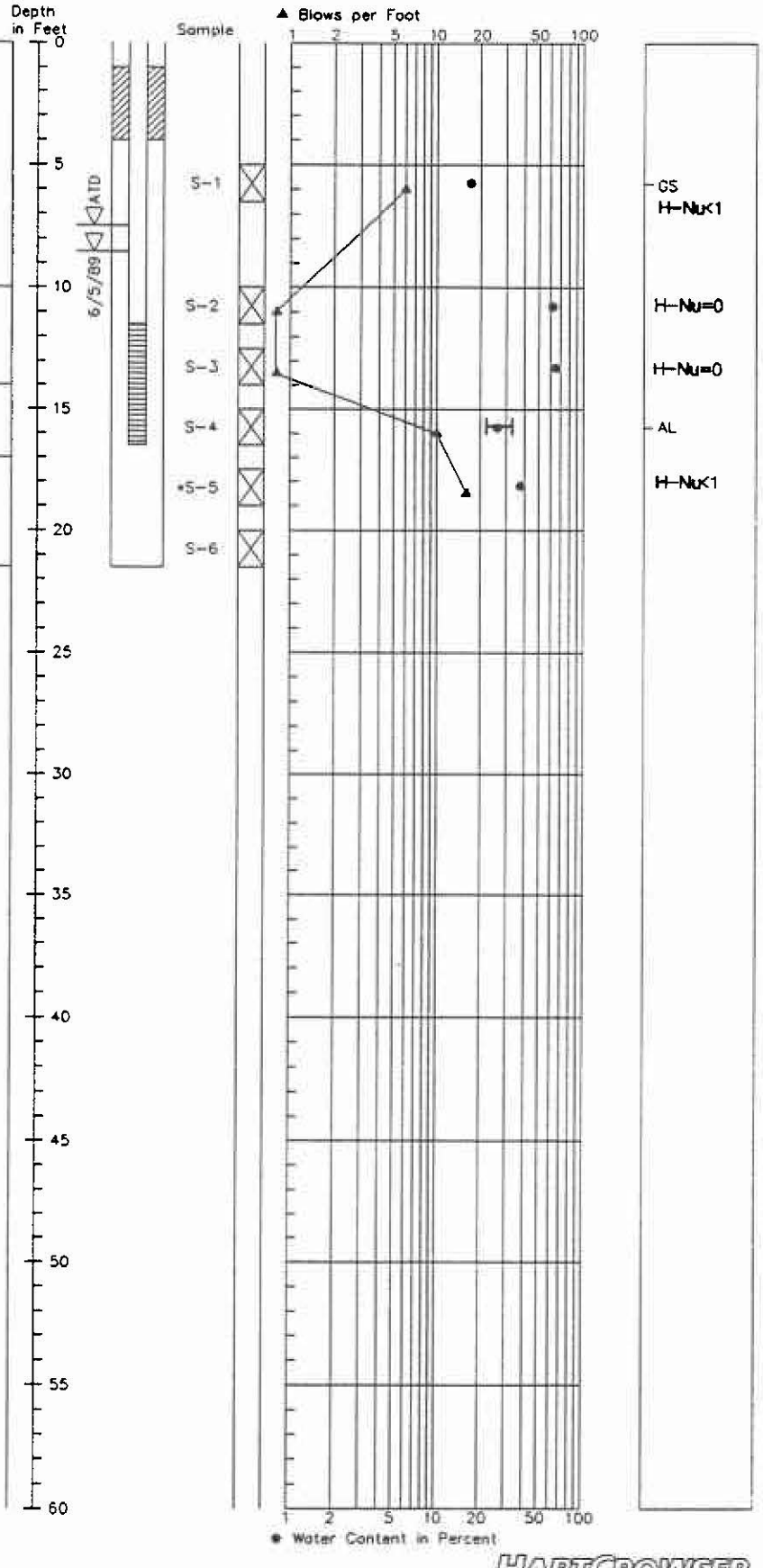
HARTCROWSER
J-2456 5/89
Figure A-9 1/1

Boring Log B-9

Soil Descriptions

Ground Surface Elevation in Feet 6.2

Soil Description
Loose, moist to wet, brown, slightly gravelly, silty SAND with debris (FILL).
Very soft, wet, light to dark gray CLAY with sand interbeds.
Stiff, wet, black, slightly sandy CLAY.
Medium dense to loose, wet, dark gray, silty SAND.
Bottom of Boring at 21.5 Feet. Completed 5/15/89.



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

HARTCROWSER

J-2456 5/89

Figure A-10 1/1

Boring Log B-10

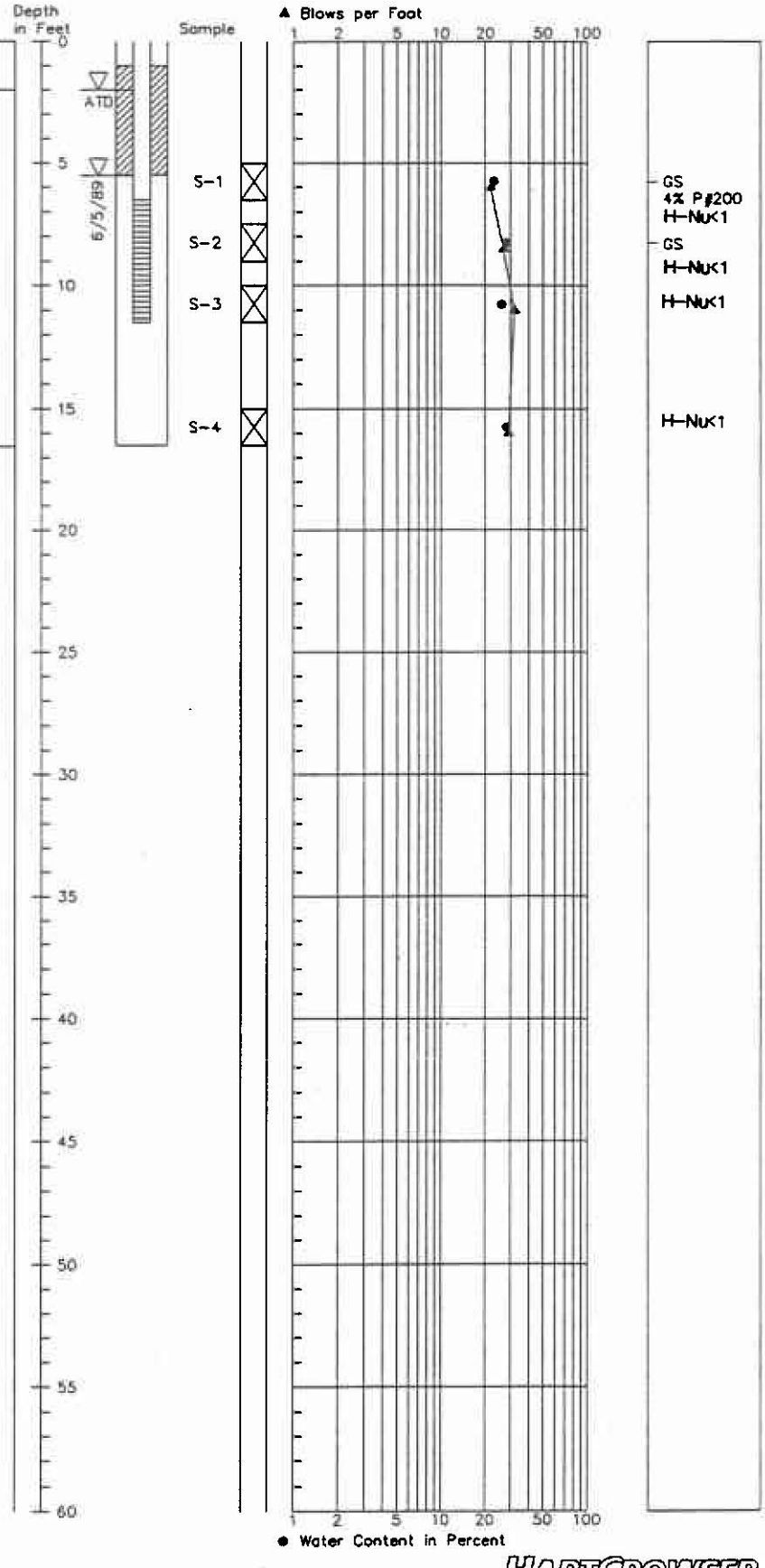
Soil Descriptions

Ground Surface Elevation in Feet 6.6

Medium dense, slightly silty, gravelly SAND.

Medium dense to dense, wet, black SAND.

Bottom of Boring at 16.5 Feet.
Completed 5/15/89.



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

HARTCROWSER

J-2456 5/89

Figure A-11 1/1

Boring Log B-11

Soil Descriptions

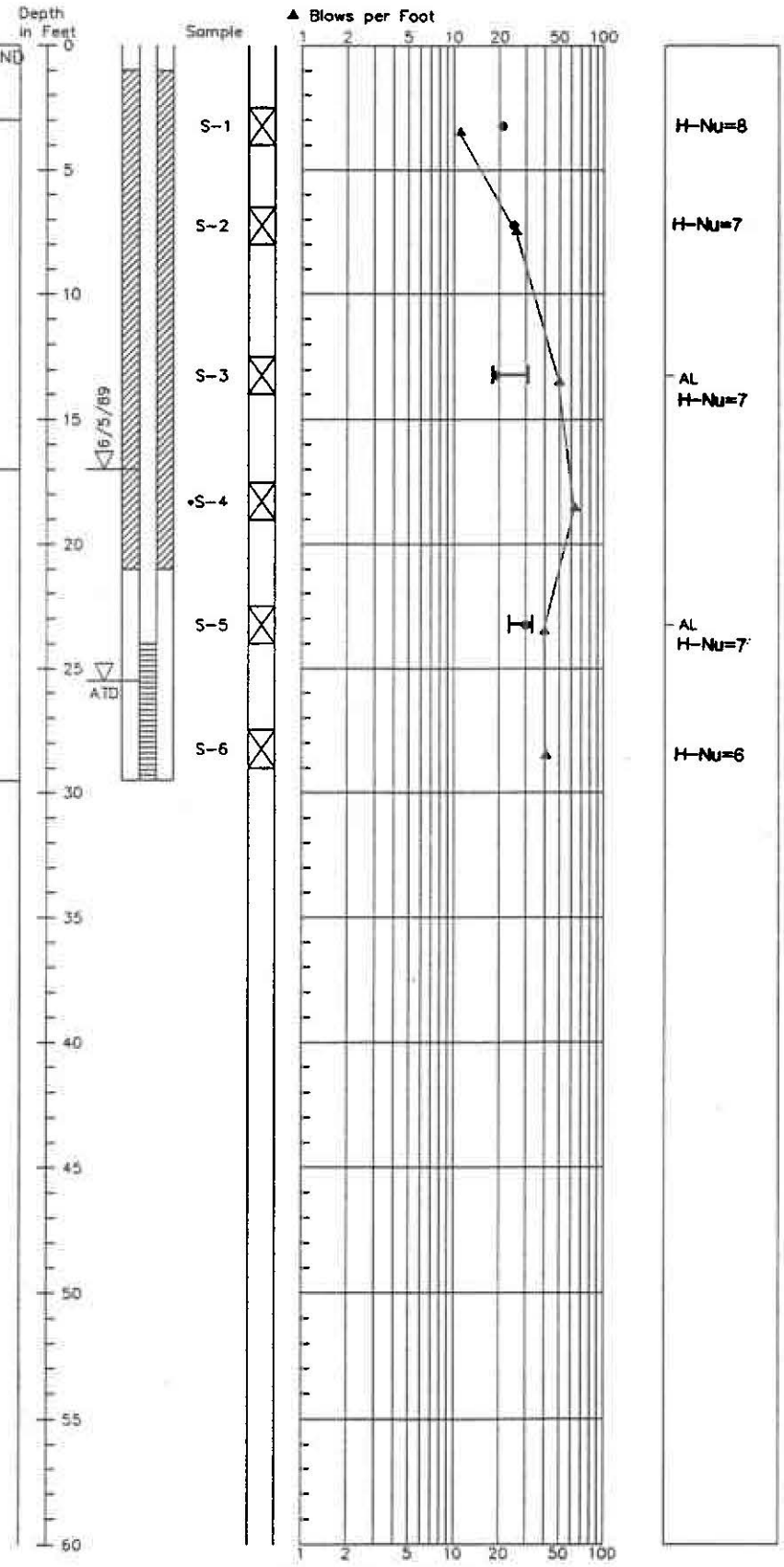
Ground Surface Elevation in Feet 166.8

Medium dense, damp to wet, brown silty SAND (FILL).

Very stiff to hard, wet, gray–brown slightly sandy CLAY with occasional gravel and cobbles.

Hard, damp to wet, gray and brown, silty CLAY.

Bottom of Boring at 29.5 Feet.
Completed 5/16/89.



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

HARTCROWSER

J-2456 5/89

Figure A-12 1/1

Boring Log B-12

Soil Descriptions

Approx. Ground Surface Elevation in Feet 5.5

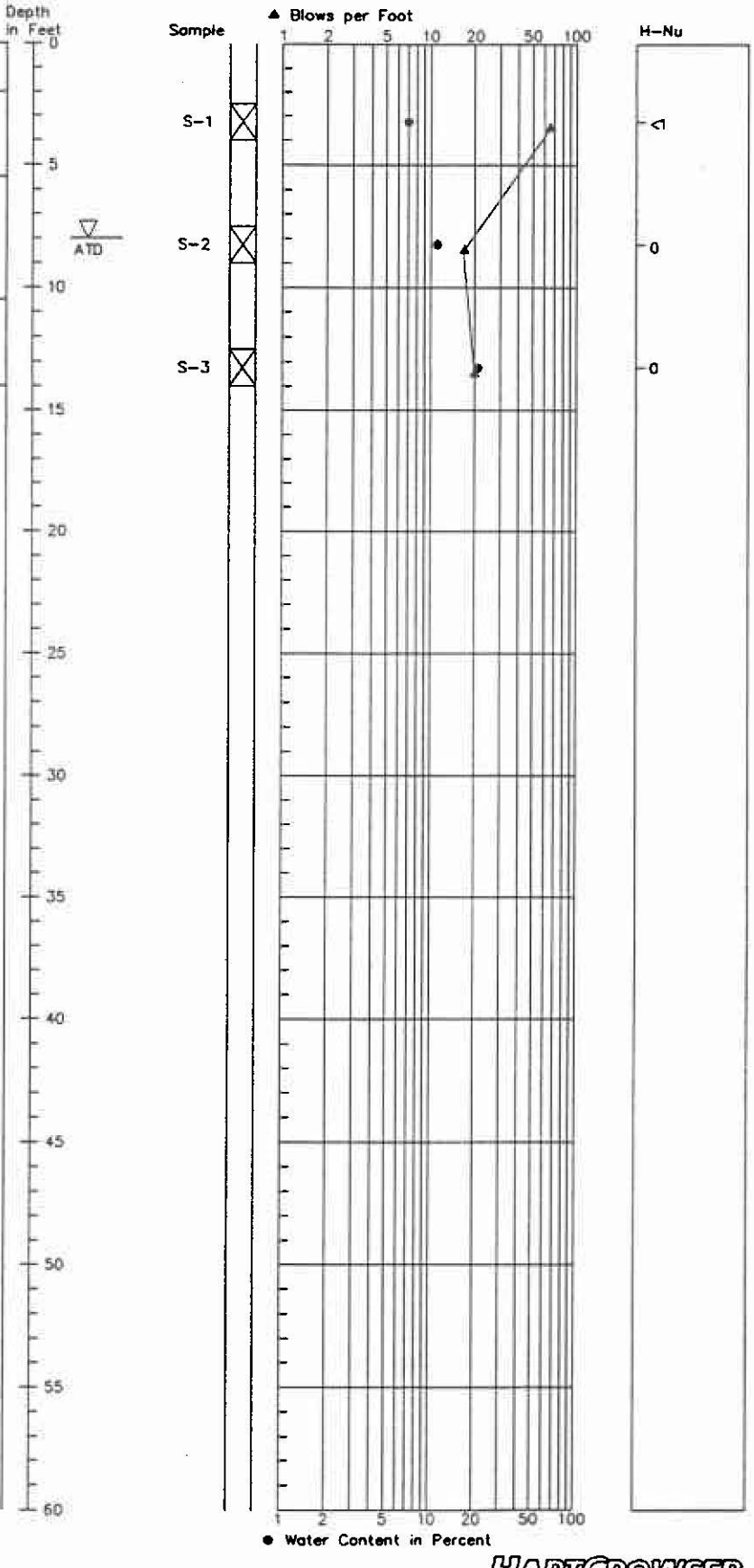
3 inches of ASPHALT over 13 inches of CONCRETE over very sandy GRAVEL. (FILL)

Intermittent layers of dense, damp, gray, slightly sandy SILT and very dense, damp, gray, very sandy GRAVEL. (FILL)

Medium dense, moist to wet, brownish gray, fine to medium SAND.

Grades to slightly silty, slightly gravelly, fine to medium SAND.

Bottom of Boring at 14.0 Feet. Completed 8/2/89.



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

HARTCROWSER

J-2456 8/89

Figure A-13 1/1

Boring Log B-13

Soil Descriptions

Approx. Ground Surface Elevation in Feet 8.0

3 inches of ASPHALT over dark gray, gravelly SAND. (FILL)

Medium dense, damp, light brown, sandy SILT with abundant organics. (FILL)

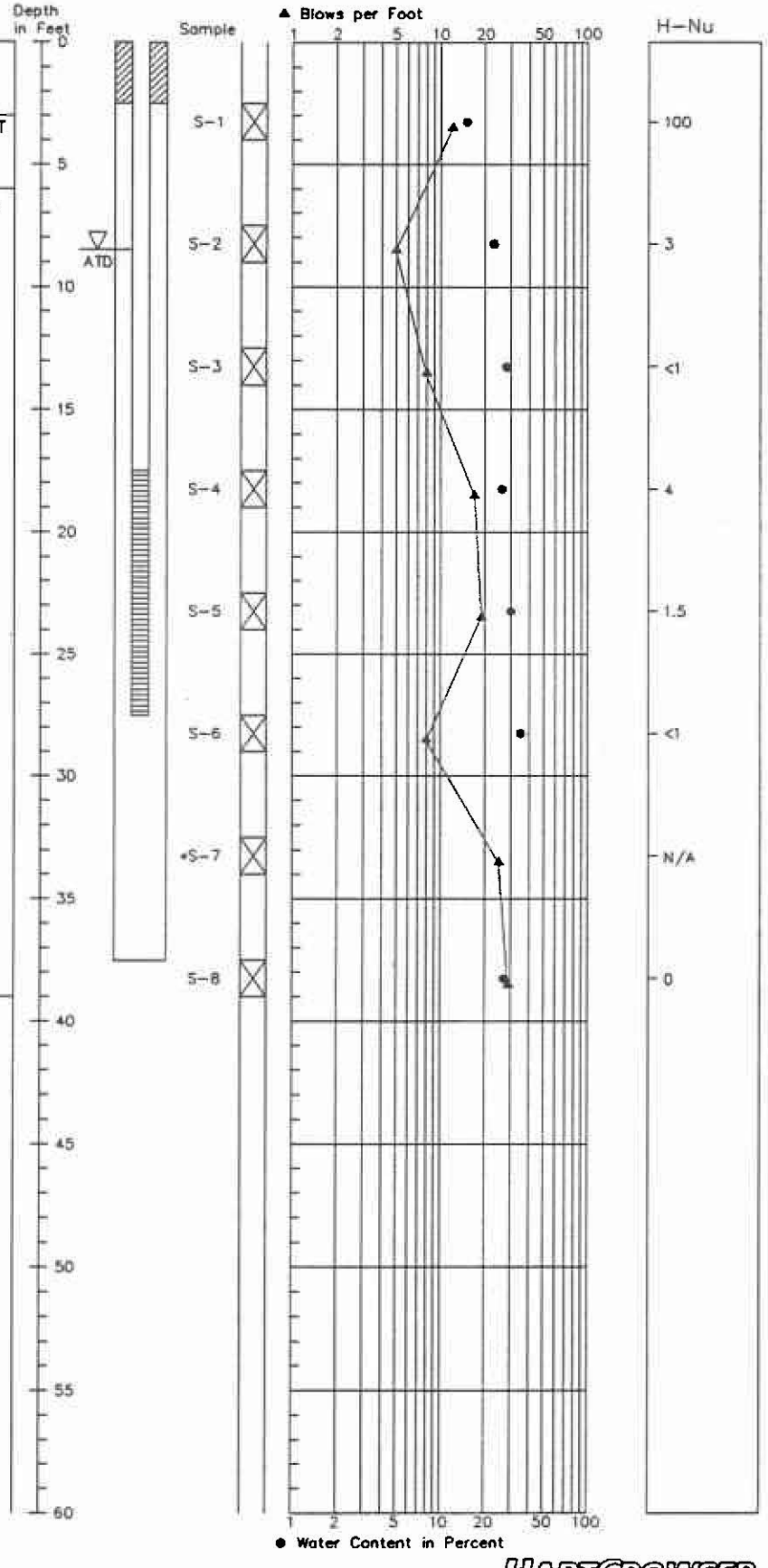
Loose to medium dense, damp to wet, gray, slightly silty to clean, fine to medium SAND.

< 1-foot of heave.

1.5 feet of heave.

Interbeds of dark gray, sandy SILT.

Bottom of Boring at 39.0 Feet.
Completed 8/1/89.



