Volume 2 of 3
Supporting Documentation Report

Wastewater Conveyance Feasibility Investigation, Cranston, RI

May 1995

US Army Corps
of Engineers
New England Division

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.

1. AGENCY USE ONLY (Leave blank)	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
	May 1995	Feasibility Study

4. TITLE AND SUBTITLE

Volume 2 of 3
Wastewater Conveyance Feasibility Investigation, Cranston, RI
Supporting Documentation Report

5. FUNDING NUMBERS

6. AUTHOR(S)

Department of the Army
Corps of Engineers, New England Division

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)

Department of the Army
Corps of Engineers, New England Division
Waltham, Massachusetts 02254-9149

8. PERFORMING ORGANIZATION REPORT NUMBER

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)

Department of the Army
Corps of Engineers, New England Division
Waltham, Massachusetts 02254-9149

10. SPONSORING/MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES

12a. DISTRIBUTION/AVAILABILITY STATEMENT

Approved for public release
Distribution unlimited

12b. DISTRIBUTION CODE

13. ABSTRACT *(Maximum 200 words)*

The Water Resources Development Act of 1990, Public Law 101-640 authorized the Corps of Engineers (Corps), in consultation with the Environmental Protection Agency (EPA), to conduct a wastewater conveyance feasibility study for transporting contaminants from the Central Landfill site and other sources of pollution in Rhode Island to a wastewater treatment facility in Cranston, Rhode Island, through the use of a regional connector system.

The study strategy was to develop and assess options to address future wastewater conveyance needs. Sites are located in Cranston and Johnston, Rhode Island. Several options were identified based on analysis of the city's existing sewer system, review of the city's wastewater flow projections, and coordination with the city. The study options include a combination of improvements to the existing system and construction of new sewers and pumping stations.

14. SUBJECT TERMS

Wastewater Conveyance, Sewer Interceptor

15. NUMBER OF PAGES

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
Unclassified	Unclassified	Unclassified	

Wastewater Conveyance Feasibility Investigation
Cranston, Rhode Island

INDEX OF VOLUMES

VOLUME 1

MAIN REPORT AND ENVIRONMENTAL ASSESSMENT

VOLUME 2

APPENDIX A Task 12b - Proposed Project, Hydraulic Analysis
APPENDIX B Task 12d - Proposed Project, Pumping Station Mechanical Design
APPENDIX C Task 12a - Proposed Project, Geotechnical Evaluation
APPENDIX D Task 12c - Proposed Project, Pumping Stations and Sewers, Civil Engineering Design
APPENDIX E Task 13b - Proposed Project, Real Estate Costs

VOLUME 3

APPENDIX F Task 3 - Identification of Wastewater Flows
APPENDIX G Task 4 - Review of Information on Cranston's Wastewater Treatment Facility Capacity
APPENDIX H Task 5 - Identification of Existing Sewer System Capacity
APPENDIX I Task 7 and 9 - Report on Feasibility Level Design and Cost Estimates for Wastewater Conveyance Options
APPENDIX J Task 10b - Socio/Economic Assessment
APPENDIX K Task 10c - Water Quality and Hydrology Assessment
APPENDIX L Task 10d - Archaeological/Historic Assessment
APPENDIX M Task 10e - Ecological Assessment

Wastewater Conveyance Feasibility Investigation
Cranston, Rhode Island

VOLUME 2
SUPPORTING DOCUMENTATION REPORT

Department of the Army
Corps of Engineers, New England Division
Waltham, Massachusetts

May 1995

APPENDIX A

TASK 12b - Proposed Project, Hydraulic Analysis

Section 117, Cranston Rhode Island
Wastewater Conveyance Feasibility Investigation

APPENDIX A

TASK 12b - Proposed Project, Hydraulic Analysis

Department of the Army
Corps of Engineers, New England Division
Waltham, Mass

March 1995

TABLE OF CONTENTS

	Page
1. Summary	A-1
2. Sewers	A-1
3. Sockanosset Interceptor	A-2
4. Siphon	A-2

LIST OF TABLES

		Page
Table 1	Design for Comstock Gravity Sewer	A-4
Table 2	Design for Tilcon Gravity Sewer	A-11
Table 3	Design for Brookdale Gravity Sewer	A-12
Table 4	Design for Natick Gravity Sewer	A-13
Table 5	Force main/varaible grade sewer from Scituate Pumping Station to VGS Highpoint year 2045 flows	A-16
Table 6	Force main from Wilbur Pumping Station to Sockanosett Interceptor	A-17
Table 7	Improvements to Sockanosset Interceptor	A-18

CRANSTON, RHODE ISLAND
FEASIBILITY REPORT APPENDIX
PRELIMINARY PROJECT DESIGN
TASK 12B - HYDRAULIC ANALYSIS

1. SUMMARY

This report presents results of hydraulic analyses of gravity, force main, and force main/variable grade sewers as part of the preliminary design of the proposed project. This report takes results from Task 7 (feasibility level design of alternatives), and examines the selected plan in detail. Design conditions are the projected year 2045 flow conditions; however, conditions with projected year 2015 flows are also examined. Trunk gravity sewers which have minimal slopes and calculated velocities less than 2 fps in year 2015, will require monitoring for solids buildup, and are noted.

2. SEWERS

a. Criteria. Criteria for sewer lines were taken from "Guides for the Design of Wastewater Treatment Works, 1980 Edition" (TR-16) prepared by the New England Interstate Water Pollution Control Commission; "Gravity Sanitary Sewer Design and Construction," ASCE Manuals and Reports on Engineering Practice No. 60, 1982, by the American Society of Civil Engineers and the Water Pollution Control Federation; and city of Cranston Sewer Use Ordinance, revised 21 February 1992. TR-16 criteria included a minimum velocity for full pipe flow of 2 feet per second (fps), and a maximum velocity not greater than 12 fps under any flow conditions. City of Cranston criteria included that pipes 21 inches diameter and smaller should not flow more than 0.6 full, and pipes larger than 21 inches should not be more than 0.7 full. Where smaller pipes met larger pipes, inverts were set such that the elevations of the crowns matched. Sewer pipe sizes were chosen such that larger pipes never discharged to smaller ones. Criteria for force mains included a minimum velocity of 2 fps at design average pumping flow conditions. ASCE criteria for siphons included that a flushing velocity of 2 to 3 fps be reached at least once a day.

b. Manning's "n" Values. Capacities of new gravity sewer lines were calculated assuming a Manning's "n" of 0.013, constant with depth, in accordance with Cranston criteria and recommendations in TR-16. Proposed force mains and the variable grade sewer (VGS) are made of plastic pipe. Friction factors for plastic pipe were taken from Manufacturer's literature, specifically, "PVC & CPVC Extruded Pipe Duct and Shapes," by Harvel Plastics, Inc., 1989. Manning's "n" values were calculated from tables of friction

loss per 100 feet of pipe for varying flows. A computed "n" value of 0.009 was used for design.

c. Results - Gravity Sewers. Tables 1 through 4 give pipe sizes, invert elevations at manholes, pipe slopes, design capacities, approximate surface elevations, and year-2045 peak flows for gravity sections of proposed sewers. There is concern that designing the sewers for the year 2045 flows will result in possible solids buildup in earlier years due to inadequate flushing velocities. Tables 1 through 4 also show year-2015 peak flows and velocities, and indicate areas that may need to be monitored for possible deposition problems.

d. Results - Force Mains. Table 5 gives results of hydraulic analyses of the force main/VGS from the proposed Scituate pumping station to the I-295 pumping station proposed by the city of Cranston in their facilities plan. Table 6 gives results for hydraulic analysis of the force main from the proposed Wilbur station to the Sockanosset interceptor.

3. SOCKANOSSET INTERCEPTOR

Flows from the Natick, Comstock, Tilcon, and Brookdale trunk sewers will be collected at the proposed Wilbur station and pumped to the Sockanosset interceptor, which will convey these flows to the WWTF. Hydraulic analyses of this interceptor showed that approximately 1,500 feet of 24-inch pipe should be added in a parallel line between manholes 3951.3 to 2103.0 to prevent excessive surcharging during projected year-2045 peak flows. An analysis of projected year 2015 peak flows showed no problems with surcharging. Table 7 summarizes the hydraulic capacity of the interceptor and the additional parallel line of 24-inch pipe.

4. SIPHON

An existing "siphon" carries flows from the Sockanosset interceptor, and Howard and Worthington pumping stations, to the Cranston WWTF. It consists of two pipes: one is 27 inches in diameter and the other is 16. These lines do not meet RIDEM siphon criteria, as given in a letter to Corps dated 21 March 1994, that each pipe be capable of carrying the average daily flow (ADF). However, this is not a conventional siphon, and conventional siphon criteria do not apply. Originally, it was a fairly standard design, but when the WWTF was upgraded, the head works location changed. Consequently, near the WWTF, there are connections to the pipeline which carry flow to the new headworks. These connections were made immediately upstream of the drain chamber, which is the lowest point on the pipeline. This layout allows cleaning either pipe with minimal time out of service. It also means this should not be treated as an

ordinary siphon. Nonetheless, in order to present a complete design, a hydraulic analysis was performed to determine the replacement pipe size for a conventional siphon. Capacity of the 27-inch pipe at 12,400 gpm is greater than the ADF of 3,900 gpm in the year 2015 and the ADF of 5,040 gpm in 2045. However, the 3,150 gpm capacity of the 16-inch pipe is less than the ADF for either year. Replacing the 16-inch pipe with a 24-inch pipe would give capacity to carry the projected ADF for year 2015 and 2045 flows, while maintaining adequate flushing velocities of at least 2 to 3 fps daily.

TABLE 1

DESIGN FOR COMSTOCK GRAVITY SEWER

Manhole Station	Node	Invert Elev.	Slope (ft/ft)	Approx. Surface Elev.	2045 Peak Flow (gpm)	2015 Peak Flow (gpm)	Pipe Size (inches)	Design Capacity (gpm)	2015 Peak Velocity (fps)
141+60		276.78		285.3					
			0.0022		224	99	12	539	1.4*
138+60		276.12		287.4					
			0.0022		224	99	12	539	1.4*
137+65		275.91		288.1					
			0.0022		224	99	12	539	1.4*
136+70		275.70		288.3					
			0.0022		224	99	12	539	1.4*
134+90		275.30		284.9					
			0.0022		224	99	12	539	1.4*
133+00		274.88		287.4					
			0.0022		224	99	12	539	1.4*
131+85		274.63		287.5					
			0.0022		224	99	12	539	1.4*
128+85		273.97		287.9					
			0.0022		224	99	12	539	1.4*
127+35		273.64		289.1					
			0.0022		224	99	12	539	1.4*
125+15	B	273.16		291.7	373	166			
125+15		272.91		291.7	373	166			
			0.0015		373	166	15	763	1.5*
123+35		272.64		281.4					
			0.0015		373	166	15	763	1.5*
121+50		272.36		283.0					
			0.0015		373	166	15	763	1.5*
119+65		272.08		279.0					
			0.0015		373	166	15	763	1.5*
116+65		271.63		279.5					

*Peak year 2015 velocities less than 2 fps: possible deposition area.

TABLE 1 (Cont.)

DESIGN FOR COMSTOCK GRAVITY SEWER

Manhole Station	Node	Invert Elev.	Slope (ft/ft)	Approx. Surface Elev.	2045 Peak Flow (gpm)	2015 Peak Flow (gpm)	Pipe Size (inches)	Design Capacity (gpm)	2015 Peak Velocity (fps)
			0.0015		373	166	15	763	1.5*
113+65		271.18		277.5					
			0.0015		373	166	15	763	1.5*
110+65		270.73		277.5					
			0.0015		373	166	15	763	1.5*
107+65		270.28		277.5					
			0.0015		373	166	15	763	1.5*
105+15		269.91		275.0					
			0.0015		373	166	15	763	1.5*
103+60		269.67		276.0					
			0.0015		373	166	15	808	1.5*
102+75	C	269.54		278.5	637	274			
			0.0015		637	274	15	763	1.6*
100+25		269.17		276.5					
			0.0015		637	274	15	763	1.6*
97+25		268.72		275.6					
			0.0015		637	274	15	763	1.6*
95+65	D	268.48		275.7	1,160	462			
			0.0254		1,160	462	15	3,140	5.5
93+35		262.65		270.0					
			0.0241		1,160	462	15	3,050	5.3
91+35		257.84		266.2					
91+35		257.59		266.2					
			0.0015		1,160	462	18	1,260	1.9*
88+35		257.14		264.2					
			0.0015		1,160	462	18	1,260	1.9*
85+65		256.73		268.0					

*Peak year 2015 velocities less than 2 fps: possible deposition area.

TABLE 1 (Cont.)

DESIGN FOR COMSTOCK GRAVITY SEWER

Manhole Station	Node	Invert Elev.	Slope (ft/ft)	Approx. Surface Elev.	2045 Peak Flow (gpm)	2015 Peak Flow (gpm)	Pipe Size (inches)	Design Capacity (gpm)	2015 Peak Velocity (fps)
			0.0015		1,160	462	18	1,260	1.9*
84+65		256.58		266.0					
			0.0015		1,160	462	18	1,260	1.9*
81+65		256.13		263.9					
			0.0015		1,160	462	18	1,260	1.9*
80+75		255.99		263.9					
			0.0015		1,160	462	18	1,260	1.9*
79+95		255.87		263.9					
			0.0015		1,160	462	18	1,260	1.9*
78+95		255.72		264.4					
			0.0015		1,160	462	18	1,260	1.9*
78+15		255.60		265.2					
			0.0100		1,160	462	18	3,190	3.9
75+55		253.00		261.2					
			0.0023		1,160	462	18	1,530	2.2
74+55		252.77		260.7					
			0.0024		1,160	462	18	1,570	2.3
72+35		252.24		263.0					
			0.0024		1,160	462	18	1,570	2.3
71+35	E	252.00		262.0	1,180	480			
71+35		250.89		262.0	1,180	480			
			0.0303		1,180	480	18	5,570	5.7
70+35		247.86		257.6					
70+35		246.08		257.6					
			0.0303		1,180	480	18	5,570	5.7
68+75		241.23		250.3					
68+75		240.01		250.3					
			0.0303		1,180	480	18	5,570	5.7

*Peak year 2015 velocities less than 2 fps: possible deposition area.

TABLE 1 (Cont.)

DESIGN FOR COMSTOCK GRAVITY SEWER

Manhole Station	Node	Invert Elev.	Slope (ft/ft)	Approx. Surface Elev.	2045 Peak Flow (gpm)	2015 Peak Flow (gpm)	Pipe Size (inches)	Design Capacity (gpm)	2015 Peak Velocity (fps)
67+65		236.68		246.1					
			0.0130		1,180	480	18	3,680	4.1
66+55		235.25		244.3					
			0.0130		1,180	480	18	3,680	4.1
64+05		232.00		243.1					
			0.0233		1,180	480	18	4,890	5.1
61+05		225.00		238.3					
			0.0200		1,180	480	18	4,530	4.7
58+55		220.00		233.2					
58+55		217.58		233.2					
			0.0303		1,180	480	18	5,570	5.7
56+05		210.00		224.5					
56+05		207.84		224.5					
			0.0303		1,180	480	18	5,570	5.7
54+10		201.93		215.1					
			0.0129		1,180	480	18	3,640	4.1
52+60		200.00		208.9					
52+60		199.06		208.9					
			0.0303		1,180	480	18	5,570	5.7
50+60		193.00		202.4					
50+60		189.67		202.4					
			0.0303		1,180	480	18	5,570	5.7
47+60		180.58		190.4					
47+60		175.27		190.4					
			0.0303		1,180	480	18	5,570	5.7
46+75		172.69		182.8					
46+75		160.36		182.8					

TABLE 1 (Cont.)

DESIGN FOR COMSTOCK GRAVITY SEWER

Manhole Station	Node	Invert Elev.	Slope (ft/ft)	Approx. Surface Elev.	2045 Peak Flow (gpm)	2015 Peak Flow (gpm)	Pipe Size (inches)	Design Capacity (gpm)	2015 Peak Velocity (fps)
			0.0303		1,180	480	18	5,570	5.7
44+65		154.00		160.33					
44+65		146.95		160.33					
			0.0274		1,180	480	18	5,300	5.4
42+95	F	142.30		148.79	2,360	812			
42+95		141.80		148.79	2,360	812			
			0.0039		2,360	812	24	5,340	3.0
41+35		141.17		148					
			0.0037		2,360	812	24	5,160	2.9
39+15		140.36		146.6					
			0.0041		2,360	812	24	5,430	3.0
38+15		139.95		147.6					
			0.0041		2,360	812	24	5,430	3.0
35+15		138.73		146.01					
			0.0041		2,360	812	24	5,430	3.0
34+35		138.41		145.56					
			0.0041		2,360	812	24	5,430	3.0
33+35		138.00		144.95					
			0.0008		2,360	812	24	2,420	1.8*
30+70		137.79		145.76					
			0.0008		2,360	812	24	2,420	1.8*
28+20		137.59		152					
			0.0008		2,360	812	24	2,420	1.8*
26+10	G	137.42		150.8	2,450	902			
			0.0008		2,450	902	24	2,420	1.8*
25+55		137.38		150.8					
			0.0008		2,450	902	24	2,420	1.8*
24+65		137.30		152					

*Peak year 2015 velocities less than 2 fps: possible deposition area.

TABLE 1 (Cont.)

DESIGN FOR COMSTOCK GRAVITY SEWER

Manhole Station	Node	Invert Elev.	Slope (ft/ft)	Approx. Surface Elev.	2045 Peak Flow (gpm)	2015 Peak Flow (gpm)	Pipe Size (inches)	Design Capacity (gpm)	2015 Peak Velocity (fps)
			0.0008		2,450	902	24	2,420	1.8*
23+45		137.21		155.3					
			0.0008		2,450	902	24	2,420	1.8*
21+45		137.05		160.5	2,450	902			
			0.0008		2,450	902	24	2,420	1.8*
19+95		136.93		162.3					
			0.0008		2,450	902	24	2,420	1.8*
18+95		136.85		160.5					
			0.0008		2,450	902	24	2,420	1.8*
17+55		136.74							
17+55		131.30		152.5					
			0.0207		2,450	902	24	12,300	5.7
15+20		126.44							
15+20		120.13		133.7					
			0.0207		2,450	902	24	12,300	5.7
14+05		117.75							
14+05		112.82		125					
			0.0207		2,450	902	24	12,300	5.7
13+05		110.75							
13+05		106.32		118					
			0.0207		2,450	902	24	12,300	5.7
12+05		104.25							
12+05		100.02		111.5					
			0.0207		2,450	902	24	12,300	5.7
11+05		97.95							
11+05		92.98		105.2					
			0.0207		2,450	902	24	12,300	5.7
9+55		89.88		97.4					

*Peak year 2015 velocities less than 2 fps: possible deposition area.

TABLE 1 (Cont.)

DESIGN FOR COMSTOCK GRAVITY SEWER

Manhole Station	Node	Invert Elev.	Slope (ft/ft)	Approx. Surface Elev.	2045 Peak Flow (gpm)	2015 Peak Flow (gpm)	Pipe Size (inches)	Design Capacity (gpm)	2015 Peak Velocity (fps)
			0.0207		2,450	902	24	12,300	5.7
6+55		83.68		91					
			0.0008		2,450	902	24	2,500	1.8*
4+30		83.50		92					
4+30		78.77		92					
			0.0207		2,450	902	24	12,300	5.7
2+50		75.05							
2+50		55.23		82					
			0.0207		2,450	902	24	12,300	5.7
1+30		52.75		59.8					
			0.0008		2,450	902	24	2,500	1.8*
0+00	A	52.64		60.6					

*Peak year 2015 velocities less than 2 fps: possible deposition area.

TABLE 2

DESIGN FOR TILCON GRAVITY SEWER

Manhole Station	Node	Invert Elev.	Slope (ft/ft)	Approx. Surface Elev.	2045 Peak Flow (gpm)	2015 Peak Flow (gpm)	Pipe Size (inches)	Design Capacity (gpm)	2015 Peak Velocity (fps)
25+95	D	63.95		70.9	2,280	1,600			
			0.0140		2,280	1,600	18	3,770	6.2
22+95	E	59.75		67.1	2,330	1,650			
			0.0140		2,330	1,650	18	3,770	6.2
20+85		56.82		64.1					
			0.0140		2,330	1,650	18	3,770	6.2
17+85		52.62		61.6					
			0.0092		2,330	1,650	18	3,100	5.3
14+85		49.87		63.2					
			0.0092		2,330	1,650	18	3,100	5.3
12+60		47.80		64.0					
			0.0055		2,330	1,650	18	2,380	4.1
11+25		47.06		55.7					
11+25		46.56		55.7					
			0.0008		2,330	1,650	24	2,330	2.1
10+45		46.50		54.7					
			0.0008		2,330	1,650	24	2,470	2.1
9+00	F	46.38		58.6	2,450	1,780			
			0.0008		2,450	1,780	24	2,470	2.2
6+00		46.13		64.2					
			0.0008		2,450	1,780	24	2,470	2.2
3+00		45.88		64.5					
			0.0008		2,450	1,780	24	2,470	2.2
0+00		45.63		60.6					

TABLE 3

DESIGN FOR BROOKDALE GRAVITY SEWER

Manhole Station	Node	Invert Elev.	Slope (ft/ft)	Approx. Surface Elev.	2045 Peak Flow (gpm)	2015 Peak Flow (gpm)	Pipe Size (inches)	Design Capacity (gpm)	2015 Peak Velocity (fps)
20+65	A	45.63		60.6	4,650	2,580			
			0.0055		4,650	2,580	24	6,330	5.0
17+65		43.98		55.0					
			0.0059		4,650	2,580	24	6,510	5.1
14+95	B	42.40		49.0	4,680	2,620			
			0.0069		4,680	2,620	24	7,090	5.3
13+65		41.50		48.2					
			0.0104		4,680	2,620	24	8,660	6.1
10+95		38.70		51.3					
			0.0118		4,680	2,620	24	9,290	6.3
8+75		36.10		42.1					
			0.0076		4,680	2,620	24	7,410	5.5
7+10		34.85		41.7					
			0.0100		4,680	2,620	24	8,530	6.0
4+60		32.35		41.0					
			0.0037		4,680	2,620	24	5,210	3.7
3+35		31.89		41.0					
			0.0037		4,680	2,620	24	5,210	3.7
2+25		31.48		41.0					
			0.0037		4,680	2,620	24	5,210	3.7
1+00		31.02		44.0					
			0.0037		4,680	2,620	24	5,210	3.7
0+00	C	30.65		42.0	5,140	2,850			

TABLE 4

DESIGN FOR NATICK GRAVITY SEWER

Manhole Station	Node	Invert Elev.	Slope (ft/ft)	Approx. Surface Elev.	2045 Peak Flow (gpm)	2015 Peak Flow (gpm)	Pipe Size (inches)	Design Capacity (gpm)	2015 Peak Velocity (fps)
46+55	G	71.00		81.7					
			0.0110		1,130	355	12	1,120	3.7
45+05		69.35		80.2					
			0.0155		1,130	355	12	1,350	4.3
44+25		68.11		75.7					
			0.0272		1,130	355	12	1,800	5.0
42+95		64.58		72.5					
			0.0520		1,130	355	12	2,470	6.7
41+15		55.22		62.9					
			0.0130		1,130	355	12	1,260	4.0
40+15		53.92		61.5					
40+15		53.42		61.5					
			0.0020		1,130	355	18	1,440	2.0
39+10		53.21		64.0					
			0.0020		1,130	355	18	1,440	2.0
37+75		52.94		63.1					
			0.0020		1,130	355	18	1,440	2.0
36+40		52.67		66.0					
			0.0020		1,130	355	18	1,440	2.0
35+00		52.39		65.2					
			0.0044		1,130	355	18	2,150	2.6
		51.53		63.9					
			0.0044		1,130	355	18	2,150	2.6
30+55		50.43		61.7					
			0.0044		1,130	355	18	2,150	2.6
28+05		49.33		60.0					
			0.0044		1,130	355	18	2,150	2.6

TABLE 4 (Cont.)

DESIGN FOR NATICK GRAVITY SEWER

Manhole Station	Node	Invert Elev.	Slope (ft/ft)	Approx. Surface Elev.	2045 Peak Flow (gpm)	2015 Peak Flow (gpm)	Pipe Size (inches)	Design Capacity (gpm)	2015 Peak Velocity (fps)
26+00		48.43		57.8					
			0.0044		1,130	355	18	2,150	2.6
		47.72		56.4					
			0.0021		1,130	355	18	1,480	2.0
22+85		47.40		59.4					
			0.0021		1,130	355	18	1,480	2.0
	H	46.92		60.6	1,170	417			
			0.0021		1,170	417	18	1,480	2.1
		46.29		56.0					
			0.0021		1,170	417	18	1,480	2.1
15+25		45.79		59.0					
			0.0021		1,170	417	18	1,480	2.1
		45.53		57.9					
			0.0103		1,170	417	18	3,280	3.7
12+70		44.19		56.2					
			0.0103		1,170	417	18	3,230	3.7
11+90		43.37		55.7					
			0.0221		1,170	417	18	4,760	4.9
11+00		41.38		52.0					
			0.0221		1,170	417	18	4,760	4.9
10+00		39.17		48.5					
			0.0066		1,170	417	18	2,600	3.1
9+10		38.58		46.0					
			0.0066		1,170	417	18	2,600	3.1
		37.19		45.8					
			0.0066		1,170	417	18	2,600	3.1
4+90		35.81		50.4					
			0.0066		1,170	417	18	2,600	3.1

TABLE 4 (Cont.)

DESIGN FOR NATICK GRAVITY SEWER

Manhole Station	Node	Invert Elev.	Slope (ft/ft)	Approx. Surface Elev.	2045 Peak Flow (gpm)	2015 Peak Flow (gpm)	Pipe Size (inches)	Design Capacity (gpm)	2015 Peak Velocity (fps)
3+90		35.15		45.0					
			0.0066		1,170	417	18	2,600	3.1
2+50		34.22		45.7					
			0.0066		1,170	417	18	2,600	3.1
1+95		33.86		46.5					
			0.0066		1,170	417	18	2,600	3.1
1+30		33.43		47.8					
		27.94							
			0.0015		1,170	417	18	1,210	1.8*
0+00		27.75		42.0					

*Peak year 2015 velocities less than 2 fps: possible deposition area.

TABLE 5

FORCE MAIN/VARIABLE GRADE SEWER
FROM SCITUATE PUMPING STATION
TO VGS HIGHPOINT
YEAR 2045 FLOWS

VGS Nominal Dia. (in)	VGS Inside Dia. (in)	2045 Peak Flow (gpm)	Proposed Pumping Rate (gpm)	Beginning Force Main Elev. (ft)	High Point Elev. (ft)	Elev Head (ft)
6 DR 18	6.09	504	504	365	438	73

Pipe Length (ft)	Manning's n	2045 Peak Flow Velocity (fps)	Minimum Pumping Rate Velocity (fps)	Friction Head (ft)	Total Head (ft)
4,100*	0.009	5.6	5.6	73	146*

*Length of pipe to high point elevation.

TABLE 6

FORCE MAIN FROM WILBUR PUMPING STATION
TO SOCKANOSSET INTERCEPTOR

VGS Nominal Dia. (in)	VGS Inside Dia. (in)	2045 Peak Flow (gpm)	Minimum Pumping Rate (gpm)	Beginning Force Main Elev. (ft)	Discharge Elev. (ft)	Elev. Head. (ft)
16 DR 18	15.46	5,140	2,000	40.5	141	101

Pipe Length (ft)	Manning's n	2045 Peak Flow Velocity (fps)	Minimum Pumping Rate Velocity (fps)	Friction Head (ft)	Total Head (ft)
9,000	0.009	8.8	3.4	115	216

TABLE 7

IMPROVEMENTS TO SOCKANOSSET INTERCEPTOR

Segment	Manhole Station	Pipe (in)	Length (ft)	Full Pipe Capacity (gpm)	Design Pipe Capacity (gpm)	Peak Year 2045 Flow (gpm)	Required Additional Pipe: Pipe Diameter (inches)	Required Additional Pipe: Design Capacity (gpm)
Gravity Line from Intersection of Park Forest Rd and Summit Ave.								
Park Forest								
Belvedere	248.7							
		30	248.7	6,190	5,180	7,740		
	0.0							
Hoffman	1620.0							
		30	269.2	6,710	5,610	7,750		
Jennings	1350.8							
		30	278.0	6,880	5,750	7,830		
Kennedy	1072.8							
		30	343.4	8,170	6,840	7,830		
Kennedy	729.4							
		30	272.9	17,970	15,040	7,860		
MH	456.5							
		30	91.6	10,870	9,100	7,860		
MH	364.9							
		30	91.9	8,200	6,870	7,860		
Cross Country	273.0							
		30	273.0	8,420	7,040	7,860		
Cross Country	0.0							
MH	7450.9							
		30	192.7	9,320	7,800	7,930		
MH	7258.2							
		30	313.0	8,660	7,240	7,930		
N Lndn A	6945.2							
		30	311.6	9,580	8,020	7,930		
	6633.6							

TABLE 7 (Cont.)

