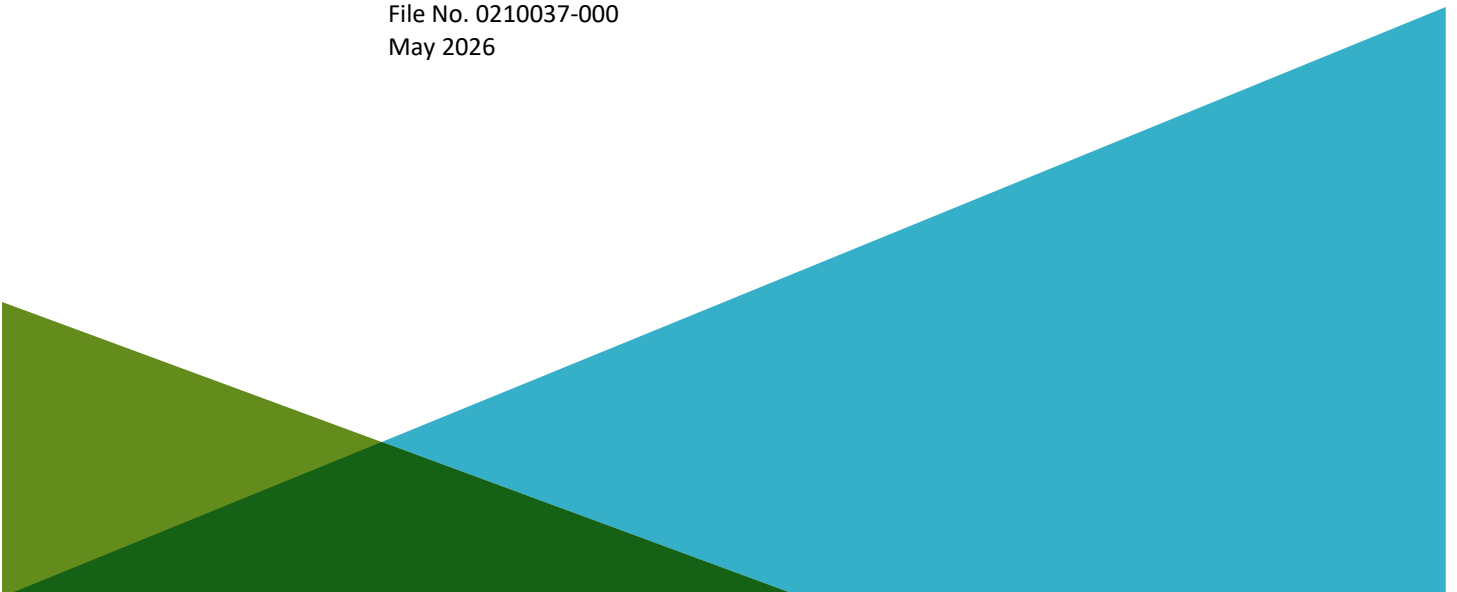


PHASE I GEOTECHNICAL DATA REPORT
VETERANS REMEMBRANCE BRIDGE
BRIDGE NO. 1558, MAINEDOT WIN 029484.00
BANGOR-BREWER, MAINE

by
Haley & Aldrich, Inc.
Portland, Maine

for
Maine Department of Transportation
Augusta, Maine

File No. 0210037-000
May 2026





HALEY & ALDRICH, INC.
75 Washington Avenue
Suite 1A
Portland, ME 04101
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May 15, 2026
File No. 0210037-000

Maine Department of Transportation
16 State House Station
Augusta, Maine 04333-0016

Attention: Laura Krusinski, P.E.
Senior Geotechnical Engineer

Subject: Phase I Geotechnical Data Report
Veterans Remembrance Bridge
Bridge No. 1558, MaineDOT WIN 029484.00
Bangor-Brewer, Maine

Ladies and Gentlemen:

This Phase I Geotechnical Data Report presents the compilation of subsurface data and results of the historical geotechnical field investigations completed for construction of the existing Veterans Remembrance Bridge (existing bridge) over the Penobscot River in Bangor-Brewer, Maine (see Figures 1 and 2). This report is intended to provide Maine Department of Transportation (MaineDOT) and their bridge subconsultant (HNTB Corporation; HNTB) with initial geotechnical information for the proposed bridge rehabilitation. Per discussions with MaineDOT, a site-specific field investigation was not conducted to support this phase of the project. This work has been completed in accordance with our proposal dated March 5, 2024, which was authorized on March 18, 2024.

Project Background

EXISTING BRIDGE STRUCTURE

The existing 1,562-foot (ft)-long, eight-span bridge carries Interstate 395 (I-395) over a railroad, the Penobscot River, and South Main Street (see Figures 1 and 2). Based on our review of the historical bridge drawings (dated September 1983) we understand the existing bridge substructures are supported on the following foundations (summarized in the table below):

Existing Bridge Substructure	Steel H-Pile Section (End Bearing in Bedrock)	Number of Piles	Estimated Pile Length (ft)	Pile Design Load (tons)	Pile Inclination	Historical Bridge Drawing Sheet No.
Abutment No. 1	HP12x53	8	48	116	Vertical and battered (3.5 in./12 in.) piles	12
Abutment No. 2	HP14x73	24	64	161		

Existing Bridge Substructure	Steel H-Pile Section (End Bearing in Bedrock)	Number of Piles	Estimated Pile Length (ft)	Pile Design Load (tons)	Pile Inclination	Historical Bridge Drawing Sheet No.
Pier No. 1	HP14x89	36	25 to 30	196	Vertical and battered (1/2 in./12 in.) piles	19
Pier No. 2	HP14x89	36	42 to 46	196	Vertical and battered (1/2 in./12 in.) piles	
Pier No. 3	HP14x102	130	46.5	135	Vertical and battered (1.5 in./12 in.) piles	
Pier No. 4	Pier bases are supported on concrete seals bearing on bedrock					20
Pier No. 5						22
Pier No. 6						
Pier No. 7	HP14x89	36	22 to 28	196	Vertical and battered (1/2 in./12 in.) piles	19

Geologic Setting

According to Maine Geological Survey's Bangor Surficial Geology Quadrangle, Maine (Open-File No. 11-6, 2011), the surficial geologic unit mapped within the site vicinity is the Presumpscot Formation which consists of silt, clay, and sand. According to Maine Geological Survey's Bangor Bedrock Geology Quadrangle, Maine (Open-File 11-57, 2011), bedrock at the site vicinity is mapped as the Penobscot River Member of the Vassalboro Group which consists of Silurian Age medium-grained to very fine-grained feldspathic metawacke.

Historical Geotechnical Field Investigations

Two geotechnical field investigations (investigations) were conducted at the subject site by MainedOT in January 1982 (preliminary investigation) and August 1983 (final investigation). The results of the investigations are summarized in the reports titled:

- "Soils Report 82-101, Bangor/Brewer – Penobscot County, Preliminary Study for Third Bridge, Project 395-8(79), January 1982" (1982 Soils Report).
- "Soils Report 83-22, Bangor & Brewer – Penobscot County, Project I-395-8(79), I-395 over Penobscot River, August 1983" (1983 Soils Report).

These Soils Reports are included for reference in Appendix A. Please note that a reference elevation datum was not indicated in the Soils Reports. Refer to Figure 2 for approximate locations of historical borings.

Generalized Subsurface Conditions

The subsurface conditions encountered in the investigations, at the existing bridge substructures, generally consisted of the following geologic units presented in order of increasing depth below ground surface (BGS): in-situ fill, marine deposit, glacial till, and bedrock. The Soils Reports did not provide a geologic unit classification for the marine deposit.

A general description of each geologic and bedrock unit encountered in the available historical borings, drilled at the existing bridge substructures, is provided separately below.

GENERALIZED GEOLOGIC UNIT DESCRIPTIONS

Geologic Unit	Approximate Range in Encountered Thickness (ft)	Generalized Description
In-situ Fill	0 to 8	Loose ¹ , brown and black, Sandy GRAVEL and Silty SAND, coal ash.
Marine Deposit ²	15 to 26	Loose to dense, brown and grey, Silty sandy fine to coarse GRAVEL, with "rocks" to soft to stiff, brown, "CLAY-SILT" and Silty CLAY.
Glacial Till	1 to 19	Dense, grey, "pebbly," "CLAY-SILT."

Notes:

1. Please note that field blow counts per foot (i.e., uncorrected N-values) and corresponding densities in the table above were based on a Sprague & Henwood soil sampler.
2. The Soils Reports did not provide a geologic unit classification for these strata. Based on the descriptions of this stratum on the boring logs, and the surficial geology map of the site, we have classified these strata as a marine deposit.

BEDROCK CONDITIONS

Bedrock was cored in 48 historical borings. In these borings, the top of the bedrock surface ranged from approximately 2 ft to 55 ft BGS (El. 24 to El. -58). The cored bedrock was generally described as metasiltstone and metagraywacke, with quartz and calcite veins, and high angles of foliation.

GROUNDWATER ELEVATIONS

Historical groundwater levels were not recorded. An indication of soil sample saturation was not indicated on the historical boring logs.

Field Investigation of Pier 3 Shaft Cracking

A concrete core testing program, cross-hole sonic logging, and geotechnical evaluations were conducted in 2005 and 2006 by MaineDOT to investigate and assess a crack observed in the shaft of Pier 3. The geotechnical evaluations are summarized in a report titled "Geotechnical Evaluation of the Veteran's Remembrance Bridge over the Penobscot River, Pier 3, Bangor-Brewer, Maine, April 2006," and is available upon request.

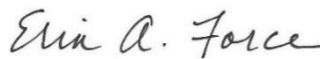
Closure

We appreciate the opportunity to provide engineering services on this project. Please do not hesitate to contact us if you have any questions or comments.

Sincerely yours,
HALEY & ALDRICH, INC.



Nathan A. Sherwood, P.E.
Senior Project Manager



Erin A. Force, P.E.
Senior Associate



Enclosures:

- Figure 1 – Project Locus
- Figure 2 – Historical Boring Location Plan
- Appendix A – Historical Soils Reports

<https://haleyaldrich.sharepoint.com/sites/MaineDepartmentofTransportation2/Shared Documents/0210037.MainedOT-Brewer I-395 Design Build/Deliverables/Phase 1 - Historic Geotech Data Reports/Veterans Bridge No. 1558/2026-0515-HAI-Veterans Bridge Phase I GR-F.docx>

References

1. Syverson, Kent M., & Thompson, Andrew H., Surficial Geology Bangor Quadrangle, Maine, Maine Geological Survey, Department of Conservation, Augusta, Maine, Open File Report No. 11-6, 2011.
2. Pollock, Stephen G., Bedrock Geology of the Bangor Quadrangle, Maine, Maine Geological Survey, Department of Conservation, Augusta, Maine, Open File Report No. 11-57, 2011.

<https://haleyaldrich.sharepoint.com/sites/MaineDepartmentofTransportation2/Shared Documents/0210037.MaineDOT-Brewer I-395 Design Build/Deliverables/Phase 1 - Historic Geotech Data Reports/Veterans Bridge No. 1558/2026-0515-HAI-Veterans Bridge Phase I GR-F.docx>

FIGURES



0210037.000 LOCUS HALEYALDRICHUBOIS



SITE COORDINATES: 44°47'03"N, 68°46'30"W



MAP SOURCE: USGS

**HALEY
ALDRICH**

VETERANS REMEMBRANCE BRIDGE
BRIDGE NO. 1558, MAINEDOT WIN 029484.00
BANGOR-BREWER, MAINE

PROJECT LOCUS

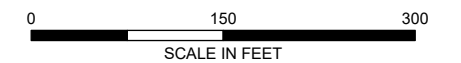
APPROXIMATE SCALE: 1 INCH = 2,000 FEET
MAY 2026

FIGURE 1

---.---.---.---. TOWN BOUNDARY

1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.

2. AERIAL IMAGERY SOURCE: NEARMAP, 22 MAY 2023



VETERANS REMEMBRANCE BRIDGE
BRIDGE NO. 1558, MAINEDOT WIN 029484.00
BANGOR-BREWER, MAINE

HISTORICAL BORING LOCATION PLAN

FIGURE 2

APPENDIX A

Historical Soils Reports

Soils Report 82-101
Bangor/Brewer - Penobscot County
Preliminary Study for Third Bridge
Project 395-8(79)
January 1982

Maine Department of Transportation

Materials & Research Division

Soils Section

PRELIMINARY

SUBSURFACE INVESTIGATION FOR THE PROPOSED CONSTRUCTION
OF A BRIDGE BETWEEN THE CITIES OF BANGOR AND BREWER

Penobscot County

Project 395-8(79)

Soils Report 82-101

January 1982

BANGOR

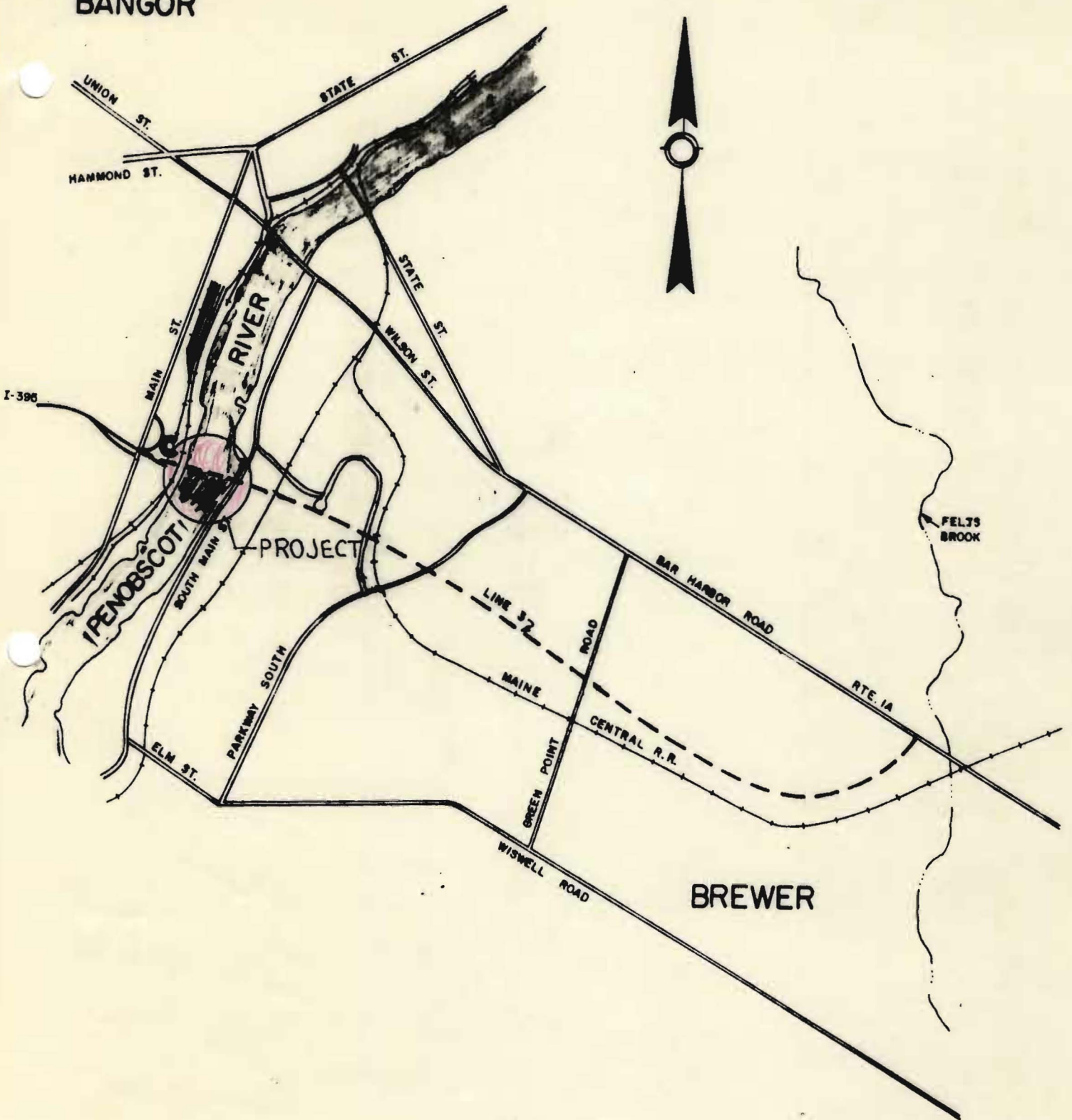


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INTRODUCTION

A preliminary soils investigation has been performed for the proposed I-395 Bridge over the Penobscot River between Bangor and Brewer in Penobscot County. Six initial washborings were made in 1978 at locations selected by the consulting firm of Edwards & Kelcey, Inc. These were followed by twelve additional borings in 1979 and 1980 made at preliminary pier locations designated by the Bridge Design Section. This report summarizes all the soils information and testing data that was obtained in these borings.

All washborings completed to date for this structure were made by a boring crew under the supervision of Gary Paine. Samples were brought to the Central Laboratory for identification and index tests. Additional washborings will be required when details of the substructure are finalized and a final soils report will be submitted then.

GENERAL CONDITIONS

All washborings encountered primarily granular soils. The soil is relatively shallow beneath the river, being generally twenty feet or less in depth. The density of the soils encountered varies from loose to dense, being generally medium to dense beneath the river and loose at the higher elevations on the river banks.

The ledge, samples of which were described as metasiltstone with quartz and calcite intrusions and a high angle of foliation, was found at Elevation -20 ± 10 beneath much of the Penobscot River, reaching a low of -50 near the Bangor shore.

DETAILED CONDITIONS AND SOIL PROPERTIES

Washboring GP-51-78 (B-1):

This boring was made at Station 164+13, sixty-seven feet right of centerline (near the railroad tracks in Bangor), and the ground elevation is +41.6. This boring was made in 1978 and was included in Soils Report 79-03 submitted in January, 1979. Three feet of surficial brown silty gravel overlies four feet of medium consistency brown pebbly clayey silt and seventeen feet seven inches of loose to dense brown medium to coarse sandy gravel with some wood pieces. Refusal was encountered at a depth of twenty-four feet seven inches (Elevation 17.0) and this is possibly the ledge surface.

The groundwater table was measured as soon as the boring operation was finished and it was found at 12.7 feet below the ground surface.

Tests performed on the split spoon samples included two sieve and hydrometer analyses, water content determinations and Atterberg limits. The clayey silt sample had a water content of 19 percent and liquid and plastic limits were 32.2 and 20.4 percent respectively. The water content of the lower sandy gravel sample was 6.7 percent.

Two grain size distribution curves can be found on Sheet 4 and the detail sheet for this boring is on Sheet 6.

Washboring GP-53-78 (B-2):

This boring was made at Station 165+35, sixty-two feet right of centerline on the edge of the railroad embankment in Bangor and its elevation is +42.1. This too is one of the initial explorations made at locations requested by Edwards & Kelsey. Underlying the top five feet of brown silty gravel with coal

pieces (railroad fill) is thirty-five feet of loose to medium density gray-brown slightly silty coarse sand and angular gravel. Assorted pebbles, cobbles and boulders were found at depth forty feet to fifty-five feet two inches. Ledge was encountered at Elevation -13.1 and core drilled five feet, and was described as metasiltstone with a high angle of foliation containing quartz and calcite intrusions by a geologist.

Groundwater observation was attempted on the day after completion of the hole, but the hole had filled in up to eleven feet and no water was noted.

Two water contents of the coarse sand and gravel samples were 7 and 3 percent. Two grain size distribution curves can be found on Sheet 3, and the boring details can be found on Sheet 6.

Washboring GP-50-78 (B-3):

Boring B-3 was made in 1978 at its designated position on the Bangor shore at Station 166+89, fifty-two feet right, and its elevation is 13.2. Ten feet of loose brown slightly silty medium sand with some rocks and pebbles was found overlying 33.5 feet of loose to medium brown and gray coarse sand and gravel with some stones. Ledge was encountered at Elevation -30.3 and is described as metasiltstone with a high angle of foliation and has occasional quartz and calcite intrusions.

Observation of the groundwater was achieved while casing was still in the ground. One measurement was at 15.3 feet and later that morning at 9.9 feet.

One water content of a sample of the pebbly medium sand was 16 percent and three water contents of the sand and gravel were 7, 8 and 9 percent. Four grain size distribution curves were obtained from samples and are shown on Sheet 2. The detail sheet for this boring is on Sheet 6.

Washboring GP-59-79:

This boring was made at Station 166+70, fifty-seven feet left of centerline (Elevation +12.98). Below two feet of surficial brown silty gravel and rock lies fifteen feet of loose to medium density brown slightly silty fine to medium sand that contains a few stones and then four feet ten inches of dense gray silty very pebbly medium sand. From the depth of twenty-one feet ten inches to thirty-two feet eight inches, dense gray pebbly silty till and rocks was core drilled and from thirty two feet eight inches (Elevation -19.7) to forty-three feet nine inches ledge was core drilled and described as gray metasiltstone with calcite veins and a high angle of foliation grading to calcareous metasiltstone.

The details of this boring are shown on Sheet 6.

The transverse diagram through this boring and GP-50-78 is shown on Sheet 9.

Washboring GP-39-80:

This boring was made in the river at Station 168+60, fifty-five feet right of centerline (Elevation -26.01). Dense brown silty gravel and rocks were drilled to a depth of twenty-six feet followed by six inches of dense gray-brown till. Ledge was encountered at Elevation -52.5 and core drilled 7.5 feet. This ledge core was lost overboard during a storm; thus, no description is available.

Details are shown on Sheet 7.

Washboring GP-40-80:

This river boring was made at Station 168+70, fifty-five feet left (Elevation -24.61). There exists twenty-two feet eight inches of loose to dense brown and gray silty gravel above the ledge surface. Ledge was encountered at Elevation 747.29 and core drilled ten feet, but the core was lost overboard during a storm and no ledge description is available.

Boring details are shown on Sheet 7.

A transverse diagram through borings GP-39-80 and GP-40-80 is shown on Sheet 9.

Washboring GP-49-78 (B-4):

This preliminary river boring was made at Station 170+90, sixty feet right of centerline in 1978 and included in Soils Report 79-03. Initially, the casing could not be positioned well due to rocks on the river bottom. After numerous attempts and equipment breakdowns, the hole was completed. Elevation of the boring is -24.2 feet. Brown gravel to a depth of 5.3 feet overlies two feet of rocks and pebbles. Ledge was encountered at a depth of 7.25 feet (Elevation -31.45), and was described as metasiltstone with some quartz and calcite veins and a high angle of foliation. The detail sheet for this boring is shown on Sheet 7.

It is believed that the river bottom in this part of the channel is kept relatively free of fine material.

Washboring GP-38-80:

This boring was made at Station 171+40, fifty five feet right of centerline (Elevation -20.81) in the river. Three feet six inches of brown silty gravelly till and rocks overlies the ledge surface which was encountered at Elevation -24.4 and core drilled for ten feet six inches. This core sample was later described as phyllite and metasiltstone with quartz and calcite intrusions and it exhibited a high angle of foliation.

Boring details are shown on Sheet 7.

Washboring GP-⁴⁶~~30~~-80:

This river boring was made at Station 171+60, fifty-five feet left (Elevation -22.0). There exists two feet of brown silty gravel and rocks and then dense gray silty till. Drilling was halted at a depth of eight feet six inches due to bent casing. The casing was pulled out and a new boring was started.

Washboring GP-37-80:

This boring was made fifty feet left of Station 171+60 (Elevation -21.7) and adjacent to GP-36-80. Two feet of surficial brown silty gravel was found overlying six feet six inches of dense gray silty till and rocks. Core drilling started at a depth of eight feet six inches through a five inch cobble and then ledge. This ledge, described as phyllite and metasiltstone with quartz and calcite intrusions and a high angle of foliation, was core drilled from Elevation -30.7 to Elevation -42.2.

Boring details are shown on Sheet 7.

A transverse diagram across Station 171+50 is shown on Sheet 9.

Washboring GP-57-79:

This boring was made fifty-five feet right of Station 173+60 (Elevation -7.0) in the river. [Below a surficial deposit of brown sandy silt mixed with wood lies six feet of ^{100% to} dense gray pebbly silty fine to medium sand and nine feet of dense gray pebbly silty till. Ledge was encountered at Elevation -23.0 and core drilled ^{4.5'} and described as greenish-gray metasiltstone with quartz veins and a high angle of foliation.]

Details are shown on Sheet 7.

Washboring GP-29-80:

This boring was made at Station 173+80, fifty-five feet left of construction centerline (Elevation -12.01). Below one foot of brown sandy silt sediments there is three feet of gray silty pebbly till with wood pieces and then nine feet seven inches of medium to dense brown and gray fine sand and pebbly clay-silt. Ledge was encountered at Elevation -25.59 and core drilled nine feet eight inches. This ledge sample was described as phyllite and metasiltstone with quartz and calcite intrusions and a high angle of foliation.

Boring details are shown on Sheet 8.

A transverse section depicting the soils stratification at Station 173+70+ is shown on Sheet 9.

Washboring GP-48-78 (B-5):

This river boring was made at Station 174+55, 155 feet right, and its elevation is -4.72. This is one of the borings made for the initial soils investigation at a location designated by the consultant; it was included in Soils Report 79-03. Underlying two feet of brown sandy silt (sediments) is ten feet of medium to dense gray pebbly sandy clayey silt (till). Ledge was encountered at Elevation -16.7 and is described as light greenish-gray metasiltstone with quartz and calcite intrusions and some pyrite and a high angle of foliation.

Atterberg limits were obtained for one of the till samples and the liquid limit was 25.1 percent, with the plastic limit being 23.7 percent. A sieve and hydrometer analysis was done also and the curve is shown on Sheet 3. The boring detail sheet is shown on Sheet 8.

Washboring GP-58-79:

[This boring was made at Station 175+40, fifty five feet right, in the intertidal zone (Elevation -3.49). There exists one foot of brown sandy silt above eleven feet ten inches of medium to dense gray pebbly sandy clay-silt. Ledge was encountered at Elevation -16.3 and core drilled to Elevation -21.3 and described as greenish-gray metasiltstone with quartz veins and a high angle of foliation.]

Details are shown on Sheet 8.

Washboring GP-56-79:

At Station 175+60, fifty-five feet left, this boring was made in the intertidal zone (Elevation -3.5). Below a foot of brown sandy silt is 14.5 feet of dense gray pebbly sandy clay-silt. Ledge was encountered at Elevation -19.0 and core drilled and described as metasiltstone with calcite and quartz veins and a sixty degree foliation angle.

Details are shown on Sheet 8.

A transverse section at Station 175+50 is shown on Sheet 9.

Washboring GP-1-80:

This boring was made at Station 177+20, fifty-five feet right of I-395 centerline on the river bank in Brewer (Elevation 21.20). The boring encountered six feet of surficial loose brown sandy pebbly silt underlain by 1 1/2 feet of brown silty pebbly sand and 6 1/2 feet of medium ^{to stiff} ~~consistency~~ brown sandy silty clay. From depth fourteen to forty-five feet six inches, dense gray pebbly clay-silt till was quarry drilled. At Elevation -24.30, ledge, described as metasiltstone with a high angle of foliation, was core drilled. Several drilling problems were experienced at this location.

Details are shown on Sheet 8.

Washboring GP-30-80:

This boring was made within the intertidal zone at Station 177+40, fifty-five feet left of centerline (Elevation -1.01). Five feet six inches of medium density brown silty fine sandy till is found above ten feet seven inches of medium density gray pebbly sandy clay-silt till. Ledge was encountered at Elevation -16.93, core drilled and described as phyllite, metasiltstone and metagraywacke with quartz and calcite intrusions and a high angle of foliation.

Boring details are shown on Sheet 8.

A transverse section across this boring and GP-1-80 is shown on Sheet 9.

Washboring GP-33-78 (B-10):

This boring was made just off South Main Street in Brewer at Station 177+65, twelve feet right of centerline (Elevation 20.3), near the location requested by the consultant as part of the initial subsurface investigation, and has been previously reported in Soils Report 79-03. A surficial layer of eight feet of loose brown slightly organic silty medium sand and fine gravel overlies six feet of stiff brown weathered silty clay and then six feet of medium density clean brown silty fine sand. At a depth of twenty feet and extending to thirty-eight feet, medium to dense gray pebbly sandy clay-silt (till) was found. Angular ledge fragments were found in the lower portions. At Elevation -17.7, ledge was core drilled and described as metasiltstone with calcite veins and a 45 to 50 degree angle of foliation.

Water contents from samples were 8.9 percent in the upper sand and fine gravel layer, 18.6 percent in the silty fine sand layer and 9.4 percent in the till layer. The liquid limit of a till sample was 23.5 percent and the plastic limit was 14.5 percent.

Several grain size curves can be found on Sheet 1 and the washboring details on Sheet 8.

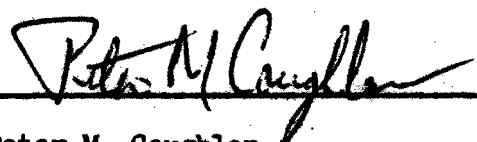
SUMMARY

A total of eighteen washborings have been made at the proposed location for a structure to carry I-395 over the Penobscot River between the cities of Bangor and Brewer. Some of the borings were made at locations designated by the consulting engineering firm of Edwards & Kelcey, Inc., as part of the initial soils

investigation for the I-395 extension into Brewer, and they were reported on in Soils Report 79-03. Additional washborings have been added at locations anticipated to be near substructure units. It is possible that a few more borings will be desirable after the structure design is further along and exact substructure unit locations are fixed.

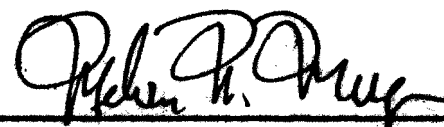
The river bottom is underlain by relatively shallow, predominantly granular soils, and piers in the river can be supported directly on ledge. The soil beneath the river banks is of quite variable density, and ledge is within 50± feet of the surface; thus, the "best" means of supporting abutments and piers beyond the top of the river bank would be piles driven to refusal. A final soils report with detailed recommendations will be completed at a later date.