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

HARTCROWSER
J-2456 8/89
Figure A-14 1/1

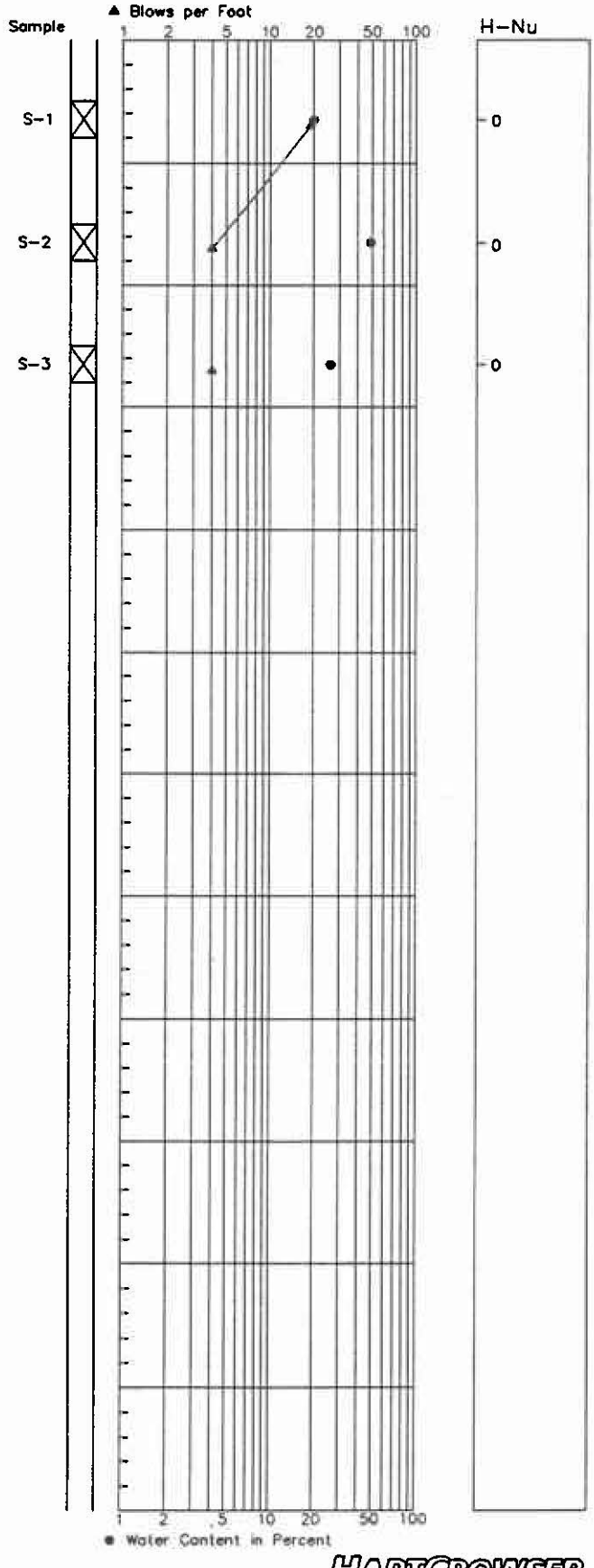
Boring Log B-14

Soil Descriptions

Approx. Ground Surface Elevation in Feet 8.0

Soil Description	Depth in Feet
3 inches of ASPHALT over dark brown, medium SAND. (FILL)	0
Medium dense, damp, grayish brown, very silty, fine SAND. (FILL)	5
Soft, wet, dark gray, slightly clayey SILT with some wood fragments.	ATD
Loose, wet, dark gray, medium SAND.	10
Bottom of Boring at 14.0 Feet. Completed 8/2/89.	15
	20
	25
	30
	35
	40
	45
	50
	55
	60

STANDARD PENETRATION RESISTANCE



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

HARTCROWSER

J-2456 8/89

Figure A-15 1/1

Boring Log B-15

Soil Descriptions

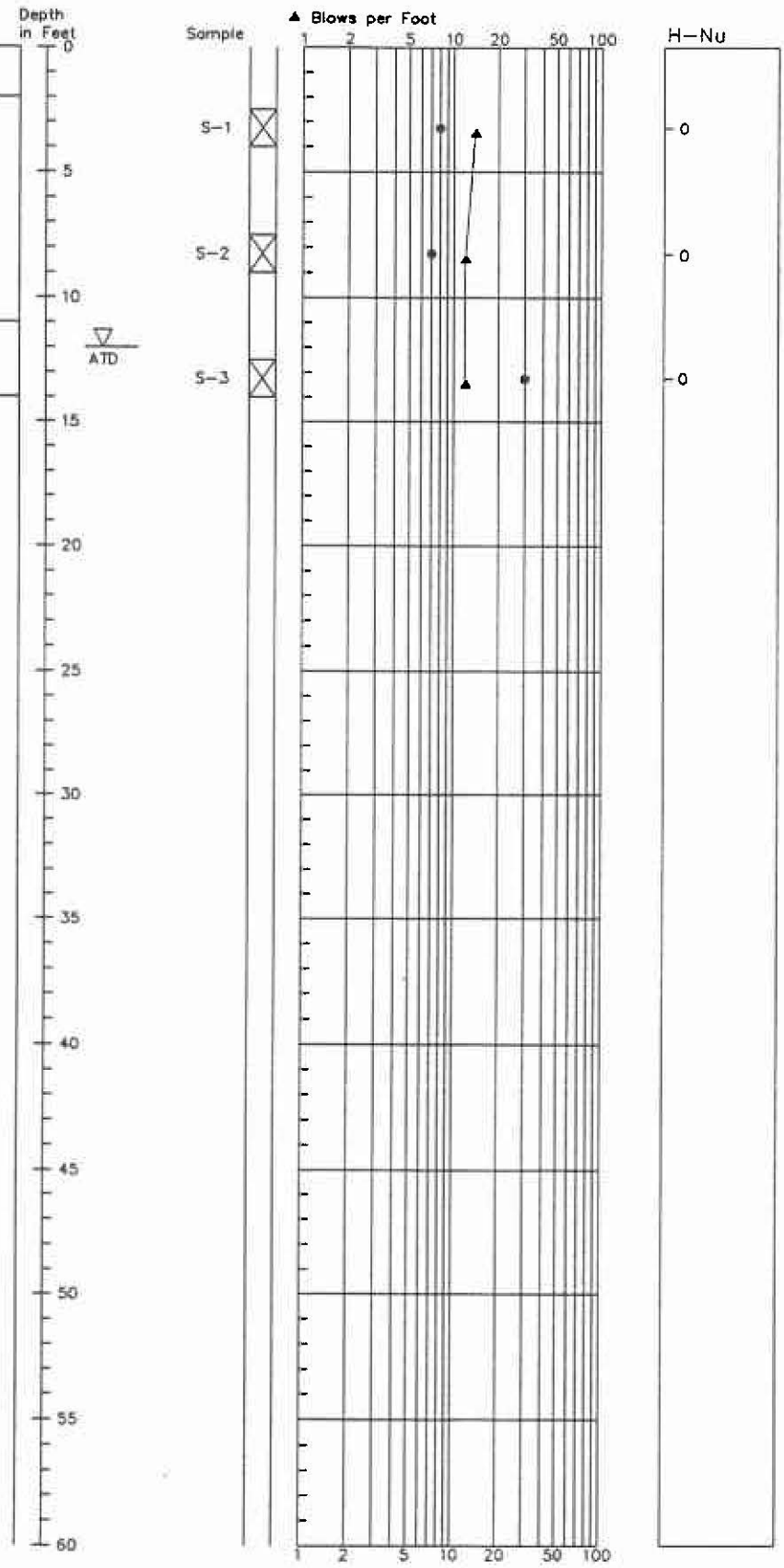
Approx. Ground Surface Elevation in Feet 7.5

3 inches of ASPHALT over brown, slightly gravelly, medium SAND. (FILL)

Medium dense, damp, dark brown, slightly gravelly, very silty, fine SAND.

Grades to silty, fine to medium SAND.

Bottom of Boring at 14.0 Feet.
Completed 8/2/89.



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

HARTCROWSER

J-2456 8/89

Figure A-16 1/1

Boring Log B-16

Soil Descriptions

Approx. Ground Surface Elevation in Feet 10.0

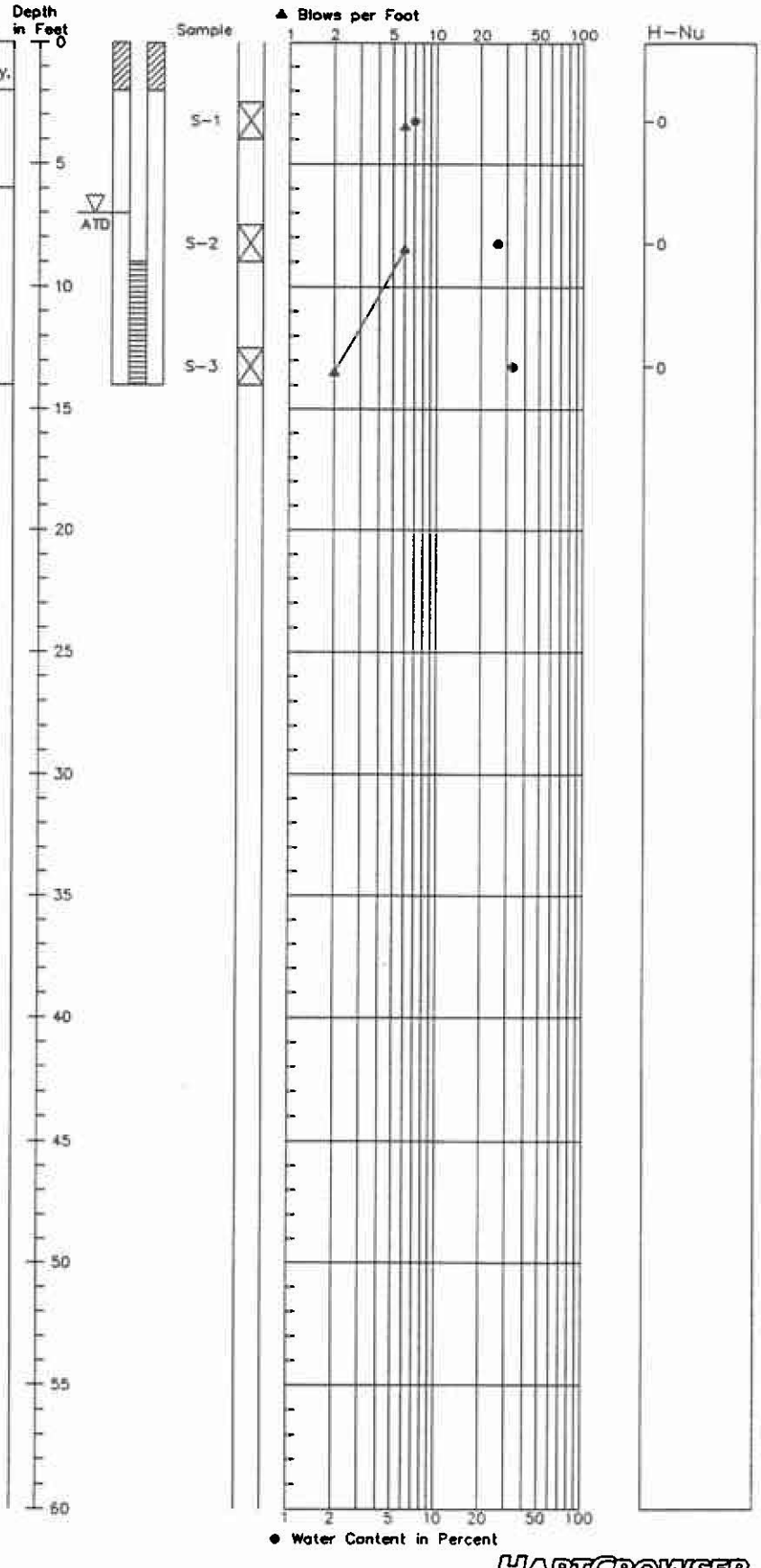
4 inches of ASPHALT over 20 inches of CONCRETE and RAILROAD TIES over dark gray, slightly silty, fine to medium SAND. (FILL)

Loose, damp, dark gray, gravelly, silty, fine to medium SAND. (FILL)

Grades to very silty, fine to medium SAND.

Some organics.

Bottom of Boring at 14.0 Feet.
Completed 8/2/89.



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

HARTCROWSER

J-2456 8/89

Figure A-17 1/1

Table B-1 Analytical methods used by ATI for chemical confirmation analyses for soil and water

Parameter	Soil Analyses		Water Analyses	
Metals & Inorganics	**Technique**	**Methods**	**Technique**	**Methods**
Antimony	AA/GF	EPA 7041	AA/GF	EPA 7041
Arsenic	AA/GF	EPA 7060	AA/GF	EPA 7060
Beryllium	AA/F	EPA 7090	AA/F	EPA 7090
Cadmium	AA/F	EPA 7130	AA/GF	EPA 7131
Chromium	AA/F	EPA 7190	AA/F	EPA 7190
Copper	AA/F	EPA 7210	AA/F	EPA 7210
Lead	AA/GF	EPA 7421	AA/GF	EPA 7421
Mercury	AA/COLD VAPOR	EPA 7470	AA/COLD VAPOR	EPA 7470
Nickel	AA/F	EPA 7520	AA/F	EPA 7520
Selenium	AA/GF	EPA 7740	AA/GF	EPA 7740
Silver	AA/F	EPA 7760	AA/F	EPA 7760
Thallium	AA/GF	EPA 7841	AA/GF	EPA 7841
Zinc	AA/F	EPA 7950	AA/F	EPA 7950
Organics				
Petroleum Hydrocarbons (TPH)	IR	EPA 418.1		EPA 642
Polynuclear Aromatic Hydrocarbons	GC/MS	EPA 8310		NA
Pentachlorophenol	GC/HALL	EPA 8040		NA
Volatile Organic Compounds	GC/MS	EPA 8240		EPA 418.1

EPA = "Test Methods for Evaluating Solid Waste (SW 846)", U.S.E.P.A., November, 1986.
NA = parameter not analyzed

TECHNIQUES:
AA/F = Atomic Absorption/Flame
AA/GF = Atomic Absorption/Graphite Furnace
GC/MS = Gas Chromatography/Mass Spectrometry
IR = Infrared spectrometric detection
GC/HALL = Gas Chromatography/Hall detection

Table B-2 Screening Data for Diagonal/CSO Soil Samples J-2456

	Method Blank	Boring:	B-1A	B-2*	B-3*	B-3	B-5	B-6	B-7	B-7	B-8*	B-9	B-10	B-11
		Sample:	S-1	S-1A	S-1	S-1	S-4	S-1	S-1	S-3	S-1A	S-1	S-1	S-1
		Depth:	7.5-9'	5-9'	2.5-9'	2.5-4'	12.5-14'	2.5-4'	3-4'	12.5-14'	2.5-9'	5-6.5'	5.5-6.5'	3-4'
Metals in mg/kg (ppm)														
Cadmium	0.5		0.5	0.4	0.4	0.6	0.8	0.7	0.9	0.5	0	0.2	0.1	0
Chromium	1.7		2	2.6	2.6	2.7	4.8	5.6	16.3	2.2	3.3	5.2	1.3	18.4
Copper	0		7.6	7.8	5.6	6	58.2	14.4	26.1	8	10.2	135.4	6	20.8
Nickel	0.8		3	5.6	5.1	6.1	13.1	10.4	26.3	8.4	12.7	5.7	7.1	46.9
Lead	3		9.7	14.8	6.8	4.3	49.8	11.6	16.8	1.1	4.9	90.4	0	1.3
Zinc	1		12.2	19.7	11.4	10.7	46.3	24.6	41	12.5	17.2	103.3	12.6	32.8
Volatiles in ug/kg (ppb)														
Methylene Chloride	24		18	NA	NA	34	<2	37	27	22	NA	10	23	17
Trichloroethylene	<2		<2	NA	NA	<2	<2	<2	<2	tr	NA	tr	<2	<2
Tetrachloroethylene	<2		tr	NA	NA	<2	<2	<2	<2	tr	NA	<2	<2	<2
Base/neutral Screen in mg/kg (ppm) (as Napththalene)	<1		<1	<1	2.78	<1	13.6	<1	203 (a)	33.6	2.3	10.5	<1	<1
PCB/Pest. Screen in mg/kg (ppm	<1		<1	<1 (b)	<1	<1	<1 (b)	<1 (c)	<1	<1	<1	<1 (b)	<1	<1

* Denotes a composite sample
tr Denotes analyte presnt between 1 and 2 ug/kg (ppb)
(a) Chromatogrph shows oil/fuel related constituents (diesel)
(b) Large peak noticed on GC/ECD chromatograph
(c) Peaks on GC/ECD chromatograph of B6-S1 may be carry-over from B5-S4

Table B-2 (continued)
Screening Data for Diagonal CSO Soil Samples

J-2456

Boring:	B-12	B-13	B-13	B-14	B-15	B-16
Sample:	S-3	S-1	S-4	S-2	S-2	S-1
Depth:	12.5'-14'	2.5'-4.0'	7.5'-19.0'	7.5'-9.0'	7.5'-9.0'	2.5'-4.0'
Metals in mg/kg (ppm)						
Cadmium	< 1.5	< 1.5	NA	< 1.5	< 1.5	NA
Chromium	< 0.5	24	NA	< 0.5	< 0.5	NA
Copper	7.9	20	NA	12	8.7	NA
Nickel	< 1.5	18	NA	< 1.5	< 1.5	NA
Lead	< 10	12	NA	< 10	< 10	NA
Zinc	8.6	32	NA	13	8.6	NA
Volatiles in ug/kg (ppb)						
Methylene Chloride	NA	7.2	< 20	< 20	NA	3.6
Trichloroethylene	NA	0.24	< 10	< 10	NA	< 10
Base/neutral Screen in mg/kg (ppm) (as Napthalene)	< 1	< 1	NA	< 1	< 1	NA
PCB/Pest. Screen in mg/kg (ppm)	NA	< 1	NA	< 1	< 1	NA

"<" indicates less than
tr denotes analyte present between 1 and 2 ug/kg (ppb)

Table B-3 Chemical Results for Diagonal/CSO Soil Samples
Analytical Technologies, Inc.

J-2456

	Method Blank	Boring:	B-9	B-5	B-7	B-7
		Sample:	S-1	S-4	S-1	S-3
		Depth:	5-6.5'	12.5-14'	3-4'	12.5-14'
		ATI No.:	8905-126-1	8905-126-3	8905-126-4	8905-126-2
Metals in mg/kg (ppm)						
Arsenic			2.8			
Antimony			0.5 U			
Beryllium			9 U			
Cadmium			1 U			
Chromium			29			
Copper			120			
Lead			200			
Mercury			1			
Nickel			11			
Thallium			0.5 U			
Zinc			320			
Volatiles in mg/kg (ppm)						
Methylene Chloride	1.1					0.76 B
Trichloroethylene						0.05 U
Tetrachloroethylene						0.05 U
Total Petroleum Hydrocarbon (418.1) in mg/kg (ppm)				16	2000	
PAHs in mg/kg (ppm)						
Flouranthene				0.32	0.2 U	
Others				0.2 U	0.2 U	
Pentachlorophenol in mg/kg (ppm)				0.003 U		

* denotes a composite sample
B analyte was also found in the analytical blank
U analyte not detected at the detection limit shown

Table B-4 Chemical Results for Diagonal/CSO Water Samples J-2456
Analytical Technologies, Inc.

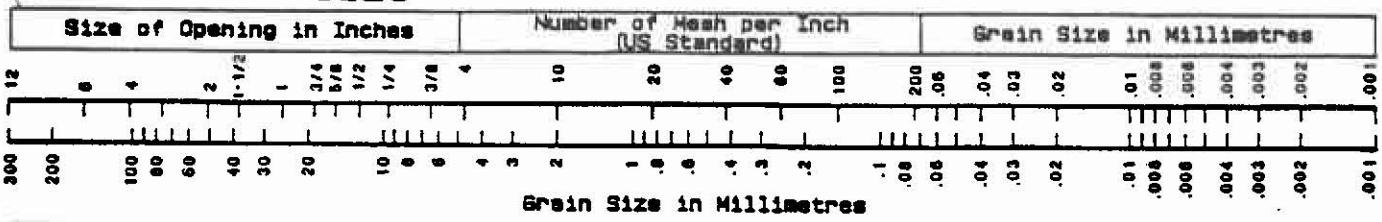
Boring No:	B-1	B-7	B-8	B-5	B-13
ATI No.:	8905-151-1	8905-151-2	8905-151-3	8905-151-4	(3)
Metals in mg/L (ppm)(1)					
Arsenic	0.12	0.048	0.08	0.018	NA
Antimony	0.005 U	0.005 U	0.005 U	0.005 U	NA
Beryllium	0.01 U	0.01 U	0.01 U	0.01 U	NA
Cadmium	0.0026	0.0038	0.0024	0.0016	NA
Chromium	0.8	0.66	0.47	0.26	NA
Copper	0.34	0.28	0.21	0.3	NA
Lead	0.17	0.072	0.06	0.18	NA
Mercury	0.0005 U	0.0005 U	0.0005 U	0.0005 U	NA
Nickel	0.35	0.23	0.09	0.03 U	NA
Selenium	0.5 U	0.5 U	0.5 U	0.5 U	NA
Silver	0.02 U	0.02 U	0.02 U	0.02 U	NA
Thallium	0.005 U	0.005 U	0.005 U	0.005 U	NA
Zinc	2	1.2	1.1	1.2	NA
Total Petroleum Hydrocarbon in mg/L (ppm)	0.05 U	0.05 U	0.05 U	0.05 U	NA
Volatiles in ug/L (ppb)					
1,1-Dichloroethane	1 U	13	1 U	1 U	1 U
1,2-Dichloroethene	1 U	6	1 U	1 U	1 U
1,1,1-Trichloroethane	11	85	1 U	1 U	1 U
Trichloroethene	1 U	8	1 U	1 U	1 U
Other Volatiles	1 U	1	1 U	1 U	1 U

Notes:

U denotes analyte was not detected at detection limit shown
(1) Samples were not filtered prior to preservation and analysis and had alot of sediment in the bottom of the bottles.
(2) Samples had ~1/2" of sediment in bottom of bottles, samples were decanted off.
(3) Sample was analyzed for volatile organics by Photovac 10S.