IMPROVEMENTS TO SOCKANOSSET INTERCEPTOR

Segment	Manhole Station	Pipe (in)	Length (ft)	Full Pipe Capacity (gpm)	Design Pipe Capacity (gpm)	Peak Year 2045 Flow (gpm)	Required Additional Pipe: Pipe Diameter (inches)	Required Additional Pipe: Design Capacity (gpm)
MH	6631.0							
		30	154.4	7,310	6,120	7,930		
MH	6476.6							
		30	275.2	8,330	6,970	7,930		
MH	6201.4							
		30	263.2	9,440	7,900	7,930		
MH	5938.2							
		22	228.5	9,610	8,040	7,930		
MH	5709.7							
		18	111.9	9,020	6,070	7,930		
MH	5597.8							
		18	98.1	9,030	6,070	7,930		
MH	5499.7							
		18	98.2	9,480	6,380	7,930		
MH	5401.5							
		18	101.7	9,300	6,250	7,930		
Midway R	5299.8							
		18	102.1	9,040	6,080	7,930		
MH	5197.7							
		18	122.1	9,060	6,090	7,930		
MH	5075.6							
		18	80.2	7,420	4,990	7,930		
		18	87.9	7,920	5,330	7,930		
MH	4995.4							
MH	4907.5							
		22	253.7	8,320	6,960	7,930		
		22	254.3	9,630	8,060	7,930		
MH	4653.8							

TABLE 7 (Cont.)

IMPROVEMENTS TO SOCKANOSSET INTERCEPTOR

Segment	Manhole Station	Pipe (in)	Length (ft)	Full Pipe Capacity (gpm)	Design Pipe Capacity (gpm)	Peak Year 2045 Flow (gpm)	Required Additional Pipe: Pipe Diameter (inches)	Required Additional Pipe: Design Capacity (gpm)
MH	4399.5							
		22	124.8	13,740	11,500	7,930		
	4274.7							
MH	4265.3							
		30	314.0	9,720	8,130	7,930		
MH	3951.3							
		30	98.5	5,370	4,490	8,130	24	2,820
MH	3852.8							
		30	303.3	7,710	6,450	8,130	24	4,070
MH	3549.5							
		30	143.1	8,490	7,100	8,130	24	4,500
MH	3406.4							
		30	166.4	8,350	6,990	8,160	24	4,410
MH	3240.0							
		30	213.4	7,530	6,300	8,490	24	3,980
MH	3026.6							
		30	313.6	8,210	6,870	8,490	24	4,330
Pettaconsett	2713.0							
		30	315.5	8,330	6,970	8,490	24	4,410
	2397.5							
		30	294.5	7,770	6,500	8,610	24	4,070
	2103.0							
		30	61.0	12,840	10,740	8,610		
	2042.0							

APPENDIX B

Task 12d -Proposed Project, Pumping Station Mechanical Design

Section 117, Cranston Rhode Island
Wastewater Conveyance Feasibility Investigation

APPENDIX B

TASK 12d - Proposed Project, Pumping Station Mechanical Design

Department of the Army
Corps of Engineers, New England Division
Waltham, Mass

March 1995

TABLE OF CONTENTS

	PAGE
Introduction	B-1
Service Area 1	B-2
Scituate Pumping Station	B-2
Service Area 2	B-7
Wilbur Pumping Station	B-7
Wastewater Treatment Faciltiy Screw Pumps .	B-16

INTRODUCTION

In Tasks 7 and 9 of the Cranston, Rhode Island Wastewater Conveyance Feasibility Study, feasibility level designs and costs were prepared for six wastewater pumping stations. After consideration of the Tasks 7 and 9 report, two new pumping stations were chosen for further study.

This report provides a more detailed description of design recommendations and a list of major mechanical equipment required for the two selected wastewater pumping stations. The design again focused on sizing wastewater pumps and force mains at each station based on projected average daily and peak wastewater flows for the years 2015 and 2045. Required pumping heads were calculated based on proposed force main/variable grade sewer (VGS) routes. The force mains were sized to provide reasonable friction losses and to accommodate pressure surges at peak flow rates. Pumping strategies were developed to maintain recommended flushing velocities in the force mains. Other aspects of station design included consideration of a screening device for the Wilbur pumping station and selection of a "packaged" pumping station design for the Scituate station. Plans of the two stations are included in this report.

Design of the station buildings, wet well storage and station auxiliaries was based on requirements and guidelines contained in the following two documents:

1. TR-16, "Guides for the Design of Wastewater Treatment Works", prepared by the Technical Advisory Board of the New England Interstate Water Pollution Control Commission, 1980 ed.

2. "Design of Wastewater and Stormwater Pumping Stations", Manual of Practice No. FD-4, Water Pollution Control Federation, 1981.

Service Area 1

SCITUATE PUMPING STATION

Selection of Force Main

The force main was sized to carry the 2045 projected peak flow of 504 gallons per minute (gpm). Plastic pipe was chosen because it retains a smooth interior surface over time, therefore reducing friction losses and required pump head. This was a concern for the Scituate pumping station because of the long force main/variable grade sewer (VGS) and high static lift required. Ultimately, polyvinyl chloride (PVC) pipe was selected because at this time, it appears to be less expensive than high density polyethylene (HDPE) pipe.

A nominal 6-inch diameter pipe is required to convey the 2045 projected peak flow without unacceptable friction losses. Due to the high pump head required at peak flow rate and potential surge pressures resulting from peak velocity, it will be necessary to use standard diameter ratio (SDR) 18 pipe with a pressure rating of 150 pounds per square inch (psi). The selected pipe is 6-inch SDR 18 PVC bell and spigot pipe (AWWA C-900) with an inside diameter of 6.09 inches.

The force main portion of the Scituate force main/VGS is approximately 4100 feet long. The volume of wastewater contained in this section of the pipe is approximately 6200 gallons. In order to ensure that the force main empties at least 4 times a day, thus reducing the potential for odor problems, a minimum daily inflow of 25,000 gallons (0.025 MGD) is recommended at the Scituate pumping station.

Pumping Considerations

In order to maintain velocities in the force main/VGS which will be adequate to resuspend settled solids and flush out low points (3-5 feet per second) it will be necessary to operate the pumps at close to the peak design flow rate. Two full size pumps were selected, each with design capacity of 504 gpm and 150 feet Total Developed Head (TDH). Each pump will require a 50-horsepower (HP) electric motor driver. The pumps are constant speed, level controlled with an alternator. Cost of a bubble type level sensing system has been included for this station; however, the city may wish to consider the use of an ultrasonic type level sensor. Unless there is a problem with foam, the ultrasonic system should provide accuracy comparable to the bubble system, but with greater reliability due to its relative simplicity (i.e. fewer parts).

Service Area 1

SCITUATE PUMPING STATION

Sump Sizing

Wet well sump size is approximately 1120 gallons based on 10 minutes of storage at the design average flow of 112 gpm. Under the worst case (which occurs when inflow rate is half of the outflow rate), the empty-fill cycle time will be approximately 9 minutes. Since the pumps are controlled to alternate operation, the time between starts will be a minimum of 18 minutes per pump. This is equivalent to 3.33 starts per hour and should be acceptable. Most of the time, the pumps will be starting and stopping less frequently.

Station Design

Preliminary cost estimates were developed for two station designs. The first design was a cast-in-place pumping station consisting of separate wet and dry wells with vertical wastewater pumps located in the dry well. The second design included a precast wet well with submersible pumps and a separate slab-on-grade structure to house the electrical equipment. Estimated construction costs for the precast station design were approximately $100,000 less than construction costs for the cast-in-place station design. Estimated operating costs for the precast station were slightly higher than for the cast-in-place station because the submersible pumps are less efficient than the vertical dry well pumps; however, the operating cost savings of the more efficient dry pit pumps do not offset the greater construction cost of the cast-in-place pumping station. (The present worth value of the operating cost differential, assuming a 7-3/4% discount rate, is about $2,000.) Therefore, the precast design was selected. Conceptual drawings of the Scituate pumping station are shown in Plate 1.

The station will consist of a packaged precast wet well with duplex submersible pumps. A basket strainer will be installed at the end of the incoming sewer pipe to strain out large debris. The strainer will be installed on guide rails and provided with a manual winch to facilitate removal for cleaning. Minimum water level in the wet well will be above the centerline of the pump impellers. Submersible pumps and motors will be located in the wet well and provided with guide rails and sliding discharge flange connections to facilitate removal and reinstallation. A portable hoist and manually operated cable winch will be provided and stored in the equipment room. Pumps will be provided with seal failure indication. Discharge line check and gate valves will be located in a separate valve pit, also of precast

Service Area 2

WILBUR PUMPING STATION

Vertical pumps and motors will be located on the lower level of the dry well; all other mechanical and electrical equipment will be located on the upper level. (Because of the length of the force main, the high peak flow velocity and the high pumping head required, consideration should be given to some sort of surge protection for the force main in the final design. This could take the form of a controlled closing type check valve on each pump discharge and/or a surge relief valve piped from the common discharge header back to the wet well. Costs for this equipment have been included in the study although the valves are not shown on the drawings.)

A Venturi-type flow meter is shown on the drawings because it provides good accuracy without obstructing the wastewater flow. Consideration should be given to magnetic or ultrasonic flow meters during the final design since these meters might provide acceptable accuracy with less pressure loss and at a lower installed cost.

Separate, forced ventilation systems will be provided for the wet and dry wells; it is assumed that both the wet well and the dry well will be ventilated continuously. Heat will be supplied to the dry well and the wet well by means of gas fired duct furnace units located outside. A utility sink will be provided in the upper level of the dry well and hose bibs will be provided at convenient locations in both the wet and dry wells to assist in cleanup of equipment.

A motor control center will be provided. Alarm systems will be provided for intrusion detection, fire detection and equipment and system malfunction. Telephone and communication lines will be provided. Indoor lighting fixtures will be industrial fluorescent vaportight. Outdoor lighting fixtures will be wall mounted high pressure sodium. Battery-backed auxiliary lighting units will be provided in the dry well.

Backup power will be provided in the form of a diesel powered emergency generator with automatic transfer switch. A 400 kw generator will be adequate to provide backup power to pump projected peak flows for the year 2015. When greater pumping capacity is needed, a second 400 kw generator can be added, or the original 400 kw unit can be replaced with a larger 650 kw unit. (Cost of the 650 kw unit has been included in the study as a future expense.) The generator(s) will be housed in a separate enclosure.

Service Area 1

SCITUATE PUMPING STATION

List of Major Mechanical Equipment[1] (for years 2015 and 2045)

Qty.	Item
2	Centrifugal, non clog submersible wastewater pump, 4" suction and discharge, 3" solids handling capability, flow capacity 504 gpm, 1750 revolutions per minute (rpm), 50 HP electric motor.
1	Pump control system including: bubble level sensing system and switches, and pump control panel. Panel to be UL listed and include pump circuit breakers, hand/off/auto switches, pump running time meters, pump running lights, alternator, control transformer, and local and remote alarm contacts. Alarm signals to be provided for pump malfunction, pump seal failure, high level in wet well, low level in wet well, loss of power, and loss of alarm transmission line.
1	Portable tripod and hand chain hoist, 1 ton lifting capacity.
1	Exhaust fan for equipment building, 300 cubic feet per minute (CFM), 1/8 HP motor.
1	Gas fired unit heater, 25 thousand Btus per hour (MBH).
1	Diesel powered emergency generator and automatic transfer switch, 70 kilowatts (KW).
1	Fuel supply system for generator: 500 gallon double walled underground tank, 10 gallon day tank, vent pipes, fill pipe, fuel oil supply and return piping, remote level gage and leak alarm system.

[1] The city has indicated a preference for an above ground fuel storage tank. An above ground tank should be considered in final design. Also the city has requested that flow monitoring at the Scituate pumping station be included in final design.

Service Area 1

SCITUATE PUMPING STATION

List of Major Electrical Equipment (for years 2015 and 2045)

Qty.	Item
1	480V Electric service drop, from utility-supplied 75KVA pole-mounted transformer.
1	Service entrance/distribution panel rated at 480 Volts for 225 Amps.
1	Station service consisting of a 10KVA, 480-208/120 transformer and a 100A, 208/120 circuit breaker panel.
1	Station interior and security lighting.
1	Wiring for all items on the mechanical equipment list.
1	Grounding and lightning protection.

Service Area 2

WILBUR PUMPING STATION

Selection of Force Main

The force main was sized to carry the 2045 projected peak flow rate of 5140 gpm. Plastic pipe was chosen because it retains a smooth interior surface over time, therefore reducing friction losses and required pump head. This was a critical concern for the Wilbur pumping station because of the long force main and high static lift required. Ultimately, PVC pipe was selected because at this time, it appears to be less expensive than HDPE pipe.

A nominal 16 inch diameter pipe is required to convey the 2045 projected peak flow without unacceptable friction losses. However, the velocity at this flow rate is greater than 8 feet per second. Due to the high pump head required at peak flow rate and potential surge pressures resulting from peak velocity, it will be necessary to use SDR 18 pipe with a pressure rating of 235 psi. The selected pipe is 16 inch SDR 18 PVC bell and spigot pipe (AWWA C-905) with an inside diameter of 15.46 inches.

The total volume contained in 9000 feet of this force main is approximately 87,000 gallons. In order to insure that the force main empties at least 4 times a day, thus reducing the potential for odor problems, a minimum daily inflow of 350,000 gallons (0.35 MGD) is recommended at the Wilbur pumping station.

Pumping Considerations

In the report of Task 7, it was recommended that two variable speed pumps be installed at the Wilbur pumping station each sized to pump the projected peak flow for the year 2015 (2830 gpm at 169 feet TDH). A space would be provided for a third identical pump to be installed sometime after the year 2015 so as to accommodate the projected peak flow for the year 2045. In order to maintain flushing velocities of between 3 and 5 feet per second in the force main, it will be necessary to control the pumps so that they do not operate below a flow rate of approximately 2000 gpm. The average daily flow rate for the year 2015 is only 906 gpm; therefore, the pump will cycle on and off at 2000 gpm in response to wet well level controls and will essentially be operating as a constant speed pump for most of the period between the present time and the year 2015. The equipment cost for two pumps, motors and variable frequency drive controls is approximately $190,000. (This cost is included in the study costs for the Wilbur pumping station because the City prefers initial installation of the variable speed pumps.)

Service Area 2

WILBUR PUMPING STATION

An alternative solution would be to install three constant speed pumps each sized to pump half of the projected peak flow for the year 2015 (1415 gpm at 169 feet TDH). The pumps would be cycled on and off by wet well level controls. When one pump is operating, it will run out on its curve to intersect the system resistance curve at approximately 2000 gpm and 142 feet TDH thus providing the minimum allowable flow without sophisticated and expensive variable speed controls. After 2015, if flows continue to increase, the three pumps can be replaced with three larger pumps each sized to pump one-half of the projected 2045 peak flow. Variable speed drives should be considered at that time. The equipment cost for three pumps, motors and constant speed controls is approximately $100,000.

The station is designed to accommodate the larger pumps and motors and variable frequency controllers. The larger pumps have the same size suction and discharge connections as the smaller pumps; therefore, replacement of piping and valves would not be required. Future equipment costs in either case would depend on actual flows and the condition of existing equipment at the time. If the two larger pumps and variable speed drive controllers are installed initially and poorly maintained, all three pumps might require replacement. If they are well maintained, installation of only one additional pump and associated controls would be required. Even assuming that only one additional pump would be required, installing the two larger variable speed pumps now is approximately 10 percent more expensive than installing three smaller constant speed pumps now and replacing them with three larger variable speed pumps later. This is primarily due to the high cost of the variable frequency drive controllers and is based on comparing the present worth of both alternatives assuming a 5 percent discount rate and planned pump replacements or additions in the year 2015. Adding one pump would be less disruptive to service than replacing three pumps; however, it should be kept in mind that variable speed control technology has changed considerably in the past 20 years and that 20 years from now, it might be desirable to replace any originally installed variable speed control system with a current "state-of-the-art" system.

Commercial power for the station is sized based on backing up pumping capability for the 2045 peak flow rates. (This means two of the larger variable speed pumps or three of the smaller constant speed pumps.) The initial cost of a transformer, service entrance/distribution panel and automatic transfer switch sized to meet the 2045 condition is only $15,000 greater than the cost of smaller units sized to meet the 2015 condition. The

transformer and panel can be expected to last 50 years and they will not be damaged by low load operation. Therefore, it is economically feasible to install the larger equipment initially.

The emergency generator is sized based on backing up pumping capability for the 2015 projected peak flow rates only. (This means one of the larger variable speed pumps or two of the smaller constant speed pumps.) The generator auxiliaries such as the enclosure and the fuel tank are sized to allow either addition of a second generator or replacement of the initial generator with a larger unit when additional pumping equipment is installed. The initial equipment cost of providing a larger generator which would meet the 2045 condition $60,000 greater than the cost of a smaller unit sized to meet the 2015 condition. In addition, operation of the engine/generator unit at loads far below its design capability is detrimental to the equipment. Installation of a unit which would provide back up power for some unspecified emergency situation cannot be economically justified without further information on expected emergency flow rates and frequency of occurrence.

Sump Sizing

Wet well sump size is approximately 9500 gallons. This will provide 5.5 minutes of storage at the design average flow rate of 1715 gpm. It is assumed that the minimum pump flow rate will be 2000 gpm. Under the worst case (which occurs when inflow rate is half of the outflow rate), the empty-fill cycle time will be approximately 19 minutes. Since the pumps are controlled to alternate operation, the time between starts will be a minimum of 38 minutes per pump for two pump operation. This is equivalent to approximately 1.6 starts per hour per pump and should be acceptable. Most of the time, the pumps will be starting and stopping less frequently.

Selection of Screening Device

Two types of screening devices were considered for the Wilbur pumping station; a mechanically-cleaned bar screen and a "Channel Monster" grinder/comminutor. The "Channel Monster" brand of comminutor was specifically chosen for investigation because it is of a different design from the rotary drum type comminutors with which the city has had problems in the past. The city has no mechanically cleaned bar screens at present; one is being installed at the Howard pumping station and one is scheduled for installation at the new I-295 pumping station.

Service Area 2

WILBUR PUMPING STATION

A major issue to be resolved before selection of a screening device can occur is whether to remove solids from the wastewater stream or to leave them in. There is concern that solids left in the wastewater stream will settle out in low portions of the force main, potentially causing blockage. Based on screen manufacturer's design data curves provided by the city's consultant, a screen with 1-1/2 inch openings will remove only about 10 percent of the total solids in the wastewater flow; a screen with 1-inch openings will remove approximately 25 percent of the solids. Use of a screen would therefore not appear to solve the potential problem of solids deposition in the force main. In addition, disposal of the screenings in landfills has become difficult in some communities due to stricter environmental regulations. Although this may not be a problem for the city at the present time, it could become an issue in the future, possibly requiring testing of the screenings, higher dumping fees and/or longer transport times.

Aside from the amount of solids in the stream, there is also concern over the type of solids; in particular, long stringy fibers which tend to bind together and create problems for treatment equipment downstream. Here the screen has a definite advantage, in that this type of material would for the most part be strained out. Rotary drum type comminutors can exacerbate the problem by tearing up larger items such as sheets and towels into long strings. The "Channel Monster" is claimed to produce shreds with maximum length of approximately 2 inches; this is unconfirmed. However, operators at the city of Keene, New Hampshire's wastewater treatment facility did not see an increase in fibers there after a 7-year-old mechanically-cleaned bar screen in their main pumping station was replaced with a "Channel Monster" comminutor in August 1992. Keene's main pumping station receives all the wastewater flow from the city (10 MGD peak) and pumps it through a two-mile-long force main to the wastewater treatment plant.

There is a significant difference in capital costs for the two types of equipment. Based on 7.4 million gallons per day (MGD) peak design flow and a 3-foot channel width, approximate equipment costs are $50,000 for the grinder/comminutor and $100,000 for the screen. Installation costs for the grinder/comminutor would be considerably less than for the screen since it is a much smaller piece of equipment and could be located completely underground. The screen is approximately 6 feet wide by 30 feet high and would require an aboveground enclosure over the wet well thus adding to the capital costs of the pumping station structure. Also, because the pumping station

is located in an historic district, there may be a political advantage to minimizing the size of the above ground portion of the station.

Although comminuting devices are generally considered high maintenance items, conversations with users of the "Channel Monster" indicate that it requires little maintenance when compared with rotary drum type comminutors or mechanically-cleaned screens. Three of the users had units installed in unmanned locations hooked up to remote alarms. All the users contacted stated that the units were very reliable and in 2-3 years of operation had only required operator intervention a few times. Mechanically-cleaned bar screens are also subject to equipment malfunction. Tracks or chains have to be greased. Chain-operated units may need to have the chain retensioned periodically. The major operating and maintenance cost associated with the mechanically-cleaned screens is removal and disposal of the screenings. Both screen users who were contacted estimated that this took 12-16 man hours per week.

In accordance with the city's preference, a mechanically-cleaned bar screen is shown on the station plans and costs for the screen have been included in the study. During the final design, it may be desirable to reevaluate the selected screening device in light of the city's experience with operation of the two mechanically-cleaned bar screens presently scheduled for installation at Howard and I-295 pumping stations.

Station Design

Conceptual drawings of the Wilbur pumping station are shown in Plate 2. The station will be cast-in-place concrete with separate wet and dry wells. It is believed that locating the station in the median of I-295 will minimize its visual impact on the surrounding historical district; therefore, no special architectural treatment is shown on the plans. Funds have been included for clapboard siding and possible roof alterations in the final design. The station can be partially hidden behind appropriate plantings and/or fencing.

A manually-cleaned bar rack and mechanically-cleaned bar screen will be installed in parallel in the incoming sewer line. Normally, flow will be directed through the mechanically-cleaned screen; the rack is provided for backup when the mechanically-cleaned screen is being serviced. Minimum water level in the wet well will be above the centerline of the pump impellers.

Service Area 2

WILBUR PUMPING STATION

Vertical pumps and motors will be located on the lower level of the dry well; all other mechanical and electrical equipment will be located on the upper level. (Because of the length of the force main, the high peak flow velocity and the high pumping head required, consideration should be given to some sort of surge protection for the force main in the final design. This could take the form of a controlled closing type check valve on each pump discharge and/or a surge relief valve piped from the common discharge header back to the wet well. Costs for this equipment have been included in the study although the valves are not shown on the drawings.)

A Venturi-type flow meter is shown on the drawings because it provides good accuracy without obstructing the wastewater flow. Consideration should be given to magnetic or ultrasonic flow meters during the final design since these meters might provide acceptable accuracy with less pressure loss and at a lower installed cost.

Separate, forced ventilation systems will be provided for the wet and dry wells; it is assumed that both the wet well and the dry well will be ventilated continuously. Heat will be supplied to the dry well and the wet well by means of gas fired duct furnace units located outside. A utility sink will be provided in the upper level of the dry well and hose bibs will be provided at convenient locations in both the wet and dry wells to assist in cleanup of equipment.

A motor control center will be provided. Alarm systems will be provided for intrusion detection, fire detection and equipment and system malfunction. Telephone and communication lines will be provided. Indoor lighting fixtures will be industrial fluorescent vaportight. Outdoor lighting fixtures will be wall mounted high pressure sodium. Battery-backed auxiliary lighting units will be provided in the dry well.

Backup power will be provided in the form of a diesel powered emergency generator with automatic transfer switch. A 400 kw generator will be adequate to provide backup power to pump projected peak flows for the year 2015. When greater pumping capacity is needed, a second 400 kw generator can be added, or the original 400 kw unit can be replaced with a larger 650 kw unit. (Cost of the 650 kw unit has been included in the study as a future expense.) The generator(s) will be housed in a separate enclosure.

Service Area 2

WILBUR PUMPING STATION

List of Major Mechanical Equipment (for year 2015)

Qty.	Item
2	Centrifugal, nonclog wastewater pump, (one operating, one spare) 6" suction and discharge, 3" solids-handling capability, flow capacity 2830 gpm, 1750 rpm maximum speed, 250 HP electric motor with variable frequency drive.
1	Pump control system including: bubble level sensing system, and pump control panel. Panel to be UL listed and include pump circuit breakers, programmable controller for variable speed operation, hand/off/auto switches, pump running time meters, pump running lights, alternator, control transformer and local and remote alarm contacts. Alarm signals to be provided for pump malfunction, high level in wet well, low level in wet well, high water level in dry well sump, loss of power, and loss of alarm transmission line.
1	Duplex seal water system, 2 pumps, 1/2 HP each. Includes tank, valves and separate control/alarm panel.
1	16" Venturi-style flow meter, pressure sensors, pressure transmitters, local flow indicator and totalizer and contacts for remote data transmission.
2	Submersible sump pump, motor and controls, 1/2 HP.
1	Weatherproof, gas-fired duct furnace and supply air blower for wet well, 5200 CFM, 3 HP motor, 260 MBH heating capacity.
1	Weatherproof, gas-fired duct furnace and supply air blower for dry well, 2000 CFM, 3/4 HP motor, 110 MBH heating capacity.
1	Mechanically-cleaned bar screen, 7.4 MGD capacity, 2 HP motor and automatic controls.

Service Area 2

WILBUR PUMPING STATION

List of Major Mechanical Equipment (Cont'd.) (for year 2015)

Qty.	Item
1	Diesel-powered emergency generator and automatic transfer switch, 400 KW.
1	Fuel supply system for generator: 1000-gallon double-walled underground tank, 25-gallon day tank, vent pipes, fill pipe, fuel oil supply and return piping, remote level gage and leak alarm system.

List of Additional Major Mechanical Equipment (for year 2045)

Qty.	Item
1	Centrifugal, nonclog wastewater pump, (two operating, one spare) 6" suction and discharge, 3" solids handling capability, flow capacity 2570 gpm, 250 HP electric motor with variable frequency drive.
1	Modifications to existing pump control system to accommodate additional pump.
1	Diesel-powered emergency generator and automatic transfer switch, 650 KW.

Service Area 2

WILBUR PUMPING STATION

List of Major Electrical Equipment (for year 2015)

Qty.	Item
1	480V Electric service, from city-supplied 750 KVA pad mount transformer.
1	Service entrance/distribution panel rated at 480 Volts for 1000 Amps.
1	Station service consisting of a 30KVA, 480-208/120 transformer and a 225A, 208/120 circuit-breaker panel.
1	Station interior and security lighting.
1	Wiring for all the items on the mechanical equipment list.
1	Grounding and lightning protection.

List of Additional Major Electrical Equipment (for year 2045)

Qty.	Item
1	Wiring for all items on the mechanical equipment list (for year 2045).

Service Area 2

WASTEWATER TREATMENT FACILITY SCREW PUMPS

The wastewater flow from the Wilbur pumping station (Service Area 2) will be pumped to existing gravity sewer lines through which it will flow into the suction end of the existing Archimedes screw pumps located at the Wastewater Treatment Facility (WWTF).

Existing Pumping Capacity

At present, there are three Archimedes screw pumps at the WWTF, each with a flow capacity of 5213 gallons per minute. This would allow a total inflow of 10,426 gpm with two pumps operating and one spare backup. The existing pumps are 54 inches in diameter and are inclined at an angle of 38 degrees. Each pump has three flights and is operated at a speed of 36.7 rpm by a gear reducer connected to a V-belt drive which is in turn connected to a 50 HP electric motor operating at 1770 rpm.

Peak Flows for the Year 2015

Projected peak flow into these pumps for the year 2015 is 8607 gpm. This estimate includes the additional flow from the proposed Wilbur pumping station, but does not include additional flows from the Howard pumping station. The existing pumps should easily be able to handle this projected flow rate with two pumps operating, leaving the third pump as a backup.