Prepared by


Peter M. Coughlan

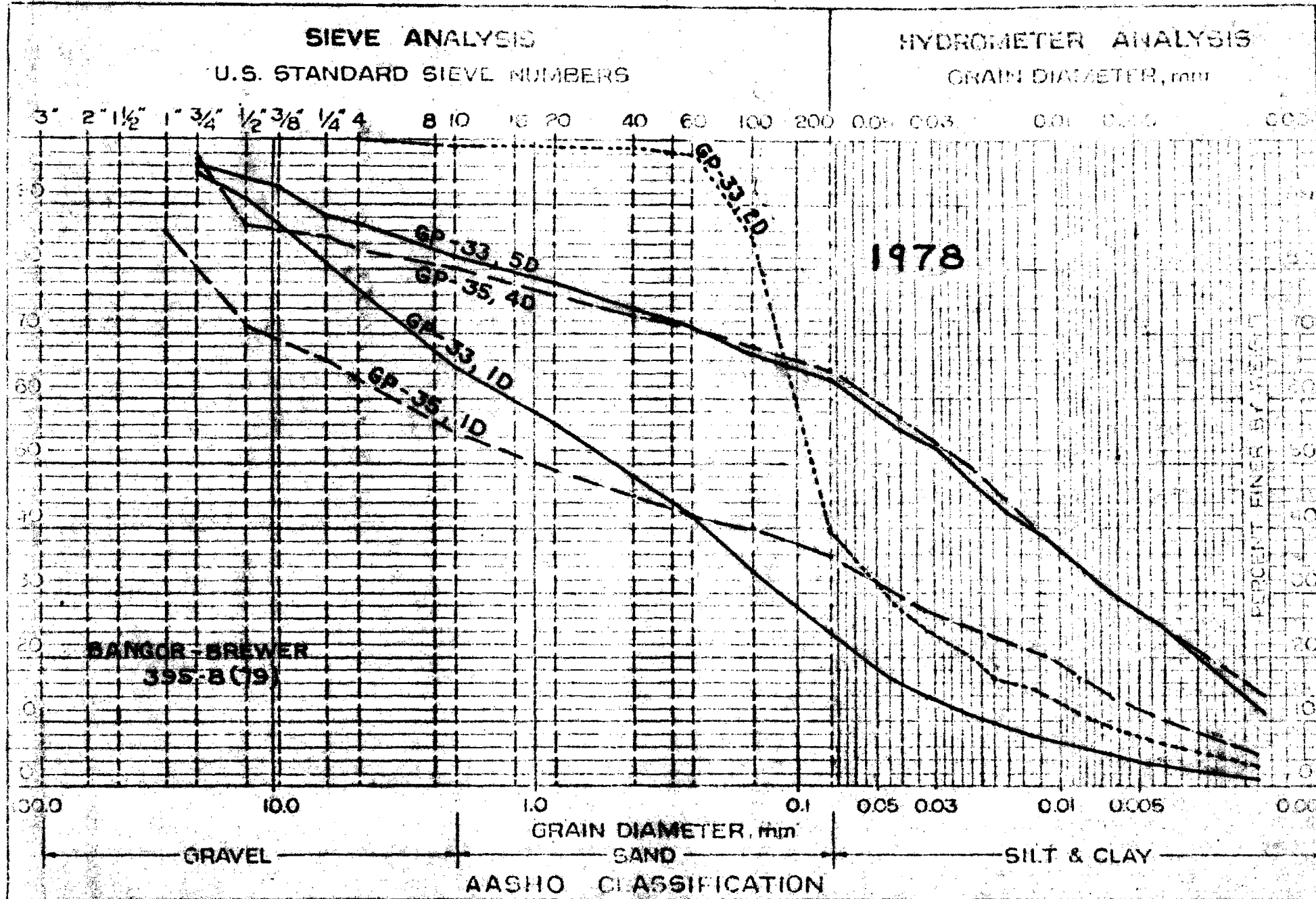
CE I

Approved by


Melvin W. Morgan

Soils Engineer

Classification of these soil samples is in accordance with AASHTO Classification System M-145-40. This classification is followed by the "Frost Susceptibility Rating" from zero (non-frost susceptible) to Class IV (highly frost susceptible). The "Frost Susceptibility Rating" is based upon the MDOT and Corps of Engineers Classification Systems.



SIEVE ANALYSIS

U.S. STANDARD SIEVE NUMBERS

3" 2 1/2" 1 3/4" 1 1/2" 3/8" 1/4" 4 8 10 16 20 40 60 100 200

HYDROMETER ANALYSIS

GRAIN DIAMETER, mm

1978

PERCENT FINER BY WEIGHT

BANGOR-BREWER
395-6 (79)

GRAIN DIAMETER, mm

GRAVEL

SAND

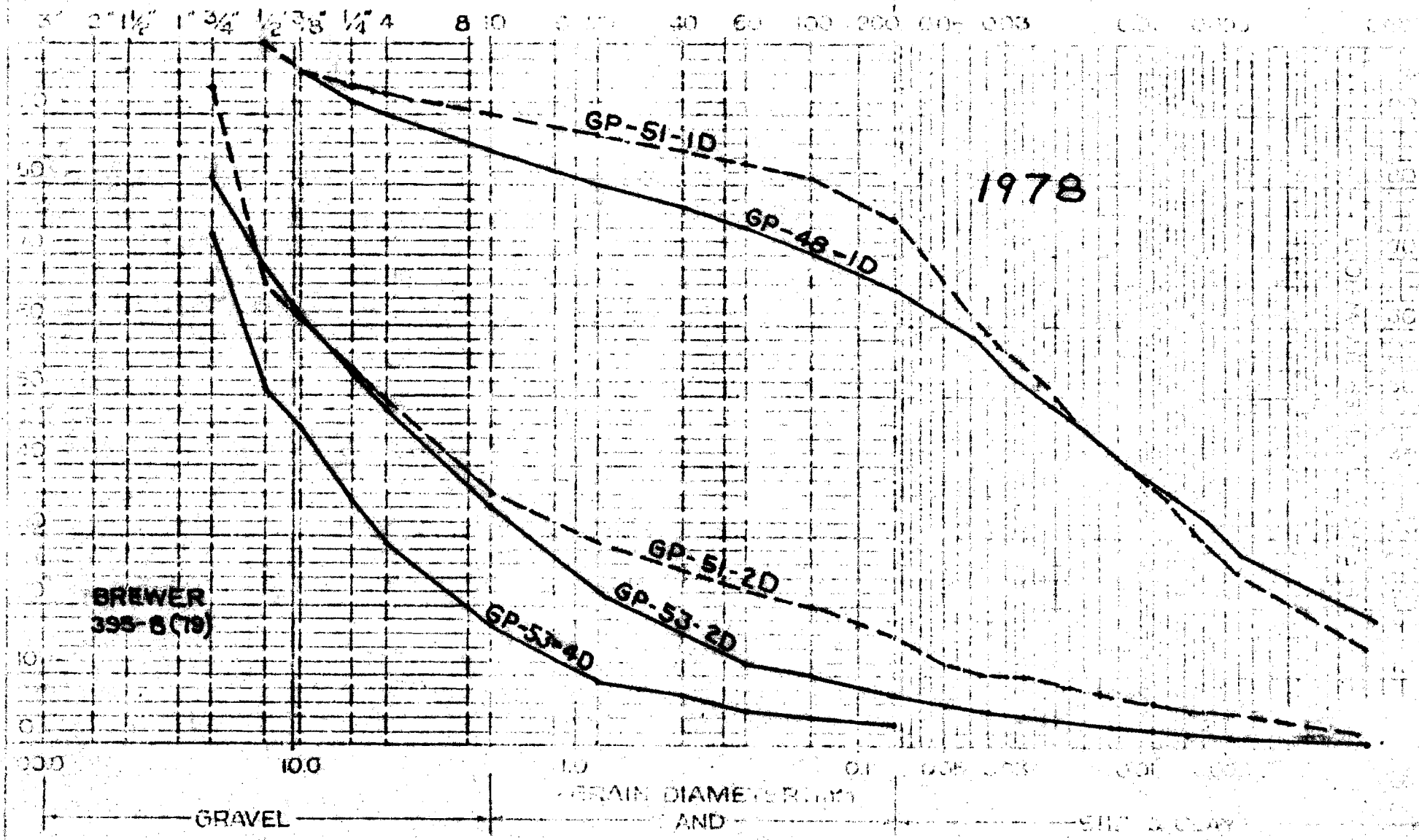
SILT & CLAY

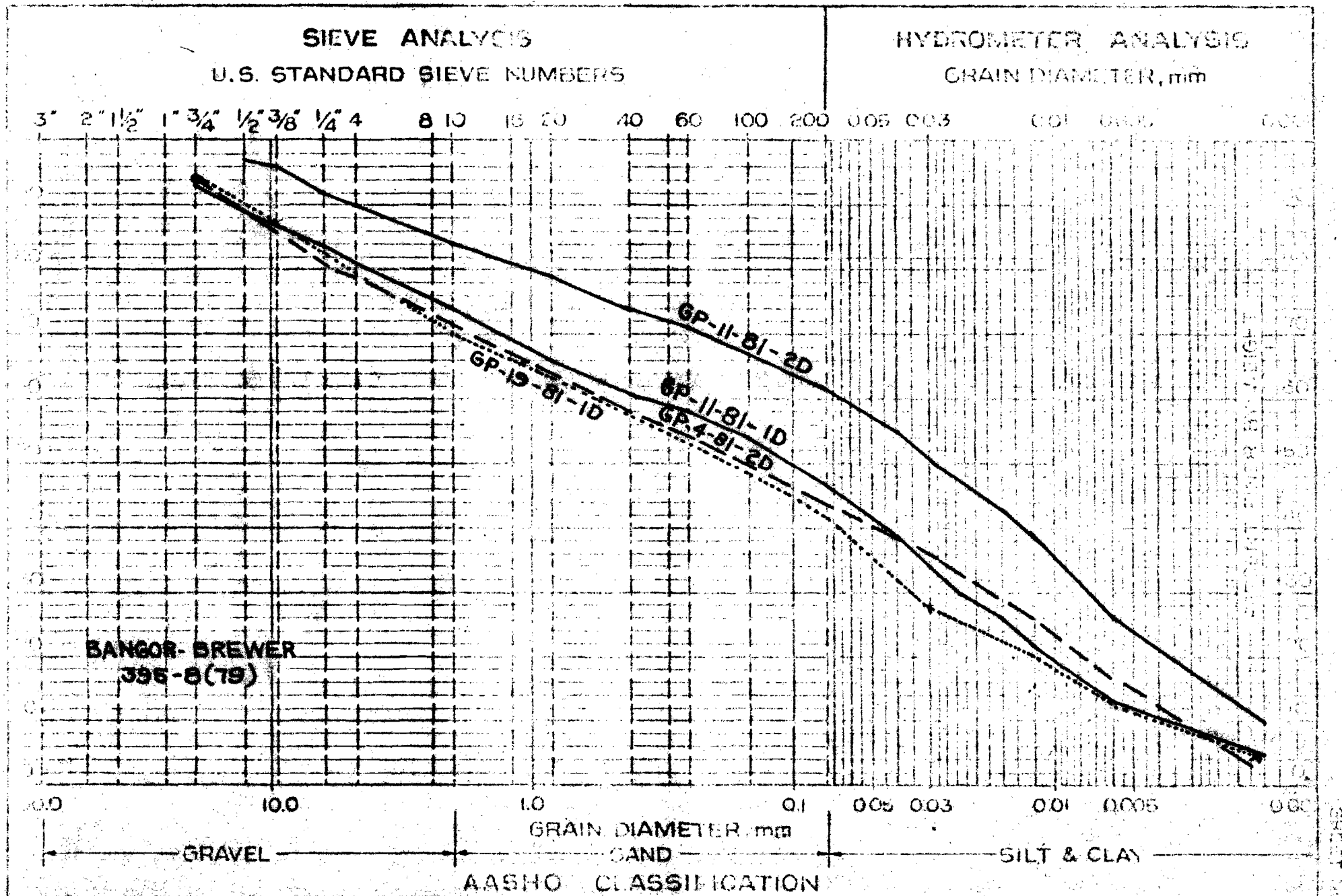
AASHTO CLASSIFICATION

AL-101 (2/88)

SIEVE ANALYSIS
U.S. STANDARD SIEVE NUMBER

100% PASSER ANALYSIS
GRAIN CHARACTERISTICS





LEGEND

PLAN SYMBOLS

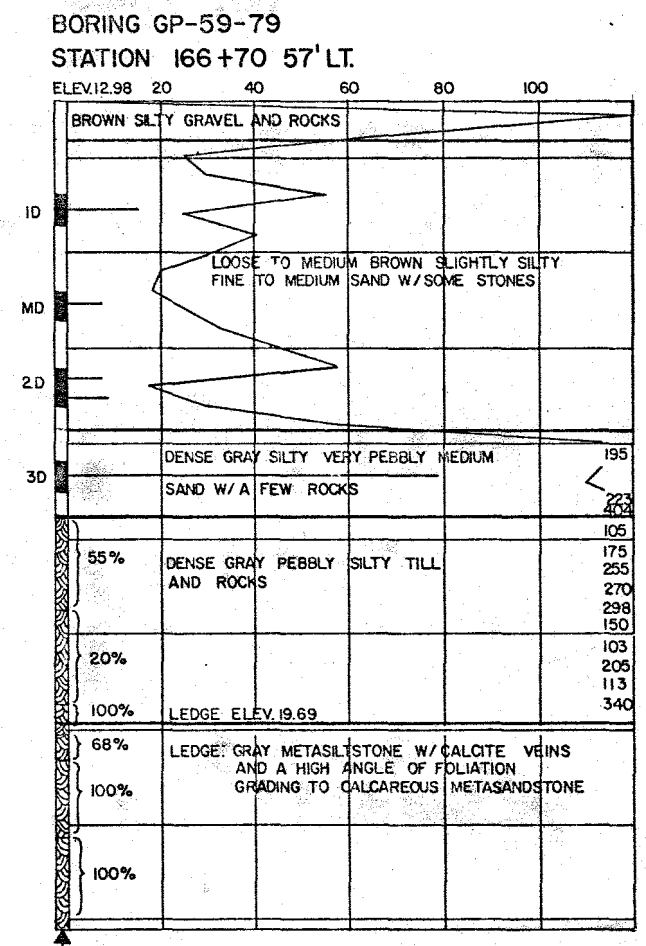
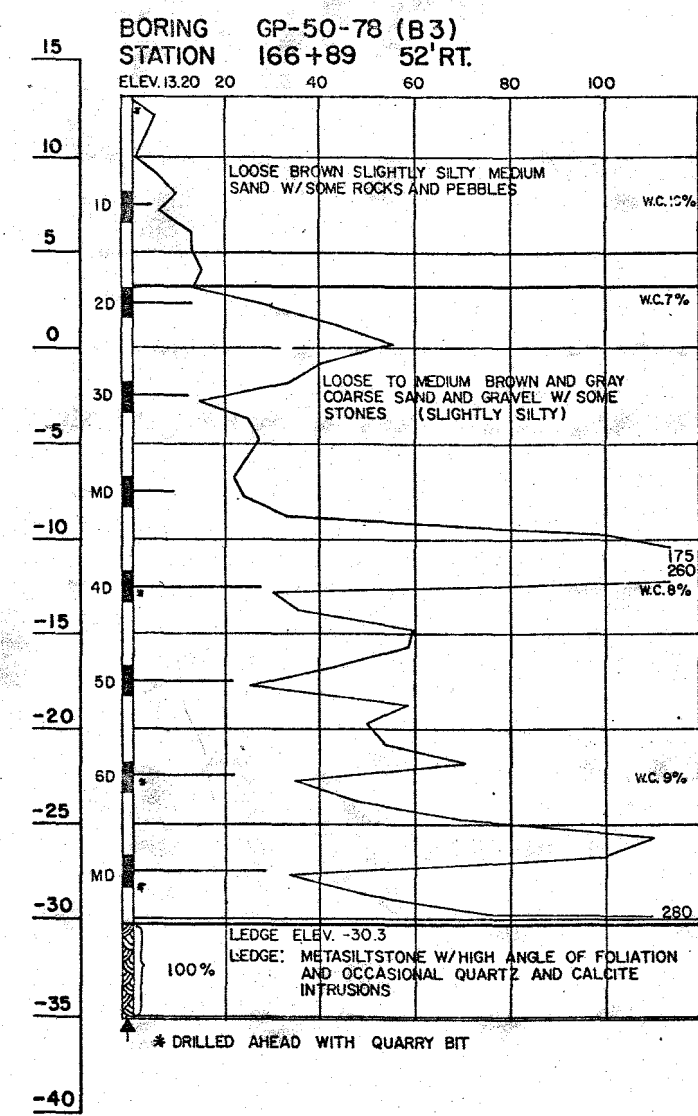
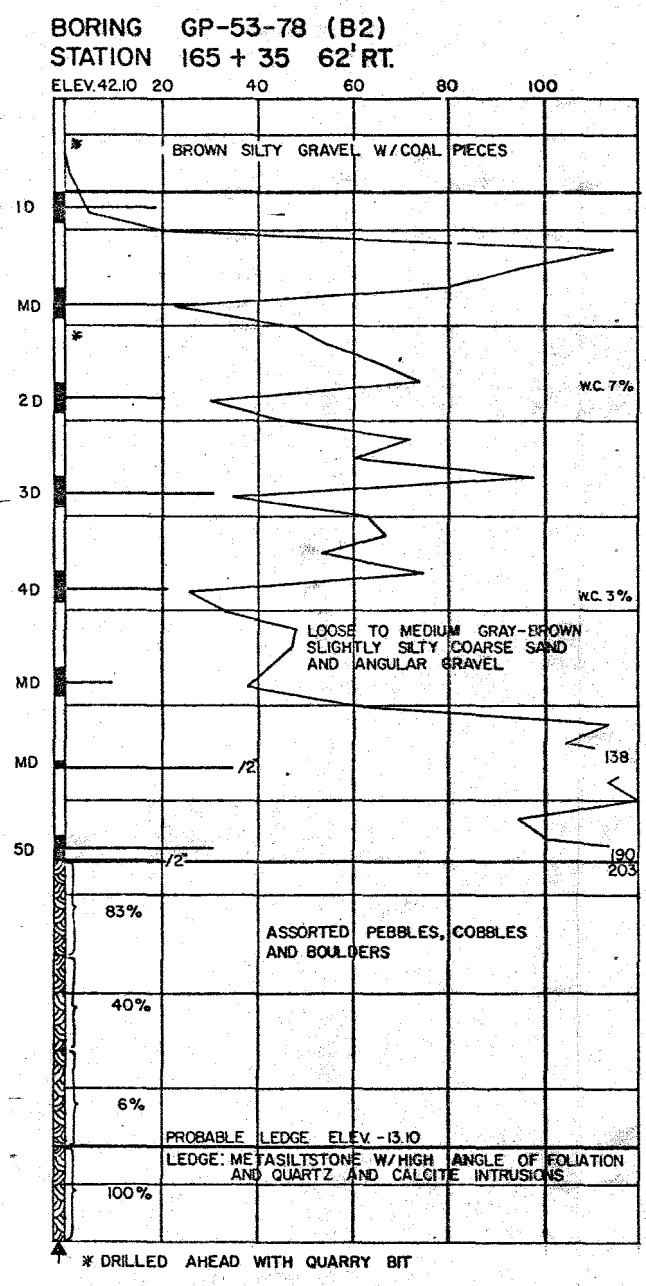
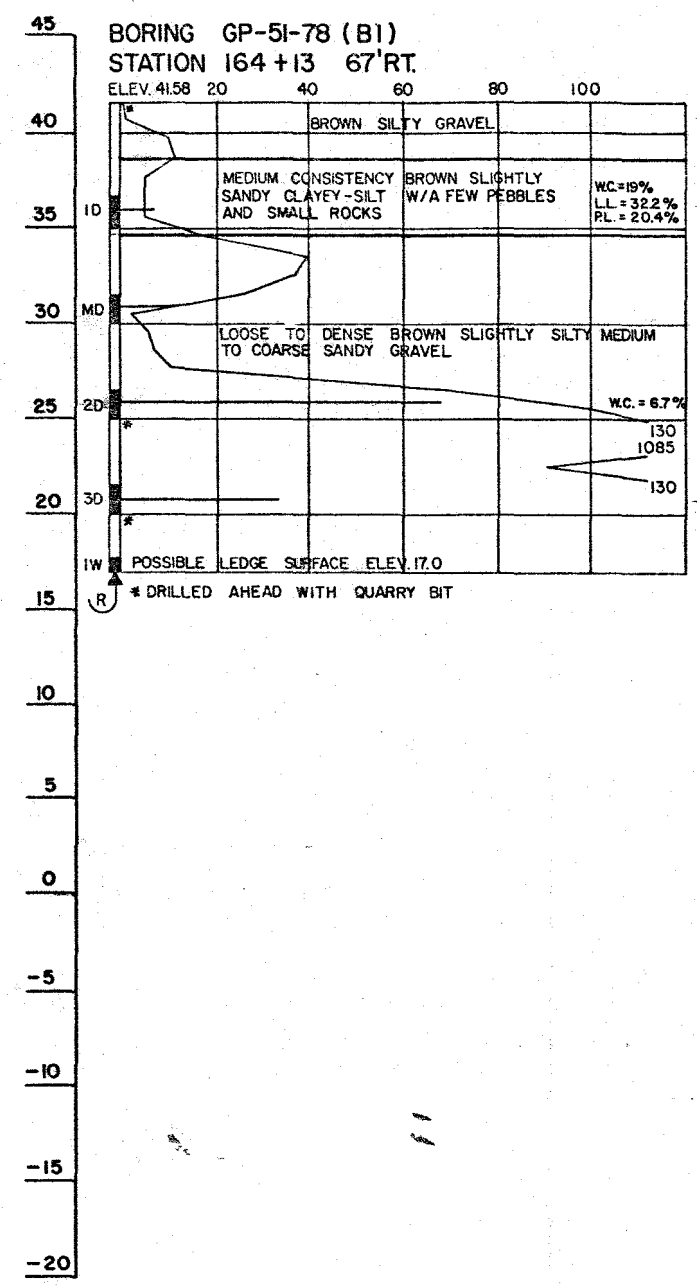
- _____ ROD SOUNDING
- ⊗ _____ AUGER BORING
- ⊗ _____ BORING & SOUNDING
- ⬡ _____ POWER AUGER
- ◎ _____ WASH BORING
- ◇ _____ SEISMIC SHOT LOCATION
- ◆ _____ RESISTIVITY TEST LOCATION
- ⊠ _____ TEST PIT
- ////// _____ LEDGE ON SURFACE

EXPLORATION NOTES

- ⌵ _____ WATER LEVEL
- ⌵
10
08 _____ BLOWS PER FOOT - ROD SOUNDINGS
- ⌵
CLAY
B-160 _____ MATERIAL & SAMPLE NO. - AUGER BORING
- ⌵
5
5 _____ DEPTH OF MATERIAL CHANGE (IN FEET)
- ⌵ _____ BOTTOM OF EXPLORATION
- ⌵
⌵ _____ REFUSAL
- ⌵
⌵ _____ LEDGE

BORING DETAILS

F.H.A. REG. NO.	STATE	PROJECT NUMBER	SHEET NO.	TOTAL SHEETS
1	MAINE	395-8 (79)	6	



- BORING NOTES**
- All samples and vials are made ahead of casing
 - Number of blows required to drive extra heavy casing one foot with 400 ft. lbs. of energy per blow
 - Location of sample or sample attempt
 - ID S & H Sampler #1290's
 - IW Wash sample and number
 - MD Unsuccessful sample attempt and type of sampler
 - Number of blows required to drive spoon or tubing one foot with 350 ft. lbs. of energy per blow
 - Bottom of boring (may not be bottom of soil strata)
 - Refusal of drill rods or casing (may not be ledge)
 - Locations cored by diamond bit and percent recovery of rock

PROJECT DESIGN ENGINEER	BY	DATE
DESIGN - DETAILED		
CHECKED		
REVISIONS		
FIELD CHANGES		

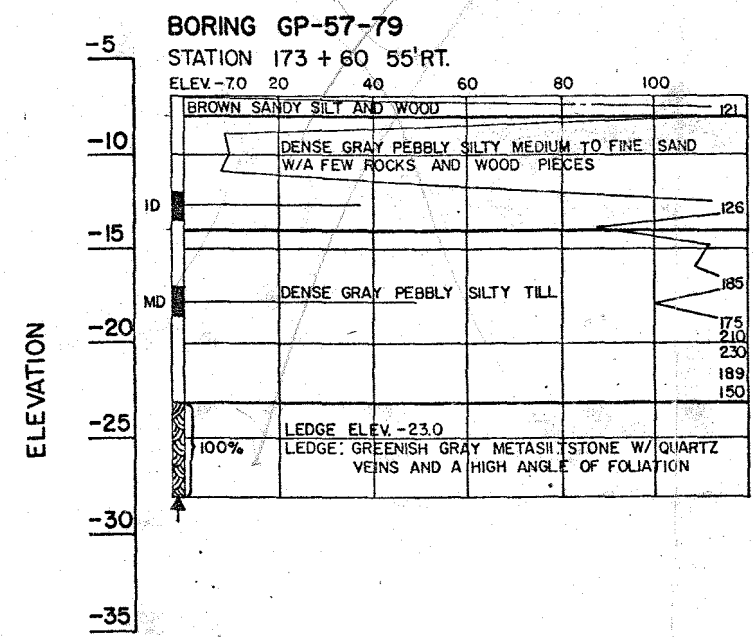
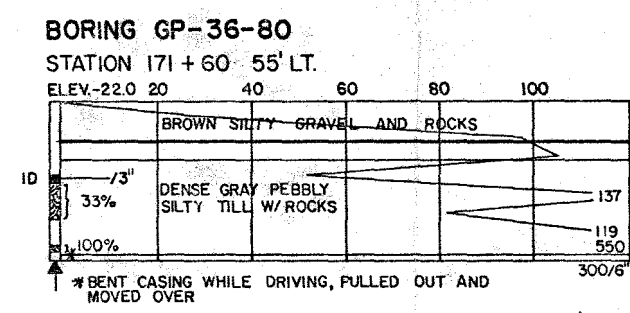
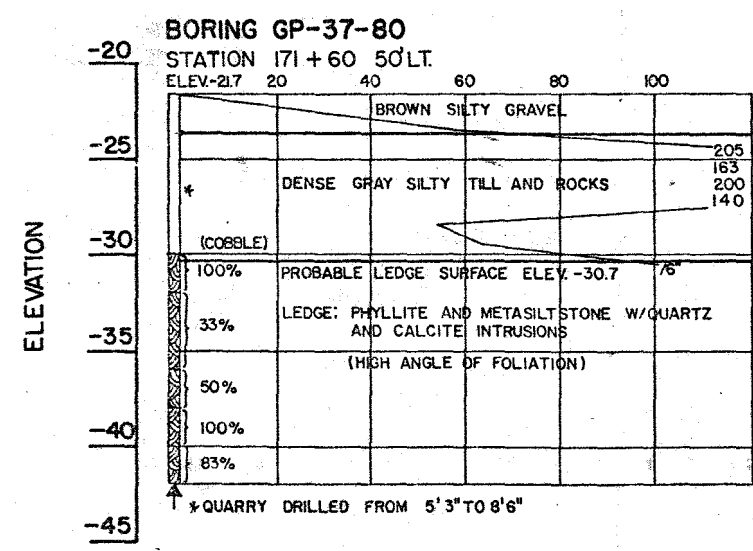
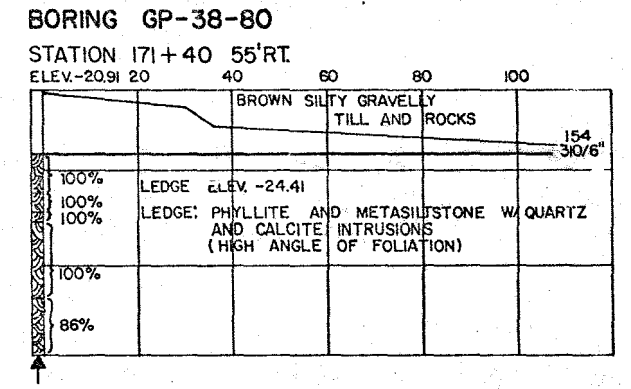
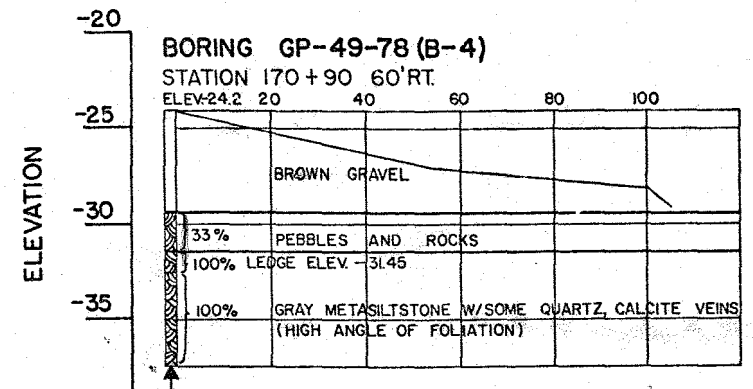
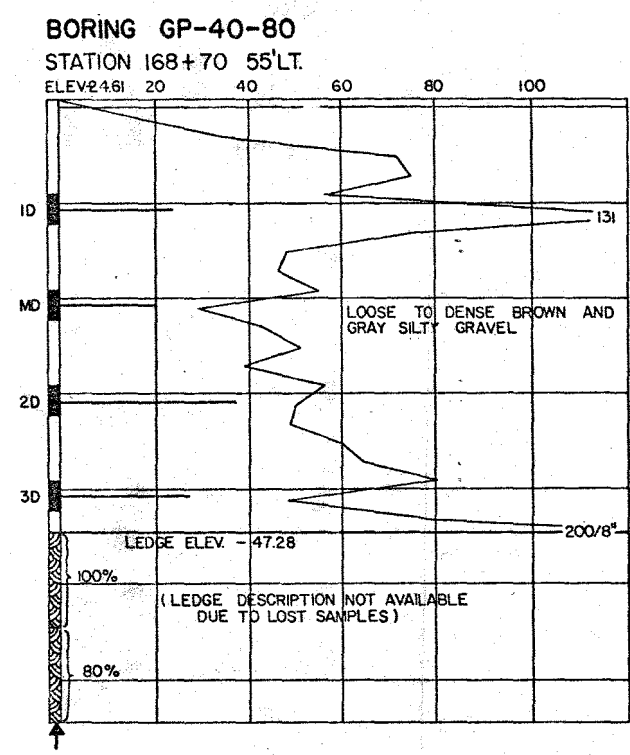
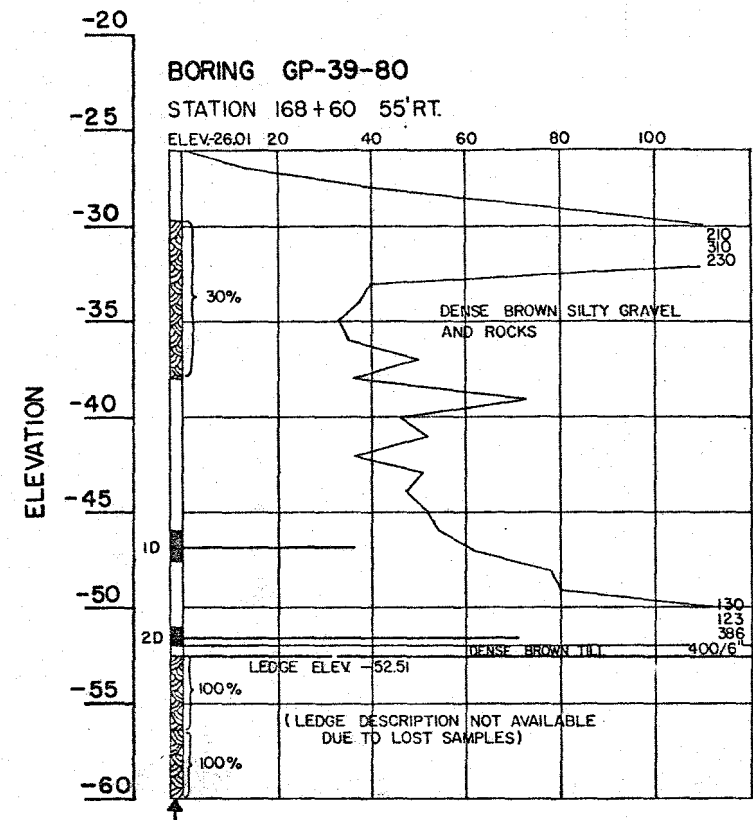
STATE OF MAINE
DEPARTMENT OF TRANSPORTATION