Unified Soil Classification (USC) System

Soil Grain Size



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

Coarse-Grained Soils

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

G W and S W $\left(\frac{D_{60}}{D_{10}}\right)$ >4 for G W, >6 for S W G $i \leq \left(\frac{(D_{30})^2}{D_{10} \times D_{60}}\right) \leq 3$ G P and S P Clean GRAVEL or SAND not meeting requirements for G W and S W

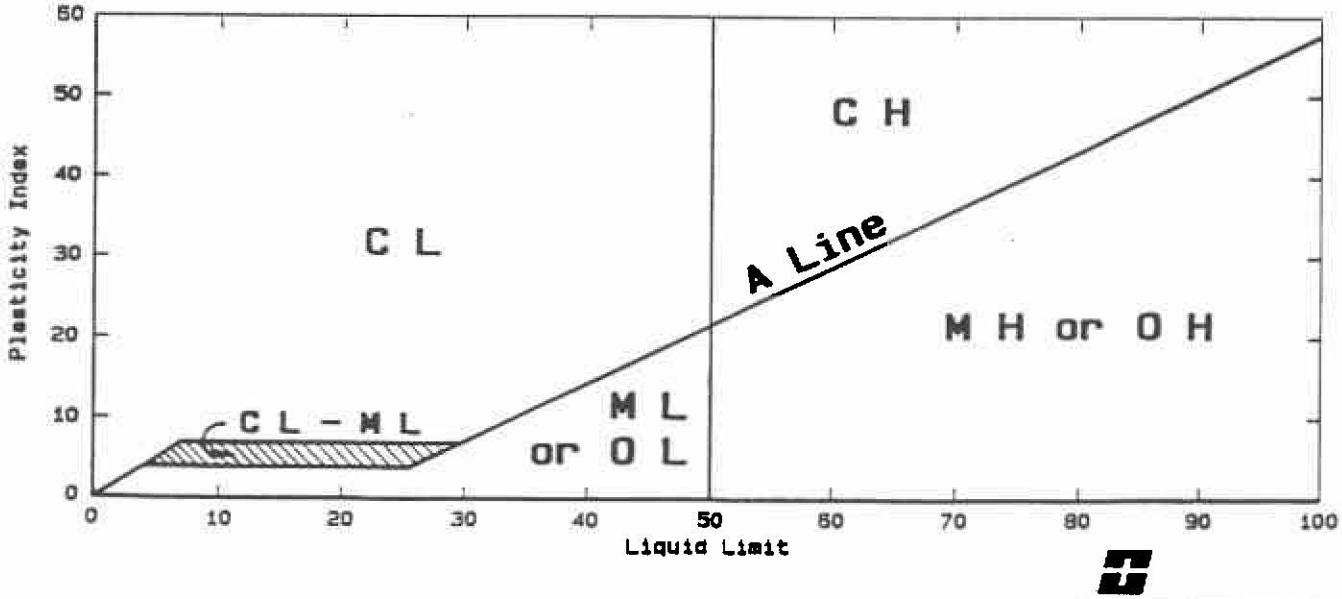
G M and S M Atterberg limits below A Line with PI <4 G C and S C Atterberg limits above A Line with PI >7

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

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

Fine-Grained Soils

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

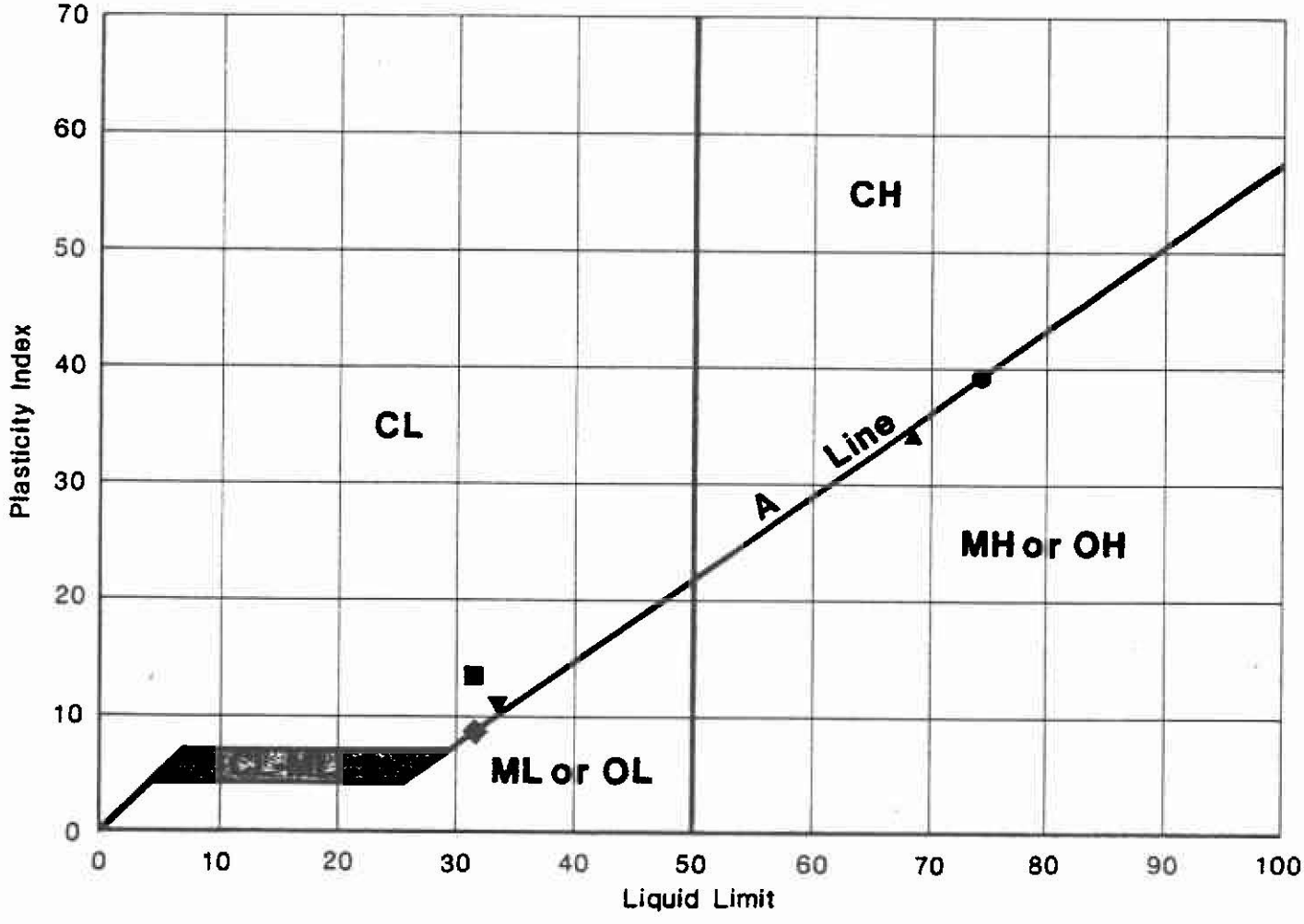


HARTCROWSER

J-2456 6/89

Figure B-1

Plasticity Chart

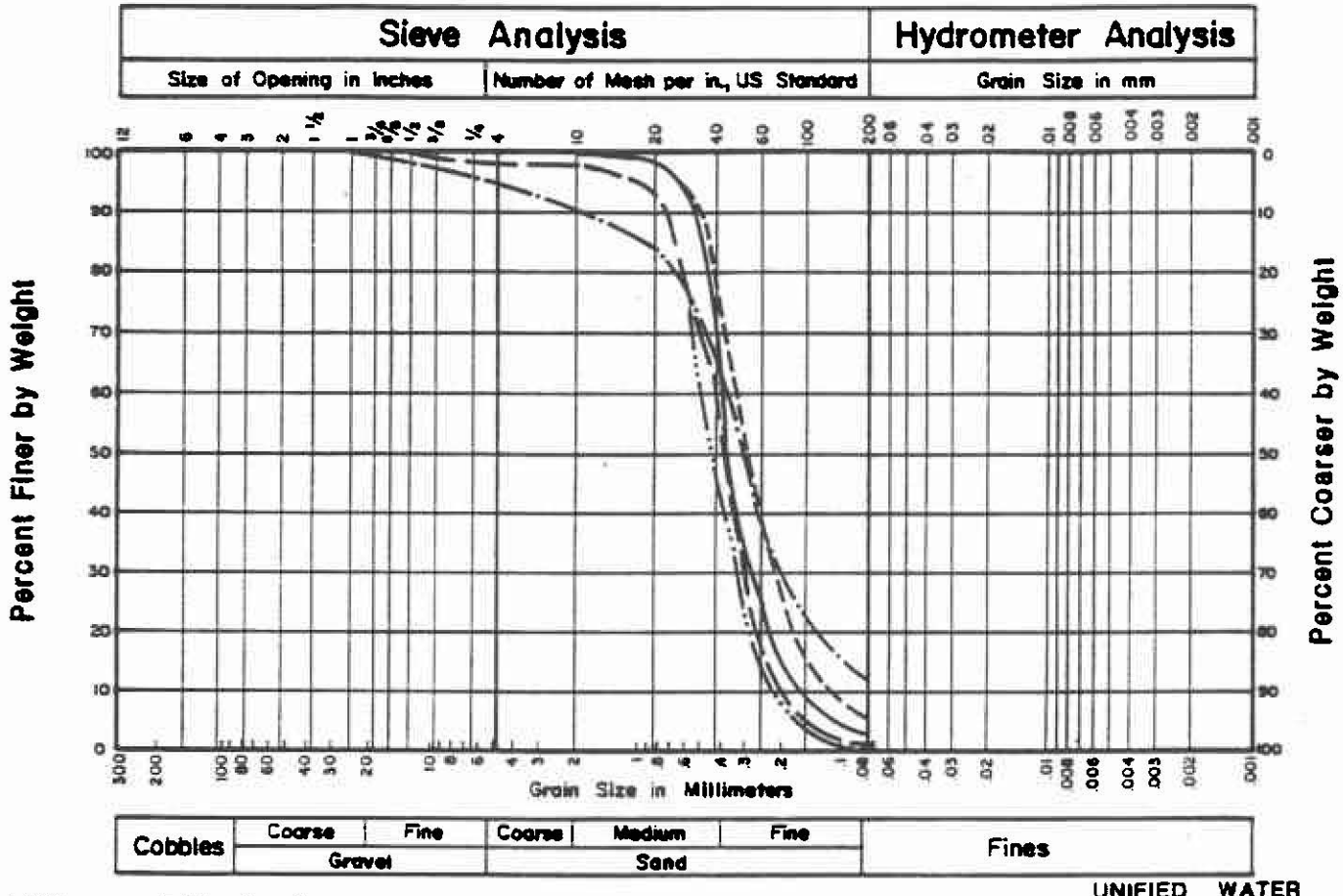


SYMBOL	BORING NUMBER	SAMPLE NUMBER	DEPTH IN FEET	WATER CONTENT IN PERCENT NAT.	L.L.	P.L.	P.I.	CLASSIFICATION	USC
●	B-2	S-3	10.0-11.5	76	74	35	39	Silty CLAY	CH
▲	B-4	S-3	10.0-11.5	75	68	34	34	Clayey SILT	MH
▼	B-9	S-4	15.0-16.5	42	33	22	11	Silty CLAY	CL
■	B-11	S-3	12.5-14.0	19	31	18	13	CLAY	CL
◆	B-11	S-4	22.5-24.0	30	32	23	9	Silty CLAY	CL

L.L. LIQUID LIMIT
P.L. PLASTIC LIMIT
P.I. PLASTICITY INDEX
USC UNIFIED SOIL CLASSIFICATION

J-2456 June 1989
HART-CROWSER & associates inc.
Figure B-2

Grain Size Classification



LINE SYMBOL	BORING NUMBER	SAMPLE NUMBER	DEPTH IN FEET	CLASSIFICATION	UNIFIED SOIL CLASS.	WATER CONTENT PERCENT
———	B-1/-1A	S-2A	12.5-14.0	Medium to fine SAND	SP	29
— —	B-4	S-2	7.5-9.0	Medium to fine SAND	SP	7
— — —	B-5	S-2	5.0-6.5	Slightly silty, medium to fine SAND	SP-SM	7
—·—	B-9	S-1	5.0-6.5	Slightly gravelly, silty, medium to fine SAND	SM	17
—··—	B-10	S-2	7.5-9.0	Medium to fine SAND	SP	28

HARTCROWSER

J-2456 6/89

Figure B-3

- [x] City box number CO-09-1990 Matlab
- [x] Title/cover page w/the following info:
  - [x] Company (author) name
  - [x] Report Date
  - [x] Project name
  - [x] Company's job number
  - [ ] City DCLU project number (7-digit number)
  - [ ] City Permit number (6-digit number)
  - [ ] Kroll map index number (3-digit number, w?/E,W,N,S)
  - [ ] Green label
  - [ ] Site address (may be on 1st or 2nd page of text)
- [x] Executive Summary and associated figures
- [x] Table of Contents
- [x] Project Location Plan/Map or Vicinity Map
- [x] Site Plan(s), Boring Location Plans, or Exploration Plans
- [ ] Survey
- [ ] Geologic Maps
- [ ] Cross Sections/Subsurface Profiles
- [ ] Fill or Peat Thickness Maps and Contour Maps
- [x] Boring Logs
- [ ] Geology Text (if no logs)
- [x] Soil Classification Key/Boring Log Key
- [ ] Probe Logs
- [ ] Test Pit Logs
- [ ] Monitoring Well Logs
- [ ] Cone Penetrometer Logs
- [ ] Shear Wave Velocity Measurements
- [ ] Groundwater Maps
- [ ] GW Elevation Tables/Data
- [ ] Soils Lab Testing (Geotechnical) Summary Tables
  - [x] Grain Size Analyses/Hydrometer Analyses
  - [ ] Atterberg Limits
  - [ ] Strength tests: Triaxial, Unconfined, Direct Shear
  - [ ] Organic Content
  - [ ] ^{14}C or Radiocarbon Testing
  - [x] Other Plasmary analy
- [x] Soil Chemical Analytical Testing Summary Tables
- [x] Water/Groundwater Chemical Analytical Summary Tables
- [ ] Comments

- [x] Date Copied 12/4/00 By Suzanne

2/9/99

HARTCROWSER

Earth and Environmental Technologies

Environmental Site Assessment and Geotechnical Engineering Report Diagonal Avenue South CSO Project Seattle, Washington

Prepared for
Kramer, Chin & Mayo, Inc.

February 28, 1990
J-2456

CONTENTS

	Page
INTRODUCTION	1
SUMMARY	2
GENERAL SITE DESCRIPTION	3
Soils	3
Groundwater	4
Site History	4
Potential Soil and Groundwater Contamination	5
SUBSURFACE CONDITIONS	6
Subbasin A	
East Marginal Way and South Idaho Street	8
Subbasin B	
Ohio Avenue South and South Alaska Street	9
Subbasin C	
Denver Avenue South and Connecting Lines	11
Subbasin D	
First Avenue South and South Andover Street	13
Subbasin G	
Airport Way South and South Edmunds Street	15
Subbasin H	
Tenth Avenue South Detention Facility	16
DESIGN AND CONSTRUCTION RECOMMENDATIONS	17
General Construction Considerations	17
Demolition	18
Contamination Potential	19
REMEDIATION/DISPOSAL OF CONTAMINATED SOIL	22
Pipe Design	24
Dewatering	25
Settlements Due to Dewatering	
Trench Side Slopes	33
Pipe Bedding and Backfill	36
Control Structure Foundations	40
Foundation Construction	41
Pavement Replacement	42
Vibration Limitation Along First Avenue	44
RECOMMENDATIONS FOR ADDITIONAL GEOTECHNICAL ENGINEERING SERVICES	44

Page

TABLES

1	Boring Locations by Subbasin	7
2	Dewatering Drawdown	31
3	Consolidation Settlement Due to Dewatering	32
4	Recommended Soil Parameters for Design of Temporary Shoring	36
5	Pavement Replacement	43

FIGURES

1	Vicinity Map Site and Exploration Plans
2	Subbasin A - East Marginal Way and South Idaho Street
3	Subbasin B - Ohio Avenue South and South Alaska Street
4	Subbasin C - Denver Avenue South and Connecting Lines
5	Subbasin D - First Avenue South and South Andover Street
6	Subbasin G - Airport Way South and South Edmunds Street, and Part of Subbasin H - Tenth Avenue South Detention Facility
7 through 12	Pipe Load Curves - Subbasins A through H

APPENDIX A A-1
FIELD EXPLORATIONS

Explorations and Their Location A-1
The Use of Auger Borings A-2
Standard Penetration Test (SPT) Procedures A-2
Monitoring Well Installation and Development A-3
Water Level Measurements A-3
Slug Test Analysis A-4

FIGURES

A-1	Key to Exploration Logs
A-2 through A-17	Boring Log B-1/B-1A through B-16

Page

APPENDIX B
LABORATORY TESTING PROGRAM B-1

Soil Classification B-1
Water Content Determinations B-1
Atterberg Limits (AL) B-1
Grain Size Analysis (GS) B-2
200-Wash B-2
Chemical Testing B-2
Data Quality Review B-3
Chemical Screening Analyses B-4
Soil Chemical Confirmation Analyses B-5
Water Chemical Analyses B-6

TABLES

B-1 Analytical Methods Used by ATI for Chemical Confirmation Analyses of Soil and Water
B-2 Screening Data for Diagonal/CSO Soil Samples
B-3 Chemical Results for Diagonal/CSO Soil Samples - Analytical Technologies, Inc.
B-4 Chemical Results for Diagonal/CSO Water Samples - Analytical Technologies, Inc.

FIGURES

B-1 Unified Soil Classification (USC) System
B-2 Plasticity Chart
B-3 Grain Size Classification

APPENDIX C
SITE BACKGROUND REVIEW C-1

Sources Consulted C-1

TABLES

C-1 Subbasin A - Locations Where Reported Site Use Could Have Resulted in Potential Contamination
C-2 Subbasin B - Locations Where Reported Site Use Could Have Resulted in Potential Contamination
C-3 Subbasin C - Locations Where Reported Site Use Could Have Resulted in Potential Contamination

Page

C-4 Subbasin D - Locations Where Reported Site Use Could Have Resulted in Potential Contamination
C-5 Subbasin G - Locations Where Reported Site Use Could Have Resulted in Potential Contamination

APPENDIX D
ENVIRONMENTAL HEALTH AND SAFETY

Health and Safety Plan Model Specification D-1
Combustible Ventilation D-3
Construction Requirements D-3
Hazardous or Suspect Materials D-4
Construction Requirements D-4

CONTINGENCY REPSONSE PLAN D-6

COUNTY LANDFILL DISPOSAL OF PETROLEUM CONTAMINATED SOIL D-7

DISPOSAL OF DESIGNATED HAZARDOUS WASTE CONTAMINATED SOIL D-8

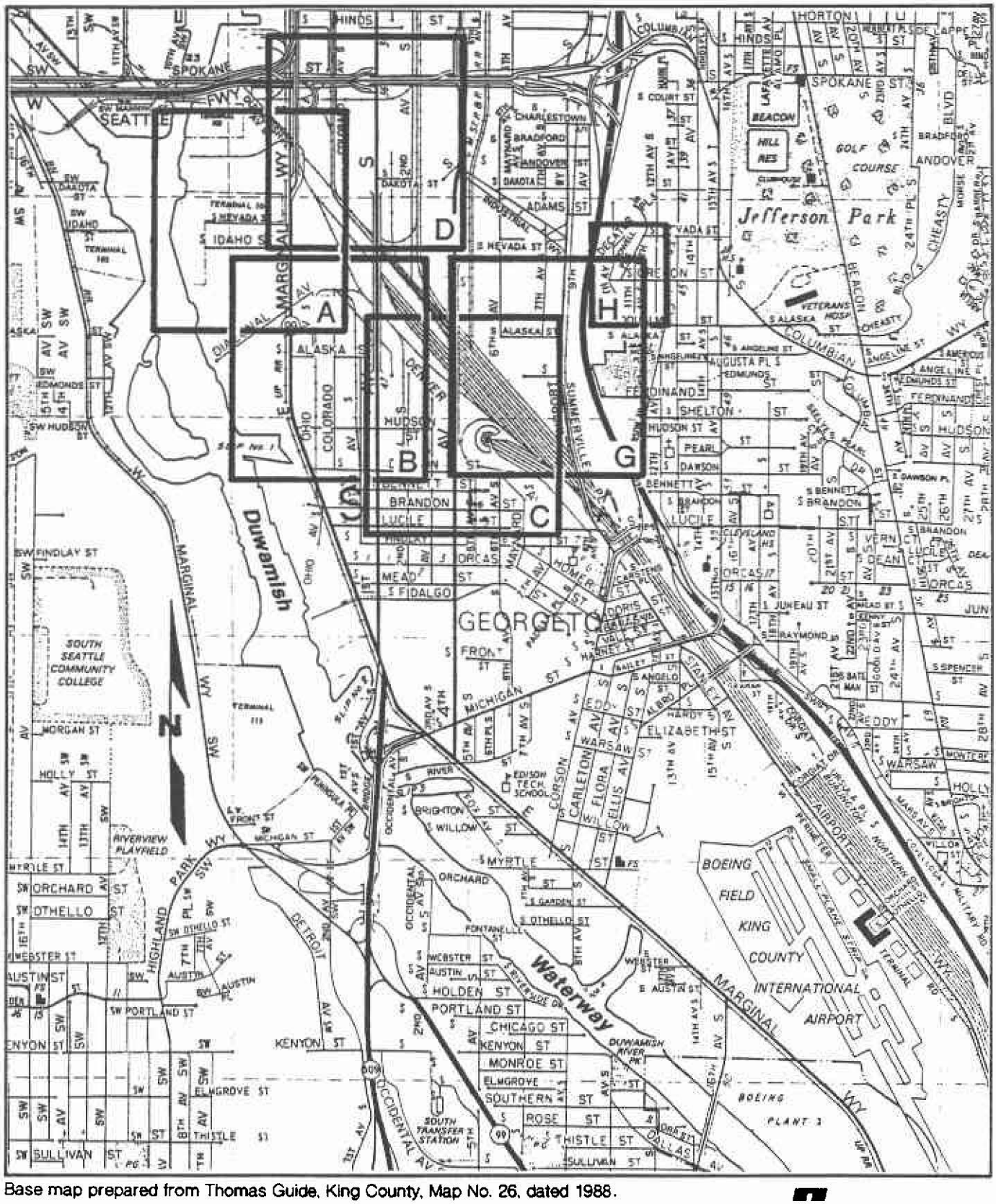
TABLE

D-1 Common Sense Criteria for Identification of Suspect Soil or Groundwater Contamination D-6

Form 2

APPENDIX E
POST-REPORT CORRESPONDENCE

Vicinity Map



Base map prepared from Thomas Guide, King County, Map No. 26, dated 1988.