Peak Flows for the Year 2045

Projected peak flow into the screw pumps for the year 2045 is 11,186 gpm. This estimate includes the additional flow from the proposed Wilbur pumping station, but does not include additional flows from the Howard pumping station. The output of the existing pumps and motors could be increased to a maximum of approximately 5600 gpm each (11,200 gpm for two) by increasing pump operating speed to approximately 40 rpm. This would be most easily accomplished by replacing the existing motor sheave on each V-belt drive with a larger diameter sheave and also replacing the belts. It should therefore not be necessary to add a fourth screw pump to accommodate the projected inflows from the Wilbur pumping station.

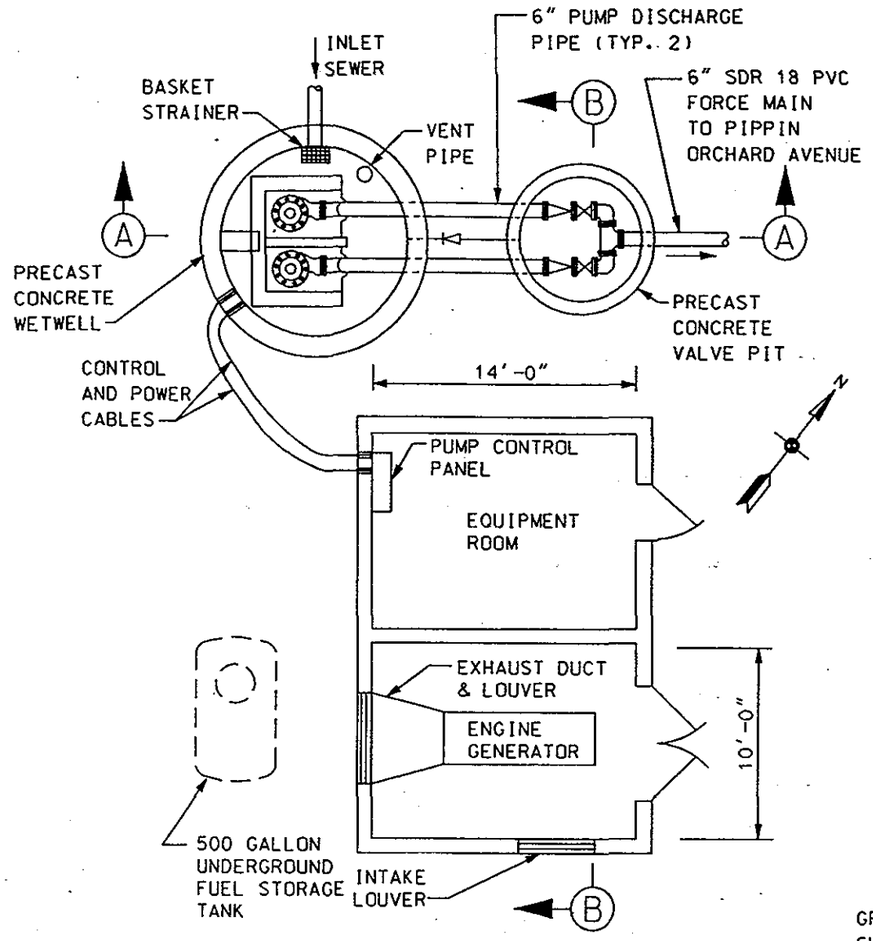
Additional Flows from other Locations

Although not included in the present study, the city may wish to make improvements to the Howard pumping station to increase its peak pumping capacity. This would result in additional flows entering the WWTF screw pumps. This would not

be a problem until after the year 2015 since the projected peak flow for that year would be 10,444 gpm including projected flows from Wilbur and additional projected flows from Howard. In 2045 the total projected inflow to the WWTF screw pumps is 12,425 gpm. This flow could not be accommodated without adding a fourth pump. However, the following points should be considered:

1. The increase in projected peak flow into the WWTF screw pumps between the years 2015 and 2045 is (12,425-10,444) = 1981 gpm. If the capacity of the existing pumps were increased as described above, the additional flows would not exceed the pump capacity until the year 2025, assuming a linear increase in peak flow rate.

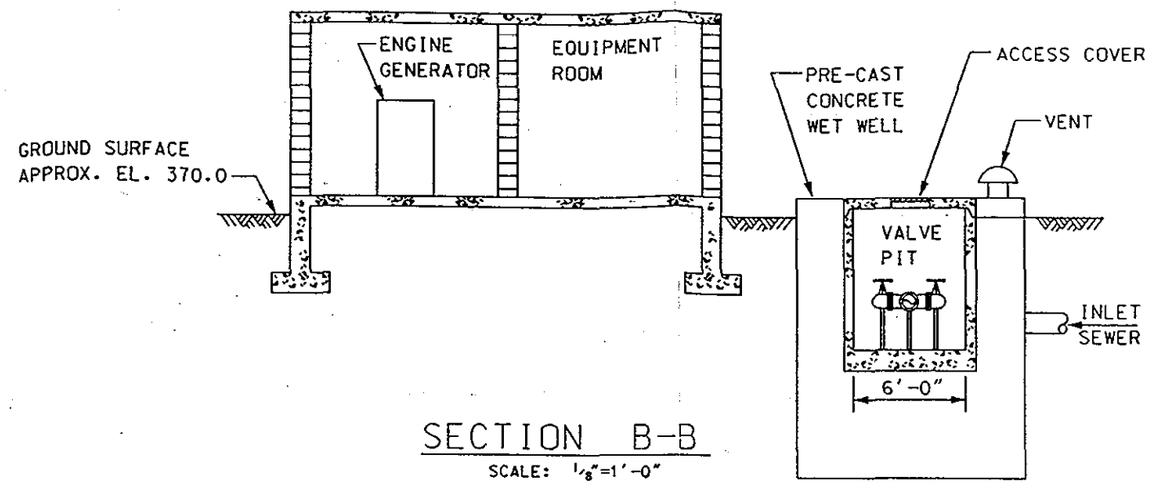
2. By 2015, the existing screw pumps will be 35 years old and may require replacement because of their age. If and when they are replaced, they should be specified to pump the maximum flow possible for that size pump. This would have little or no effect on the total price of the new pump(s) and associated equipment.



WET WELL AND VALVE PIT COVERS REMOVED

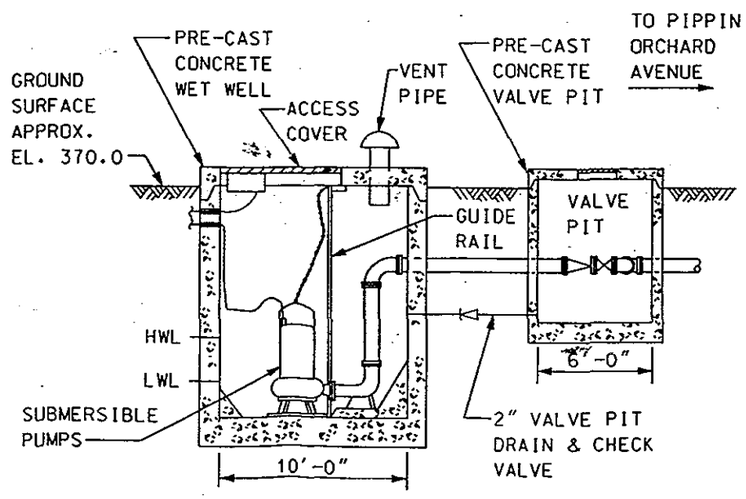
PLAN AT EL. 371.0

SCALE: 1/8"=1'-0"



SECTION B-B

SCALE: 1/8"=1'-0"



SECTION A-A

SCALE: 1/8"=1'-0"

1/8"=1'-0"

4' 0 4' 8' 12' 16' 20'

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MA.

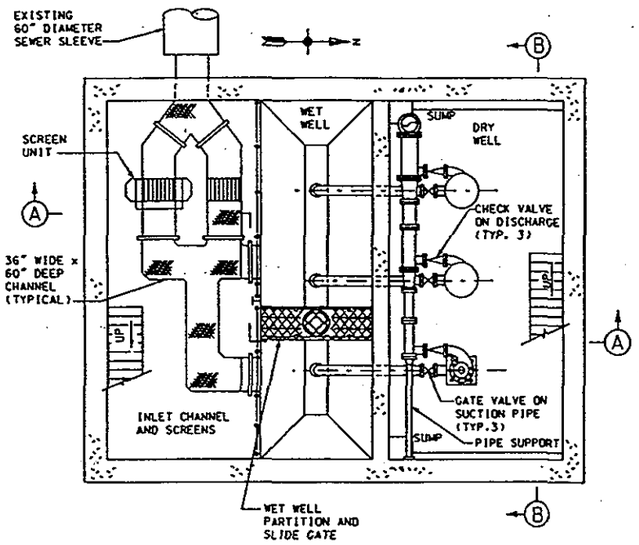
WASTEWATER CONVEYANCE FEASIBILITY INVESTIGATION

CRANSTON, R.I.

PROPOSED SCITUATE PUMPING STATION

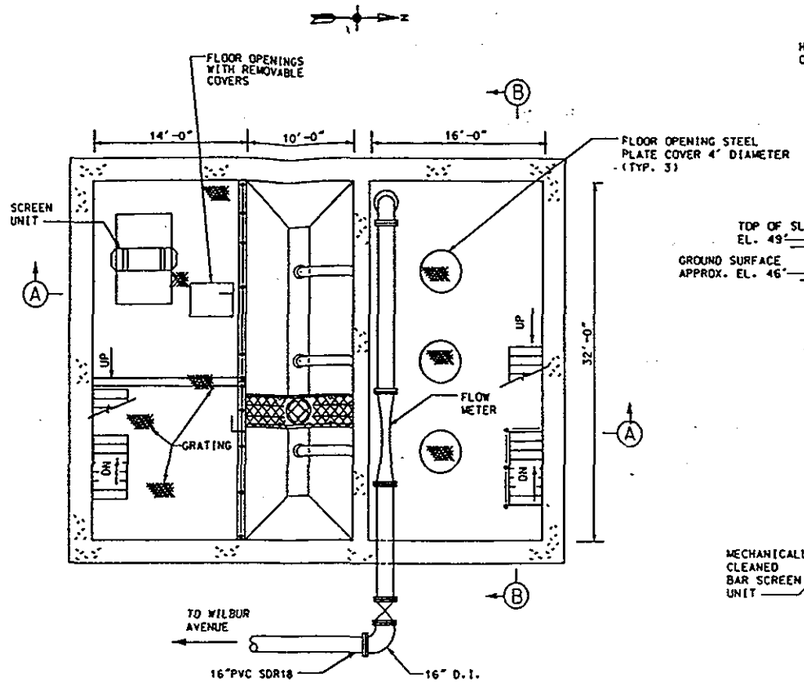
MECHANICAL PLANS & SECTIONS

PLATE: B-1



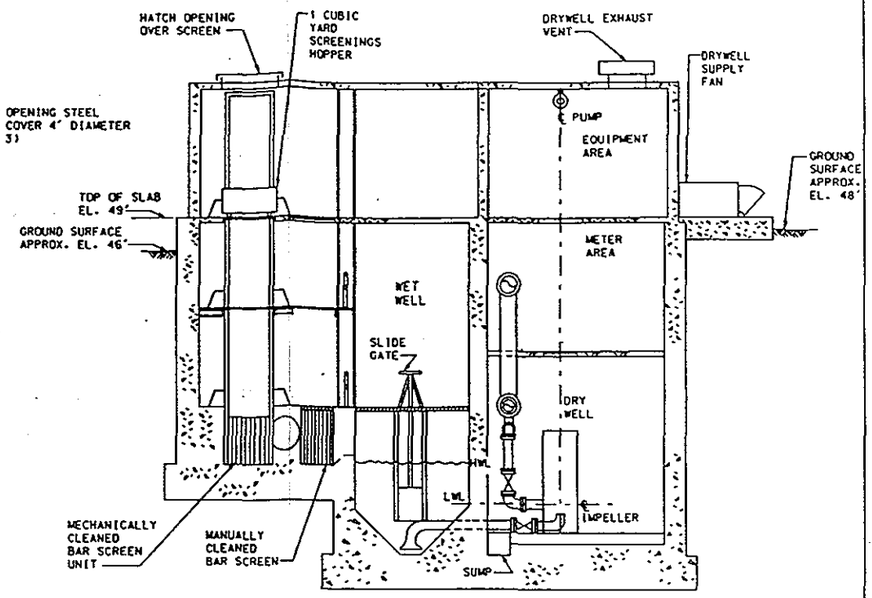
PLAN AT EL. 35.0

SCALE: 1/8"=1'-0"



PLAN AT EL. 46.0

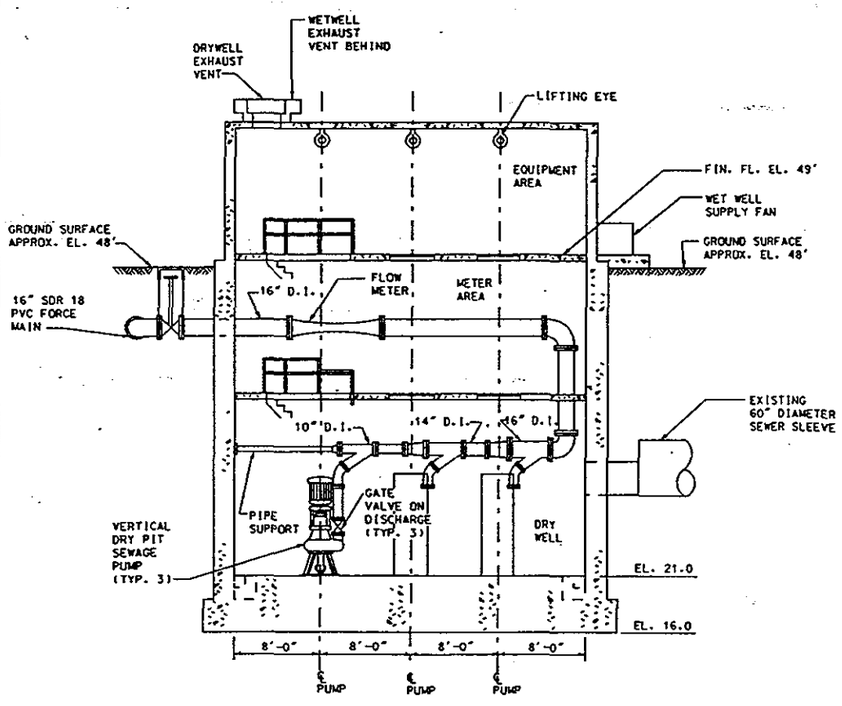
SCALE: 1/8"=1'-0"



SECTION A-A (STAIRS NOT SHOWN)

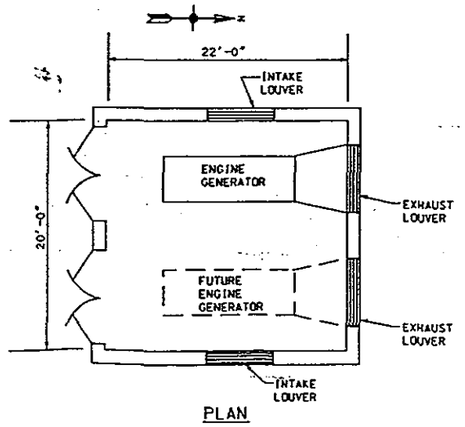
SCALE: 1/8"=1'-0"

ABBREVIATIONS	
ITEM	DESCRIPTION
℄	CENTER LINE
D.I.	DUCTILE IRON
EL.	ELEVATION
HWL	HIGH WATER LEVEL
LWL	LOW WATER LEVEL
PVC	POLY VINYL CHLORIDE
SDR	STANDARD DIAMETER RATIO
TYP.	TYPICAL



SECTION B-B

SCALE: 1/8"=1'-0"



PLAN

GENERATOR ENCLOSURE

SCALE: 1/8"=1'-0"

1/8"=1'-0"

NOTE:
THIS DRAWING HAS BEEN REDUCED.

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MA.

WASTEWATER CONVEYANCE FEASIBILITY INVESTIGATION

CRANSTON, R.I.

PROPOSED WILBUR PUMPING STATION

MECHANICAL PLANS & SECTIONS

PLATE: B-2

APPENDIX C

Task 12a - Proposed Project, Geotechnical Evaluation

Section 117, Cranston Rhode Island Wastewater Conveyance
Feasibility Investigation

APPENDIX C

TASK 12a - Proposed Project, Geotechnical Evaluation

Department of the Army
Corps of Engineers, New England Division
Waltham, Mass

March 1995

TABLE OF CONTENTS

	SUBJECT	PAGE NO.
1.	PERTINENT DATA	C-1
	a. Purpose	
	b. Location	
	c. Sewer Lines and Pumping Stations	
2.	INTRODUCTION	C-3
	a. General	
	b. Elevations	
3.	TOPOGRAPHY, GEOLOGY	C-4
	a. Topography	
	b. Geology	
4.	SUBSURFACE INVESTIGATIONS	C-10
	a. Subsurface Explorations	
	b. Future Explorations	
	c. Laboratory Tests	
	d. Presentation of Data	
5.	SUBSURFACE CONDITIONS	C-16
	a. General	
	b. Sewer Lines	
	c. Pumping Stations	
6.	DESIGN AND CONSTRUCTION CONSIDERATIONS	C-18
	a. Description of Materials	
	b. Environmental	
	c. Sewer Lines	
	d. Wilbur Pumping Station	
	e. Scituate Pumping Station	

TABLES	TABLE NO.
Summary of Subsurface Exploration Programs	C-1
Laboratory Soil Test Results	C-2

PLATES	PLATE NO.
General Map of Proposed Project	C-1
Natick Gravity Trunk Sewer	C-2,3
Comstock Gravity Trunk Sewer	C-4 thru C-8
Tilcon Gravity Trunk Sewer	C-9
Brookdale Gravity Trunk Sewer	C-10
Wilbur Force Main	C-11
Scituate Force Main/Variable Grade Sewer	C-12 thru C-15
Wilbur Pumping Station	C-16
Scituate Pumping Station	C-17

ATTACHMENTS	ATTACHMENT NO.
U.S. Army Corps of Engineers Logs	C-1
Providence Water Supply Board Logs	C-2
Tutela Engineering Logs	C-3
Meshanticut Valley Sewer System Logs	C-4
DiPrete Engineering Logs	C-5
U.S. Army Corps of Engineers Laboratory Test Results	C-6
Universal Engineering Bedrock Depths	C-7
Rhode Island Department of Transportation Boring Logs	C-8
Cranston Department of Public Works Boring Logs	C-9

SECTION 117, CRANSTON RHODE ISLAND
WASTEWATER CONVEYANCE FEASIBILITY INVESTIGATION
GEOTECHNICAL STUDIES

1. PERTINENT DATA

a. Purpose

Sewage Conveyance for Western Cranston

b. Location

State - Rhode Island
County - Providence
City - Cranston

c. Sewer Lines and Pumping Stations

(1) Natick Gravity Trunk Sewer
Type - Gravity Sewer
Length - 4,655 feet
Pipe Diameter - varies from 12 to 18 inches
Depth of Excavation - Varies from a maximum of 17 feet at sta 35+90 to a minimum of seven feet at sta 41+60.
Bedrock Depth - Varies from 12 feet deep in U. S. Army Corps of Engineers (USACE) boring FD-94-13 near station 45+00 to over 15 feet deep in the remainder of the explorations on this line.
Groundwater Depth - Varies from three feet deep in USACE boring FD-94-13 near station 45+00 to deeper than 15 feet in FD-94-15 and FD-94-17, near stations 33+00 and 14+00, respectively.

(2) Comstock Gravity Trunk Sewer
Type - Gravity Sewer
Length - 14,160 feet
Pipe Diameter - varies from 12 to 24 inches
Depth of Excavation - Varies from a minimum of five feet at sta 40+00 to a maximum of 20 feet at sta 125+00.
Bedrock Depth - varies from an area of outcrops at approximately sta 20+00 and adjacent surface bedrock on Council Rock Road to bedrock deeper than 15 feet from sta 0+00 to sta 10+00.
Groundwater Depth - varies from deeper than 15 feet from sta 0+00 to sta 10+00 to two feet deep from sta 30+00 to sta 40+00 and at the surface at Furnace Hill Brook.

(3) Tilcon Gravity Trunk Sewer
Type - Gravity Sewer
Length - 2,595 feet
Pipe Diameter - varies from 18 to 24 inches
Depth of Excavation - varies from a maximum of 22 feet at sta 4+20 to a minimum of 9 feet at sta 26+00.
Bedrock Depth - 47 feet deep at sta 25+95
Groundwater Depths - varies from deeper than 15 feet at sta 0+00 to ground surface at Furnace Hill Brook.

(4) Brookdale Gravity Trunk Sewer
Type - Gravity Sewer
Length - 2,065 feet
Pipe Diameter - 24 inches
Depth of Excavation - varies from a minimum of 16 feet at sta 0+00 to a maximum of 17 feet at sta 20+65.
Bedrock Depth - none found or indicated
Groundwater Depth - varies from ground surface at Rhode Island Department of Transportation (RIDOT) boring H-113 near sta 3+00 to deeper than 15 feet at USACE boring FD-94-20 near sta 20+00.

(5) Wilbur Force Main
Type - Force Main
Length - 9,000 feet
Pipe Diameter - 16 inches
Depth of Excavation - eight feet deep
Bedrock Depth - at least 30 feet deep from Wilbur Pumping Station to beginning of Sherman Ave. From Sherman Ave. to end varies from three feet to deeper than 15 feet.
Groundwater Depth - varies from 35 feet deep at RIDOT boring B-154 at the Route 37 underpass to four feet deep at USACE boring FD-94-7 at D'Ericole Street.

(6) Scituate Force Main/Variable Grade Sewer
Type - Force Main
Length - 12,290 feet
Pipe Diameter - six inches
Depth of Excavation - six feet up to the last 600 feet of line, where the depth is eight feet.
Bedrock Depth - the depth of bedrock at the Scituate Pumping Station is assumed to be three to seven feet deep.
From sta 35+00 to sta 55+00 bedrock is over 15 feet deep.
Groundwater Depth - varies from over 15 feet deep in boring FD-94-37 near sta 100+00 and FD-94-47 near sta 39+00 to the surface at Furnace Hill Brook.

(7) Wilbur Pumping Station
Building Dimensions - 35 by 45 feet
Depth of Excavation - 37 feet
Bedrock Depth - approximately 106 feet deep
Groundwater Depth - approximately 10 feet deep

(8) Scituate Pumping Station
Building Dimensions - 16 by 23 feet; (wet well 12.5-foot diameter)
Depth of Excavation - 15 feet (wet well)
Bedrock Depth - assumed to be 3 to 7 feet deep
Groundwater Depth - assumed to be 2 feet deep

2. INTRODUCTION

a. General. Subsurface investigations and geotechnical engineering studies were performed to characterize the subsurface conditions along the proposed sewer alignments and at pumping stations. The subsurface investigations included research of available information, geological studies, subsurface explorations and laboratory testing. The subsurface investigations were performed to determine the depth and extent of bedrock, the depth and extent of groundwater, and the characteristics of the soils at the pumping stations and along the sewer lines. All subsurface investigations performed for the USACE (1994) were observed on a full time basis by a USACE engineer. Previous subsurface investigations by others in the vicinity of the proposed project were collected and used for this project and are presented in Table C-1.

b. Elevations. All elevations mentioned in this report are in reference to the city of Cranston Vertical Datum (Mean High Water) excluding RIDOT subsurface elevations which reference Mean Sea Level.

3. TOPOGRAPHY, SURFICIAL GEOLOGY

a. Topography. Rhode Island is located in the Seaboard Lowland section of the New England physiographic province. The route of the regional connector system extends from the suburbs of Cranston, through the city to the Cranston Wastewater Treatment Facility. Overall, the topography traversed by the connector system is characterized by hills of slight to moderate relief, with elevations ranging from approximately 25 feet at the Cranston Wastewater Treatment Facility to approximately 430 feet in north West Cranston. The topography to the east of the connector system is described as a lowland area (Narragansett Basin).

b. Geology

(1) General. The geology of New England is the result of a complicated history of orogeny, intrusion, and metamorphism.

There are mixed rock types in very complex associations. Although numerous faults have been mapped or otherwise suspected, none are presently known to be active. The area has been glaciated several times and the modern landscape is largely one of remnant surficial deposits of glacial origin overlying bedrock. The retreat of the glaciers brought about a rise in sea level, accompanied by the tectonic rebound of the land as it was unloaded. This trend appears to have stabilized, and now the New England region appears to be subsiding very slowly with the sea level continuing to rise very slowly.

(2) Bedrock Geology. Geologically, Rhode Island is divided into two areas. The eastern one-third of the state is located in a topographic lowland, a structural feature known as the Narragansett basin, composed of a Pennsylvanian sequence of sedimentary rocks. The western two-thirds of the state is considered an upland area derived mostly of plutonic and metamorphic rocks that are older than the Pennsylvanian rocks of the Narragansett Basin (Quinn, 1963).

The more resistant rocks such as the granites and gneisses form an escarpment with the Narragansett Basin. This escarpment may be due to an unconformity between them, to faulting, or to both (Quinn, 1959). The rocks in the western portion of the basin where the connector system is located include a "highly heterogeneous assemblage of gneisses, foliated granites, and non-foliated granites, together with low to medium grade metasedimentary and metavolcanic sequences" (Cameron, 1976).

Bedrock within the study area is underlain by rock types consisting primarily of granites, gneisses, and schists. The rocks identified in the study area are the Rhode Island Formation, a granite gneiss, a member of the Mussey Brook schist, Esmond granite, Scituate granite gneiss, and a metadiorite. These rocks vary in age from Precambrian (?) to Pennsylvanian (Quinn, 1951; 1959; 1963; 1971).

There were at least two incidents of metamorphism within the area. The first metamorphism episode occurred after the deposition of the Blackstone Series and before or partly during the intrusion of the Scituate granite gneiss. The second metamorphic event occurred after the deposition of the Pennsylvanian sedimentary rocks of the Narragansett basin (Quinn, 1963). Generally, there is a gradual increase in metamorphic gradation from north to south (Quinn, 1971). These rocks were subjected to high temperature and great pressure.

(3) Surficial Geology. The Rhode Island area was glaciated at least once during the Pleistocene epoch even though two or more stages of glaciation may have occurred which field data on Long Island, New York and other locations suggests. The current surficial materials in Rhode Island and surrounding area were

deposited during the last glacial period known as the Wisconsin stage which occurred approximately 10,000 to 13,000 years ago. In some places the bedrock has been mechanically weathered up to 30 feet in depth prior to the advance of the Wisconsin stage glacier. A majority of the moraine deposits (till) are derived from local bedrock which was removed and transported relatively short distances by glacial action. The ground moraine is fairly thin in most places but in others was deposited in larger quantities to form drumlins. Drumlins are elongate-shaped hills created by the movement of glaciers over the land, and composed of variable materials (coarse granular to fine-grained), sometimes mantled over bedrock of composed wholly of rock. Other surficial features produced by glacial processes include kames, kame terraces, ice-channel deposits, valley trains and kame plains, and outwash plains (Smith, 1956a; 1956b).

Sediments overlying the bedrock consist primarily of glacial moraine deposits characterized by tills, with lenses of sand and gravel. These glacial moraine deposits overlie the bedrock throughout most of the study area (Smith, 1956a; 1956b).

4. SUBSURFACE INVESTIGATIONS

a. Subsurface Explorations

(1) Natick Gravity Trunk Sewer. Nine test borings (FD-94-11 through FD-94-18 and FD-94-52) were performed along the proposed Natick line by the USACE from March 30 to April 11, 1994. The location and an Engineering Log-Profile of the borings are shown on Plates C-2 and C-3. The boring logs are shown in Attachment 1. The test borings were terminated at depths ranging from 15 feet to 19 feet. Split spoon samples and standard penetration tests were generally taken at 2 1/2 foot intervals. Rock cores were AWX size and five feet in length. Borings FD-94-11, FD-94-14, FD-94-18, and FD-94-52 were conducted as part of the investigation for this line but were not used in the design due to later changes in the proposed alignment.

The Providence Water Supply Board (PWSB) executed a test boring (BH-74A) at the intersection of Brookdale Street and Wilbur Avenue as part of the subsurface exploration program for a 102" Aqueduct. The samples were taken by driving a 1 3/8 inch inner diameter split spoon with a 140 pound hammer falling 30 inches. The location of the boring is shown on Plate C-3 and the boring log is shown in Attachment 2. The boring was conducted on August 20, 1965 and was advanced to a depth of 15 feet.