I-395 BRIDGE
OVER
PENOBSCOT RIVER
BETWEEN THE TOWNS OF
BANGOR AND BREWER
PENOBSCOT COUNTY
AUGUSTA, MAINE

SHEET OF

BORING DETAILS

BORING DETAILS



BORING NOTES

All samples and vanes are made ahead of casing

Number of blows required to drive extra heavy casing one foot with 400 ft. lbs. of energy per blow

Location of sample or sample attempt

Number and type of dry sample

S&H Sampler # 1290's

Unsuccessful sample attempt and type of sampler

Number of blows required to drive spoon or tubing one foot with 350 ft. lbs. of energy per blow

Bottom of boring (may not be bottom of soil strata)

71% Locations cored by diamond bit and percent recovery of rock

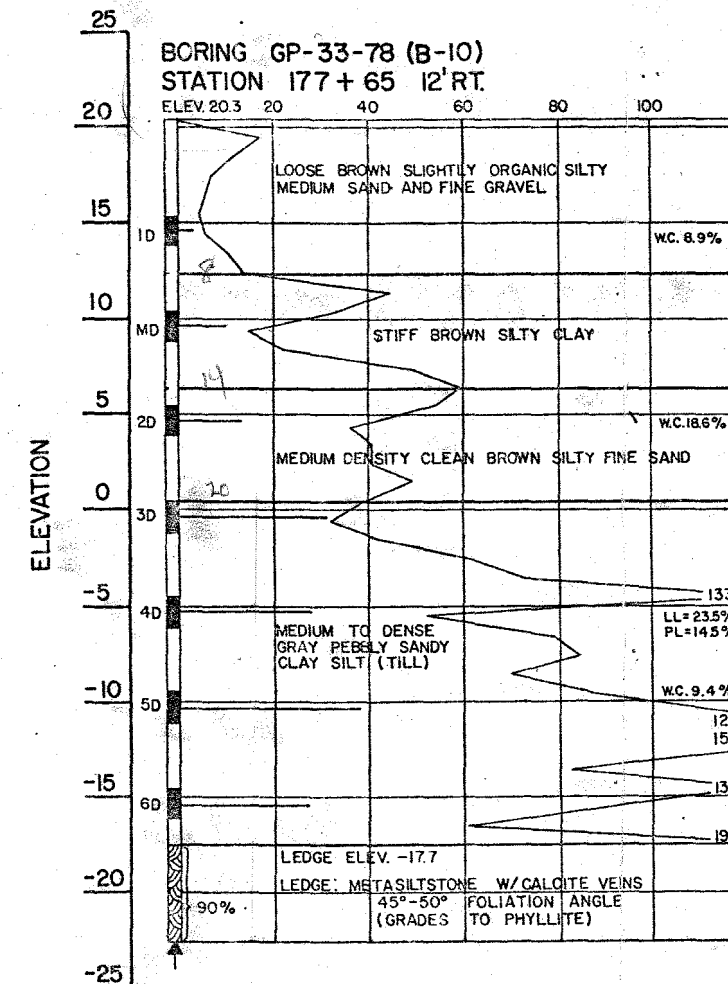
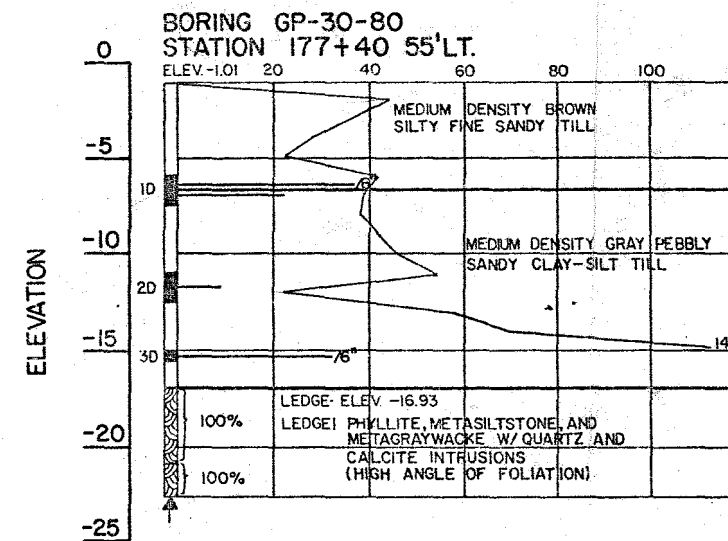
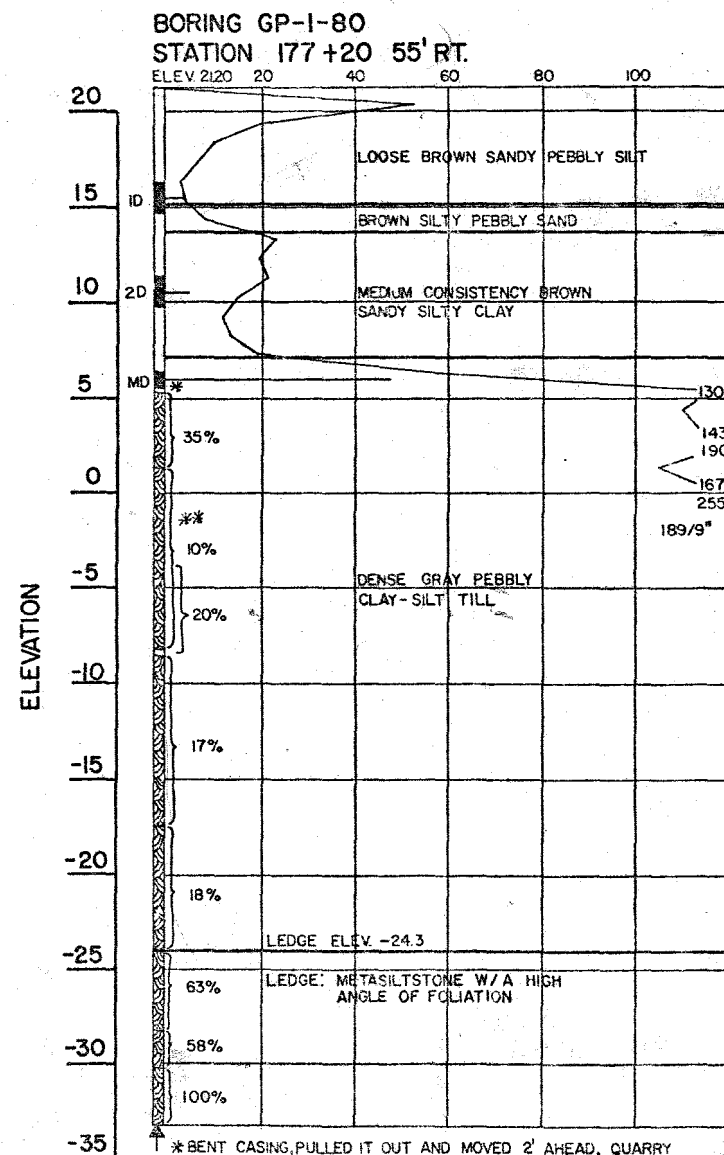
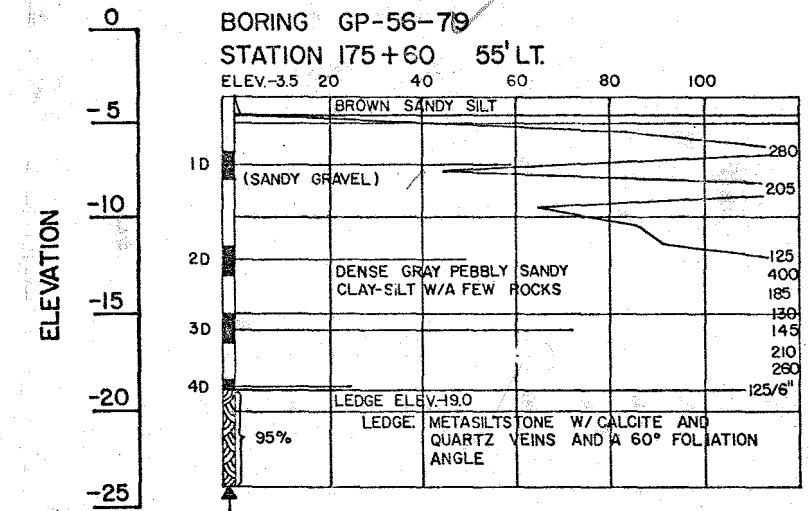
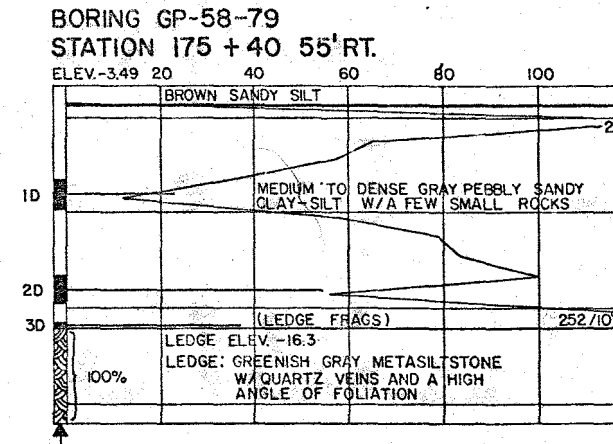
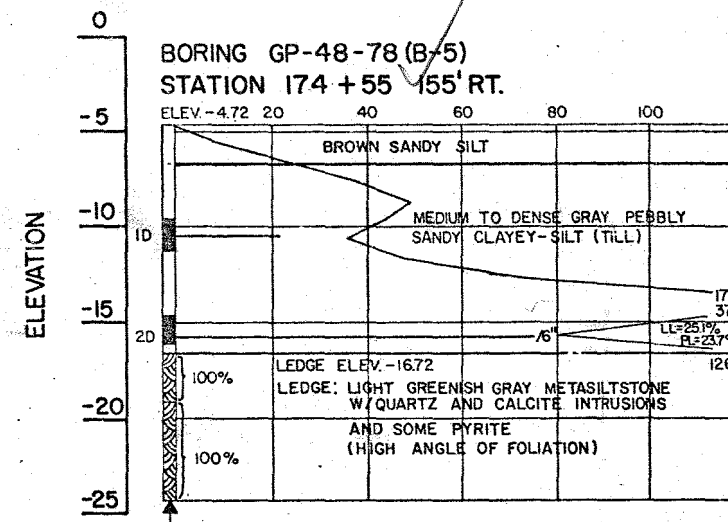
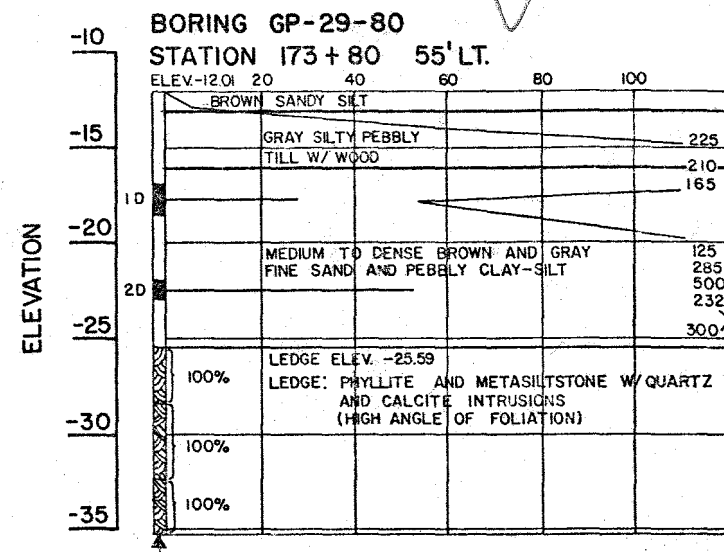
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STATE OF MAINE
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I-395 BRIDGE
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SHEET OF AUGUSTA, MAINE

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PROJECT DESIGN ENGINEER	BY	DATE
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REVISIONS		
FIELD CHANGES		

PLANS

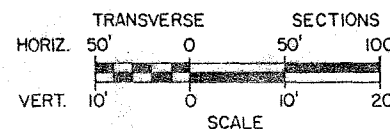
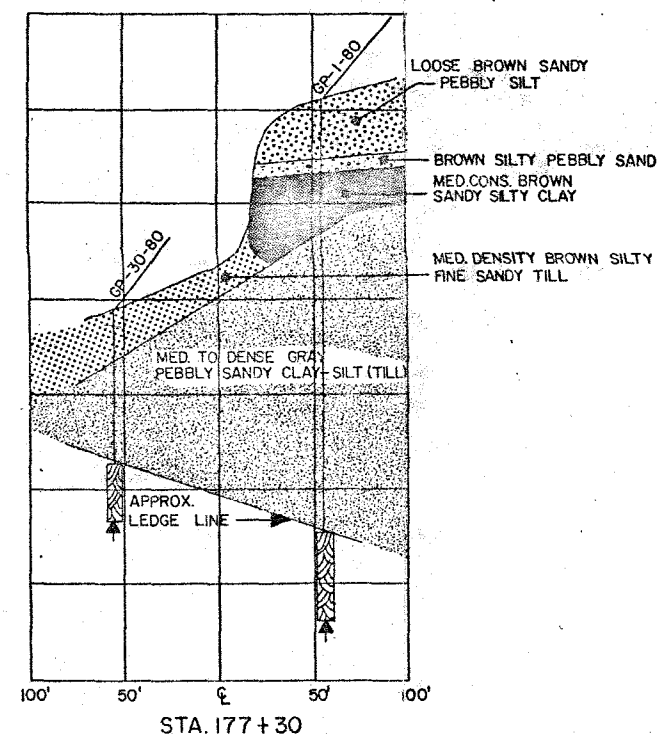
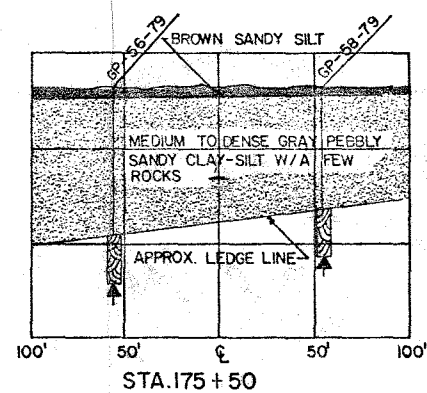
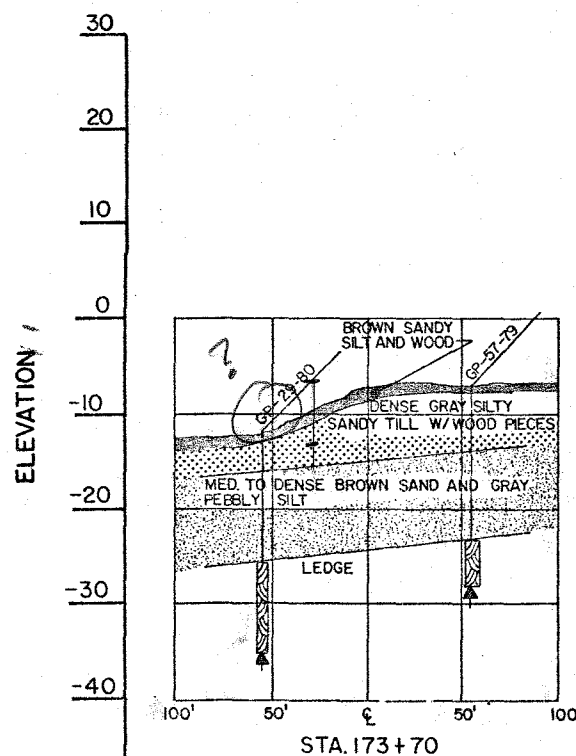
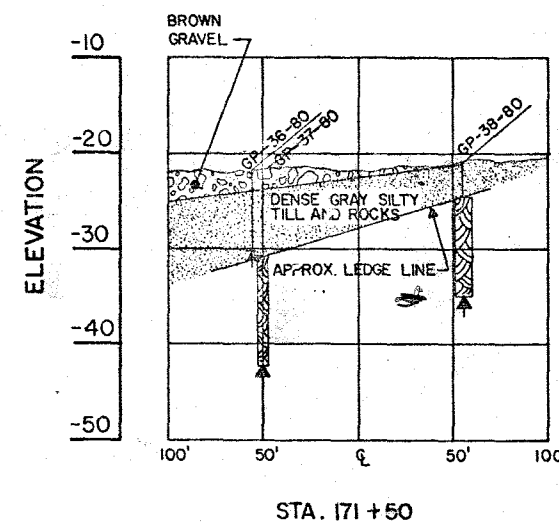
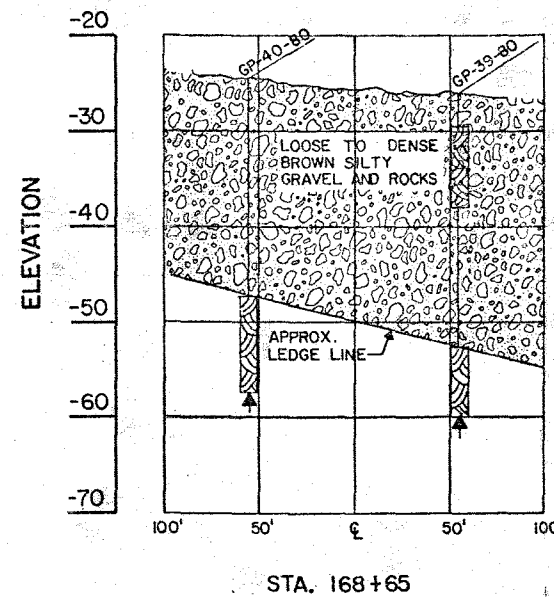
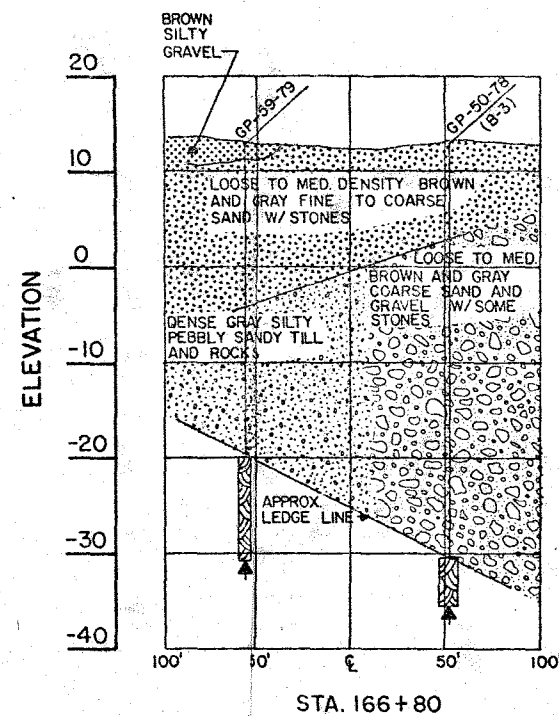
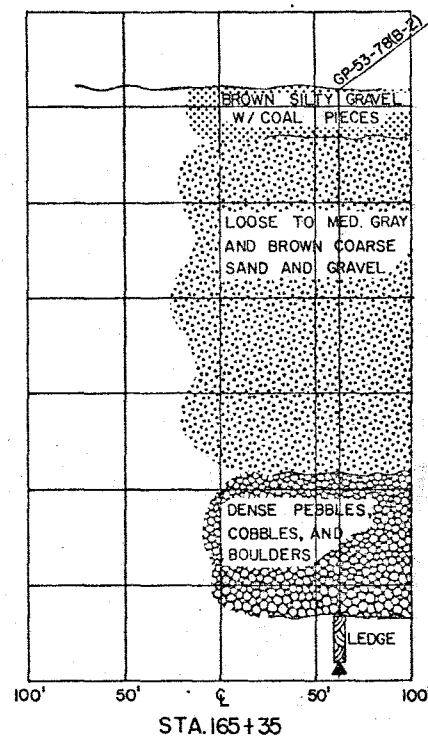
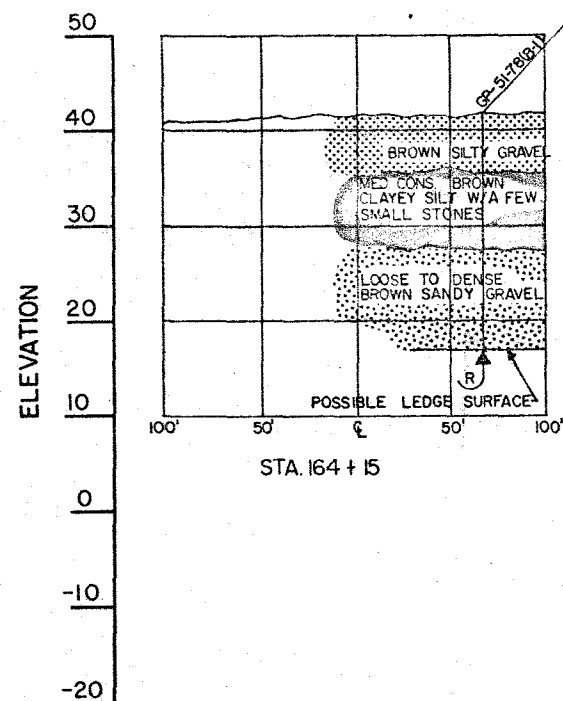
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STATE OF MAINE
DEPARTMENT OF TRANSPORTATION

I-395 BRIDGE
OVER
PENOBSCOT RIVER
BETWEEN THE TOWNS OF
BANGOR AND BREWER
PENOBSCOT COUNTY

SHEET OF AUGUSTA, MAINE

BORING DETAILS



PROJECT DESIGN ENGINEER	BY	DATE
DESIGN-DETAILED		
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REVISIONS		
FIELD CHANGES		

PLANS

BRUNING 44 132 45710

STATE OF MAINE
DEPARTMENT OF TRANSPORTATION

I 395 BRIDGE
OVER
PENOBSCOT RIVER
BETWEEN THE TOWNS OF
BANGOR AND BREWER
PENOBSCOT COUNTY

SHEET OF AUGUSTA, MAINE

TRANSVERSE SECTIONS

Soils Report 83-22
Bangor & Brewer - Penobscot County
Project I-395-8(79)
I-395 Over Penobscot River
August, 1983

Maine Department of Transportation
Materials and Research Division
Soils Section

SUBSURFACE INVESTIGATION FOR THE PROPOSED CONSTRUCTION
OF THE I-395 BRIDGE OVER THE PENOBSCOT RIVER
BETWEEN THE CITIES OF BANGOR AND BREWER

Penobscot County

Project I-395-8(79)
August, 1983

Soils Report 83-22

BANGOR

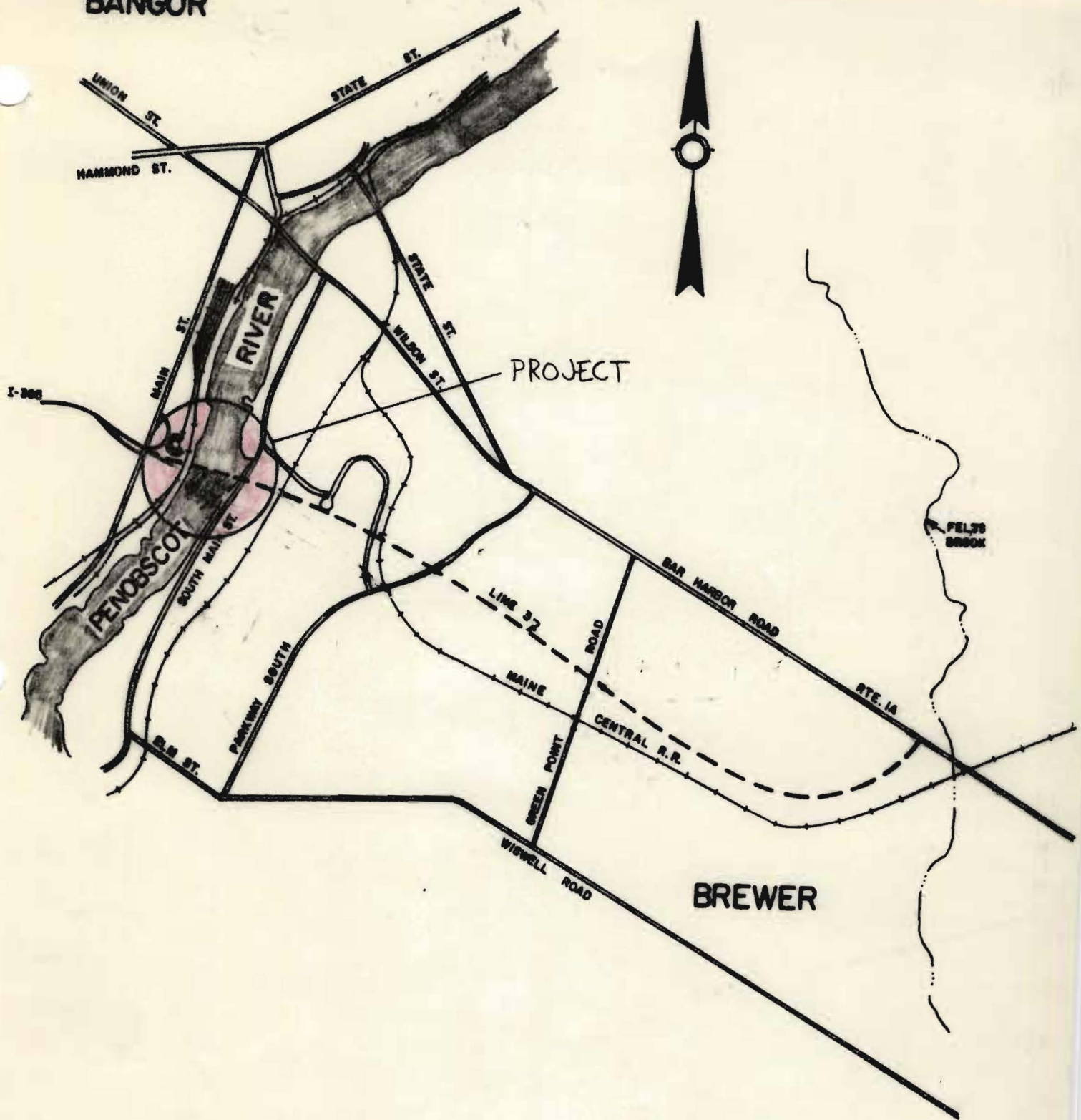


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INTRODUCTION

Final subsurface investigations have been completed for the proposed construction of the I-395 bridge over the Penobscot River between Bangor and Brewer in Penobscot County. A preliminary soils report was provided in January, 1982 and summarizes preliminary soils information obtained on both shores and in the river. More recent borings were made at numerous locations during the summer of 1983 by two Maine Department of Transportation boring crews and Maine Test Borings, Inc. of Orrington, Maine.

In 1982 it was decided to include an alternate design for this structure prepared by a consulting firm. The design prepared by Maine Department of Transportation would consist of steel beams and a concrete deck; whereas, the alternate design would be a cast-in-place segmental concrete bridge. Each alternate would be supported on different pier locations with identical abutment locations. Thus, explorations were made at each substructure location for each alternate design.

The locations of the explorations are shown on the plan-profile sheets on Sheets 11 and 13 and the individual washboring details are shown on Sheets 2 to 10. Transverse sections at all substructure locations are shown with subsurface stratification on Sheets 12 and 14. The masters of these sheets are to be forwarded to the Design Section for inclusion within the construction plans.

GENERAL CONDITIONS

The proposed 1,555 foot long bridge crosses over the Maine Central Railroad (MCRR) yard in Bangor, 1,000 feet of the Penobscot River and South Main Street in Brewer. The MCRR tracks appear to be built on a manmade granular fill on the Bangor shore which is generally described as medium to dense gray and brown sand and gravel which is underlain by 10+ feet of large boulders and cobbles in

some areas. The bedrock surface drops sharply in elevation between the proposed abutment location and the river. Along the Bangor shore, there is an old, deteriorated log cribwork that apparently was used in the past for coal unloading. This cribwork is in rather poor condition and it appears that the river face is essentially vertical.

The riverbed along the I-395 centerline is quite flat on the Bangor side but there are several areas where the river bottom is strewn with boulders and various size rocks. The underlying soil consists of up to 30+ feet of loose to dense fine to coarse gravel with rocks. The riverbed rises gradually towards Brewer and in the intertidal zone, there is up to 4 feet of soft brown sandy clay-silt overlying the gravel. Dense glacial till underlies the gravel in this area and the ledge surface rises gradually towards South Main Street. On the Brewer riverbank, the soil overburden is generally granular fill over stiff brown silty clay over dense glacial till.

DETAILED CONDITIONS AND FOUNDATION RECOMMENDATIONS

Bangor Approach Embankment

The approach fill to the Bangor abutment reaches a proposed height of 50+ feet near the abutment and will be over 200 feet wide due to the presence of access ramps on each side. The existing topography is flat and essentially it is an open, flat field which is believed to have been filled in with material and levelled sometime in the past.

Two washborings were made on the median centerline to check subsurface conditions. At Station 161+85, Washboring GP-36-83 was completed after several attempts were made to get through surface boulders and rocks. There exists at this location 9 feet 8 inches of loose to medium density brown silty sand with gravel and some sandy silty clay. Ledge was core drilled for 6 feet 7 inches and described as metagraywacke with quartz and calcite veins and a high angle of foliation. At Station 163+00, Washboring GP-35-83 was made and encountered

10 feet of loose brown silty fine to medium sand over 3 1/2 feet of soft gray clay-silt that contains some pieces of wood. Underlying this material is 6 1/2 feet of dense gray and brown sandy pebbly gravel. The ledge surface was encountered at the depth of 20 feet (Elevation 24.0) and core drilled for 8 feet 9 inches. The ledge is described as metamorphosed graywacke and siltstone with quartz and calcite intrusions and it exhibits a high angle of foliation.

Judging from these two borings and the general subsurface conditions in this area, no problems with embankment stability or settlement are anticipated.

Abutment No. 1

The proposed centerline of bearing of Abutment No. 1 crosses the median centerline perpendicularly at Station 163+43. Three washborings were made along the proposed abutment location.

Seventy feet to the right of the I-395 centerline, Washboring GP-31-83 was made. The surficial 8 feet of soil at this location is loose gray and brown silty fine sand with some pebbly gravel. This is underlain by 5 feet 9 inches of dense brown and gray silty sand, gravel and ledge fragments. Solid ledge was encountered at Elevation 22.9 and core drilled 5 feet and described as metagraywacke, phyllite and slate with calcite seams and a high foliation angle.