B Subbasin Location and Designation

0 2000 4000

Scale in Feet

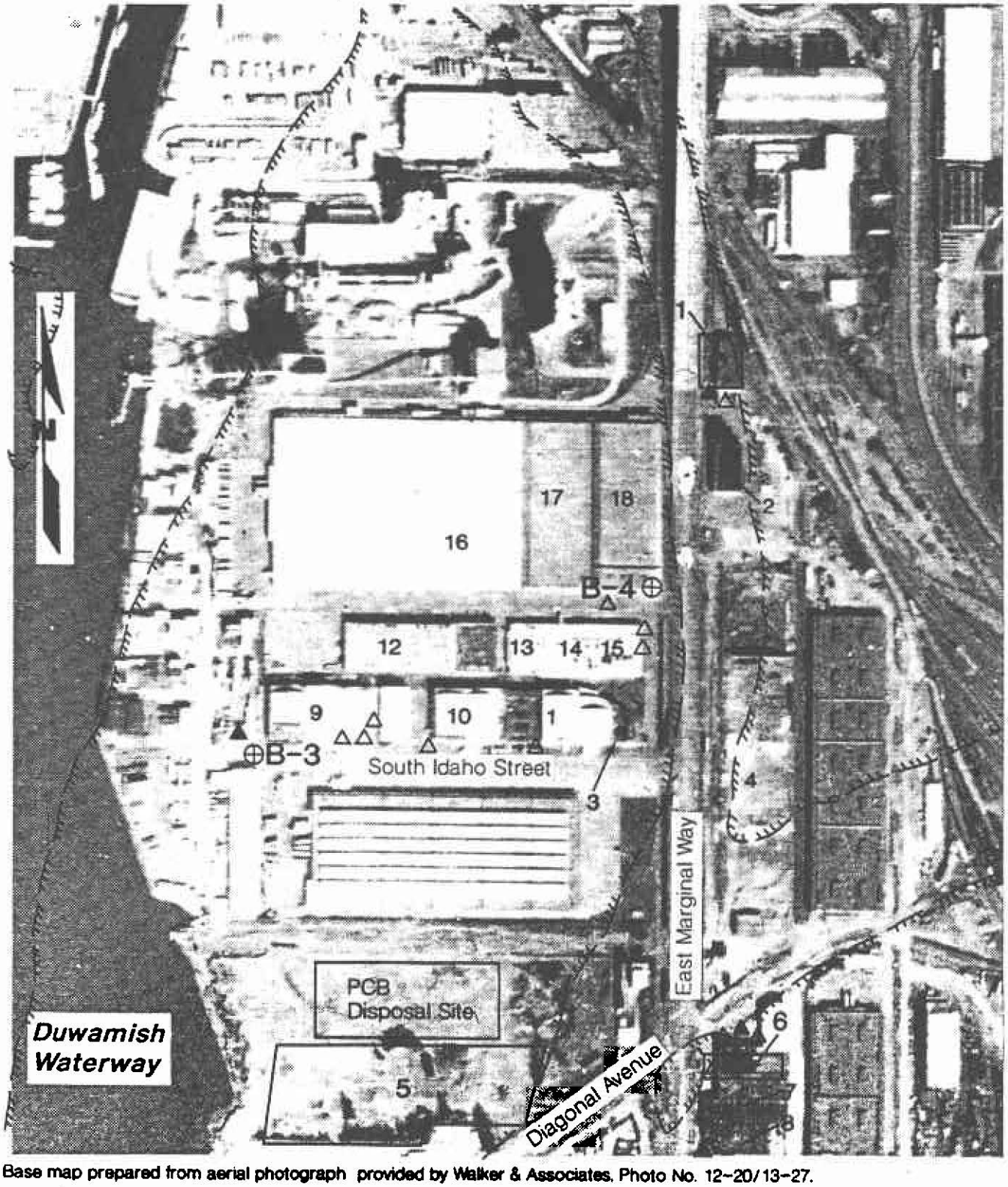
HARTCROWSER

J-2456 6/89

Figure 1

Site and Exploration Plan

Subbasin A –East Marginal Way and South Idaho Street



Base map prepared from aerial photograph provided by Walker & Associates. Photo No. 12-20/13-27.

Former Duwamish River Channel

⊕ B-3 Boring Location and Number

0 400 800

Scale in Feet

△ Existing Underground Storage Tank

▲ Historical Underground Storage Tank

12 Facility Identification Number

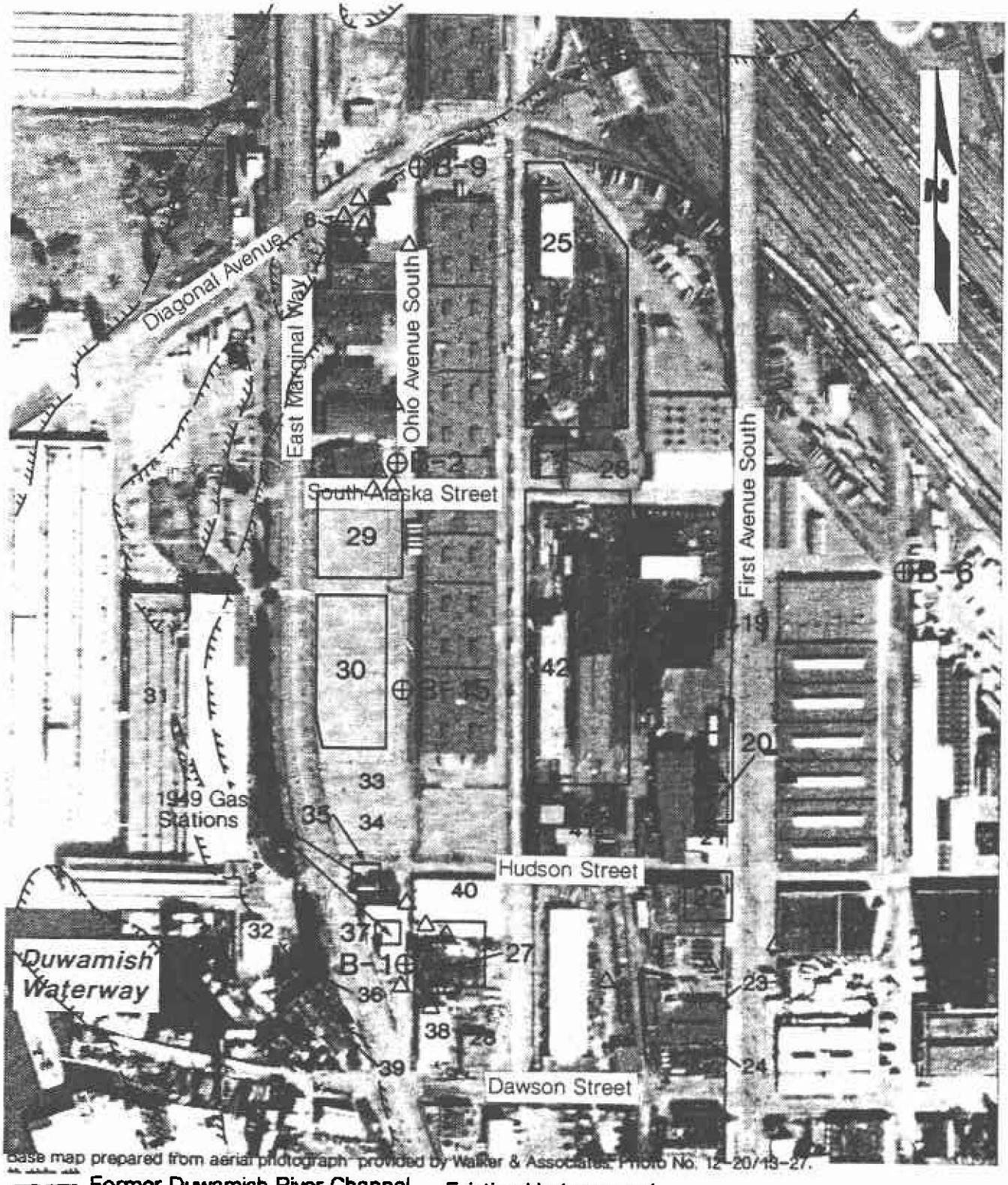
HARTCROWSER

J-2456 6/89

Figure 2

Site and Exploration Plan

Subbasin B –Ohio Avenue South and South Alaska Street



Base map prepared from aerial photograph provided by Walker & Associates, Photo No. 12-20/13-27.

Former Duwamish River Channel

⊕B-9 Boring Location and Number

0 400 800

Scale in Feet

△ Existing Underground Storage Tank

▲ Historical Underground Storage Tank

5 Facility Identification Number

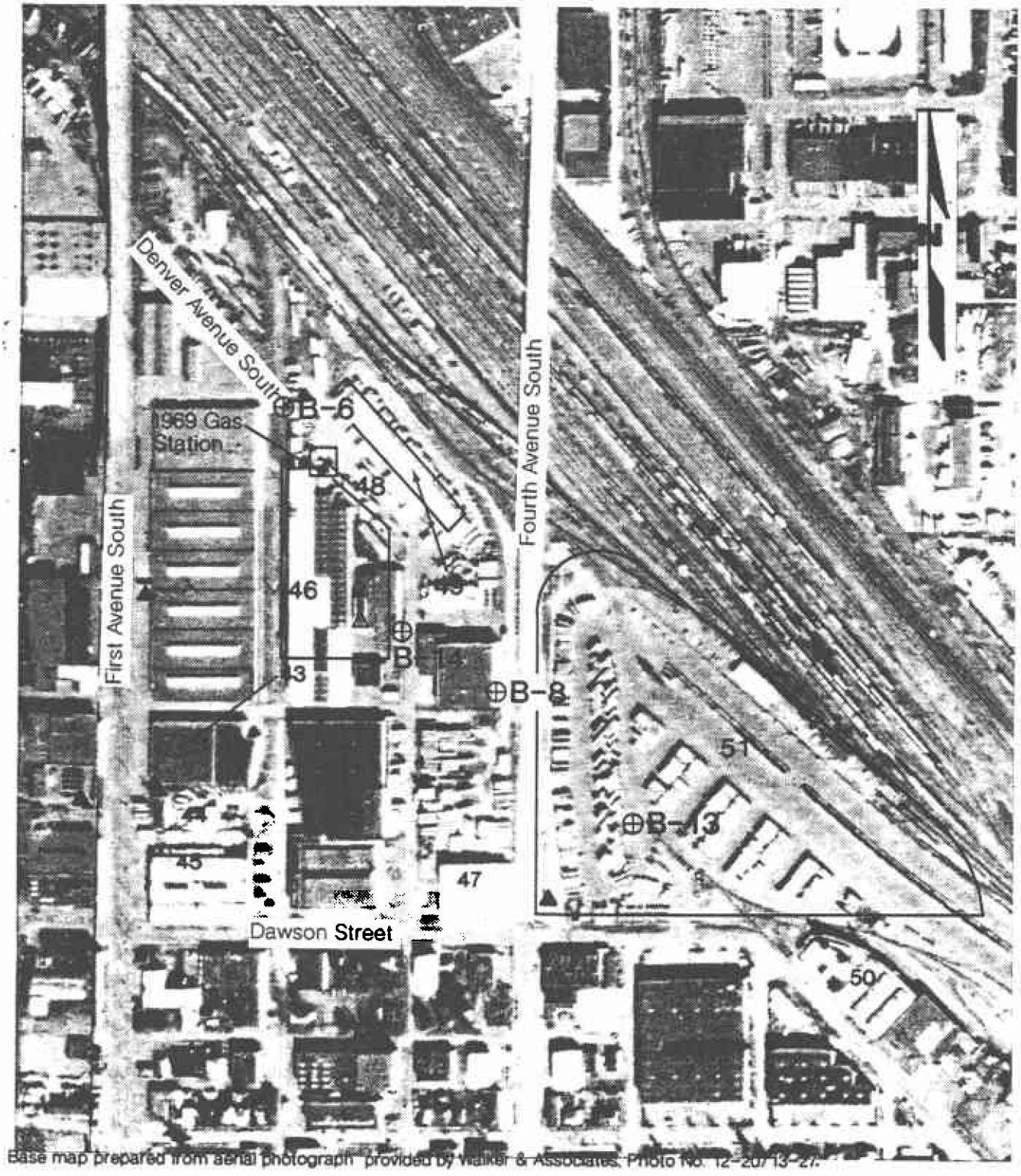
HARTCROWSER

J-2456 6/89

Figure 3

Site and Exploration Plan

Subbasin C–Denver Avenue South and Connecting Lines



Base map prepared from aerial photograph provided by Walker & Associates. Photo No. 12-20/13-27.

⊕B-6 Boring Location and Number

0 400 800

Scale in Feet

△ Existing Underground Storage Tank

▲ Historical Underground Storage Tank

50 Facility Identification Number

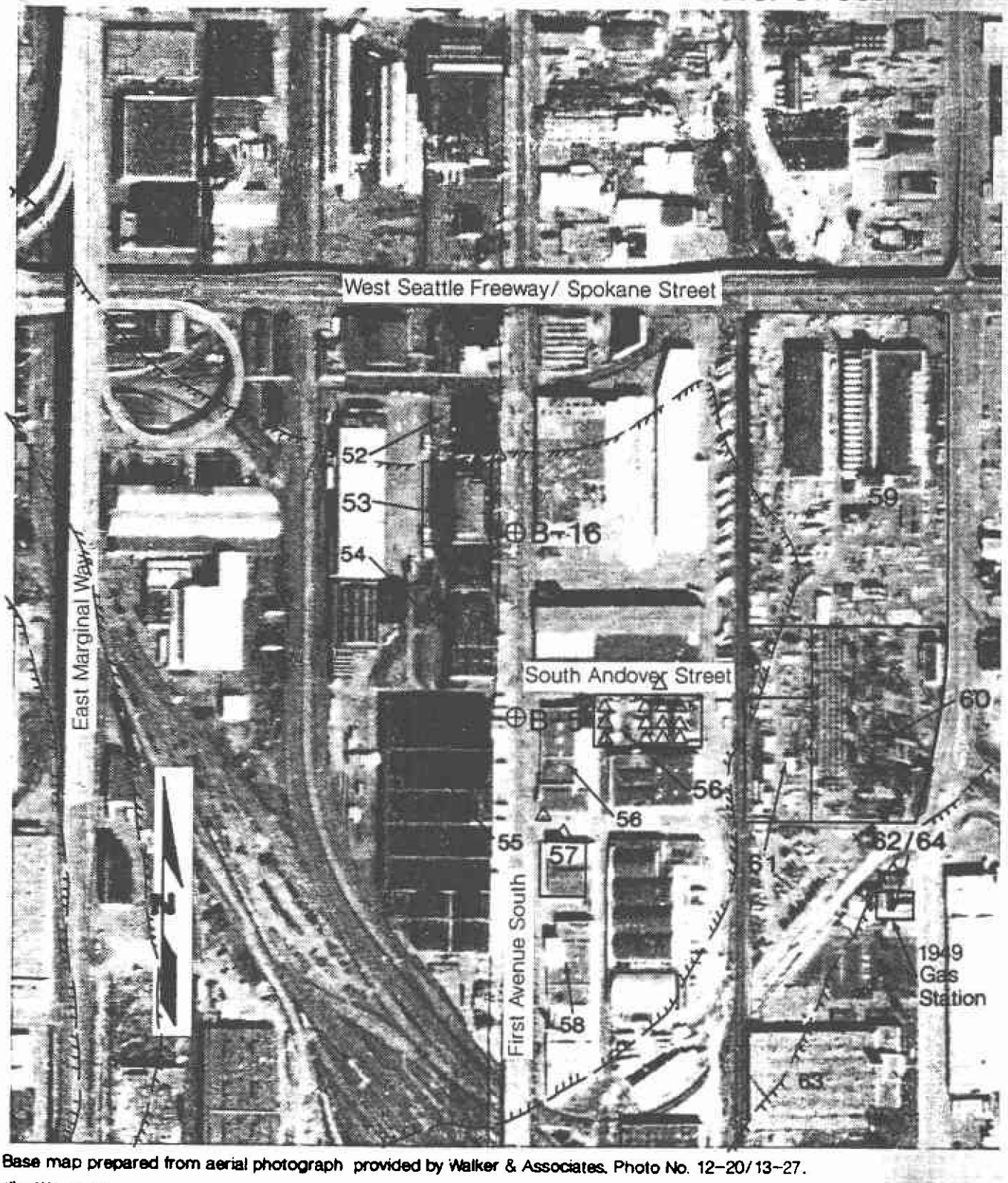
HARTCROWSER

J-2456 6/89

Figure 4

Site and Exploration Plan

Subbasin D–First Avenue South and South Andover Street



Base map prepared from aerial photograph provided by Walker & Associates. Photo No. 12-20/13-27.

Former Duwamish River Channel

⊕B-5 Boring Location and Number

0 400 800

Scale in Feet

△ Existing Underground Storage Tank

▲ Historical Underground Storage Tank

58 Facility Identification Number

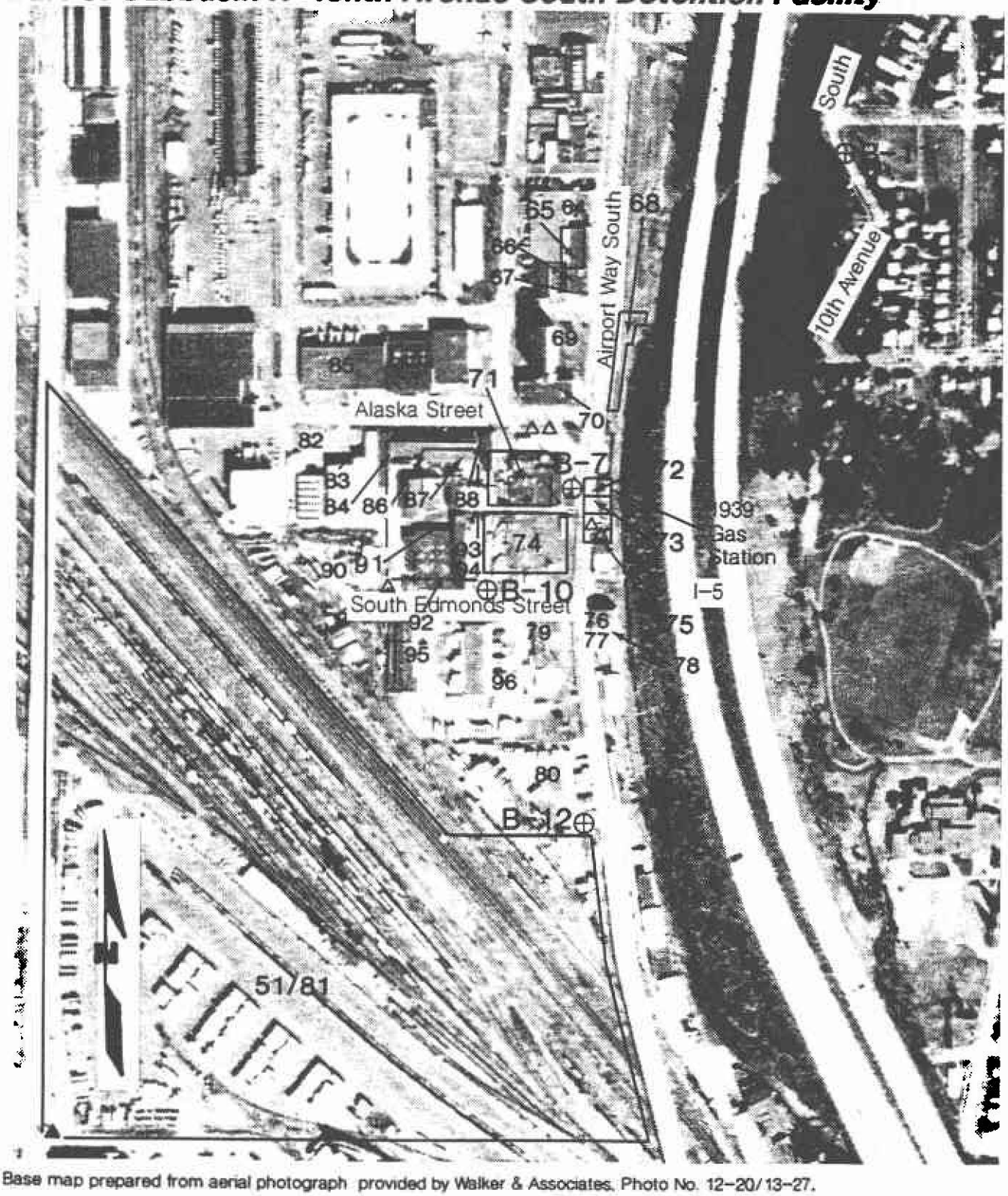
HARTCROWSER

J-2456 6/89

Figure 5

Site and Exploration Plan

Subbasin G – Airport Way South and South Edmonds Street and Part of Subbasin H – Tenth Avenue South Detention Facility



Base map prepared from aerial photograph provided by Walker & Associates, Photo No. 12-20/13-27.