(2) Comstock Gravity Trunk Sewer. Sixteen test borings (FD-94-20, FD-94-24 through FD-94-33 and FD-94-39 through FD-94-43) were performed along the proposed Comstock line by the USACE from March 31 to April 6, 1994. The location and an Engineering Log-Profile of the borings are shown on Plates C-4 through C-8. The

boring logs are shown in Attachment 1. The test borings were terminated at depths ranging from 6.5 feet to 19.5 feet. Split spoon samples and standard penetration tests were generally taken at 2 1/2 foot intervals. Rock cores were AWX size and five feet in length. Boring FD-94-41 was conducted as part of the investigation for this line but was not used in the design due to later changes in the proposed alignment.

DiPrete Engineering Associates Inc. of Cranston, RI conducted test pits for the proposed Meadowbrook Estates subdivision in November and December 1986. The proposed subdivision is located between Hines Farm Road and Phenix Avenue just south of Furnace Hill Brook. The test pits used in the design of the Comstock line include TP-22, TP-29, TP-36,and TP-50. The location and a log-profile of the test pits are shown on plate C-5. The test pit logs are shown in Attachment 5. The test pits were terminated at a ten foot depth. The groundwater depths were monitored for approximately two months after the test pits were conducted.

(3) Tilcon Gravity Trunk Sewer. Four test borings (FD-94-20 through FD-94-23) were performed along the proposed Tilcon route by the USACE on March 31, 1994. The location and an Engineering Log-Profile of the borings are shown on Plate C-9. The boring logs are shown in Attachment 1. The test borings were terminated at a 15 foot depth. Split spoon samples and standard penetration tests were generally taken at 2 1/2 foot intervals.

(4) Brookdale Gravity Trunk Sewer. Two test borings (FD-94-19 and FD-94-20) were performed on Herod Street by the USACE on March 31, 1994. The location and an Engineering Log-Profile of the borings are shown on Plate C-10. The boring logs are shown in Attachment 1. The test borings were terminated at 15 feet. Split spoon samples and standard penetration tests were generally taken at 2 1/2 foot intervals.

RIDOT executed test borings in the vicinity of the Brookdale line for Interstate 295. RIDOT test borings used in the design of the Brookdale Line include H-113 and H-117. The samples were taken by driving a 2 inch outer diameter sampling spoon with a 140 pound hammer falling 30 inches. The locations of the borings are shown on Plate C-10 and the boring logs are shown in Attachment C-8. The borings were conducted on January 25 and January 31, 1966 respectively. The borings were 26.5 and 75.0 feet in depth respectively.

The PWSB executed test borings along Brookdale and Dwight Streets as part of the subsurface exploration program for a 102" Aqueduct. PWSB test borings used in the design of the Brookdale line include BH-74A, BH-75, BH-76, BH-76A, and BH-77. The samples were taken by driving a 1 3/8 inch inner diameter split spoon with a 140 pound hammer falling 30 inches. The locations of the borings

are shown on Plate C-10 and the boring logs are shown in Attachment 2. The borings were conducted from August to September 1965. The borings ranged in depth from 15 feet to 36.5 feet.

(5) Wilbur Force Main. Eleven test borings (FD-94-1 through 10 and FD-94-51) were performed at selected locations along the proposed route by the USACE, March 29 through April 11,1994. The location of the borings is shown on Plate C-11. The boring logs are shown in Attachment 1. The test borings were terminated at a typical depth of 15 feet. Split spoon samples and standard penetration tests were generally taken at 2 1/2 foot intervals. Borings FD-94-2, FD-94-3 and FD-94-4 were conducted as part of the investigation for this line but were not used in the design due to later changes in the proposed alignment.

RIDOT executed many test borings in the vicinity of the Wilbur Line for Interstate 295. RIDOT test borings used in the design of the Wilbur Line include B-12, B-103, B-154, B-155, B-156, B-157 and B-158 and were specifically executed for the Wilbur Avenue bridge and the Cranston Street ramp and bridge at Route 37. The samples were taken by driving a 2 inch outer diameter sampling spoon with a 140 pound hammer falling 30 inches. The locations of the borings are shown on plate C-11 and the boring logs are shown in Attachment C-8. The borings were conducted from June 29, 1964 to April 1, 1966. The borings ranged in depth from 33 feet to 99 feet.

The Cranston Department of Public Works conducted test borings in the vicinity of the Wilbur Line for the Meshanticut Valley Sewer System (MVSS). MVSS test borings used in the analysis of the Wilbur Line include 47, 48 and 48A on Cranston Street from part 3 of the MSVV and 2 and 3 on Sherman Avenue from part 2 of the MVSS. The samples were taken by driving a 1 3/8 inner diameter split spoon with a 140 pound hammer falling 30 inches. The locations of the borings are shown on Plate C-11 and the boring logs are shown in Attachment 4. The borings were conducted from February to April, 1960. The borings ranged in depth from 11 feet to 25 feet.

(6) Scituate Force Main/Variable Grade Sewer. Twelve test borings (FD-94-34 through FD-94-38 and FD-94-44 through FD-94-50) were performed along the proposed Scituate line by the USACE from April 5 to April 11, 1994. The location and an Engineering Log-Profile of the borings are shown on Plates C-12 through C-15. The boring logs are shown in Attachment 1. The test borings were terminated at depths ranging from 9 feet to 19.5 feet. Split spoon samples and standard penetration tests were generally taken at 2-1/2 foot intervals. Rock cores were AWX size and five feet in length. Boring FD-94-38 was conducted as part of the investigation for this line but was not used in the design due to later changes in the proposed alignment.

Universal Engineering Corporation conducted test borings on Comstock Parkway for a proposed water main for Western Cranston sometime before March 1970. Borings used in the design of the Scituate Line include A-18A and A-20. The method of sampling is unknown. The location of the borings is shown on Plate C-14 and the boring logs are shown in Attachment C-7. The depth of the explorations was 12 feet.

Tutela Engineering conducted two test borings (B-2, B-3) for the proposed Interstate 295 Pumping Station on Plainfield Pike which is the end of the Scituate line. Split spoon samples and standard penetration tests were generally taken at five foot intervals. Five foot rock cores were taken in each hole. The locations of the borings are shown on Plate C-15 and the boring logs are shown in Attachment 3. The depth of the explorations was 20 feet and 17.5 feet respectively. The borings were conducted from December 21, 1992 to January 7, 1993.

(7) Wilbur Pumping Station. One test boring (FD-94-53) was performed at the proposed location of the Wilbur Pumping Station by the USACE on April 12, 1994. The location and an Engineering Log-Profile of the boring are shown on Plate C-16. The boring log is shown in Attachment 1. Split spoon samples and standard penetration tests were generally taken at 2 1/2 foot intervals. The test boring was terminated at a 55 foot depth.

RIDOT executed many test borings in the vicinity of the Wilbur Pumping Station for Interstate 295. RIDOT test borings used in the design of the Wilbur Line include B-101 and B-103. The test borings were specifically executed for the Wilbur Avenue bridge. The samples were taken by driving a 2 inch outer diameter sampling spoon with a 140 pound hammer falling 30 inches. The location of the borings are shown on Plate C-16 and the graphic logs are shown in Attachment C-8. The borings were conducted in January, 1966. The borings were conducted to depths of 90 feet and 89 feet respectively.

(8) Scituate Pumping Station. No borings were conducted for the evaluation of the Scituate Pumping Station due to the inability to gain rights-of-entry.

(9) Sockanosset Interceptor. A 1,500 foot section of the existing Sockanosset Interceptor to be upgraded was analyzed for subsurface conditions from Pettaconsett Avenue heading westerly. The Cranston Department of Public Works conducted test borings along this reach of the Sockanosset Interceptor for the Meshanticut Valley Sewer System (MVSS). MVSS test borings used in the analysis include 10, 11, 11A, 12, 13, 14, and 15A from part 1 of the MVSS. The samples were taken by driving a 1 3/8 inner diameter split spoon with a 140 pound hammer falling 30 inches. The borings are thought to have been conducted sometime in 1959. The borings ranged in depth from 10 feet to 40 feet. The test boring logs and

location plans are available for viewing in Waltham, MA, United States Army Corps of Engineers, New England Division, Geotechnical Engineering Division.

(10) Wastewater Treatment Facility Siphon. Approximately 1250 feet of the siphon leading up to the Cranston Wastewater Treatment Facility to be replaced was analyzed for subsurface conditions from the intersection of Pettaconsett Avenue and Webb Street heading in an easterly direction. The Cranston Department of Public Works conducted test borings along this reach of the siphon for the Meshanticut Valley Sewer System (MVSS). MVSS test borings used in the analysis include 5, 6, 7, 8, 8A, and 9 from part 1 of the MSVV. The samples were taken by driving a 1 3/8 inner diameter split spoon with a 140 pound hammer falling 30 inches. The borings are thought to have been conducted sometime in 1959. The borings ranged in depth from 15 feet to 32 feet. The test boring logs and location plans are available for viewing in Waltham, MA , United States Army Corps of Engineers, New England Division, Geotechnical Engineering Division.

b. Future Explorations

(1) General. Investigations in general, should be spaced approximately every 500 feet to adequately characterize subsurface conditions along the proposed sewer alignments, and more frequently in other areas where bedrock or other special concerns are suspected.

Geophysical investigations could further delineate the bedrock surface between borings along the proposed alignments and may eliminate the need for additional borings. Geophysical investigations include seismic wave propagation techniques, seismic reflection, and resistivity and conductance among others.

(2) Natick Gravity Trunk Sewer. Two borings are recommended for further bedrock delineation and to verify the subsurface information from other agencies. One boring, at the intersection of Comfort Drive and Natick Avenue, should be 15 feet deep, and the other located approximately 300 feet south of the same intersection, on Natick Avenue, should be 10 feet deep. Both explorations, if bedrock is encountered, should be cored five feet with an NX size core barrel. NX size core barrel is recommended for representative Rock Quality Data (RQD).

(3) Comstock Gravity Trunk Sewer. Several future explorations are recommended on the Comstock Line for bedrock delineation. The first is at station 12+00 on Hines Farm Road and should be advanced 20 feet. The second is at station 20+00 on Hines Farm Road and should be advanced to bedrock and verified with a five foot NX size rock core. Several more explorations should be performed at stations 67+00, 80+00, 90+00, 110+00, 115+00, 120+00, 132+00, and 141+00 and should be advanced to at least two feet

below the sewer invert elevation. Bedrock, if encountered, should be verified with a five foot NX size rock core.

(4) Tilcon Gravity Trunk Sewer. No future explorations are recommended for this line.

(5) Brookdale Gravity Trunk Sewer. No future explorations are recommended for this line.

(6) Wilbur Force Main. No future explorations are recommended for this line, however more boring data exists which was not located along Wilbur Avenue, Exchange Street and Vinton Avenue which would further define subsurface conditions along the Wilbur Line.

(7) Scituate Force Main/Variable Grade Sewer. Future explorations on the Scituate line are recommended at the following Stations: -2+00, 3+00, 8+00, 17+00, 25+00, 35+00, 51+00, 56+00, 64+50, 79+00, 105+00, and 110+00. The explorations should be advanced to a 10 foot depth. If bedrock is encountered, a five foot long NX size rock core should be acquired.

(8) Wilbur Pumping Station. Four additional test borings will be required at each corner of the proposed pumping station. The borings should be advanced to a 60-foot depth to characterize the depth and breadth of the silt and sand layers. The delineation of these layers will be needed for pumping station foundation design and braced cut analysis.

Explorations will also be required for the proposed retaining wall surrounding the pumping station.

(9) Scituate Pumping Station. Three borings will be required at the proposed pumping station; two borings at opposite corners of the pumping station and one at the wet well location. The borings at the pumping station should be advanced to a 20 foot depth or bedrock and the boring at the wet well location should be advanced to a 30 foot depth or bedrock. The bedrock should be verified with a ten foot NX size rock core. The pumping station area should also be visually observed and mapped for bedrock outcroppings.

c. Laboratory Tests. All soil samples for USACE test borings were visually classified on site in accordance with The American Society of Testing and Materials - ASTM D 2488, " Description of Soils (Visual-Manual Procedure)". All laboratory tests were performed in accordance with ASTM D 2487, "Standard Test Method for Classification of Soils for Engineering Purposes. Eight grain size analyses and five hydrometer analyses were performed on test boring FD-94-53 to help classify the materials encountered and to provide more precise data for the Wilbur Pumping Station. The test results are presented in Attachment 5.

Soil samples for the explorations by others collected for this project were classified using the Burmister Classification System.

d. Presentation of Data. Subsurface information from one project specific exploration and laboratory testing program (USACE), as well as, exploration programs from two proposed (I-295 Pumping Station, Meadowbrook Estates Subdivision) and four completed projects (I-295, MVSS, PWSB aqueduct, West Cranston water line) that lie in the vicinity of the proposed sewer alignments are presented. Summaries of the exploration and laboratory testing programs are listed in Table Nos. C-1 and C-2. Locations and profiles of the subsurface explorations are shown on Plates C-2 through C-17. Logs of the explorations performed for or in the vicinity of the proposed sewer alignments are presented in Attachments C-1 through C-9. Laboratory test results for USACE test boring FD-94-53 are presented in Attachment C-6.

5. Subsurface Conditions

a. General. The nature of the subsurface conditions along the sewer lines and the pumping stations was studied by reviewing boring logs, field reconnaissance and resources such as USGS geology maps and the USDA Soil Survey of Rhode Island. In general the soils encountered were sands, silts, and gravels mixed with cobbles and boulders in some areas. Contingencies for rock excavation were developed and used in the analysis of the sewer lines to account for rock excavation zones, boulders and other hard subsurface material zones which are not readily identifiable by subsurface exploration analysis.

Rock Quality Designation (RQD) was performed on all recovered rock cores. RQD is an index of rock quality, the ratio of the sum-length of all the single pieces of naturally unfractured rock core of lengths equal to or longer than 4 inches to the total length of rock core attempted in the particular core run being assessed. The RQD for most (approximately 91 %) of the rock cores from the connector system were classified as Fair to Very Poor, indicating that the bedrock in those locations was altered or fractured sufficiently and might be excavated with mechanized equipment without the benefit of explosive agents. A majority of the rock cores were fractured, some heavily. In some rock cores, altered surfaces were observed at the core break and in others the natural parting of the mineral surfaces induced breakage of the rock core.

b. Sewer Lines

Natick Gravity Trunk Sewer. Natick Avenue up to Comfort Drive appears to consist of a thin layer of sands, silts, cobbles and boulders one to ten feet thick. From Comfort Drive to Wilbur Avenue appears to consist of sands and silts to over 15 feet thick and most likely much deeper, getting deeper in the easterly direction. Combinations of locally derived and native fill

materials may have been encountered during advancement of the borings.

Topography in this area is characterized by gently rolling terrain. Soil borings were advanced on shoulder segments of most of the roadways and through private property. See Natick Gravity Trunk Sewer Plates C-2 and C-3 for information regarding borings and placement of the connector line.

Bedrock within the vicinity is described as the Pondville conglomerate and the Esmond granite. Reportedly, bedrock outcrops are present in this area. Bedrock was encountered at approximately 14 feet at location FD-94-13. Bedrock was not encountered in the other USACE borings. The RQD for the rock core at boring location FD-94-13 is Fair. Visual observations of the rock core identified a high angle fracture and altered fracture surfaces. Depth to groundwater from borings varied from 3 feet to greater than 15 feet.

Comstock Gravity Trunk Sewer. From station 0+00 to station 10+00 appears to be sands, silts, and gravels to at least a 15 foot depth. From station 10+00 to sta. 23+00 appears to be sands and silts ranging in depth from 0 to 20 feet deep underlain by bedrock. From sta. 23+00 to sta. 45+00 appears to be sands, silts and gravels to at least a 15 foot depth. Test pits excavated by other contractors encountered similar materials. From sta. 45+00 to sta. 110+00 appears to be sands to at least a 15-foot depth. From sta. 110+00 to the end of the line appears to be a thin layer of sands ranging in depth from 0 to 10 feet deep, underlain by bedrock. Combinations of locally derived and native fill materials may have been encountered during advancement of the borings.

Topography in this area is characterized by a moderate southeast sloping terrain towards the escarpment with the Narragansett Basin. Soil borings were advanced on shoulder segments of most of the road ways and through private property. See Comstock Gravity Trunk Sewer Plates C-4 through C-8 for information regarding borings and placement of the connector line.

Bedrock in the vicinity is described as the Esmond granite and the Scituate granite gneiss. Depth to bedrock varied from 1.5 feet at boring FD-94-43 to 19 feet at boring FD-94-42. Bedrock outcrops were observed (sta 20+00) approximately 100 feet west of FD-94-25 where bedrock was encountered at 8.5 feet. Bedrock was encountered at borings FD-94-40, FD-94-42, and FD-94-43. These boring locations are located at the highest elevation in the Comstock line on the eastern flank of Lawton Hill. Bedrock was not encountered in the balance of the borings. All of the rock cores contained alteration zones at various positions along the cores. RQDs for these four rock cores vary from fair to very poor suggesting that the rock might be excavated by mechanical methods.

Groundwater levels along the Comstock Gravity Sewer line varied from 3 feet at boring FD-94-28 to 12.5 feet at boring FD-94-31.

Tilcon Gravity Trunk Sewer - Topography in this area is characterized by a relatively flat terrain. Soil borings were advanced on shoulder segments of most of the road ways and through private property. See Tilcon Gravity Trunk Sewer Plate C-9 for information regarding borings and placement of the connector line.

Surficial materials along the Tilcon line are composed of sands, silts, and gravels over 15 feet thick for the entire length of the line. Combinations of locally derived and native fill materials may have been encountered during advancement of the borings.

Bedrock beneath this line is described as the Esmond granite, Mussey Brook schist, and the Rhode Island formation. Bedrock was not encountered in any of the borings advanced by the USACE. However, bedrock is reported to be 47 feet deep at sta 25+95. Depth to groundwater varied between ground surface at Furnace Hill Brook located approximately 300 feet north of boring FD-94-21 and greater than 15 feet at boring FD-94-20.

Brookdale Gravity Trunk Sewer. The Brookdale line appears to consist of a relatively thick layer of sands ranging from at least 15 feet thick at Natick Avenue to over 75 feet thick along Interstate 295 along with some peat deposits closer to Meshanticut Brook. Combinations of locally derived and native fill materials may have been encountered during advancement of the borings.

Topography in the area is characterized by slight relief rising to higher elevations at the western end of the alignment. Soil borings were advanced on shoulder segments of most of the road ways, through private property, and where feasible at road intersections. See Brookdale Gravity Trunk Sewer Plate C-10 for information regarding borings and placement of the connector line.

Bedrock beneath this alignment is described as the Rhode Island formation. Bedrock was not encountered in the borings advanced by the USACE or by other contractors in the vicinity of the Brookdale alignment. Depth to groundwater varies from ground surface at RIDOT boring H-113 to deeper than 15 feet at USACE boring FD-94-20.

Wilbur Force Main. The Wilbur line appears to consist of sands and silts to deeper than 50 feet up to Cranston Street. From Cranston Street to the beginning of Sherman Avenue appears to consist of 20 to 40 feet of sand underlain by bedrock. From Sherman Avenue up Freehold Street to D'Ericole Street appears to consist of a thin layer of sands, silts, cobbles and boulders with peaks of bedrock. From D'Ericole to the end of the Wilbur line

appears to consist of sand and silts to deeper than 15 feet. Combinations of locally derived and native fill materials may have been encountered during advancement of the borings.

Soil borings were advanced on shoulder segments of most of the road ways. See Wilbur Force Main Plate C-11 for information regarding borings locations.

Bedrock in the vicinity is described as the Rhode Island formation. Bedrock was not encountered in any of the borings advanced by the USACE. Bedrock was encountered by other contractors at depths ranging from 3 feet to approximately 34 feet at borings B-156 and B-157. Cobbles and boulders were encountered in boring FD-94-6 between 4.5 feet and 6 feet and in boring FD-94-10 between 12 feet and 14.5 feet. Cobbles were also present in most of boring B-156. Groundwater levels varied from approximately 4 feet at boring FD-94-7 to 35 feet at RIDOT boring B-154.

c. Pumping Stations

Wilbur Pumping Station. Based on test boring FD-94-53, the subsurface soils beneath the proposed pumping station location consist primarily of medium dense sands (SP-SM & SM) and loose to medium dense silts with sand (ML). The first layer (0 -14 foot depth) consists of medium dense sands and silts (SP-SM, SM & ML) except for a layer of silty sand (7-10 foot depth) which is loose. The next layer consists of very loose to loose silt with sand (ML) from the 14 to 28 foot depth. The third layer (28-51 foot depth) consists of medium dense sand with silt (SP-SM). The deepest layer explored (51-55 foot depth) consists of medium dense silt with sand (ML). This area is underlain by materials composed of glacial river and kame terrace deposits. Based on the proposed location of the Wilbur Pumping Station, and the fact that the area has been heavily influenced by man, locally derived fill materials may have been encountered in the boring.

The proposed site for the Wilbur Pumping Station is located in a median area between Interstate 295. See Wilbur Pumping Station Plate C-16 for information regarding the location of the boring and placement of the proposed Wilbur Pumping Station.

Bedrock in this area is described as the Rhode Island formation. Bedrock was not encountered in boring FD-94-53 but a small zone (approximately 0.5 feet) of black weathered rock was encountered in the last five feet of the boring. Reportedly, bedrock beneath the site is approximately 106 feet deep and depth to groundwater is approximately 10 feet.

Scituate Pumping Station. Based on the United States Department of Agriculture Soil Survey of Rhode Island, a bedrock depth shown on Attachment C-7 in the vicinity of the pumping station, and bedrock outcrops shown on the USGS Map of Bedrock

Geology along Furnace Hill Brook, the subsurface soils beneath the proposed Scituate Pumping Station consist of sandy loam to a depth of approximately 3 to 7 feet, underlain by bedrock. Bedrock in this area is described as the Scituate granite gneiss.

Due to rights-of-entry constraints no borings were conducted in this area. See Scituate Pumping Station Plate C-17 for pumping station location and sections.

6. Design and Construction Considerations

a. Descriptions of Materials

Topsoil - State Specification. The material to be furnished shall consist of loose, friable, sandy loam or loam topsoil free from subsoil, refuse, stumps, roots, rocks, brush, weeds and other material which will prevent the formation of a suitable seed bed.

Random Fill - USACE Specification. Suitable materials from required excavations will be utilized as random fill. Random fill will be a friable, granular, low plasticity unprocessed soil. The amount of soil particles passing the No. 200 sieve will be less than 35 percent of the random fill's dry unit weight. Random fill shall be free from stumps, trash, debris, cinders, ashes, topsoil, sod, roots, organic soils, boulders, and other deleterious materials.

Pipe Bedding - State Specification. The material to be furnished shall be gravel borrow and may be bank run or filler may be added by approved methods and shall consist of sound durable particles of crushed or uncrushed gravel, free from loam, clay, vegetable matter and soft, elongated pieces of rock, and shall meet the following gradation:

Sieve Size (U.S. Standard)	Percent Passing (by Dry Weight)
1 1/2 inch	100
1/2 inch	50-85
3/8 inch	45-80
No. 4	40-75
No. 40	0-45
No. 200	0-10

Gravel Borrow - State Specification. Gravel borrow may be bank run or filler may be added by approved methods and shall consist of sound durable particles of crushed or uncrushed gravel, free from loam, clay, vegetable matter and soft, elongated pieces of rock, and shall meet the following gradation:

Sieve Size (U.S. Standard)	Percent Passing (by Dry Weight)
3 inch	100
1/2 inch	50-85
3/8 inch	45-80
No. 4	40-75
No. 40	0-45
No. 200	0-10

Bituminous Concrete. Shall conform to the requirements of The State of Rhode Island, Department of Transportation, Division of Public Works "Standard Specification for Road and Bridge Construction" dated 1971 (Rev.) for Bituminous Pavements.

b. Environmental. Perched groundwater wetlands may be encountered along some of the sewer line excavation. The backfilled trenches may allow the wetland to drain by the granular backfill surrounding the sewer pipe acting as a conduit out of the wetland. Steel or concrete diaphragms (cutoff wall) can be added in the form of a collar or series of collars around the sewer pipe to prevent the migration of water from the wetland.

c. Sewer Lines

Soft Ground. Based on the available boring log data, no appreciable amounts of soft ground will be encountered. When soft ground is encountered in a sewer trench, the undesirable material can be excavated to a more stable strata and gravel backfilled to invert elevation. When a stable strata is too deep for practical excavation, concrete cradles can be utilized for stability.

Dewatering. Several areas of sewerline excavation will encounter groundwater. A trench box can be used in areas where groundwater is less than two feet above the top of the proposed pipe location. In areas where the groundwater is more than two feet above the top of the proposed pipe location, an earth support system will be required with dewatering pumps so that the sewer pipe and backfill materials can be placed in the dry. Stability and uplift failures caused by upward seepage pressures may present difficulties when trench excavation is deep into the groundwater. In such a case the dewatering system (wellpoint) should penetrate deeper than the proposed cut and the excavation should follow the drawdown of the groundwater.

River Crossings. Temporary cofferdams consisting of steel sheet piling can be used for sewerline construction at river crossings. To maintain flow of the river during construction, half of the river crossing can be constructed and then covered, and then the other half completed in succession.

d. Wilbur Pumping Station. A 35 by 45-foot structure requiring a cut of about 37 feet is proposed at the Wilbur Pumping Station site. Based on test boring FD-94-53, the subsurface soils beneath the proposed pumping station consist of a 14 foot layer of sand and silt, underlain by a 14 foot layer of silt underlain by a 23 foot layer of sands followed by a layer of silt at least four feet thick. Water was noted at ten feet below the surface. The subsurface analysis indicates there could be stability and uplift difficulties caused by upward seepage pressure in the sand during construction at the Wilbur Pumping Station. A suggested construction procedure to reduce potential problems is as follows:

(1) Install sheeting into the bottom (El. -7.0) silt layer to cut off seepage into the materials to be excavated (this procedure is contingent upon future explorations at the site to verify the depth and breadth of the silt layer). The sheeting must be braced to resist lateral earth pressures. It is recommended that the Contractor be required to engage an experienced professional engineer to design the earth support system.

(2) Set up a dewatering system within the limits of the sheeting, penetrating into the sand stratum to approximately a 40-foot depth.

(3) Excavate soil as required for the proposed structure. Operate a dewatering system as necessary. Construct the gravel fill working mat at the bottom of the excavation.

(4) The structure must be designed and constructed to prevent flotation. Pumping must be maintained until sufficient structure dead weight is developed to resist hydrostatic uplift.

The construction of the sheetpile retaining wall surrounding the pumping station will require driving of the sheetpile and excavations into the existing Interstate 295 highway embankments. Protective measures will be necessary to ensure that no damage or movement occurs to the highway embankments during construction.

e. Scituate Pumping Station. A 16 by 23-foot structure requiring an excavation of approximately four feet and a 12.5 foot diameter wet well requiring a 15 foot cut are proposed at the Scituate Pumping Station site. The subsurface conditions are assumed to be a three to seven foot thick layer of silty loam underlain by bedrock. Water is assumed to be at a depth of approximately two feet.

Open cut excavation is recommended with 1 on 2 slopes and dewatering as necessary. The bedrock may not be rippable with mechanical equipment and blasting may be necessary.

REFERENCES

Cameron, B. (Editor), 1976. Geology of Southeastern New England, 68th Annual Meeting, New England Intercollegiate Geological Conference, Boston.

Quinn, A.W., 1951. Bedrock Geology of the North Scituate Quadrangle, Rhode Island. U.S. Geological Survey.

Quinn, A.W., 1959. Bedrock Geology of the Providence Quadrangle, Rhode Island. U.S. Geological Survey Map GQ-118.

Quinn, A.W., 1963. Bedrock Geology of the Crompton Quadrangle, Rhode Island. U.S. Geological Survey Bulletin 1158-B.

Quinn, A.W., 1971. Bedrock Geology of Rhode Island. U.S. Geological Survey Bulletin 1295.

Smith, J.H., 1956a. Surficial Map of the Crompton Quadrangle, Rhode Island. U.S. Geological Survey Map GQ-94.

Smith, J.H., 1956b. Surficial Map of the Providence Quadrangle, Rhode Island. U.S. Geological Survey Map GQ-84.

USGS. 1955. North Scituate Quadrangle, Rhode Island. U.S. Geological Survey Series (Topographic). Photorevised 1970 and 1975.

USGS. 1957. East Greenwich Quadrangle, Rhode Island. U.S. Geological Survey Series (Topographic). Photorevised 1970 and 1975.

USGS. 1955. Crompton Quadrangle, Rhode Island. U.S. Geological Survey Series (Topographic). Photorevised 1970 and 1975.