Washboring GP-32-83 was made at Station 163+43 on median centerline. There exists 9 feet of loose brown fine sand and clay-silt with some pebbly gravel and this is underlain by 8 1/2 feet of medium to dense brown silty sandy gravel. Ledge was encountered at the depth of 17.5 feet (Elevation 19.0) and core drilled 10.5 feet. The ledge sample was described as metagraywacke with calcite veins.

At 70 feet to the left of Station 163+43, Washboring GP-33-83 was made. Three feet of brown silty sand and gravel overlies 4.5 feet of loose brown

sandy clay-silt with silty fine sand layers. From the depth of 7.5 to 20.5 feet, there exists brown and gray silty sandy gravel the density of which varies throughout its thickness. Ledge was encountered at Elevation 15.4 and described as metamorphosed graywacke and siltstone which was highly intruded with quartz.

The washboring details for these borings are shown on Sheet 2 and a transverse section depicting the soils stratification at this abutment location is shown on Sheet 14.

It is recommended to support this structure on end-bearing steel H-piles driven to the ledge surface or practical refusal. The ledge surface slopes downward across the abutment area from Elevation 22.9 on the right end to Elevation 15.4 on the left end.

Consideration was given to the use of a spread footing for this abutment either on the existing ground or in the compacted embankment. The surficial 7 to 10 feet of soil is loose density fine sandy clay-silt and would not be suitable for support of the abutment. Construction of a spread footing in the embankment would require the use of good granular material compacted to at least 95 percent of the T-180 maximum density. Some movement of the spread footing would be inevitable due to embankment consolidation and compression of the underlying native soil. Thus, the use of a spread footing for abutment support is not recommended.

CONCRETE ALTERNATE

Pier No. 1

The centerline of bearing of this proposed pier intersects the median centerline at Station 164+93 in the MCRR yard and runs adjacent to Track #6. Also, several old concrete footings that supported the coaling tower can be found in this area. Two washborings were completed by Maine Test Boring, Inc. in this proposed footing area.

Washboring MT-7 (Elevation 42.15) was made 37 feet right of Station 164+93 - a few feet to the east of Track #6. There exists 3.5 feet of loose brown silty sand and gravel, coal, and tar over 20.5 feet of dense gray and brown silty fine to medium sand that contains some rocks and pebbles. Underlying this sand is 23 feet of dense gray and brown medium to coarse sandy gravel with rocks. A large boulder was core drilled at the bottom of this stratum. Ledge was encountered at Elevation -4.9 and the 8.5 foot core sample was described as metasiltstone and metagraywacke with quartz and calcite veins and a high angle of foliation.

Washboring MT-8 (Elevation 41.29) was also made adjacent to Track #6, 35 feet left of Station 163+93. This boring indicates that there exists 18 feet of medium to dense brown fine to medium sand with some pebbles over 29.5 feet of dense brown silty medium to coarse sandy gravel that has some cobbles and rocks. In the lower 4 feet to 5 feet, there exists many cobbles and boulders that had to be core drilled. The solid ledge surface was encountered at Elevation -6.2 and core drilled 9 feet. The sample was described as meta-graywacke with quartz and calcite veins and a high angle of foliation.

The washboring details for these two borings are shown on Sheet 3 and a transverse section for this pier location is shown on Sheet 14.

In order to do these borings, an existing oil pipeline and electrical cable which runs through this footing area had to be physically located. MCRR personnel used a detector and the 4 inch oil line and 550 volt cable were found to run parallel with and 7 1/2 feet to the west of the westerly rail of the Main Track.

Also, a coaling tower used to exist between Station 164+50+ and Station 165+00 and it straddled Tracks #4 and #6. This tower was supported on individual concrete footings spaced 7 feet apart in four parallel rows. Upon demolition of this building

many years ago, the footings were left in place and now there exists 6 inches to 3+ feet of loose gravelly overburden over them. Several rod soundings were made to locate the footings and they were tied in with the I-395 centerline as accurately as possible and are shown on Plan Sheets 11 and 13.

It is recommended to support this pier on steel end-bearing H-piles driven to the ledge surface or to practical refusal in the boulders and cobbles. Protective points should be used on the piles due to the rocky nature of the subsoils, especially in the lower elevations. The ledge apparently drops sharply along the I-395 centerline in this area. Also, removal of the old coaling tower footings will be necessary before pile driving begins.

The use of a spread footing foundation was considered for this pier and from a soils and bearing capacity viewpoint, the conditions appear to be satisfactory for this type of foundation. However, all of the other substructure units will be pile supported or built on bedrock and will undergo essentially no future movement. Thus, it is believed that a pier of this magnitude should not be the only exception and should be pile supported.

Pier No. 2

This proposed pier is located in the river adjacent to the old log cribbing. The centerline of bearing intersects the median centerline at Station 167+50 and the proposed footing length is 120+ feet. Several washborings were made in this location along with several depth soundings in order to investigate the contour of the river bottom adjacent to the cribwork.

Forty-two feet to the right of Station 167+37, Washboring GP-40-83 was made from the raft. At this location there exists 4 feet of brown sandy silt with wood over 18 feet of loose density brown sandy silty gravel. Ledge was encountered at the depth of 22 feet (Elevation -44.6) and core drilled 8 feet with 100 percent recovery. The rock was described as metagraywacke with quartz and calcite veins and a typical high angle of foliation.

Washboring GP-39-83 was made on median centerline at Station 167+42, and encountered conditions very similar to the previous boring. There exists 3 feet of river sediments of loose brown sandy silt over 22 feet of loose gray and brown silty sandy gravel. Two of four split spoon sampling attempts were unsuccessful due to the loose granular conditions. Ledge was encountered at Elevation -46.5 and core drilled 10 feet with 80 percent and 100 percent recovery. The ledge was described as calcareous metagraywacke and metasiltstone with a high angle of foliation.

To the left of centerline, more difficult drilling conditions were encountered. The river bottom in this area apparently has many boulders strewn around and several attempts were made at penetrating these rocks. Washboring GP-41-83 was made at Station 167+43, 45 feet left of median centerline. There are several boulders on the river bottom and after getting by these, 12 feet of loose to medium density brown sandy silt with wood was encountered over 13.5 feet of medium density gray and brown silty sandy gravel. At the depth of 25.5 feet, core drilling was begun through a layer of assorted rocks, cobbles and pebbles and continued for 12.5 feet. It appears that the ledge surface may have been encountered in the last 10+ inches of drilling (Elevation -58.0) since this portion of the sample was metagraywacke with thin calcite seams and a high angle of foliation. Further drilling was not possible due to troublesome drilling conditions. In order to accurately define the ledge surface, another washboring was drilled 5 feet to the left of these borings at a 50 foot offset from centerline. Washboring GP-42-83 also encountered many boulders on the river bottom and similar soils conditions to a depth of 27+ feet. However, the casing bent overnite and had to be pulled back and a third attempt made. Washboring GP-43-83 was made at Station 167+59, 50 feet left of centerline through a layer of boulders. There exists 3 feet of soft brown silt over 19 feet of loose density gray and brown silty fine to coarse gravel. At the depth of 22 feet, the troublesome layer of boulders, cobbles and pebbles was encountered. After the casing was bent and consequently readjusted, 17 feet of rocks was core drilled with

fair recovery rates. It is believed by the crew foreman that the last 1 inch of drilling may have been into the ledge surface. Drilling was halted at a depth of 39 feet 2 inches due to drill bit problems. A fourth and final boring was completed within the proposed footing area and it is designated GP-54-83. This was made 21 feet to the left of Station 167+41 for the primary purpose of locating the ledge surface. The river bottom is strewn with boulders and after getting by these, the boring penetrated 6 feet of soft brown silt and 22 feet of sandy gravel. At the depth of 28 feet a layer of rocks and cobbles was encountered and core drilled for 4 feet. According to the drill crew foreman, ledge was encountered at Elevation -52.1 and core drilled for 6 feet with 100 percent recovery. This 6 feet of rock was described as metamorphosed graywacke and siltstone with quartz and calcite veins and a high angle of foliation.

The washboring details for all of these borings are shown on Sheets 5 and 6 and a transverse section at Station 167+40 is shown on Sheet 14. As shown on the transverse section, the ledge surface drops sharply from centerline to the left and there is at least 12 feet of cobbles, boulders, pebbles, etc. in this "hole". In terms of elevations, the ledge surface is at Elevation -44+ on the right side and decreases slightly to -46.5 at the centerline and then drops to Elevation -58.0+ on the left end of the proposed footing.

It is recommended to construct this pier directly on the ledge surface for best support. Excavation to the left of centerline could be quite difficult due to the rocky layer. Also, the driving of sheeting into and/or through these rocks could be difficult. Penetration through the overlying gravel should be relatively troublefree.

Steel H-piles were also considered for this river pier and are a possible alternative for support. Cost may be the deciding factor along with the fact that pile driving through rocks will likely be very difficult on the left half of this pier and the pile lengths would be quite short. Pile protection would be necessary due to the high probability of pile tip damage in the rocky stratum.

The proximity of the old log cribwork adjacent to this pier may be of some concern during the construction period especially during the driving of the sheet piles. It appears that the bottom of the crib may be below Elevation -20 and that the river front face is essentially vertical. This was difficult to determine because the lowest low tide does not go below Elevation -10⁺. Because the sheeting will be driven within 5 feet of the log crib face, some caution will be necessary to avoid any damage to the cribwork.

Pier No. 3

This proposed river pier spans the Bangor-Brewer boundary line and its centerline of bearing crosses the median centerline perpendicularly at Station 171+20. Three recent washborings were completed within the proposed footing area.

Washboring GP-48-83 (Elevation -23.4) was made 40 feet to the left of Station 171+20. There exists 8 feet 3 inches of dense gray and brown silty fine to coarse gravel with many rocks. Ledge was encountered at Elevation -31.7 and core drilled 10 feet with 100 percent recovery. The ledge is described as metagraywacke with quartz and calcite veins and a high angle of foliation.

Thirty-five feet to the right of centerline, Washboring GP-50-83 (Elevation -23.0) was made. After penetrating 4 feet of brown gravel, a layer of assorted rocks, pebbles, etc. was encountered and had to be core drilled. According to the crew foreman, solid drilling into the probable ledge surface began at a depth of 11 feet (Elevation -34.0) and continued for the next 2 feet of depth. Percent recovery of the core drilled rocks and ledge was low due to the breakup and loss of the material. Thus, the rig was moved 5 feet to the right of this boring and Washboring GP-51-83 was completed. There exists 6 feet of brown gravel and rocks over 5 feet 4 inches of cobbles, pebbles, etc. The ledge surface was encountered at Elevation -34.3 and core drilled for 9 feet 2 inches with a high rate of recovery. The ledge is described as metagraywacke with quartz and calcite veins which grades to phyllite and has a high angle of foliation.

Near the southeast corner of this pier, Washboring GP-38-80 (Station 171+40, 55 feet right) was made three years ago. It should be noted that the ledge surface was encountered at Elevation -24.4 - approximately 10 feet higher than the two recent borings made 25 feet away.

These washboring details are shown on Sheets 7 and 10. Also, a detailed transverse section is shown on Sheet 14.

It is recommended to construct this pier directly on the ledge surface. The ledge surface appears to slope downward from Elevation -31.7 on the left side to Elevation -34+ on the right side, however, some abrupt changes in elevation may be found within the footing area. Also, some difficulty may be experienced with the rocks and cobbles during excavation and/or coffer dam construction. Excavated material should consist of the brown gravel and assorted cobbles and pebbles.

Pier No. 4

This proposed pier is located near the low tide water line in a relatively flat intertidal zone. Two recent washborings were made along the proposed centerline of bearing which intersects the construction centerline at Station 173+55. Two older borings were made in the vicinity of the footing area to the left and right.

Washboring CB-28-83 (Elevation -6.2) was made at 30 feet to the left of Station 173+55. Under 18 inches of soft gray sandy clay-silt sediments, there exists over 3 feet of gray sand and gravel mixed with wood. At the depth of 4 feet 8 inches, a large rock was encountered and prevented any further driving of the casing. This rock and the underlying 18+ inches of rocks and gravel was quarry drilled until the ledge surface was encountered at the depth of 6.5 feet (Elevation -12.7). Below this elevation, 10.5 feet of ledge was core drilled and the sample was described as metasiltstone, phyllite and metagraywacke with quartz and calcite veins and a high angle of foliation. Recovery rates of this

ledge ranged between 70 percent and 75 percent due to core drilling equipment difficulties.

Twenty-five feet to the right of Station 173+55, Washboring CB-32-83 was made. The surficial 4 feet of sediment is described as soft gray sandy clay-silt mixed with wood chips and this is underlain by 7 feet of loose gray sand and gravel. From the depth of 11 feet to 13.5 feet, gray glacial till was found overlying the ledge surface. The ledge surface elevation is -20.1 and 10 feet of cored rock indicates this rock to be metasiltstone with areas of meta-graywacke and quartz and calcite veins and a high angle of foliation. Core blockage problems in this boring again resulted in lower than expected recovery rates.

To the right of the proposed footing area, Washboring GP-57-79 (Elevation -7.0) was made during the preliminary subsurface investigation for this structure. Below a surficial deposit of brown sandy silt mixed with wood lies 6 feet of loose to dense gray pebbly silty fine to medium sand and 9 feet of dense gray pebbly silty till. Ledge was encountered at Elevation -23.0 and core drilled for 5 feet and described as greenish-gray metasiltstone with quartz veins and a high angle of foliation. Also, near the northeast corner of this footing area, GP-29-80 (Station 173+80, 55 feet left) was made and this boring indicates that there is 13.6+ feet of soil deposits - over double the depth of CB-28-83 which is 25 feet away. This indicates that the ledge may drop off near the left end of this footing, or it may be that Boring CB-28-83 near the left end of the proposed footing hit a high spot on the ledge.

The details for these borings can be found on Sheets 7 and 10 along with a transverse section depicting the soils stratification shown on Sheet 14.

It is recommended to construct this pier directly on the ledge surface. The ledge surface appears to drop substantially from Elevation -12.7+ on the

left end to Elevation -22+ on the right end, but it's possible that Boring CB-28-83 at the left end hit a high point on the ledge surface. The excavated material should consist of the soft sediments, sand and gravel and dense gray till.

Pier No. 5

This proposed pier is located within the intertidal zone and its centerline of bearing crosses the median centerline at Station 175+25. Two washborings were made recently within the proposed footing area and one older boring was made to the right of the footing area.

Washboring CB-27-83 (Elevation -4.3) was made 40 feet to the left of Station 175+20 at the left end of the proposed footing area. Under 18 inches of soft gray and brown clay-silt there is 3 feet of gray sand and gravel over 1 foot of dense gray till. Ledge was encountered at Elevation -9.8 and core drilled 10 feet with good recovery. The ledge was described as metasiltstone with quartz and calcite veins and a high angle of foliation.

Thirty-five feet to the right of Station 175+20, Washboring CB-31-83 was made. At this location there exists 2 feet of soft gray sandy clay-silt over 6 feet 9 inches of medium to dense glacial till described as gray pebbly sandy clay-silt. At the depth of 8 feet 9 inches (Elevation -12.5) rock was encountered and core drilled for the next 10 feet. Although the drilling foreman experienced solid drilling, he did indicate that the rock broke up rather easily during drilling and appeared to be quite fractured. Upon arrival at the Central Lab in Bangor, the geologist described the material as the typical parent rock (metasiltstone), however, the foliation angles were variable and in one case flat. It appears that there exists metasiltstone boulders and rocks above the ledge surface and it is difficult to precisely define the ledge surface. The last 17 inches of recovered rock does appear to surely be ledge because of the high foliation angle.

Twenty-eight feet to the southeast of this boring, Washboring GP-58-79 was completed four years ago. This boring was made at Station 175+40, 55 feet right, in the intertidal zone (Elevation -3.49). There exists one foot of brown sandy silt above 11 feet 10 inches of medium to dense gray pebbly sandy clay-silt. Ledge was encountered at Elevation -16.3 and core drilled to Elevation -21.3 and described as greenish-gray metasiltstone with quartz veins and a high angle of foliation.

Thus, it appears likely that the ledge surface does drop rather substantially from left to right across this footing. Ledge elevation on the left end is -9.8 and drops to Elevation -16.3 on the right end.

Washboring details are shown on Sheet 7 and a transverse section at this pier location is shown on Sheet 14.

It is recommended to construct this pier directly on the solid ledge surface. The excavated material should consist of the soft sediments, sand and gravel, the gray glacial till and possibly some rocks or boulders on the ledge surface.

Pier No. 6

This pier's location is along the Brewer shoreline and the left half is currently in the high tidewater area and the right half is on the surrounding embankment. The centerline of bearing crosses the median centerline perpendicularly at Station 177+28. Four washborings were made within or adjacent to the proposed footing area.

On the right end, Washboring GP-1-80 (Elevation +21.20) was made at Station 177+20, 55 feet right of I-395 median centerline on the river bank in Brewer. This boring encountered 6 feet of surficial loose brown sandy pebbly silt underlain by 1 1/2 feet of brown silty pebbly sand and 6 1/2 feet of medium to stiff brown sandy silty clay. From depth 14 to 45 feet 6 inches, dense gray pebbly clay-silt till was core drilled. Because of the till density, the casing was

bent twice and had to be pulled back. At Elevation -24.30, ledge, described as metasiltstone with a high angle of foliation, was core drilled for 9 feet 3 inches. In 1983, a boring was made by Maine Test Boring, Inc. (MT-6) at 30 feet right of Station 177+35 on the top edge of the riverbank. Under 8 inches of topsoil, there is 7.3 feet of loose brown silty fine sand (possibly fill material) over 5 feet of stiff gray and brown mottled sandy silty clay. This is underlain by 5 feet of medium density brown silty fine sand and at the depth of 18 feet (Elevation +1.6) glacial till was encountered. This till, described as dense gray pebbly sandy clay-silt mixed with some gravel, was drilled for the next 25.2 feet, until the ledge surface was found at Elevation -23.6. The ledge was core drilled for 10 feet with excellent recovery and described as metagraywacke with quartz and calcite veins and a high angle of foliation.

To the left of centerline, Washboring CB-30-83 (Elevation -0.3) was made at Station 177+28, 30 feet left. Under 1 foot of gray sandy clay-silt, there is 4 feet of gray silty sand and gravel and 9 feet of glacial till described as medium to dense gray pebbly clay-silt with some rocks. At the depth of 14 feet, core drilling began; however, the initial 3 feet was through large boulders and cobbles. At Elevation -17.3, the ledge surface was encountered and core drilled for 10.5 feet. The recovered sample was described as metagraywacke with quartz and calcite veins and a high angle of foliation.

Off the left end of the proposed footing, Washboring GP-30-80 was made three years ago. This boring was made within the intertidal zone at Station 177+40, 55 feet left of centerline (Elevation -1.01). Five feet six inches of medium density brown silty fine sandy till was found above 10 feet 7 inches of medium density gray pebbly sandy clay-silt till. Ledge was encountered at Elevation -16.93, core drilled and described as phyllite, metasiltstone and metagraywacke with quartz and calcite intrusions and a high angle of foliation.

The boring details of these four borings are shown on Sheet 8 and a transverse section at Station 177+28 is shown on Sheet 14.

It is recommended to support this pier on steel end-bearing H-piles driven to the ledge surface or practical refusal. The glacial till will probably slow pile driving due to its dense state and pile tip protection is recommended. The ledge surface drops from an Elevation of -17.0 on the left end to -24.3 on the right end.

STEEL ALTERNATE

Abutment No. 1

The westerly abutment to this proposed bridge is common to both alternate designs. Discussion of soils investigations at the site is included as Pages 3 and 4 under the details for the concrete alternate.

Pier No. 1

The centerline of bearing of this proposed pier crosses the I-395 centerline at Station 164+60 and follows the existing Track #4 in the MCRR yard. Also, there exists several individual concrete footings to an old coaling tower within the proposed footing area generally to the right of centerline. Three washborings were made along the proposed footing length and several rod soundings were done to investigate the depth and location of the old concrete footings.

Sixty feet to the left of Station 164+60 and a few feet from Track #4, Boring MT-9 was made by Maine Test Borings, Inc. The granular soils at this site consist of 2 feet of brown silty fine to coarse sand mixed with gravel and tar over 30.4 feet of dense brown and gray sandy gravel with some cobbles. Split spoon samples taken at varying depths in the gravel layer consistently averaged 35± blows per foot. At the depth of 32.4 feet (Elevation +9.0) ledge was encountered and core drilled 10 feet. The recovered rock was described as metaquartzite with quartz and calcite veins, some eroded zones, and a 60 degree foliation angle.

Seven feet to the left of Station 164+58, Washboring GP-38-83 (Elevation 41.65) was drilled adjacent to Track #4. The surficial 5 feet of material is relatively loose density coal ash and this overlies 26 feet of loose brown and gray sandy silty gravel. Split spoon samples required between 13 and 22 blows per foot within the gravel layer. At Elevation +10.65, ledge was encountered and core drilled 10 feet with an 80 percent recovery. The rock was identified as meta-graywacke with quartz and calcite veins and a high angle of foliation.

On the right side of this proposed pier location, Washboring GP-37-83 was made 54 feet to the right of Station 164+58. Continuous spoon samples were obtained in the upper 16.5 feet to determine the insitu density of this material. The surficial 4.5 feet is loose black sandy coal cinders and this is underlain by 25.2 feet of medium to dense brown and gray silty sandy gravel. Blow counts per foot in this sandy gravel averaged 26+. At the depth of 28.7 feet (Elevation 13.6) ledge was encountered and core drilled 10 feet with 100 percent recovery. The rock was identified as metagraywacke with quartz and calcite veins and a high angle of foliation.

Details of these washborings are shown on Sheets 2 and 3 and a transverse section depicting the soils stratification at Station 164+58 is shown on Sheet 12.

Also a coaling tower used to exist between Station 164+50+ and Station 165+00 which straddled Tracks #4 and #6. This tower was supported on individual concrete footings spaced 7 feet apart in four parallel rows. Upon demolition of this building many years ago, the footings were left in place and now there exists 6 inches to 3+ feet of loose gravelly overburden over them. Several rod soundings were made to locate the footings and they were tied in with the I-395 centerline as accurately as possible and are shown on Plan Sheets 11 and 13.

It is recommended to construct this first pier on steel end-bearing H-piles driven to the ledge surface. The ledge rises in elevation from Elevation 9.0

on the left end to Elevation 10.7 at centerline and to Elevation 13.6 on the right end. Removal of the old coaling tower footings will be necessary before pile driving begins.

A spread footing design was also considered for this pier but the density of the existing subsoils is variable and would inevitably result in some settlement of this pier. With a pier of this magnitude and the fact that the remaining substructure units are to be supported by the ledge surface, either directly or on piles, it is not desirable to use a spread footing foundation for a single pier.

Pier No. 2

This proposed pier location is on an existing 2:1 embankment slope between two sets of MCRR tracks. The centerline of bearing of this pier intersects the median centerline at Station 165+80 at a 90 degree angle.

Borings by Maine Test Boring, Inc. were made as close as possible to the proposed footing area. In order to maintain stability of the drill rig on the steep slope, the borings had to be made just ahead of the proposed footing area.

Washboring MT-11 (Elevation 17.14) was made 52 feet right of Station 165+90. The initial 2 feet is black sandy gravel with some cobbles and the underlying 10 feet is dense brown silty fine to coarse sand with gravel and some cobbles. The same type of material exists to a depth of 25 feet except that it is black in color and was found to be quite oily. From 25 feet to 42.6 feet, the granular material is dense brown silty sandy fine to coarse gravel with some cobbles and boulders. At the depth of 42.6 feet (Elevation -25.5), the ledge surface was encountered and core drilled 10 feet with 100 percent recovery. The rock is described as metagraywacke with quartz and calcite veins and a high angle of foliation.

Near the left end of this pier, two washborings were made. At Station 165+95, 49 feet left of I-395 centerline, Boring MT-10 (Elevation 16.59) was made through

the granular soils. There is 2.8 feet of surficial black silty fine to coarse sand mixed with coal and oily tar over 5.7 feet of dense brown fine to coarse sand with gravel, various rocks and some boulders. The underlying 9 feet is similar material, however, it is black in color and contains more oil and tar throughout. From the depth of 17.5 feet to 35.6 feet, the soil is dense gray and brown silty sandy fine to coarse gravel with cobbles and boulders. At the depth of 35.6 feet, a large quartzite boulder was core drilled and found to be 5.0 feet thick in the vertical dimension. Underlying this boulder, core drilling was continued for 2.0 feet and encountered portions of boulders, cobbles, etc. Drilling was suspended at this depth of 42.6 feet (Elevation -26.0) due to core drilling difficulties and another boring was started a few feet away in order to reach the ledge surface. Boring MT-10A (Elevation 18.38) was made 6 feet away at Station 165+89, 49 feet left and an auger was used in the initial 30 feet with no sampling. Casing was advanced to a depth of 46.7 feet (Elevation -28.3) until the ledge surface was encountered and it was core drilled with essentially full recovery. The rock was described as metaquartzite with quartz and calcite veins and a high angle of foliation.

The boring details are shown on Sheet 4 and a stratified transverse section at Station 165+88 is shown on Sheet 12.

It is recommended to support this pier on steel end-bearing H-piles driven to the ledge surface or practical refusal. There is a great potential for pile tip damage in this location due to boulders and thus, protective pile points are recommended. It is not known to what extent the boulders exist across this pier so the protective points should be used on all the piles at this site.

A spread footing design was considered for this pier, but it is not considered prudent to support this pier differently than the remaining footings. Although the soil density at and below the proposed footing elevation of +10 appears to be adequate, some movement would be inevitable with a spread footing while other

piers supported either on piles or directly on ledge should not move; thus, a rigid, pile supported footing is recommended.

Pier No. 3

This proposed pier is located in the river within 40 feet of the Bangor shore. The centerline of bearing crosses the I-395 centerline on a slight skew back on the left at Station 167+80 and the pier length is 120+ feet. Washborings were completed near each end.

Washboring GP-45-83 (Elevation -26.4) was made 45 feet right of Station 167+85 within the proposed footing area. There exists 17 feet of loose density gray silty sandy fine to coarse gravel with rocks over 7 feet of dense sandy gravel mixed with rocks and pebbles. Portions of this latter layer were core drilled due to its dense state. At the depth of 22.5 feet, core drilling through rock was again started; however, it was not until a depth of 24 feet (Elevation -50.4) that the drilling foreman encountered the apparent ledge surface. Drilling continued solidly for the next 8.5 feet and the 50 percent recovery was due to core barrel problems. The ledge material was described as tan and gray metagraywacke with a high angle of foliation.

Forty-five feet to the left of Station 167+75, Washboring GP-44-83 (Elevation -25.7) was made after maneuvering around several boulders found on the river bottom. There exists 21 feet of loose brown and gray silty sandy fine to coarse gravel over 8.5 feet of dense gray and brown silty sandy gravelly till. A quarry drill bit was necessary to penetrate this dense till layer. At the depth of 29.5 feet, core drilling was started, however, the initial 2.5 feet was through pebbles and rocks. At depth 32 feet (Elevation -57.7) ledge was encountered and drilled for the next 11 feet with good recovery of the rock. The rock was described as metamorphosed graywacke and siltstone with thin calcite veins and a high angle of foliation.

The boring details for these two explorations are shown on Sheet 7A. Also, a transverse section across Station 167+80 which depicts the soils stratification is shown on Sheet 12.

It is recommended to support this pier directly on the solid ledge surface. The apparent ledge surface rises in elevation from left to right from Elevation -58₊ to -50₊. Excavated material should consist of surface boulders, sandy gravel, and various sizes of rocks and pebbles.

The use of steel H-piles was also considered and is certainly a possible alternative for support. However, pile driving may be difficult in the lower elevations due to the dense rocky nature of the soil and cost considerations may eliminate the feasibility of piles. The use of protective points on the piles would also be necessary due to the high probability of pile tip damage.

Pier No. 4

This pier will be located near mid-channel and its centerline of bearing intersects the I-395 centerline at Station 170+80 near the Bangor-Brewer boundary line. Several washborings were made within the footing area.

Forty feet to the left of Station 170+75, Washboring GP-46-83 (Elevation -23.85) was made. Seven feet of dense gray and brown fine to coarse gravel with frequent rocks was found before core drilling began. Below this 11 feet of rock was core drilled and there exists several feet of assorted rocks and pebbles above the ledge surface. Because there were problems with the core barrel and recovery was poor, it was difficult to determine precisely where the ledge surface began. The recovered rock was described as pebbles over metagraywacke and gray slate with a high angle of foliation. Due to this uncertainty, a new boring was started 2 feet away. After getting through rocks on the river bottom, Washboring GP-47-83 penetrated 7 feet 8 inches of the dense sandy gravel before core drilling began at this depth. Seven feet of rock was core drilled but it was not until the

depth of 11 feet 8 inches (Elevation -35.6) that the drilling foreman believes that the ledge surface was encountered. The initial 4 feet of rock cored was various rocks and pebbles and the ledge was described as metagraywacke with a high angle of foliation. Drilling was suspended due to drill bit problems. Three weeks later, another washboring was made in this footing area to the left of centerline. Washboring GP-55-83 (Elevation -23.8) was made 20 feet left of centerline at Station 170+85 primarily to define the ledge surface. There exists 6 feet of dense brown gravel over 3.5 feet of dense glacial till described as gray pebbly clay-silt. Ledge was encountered at the depth of 9 feet 6 inches (Elevation -33.3) and core drilled for 11 feet with a 100 percent recovery. This rock was described as metagraywacke with quartz and calcite veins and a high angle of foliation.

To the right of centerline, Washboring GP-49-83 (Elevation -23.97) was made at Station 170+75, 35 feet right. This was the shallowest of all the river borings as it penetrated only 2 feet 4 inches of brown rocky gravel before encountering the ledge surface at Elevation -26.2. The ledge was described as phyllite grading to metagraywacke with a heavy intrusion of quartz and calcite and a high angle of foliation. It was core drilled for 7 feet 8 inches and 100 percent of the drilled rock was recovered.

Ten feet beyond the right end of the proposed footing area a preliminary washboring was made five years ago. Washboring GP-49-78 (Boring B-4) encountered several rocks on the river bottom and after numerous attempts, the crew succeeded in penetrating 5.3 feet of brown gravel and 2 feet of underlying rocks and pebbles. Ledge was encountered at Elevation -31.4 and core drilled. Thus, it appears that the ledge surface may drop in elevation near the right end of this pier.

Boring details are shown on Sheets 7A and 10 and a transverse section at Station 170+75 on Sheet 12 illustrates the subsoil conditions.

It is recommended to support this pier directly on the ledge surface. The ledge appears to rise in elevation from $-35\pm$ on the left end to $-26\pm$ on the right end. However, the ledge may drop several feet near the extreme right end, or Boring GP-49-83 may have hit a high point on the ledge surface and the slope of the ledge surface may be less pronounced than depicted.

Excavation of overburden will consist of boulders on the river bottom, fine to coarse gravel, some dense gray glacial till and some assorted rocks and pebbles on the ledge surface.