⊕B-7 Boring Location and Number

0 400 800

Scale in Feet

△ Existing Underground Storage Tank

▲ Historical Underground Storage Tank

80 Facility Identification Number

HARTCROWSER

J-2456 6/89

Figure 6

Key to Exploration Logs

Sample Descriptions

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

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

Density/Consistency

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

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

Moisture

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

Minor Constituents

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

Legends

Sampling

BORING SAMPLES

- ☒ Split Spoon
- ⧅ Shelby Tube
- ▥ Cuttings
- ◫ Core Run
- * No Sample Recovery
- P Tube Pushed, Not Driven

TEST PIT SAMPLES

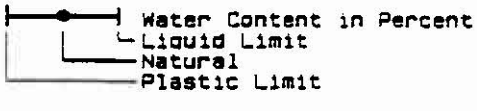
- ☒ Grab (Jar)
- ⧄ Bag
- ⧅ Shelby Tube

Ground Water Observations

- Surface Seal
- Ground Water Level on Date (ATD) At Time of Drilling
- Observation Well Tip or Slotted Section
- Ground Water Seepage (Test Pits)

Test Symbols

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



HARTCROWSER

J-2456 6/89

Figure A-1

Boring Log B-1/B-1A

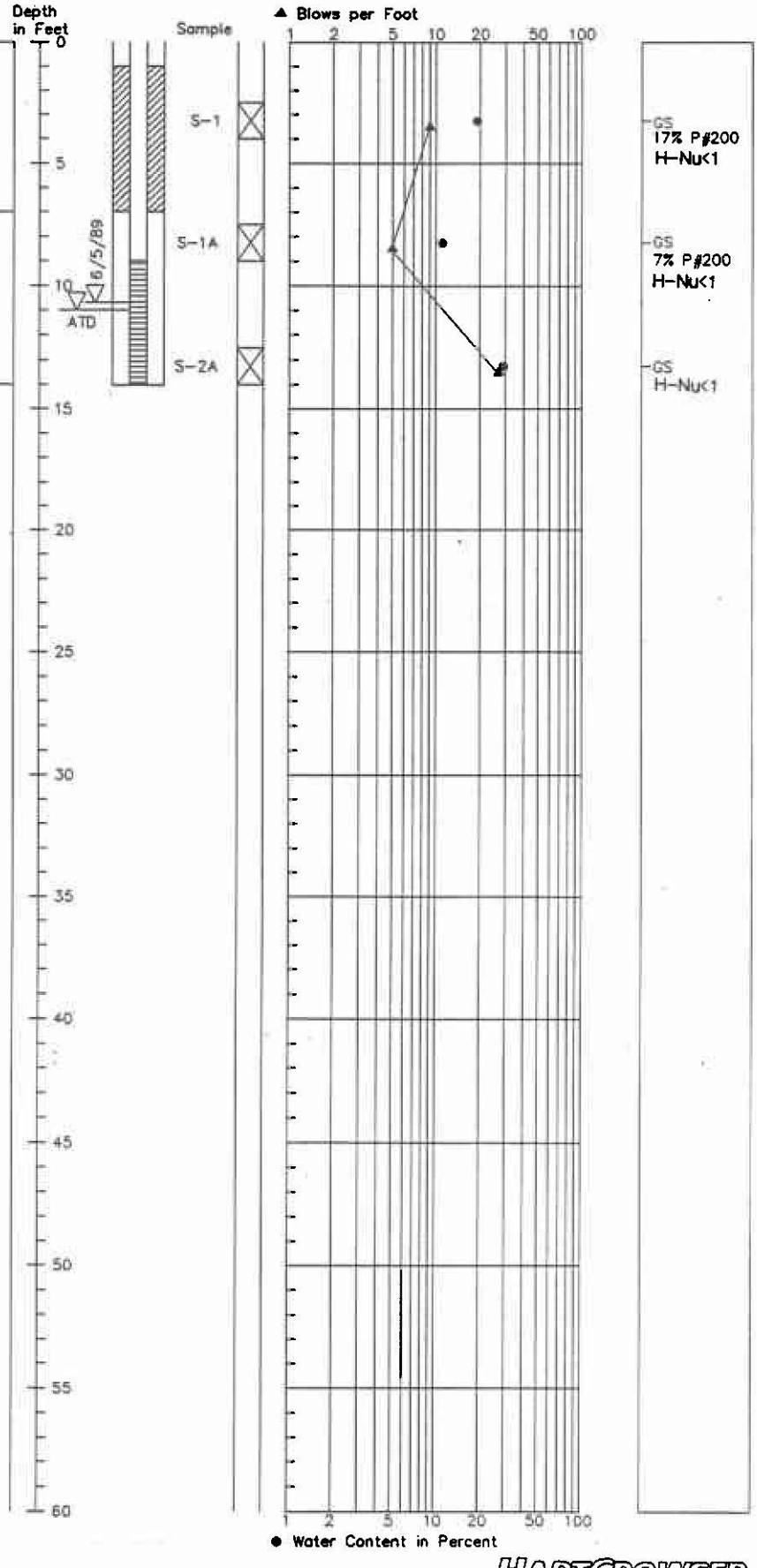
Soil Descriptions

Ground Surface Elevation in Feet 8.2

3 inches ASPHALT over medium to dense, damp, black, very silty SAND and sandy SILT with debris. (FILL)

Loose to medium dense, damp to wet, black, clean to slightly silty, fine to medium SAND.

Bottom of Boring at 14.0 Feet.
Completed 5/15/89.
Note: Boring B-1 abandoned due to debris between approx. 5-1/2 to 8 feet in depth. Boring B-1A redrilled 2 feet to north.



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

HARTCROWSER

J-2456 5/89

Figure A-2 1/1

Boring Log B-2

Soil Descriptions

Ground Surface Elevation in Feet 6.6

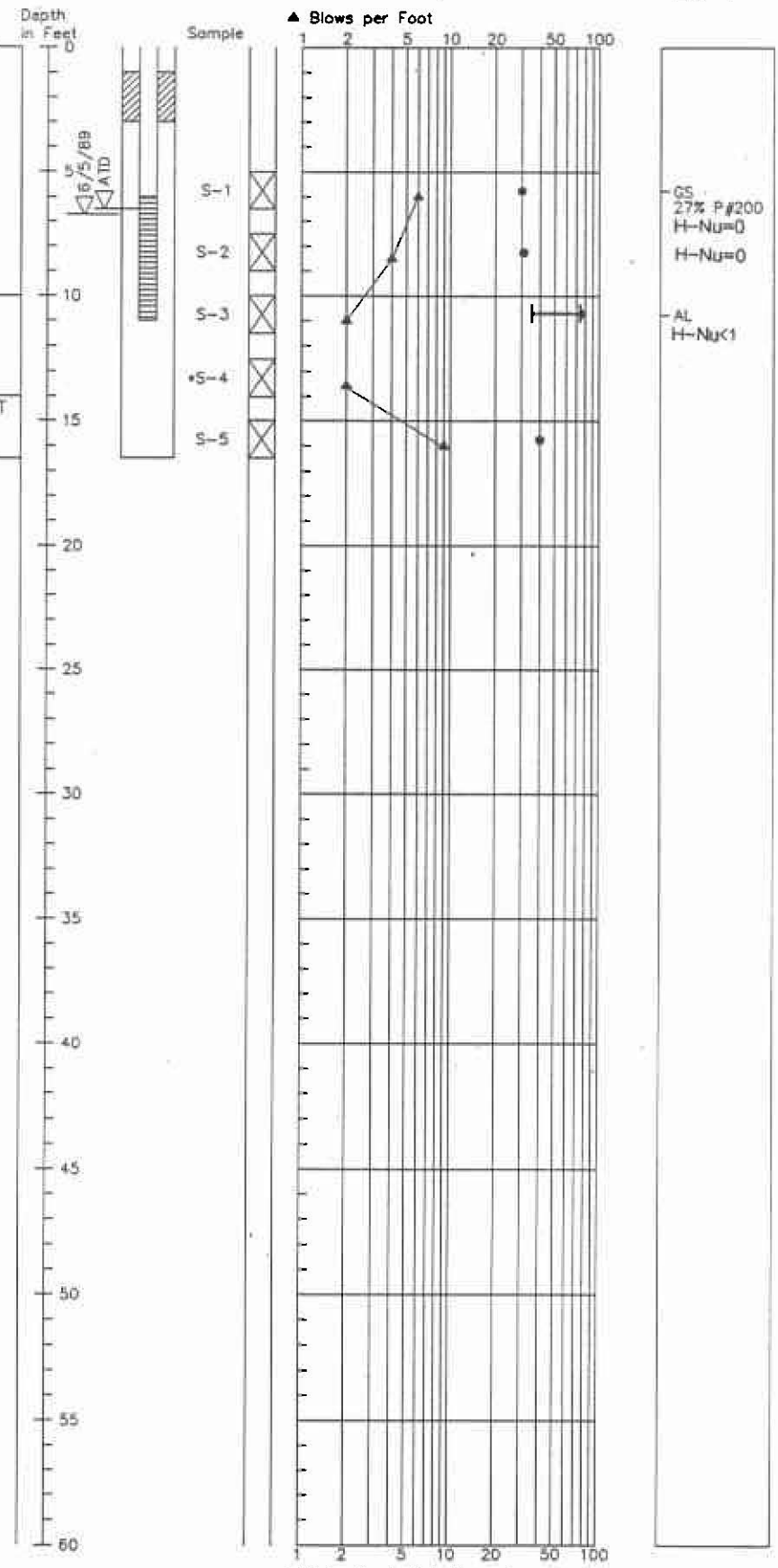
4 inches ASPHALT over loose to very loose, moist to wet, brown, silty SAND. (Possible FILL)

1 foot of heave.

Very soft, wet, brownish gray, silty CLAY.

Medium stiff, wet, dark gray, fine sandy SILT and silty, fine SAND.

Bottom of Boring at 16.5 Feet.
Completed 5/15/89.



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

HARTCROWSER

J-2456 5/89

Figure A-3 1/1

Boring Log B-3

Soil Descriptions

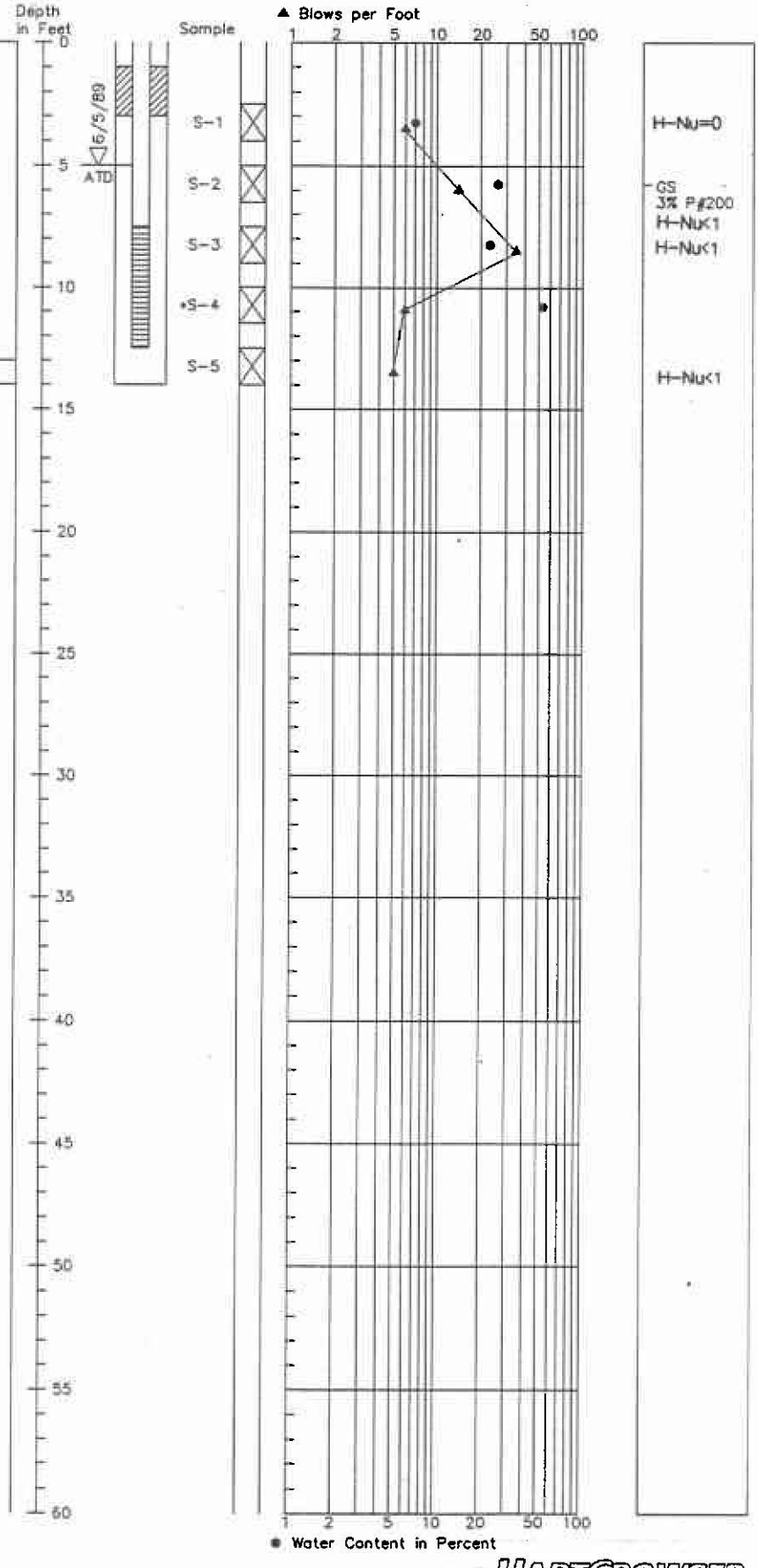
Ground Surface Elevation in Feet 6.1

3 inches ASPHALT over loose to dense, dry to wet, brown SAND.

Becomes silty.

Medium stiff, wet, gray, SILT with abundant organics and sand interbeds.

Bottom of Boring at 14 Feet.
Completed 5/15/89.



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

HARTCROWSER

J-2456 5/89

Figure A-4 1/1

Boring Log B-4

Soil Descriptions

Ground Surface Elevation in Feet 7.1

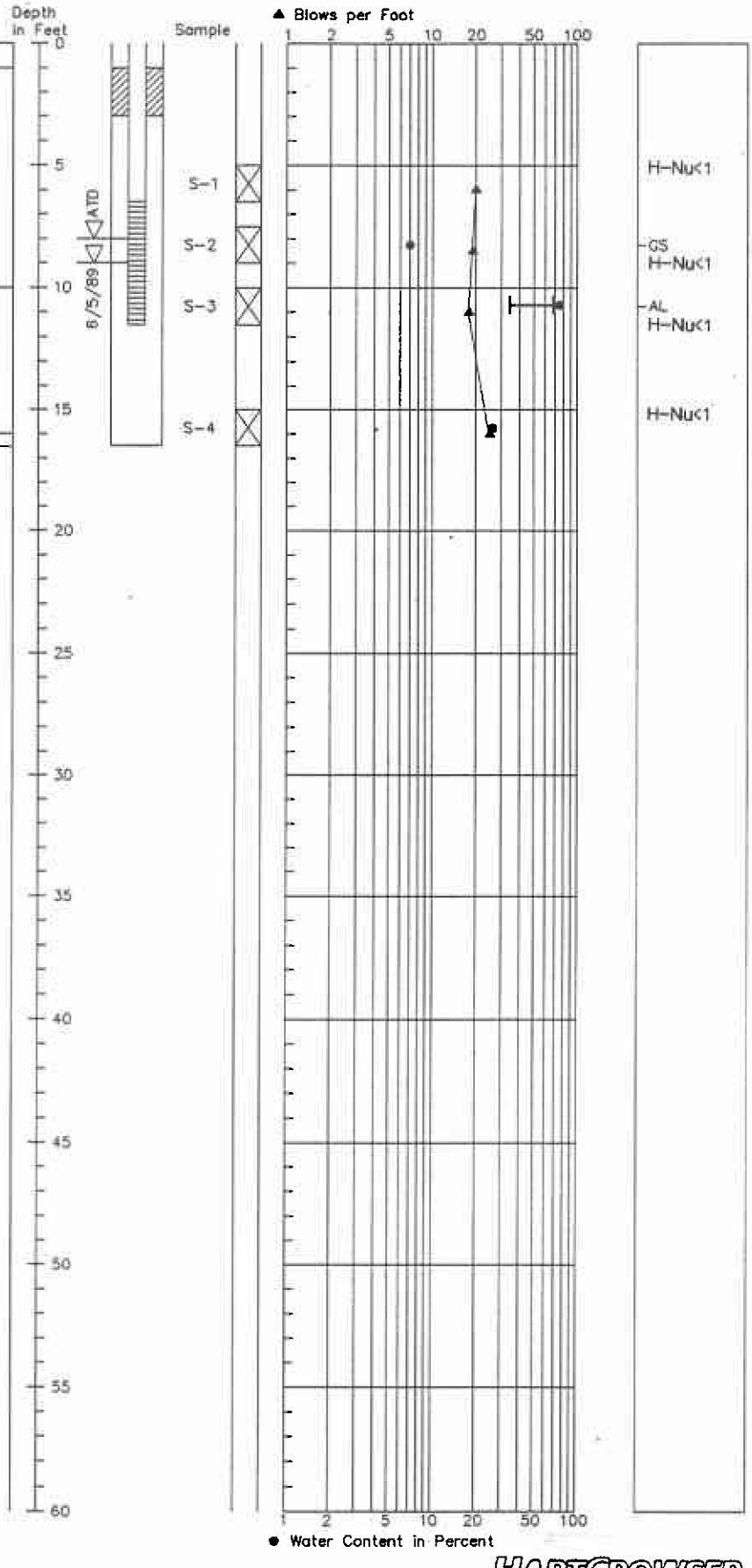
Dry, dark brown, very gravelly SAND.

Medium dense, moist to wet, brown SAND.

Very stiff to stiff, wet, brown SILT with abundant organic and wood fragments. (PEAT)

Medium dense, wet, dark gray, fine SAND.

Bottom of Boring at 16.5 Feet.
Completed 5/15/89.



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

HARTCROWSER

J-2456 5/89

Figure A-5 1/1

Boring Log B-5

Soil Descriptions

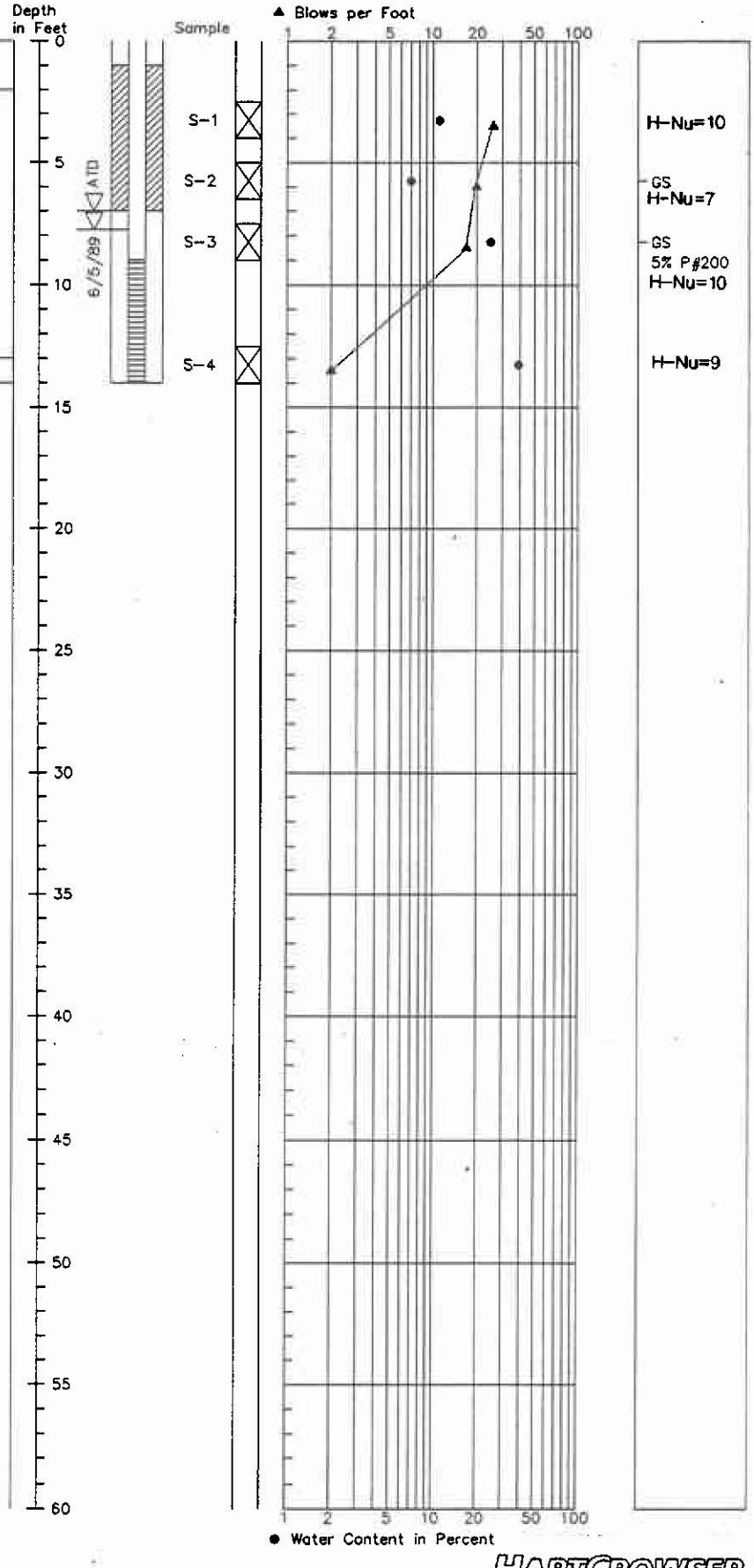
Ground Surface Elevation in Feet 9.5

Concrete with railroad ties.