USGS. 1957. Providence Quadrangle, Rhode Island. U.S. Geological Survey Series (Topographic). Photorevised 1970 and 1975.

TABLE C-1- SUMMARY OF SUBSURFACE EXPLORATION PROGRAMS

SYMBOL	TYPE	DATE	NUMBER	DEPTH(S)	CLIENT	CONTRACTOR	LOGS BY
				(feet)			
FD	BORINGS	1994	53	6.5-55	NEW ENGLAND DIVISION	ATLANTIC TESTING LABS	NEW ENGLAND DIVISION
BH	BORINGS	1965	5	15-36.5	PROVIDENCE WATER SUPPLY BOARD	C.A. MAGUIRE & ASSOCIATES	AMERICAN DRILLING & BORING CO.
B & H	BORINGS	1964-1966	10	33-111	RHODE ISLAND DEPT. OF TRANS.	C.A. MAGUIRE & ASSOCIATES	**
B	BORINGS	1992-1993	2	17.5-20	CITY OF CRANSTON	TUTELA ENGINEERING	ALLSTATE DRILLING CO.
*	BORINGS	1960	5	11-25	CITY OF CRANSTON	FAY SPOFFORD & THORNDIKE	AMERICAN DRILLING CO.
A	BORINGS	1970	2	10	CITY OF CRANSTON	UNIVERSAL ENGINEERING CORPORATION	UNKNOWN
TP	TEST PIT	1987	4	10	HILLSIDE ASSOCIATES	DIPRETE ENGINEERING ASSOCIATES	DIPRETE ENGINEERING ASSOCIATES

* These borings were drilled as part of the Meshanticut Valley Sewer System and are designated by number only.

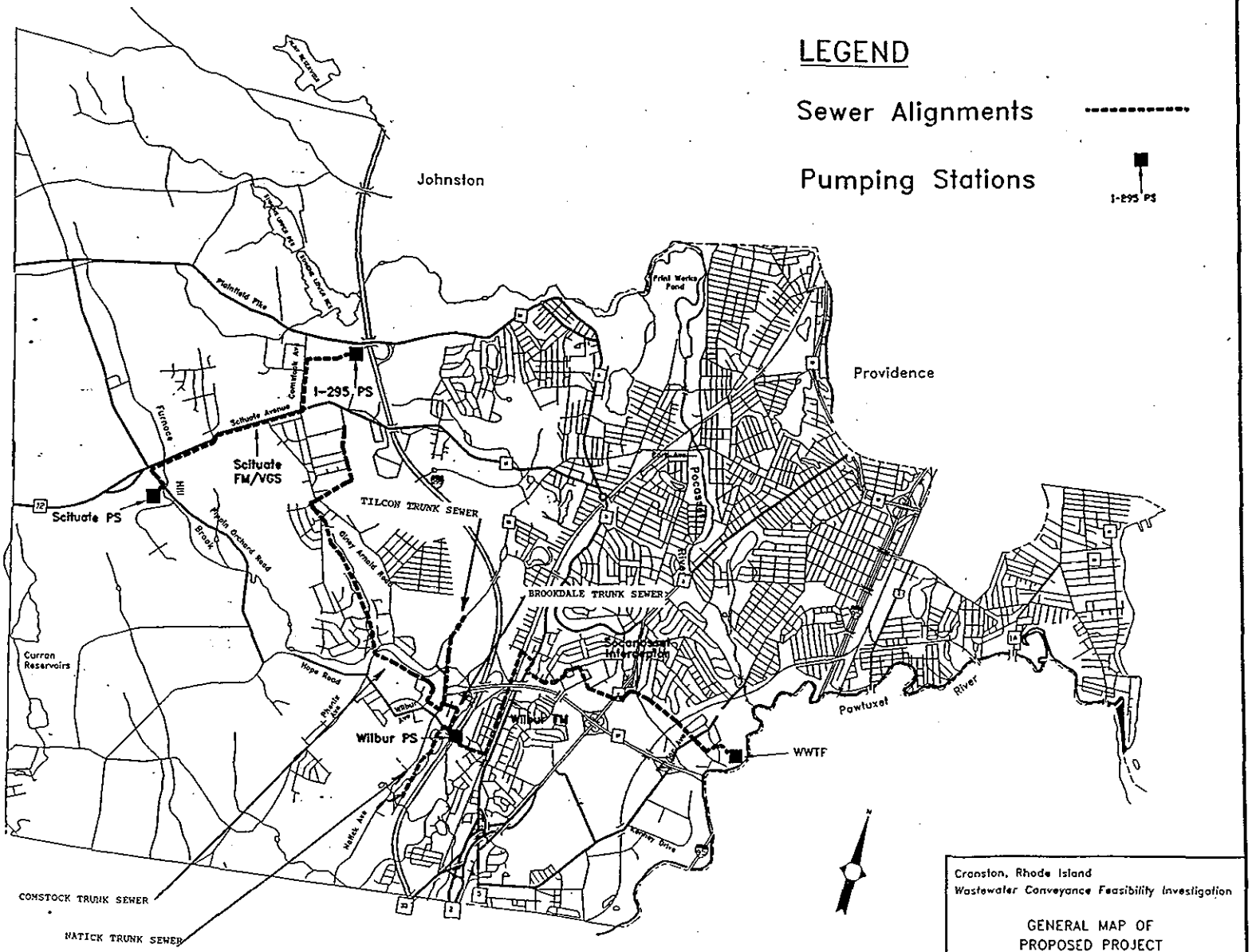
** Various drilling companies were employed including American Drilling and Boring Co., Inc. and University Engineering Services Inc.

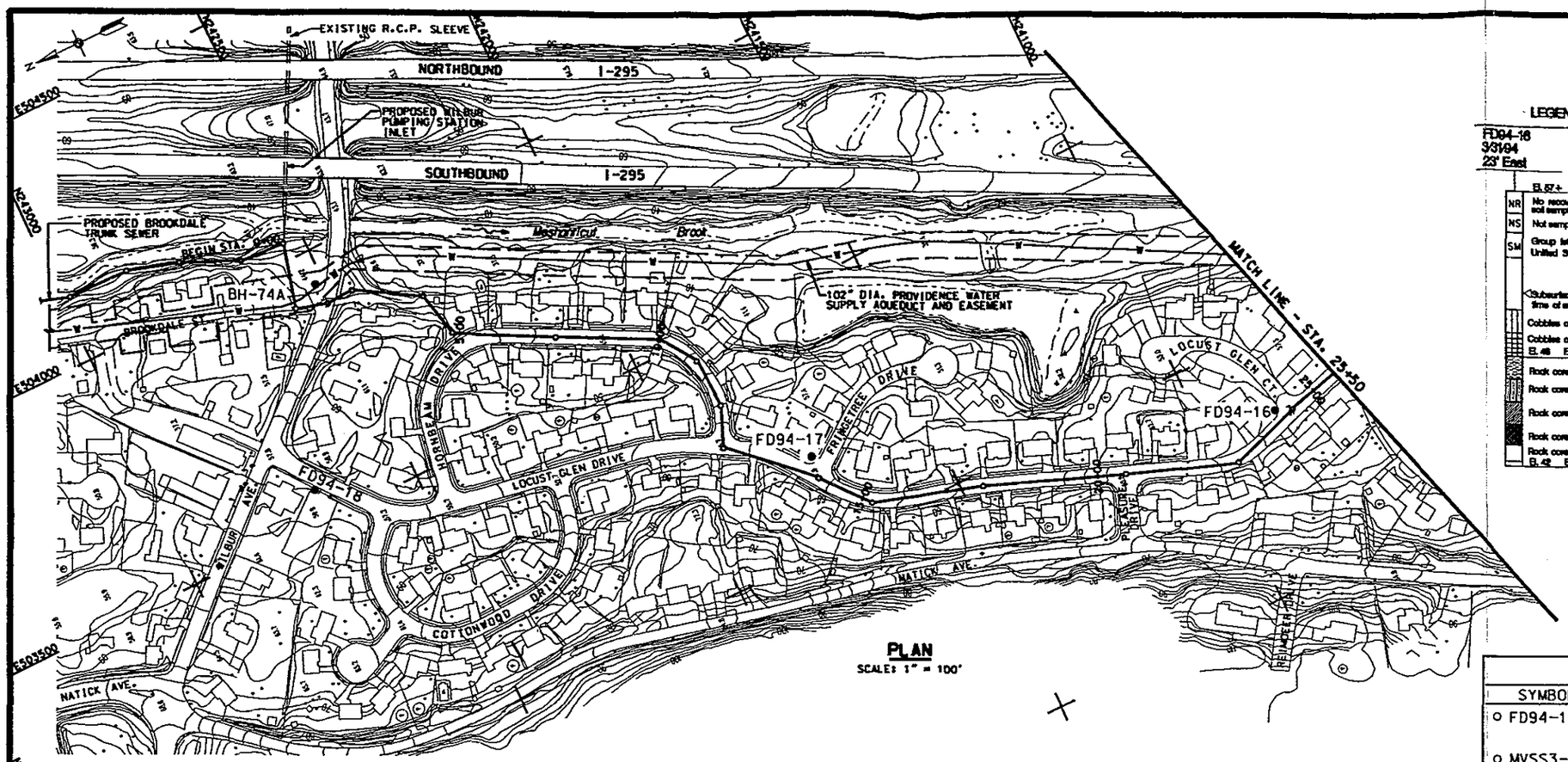
TABLE C-2 - **SOIL TEST RESULTS**

EXPL. NO.	TOP ELEV. FT.	SAMPLE NO.	DEPTH FT.	SOIL SYMBOL	MECHANICAL ANALYSIS				ATT. LIMITS		SPECIFIC GRAVITY	NAT. WATER CONTENT % DRY WT		COMPACTION DATA			NAT. DRY DENSITY LBS/CU FT		OTHER TESTS		
														STND. AASHO		*					
					GRAVEL %	SAND %	FINES %	D_{10} mm.	LL	PL		TOTAL	- NO4	OPT. WATER % DRY WT	MAX. DRY DENS. LBS/CU FT	PVD LBS/CU FT	TOTAL	- NO4	SHEAR	CONSOL.	PERM.
FD-94-53	42.5	S-2	2.5-4.5	ML		10	90				2.7										
"	37.5	S-4	7.5-9.5	SM	33	49	18				2.7										
"	34	S-5B	11-12	SM	22	64	14														
"	30	S-7	15-17	ML		15	85				2.7										
"	22.5	S-10	22.5-24.5	ML		17	83				2.7										
"	15	S-13	30-32	SP-SM	39	53	8														
"	-2.5	S-20	47.5-49.5	SP-SM	11	79	10														
"	-8	S-22	53-55	ML		15	85				2.72										

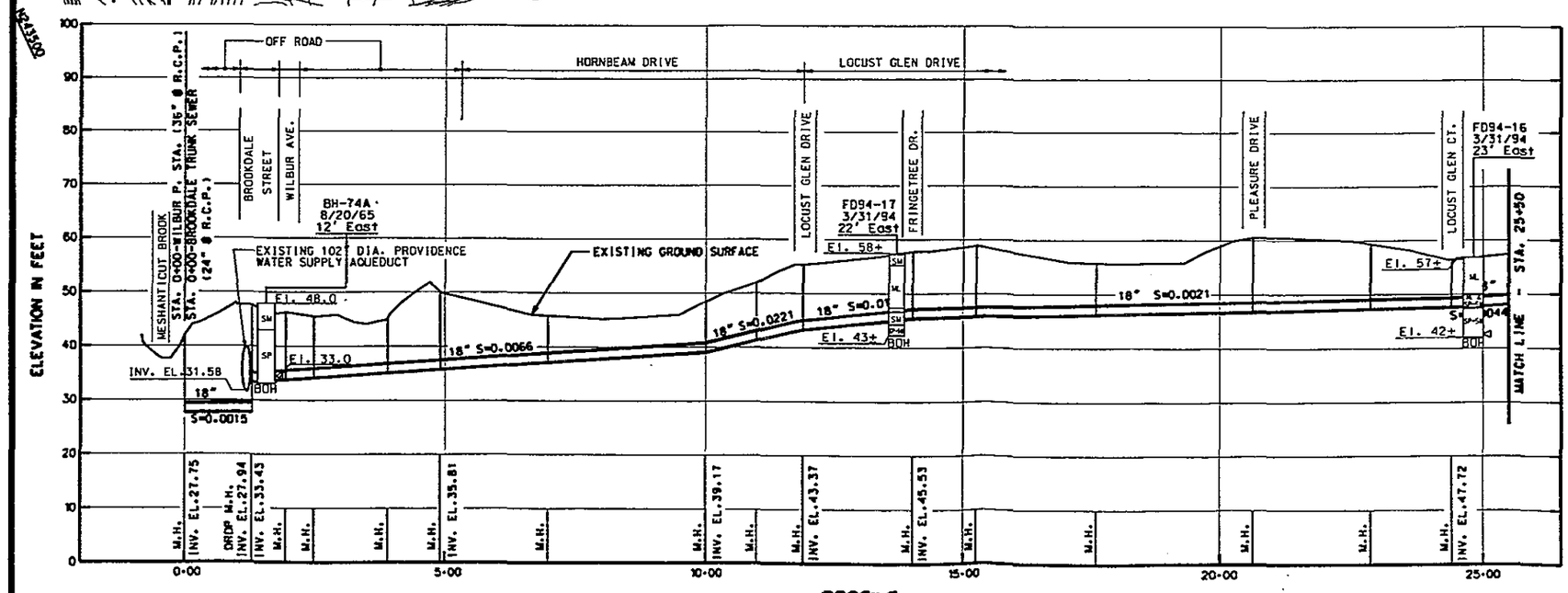
NED FORM JUL 63 510

* PROVIDENCE VIBRATED DENSITY TEST


LEGEND
Sewer Alignments
Pumping Stations
I-295 PS
Johnston
Providence
Plainfield Pike
Comstock Av
I-295 PS
Scituate Avenue
Furnace Hill Brook
Scituate FM/VGS
Scituate PS
TILCON TRUNK SEWER
Glory Arnold Road
BROOKDALE TRUNK SEWER
Pocasset River
Southeast Interceptor
Curran Reservoirs
Hope Road
Phenix Ave
Wilbur Ave
Wilbur PS
Wilbur FM
Natick Ave
Pawtuxet River
WWTF
Kenney Drive
COMSTOCK TRUNK SEWER
NATICK TRUNK SEWER
NOT TO SCALE
Cranston, Rhode Island
Wastewater Conveyance Feasibility Investigation
GENERAL MAP OF
PROPOSED PROJECT
PLATE NO. C-1



PLAN
SCALE: 1" = 100'



PROFILE
SCALE: HOR. 1" = 100'
VER. 1" = 10'

LEGEND FOR GRAPHIC LOG

FD94-16	Type, year, and number of exploration
3/31/94	Month/day/year exploration completed.
23' East	Offset from stationing
El. 57+	Elevation of ground surface at time of exploration
NR	No recovery or unsatisfactory soil sample recovered
NS	Not sampled
SM	Group letter symbol according to Unified Soil Classification System
	Subsurface water level in boring during time of exploration
	Cobbles or boulders (Core-drilled)
	Cobbles or boulders, continuous or nested.
El. 48	Elevation of bedrock surface
	Rock core recovery 0 – 25 %
	Rock core recovery 25 – 50 %
	Rock core recovery 50 – 75 %
	Rock core recovery 75 – 90 %
	Rock core recovery 90 – 100 %
El. 42	Elevation at bottom of exploration

LEGEND

SYMBOL	DESCRIPTION
o FD94-16	U.S. Army Corps of Engineers Boring
o MVSS3-2	Meshanticut Valley Sewer System Boring
o H-113 B-103	Rhode Island Department of Transportation Boring
o BH-75	Providence Water Supply Board Boring
□ TP-36	Test Pit (DiPrete Engineering)
	Assumed Bedrock Surface
BOH	Bottom of Hole
B/R	Bedrock

GRAPHIC SCALES
1" = 100' 100' 0 100' 200'
1" = 10' 10' 0 10' 20'

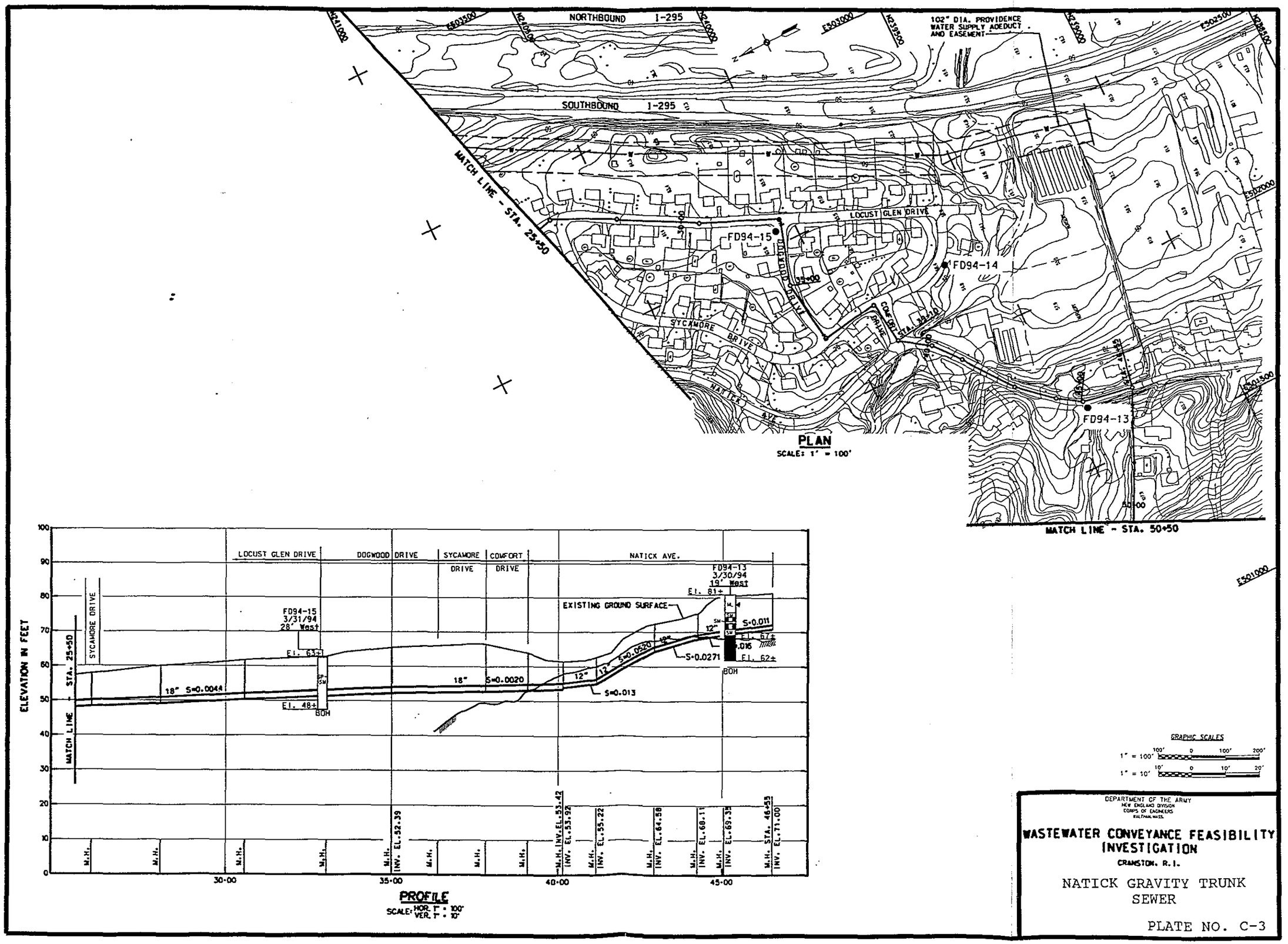
DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.

WASTEWATER CONVEYANCE FEASIBILITY INVESTIGATION

CRANSTON, R.I.

NATICK GRAVITY TRUNK SEWER

PLATE NO. C-2



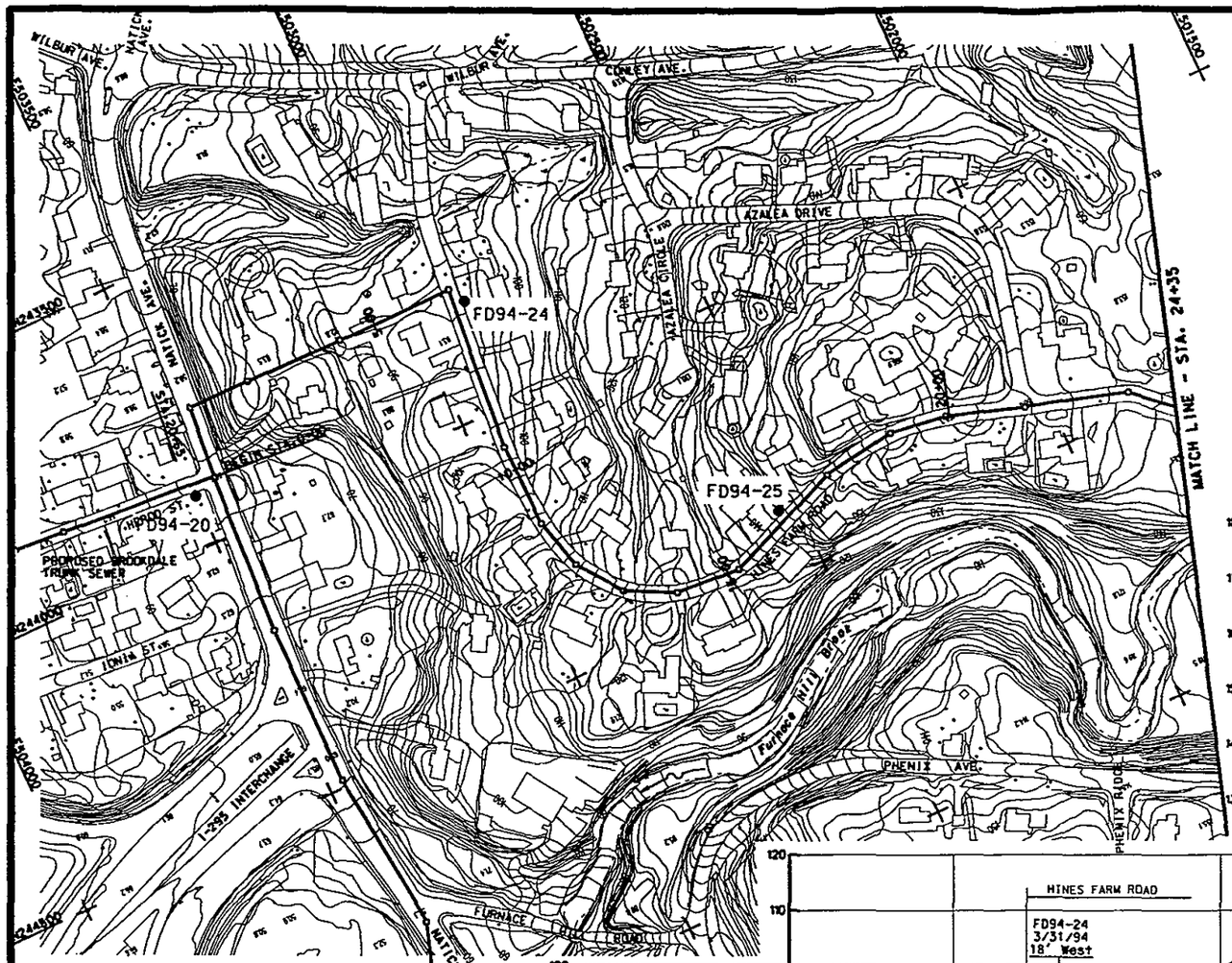
DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.

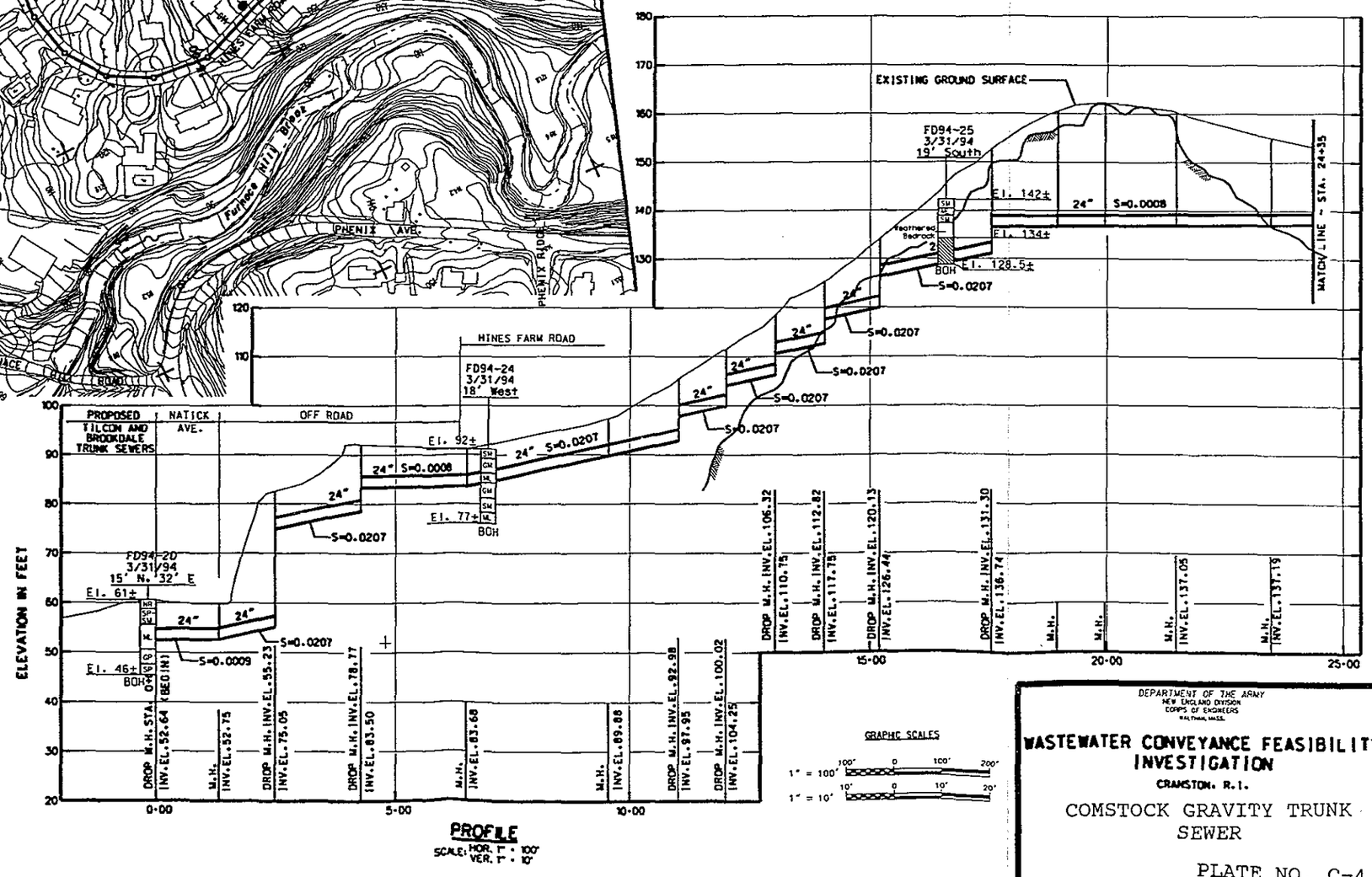
WASTEWATER CONVEYANCE FEASIBILITY INVESTIGATION

CRANSTON, R.I.