Pier No. 5

The centerline of bearing of this proposed pier intersects the I-395 centerline at Station 173+28 at a perpendicular angle. Two washborings were made within the proposed footing area.

Washboring CB-29-83 (Elevation -8.1) was made 40 feet left of Station 173+20 and penetrated 2 feet 6 inches of soft gray sandy clay-silt over 5 feet 2 inches of dense gray sand and gravel. Ledge was encountered at the depth of 7 feet 8 inches (Elevation -15.8) and core drilled for 10 feet with excellent recovery. The rock was described as metamorphosed graywacke and siltstone with interbedded phyllite and a high angle of foliation.

At 40 feet to the right of Station 173+20, Washboring GP-53-83 was made. Under the surficial 4 feet of soft brown silt and wood, there exists 6 feet of loose gray silty sandy gravel over 3 feet 10 inches of medium to dense gray pebbly sandy clay-silt till. Ledge was encountered at the depth of 13 feet 10 inches (Elevation -22.8) and core drilled for 9 feet 8 inches. The rock was identified as phyllite and metagraywacke with quartz and calcite veins and a high angle of foliation. Poor recovery in the initial 4 feet cored was due to drill bit problems.

Washboring details are illustrated on Sheet 7A and a transverse section depicting the soils stratification at Station 173+20 is shown on Sheet 12.

It is recommended to construct the pier footing directly on the ledge surface which slopes downward from the left end to the right end. Ledge was found at Elevation -15.7 on the left end and decreased to Elevation -22.8 on the right end.

Overburden excavation should consist of the soft surficial sediments, gray sandy gravel and some gray glacial till.

Pier No. 6

This proposed pier is located within the flat intertidal zone and its centerline of bearing intersects the I-395 centerline at Station 172+28. Two washborings were made recently within the proposed footing area and one older boring was made to the right of the footing area. This pier is at essentially the same location as Pier No. 5 on the concrete alternate.

Washboring CB-27-83 (Elevation -4.3) was made 40 feet to the left of Station 175+20 near the left end of the proposed footing area. Under 18 inches of soft gray and brown clay-silt there is 3 feet of gray sand and gravel over 1 foot of dense gray till. Ledge was encountered at Elevation -9.8 and core drilled 10 feet with good recovery. The ledge was described as metasiltstone with quartz and calcite veins and a high angle of foliation.

Thirty-five feet to the right of Station 175+20, Washboring CB-31-83 was made. At this location there exists 2 feet of soft gray sandy clay-silt over 6 feet 9 inches of medium to dense glacial till described as gray pebbly sandy clay-silt. At the depth of 8 feet 9 inches (Elevation -12.5) rock was encountered and core drilled for the next 10 feet. Although the drilling foreman experienced solid drilling, he did indicate that the rock broke up rather easily during drilling and appeared to be quite fractured. Upon inspection of the rock core at the Central

Laboratory in Bangor, the geologist described the material as the typical parent rock (metasiltstone), however, the foliation angles were variable and in one case flat. It appears that there exists metasiltstone boulders and rocks above the ledge surface and it is difficult to precisely define the ledge surface. The last 17 inches of recovered rock does appear to be ledge because of the high foliation angle.

Twenty-eight feet to the southeast of this boring, Washboring GP-58-79 was completed four years ago. This boring was made at Station 175+40, 55 feet right, in the intertidal zone (Elevation -3.49). There exists one foot of brown sandy silt above 11 feet 10 inches of medium to dense gray pebbly sandy clay-silt. Ledge was encountered at Elevation -16.3 and core drilled to Elevation -21.3 and described as greenish-gray metasiltstone with quartz veins and a high angle of foliation.

Thus, it appears likely that the ledge surface does drop rather substantially from left to right across this footing. Ledge elevation on the left end is -9.8 and drops to Elevation -16.3 on the right end.

Washboring details are shown on Sheet 7 and a transverse section at this pier location is shown on Sheet 14.

It is recommended to construct this pier directly on the solid ledge surface. The excavated material should consist of the soft sediments, sand and gravel, the gray glacial till and possibly some rocks or boulders on the ledge surface.

Pier No. 7

The pier's location is along the Brewer shoreline and the left half is currently in the high tidewater area and the right half is on the surrounding embankment. The centerline of bearing crosses the median centerline perpendicularly at Station 177+28. Four washborings were made within or adjacent to the proposed footing area. This pier location is identical to that of Pier No. 6 on the concrete alternate.

On the right end, Washboring GP-1-80 (Elevation +21.20) was made at Station 177+20, 55 feet right of I-395 centerline on the riverbank in Brewer. This boring encountered 6 feet of surficial loose brown sandy pebbly silt underlain by 1 1/2 feet of brown silty pebbly sand and 6 1/2 feet of medium to stiff brown sandy silty clay. From depth 14 to 45 feet 6 inches, dense gray pebbly clay-silt till was core drilled. Because of the till density, the casing was bent twice and had to be pulled back. At Elevation -24.30 ledge, described as metasiltstone with a high angle of foliation, was core drilled for 9 feet 3 inches. In 1983, a boring was made by Maine Test Boring, Inc. (Boring MT-6) 30 feet right of Station 177+35 on the top edge of the riverbank. Under 8 inches of topsoil, there is 7.3 feet of loose brown silty fine sand (possibly fill material) over 5 feet of stiff gray and brown mottled sandy silty clay. This is underlain by 5 feet of medium density brown silty fine sand and at the depth of 18 feet (Elevation +1.6) glacial till was encountered. This till, described as dense gray pebbly sandy clay-silt mixed with some gravel, was drilled for the next 25.2 feet, until the ledge surface was reached at Elevation -23.6. The ledge was core drilled for 10 feet with excellent recovery and described as meta-graywacke with quartz and calcite veins and a high angle of foliation.

To the left of centerline, Washboring CB-30-83 (Elevation -0.3) was made at Station 177+28, 30 feet left. Under 1 foot of gray sandy clay-silt, there is 4 feet of gray silty sand and gravel and 9 feet of glacial till described as medium to dense gray pebbly clay-silt with some rocks. At the depth of 14 feet, core drilling began, however, the initial 3 feet was through large boulders and cobbles. At Elevation -17.3, the ledge surface was encountered and core drilled for 10.5 feet. The recovered sample was described as meta-graywacke with quartz and calcite veins and a high angle of foliation.

Off the left end of the proposed footing, Washboring GP-30-80 was made three years ago. This boring was made within the intertidal zone at Station 177+40, 55 feet left of centerline (Elevation -1.01). Five feet six inches of medium density brown silty fine sandy till was found above ten feet seven inches of medium density gray pebbly sandy clay-silt till. Ledge was encountered at Elevation -16.9, core drilled and described as phyllite, metasiltstone and metagraywacke with quartz and calcite intrusions and a high angle of foliation.

The boring details of these four borings are shown on Sheet 8 and a transverse section at Station 177+28 is shown on Sheet 12.

It is recommended to support this pier on steel end-bearing H-piles driven to the ledge surface or practical refusal. The glacial till will probably slow pile driving due to its dense state and pile tip protection is recommended. The ledge surface drops from an Elevation of -17.0 on the left end to -24.3 on the right end.

Abutment No. 2

The Brewer abutment for this bridge is located on the west bank of Dyer Cove and its centerline of bearing intersects the construction centerline of I-395 at Station 178+98. Several washborings were made in this area by a Maine Department of Transportation crew and a Maine Test Boring crew.

Along the I-395 centerline, two washborings were made through an existing gravel road. After several unsuccessful attempts were made to advance a hole through rocks and the casing was bent twice, Washboring GP-40-81 was made on centerline at Station 178+75. Five feet of gravel and rocks (probably fill) was found overlying medium to dense brown and gray pebbly sandy clay-silt with rocks. At the depth of 15 feet, the spoon sampler and drill rods were broken within the casing and this boring was abandoned. Seven feet ahead of this location at Station 178+83, Washboring GP-1-82 was made through the gravel road. By continually using a quarry bit, the surficial 5 feet of brown gravel and rocks was

penetrated until the rocky clay-silt was encountered. Twenty-one feet three inches of this material described as medium density gray and brown sandy pebbly clay-silt with rocks, was drilled until the ledge surface was encountered at Elevation -9.1. Five feet of rock was core drilled with 89 percent recovery and described as meta-siltstone with some calcite veins and a heavy intrusion of quartz and a high angle of foliation.

To the left of centerline, Boring MT-12 (Station 179+00, 30 feet left) was made on the existing riprap slope between the sewer station and the cove. This boring was the third attempted hole in this vicinity. At 36 feet left, the initial boring was made to the probable ledge surface at a depth of 19.0 feet (Elevation -7.1). At this point the drill rods broke and a second boring was attempted at 34 feet left but the large riprap stones prevented penetration at this location. Thus, Boring MT-12 was made at 30 feet left and proved to be successful. At this time, there exists 8 feet of brown rocky sandy fill over 4 feet of loose gray and brown fine sandy silt and 7.3 feet of medium density brown silty fine sand. At Elevation -7.4 ledge was encountered and core drilled 9 feet and described as metamorphosed graywacke and siltstone with quartz and calcite veins, zones of phyllite and a high angle of foliation.

Two borings were made to the right of centerline in a grassed yard. Boring MT-5 was made 50 feet to the right of Station 178+98 under the right end of the proposed footing. Under 8 inches of topsoil there is 6.7 feet of stiff brown and gray mottled sandy silty clay with a few stones underlain by 15.8 feet of glacial till described as dense gray pebbly sandy clay-silt with some gravel. At the depth of 23.3 feet (Elevation -10.1) ledge was encountered and core drilled for 10 feet with 100 percent recovery. The ledge sample was described as meta-graywacke with quartz and calcite veins and a high angle of foliation. The second boring on the right was made 40+ feet beyond the right end of the proposed footing

at Station 179+10, 100 feet right. Washboring GP-55-82 (Elevation +14.14) shows that there exists 10 feet of dense brown pebbly sandy clay-silt over 12.9 feet of dense gray glacial till. The lower 3 feet of this till was found to be very dense. At the depth of 22.9 feet (Elevation -8.7) refusal was encountered and this is believed to be on the ledge surface.

The boring details of all these borings are illustrated on Sheet 9. A transverse section illustrating the soils stratification at Station 178+98 is shown on Sheets 12 and 14.

It is recommended to support this abutment on steel end-bearing H-piles that are driven to the ledge surface. The ledge surface is relatively flat within the footing area and ranges from Elevation -7.4 on the left end, -9.1 at the center and -10.1 on the right end. It is recommended to remove the riprap on the existing embankment for the sewer station to the left of centerline prior to placing fill. The size of these rocks could effectively stop a pile and prevent it from reaching the ledge surface more than 15 feet below.

Brewer Approach Embankment

This embankment is discussed in detail in Section 5.1 of Soils Report 83-6. Generally, the high embankments that will carry the northbound and southbound lanes along with Ramps SM-2B and SM-1 do not present any stability problems. However, some settlement of the fill in the Dyer Cove section is anticipated during the construction phase. Approximately 11 inches of settlement was theoretically calculated to occur at Station 180+00 with 95 percent consolidation occurring within 1 to 3 months after embankment construction.

SUMMARY

A subsurface soils investigation has been completed for the proposed I-395 bridge over the Penobscot River between Bangor-Brewer. Two design alternatives are being developed for this structure and the pier locations for each alternate generally occur at different stations. Many washborings were made on each shore and in the river at each proposed footing location over the last several years by

Maine Department of Transportation and Maine Test Boring, Inc. crews. The resultant subsurface data is presented in a divided format - Concrete Alternate and Steel Alternate. The locations of all the explorations are shown on Sheets 11 and 13 along with a stratified profile along the I-395 centerline. Transverse sections showing subsurface stratification at each pier for each alternate are shown on Sheets 12 and 14. Also, the individual boring details are shown on Sheets 2 through 10.

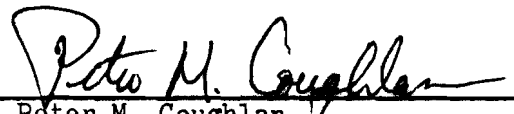
Generally, the subsurface conditions at this site consist of granular soils and the underlying ledge surface is solid metamorphosed siltstone and graywacke with a high angle of foliation. On the Bangor side, the abutment and first pier(s) are to be located in the MCRR yard. The soils consist of medium to dense brown-gray sand and gravel with pebbles, cobbles and various sizes of rocks. Between Stations 164+90₊ and 166+00₊, the material just above the ledge surface contains several large boulders (5₊ feet thick) and cobbles. The underlying ledge surface drops sharply in elevation towards the river along the centerline. The subsoils beneath the Penobscot River are granular and tend to be kept free of sediments due to the constant tidal exchange, except for the first 400₊ feet from the Brewer shore where this relatively flat area is covered with up to 4 feet of soft brown sediments. In the main channel on the Bangor side, the subsoils are loose to dense gray-brown fine to coarse gravel with rocks. Within the first 100₊ feet from the Bangor shore, this gravel is underlain by up to 16₊ feet of cobbles, pebbles and rocks especially in the area to the left of the proposed I-395 centerline. A similar rocky layer can be found near Station 171+00. On the Brewer shore, the roadway fill overlies a small layer of stiff brown silty clay and up to 30₊ feet of dense gray glacial till.

It is recommended to support the two abutments and accompanying piers directly on the ledge surface or on steel end-bearing H-piles driven to the


ledge surface. No spread footing foundations are recommended even though at some locations the subsurface soils have adequate bearing capacity. The reasoning being that the substructure units of this structure are predominantly going to be supported either directly on ledge or on piles driven to ledge and should not move. Thus, it does not seem prudent to support one or two piers on spread footings which almost certainly will experience some movement. Generally, the land substructures are to be pile supported and the river piers are to be constructed directly on the solid ledge surface. Pile driving on the Bangor side could be difficult at times due to the presence of boulders, cobbles, etc. in the overburden especially just above the ledge surface. Pile points to protect the H-piles are recommended for all piles. The excavation for the river piers may also be difficult at times, especially adjacent to the log cribwork in Bangor, due to the deposit of various sizes of rocks above the ledge. The driving of sheets for coffer dams may also be hindered by these rocks. There also is evidence that the river bottom adjacent to the log cribwork is strewn with boulders as several attempts were required at times to get a boring started through them.

In some locations borings made during the preliminary subsurface investigation for this project and located quite near presently proposed pier locations encountered what appears to be ledge at a significantly different elevation from where the borings recently completed for the final proposed structures encountered ledge. Thus, it is probable that within a footing area there may be irregularities in the ledge surface; i.e., individual washborings may have hit a local high spot or crevasse in the ledge.










Prepared By:


Peter M. Coughlan
Associate Geotechnical Engineer

Approved By:


Guy L. Baker
Assistant Soils Engineer

BORING NOTES

- All samples and vanes are made ahead of casing
-  Water elevation
-  Number of blows required to drive extra heavy casing one foot with 400 ft. lbs. of energy per blow
-  Location of sample or sample attempt
-  Number and type of dry sample
- ID 3 $\frac{1}{2}$ H Sampler #1290's
- IC 2" O.D. 16 ga. seamless tubing
- IU 3 $\frac{1}{2}$ " O.D 16 ga. seamless tubing
- IW Wash sample and number
- MD Unsuccessful sample attempt and type of sampler
-  Number of blows required to drive spoon or tubing one foot with 350 ft. lbs. of energy per blow
- H Sampling spoon or seamless tubing driven by static weight of drill rods and hammer
- P Piston sampler
-  Field vane test
-  Bottom of boring (may not be bottom of soil strata)
-  Refusal of drill rods or casing (may not be ledge)
-  Locations cored by diamond bit and per cent recovery of rock

SHEAR NOTES

- Field vane shear strengths
- X Laboratory vane shear strengths
- Shear strengths in excess of capacity of equipment
- One half unconfined compressive strengths

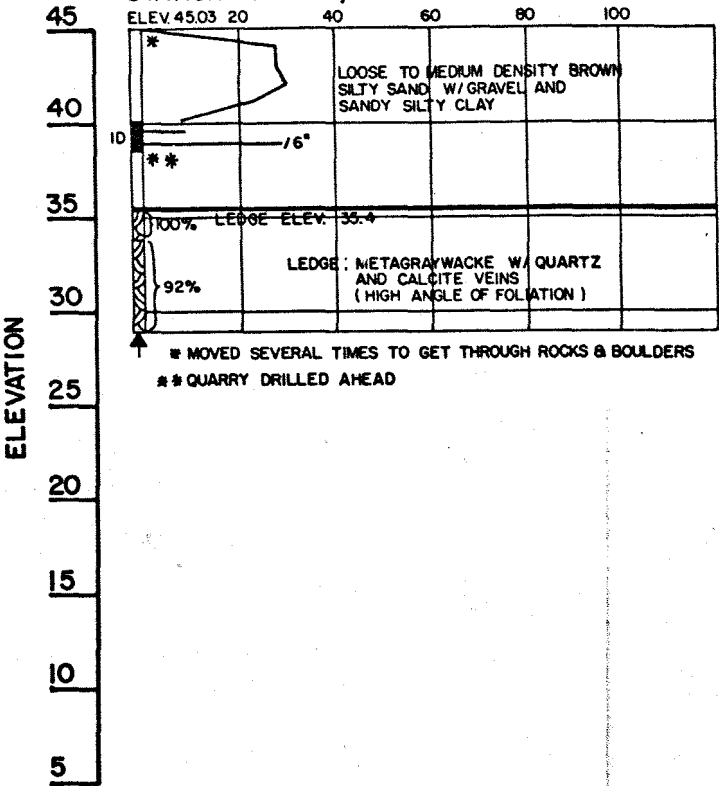
WATER CONTENT NOTES

- Natural water contents, given as per cent of dry weight
 - X Plastic and liquid limits
- Ignition losses are given as per cent of dry weight

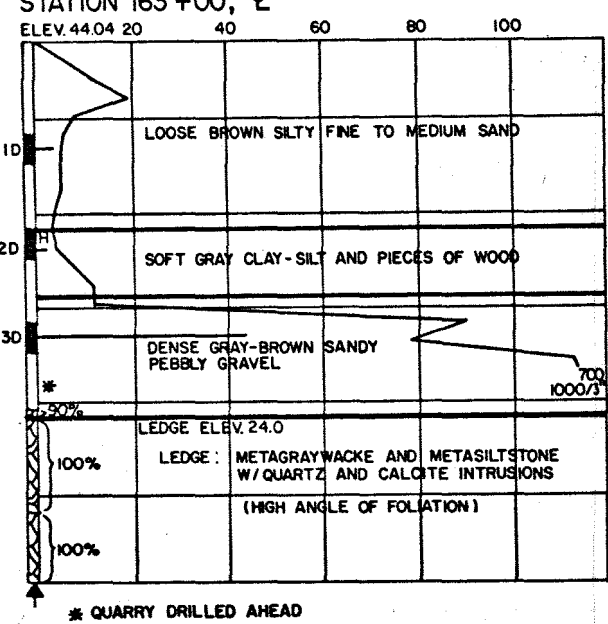
BORING DETAILS

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1	MAINE	395-8(79)	2	

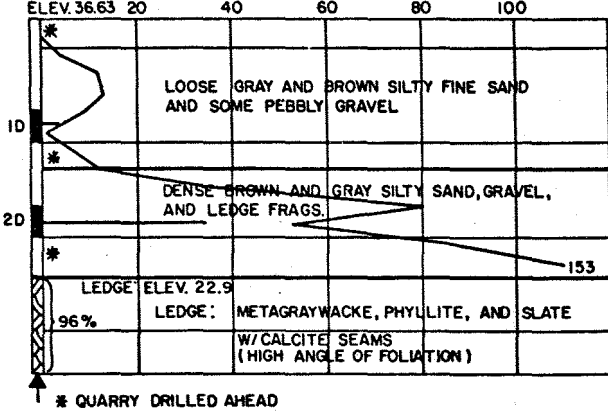
BORING GP-36-83
STATION 161+85, C



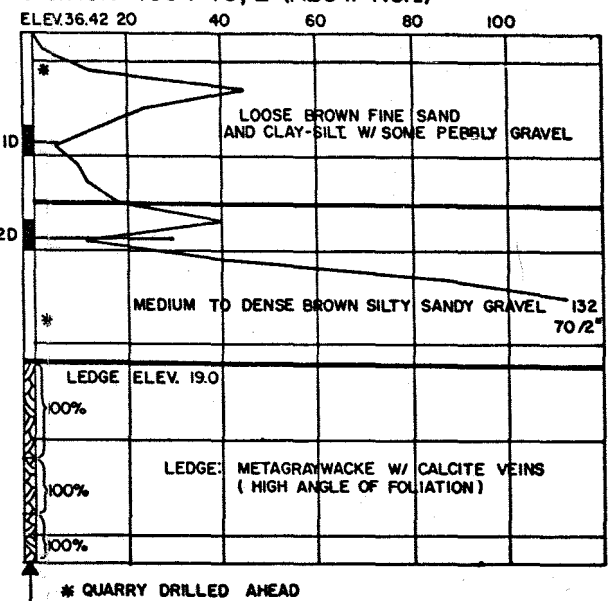
BORING GP-35-83
STATION 163+00, C



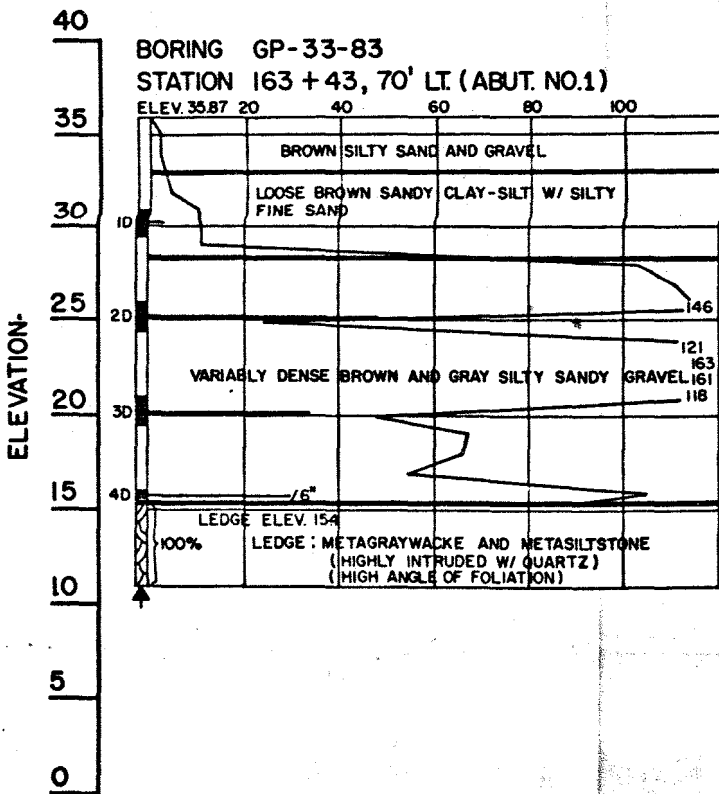
BORING GP-31-83
STATION 163+43, 70' RT. (ABUT. NO.1)



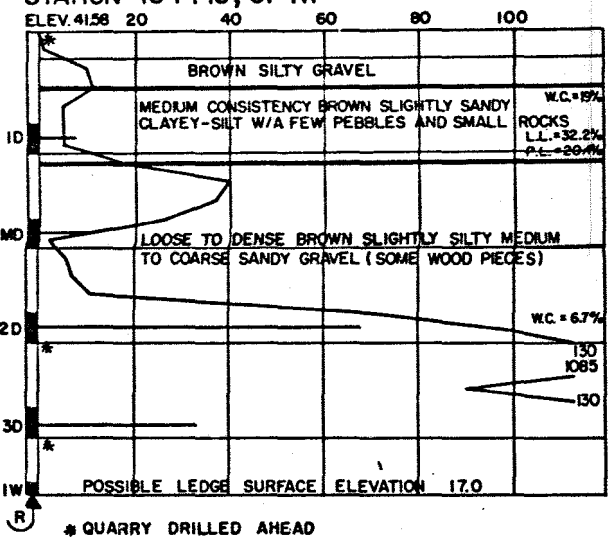
BORING GP-32-83
STATION 163+43, C (ABUT. NO.1)



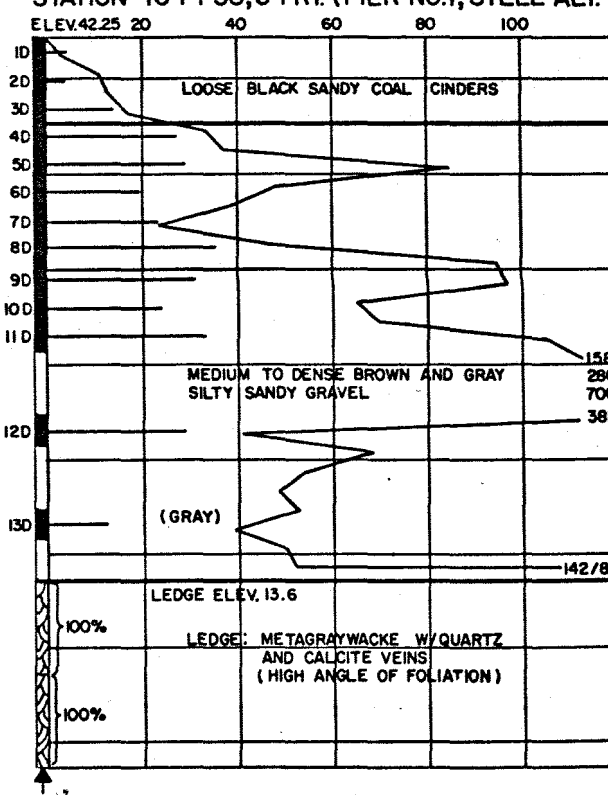
BORING GP-33-83
STATION 163+43, 70' LT. (ABUT. NO.1)



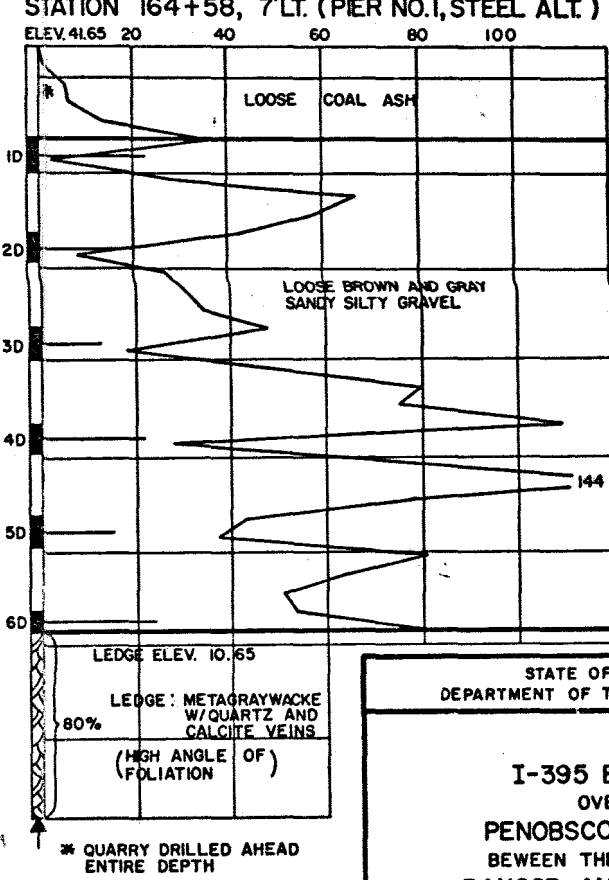
BORING GP-51-78 (B-1)
STATION 164+13, 67' RT



BORING GP-37-83
STATION 164+58, 54' RT. (PIER NO.1, STEEL ALT.)



BORING GP-38-83
STATION 164+58, 7' LT. (PIER NO.1, STEEL ALT.)