Loose to medium dense, damp to moist, slightly silty SAND with debris (FILL).

Very soft, slightly sandy SILT with wood fragments and other debris (FILL).

Bottom of Boring at 14 Feet.
Completed 5/16/89.



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

HARTCROWSER

J-2456 5/89

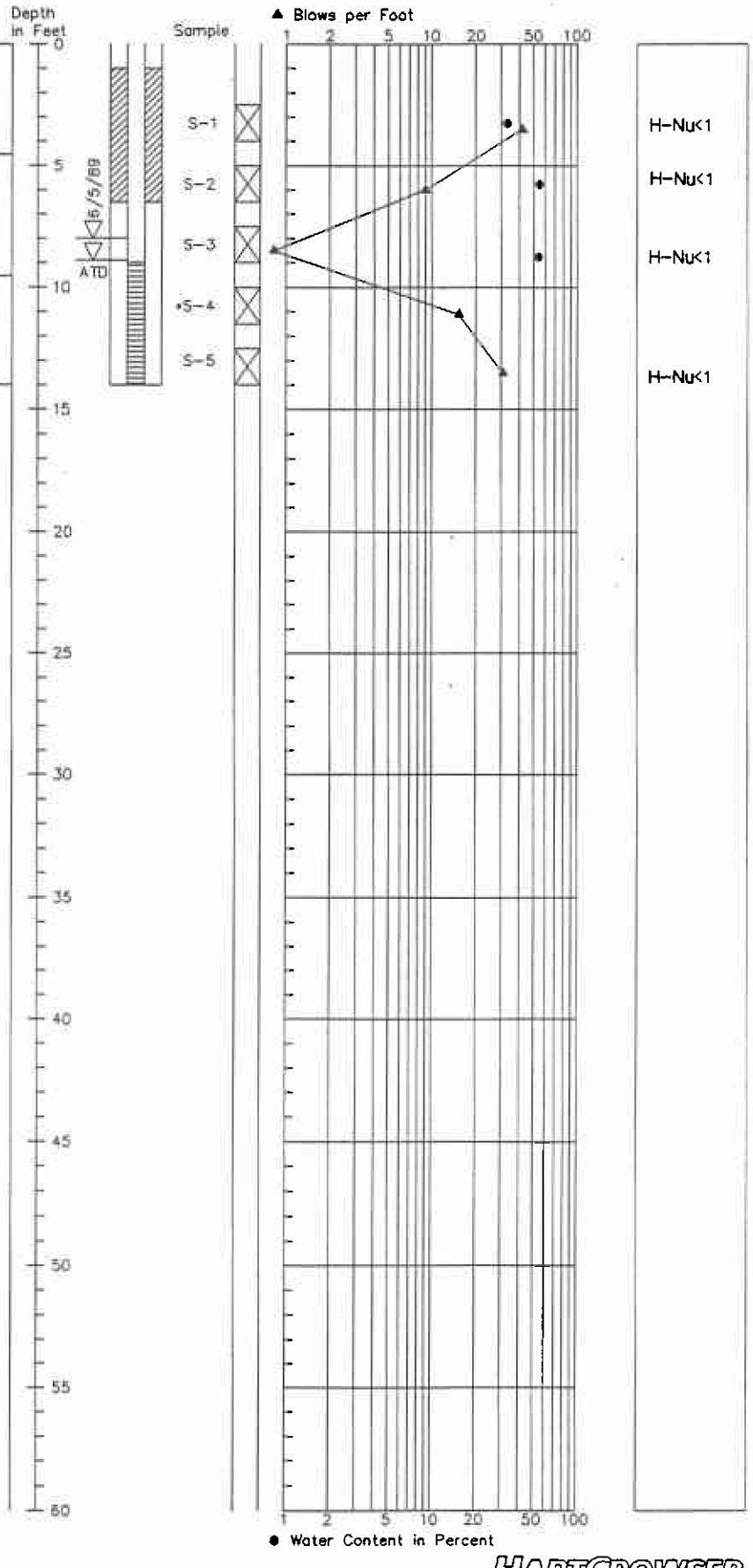
Figure A-6 1/1

Boring Log B-6

Soil Descriptions

Ground Surface Elevation in Feet 7.7

Soil Descriptions
Hard, damp, black SILT and silty, fine SAND and wood fragments (FILL).
Stiff to very soft, damp, black SILT with SAND interbeds.
Medium dense to dense, wet, black, silty to slightly silty SAND.
Bottom of Boring at 14.0 Feet. Completed 5/15/89.



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

HARTCROWSER

J-2456 5/89

Figure A-7 1/1

Boring Log B-7

Soil Descriptions

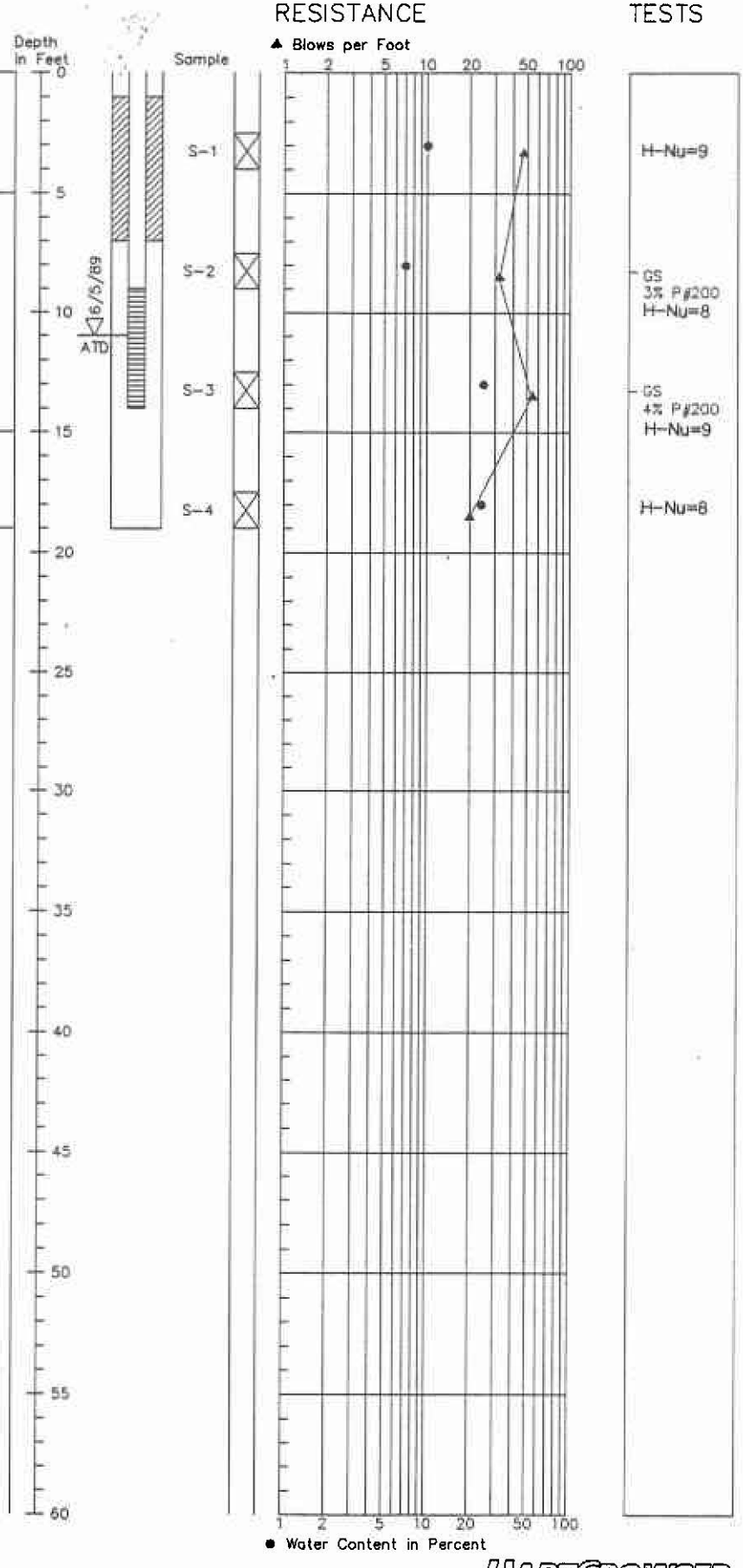
Ground Surface Elevation in Feet 12.9

Dense, brown, moist, silty, gravelly SAND (FILL).

Dense to very dense, damp to wet, black, clean SAND.

Medium dense, wet, gray, very silty SAND with shell fragments.

Bottom of Boring at 19 Feet. Completed 5/16/89.



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

HARTCROWSER

J-2456 5/89

Figure A-8 1/1

Boring Log B-8

Soil Descriptions

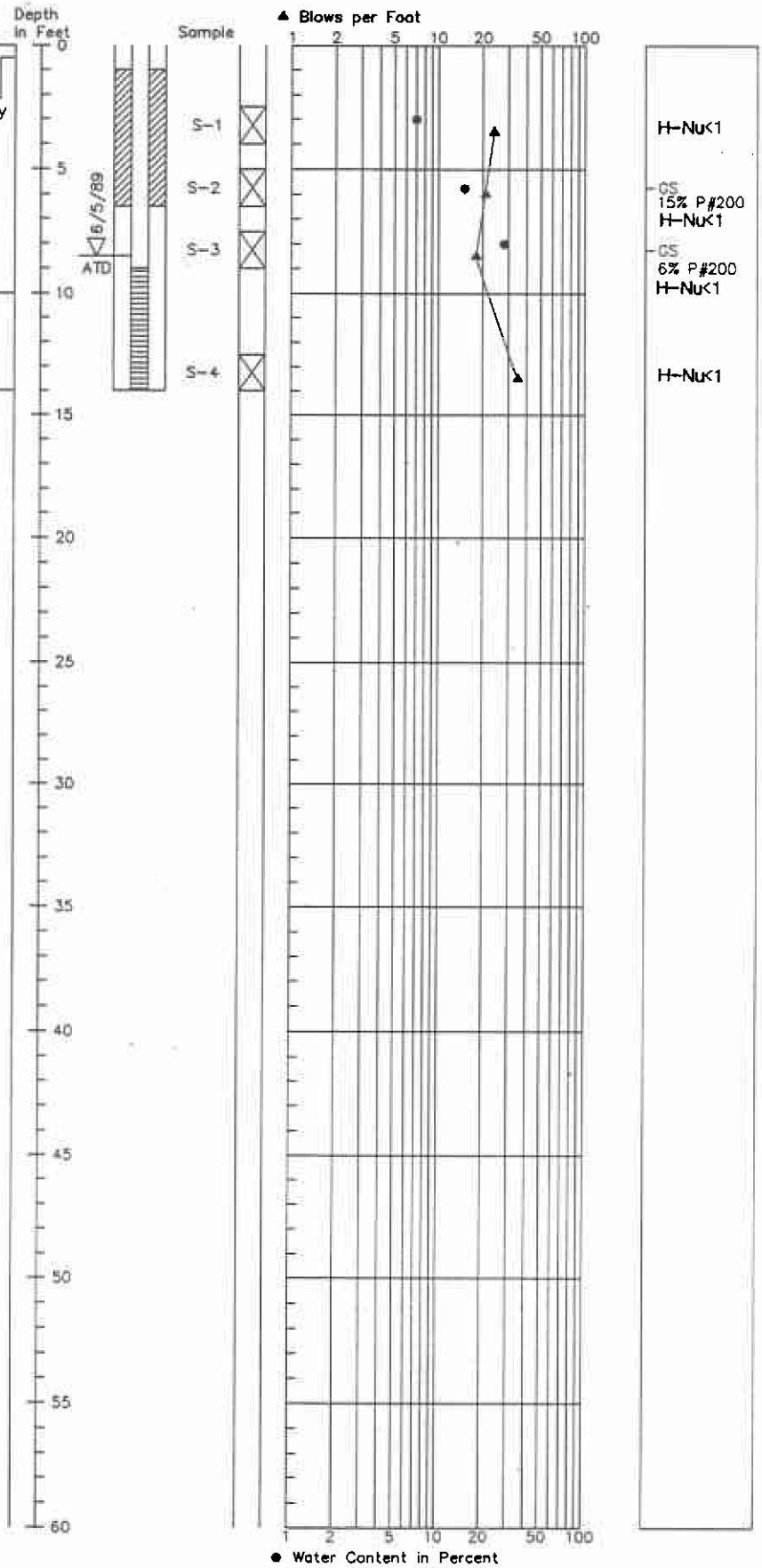
Ground Surface Elevation in Feet 9.2

2 inches of ASPHALT over 4 inches of slightly silty, gravelly SAND.

Medium dense, damp to moist, black, slightly silty to silty SAND.

Dense, wet, black, SAND.

Bottom of Boring at 14 Feet.
Completed 5/15/89.



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

HARTCROWSER

J-2456 5/89

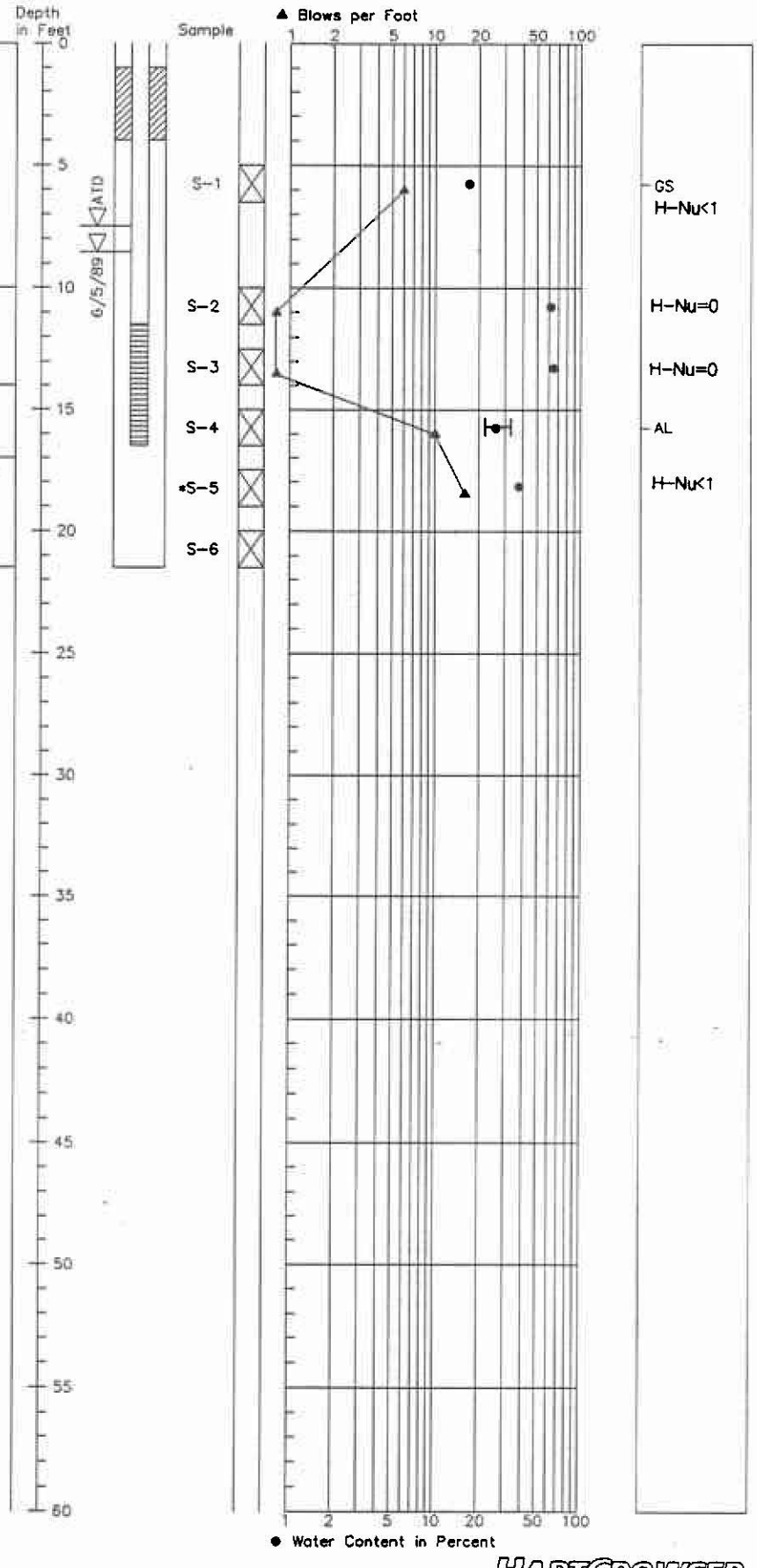
Figure A-9 1/1

Boring Log B-9

Soil Descriptions

Ground Surface Elevation in Feet 6.2

Soil Descriptions
Loose, moist to wet, brown, slightly gravelly, silty SAND with debris (FILL).
Very soft, wet, light to dark gray CLAY with sand interbeds.
Stiff, wet, black, slightly sandy CLAY.
Medium dense to loose, wet, dark gray, silty SAND.
Bottom of Boring at 21.5 Feet. Completed 5/15/89.



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

HARTCROWSER

J-2456 5/89

Figure A-10 1/1

Boring Log B-10

Soil Descriptions

Ground Surface Elevation in Feet 6.6

Medium dense, slightly silty, gravelly SAND.

Medium dense to dense, wet, black SAND.

Bottom of Boring at 16.5 Feet.
Completed 5/15/89.

Depth in Feet: 0, 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60

ATD

5/5/89

Sample: S-1, S-2, S-3, S-4

STANDARD PENETRATION RESISTANCE

▲ Blows per Foot

1 2 5 10 20 50 100

● Water Content in Percent

TESTS

S-1: GS, 4% P#200, H-Nu<1

S-2: GS, H-Nu<1

S-3: H-Nu<1

S-4: H-Nu<1

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

HARTCROWSER

J-2456 5/89

Figure A-11 1/1

Boring Log B-11

Soil Descriptions

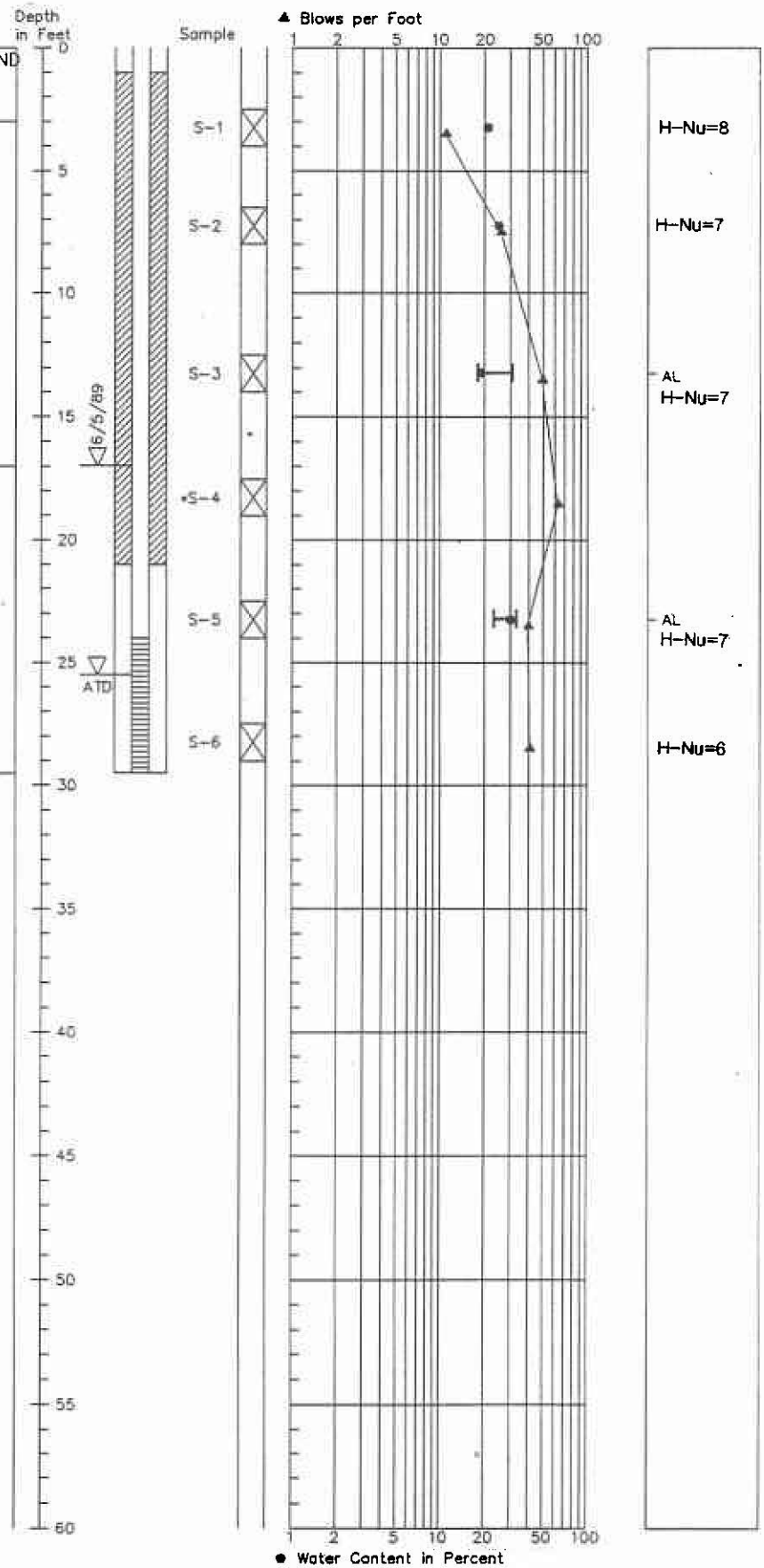
Ground Surface Elevation in Feet 166.8

Medium dense, damp to wet, brown silty SAND (FILL).