NATICK GRAVITY TRUNK SEWER

PLATE NO. C-3





GRAPHIC SCALES

1" = 100' 100' 0 100' 200'

1" = 10' 10' 0 10' 20'

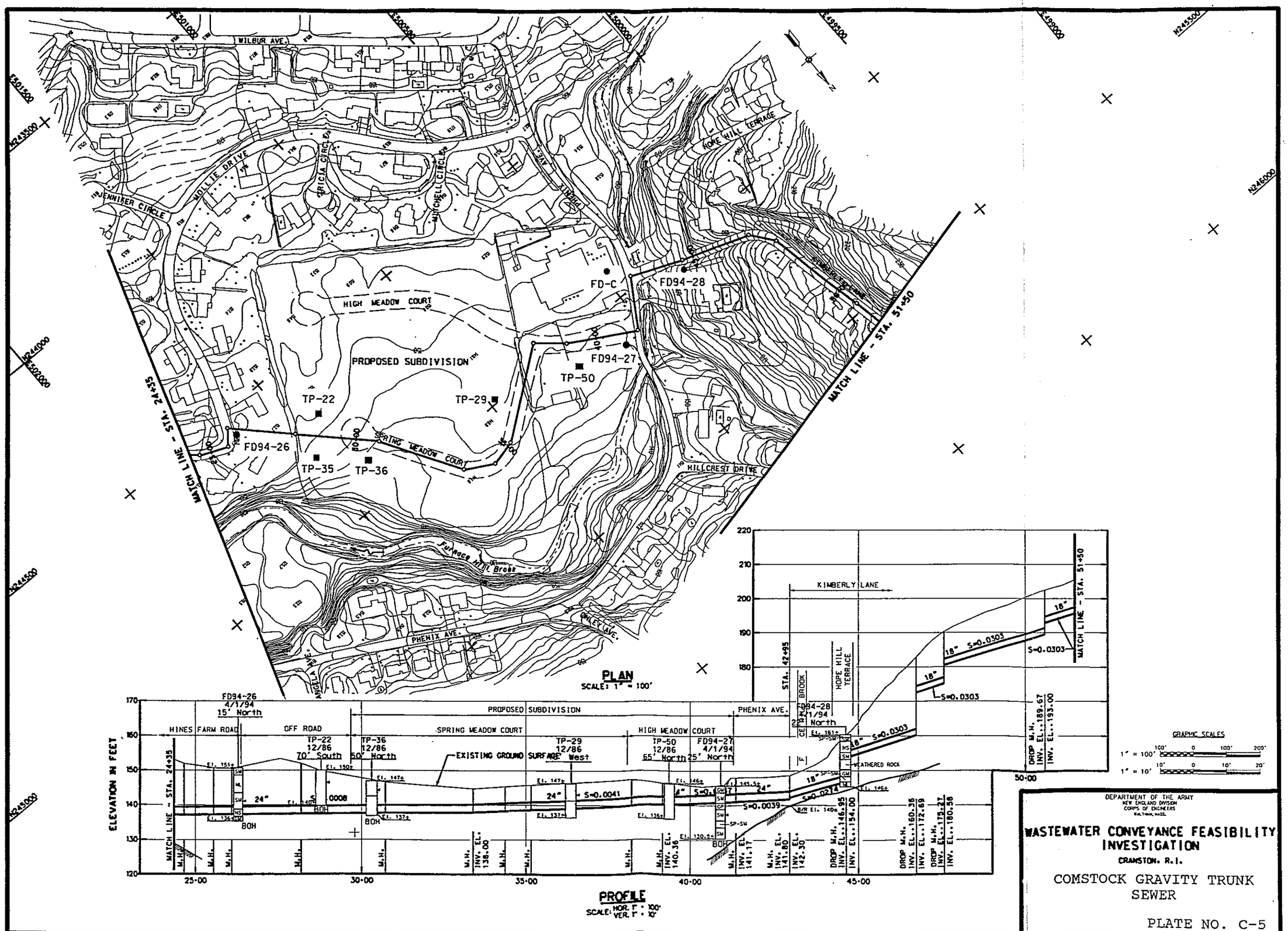
DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.

WASTEWATER CONVEYANCE FEASIBILITY INVESTIGATION

CRANSTON, R.I.

COMSTOCK GRAVITY TRUNK SEWER

PLATE NO. C-4



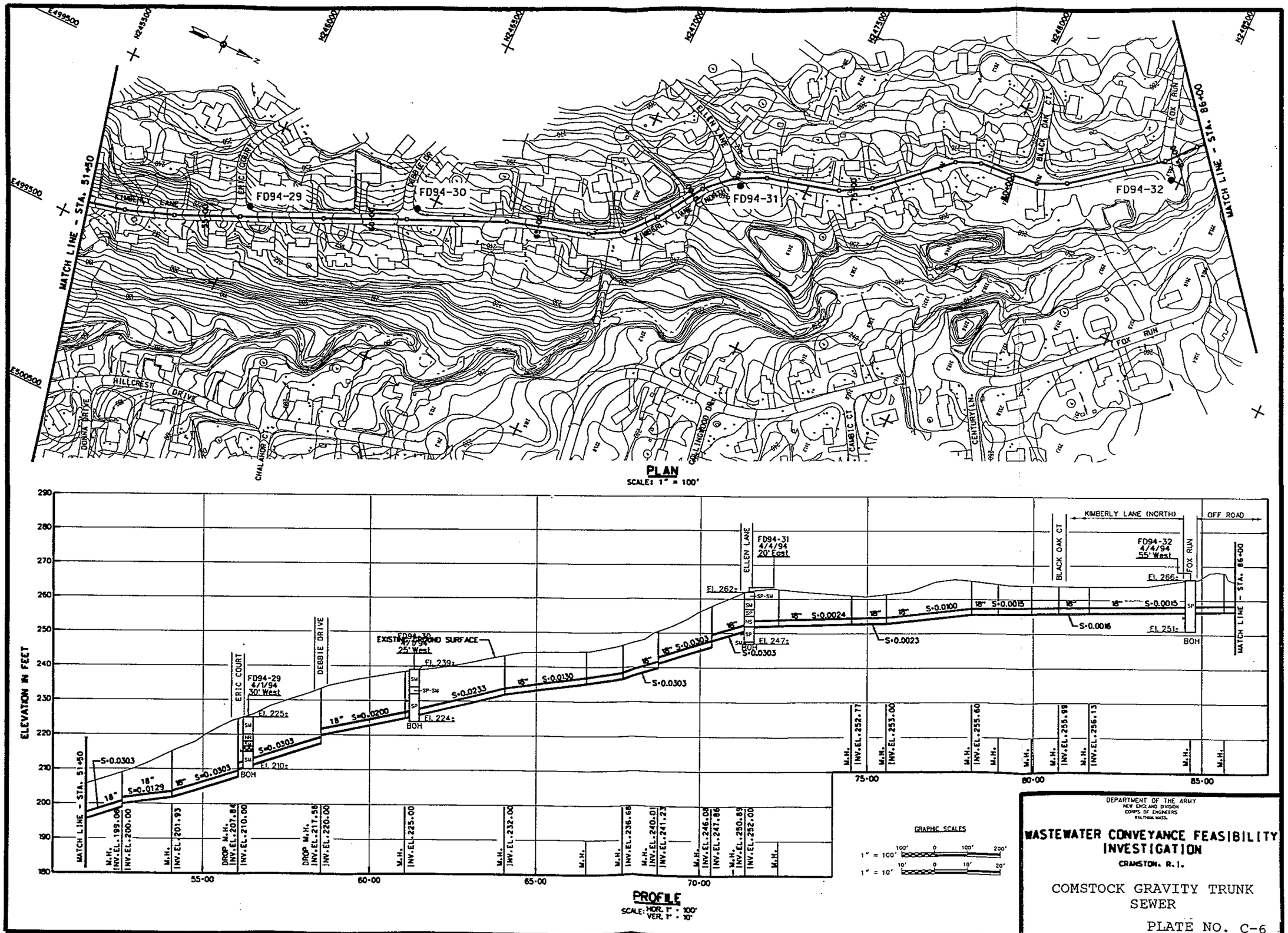
DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
BALTIMORE, MASS.

WASTEWATER CONVEYANCE FEASIBILITY INVESTIGATION

CRANSTON, R.I.

COMSTOCK GRAVITY TRUNK SEWER

PLATE NO. C-5



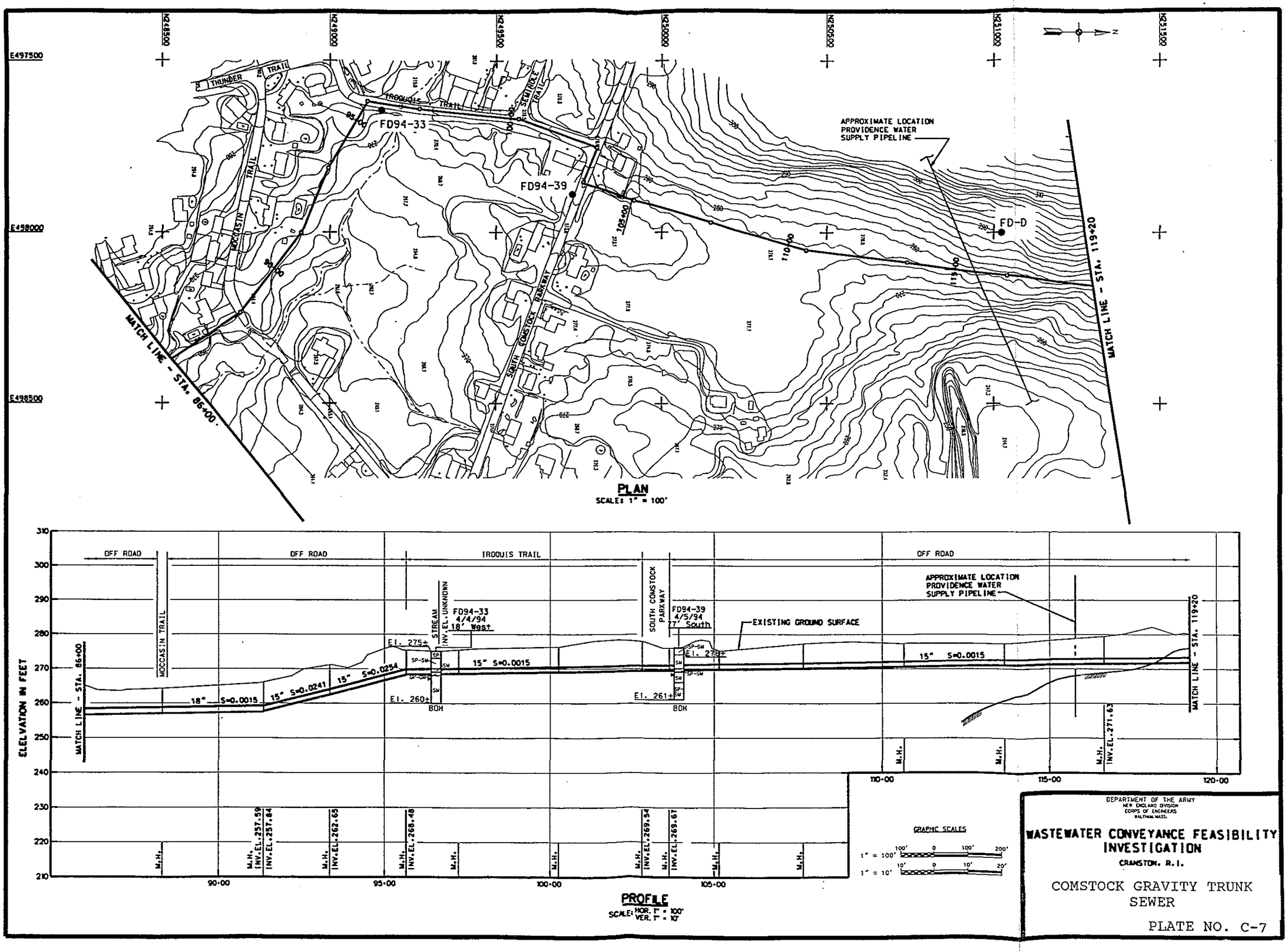
DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.

WASTEWATER CONVEYANCE FEASIBILITY INVESTIGATION

CRANSTON, R.I.

COMSTOCK GRAVITY TRUNK SEWER

PLATE NO. C-6



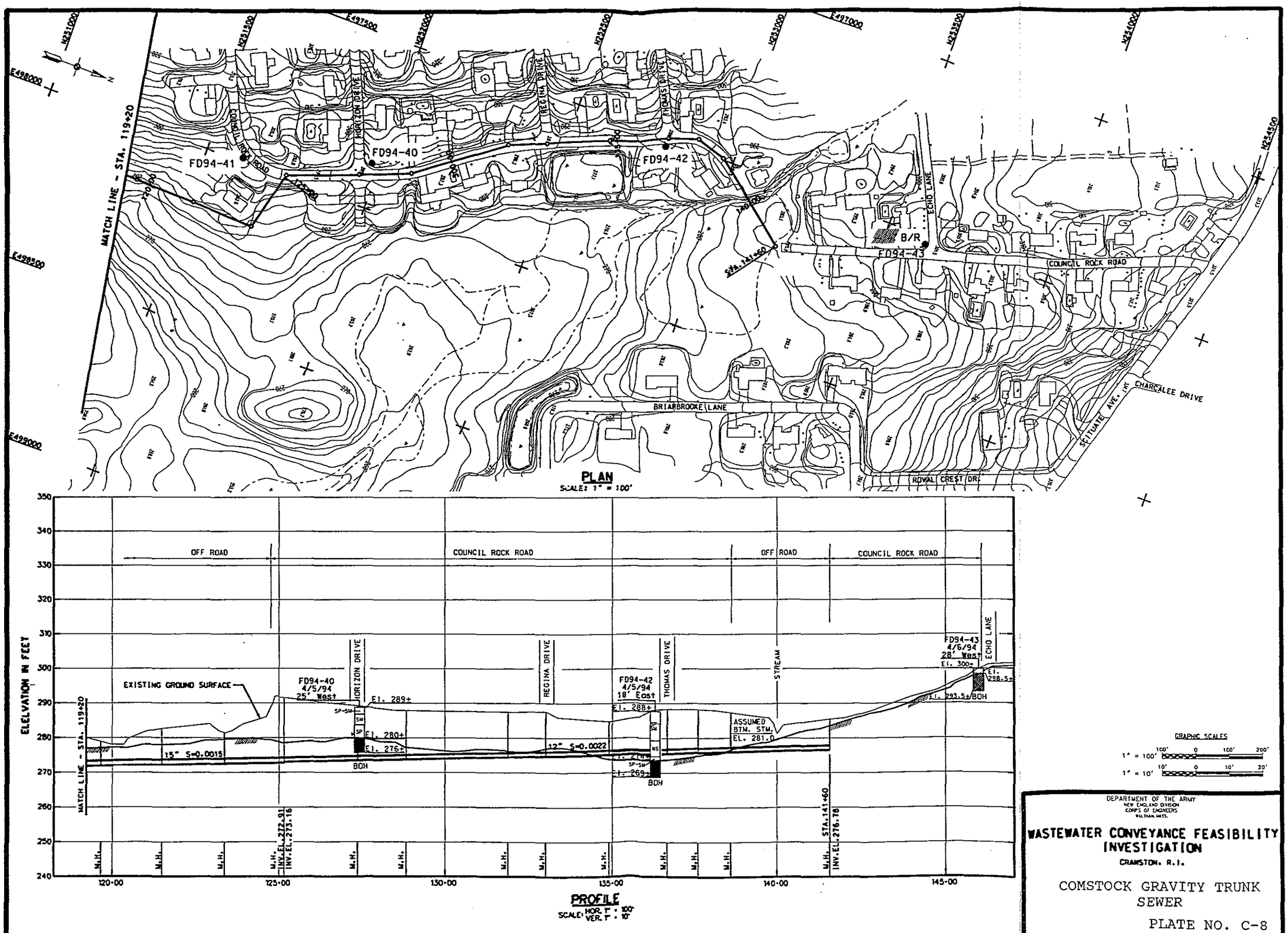
DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.

WASTEWATER CONVEYANCE FEASIBILITY INVESTIGATION

CRANSTON, R.I.

COMSTOCK GRAVITY TRUNK SEWER

PLATE NO. C-7



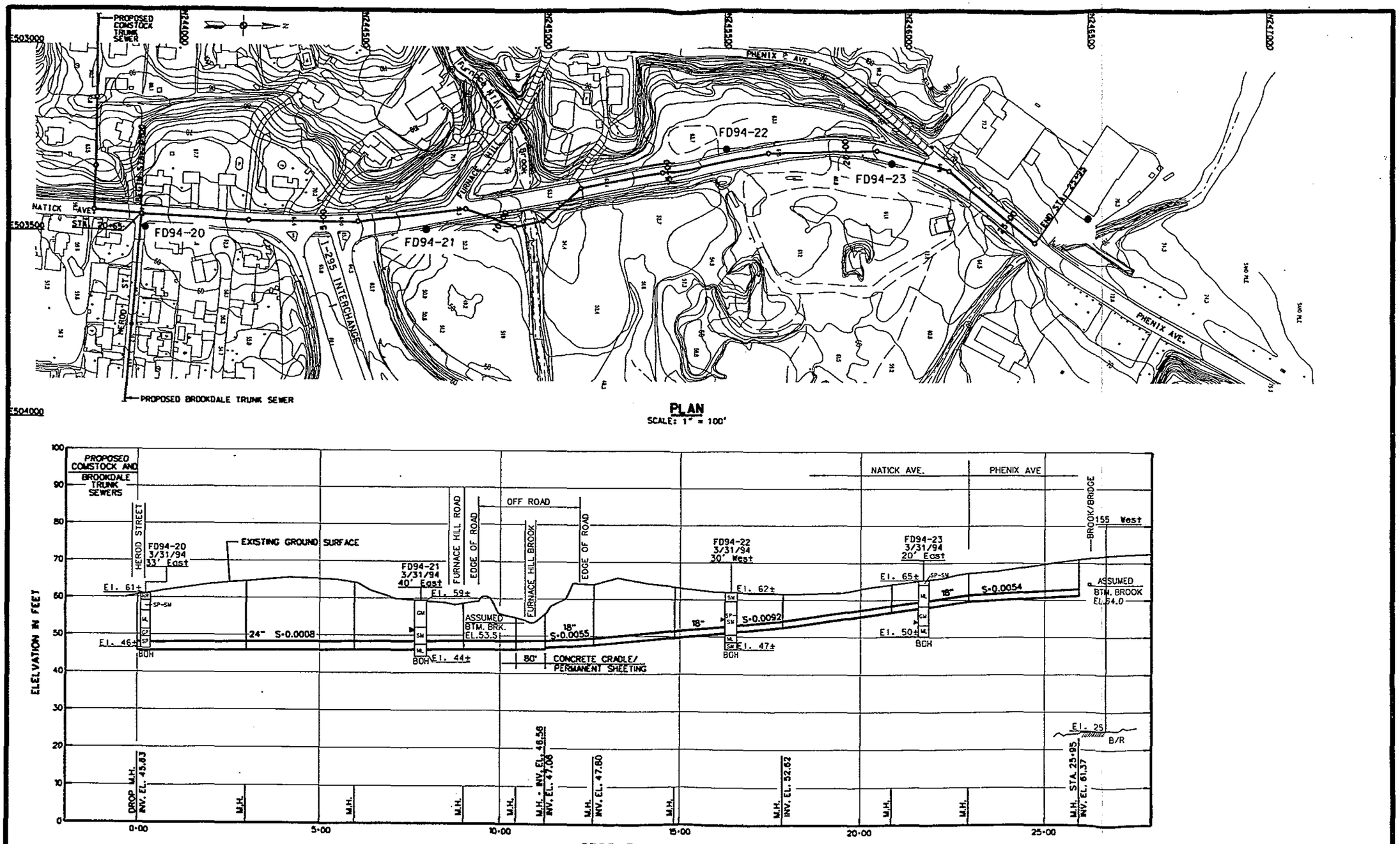
DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.

WASTEWATER CONVEYANCE FEASIBILITY INVESTIGATION

CRANSTON, R.I.

COMSTOCK GRAVITY TRUNK SEWER

PLATE NO. C-8



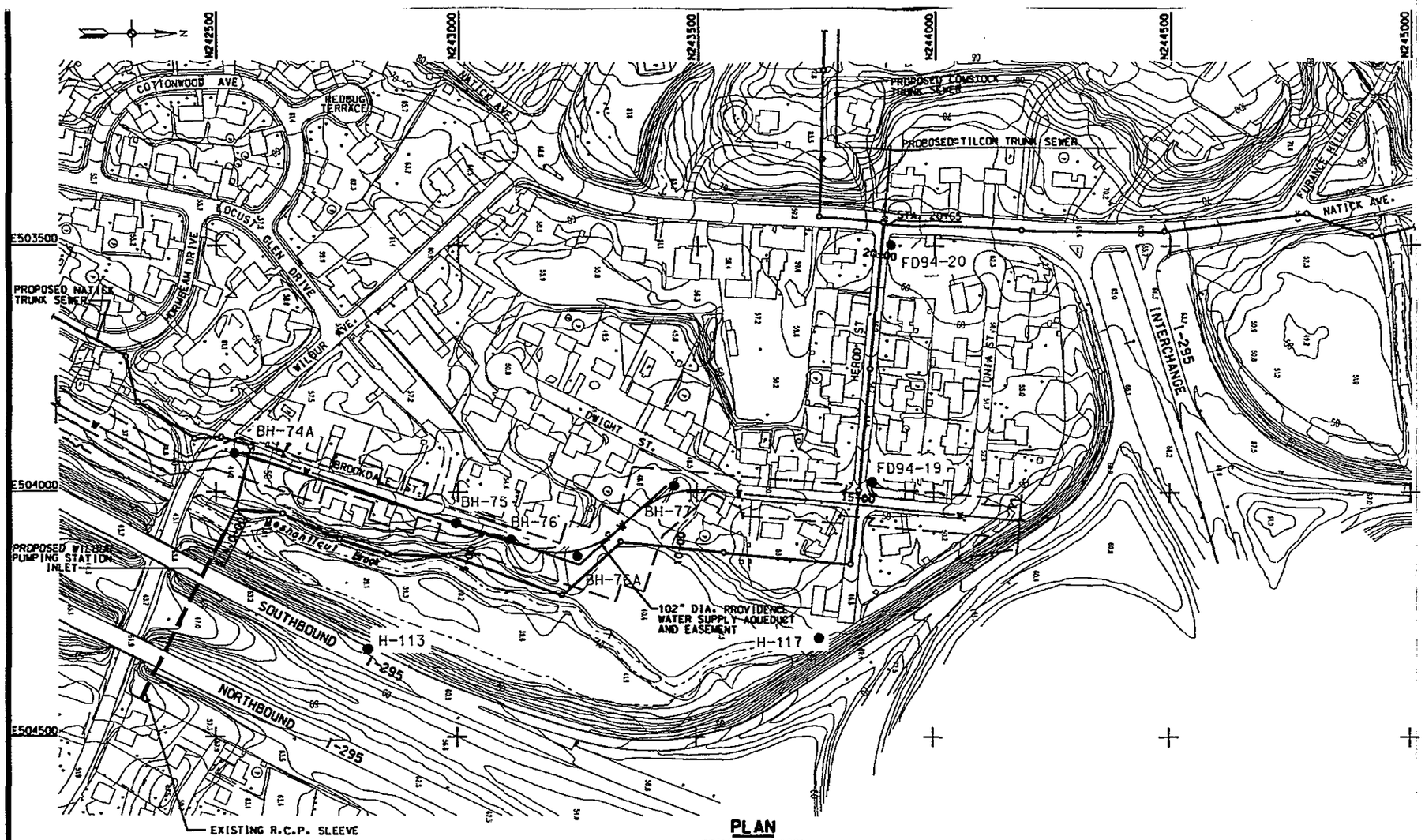
DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.

WASTEWATER CONVEYANCE FEASIBILITY INVESTIGATION

CRANSTON, R.I.

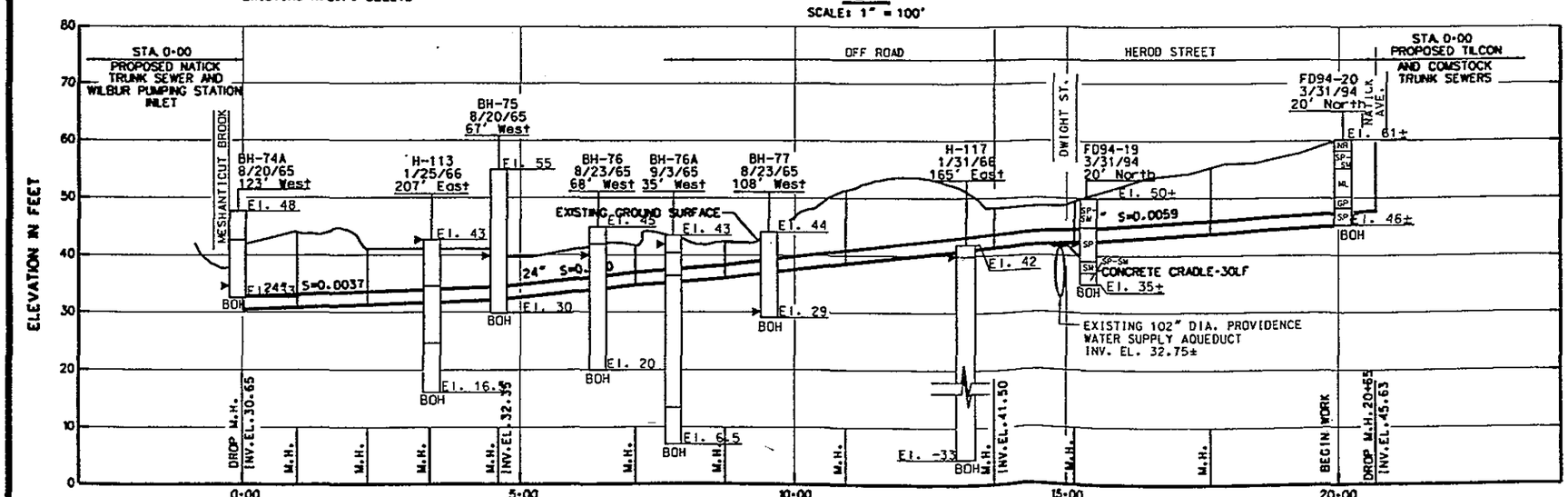
TILCON GRAVITY TRUNK SEWER

PLATE NO. C-9



PLAN

SCALE: 1" = 100'



PROFILE

SCALE: HOR. 1" = 100' VER. 1" = 10'

GRAPHIC SCALES

1" = 100' 100' 0 100' 200'

1" = 10' 10' 0 10' 20'

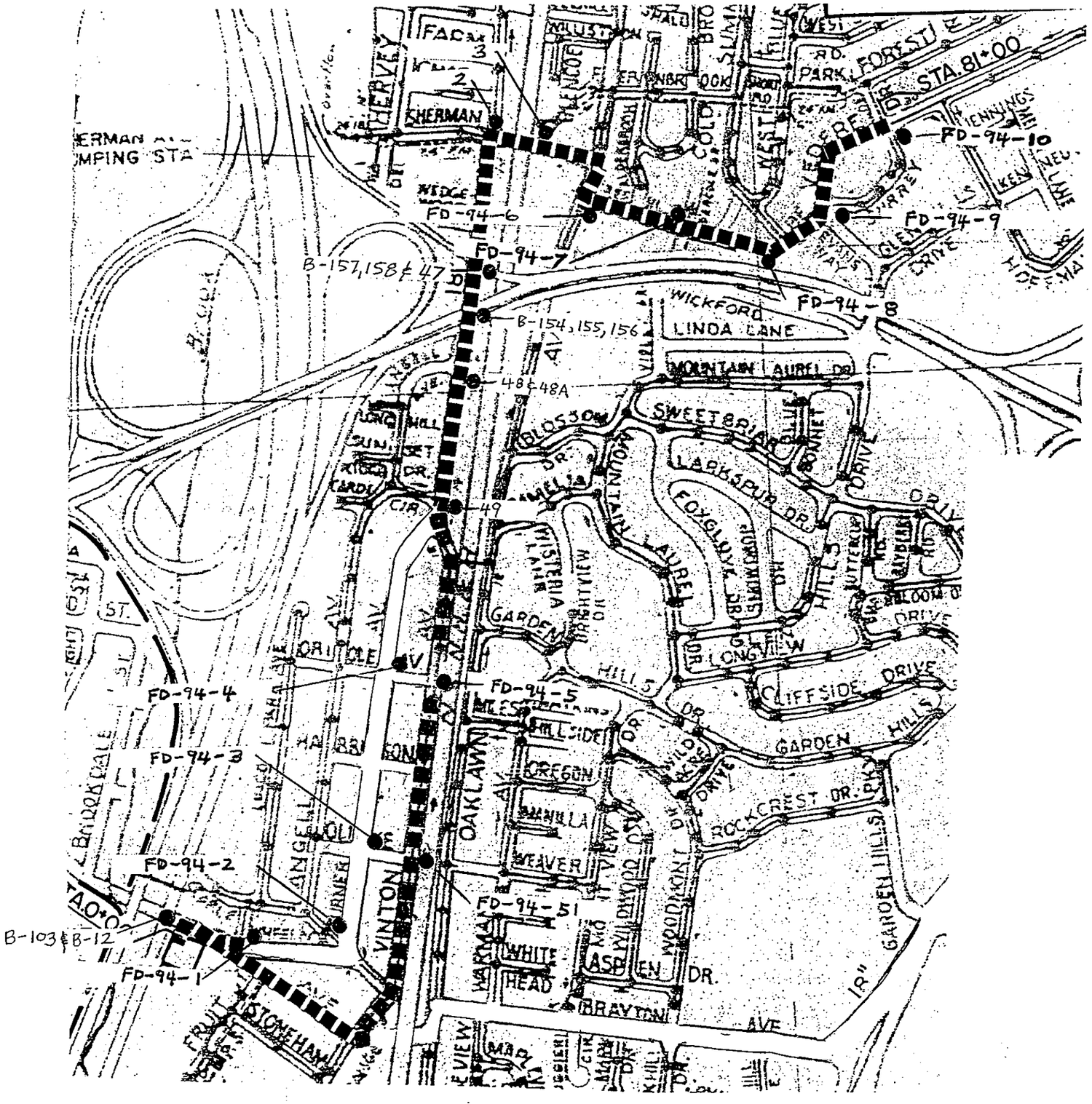
DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.