STATE OF MAINE
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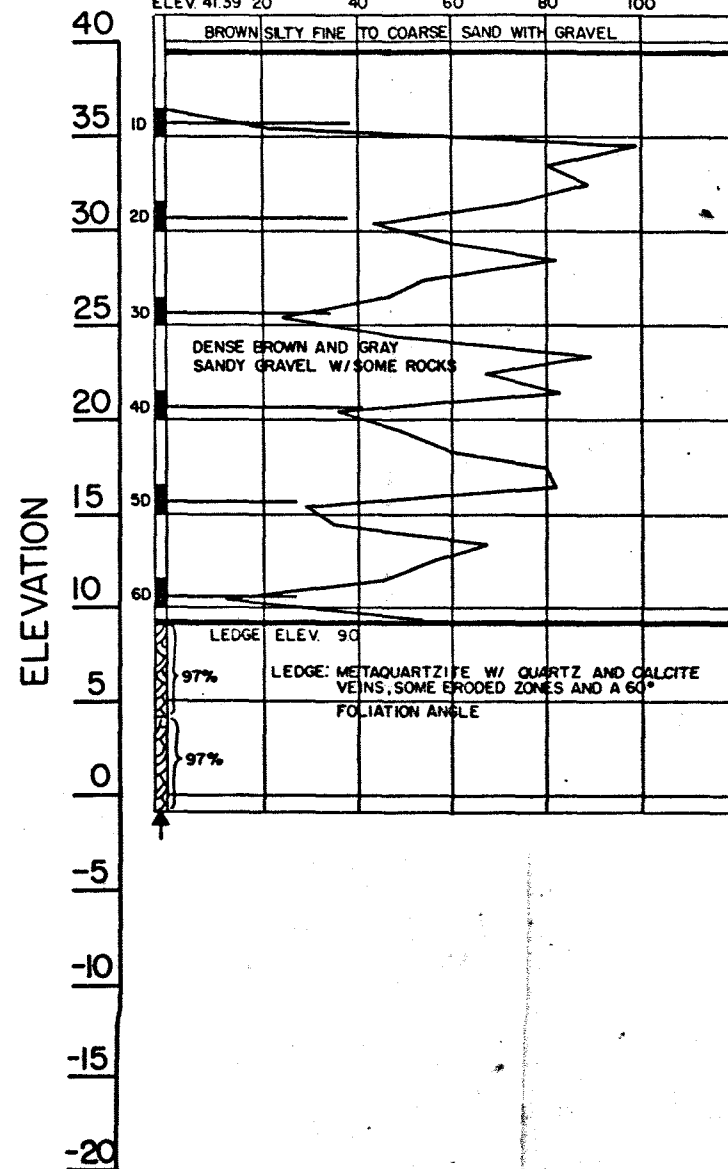
I-395 BRIDGE
OVER
PENOBSCOT RIVER
BETWEEN THE CITIES OF
BANGOR AND BREWER
PENOBSCOT COUNTY
BORING DETAILS

SHEET OF AUGUSTA, MAINE

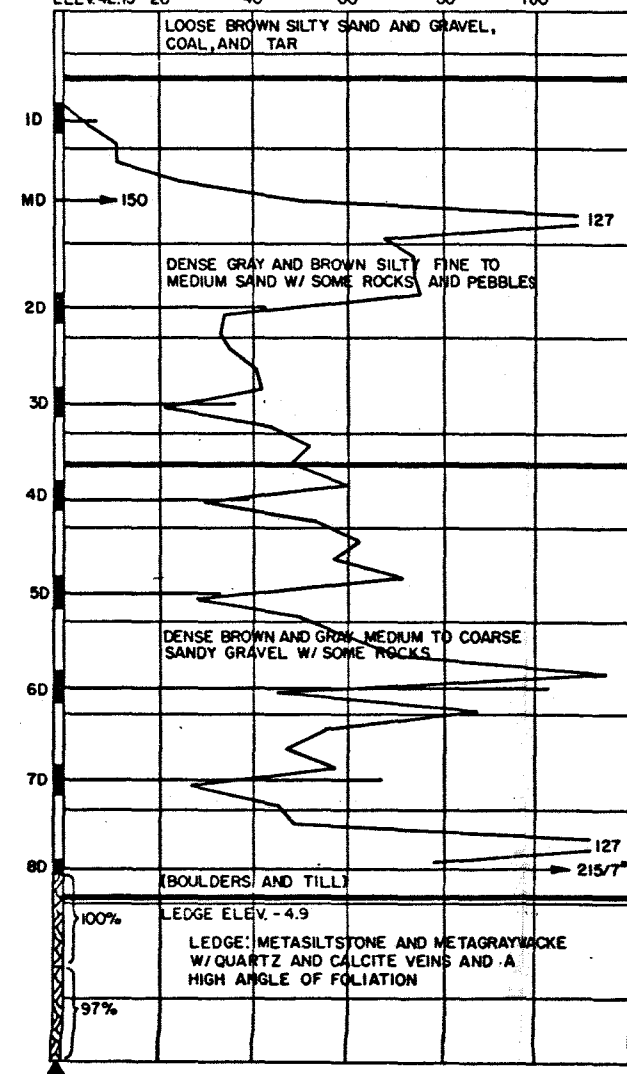
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BORING 44-132-5710

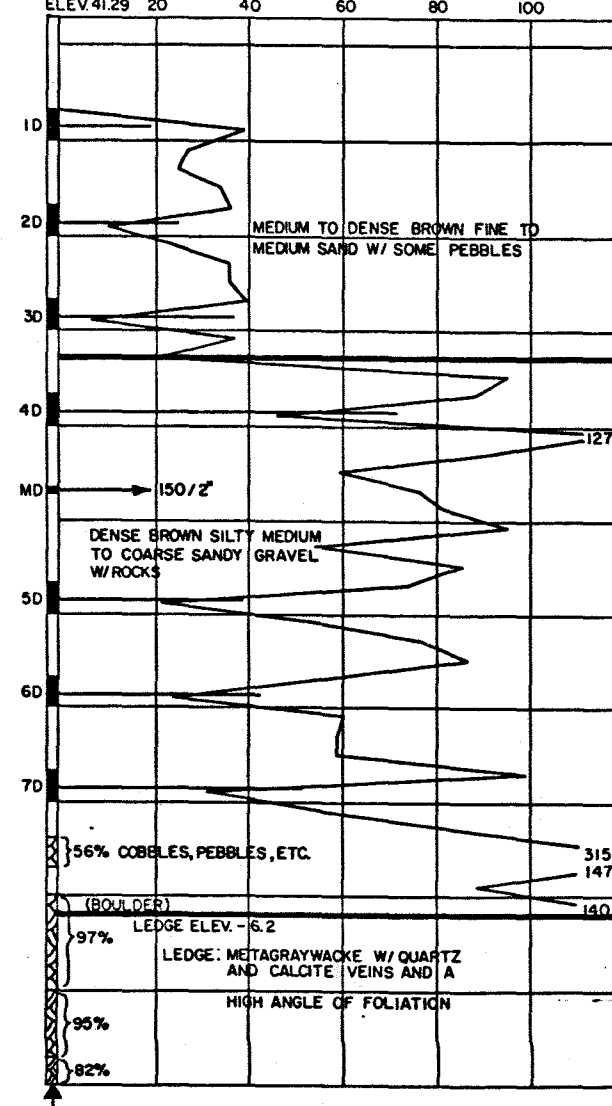
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STATION 164+60, 60' LT. (PIER NO.1, STEEL ALT.)
ELEV. 41.39 20 40 60 80 100



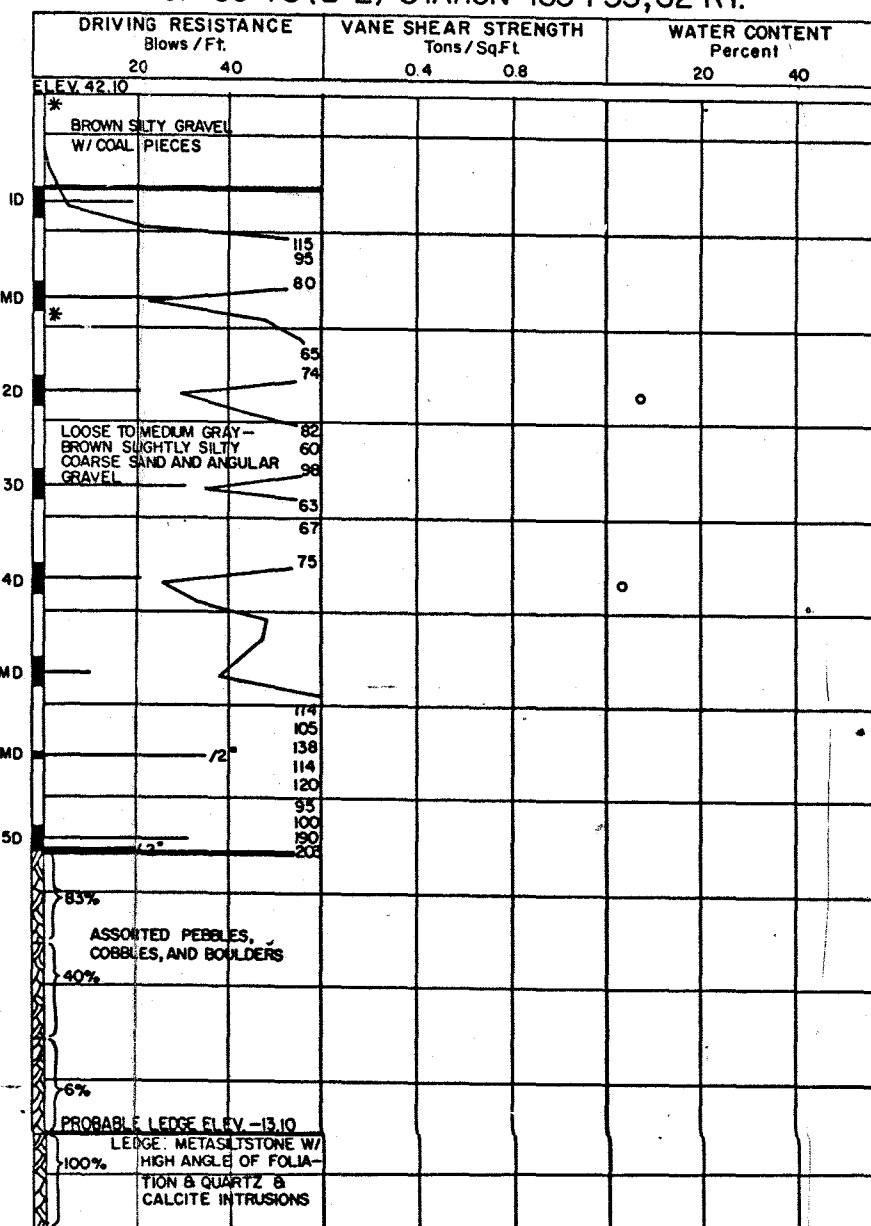
BORING MT-7
STATION 164+93, 37' RT. (PIER NO.1, CONC. ALT.)
ELEV. 42.15 20 40 60 80 100



BORING MT-8
STATION 164+93, 35' LT. (PIER NO.1, CONC. ALT.)
ELEV. 41.29 20 40 60 80 100



BORING GP-53-78 (B-2) STATION 165+35, 62' RT.



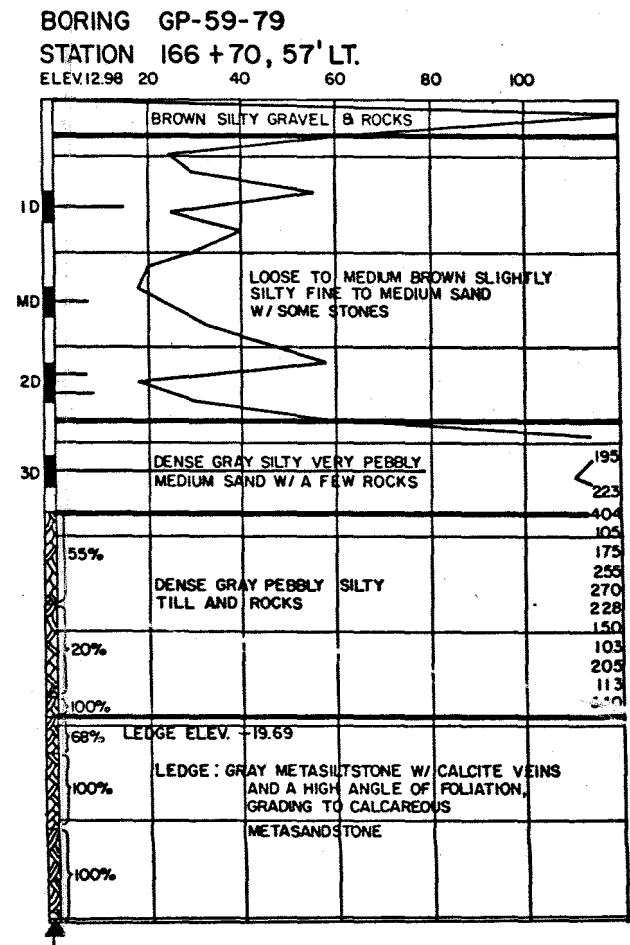
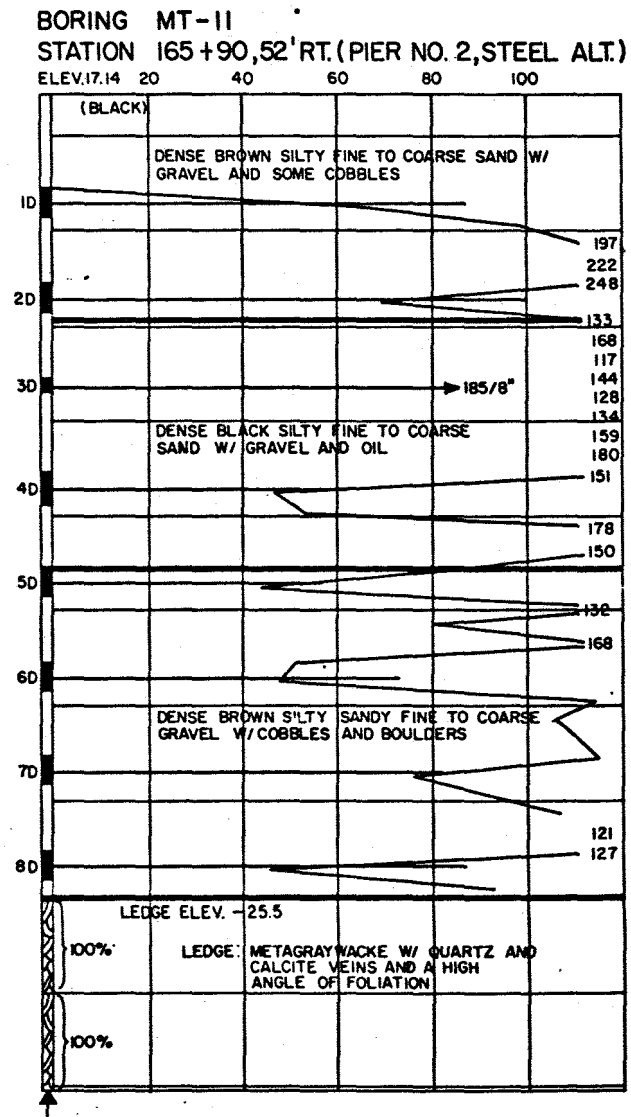
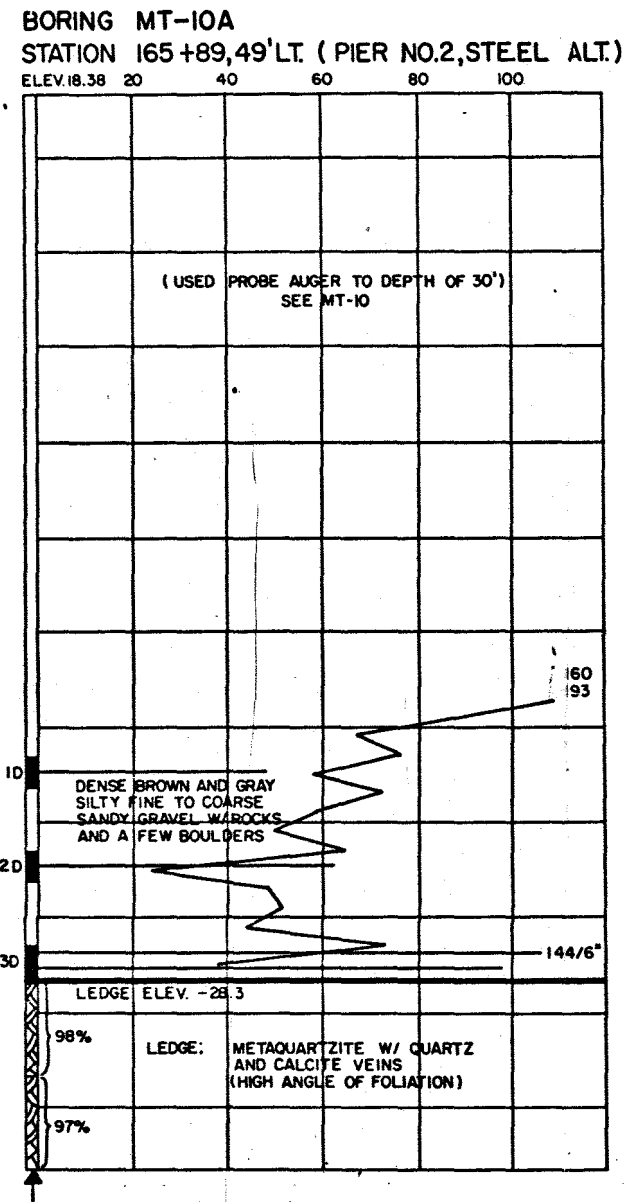
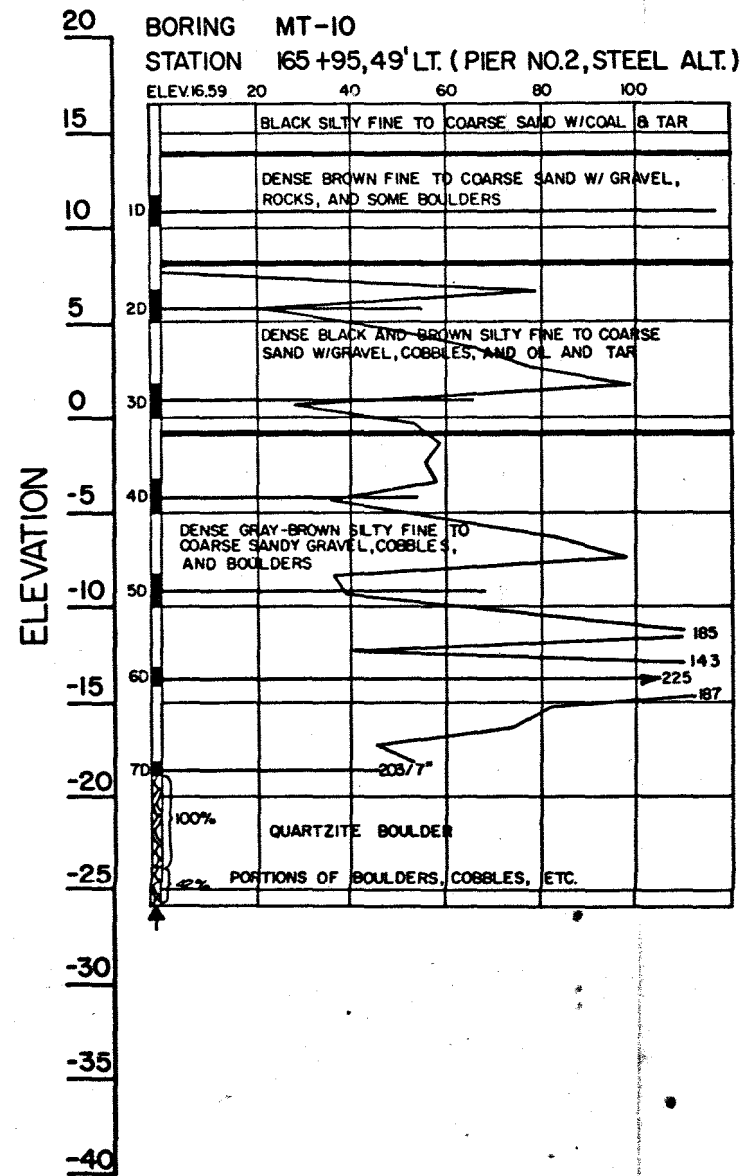
NOTE: "MT" BORINGS MADE W/ 2 3/8" CASING

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STATE OF MAINE
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I-395 BRIDGE
OVER
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BETWEEN THE CITIES OF
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PENOBSCOT COUNTY
BORING DETAILS

SHEET OF AUGUSTA, MAINE



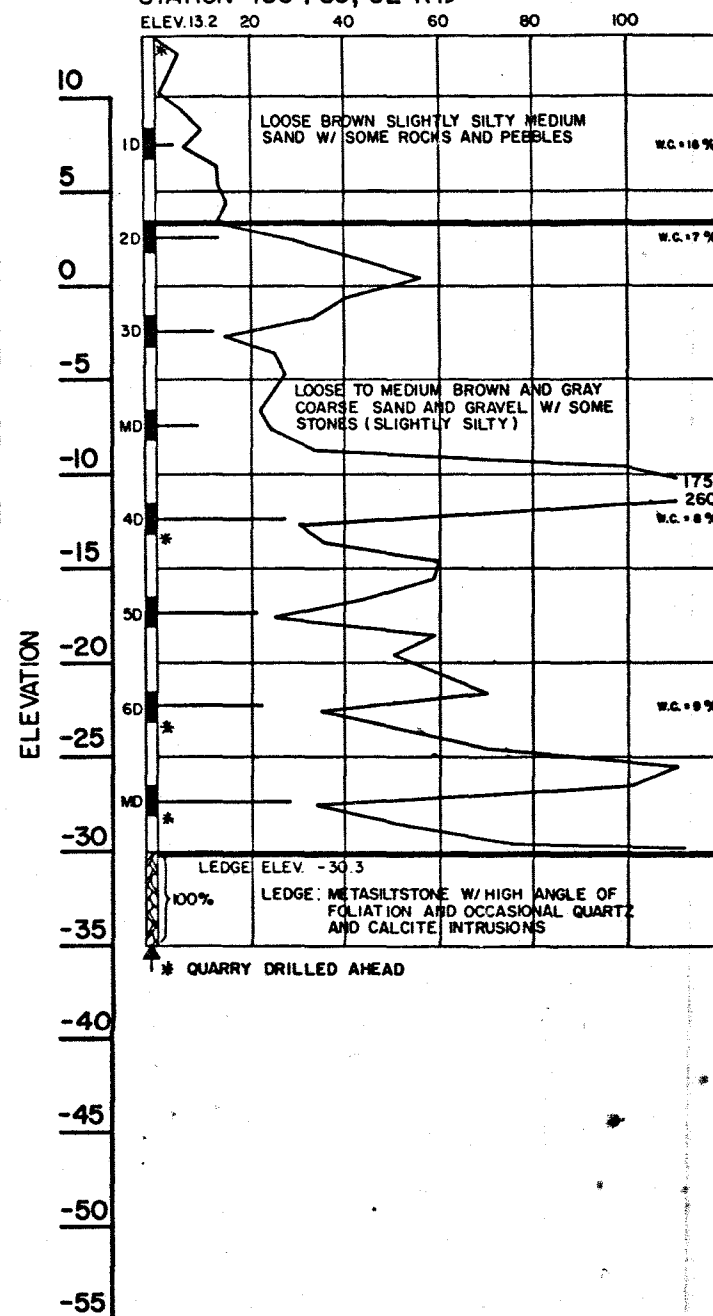
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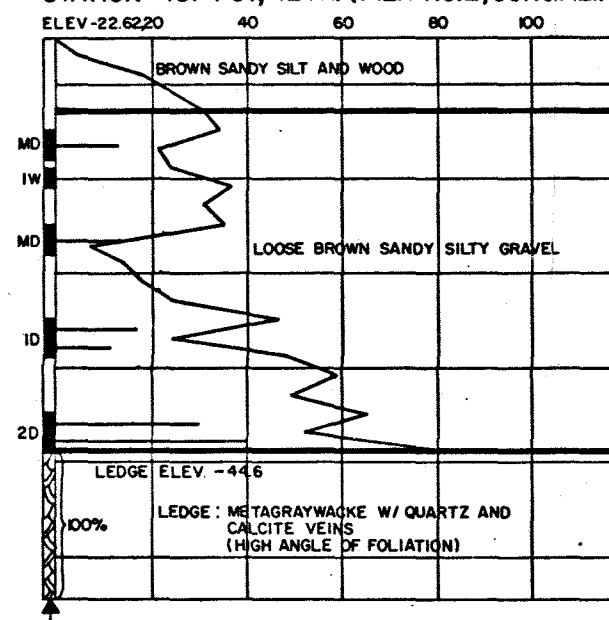
STATE OF MAINE
DEPARTMENT OF TRANSPORTATION

I-395 BRIDGE
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BETWEEN THE CITIES OF
BANGOR AND BREWER
PENOBSCOT COUNTY
BORING DETAILS-STEEL ALTERNATE
SHEET OF AUGUSTA, MAINE

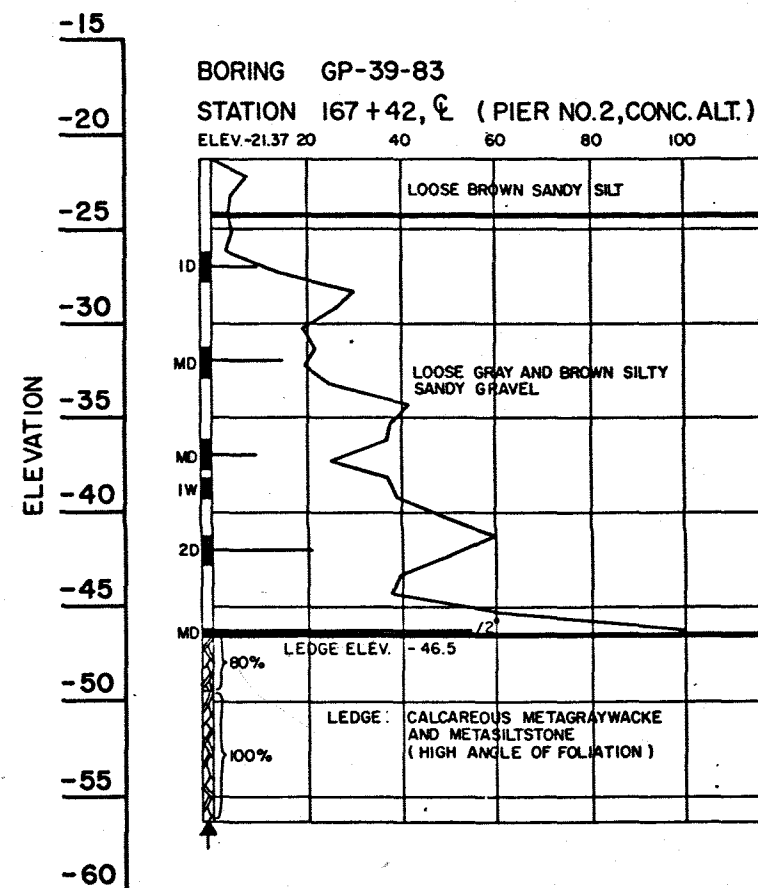
BORING GP-50-78 (B-3)
STATION 166+89, 52' RT.



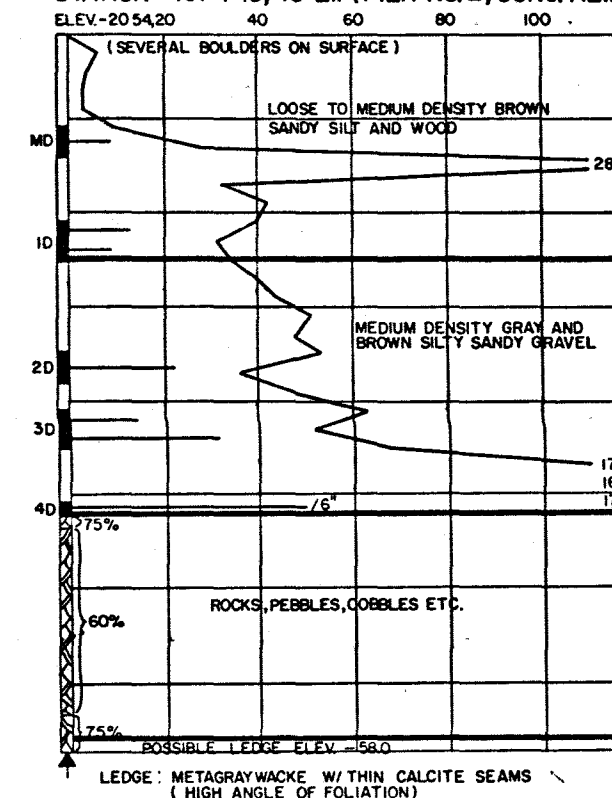
BORING GP-40-83
STATION 167+37, 42' RT. (PIER NO.2, CONC. ALT.)



BORING GP-39-83
STATION 167+42, 42' (PIER NO.2, CONC. ALT.)



BORING GP-41-83
STATION 167+43, 45' LT. (PIER NO.2, CONC. ALT.)



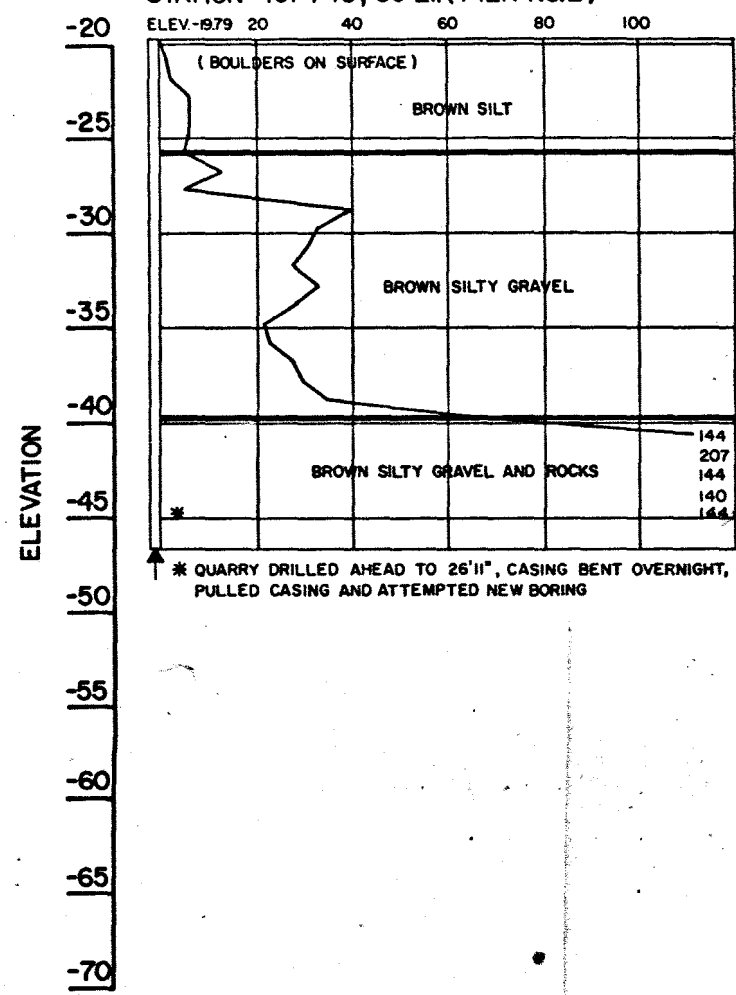
STATE OF MAINE
DEPARTMENT OF TRANSPORTATION

I-395 BRIDGE
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BETWEEN THE CITIES OF
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PENOBSCOT COUNTY

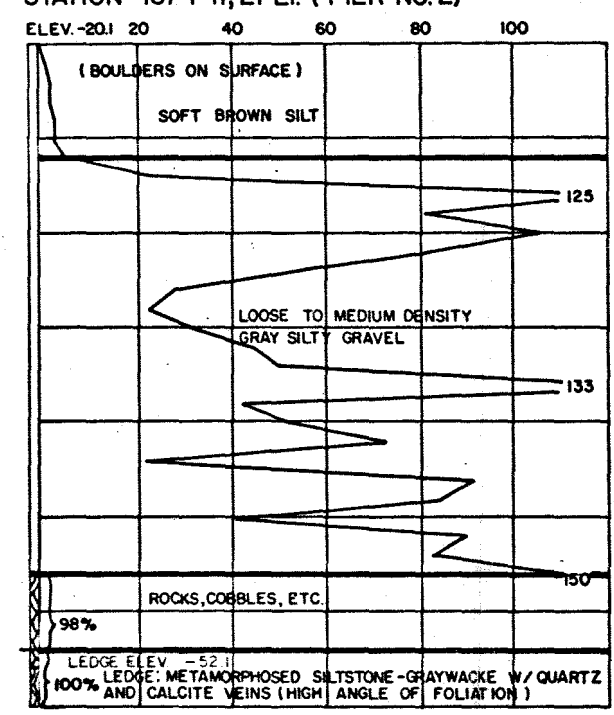
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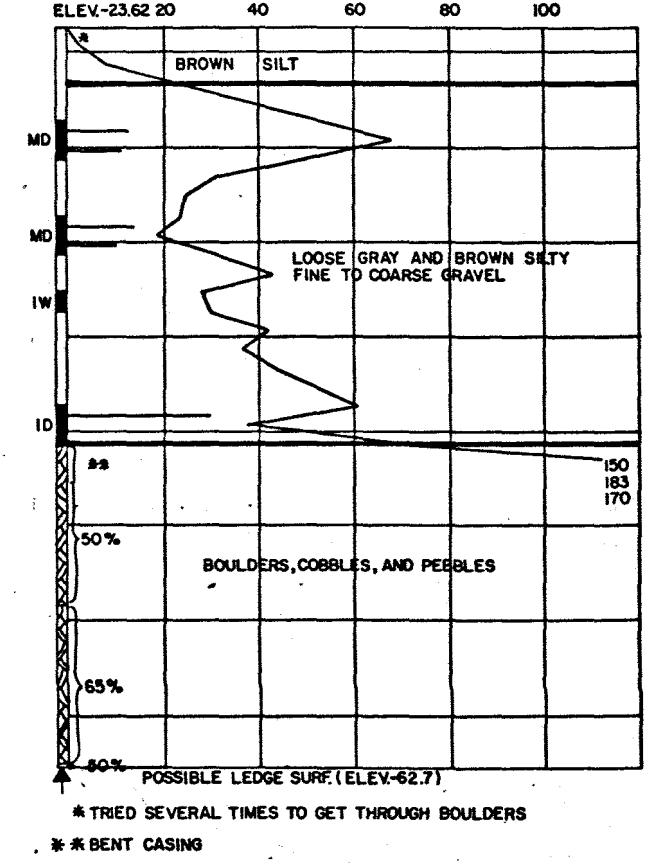
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STATION 167+43, 50' LT. (PIER NO.2)