Very stiff to hard, wet, gray-brown slightly sandy CLAY with occasional gravel and cobbies.

Hard, damp to wet, gray and brown, silty CLAY.

Bottom of Boring at 29.5 Feet. Completed 5/16/89.



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

HARTCROWSER

J-2456 5/89

Figure A-12 1/1

Boring Log B-12

Soil Descriptions

Approx. Ground Surface Elevation in Feet 5.5

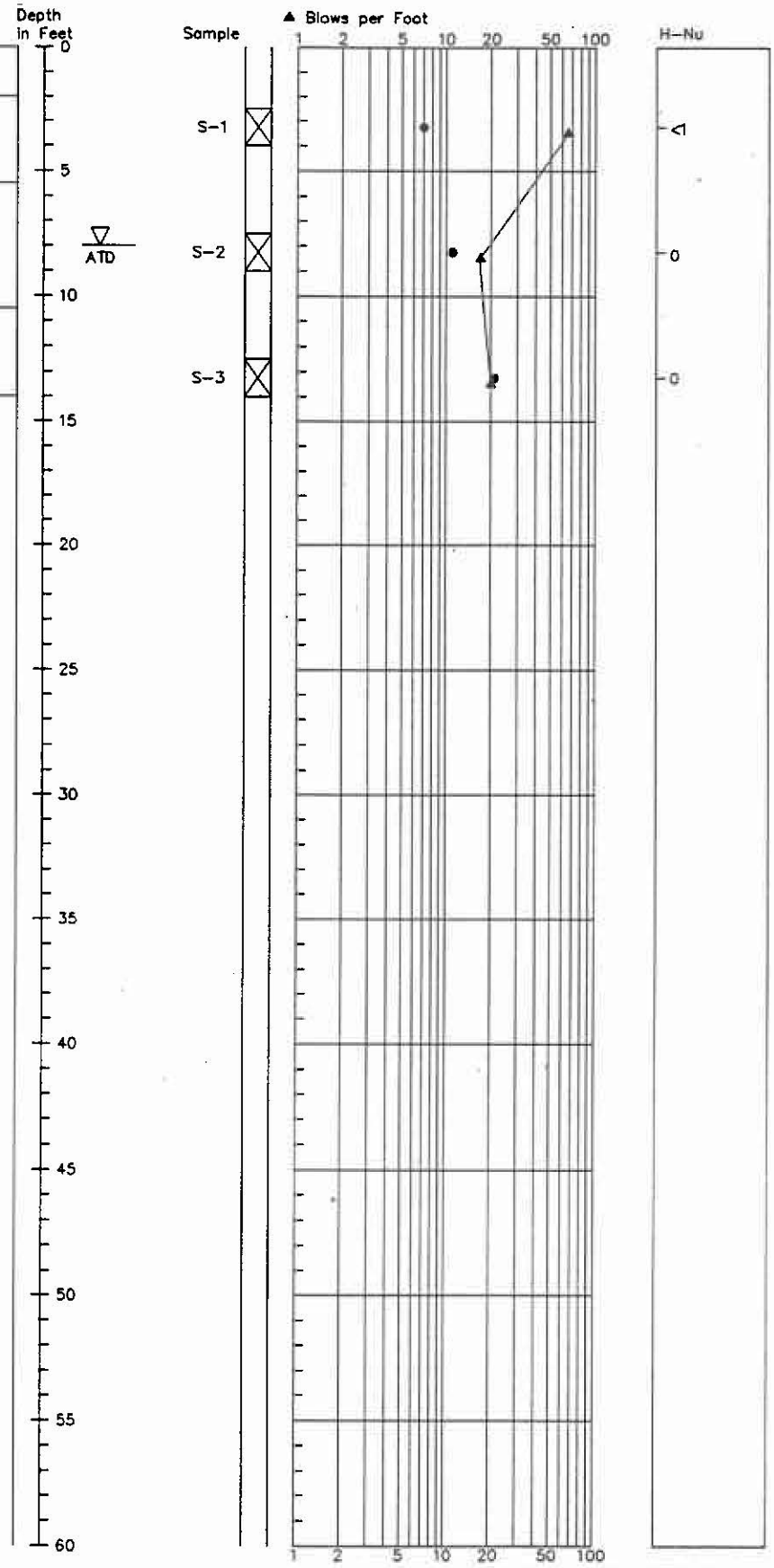
3 inches of ASPHALT over 13 inches of CONCRETE over very sandy GRAVEL. (FILL)

Intermittent layers of dense, damp, gray, slightly sandy SILT and very dense, damp, gray, very sandy GRAVEL. (FILL)

Medium dense, moist to wet, brownish gray, fine to medium SAND.

Grades to slightly silty, slightly gravelly, fine to medium SAND.

Bottom of Boring at 14.0 Feet.
Completed 8/2/89.



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

HARTCROWSER
J-2456 8/89
Figure A-13 1/1

Boring Log B-13

Soil Descriptions

Approx. Ground Surface Elevation in Feet 8.0

3 inches of ASPHALT over dark gray, gravelly SAND. (FILL)

Medium dense, damp, light brown, sandy SILT with abundant organics. (FILL)

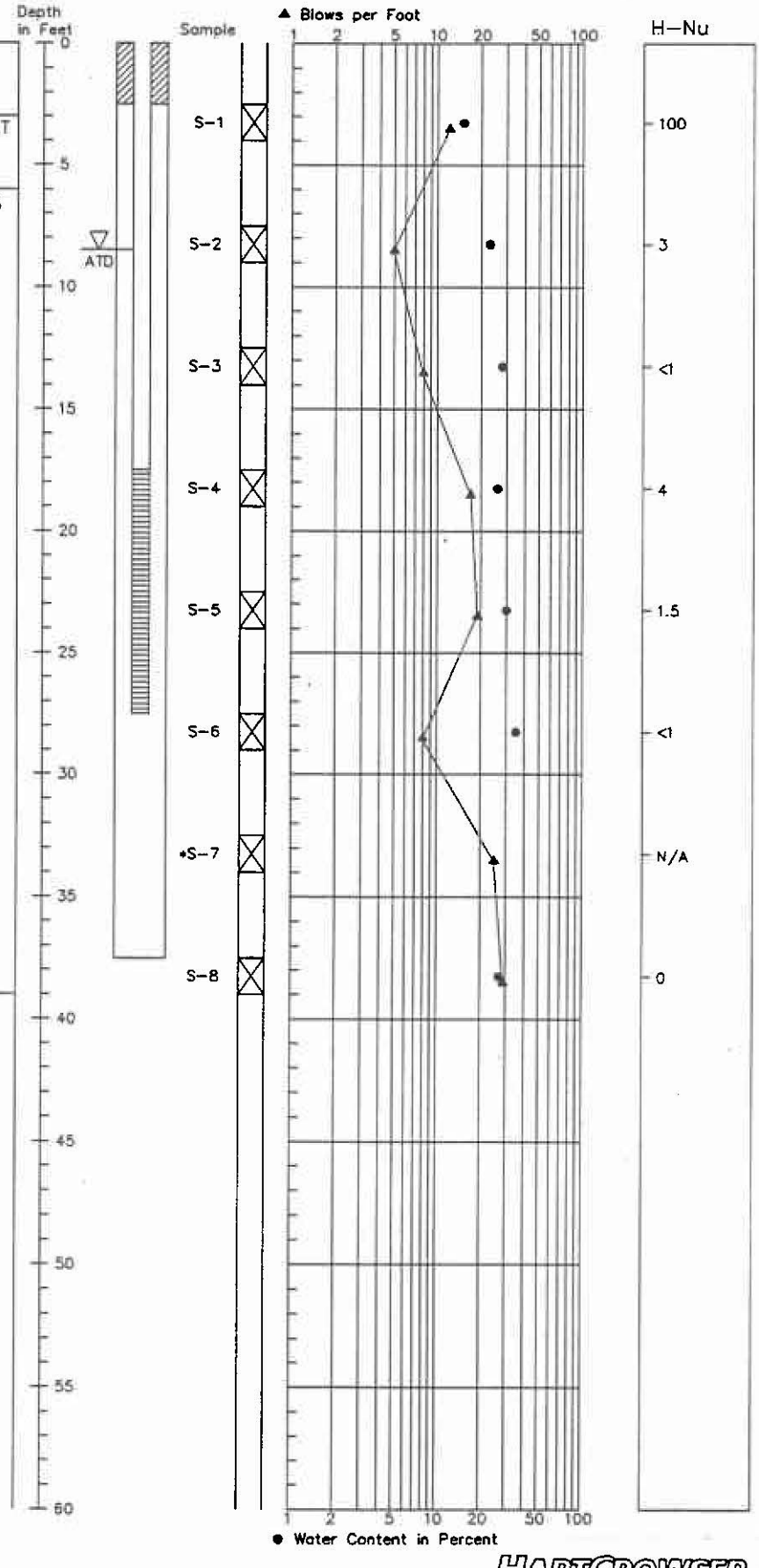
Loose to medium dense, damp to wet, gray, slightly silty to clean, fine to medium SAND.

< 1-foot of heave.

1.5 feet of heave.

Interbeds of dark gray, sandy SILT.

Bottom of Boring at 39.0 Feet.
Completed 8/1/89.



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

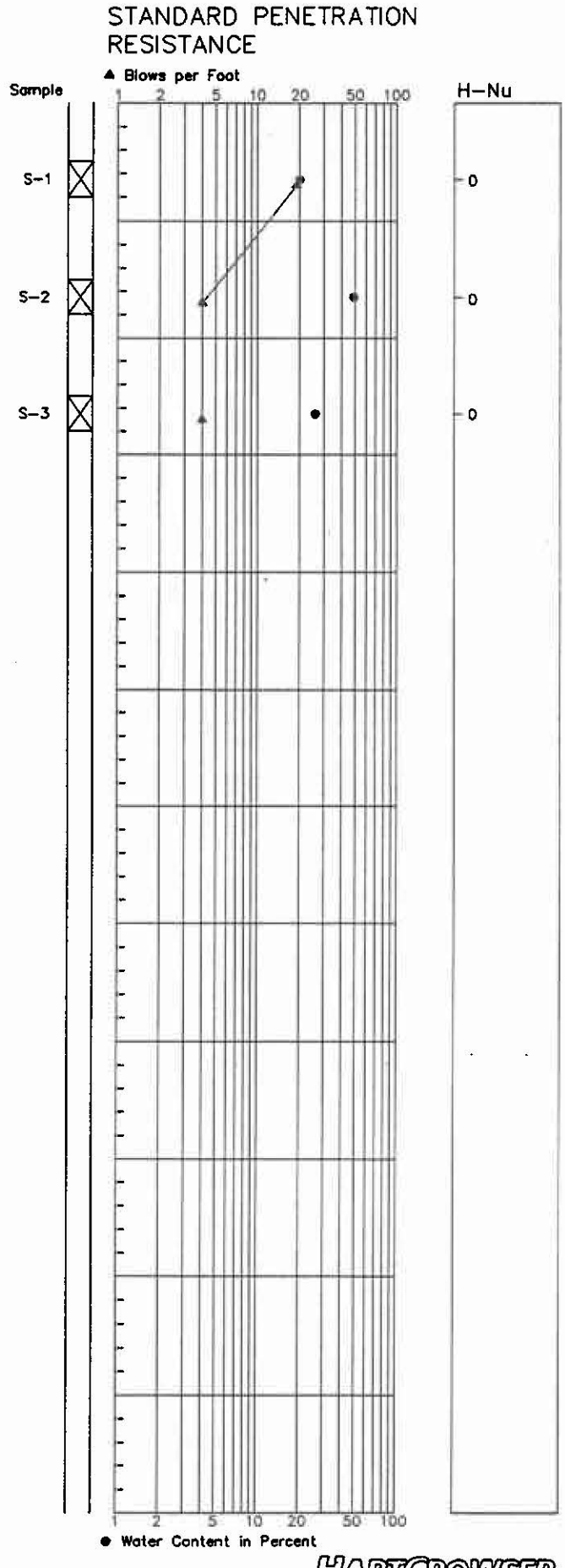
HARTCROWSER
J-2456 8/89
Figure A-14 1/1

Boring Log B-14

Soil Descriptions

Approx. Ground Surface Elevation in Feet 8.0

Soil Description	Depth in Feet
3 inches of ASPHALT over dark brown, medium SAND. (FILL)	0
Medium dense, damp, grayish brown, very silty, fine SAND. (FILL)	5
Soft, wet, dark gray, slightly clayey SILT with some wood fragments.	ATD
Loose, wet, dark gray, medium SAND.	10
Bottom of Boring at 14.0 Feet. Completed 8/2/89.	15



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

HARTCROWSER
J-2456 8/89
Figure A–15 1/1

Boring Log B-15

Soil Descriptions

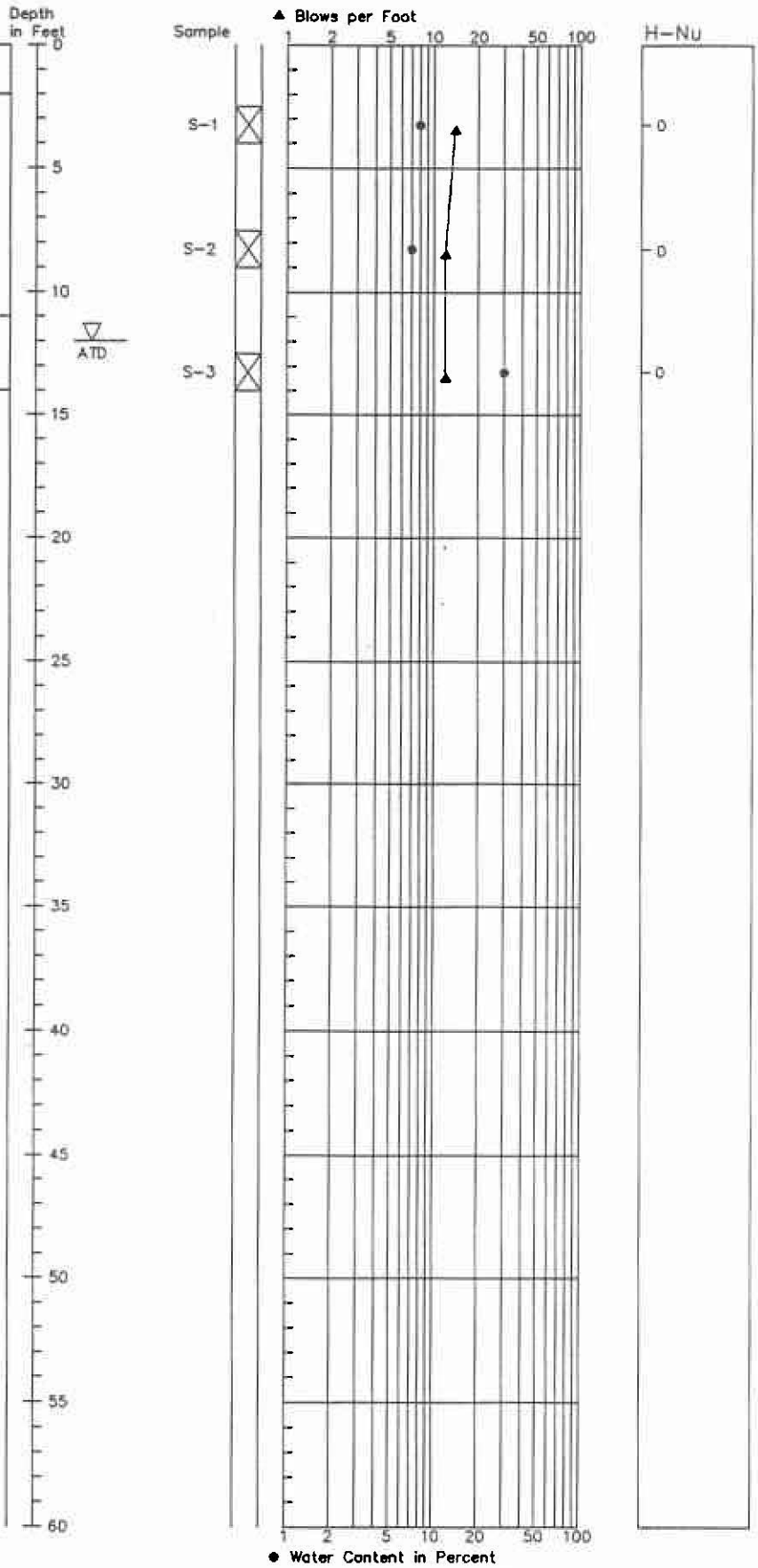
Approx. Ground Surface Elevation in Feet 7.5

3 inches of ASPHALT over brown, slightly gravelly, medium SAND. (FILL)

Medium dense, damp, dark brown, slightly gravelly, very silty, fine SAND.

Grades to silty, fine to medium SAND.

Bottom of Boring at 14.0 Feet.
Completed 8/2/89.



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

HARTCROWSER
J-2456 8/89
Figure A-16 1/1

Boring Log B-16

Soil Descriptions

Approx. Ground Surface Elevation in Feet 10.0

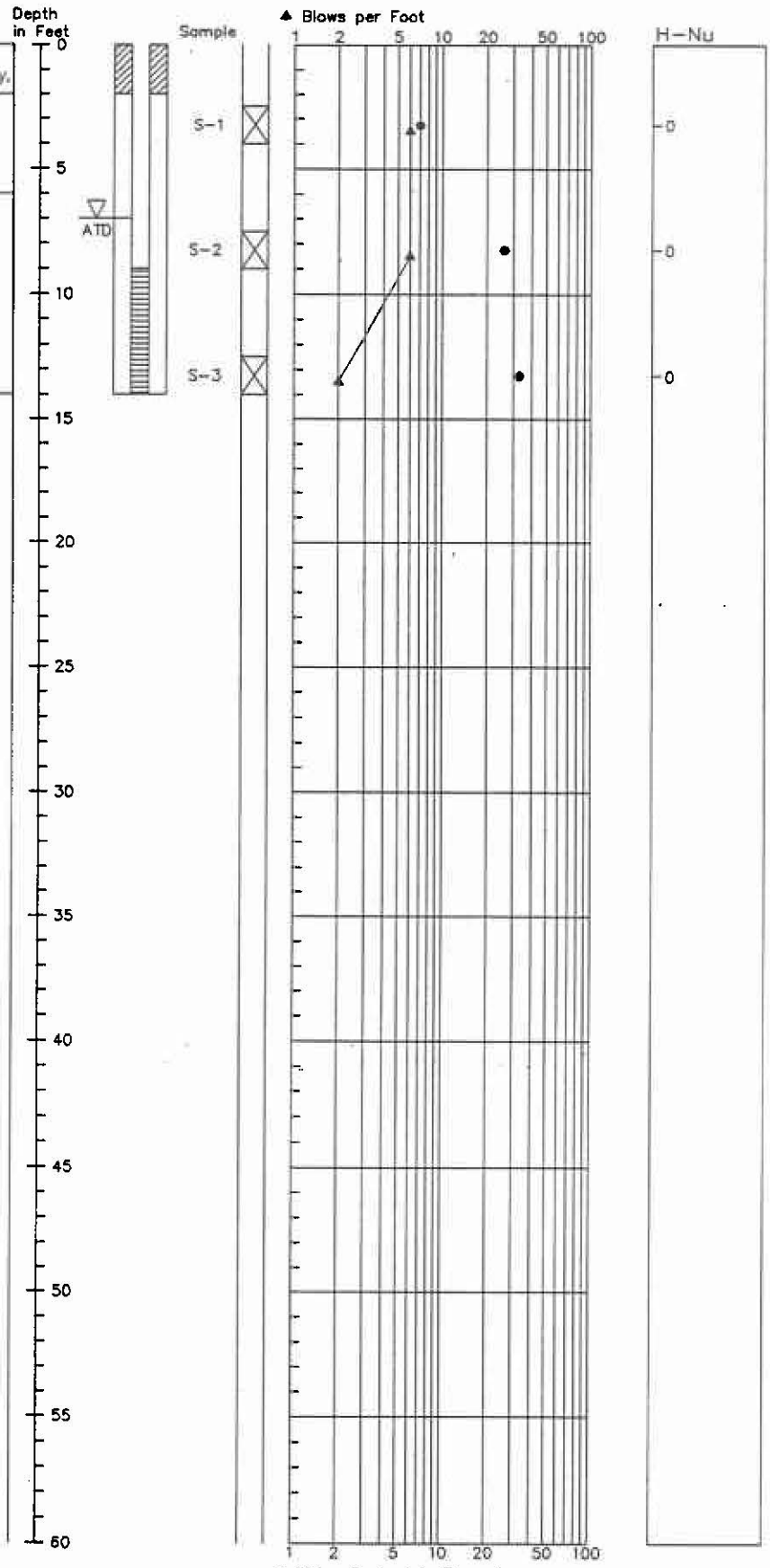
4 inches of ASPHALT over 20 inches of CONCRETE and RAILROAD TIES over dark gray, slightly silty, fine to medium SAND. (FILL)

Loose, damp, dark gray, gravelly, silty, fine to medium SAND. (FILL)

Grades to very silty, fine to medium SAND.

Some organics.

Bottom of Boring at 14.0 Feet.
Completed 8/2/89.