WASTEWATER CONVEYANCE FEASIBILITY INVESTIGATION

CRANSTON, R.I.

BROOKDALE GRAVITY TRUNK SEWER

PLATE NO. C-10



N

SCALE : 1" = 600'

600' 0 600' 1200'

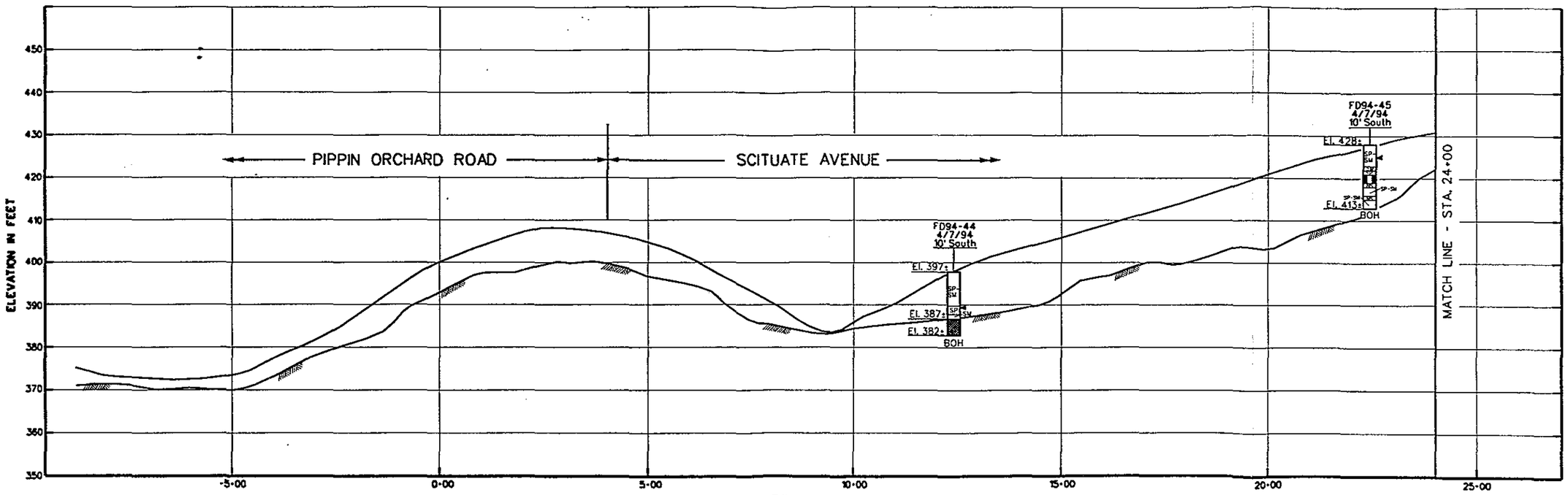
DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.

WASTEWATER CONVEYANCE FEASIBILITY INVESTIGATION

CRANSTON, R.I.

PROPOSED WILBUR FORCE MAIN

PLATE NO. C-11



PROFILE

SCALE: HOR. 1" = 100'
VER. 1" = 10'

GRAPHIC SCALES

1" = 100' 100' 0 100' 200'

1" = 10' 10' 0 10' 20'

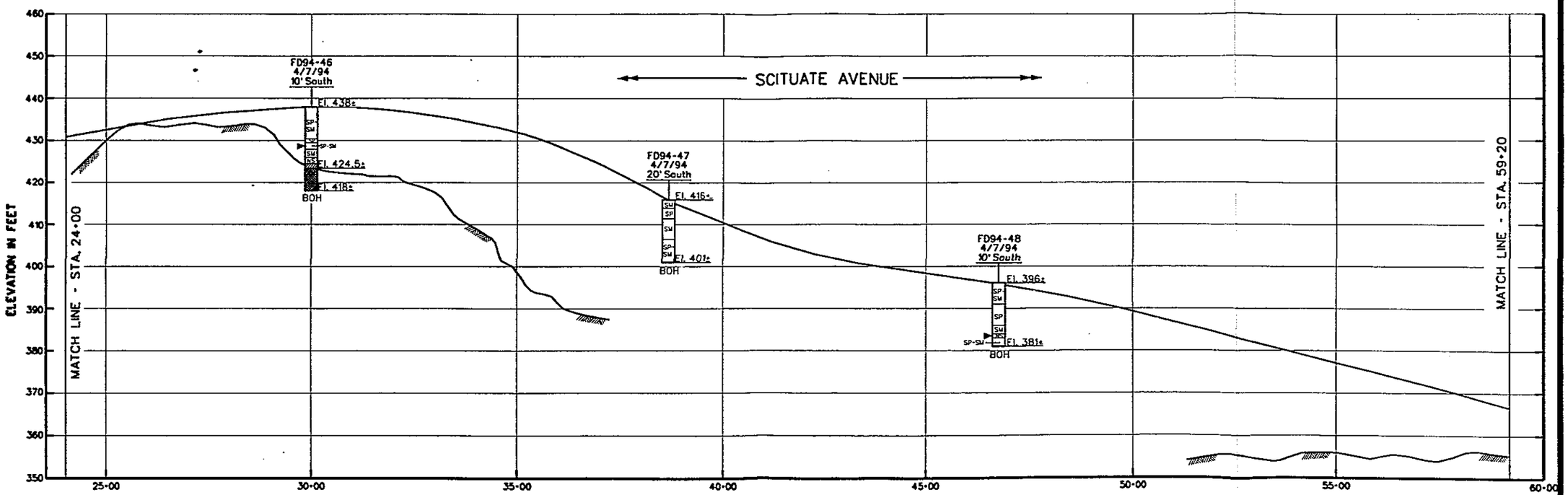
DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.

WASTEWATER CONVEYANCE FEASIBILITY INVESTIGATION

CRANSTON, R.I.

SCITUATE FORCE MAIN/
VARIABLE GRADE SEWER

PLATE NO. C-12



PROFILE

SCALE: HOR. 1" = 100'
VER. 1" = 10'

GRAPHC SCALES

1" = 100' 100' 0 100' 200'

1" = 10' 10' 0 10' 20'

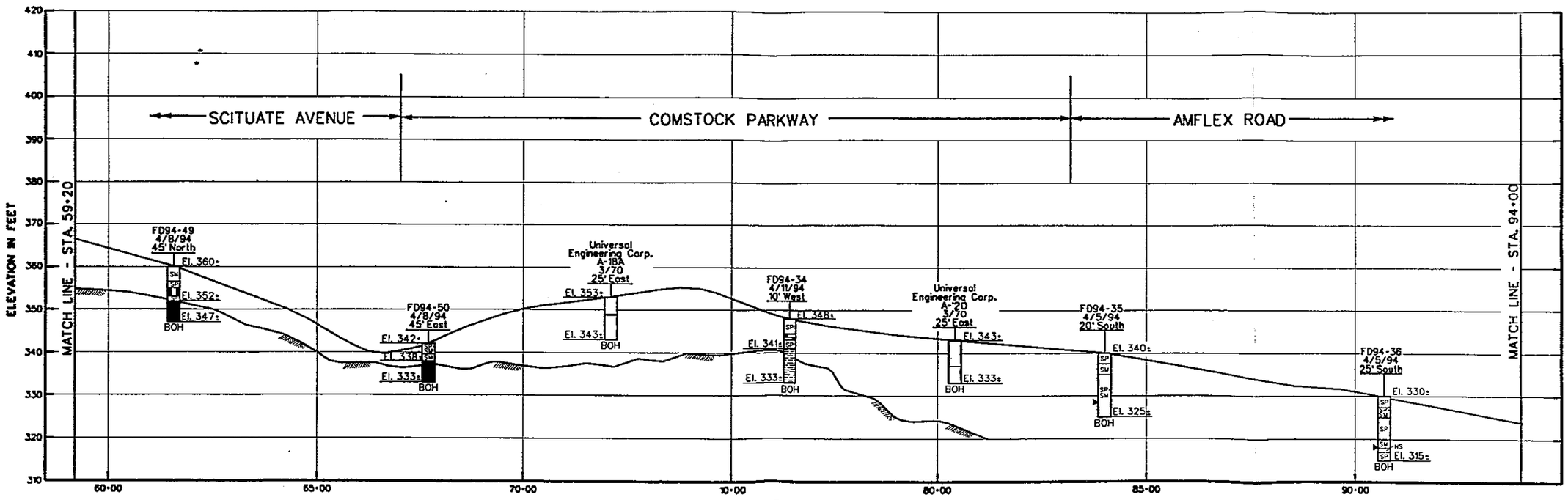
DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.

WASTEWATER CONVEYANCE FEASIBILITY INVESTIGATION

CRANSTON, R.I.

SCITUATE FORCE MAIN/
VARIABLE GRADE SEWER

PLATE NO. C-13



PROFILE

SCALE: HOR. 1" = 100'
VER. 1" = 10'

GRAPHIC SCALES

1" = 100' 100' 0 100' 200'

1" = 10' 10' 0 10' 20'

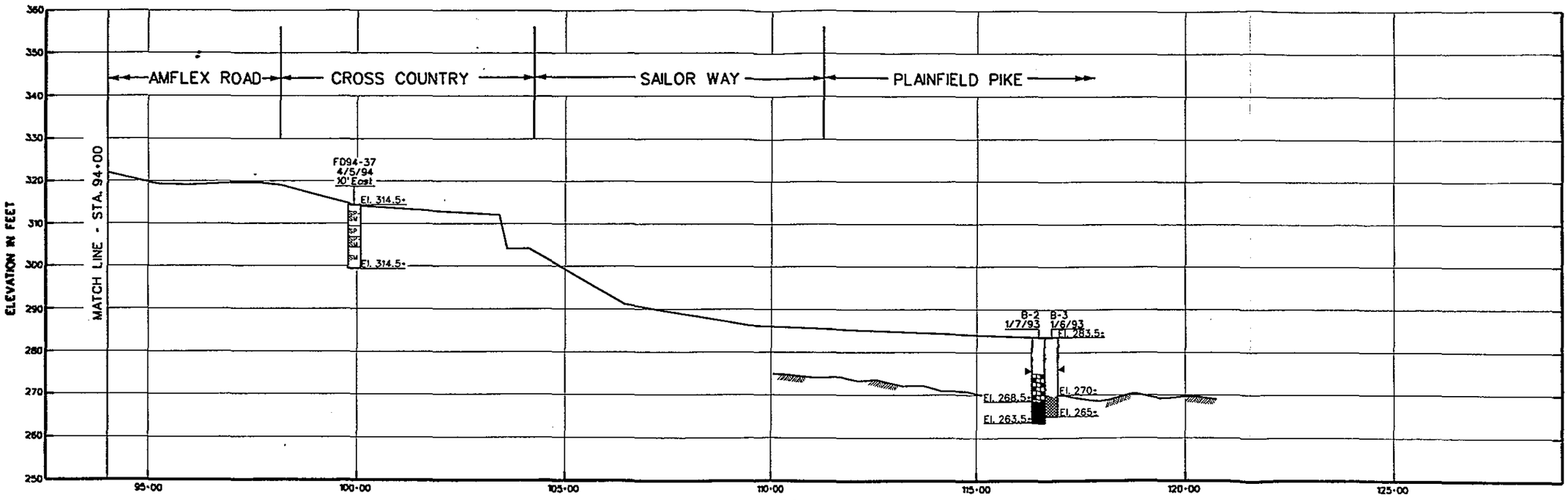
DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.

WASTEWATER CONVEYANCE FEASIBILITY INVESTIGATION

CRANSTON, R.I.

SCITUATE FORCE MAIN/
VARIABLE GRADE SEWER

PLATE NO. C-14



PROFILE

SCALE: HOR. 1" = 100'
VER. 1" = 10'

GRAPHIC SCALES

1" = 100' 100' 0 100' 200'

1" = 10' 10' 0 10' 20'

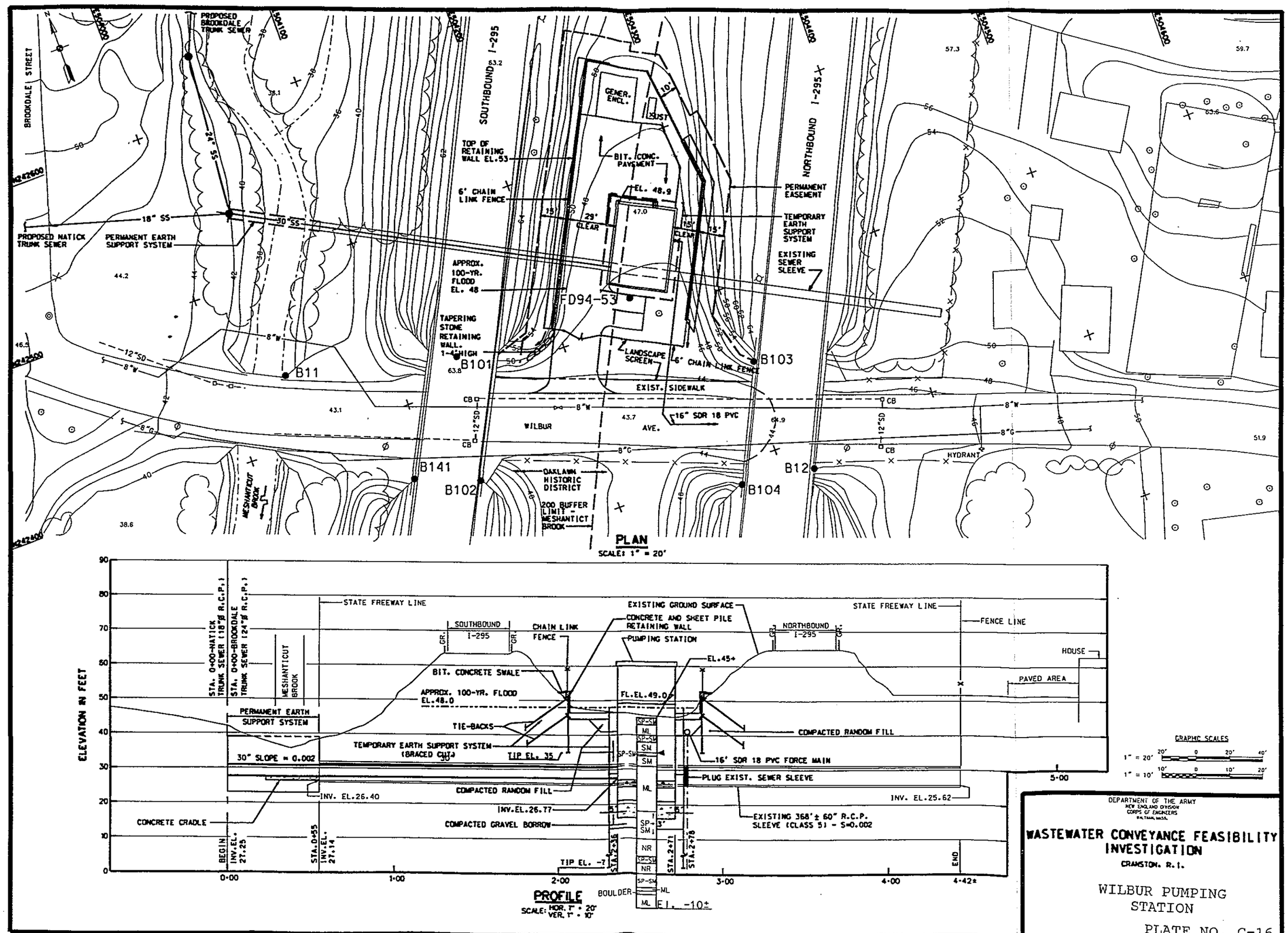
DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.

WASTEWATER CONVEYANCE FEASIBILITY INVESTIGATION

CRANSTON, R.I.

SCITUATE FORCE MAIN/
VARIABLE GRADE SEWER

PLATE NO. C-15



GRAPHIC SCALES
1" = 20'
1" = 10'

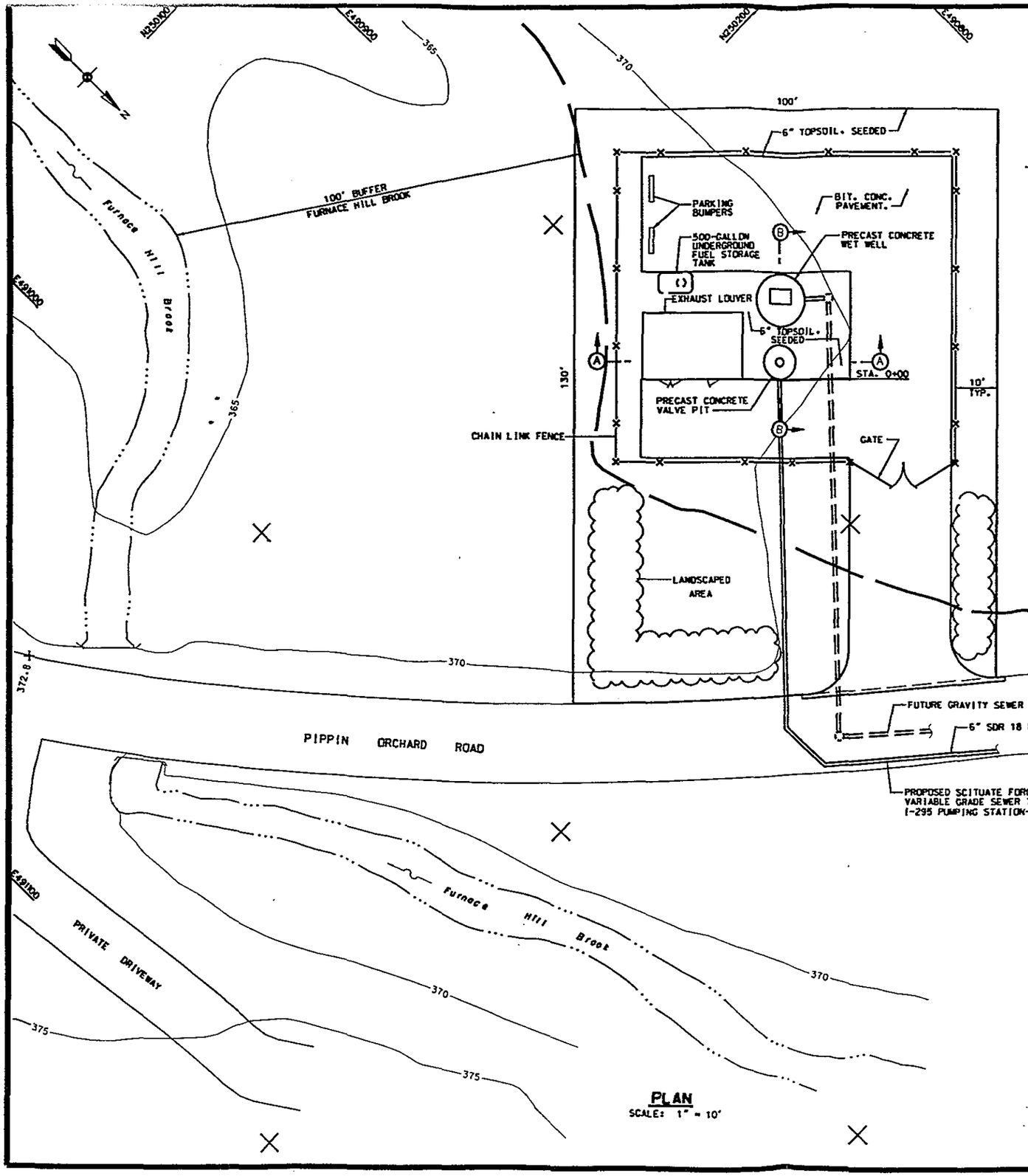
DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
BALTIMORE, MASS.

WASTEWATER CONVEYANCE FEASIBILITY INVESTIGATION

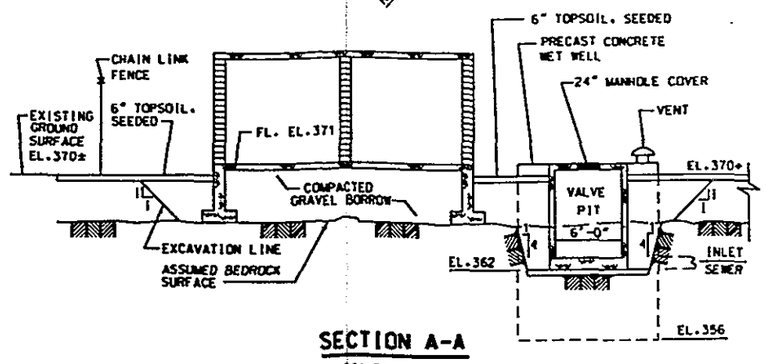
CRANSTON, R.I.

WILBUR PUMPING STATION

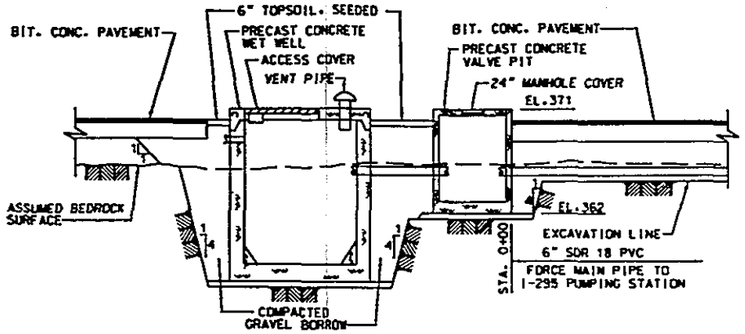
PLATE NO. C-16



PLAN
SCALE: 1" = 10'



SECTION A-A
SCALE: 1" = 5'



SECTION B-B
SCALE: 1" = 5'

NOTE: EQUIPMENT NOT SHOWN

GRAPHIC SCALES
1" = 5' 5' 0 5' 10'
1" = 10' 10' 0 10' 20'

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.

WASTEWATER CONVEYANCE FEASIBILITY INVESTIGATION

CRANSTON, R.I.

SCITUATE PUMPING STATION

PLATE NO. C-17

ATTACHMENT C-1

U.S. Army Corps of Engineers Logs

NOTE: Elevations in these logs are in reference to the city of Cranston Vertical Datum (Mean High Water).

U. S. ARMY
CORPS OF ENGINEERS
NEW ENGLAND DIVISION

FIELD LOG OF TEST BORING

Site Cranston, RI Sewer — Page 1 of 2 Pages

Boring No. FD94-1 Desig. T-1 Diam. (Casing) _____

Co-ordinates: N _____ E _____

Elevation Top of Boring El. 58± [redacted]. Hammer Wt. 140 lb Boring Started 3/29/94

Total Overburden Drilled 15.0 Feet Hammer Drop 30"

Elevation Top of Rock — [redacted]. Casing Left — Boring Completed 3/29/94

Total Rock Drilled — Feet Subsurface Water Data Dry Page —

Elevation Bottom of Boring El. 43± [redacted]. Obs. Well —

Total Depth of Boring 15.0 Feet Drilled By ATL, Canton NY

Core Recovered — % No. Boxes — Mfg. Des. Drill CME 75

Core Recovered — Ft: ____ Diam. ____ In. Inspected By: JAK

Soil Samples 1 3/8" In. Diam. ____ No. Classification By: JAK

Soil Samples ____ In. Diam. ____ No. Classification By: ____

DEPTH 1"=2'	CORE/SAMPLE NO.	SIZE	DEPTH RANGE	BLOWS PER FT. / CORE REC'VY	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
1.0	S-1		0 – 2.0	2 2 2 4 / 100%	-Sample with 1 3/8" I.D. 2 ft long split spoon with 140 lb. hammer and a 30" drop. (SPT)	2 inches top soil — Dk. Br. silty (30-40) SAND (SM)
2.0	NS					NS
3.0	S-2A		2.5 – 3.5	5 6	- Advance hole with 3 1/4" I.D. hollow stem auger.	Dk. Br. silty (30-40) SAND (SM)
4.0	S-2B		3.5 – 4.5	8 15 / 60%		Lt. Br. poorly graded SAND w/silt (5-15) (SP-SM)
5.0	NS					NS
6.0	S-3		5.0 – 7.0	11 27 34 38 / 100%		Lt. Br. poorly graded SAND w/ silt (5-15) (SP-SM)
7.0	NS					NS
8.0	S-4		7.5 – 9.5	10 19 22 26 / 80%		Lt. Br. m-c poorly graded SAND w/ silt (5-15) (SP-SM)
10.0	NS					NS

GENERAL REMARKS:

NED FORM 58 (Test) MAR 71

Boring No. FD94-1

Site	Boring No.	Page 2 of 2
Cranston, RI	FD 94-1 (T-1)	

DEPTH		CORE/SAMPLE NO.	SIZE	DEPTH RANGE	BLOWS PER FT. / CORE REC'VY	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
10.0				10.0	9	SAME AS ABOVE	Lt. Br. poorly graded SAND w/ silt (5-15) and gravel (10-20) (SP-SM)
					21		
11.0		S-5			19		
					22		
				12.0	90%		
12.0		NS					NS
13.0				13.0	12	Sample w/ 1 3/8" I.D. 2' long split spoon w/ 140 lb hammer and 18" drop	Lt. Br. poorly graded SAND w/ silt (5-15) (SP-SM)
					9		
14.0		S-6			8		
					10		
				15.0	100%		
15.0						End of Hole	

U. S. ARMY
CORPS OF ENGINEERS
NEW ENGLAND DIVISION

FIELD LOG OF TEST BORING

Site Cranston, RI Sewer — Page 1 of 2 Pages

Boring No. FD94-2 Desig. T-2 Diam. (Casing) _____

Co-ordinates: N _____ E _____

Elevation Top of Boring Ground Surface [redacted]. Hammer Wt. 140 lb Boring Started 3/29/94

Total Overburden Drilled 15.0 Feet Hammer Drop 30" Boring Completed 3/29/94

Elevation Top of Rock — [redacted]. Casing Left _____

Total Rock Drilled — Feet Subsurface Water Data Dry Page _____

Elevation Bottom of Boring _____ [redacted]. Obs. Well _____

Total Depth of Boring 15.0 Feet Drilled By ATL, Canton NY

Core Recovered - % No. Boxes - Mfg. Des. Drill CME 75

Core Recovered - Ft : ____ Diam. ____ In. Inspected By: JAK

Soil Samples 1 3/8 In. Diam. ____ No. Classification By: JAK

Soil Samples _____ In. Diam. ____ No. Classification By: _____

DEPTH		CORE/SAMPLE NO.	SIZE	DEPTH RANGE	BLOWS PER FT. / CORE RECV'Y	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
		S-1		0 / 2.0	4 3 1 4 / 40%	-Sample w/ 1 3/8" I.D. split spoon w/ 140 lb hammer and 30" drop. (SPT)	2" Topsoil — Br. silty (10-20) SAND w/ organics (SM)
2.0		NS					NS
		S-2		2.5 / 4.5	3 4 3 5 / 60%	- Advance hole w/ 3 1/4" I.D. Hollow stem auger.	Lt. Br. poorly graded fine SAND w/ silt (5-15) (SP-SM)
4.0		NS					NS
		S-3		5.0 / 7.0	5 8 14 17 / 100%		Lt. Br. poorly graded fine SAND w/ silt (5-15) (SP-SM)
6.0		NS					NS
		S-4		7.5 / 9.5	7 7 10 13 / 60%		Lt. Br. Poorly graded SAND (SP)
8.0							
10.0		NS					NS