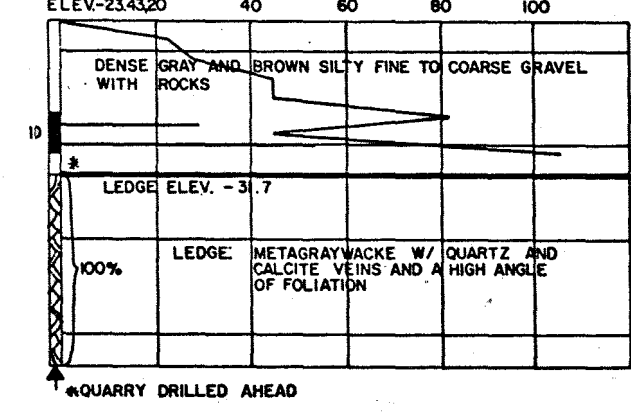
BORING GP-54-83
STATION 167+41, 21' LT. (PIER NO.2)



BORING GP-43-83
STATION 167+59, 50' LT. (PIER NO.2)



BORING GP-48-83
STATION 171+20, 40' LT. (PIER NO.3)



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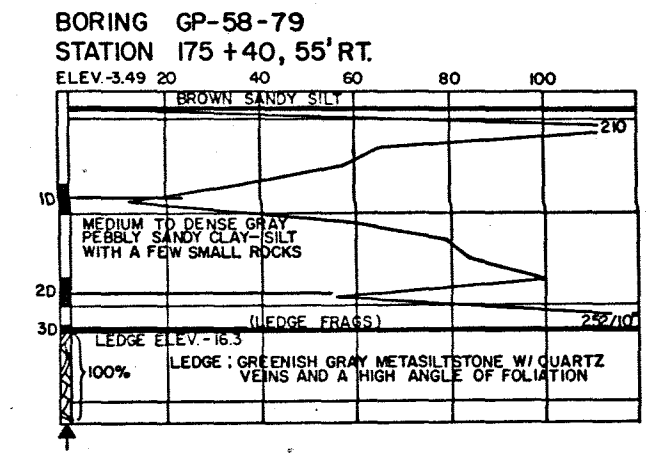
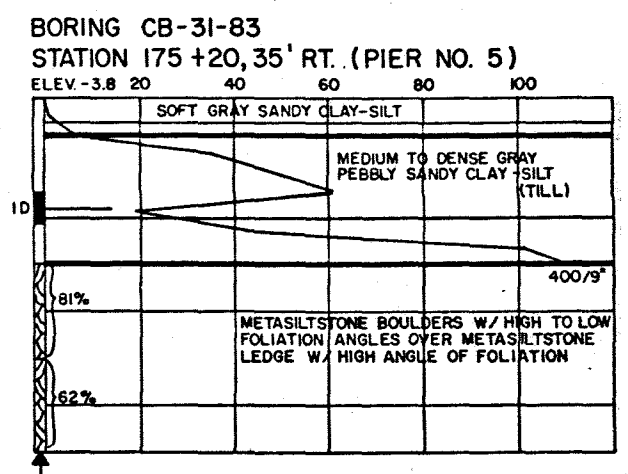
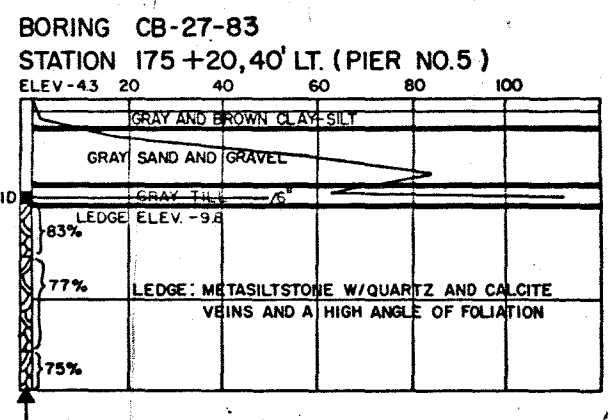
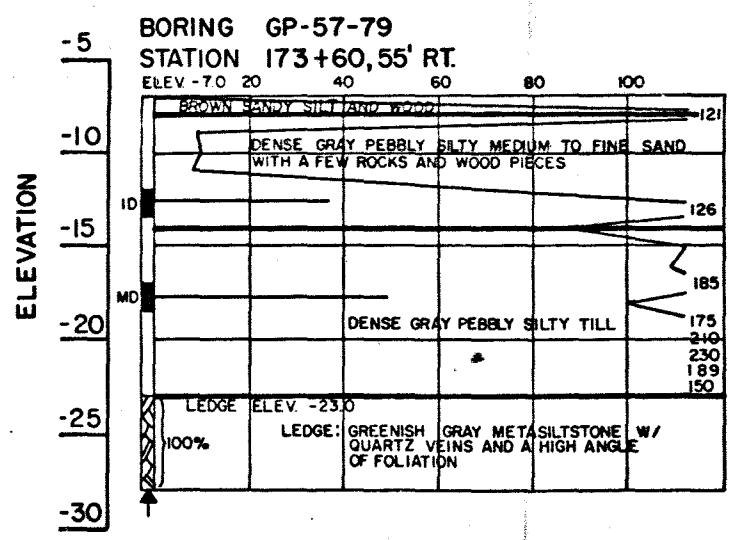
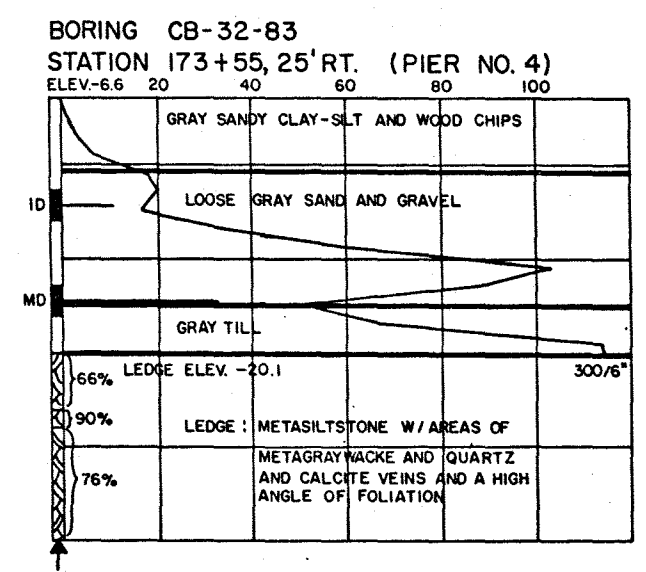
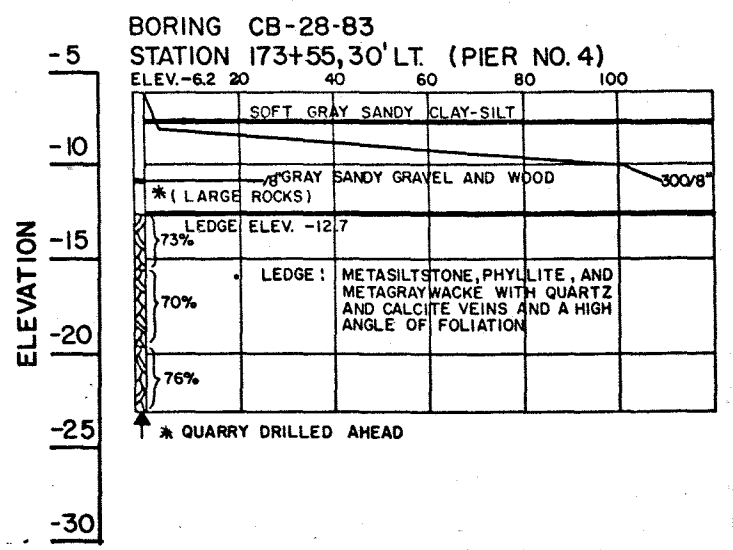
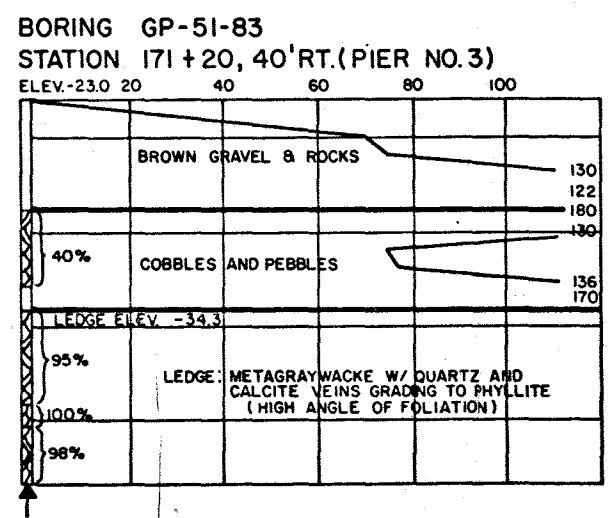
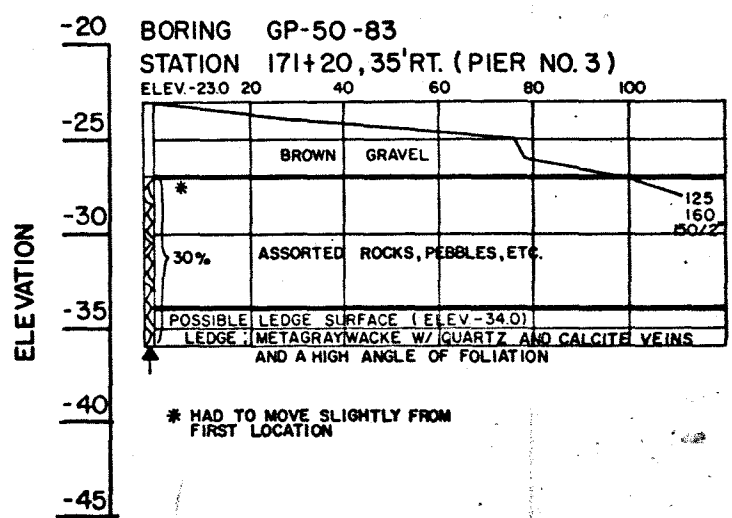
BORING 44-132-42710

STATE OF MAINE
DEPARTMENT OF TRANSPORTATION

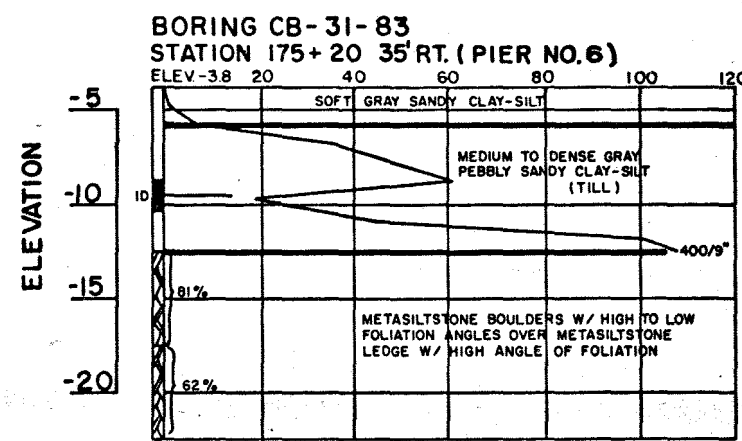
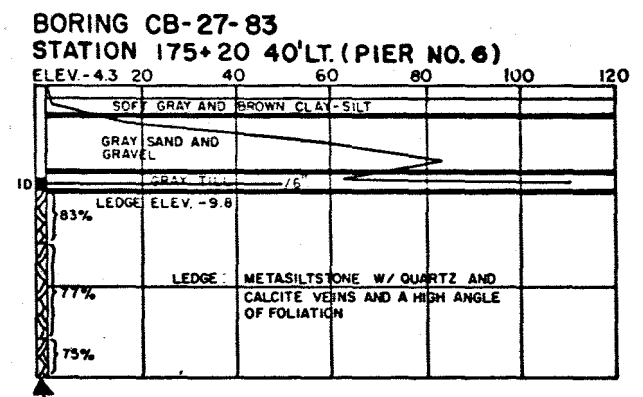
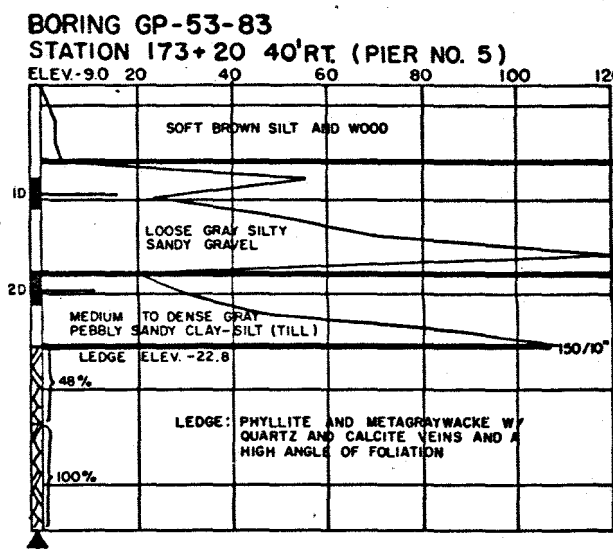
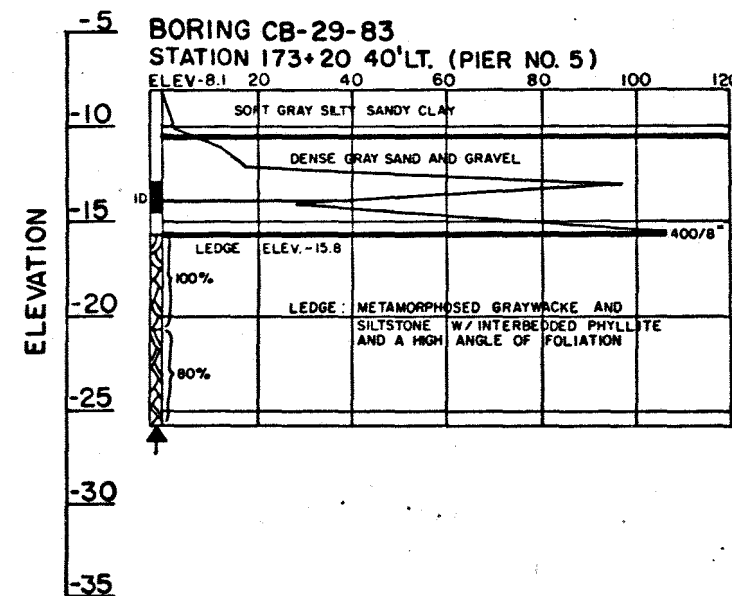
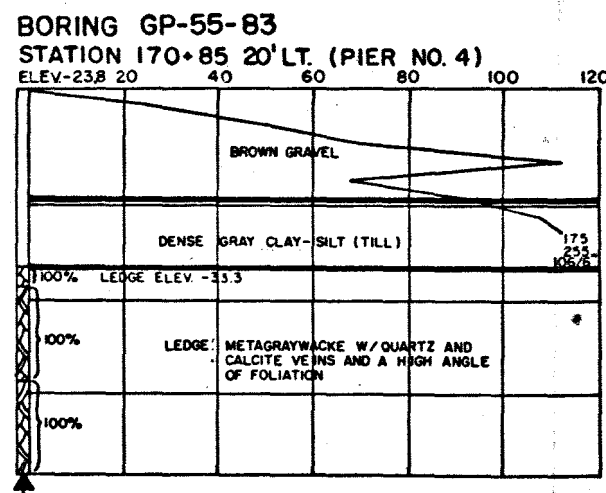
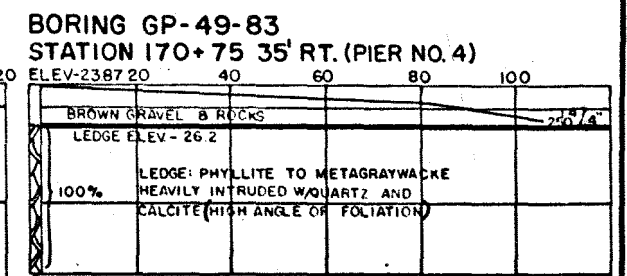
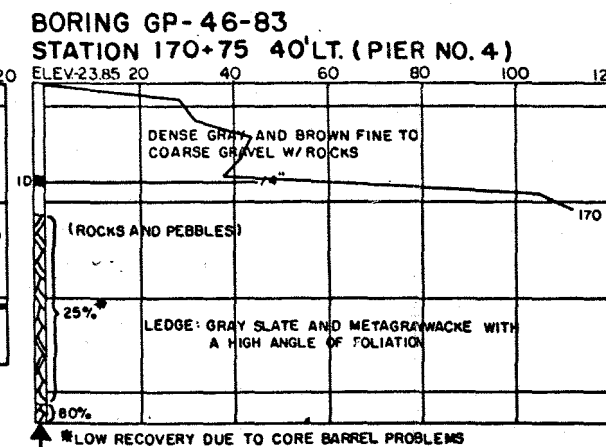
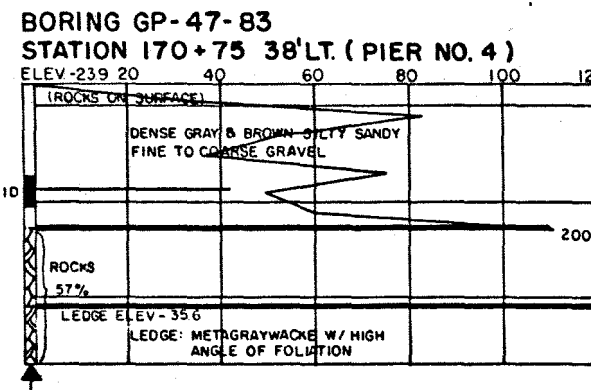
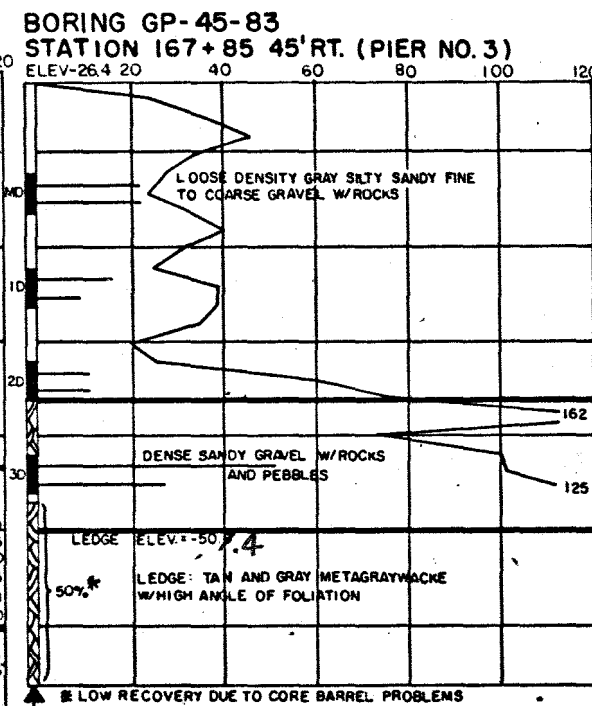
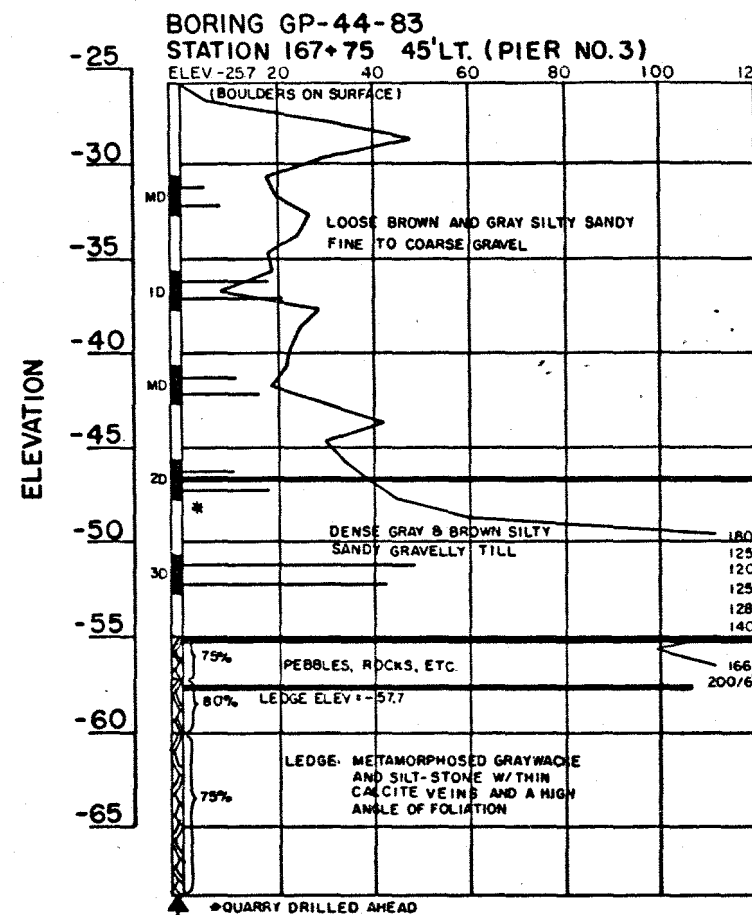
I-395 BRIDGE
OVER
PENOBSCOT RIVER
BETWEEN THE CITIES OF
BANGOR AND BREWER
PENOBSCOT COUNTY

BORING DETAILS - CONCRETE ALTERNATE

SHEET OF AUGUSTA, MAINE

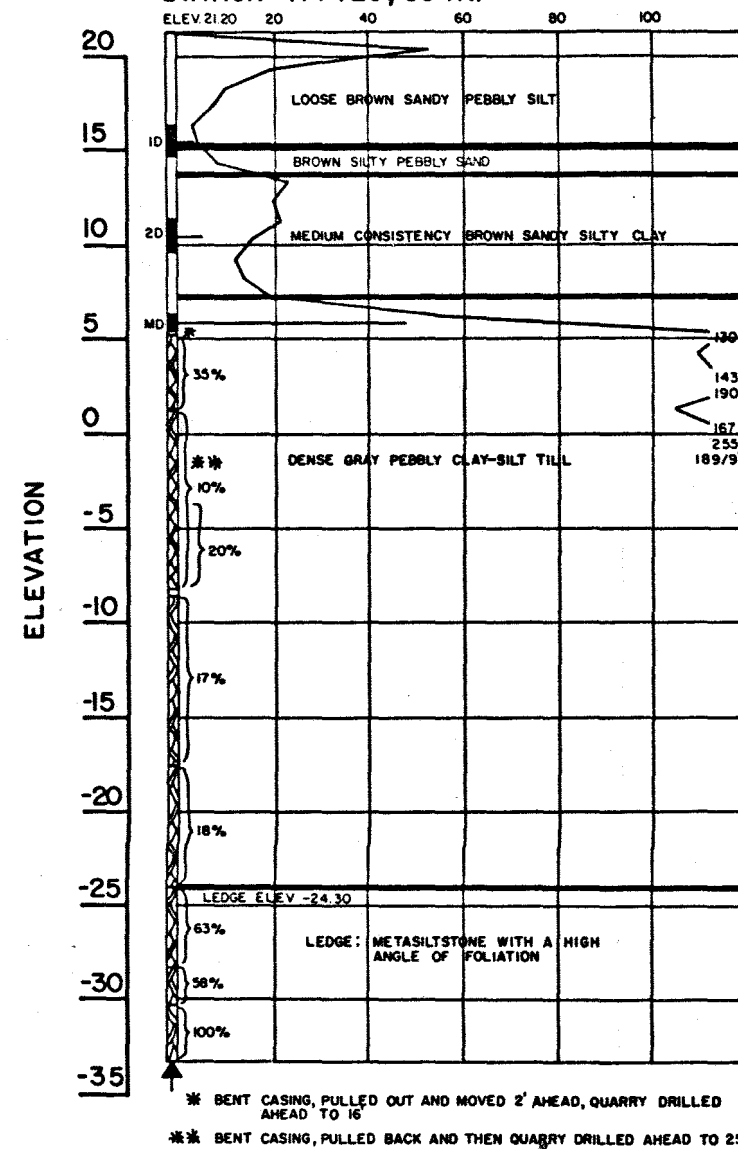


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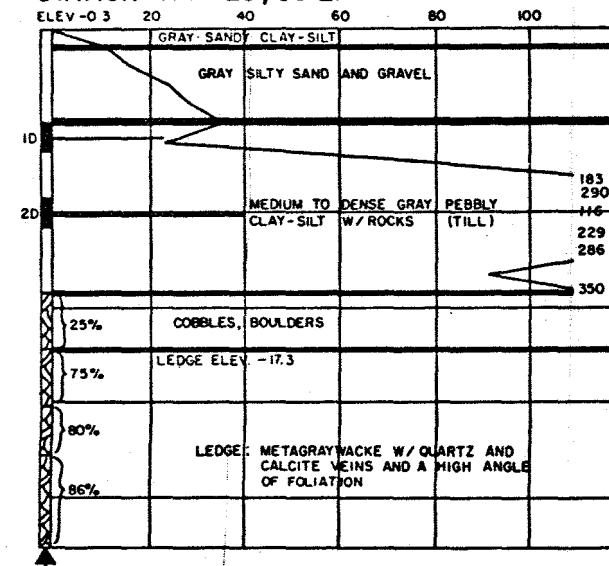


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PLANS	

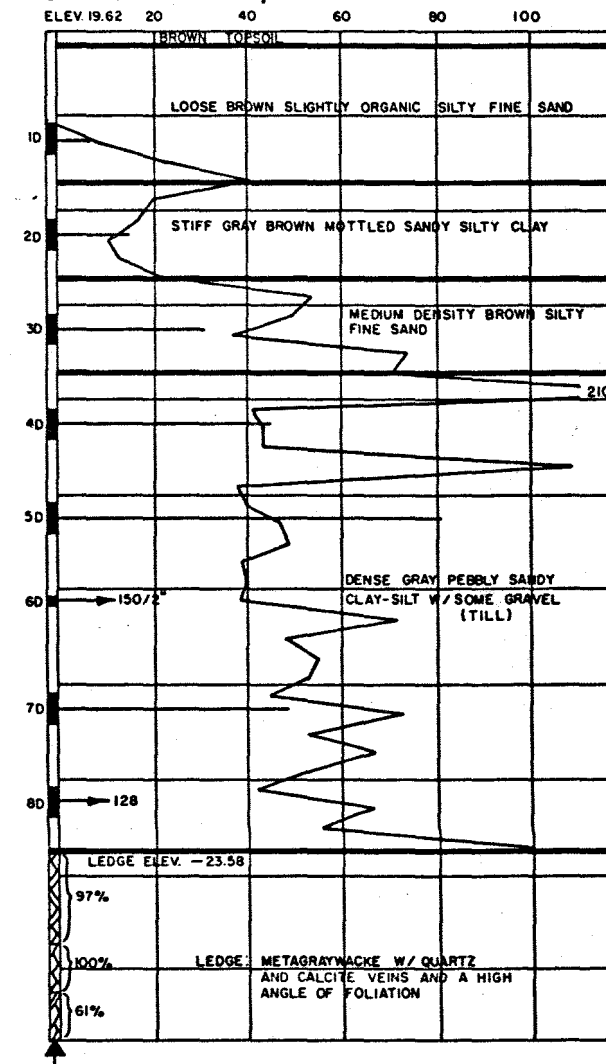
BORING GP-1-80
STATION 177+20, 55' RT.



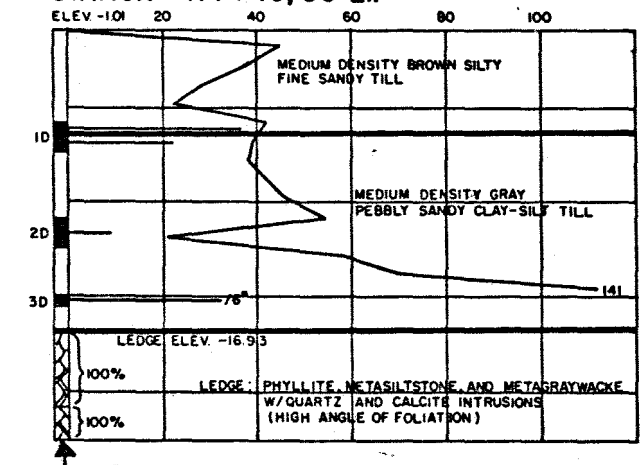
BORING CB-30-83
STATION 177+28, 30' LT



BORING MT-6
STATION 177+35, 30' RT.



BORING GP-30-80
STATION 177+40, 55' LT.