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

HARTCROWSER

J-2456 8/89

Figure A-17 1/1

Table B-1 Analytical methods used by ATI for chemical confirmation analyses for soil and water

Parameter	Soil Analyses		Water Analyses	
Metals & Inorganics	**Technique**	**Methods**	**Technique**	**Methods**
Antimony	AA/GF	EPA 7041	AA/GF	EPA 7041
Arsenic	AA/GF	EPA 7060	AA/GF	EPA 7060
Beryllium	AA/F	EPA 7090	AA/F	EPA 7090
Cadmium	AA/F	EPA 7130	AA/GF	EPA 7131
Chromium	AA/F	EPA 7190	AA/F	EPA 7190
Copper	AA/F	EPA 7210	AA/F	EPA 7210
Lead	AA/GF	EPA 7421	AA/GF	EPA 7421
Mercury	AA/COLD VAPOR	EPA 7470	AA/COLD VAPOR	EPA 7470
Nickel	AA/F	EPA 7520	AA/F	EPA 7520
Selenium	AA/GF	EPA 7740	AA/GF	EPA 7740
Silver	AA/F	EPA 7760	AA/F	EPA 7760
Thallium	AA/GF	EPA 7841	AA/GF	EPA 7841
Zinc	AA/F	EPA 7950	AA/F	EPA 7950
Organics				
Petroleum Hydrocarbons (TPH)	IR	EPA 418.1		EPA 642
Polynuclear Aromatic Hydrocarbons	GC/MS	EPA 8310		NA
Pentachlorophenol	GC/HALL	EPA 8040		NA
Volatile Organic Compounds	GC/MS	EPA 8240		EPA 418.1

EPA = "Test Methods for Evaluating Solid Waste (SW 846)", U.S.E.P.A., November, 1986.
NA = parameter not analyzed

TECHNIQUES:
AA/F = Atomic Absorption/Flame
AA/GF = Atomic Absorption/Graphite Furnace
GC/MS = Gas Chromatography/Mass Spectrometry
IR = Infrared spectrometric detection
GC/HALL = Gas Chromatography/Hall detection

Table B-2 Screening Data for Diagonal/CSO Soil Samples

J-2456

	Method Blank	Boring:	B-1A	B-2*	B-3*	B-5	B-5	B-6	B-7	B-7	B-9*	B-9	B-10	B-11
		Sample:	S-1	S-1A	S-1	S-1	S-4	S-1	S-1	S-3	S-1A	S-1	S-1	S-1
		Depth:	7.5-9'	5-9'	2.5-9'	2.5-4'	12.5-14'	2.5-4'	3-4'	12.5-14'	2.5-9'	5-6.5'	5.5-6.5'	3-4'
Metals in mg/kg (ppm)														
Cadmium	0.5		0.5	0.4	0.4	0.6	0.8	0.7	0.9	0.5	<0.1	0.2	0.1	<0.1
Chromium	1.7		2	2.6	2.6	2.7	4.8	5.6	16.3	2.2	3.3	5.2	1.3	18.4
Copper	<5		7.6	7.8	5.6	6	58.2	14.4	26.1	8	10.2	135.4	6	20.8
Nickel	0.8		3	5.6	5.1	6.1	13.1	10.4	26.3	8.4	12.7	5.7	7.1	46.9
Lead	3		9.7	14.8	6.8	4.3	49.8	11.6	16.8	1.1	4.9	90.4	<1.0	1.3
Zinc	1		12.2	19.7	11.4	10.7	46.3	24.6	41	12.5	17.2	103.3	12.6	32.8
Volatiles in ug/kg (ppb)														
Methylene Chloride	24		18	NA	NA	34	<2	37	27	22	NA	10	23	17
Trichloroethylene	<2		<2	NA	NA	<2	<2	<2	<2	tr	NA	tr	<2	<2
Tetrachloroethylene	<2		tr	NA	NA	<2	<2	<2	<2	tr	NA	<2	<2	<2
Base/neutral Screen in mg/kg (ppm)(as Napththalene)	<1		<1	<1	2.78	<1	13.6	<1	203 (a)	33.6	2.3	10.5	<1	<1
PCB/Pest. Screen in mg/kg (ppm)	<1		<1	<1 (b)	<1	<1	<1 (b)	<1 (c)	<1	<1	<1	<1 (b)	<1	<1

* Denotes a composite sample
tr Denotes analyte presnt between 1 and 2 ug/kg (ppb)
(a) Chromatogrph shows oil/fuel related constituents (diesel)
(b) Large peak noticed on GC/ECD chromatograph
(c) Peaks on GC/ECD chromatograph of B6-S1 may be carry-over from B5-S4
"<" Indicates less than

TAB22456

Table B-2 (continued)
Screening Data for Diagonal CSO Soil Samples

J-2456

Boring:	B-12	B-13	B-13	B-14	B-15	B-16
Sample:	S-3	S-1	S-4	S-2	S-2	S-1
Depth:	12.5'-14'	2.5'-4.0'	7.5'-19.0'	7.5'-9.0'	7.5'-9.0'	2.5'-4.0'
Metals in mg/kg (ppm)						
Cadmium	< 1.5	< 1.5	NA	< 1.5	< 1.5	NA
Chromium	< 0.5	24	NA	< 0.5	< 0.5	NA
Copper	7.9	20	NA	12	8.7	NA
Nickel	< 1.5	18	NA	< 1.5	< 1.5	NA
Lead	< 10	12	NA	< 10	< 10	NA
Zinc	8.6	32	NA	13	8.6	NA
Volatiles in ug/kg (ppb)						
Methylene Chloride	NA	7.2	< 20	< 20	NA	3.6
Trichloroethylene	NA	0.24	< 10	< 10	NA	< 10
Base/neutral Screen in mg/kg (ppm) (as Napthalene)	< 1	< 1	NA	< 1	< 1	NA
PCB/Pest. Screen in mg/kg (ppm)	NA	< 1	NA	< 1	< 1	NA

"<" indicates less than
tr denotes analyte present between 1 and 2 ug/kg (ppb)

Table B-3 Chemical Results for Diagonal/CSO Soil Samples
Analytical Technologies, Inc.

	Method Blank				
Boring:		B-9	B-5	B-7	B-7
Sample:		S-1	S-4	S-1	S-3
Depth:		5-6.5'	12.5-14'	3-4'	12.5-14'
ATI No.:		8905-126-1	8905-126-3	8905-126-4	8905-126-2
Metals in mg/kg (ppm)					
Arsenic		2.8			
Antimony		0.5 U			
Beryllium		9 U			
Cadmium		1 U			
Chromium		29			
Copper		120			
Lead		200			
Mercury		1			
Nickel		11			
Thallium		0.5 U			
Zinc		320			
Volatiles in mg/kg (ppm)					
Methylene Chloride	1.1				0.76 B
Trichloroethylene					0.05 U
Tetrachloroethylene					0.05 U
Total Petroleum Hydrocarbon (418.1) in mg/kg (ppm)			16	2000	
PAHs in mg/kg (ppm)					
Flouranthene			0.32	0.2 U	
Others			0.2 U	0.2 U	
Pentachlorophenol in mg/kg (ppm)			0.003 U		

* denotes a composite sample
B analyte was also found in the analytical blank
U analyte not detected at the detection limit shown

Table B-4 Chemical Results for Diagonal/CSO Water Samples J-2456
Analytical Technologies, Inc.

Boring No:	B-1	B-7	B-8	B-5	B-13
ATI No.:	8905-151-1	8905-151-2	8905-151-3	8905-151-4	(3)
Metals in mg/L (ppm)(1)					
Arsenic	0.12	0.048	0.08	0.018	NA
Antimony	0.005 U	0.005 U	0.005 U	0.005 U	NA
Beryllium	0.01 U	0.01 U	0.01 U	0.01 U	NA
Cadmium	0.0026	0.0038	0.0024	0.0016	NA
Chromium	0.8	0.66	0.47	0.26	NA
Copper	0.34	0.28	0.21	0.3	NA
Lead	0.17	0.072	0.06	0.18	NA
Mercury	0.0005 U	0.0005 U	0.0005 U	0.0005 U	NA
Nickel	0.35	0.23	0.09	0.03 U	NA
Selenium	0.5 U	0.5 U	0.5 U	0.5 U	NA
Silver	0.02 U	0.02 U	0.02 U	0.02 U	NA
Thallium	0.005 U	0.005 U	0.005 U	0.005 U	NA
Zinc	2	1.2	1.1	1.2	NA
Total Petroleum Hydrocarbon in mg/L (ppm)	0.05 U	0.05 U	0.05 U	0.05 U	NA
Volatiles in ug/L (ppb)					
1,1-Dichloroethane	1 U	13	1 U	1 U	1 U
1,2-Dichloroethene	1 U	6	1 U	1 U	1 U
1,1,1-Trichloroethane	11	85	1 U	1 U	1 U
Trichloroethene	1 U	8	1 U	1 U	1 U
Other Volatiles	1 U	1	1 U	1 U	1 U

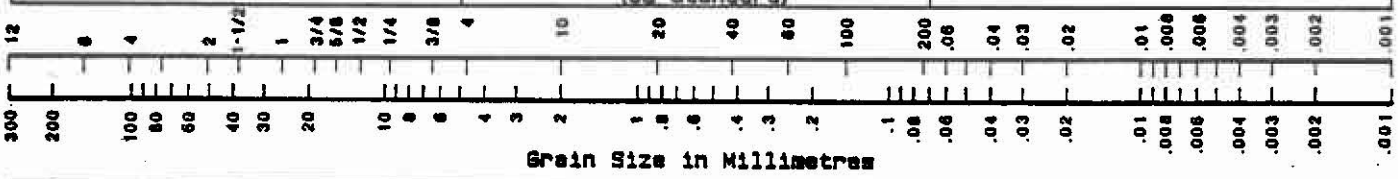
Notes:

U denotes analyte was not detected at detection limit shown
(1) Samples were not filtered prior to preservation and analysis and had alot of sediment in the bottom of the bottles.
(2) Samples had ~1/2" of sediment in bottom of bottles, samples were decanted off.
(3) Sample was analyzed for volatile organics by Photovac 10S.

Unified Soil Classification (USC) System

Soil Grain Size

Size of Opening in Inches	Number of Mesh per Inch (US Standard)	Grain Size in Millimetres



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

Coarse-Grained Soils

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

G W and S W $\left(\frac{D_{60}}{D_{10}}\right) > 4$ for G W, > 6 for S W G $1 \leq \left(\frac{(D_{30})^2}{D_{10} \times D_{60}}\right) \leq 3$ G P and S P Clean GRAVEL or SAND not meeting requirements for G W and S W

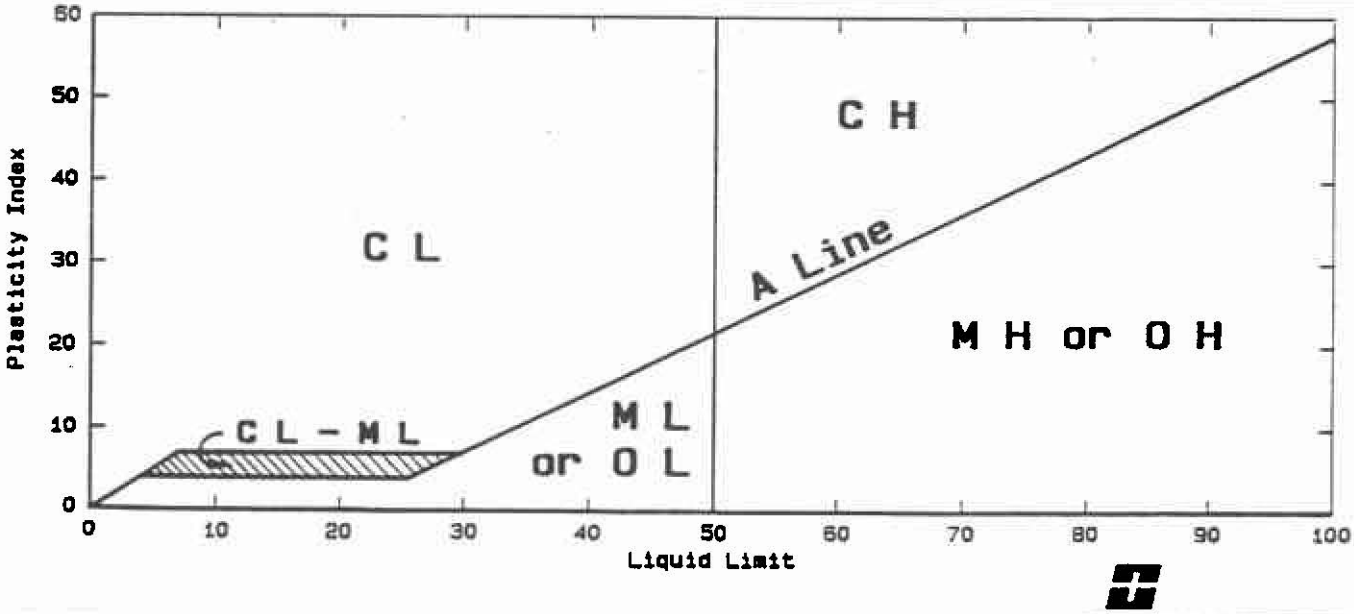
G M and S M Atterberg limits below A Line with PI <4 G C and S C Atterberg limits above A Line with PI >7

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

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

Fine-Grained Soils

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

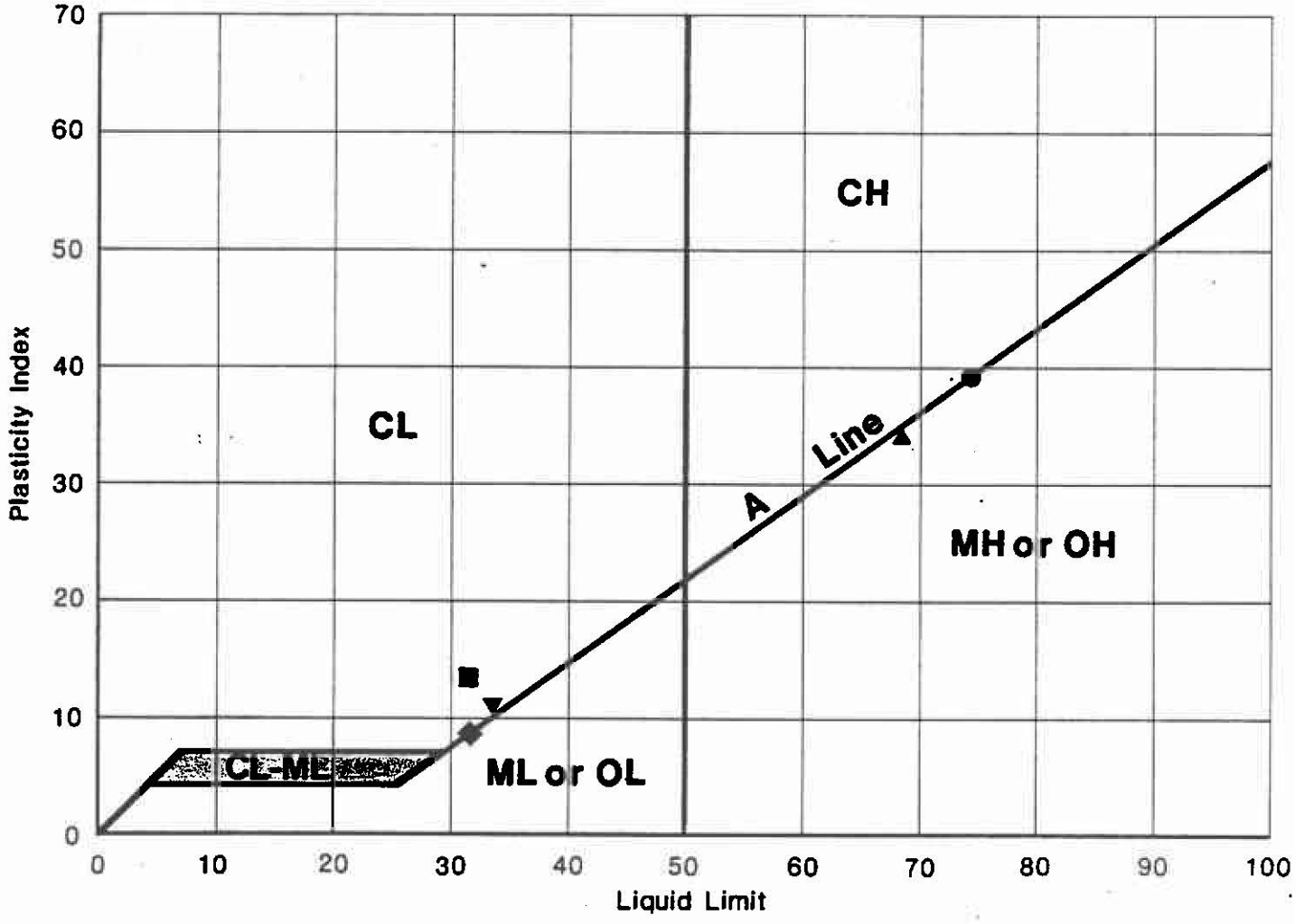


HARTCROWSER

J-2456 6/89

Figure B-1

Plasticity Chart

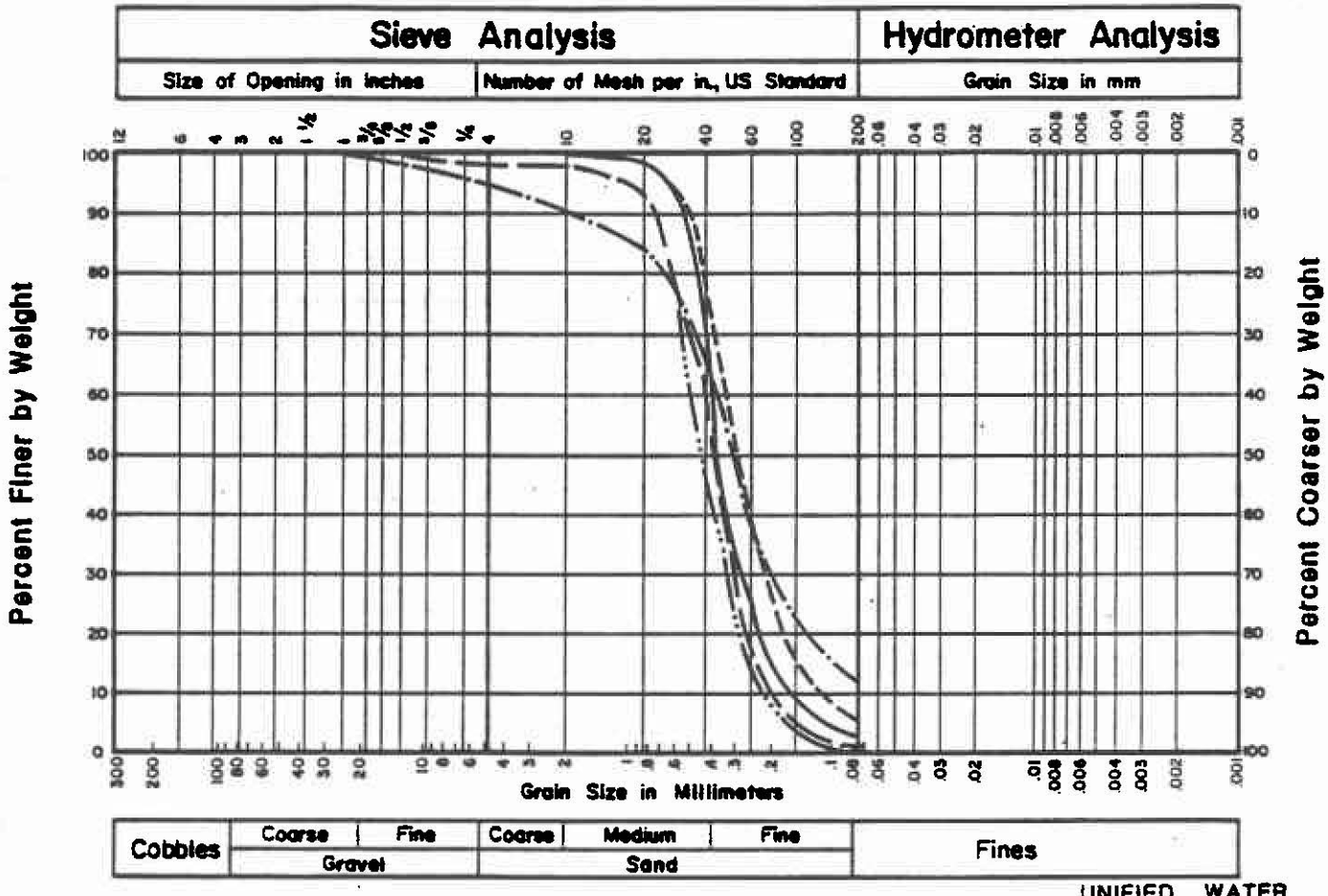


SYMBOL	BORING NUMBER	SAMPLE NUMBER	DEPTH IN FEET	WATER CONTENT IN PERCENT NAT.	L.L.	P.L.	P.I.	CLASSIFICATION	USC
●	B-2	S-3	10.0-11.5	76	74	35	39	Silty CLAY	CH
▲	B-4	S-3	10.0-11.5	75	68	34	34	Clayey SILT	MH
▼	B-9	S-4	15.0-16.5	42	33	22	11	Silty CLAY	CL
■	B-11	S-3	12.5-14.0	19	31	18	13	CLAY	CL
◆	B-11	S-4	22.5-24.0	30	32	23	9	Silty CLAY	CL

L.L. LIQUID LIMIT
P.L. PLASTIC LIMIT
P.I. PLASTICITY INDEX
USC UNIFIED SOIL CLASSIFICATION

J-2456 June 1989
HART-CROWSER & associates inc.
Figure B-2

Grain Size Classification



LINE SYMBOL	BORING NUMBER	SAMPLE NUMBER	DEPTH IN FEET	CLASSIFICATION	UNIFIED SOIL CLASS.	WATER CONTENT PERCENT
———	B-1/-1A	S-2A	12.5-14.0	Medium to fine SAND	SP	29
— —	B-4	S-2	7.5-9.0	Medium to fine SAND	SP	7
- - -	B-5	S-2	5.0-6.5	Slightly silty, medium to fine SAND	SP-SM	7
—·—	B-9	S-1	5.0-6.5	Slightly gravelly, silty, medium to fine SAND	SM	17
—···—	B-10	S-2	7.5-9.0	Medium to fine SAND	SP	28

HARTCROWSER
J-2456 6/89
Figure B-3