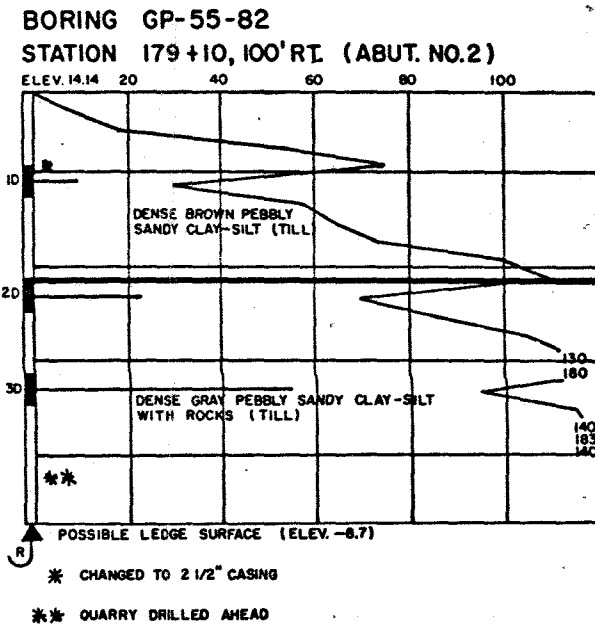
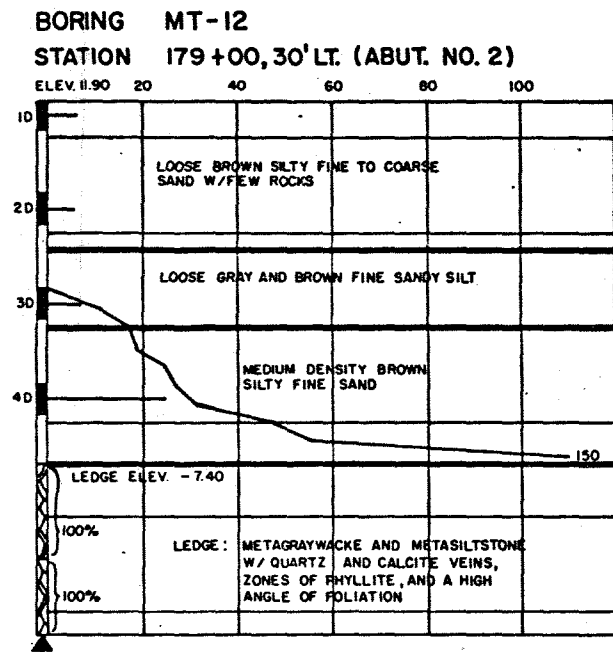
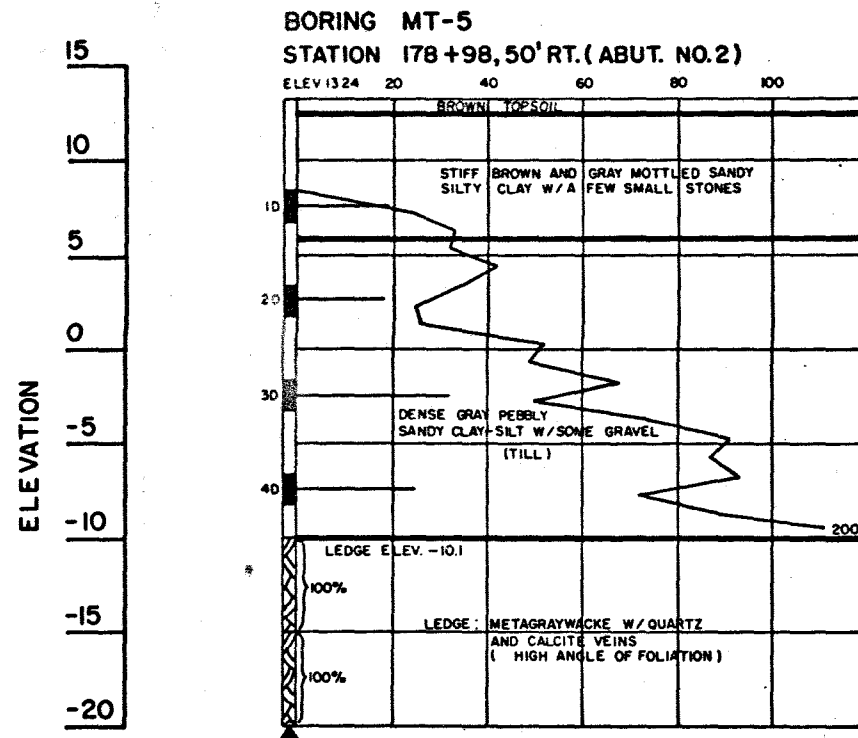
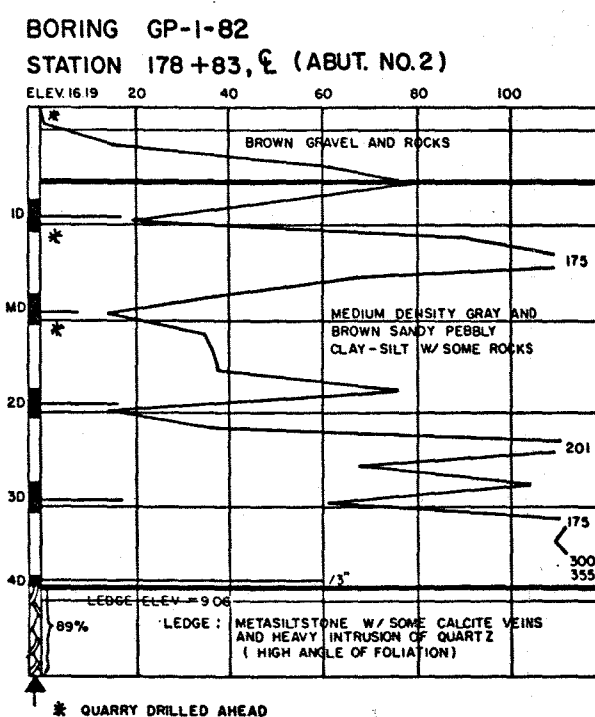
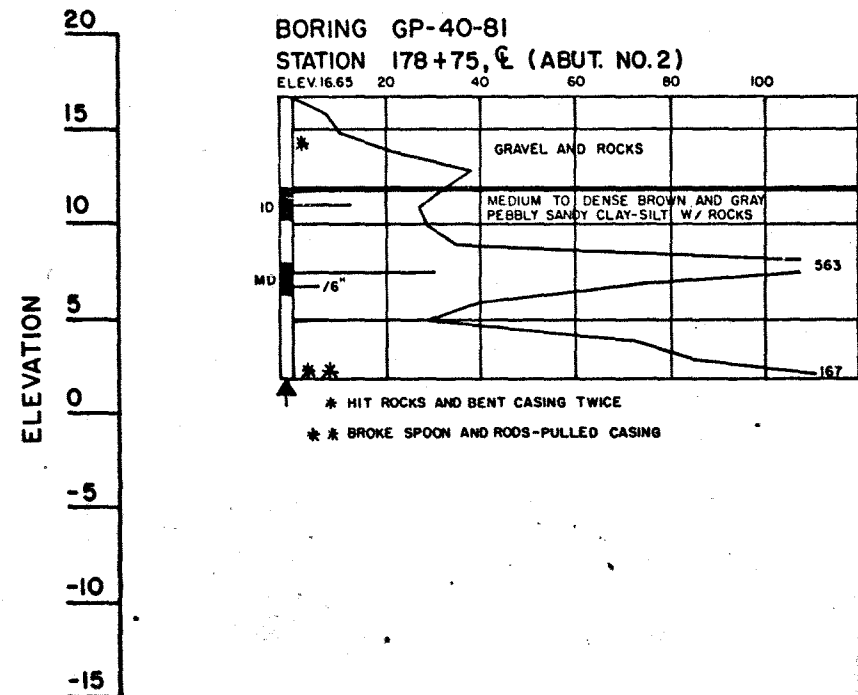
PROJECT DESIGN ENGINEER
DESIGN - DETAILED
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STATE OF MAINE
DEPARTMENT OF TRANSPORTATION

I-395 BRIDGE
OVER
PENOBSCOT RIVER
BETWEEN THE CITIES OF
BANGOR AND BREWER
PENOBSCOT COUNTY

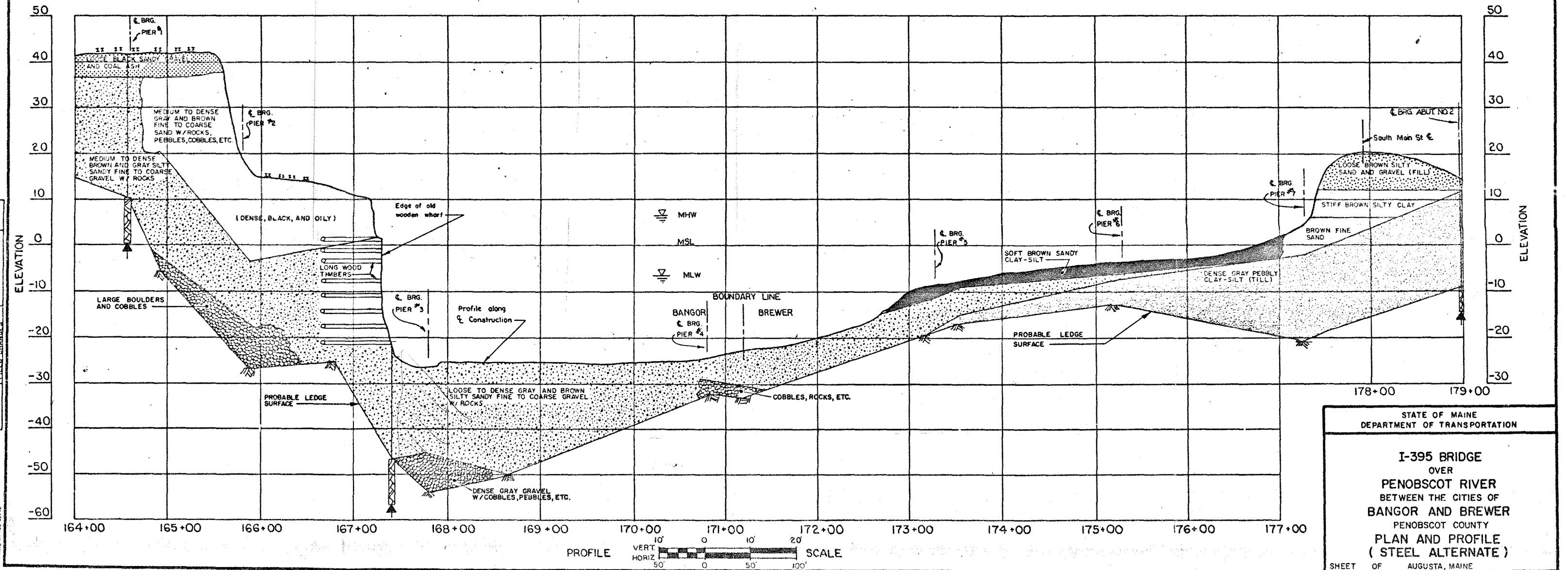
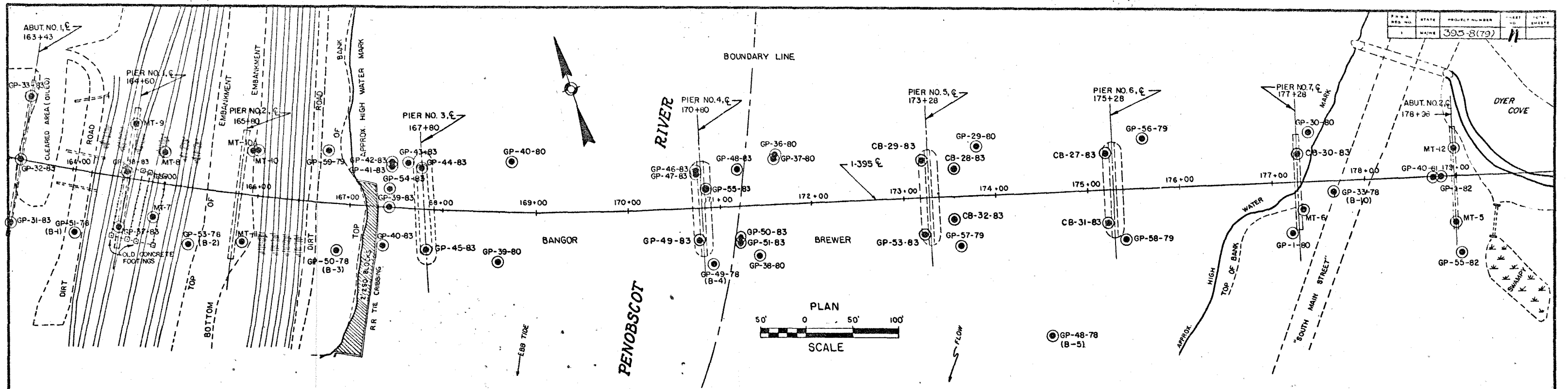
BORING DETAILS

SHEET OF AUGUSTA, MAINE



PROJECT DESIGN ENGINEER	BY	DATE
DESIGN - DETAILED		
CHECKED		
REVISIONS		
FIELD CHANGES		

BORING 44-13 45710



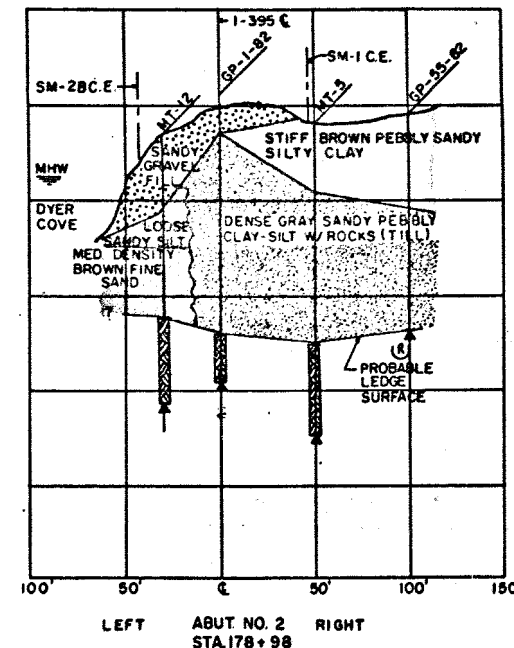
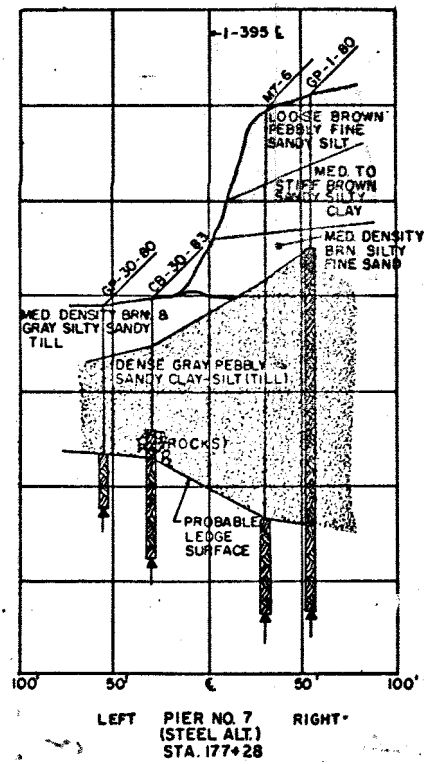
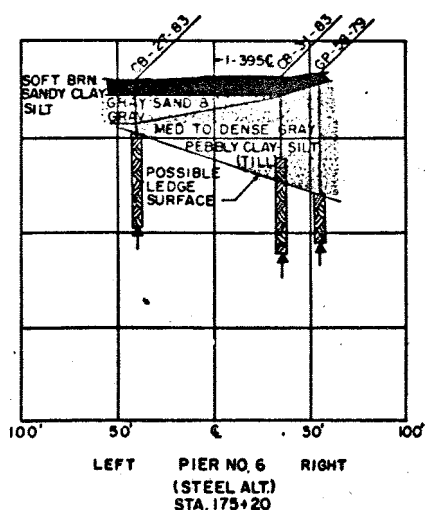
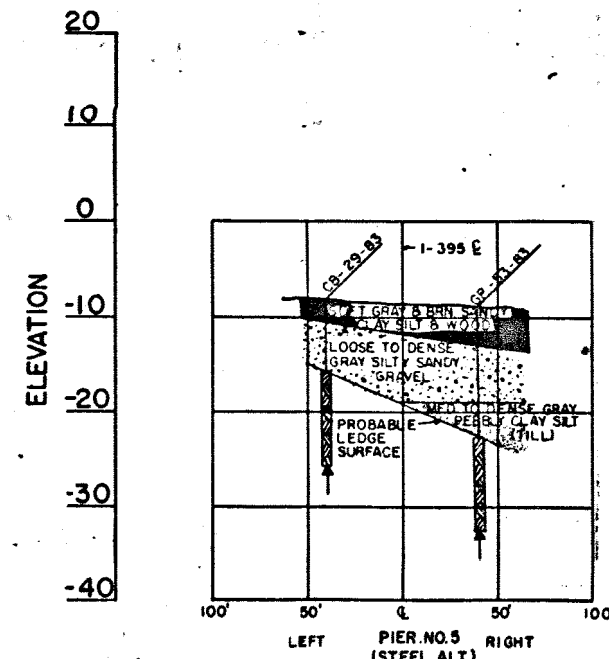
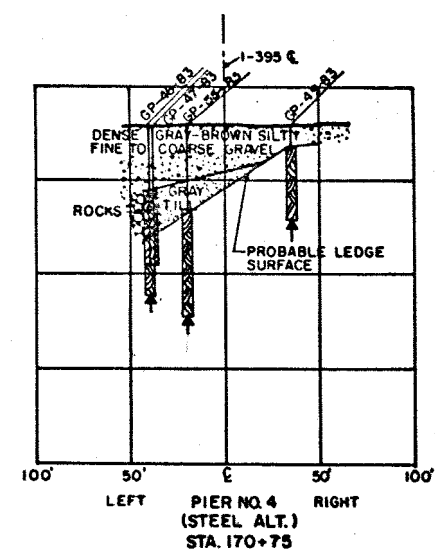
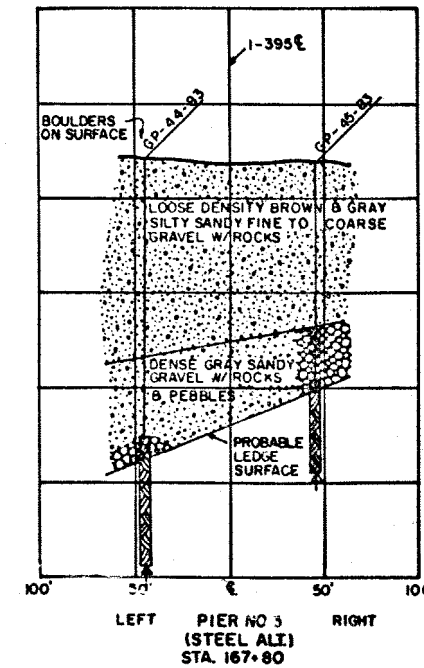
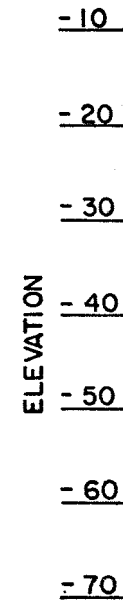
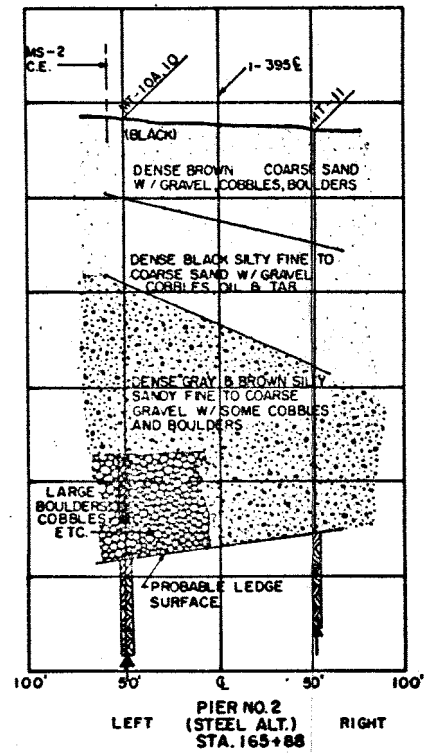
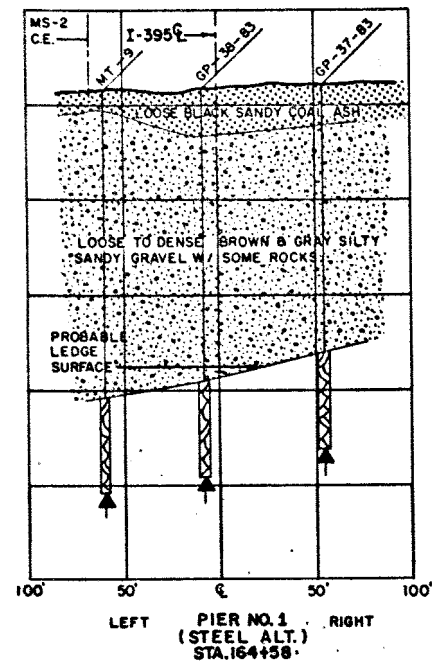
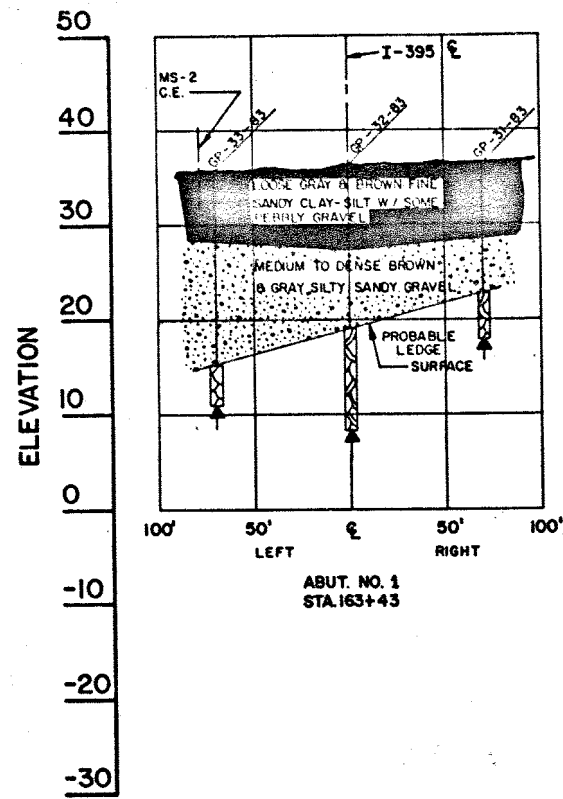
PROJECT DESIGN ENGINEER	DATE
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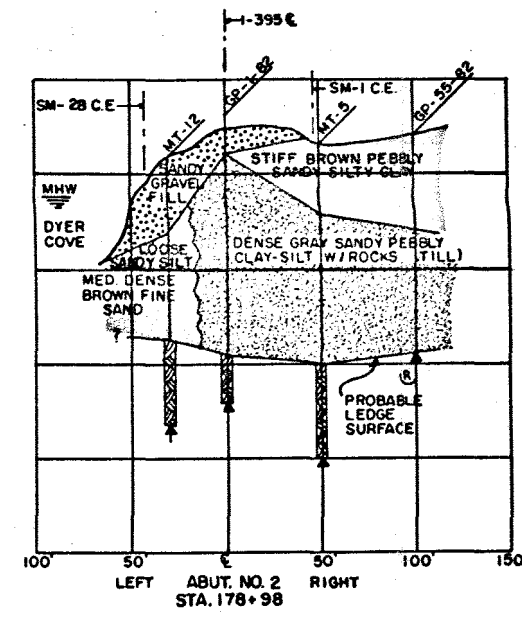
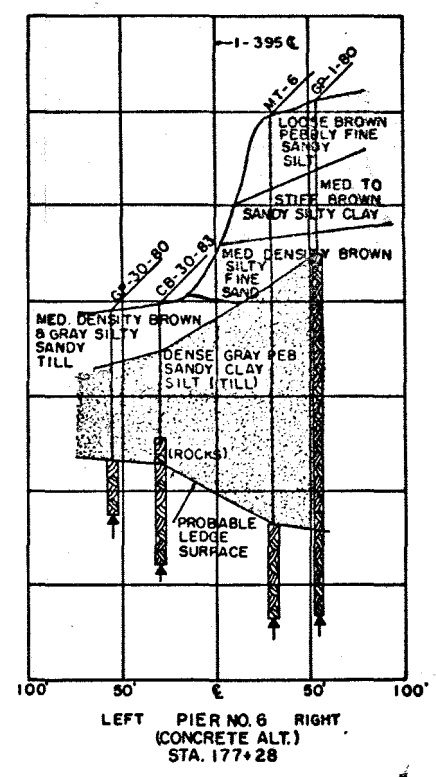
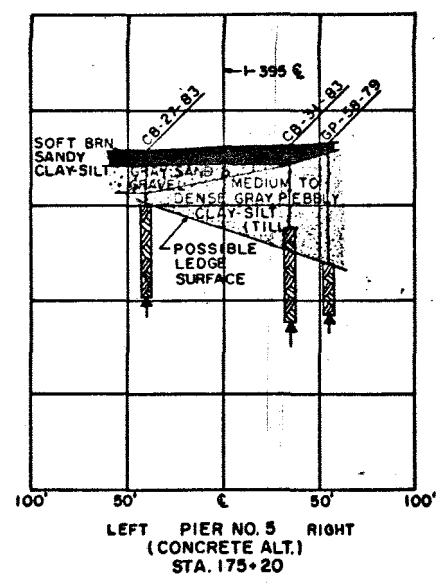
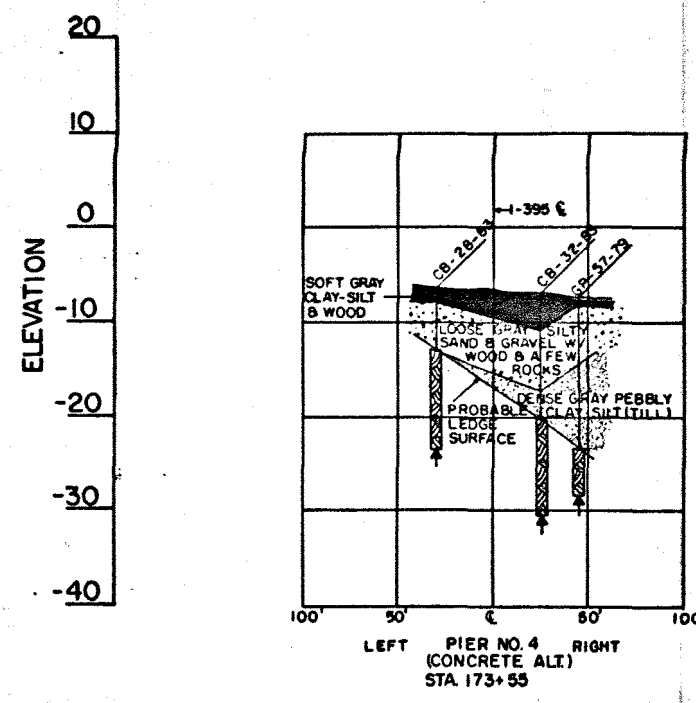
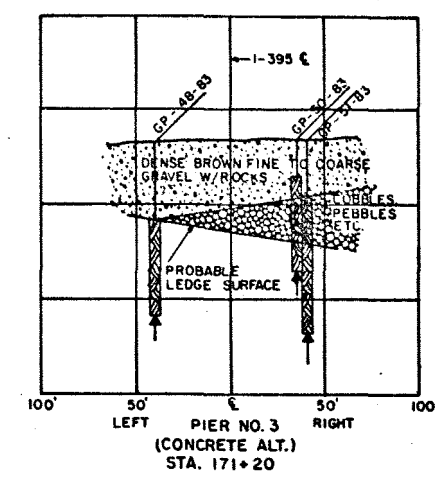
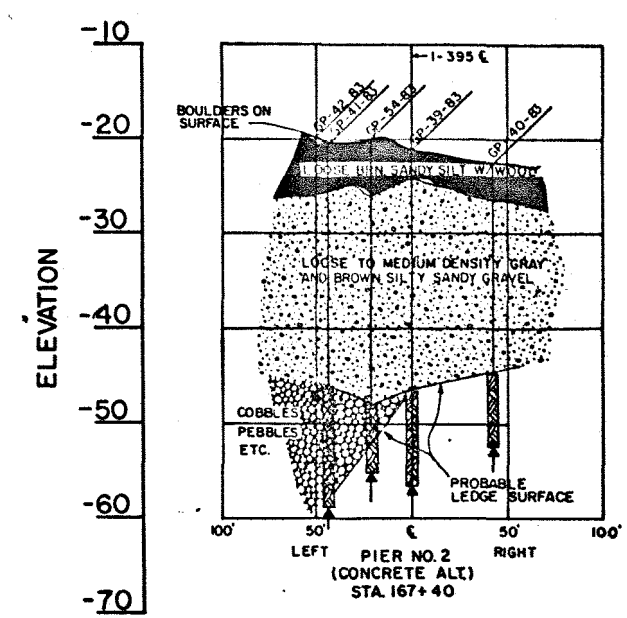
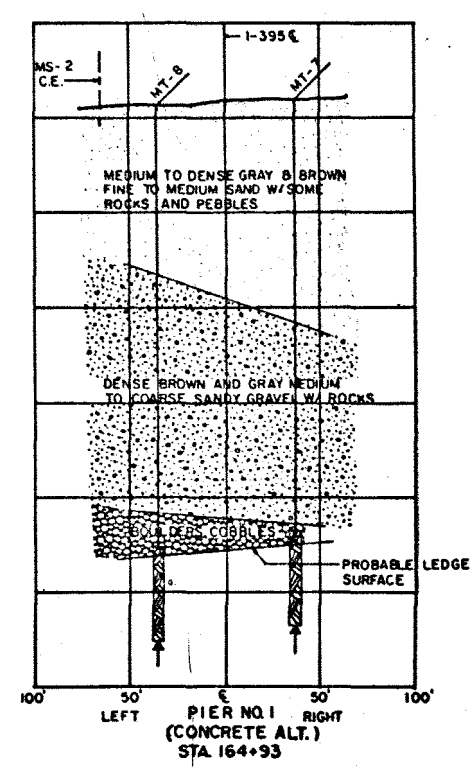
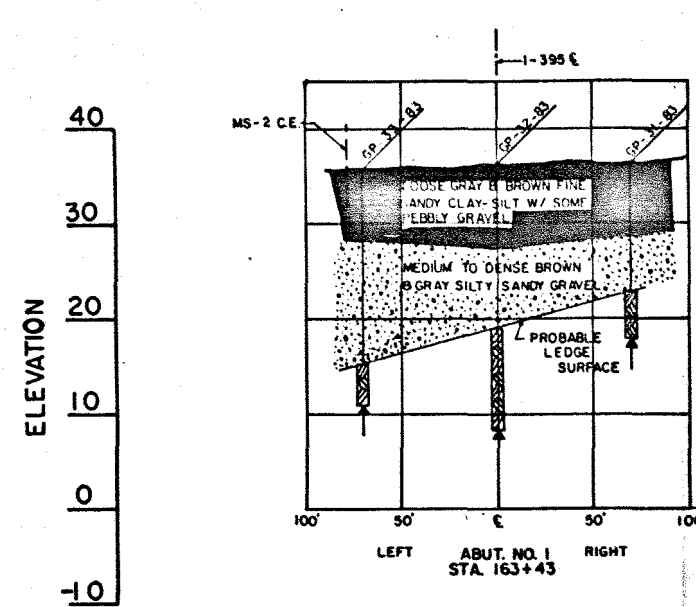
BRIDGE 44-122-6710

STATE OF MAINE
DEPARTMENT OF TRANSPORTATION

**I-395 BRIDGE
OVER
PENOBSCOT RIVER
BETWEEN THE CITIES OF
BANGOR AND BREWER
PENOBSCOT COUNTY
PLAN AND PROFILE
(STEEL ALTERNATE)**

SHEET OF AUGUSTA, MAINE





STATE OF MAINE
DEPARTMENT OF TRANSPORTATION

I-395 BRIDGE
OVER
PENOBSCOT RIVER
BETWEEN THE CITIES OF
BANGOR AND BREWER
PENOBSCOT COUNTY

TRANSVERSE SECTIONS-CONCRETE ALT.

SHEET OF AUGUSTA, MAINE

PROJECT DESIGN ENGINEER	DATE
BY	
DESIGN-DETAILED	
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REVISIONS	
FIELD CHANGES	