GENERAL REMARKS:

NED FORM MAR 71 58 (Test)

Boring No. FD94-2

Site	Boring No.	Page 2 of 2
Cranston, RI Sewer	FD94-2 (T-2)	

DEPTH		CORE/SAMPLE NO.	SIZE	DEPTH RANGE	BLOWS PER FT. / CORE REC'VY	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
10.0		S-5		10.0 – 12.0	6 7 9 9 / 75%	Same as above	Lt. Br. poorly graded SAND (SP)
12.0		NS					NS
		S-6		13.0 – 15.0	6 9 13 13 / 90%	Sample w/ 1 3/8" I.D. 2' long split spoon w/ 140# hammer and 30" drop (SPT)	Lt. Br. poorly graded SAND (SP)
15.0						End of Hole	

58A(Test)

Boring No. FD94-2

U. S. ARMY
CORPS OF ENGINEERS
NEW ENGLAND DIVISION

FIELD LOG OF TEST BORING

Site Cranston, RI Sewer

Boring No. FD94-3 Desig. T-3 Diam. (Casing) _____

Co-ordinates: N _____ E _____

Elevation Top of Boring Ground Surface Hammer Wt. 140 lb Boring Started 3/29/94

Total Overburden Drilled 16.0 Feet Hammer Drop 30" Boring Completed 3/29/94

Elevation Top of Rock – Casing Left –

Total Rock Drilled – Feet Subsurface Water Data Dry Page –

Elevation Bottom of Boring _____ Obs. Well –

Total Depth of Boring 15.0 Feet Drilled By ATL, Canton NY

Core Recovered – % No. Boxes – Mfg. Des. Drill CME 75

Core Recovered – Ft: ____ Diam. ____ In. Inspected By: JAK

Soil Samples 1 3/8 In. Diam. ____ No. Classification By: JAK

Soil Samples _____ In. Diam. ____ No. Classification By: _____

DEPTH		CORE/SAMPLE NO.	SIZE	DEPTH RANGE	BLOWS PER FT. / CORE REC'VY	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
		S-1		0 / 2.0	1 2 5 6 / 80%	-Sample w/ 1 3/8" I.D. 2' long split Spoon w/ 140 lb hammer and 30" drop (SPT)	2" Top Soil — Brown silty (30-40) f. SAND (SM)
2.0		NS					NS
		S-2A		2.5 / 3.5	4 11	-Advance hole w/ 3 1/4" I.D. Hollow Stem Auger.	Br. silty (30-40) f. SAND (SM)
4.0		S-2B		3.5 / 4.5	14 20 / 75%		Lt. Br. GRAVEL w/ sand (25-35) (GP-GM)
		NS					NS
6.0		S-3		5.0 / 7.0	7 15 19 27 / 75%		Lt. Br. GRAVEL w/ sand (25-35) (GP-GM)
		NS					NS
8.0		S-4		7.5 / 9.5	7 34 39 40 / 75%		Lt. Br. GRAVEL w/ sand (25-35) (GP-GM)
10.0		NS					NS

GENERAL REMARKS:

Site	Boring No.	Page 2 of 2
CRANSTON, RI Sewer	FD94-3 (T-3)	

DEPTH		CORE/SAMPLE NO.	SIZE	DEPTH RANGE	BLOWS PER FT. / CORE REC'VY	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
10.0		S-5		10.0 / 12.0	17 17 17 40 / 65%	Same as above	Lt. Br. GRAVEL w/ sand (25-35) (GP-GM)
12.0		NS					NS
15.0		S-6		13.0 / 15.0	5 12 20 20 / 50%	Sample w/ 1 3/8" I.D. 21 long split spoon with 140lb hammer and 30" drop (SPT)	Lt. Br. Poorly graded SAND w/ gravel (10-20) (SP-SM)
						END of Hole	

58A(Test)

Boring No. FD94-3

U. S. ARMY
CORPS OF ENGINEERS
NEW ENGLAND DIVISION

FIELD LOG OF TEST BORING

Site Cranston, RI Sewer — Page 1 of 2 Pages

Boring No. FD94-4 Desig. T-4 Diam. (Casing) _____

Co-ordinates: N _____ E _____

Elevation Top of Boring Ground Surface [redacted]. Hammer Wt. 140 lb. Boring Started 3/29/94

Total Overburden Drilled 15.0 Feet Hammer Drop 30" Boring Completed 3/29/94

Elevation Top of Rock — [redacted]. Casing Left —

Total Rock Drilled — Feet Subsurface Water Data Dry Page —

Elevation Bottom of Boring _____ [redacted]. Obs. Well _____

Total Depth of Boring 15.0 Feet Drilled By ATL, Canton NY

Core Recovered — % No. Boxes — Mfg. Des. Drill CME 75

Core Recovered — Ft. _____ Diam. _____ In. Inspected By: JAK

Soil Samples 1 3/8 In. Diam. _____ No. Classification By: JAK

Soil Samples _____ In. Diam. _____ No. Classification By: _____

DEPTH (1" = 2')	CORE/SAMPLE NO.	SIZE	DEPTH RANGE	BLOWS PER FT. / CORE REC'VY	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
	S-1		0 – 2.0	1 2 2 3 / 100%	- Sample w/ 1 3/8" I.D. 2' long split spoon w/ 140 lb hammer and a 30" drop. (SPT)	5" Top soil — Br. silty (30-40) f. SAND (SM)
2.0	NS					NS
	S-2		2.5 – 4.5	3 4 6 14 / 70%	- Advance hole w/ 3 1/4" I.D. hollow stem auger	Gr. silty (10-20) f. SAND (SM)
4.0	NS					NS
	S-3		5.0 – 7.0	12 16 19 22 / 70%		Gr. poorly graded SAND w/ gravel (20-30) (SP-SM)
6.0	NS					NS
	S-4		7.5 – 9.5	4 5 14 40 / 75%		Gr. SILT w/ sand (10-20) (ML)
8.0	NS					NS
10.0						

GENERAL REMARKS:

NED FORM MAR 71 58 (Test)

Boring No. FD94-4

Site	Boring No.	Page 2 of 2
Cranston, RI Sewer	FD94-4 (T-4)	

DEPTH		CORE/SAMPLE NO.	SIZE	DEPTH RANGE	BLOWS PER FT. / CORE REC'VY	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
10.0		S-5		10.0 / 12.0	22 22 30 35 / 60%	Same as above	Gr. GRAVEL w/ sand (10-20) (GP-GM)
12.0		NS					NS
		S-6		13.0 / 15.0	11 18 21 28 / 60%	Sample w/ 1 3/8" I.D. 2' long split Spoon w/ 140 lb. hammer and 30" drop (SPT)	Gr. poorly graded SAND w/ gravel (10-20) (SP-SM)
15.0						END of HOLE	

U. S. ARMY
CORPS OF ENGINEERS
NEW ENGLAND DIVISION

FIELD LOG OF TEST BORING

Site Cranston RI Sewer Page 1 of 1 Pages

Boring No. FD 94-43 Desig. C-15 Diam. (Casing) _____

Co-ordinates: N _____ E _____

Elevation Top of Boring El. 300± [redacted]. Hammer Wt. 140 lb Boring Started 4/6/94

Total Overburden Drilled 1.5 Feet Hammer Drop 30" Boring Completed 4/6/94

Elevation Top of Rock El 298.5± [redacted]. Casing Left –

Total Rock Drilled 5 Feet Subsurface Water Data Dry Page –

Elevation Bottom of Boring El. 293.5± [redacted]. Obs. Well –

Total Depth of Boring 6.5 Feet Drilled By ATL, Canton NY

Core Recovered 83 % No. Boxes _____ Mfg. Des. Drill CME 75

Core Recovered 4.2 Ft: _____ Diam. 1 3/8 In. Inspected By: S. Bergeron

Soil Samples 1 3/8 In. Diam. 2 No. Classification By: S. Bergeron

Soil Samples _____ In. Diam. _____ No. Classification By: PJY

DEPTH		CORE/SAMPLE NO.	SIZE	DEPTH RANGE	BLOWS PER FT. / CORE REC'VY	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
		S-1A		0 0.5	2	Sample with 1 3/8" I.D. 2 foot long split spoon with a 140 lb hammer and 30" drop.	Dk. Br. SAND w/silt & org. (SP-SM)
1.0		S-1B		0.5 1.5	5 4 100+/- 90%		Br. mostly f. SAND w/silt (S-15) and gravel (SP-SM)
2.0		Run1		1.5		-Cleaned out with 3 1/4" I.D. Hollow Stem Auger and 2 7/8" roller bit -Drilled with AX diamond bit rock core for 35 minutes at 300 psi.	GRANITE; GREY, ALTERED ZONES AT TOP OF CORE, AT APPROXIMATELY 3', AND NEAR END OF CORE. RQD = 69.2% (FAIR)
3.0							
4.0							
5.0							
6.0				6.5			
						End of Hole 6.5'	

GENERAL REMARKS:

ED FORM MAR 71 58 (Test)

Boring No. FD 94-43

Site	Boring No.	Page 2 of 2
Cranston, RI Sewer	FD94-5 (T-5)	

DEPTH		CORE/SAMPLE NO.	SIZE	DEPTH RANGE	BLOWS PER FT. / CORE REC'VY	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
10.0		S-5A		10.0 – 11.0	8 4 5	Same as above	Lt. Br. silty (10-20) SAND w/ gravel (25-35) (SP-SM)
		S-5B		11.0 – 12.0	5 75%		Lt. Br. m-c poorly graded SAND (SP)
12.0		NS					NS
		S-6		13.0 – 15.0	3 5 7 10	- Sample w/ 1 3/8" I.D. 2' long split Spoon w/ 140 lb hammer and 30" drop (SPT)	Lt. Br. m-c poorly graded SAND (SP)
15.0							

58A(Test)

Boring No. FD94-5

U. S. ARMY
CORPS OF ENGINEERS
NEW ENGLAND DIVISION

FIELD LOG OF TEST BORING

Site Cranston, RI Sewer Page 1 of 2 Pages

Boring No. FD94-6 Desig. T-6 Diam. (Casing) _____

Co-ordinates: N _____ E _____

Elevation Top of Boring El. 110 ± [redacted]. Hammer Wt. 140 lb Boring Started 3/29/94

Total Overburden Drilled 15.0 Feet Hammer Drop 30" Boring Completed 3/29/94

Elevation Top of Rock - [redacted]. Casing Left -

Total Rock Drilled - Feet Subsurface Water Data DRY Page -

Elevation Bottom of Boring El. 95 ± [redacted]. Obs. Well -

Total Depth of Boring 15.0 Feet Drilled By ATL, Canton, NY

Core Recovered - % No. Boxes - Mfg. Des. Drill CME 75

Core Recovered - Ft: - Diam. - In. Inspected By: JAK

Soil Samples 1 3/8" In. Diam. - No. Classification By: JAK

Soil Samples - In. Diam. - No. Classification By: -

DEPTH		CORE/SAMPLE NO.	SIZE	DEPTH RANGE	BLOWS PER FT. / CORE REC'VY	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
	1"=2"						
		S-1		0 – 2.0	1 6 6 8 / 50%	- Sample w/ 1 3/8" I.D. 2' long split spoon w/ 140 lb. hammer (SPT)	5" Top soil — Br. silty (10-20) m-c SAND (SM)
2.0		NS					NS
		S-2A		2.5 – 3.5	10 9 18	- Advance hole w/ 3 1/4" I.D. hollow stem auger.	Gr. silty (10-20) SAND w/ gravel (10-20) (SM)
4.0		S-2B		3.5 – 4.5	55 / 75%	- hook up water for RB at 4.5'	Br. poorly graded m-c SAND (SP)
6.0		NS		4.5 – 6.0		- Roller bit (2 7/8") through cobbles from 4.5 to 6'.	Cobbles
		S-3		6.0 – 8.0	20 20 11 20 / 80%		Gr. silty (15-25) SAND (SM)
8.0		NS					NS
10.0							

GENERAL REMARKS:

Site	Boring No.	Page 2 of 2
Cranston, RI Sewer	FD94 – 6	

DEPTH		CORE/SAMPLE NO.	SIZE	DEPTH RANGE	BLOWS PER FT. / CORE REC'VY	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
10.0		S-4A		10.0 11.5	13 27 32 47	Same as above	Gr. silty (15–25) SAND (SM)
12.0		S-4B		12.0	90%		Gr. SILT (ML)
		NS					NS
		S-5		13.0 14.3	23 36 80	Sample w/ 1 3/8" I.D. 2' long split spoon with a 140 lb hammer and a 30" drop. (SPT)	Gr. SILT (ML)
15.0		NS		14.3 15.5		– Bouncing refusal at 14.3 – Auger down to 15.5 with no resistance	NS

U. S. ARMY
CORPS OF ENGINEERS
NEW ENGLAND DIVISION

FIELD LOG OF TEST BORING

Site Cranston, RI Sewer Page 1 of 2 Pages

Boring No. FD94-7 Desig. T-7 Diam. (Casing) _____

Co-ordinates: N _____ E _____

Elevation Top of Boring El. 119± [redacted]. Hammer Wt. 140 lb Boring Started 3/29/94

Total Overburden Drilled 15.0 Feet Hammer Drop 30" Boring Completed 3/29/94

Elevation Top of Rock — [redacted]. Casing Left -

Total Rock Drilled — Feet Subsurface Water Data 4.3 ft Page -

Elevation Bottom of Boring El. 104± [redacted]. Obs. Well -

Total Depth of Boring 15.0 Feet Drilled By ATL, Canton, NY

Core Recovered - % No. Boxes - Mfg. Des. Drill CME 75

Core Recovered - Ft. ____ Diam. ____ In. Inspected By: JAK

Soil Samples 1 3/8" In. Diam. ____ No. Classification By: JAK

Soil Samples _____ In. Diam. ____ No. Classification By: _____

DEPTH (1"=2')	CORE/SAMPLE NO.	SIZE	DEPTH RANGE	BLOWS PER FT. / CORE REC'VY	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
	S-1		0 / 2.0	2 6 4 4 / 60%	- Sample w/ 1 3/8" I.D. 2' long split spoon w/ 140 lb. hammer (SPT)	5" Top Soil — Lt. Br. f. poorly graded SAND (SP-SM)
2.0	NS					NS
	S-2		2.5 / 4.5	2 2 2 2 / 60%	- Advance hole w/ 3 1/4" I.D. Hollow Stem Auger	Black and Gray SILT (ML)
4.0 ▽	NS					NS
	S-3A		5.0 / 6.0	4 4 18		Black & Gray SILT (ML)
6.0	S-3B		6.0 / 7.0	16 / 90%		Lt. Br. poorly graded SAND (SP-SM)
	NS					NS
8.0	S-4		7.5 / 9.5	9 13 16 17 / 90%		Gr. sandy (40-50) SILT (ML)
10.0	NS					NS

GENERAL REMARKS:

NED FORM MAR 71 58 (Test)

Boring No. FD94-7

Site	Boring No.	Page
Cranston, RI Sewer	FD94-7 (T-7)	2 of 2

DEPTH	1" = 2"	CORE/SAMPLE NO.	SIZE	DEPTH RANGE	BLOWS PER FT. / CORE REC'VY	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
10.0		S-5		10.0	10 15 16 13	Same as above	Gr. & Br. sandy (40-50) SILT (ML)
12.0				12.0	100%		
		NS					NS
		S-6A		13.0	19 23 23 22	Sample w/ 1 3/8" I.D. 2' long split spoon with a 140 lb hammer and a 30" drop. (SPT)	Gr. SILT w/ Sand (15-25) (ML)
				14.5			
15.0		S-6B		15.0	100%		weathered rock
						END of Hole	

U. S. ARMY
CORPS OF ENGINEERS
NEW ENGLAND DIVISION

FIELD LOG OF TEST BORING

Site Cranston, RI Sewer Page 1 of 2 Pages

Boring No. FD94-8 Desig. T-8 Diam. (Casing) _____

Co-ordinates: N _____ E _____

Elevation Top of Boring El. 120± [redacted]. Hammer Wt. 140 lb Boring Started 3/29/94

Total Overburden Drilled 15.0 Feet Hammer Drop 30" Boring Completed 3/29/94

Elevation Top of Rock – [redacted]. Casing Left –

Total Rock Drilled – Feet Subsurface Water Data Dry Page –

Elevation Bottom of Boring El. 105± [redacted]. Obs. Well –

Total Depth of Boring 15.0 Feet Drilled By ATL, Canton, NY

Core Recovered – % No. Boxes – Mfg. Des. Drill CME 75

Core Recovered – Ft: ____ Diam. ____ In. Inspected By: JAK

Soil Samples 1 3/8" In. Diam. ____ No. Classification By: JAK

Soil Samples _____ In. Diam. ____ No. Classification By: _____

DEPTH 1" = 2'	CORE/SAMPLE NO.	SIZE	DEPTH RANGE	BLOWS PER FT. / CORE REC'VY	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
	S-1		0 – 2.0	3, 9, 8, 14 / 90%	– Sample w/ 1 3/8" I.D. 2' long split spoon w/ 140 lb. hammer (SPT)	– 4" Top Soil Lt. Br. poorly graded SAND w/ silt (5-15) (SP-SM)
2.0	NS					NS
	S-2		2.5 – 4.5	18, 24, 24, 34 / 85%	– Advance hole w/ 3 1/4" I.D. Hollow Stem Auger.	Gr. silty (40-50) fine SAND (SM)
4.0	NS					NS
	S-3		5.0 – 7.0	15, 20, 21, 16 / 70%		Gr. silty (40-50) fine SAND (SM)
6.0	NS					NS
	S-4		7.5 – 9.5	7, 19, 13, 10 / 60%		Gr. silty (40-50) fine SAND (SM)
8.0	NS					NS
10.0						

GENERAL REMARKS:

Site	Boring No.	Page 2 of 2
Cranston, RI Sewer	FD94 – 8 (T-8)	

DEPTH		CORE/SAMPLE NO.	SIZE	DEPTH RANGE	BLOWS PER FT. / CORE REC'VY	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
	1" 2"						
10.0		S-5		10.0 – 12.0	8, 11, 14, 18 / 50%	Same as above	Gr. silty (40-50) fine SAND (SM)
12.0		NS					NS
		S-6		13.0 – 15.0	3, 4, 13, 37 / 70%	Sample w/ 1 3/8" I.D. 2' long split spoon with a 140 lb hammer and a 30" drop. (SPT)	Gr. silty (40-50) fine SAND (SM)
15.0						END of Hole	

U. S. ARMY
CORPS OF ENGINEERS
NEW ENGLAND DIVISION

FIELD LOG OF TEST BORING

Site Cranston, RI Sewer Page 1 of 2 Pages

Boring No. FD94-9 Desig. T-9 Diam. (Casing) _____

Co-ordinates: N _____ E _____

Elevation Top of Boring El. 138± [redacted]. Hammer Wt. 140 lb Boring Started 3/30/94

Total Overburden Drilled 15.0 Feet Hammer Drop 30" Boring Completed 3/30/94

Elevation Top of Rock - [redacted]. Casing Left -

Total Rock Drilled - Feet Subsurface Water Data 11.0 ft Page -

Elevation Bottom of Boring El. 123± [redacted]. Obs. Well -

Total Depth of Boring 15.0 Feet Drilled By ATL, Canton, NY

Core Recovered - % No. Boxes - Mfg. Des. Drill CME 75

Core Recovered - Ft: ____ Diam. ____ In. Inspected By: JAK

Soil Samples 1 3/8" In. Diam. ____ No. Classification By: JAK

Soil Samples ____ In. Diam. ____ No. Classification By: ____

DEPTH		CORE/SAMPLE NO.	SIZE	DEPTH RANGE	BLOWS PER FT. / CORE REC'VY	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
	1"=2"						
		S-1		0 / 2.0	1, 3, 5, 9 / 80%	- Sample w/ 1 3/8" I.D. 2' long split spoon w/ 140 lb. hammer (SPT)	4" Top Soil — Lt. Br. silty (10-20) SAND (SM)
2.0		NS					NS
		S-2		2.5 / 4.5	8, 12, 18, 27 / 75%	- Advance hole w/ 3 1/4" I.D. Hollow Stem Auger.	Lt. Br. silty (10-20) SAND with a cobble (SM)
4.0		NS					NS
		S-3		5.0 / 7.0	9, 12, 18, 16 / 80%		Lt. Br. silty (25-35) SAND (SM)
6.0		NS					NS
		S-4		7.5 / 9.5	12, 23, 25, 27 / 80%		Gr silty (25-35) SAND (SM)
8.0		NS					NS
10.0							

GENERAL REMARKS:

Site	Boring No.	Page 2 of 2
Cranston, RI Sewer	FD94 – 9 T-9	

DEPTH 1" = 2"	CORE/SAMPLE NO.	SIZE	DEPTH RANGE	BLOWS PER FT. / CORE REC'VY	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
10.0	S-5		10.0 – 12.0	28, 43, 68, 100 / 80%	Same as above	Gr. SILT w/ sand (20-30) (ML)
12.0	NS					NS
	S-6		13.0 – 15.0	34, 42, 58, 97 / 100%	Sample w/ 1 3/8" I.D. 2' long split spoon with a 140 lb hammer and a 30" drop. (SPT)	Gr. SILT w/ sand (20-30) (ML)
15.0					END of Hole	

58A(Test)

Boring No. FD94 – 9

U. S. ARMY
CORPS OF ENGINEERS
NEW ENGLAND DIVISION

FIELD LOG OF TEST BORING

Site Cranston, RI Sewer Page 1 of 2 Pages

Boring No. FD94-10 Desig. (T-10) Diam. (Casing) _____

Co-ordinates: N _____ E _____

Elevation Top of Boring El. 148± [redacted]. Hammer Wt. 140 lb Boring Started 3/30/94

Total Overburden Drilled 15.0 Feet Hammer Drop 30" Boring Completed 3/30/94

Elevation Top of Rock – [redacted]. Casing Left –

Total Rock Drilled – Feet Subsurface Water Data 7.5 ft Page –

Elevation Bottom of Boring El. 133± [redacted]. Obs. Well –

Total Depth of Boring 15.0 Feet Drilled By ATL, Canton, NY

Core Recovered – % No. Boxes – Mfg. Des. Drill CME 75

Core Recovered – Ft. ____ Diam. ____ In. Inspected By: JAK

Soil Samples 1 3/8" In. Diam. ____ No. Classification By: JAK

Soil Samples ____ In. Diam. ____ No. Classification By: ____

DEPTH 1"=2"	CORE/SAMPLE NO.	SIZE	DEPTH RANGE	BLOWS PER FT. / CORE RECV'Y	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
	S-1		0 – 2.0	1 8 7 5 / 40%	- Sample w/ 1 3/8" I.D. 2' long split spoon w/ 140 lb. hammer (SPT)	6" Top Soil — Gr. silty (35-45) GRAVEL (GM)
2.0	NS					NS
	S-2		2.5 – 4.5	3 5 14 18 / 80%	- Advance hole w/ 3 1/4" I.D. Hollow stem Auger	Br. & Gr. silty (30-40) SAND (SM)
4.0	NS					NS
	S-3		5.0 – 7.0	14 16 14 16 / 100%		Lt. Br. SILT, w/ sand (15-25) (ML)
6.0	NS					NS
	S-4		7.5 – 9.5	12 42 38 15 / 90%		Br. silty (30-40) SAND w/ a weathered cobble (SM)
8.0						
10.0	NS					NS

GENERAL REMARKS:

NED FORM 58 (Test) MAR 71

Boring No. FD94-10

Site	Boring No.	Page 2 of 2
CRANSTON, RI Sewer	FD94-10 (T-10)	

DEPTH	1" = 2'	CORE/SAMPLE NO.	SIZE	DEPTH RANGE	BLOWS PER FT. / CORE REC'VY	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
10.0		S-5		10.0	14 15 16 28	Same as above	Lt. Br. SILT w/ sand (20-30) (ML)
				12.0	90%	• from 13 to 14.5 ft auger through boulder	
12.0		NS					NS (Boulder)
						Sample w/ 1 3/8" I.D. 2' long split spoon with a 140 lb hammer and a 30" drop. (SPT)	
		S-6		15.0	60		Lt. Br. silty (30-40) SAND (SM)
15.0						END of Hole	

U. S. ARMY
CORPS OF ENGINEERS
NEW ENGLAND DIVISION

FIELD LOG OF TEST BORING

Site Cranston, RI Sewer Page 1 of 2 Pages

Boring No. FD94-11 Desig. NP-7 Diam. (Casing) _____

Co-ordinates: N _____ E _____

Elevation Top of Boring El. 238.5± [redacted]. Hammer Wt. 140 lb Boring Started 3/30/94

Total Overburden Drilled 15.0 Feet Hammer Drop 30" Boring Completed 3/30/94

Elevation Top of Rock – [redacted]. Casing Left –

Total Rock Drilled – Feet Subsurface Water Data 7.3 ft Page –

Elevation Bottom of Boring El. 223.5± [redacted]. Obs. Well –

Total Depth of Boring 15.0 Feet Drilled By ATL, Canton, NY

Core Recovered – % No. Boxes –

Core Recovered – Ft: ____ Diam. ____ In. Mfg. Des. Drill CME 75

Soil Samples 1 3/8" In. Diam. ____ No. Inspected By: JAK

Soil Samples ____ In. Diam. ____ No. Classification By: JAK

Classification By: _____

DEPTH 1"=2'	CORE/SAMPLE NO.	SIZE	DEPTH RANGE	BLOWS PER FT. / CORE REC'VY	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
	S-1		0	2 3 3 2	- Sample w/ 1 3/8" I.D. 2' long split spoon w/ 140 lb. hammer	Br. silty (25-35) SAND (SM)
2.0			2.0	50%		
	NS					NS
	S-2		2.5	4 2 1 7	- Advance hole w/ 3 1/4" I.D. Hollow stem Auger.	Lt. Br. SILT w/ sand (10-20) (ML)
4.0			4.5	80%		
	NS					NS
	S-3		5.0	2 2 4 16		Lt. Br. silty (20-30) SAND (SM)
6.0			7.0	50%		
	NS					NS
	S-4		7.5	8 12 22 30		Lt. Br. silty (10-20) SAND (SM)
8.0			9.5	70%		
10.0	NS					NS

GENERAL REMARKS:

NED FORM 58 (Test) MAR 71

Boring No. FD94-11

Site	Boring No.	Page 2 of 2
Cranston, RI Sewer	FD94-11 (NP-7)	

DEPTH		CORE/SAMPLE NO.	SIZE	DEPTH RANGE	BLOWS PER FT. / CORE REC'VY	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
10.0		S-5		10.0	10 18 16 17	Same as above	Lt. Br. poorly graded SAND w/ silt (5-15) (SP-SM)
12.0		NS		12.0	60%		NS
		S-6		13.0	10 16 23 35	Sample w/ 1 3/8" I.D. 2' long split spoon with a 140 lb hammer and a 30" drop. (SPT)	Gr. silty (20-30) SAND (SM)
15.0				15.0	90%		
						END of Hole	

U. S. ARMY
CORPS OF ENGINEERS
NEW ENGLAND DIVISION

FIELD LOG OF TEST BORING

Site Cranston, RI Sewer Page 1 of 2 Pages

Boring No. FD94-12 Desig. NP-9 Diam. (Casing) _____

Co-ordinates: N _____ E _____

Elevation Top of Boring El. 290± [redacted]. Hammer Wt. 140 lb Boring Started 3/30/94

Total Overburden Drilled 15.0 Feet Hammer Drop 30" Boring Completed 3/30/94

Elevation Top of Rock - [redacted]. Casing Left -

Total Rock Drilled - Feet Subsurface Water Data 11.5 ft. Page

Elevation Bottom of Boring El. 275± [redacted]. Obs. Well -

Total Depth of Boring 15.0 Feet Drilled By ATL, Canton, NY

Core Recovered - % No. Boxes - Mfg. Des. Drill CME 75

Core Recovered - Ft. ____ Diam. ____ In. Inspected By: JAK

Soil Samples 1 3/8" In. Diam. ____ No. Classification By: JAK

Soil Samples _____ In. Diam. ____ No. Classification By: _____

DEPTH 1"=2'	CORE/SAMPLE NO.	SIZE	DEPTH RANGE	BLOWS PER FT. / CORE REC'VY	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
	S-1		0 – 2.0	3, 6, 6, 6 / 20%	- Sample w/ 1 3/8" I.D. 2' long split spoon w/ 140 lb. hammer (SPT)	4" Topsoil. No recovery beneath top soil.
2.0	NS					NS
	S-2A		2.5 – 3.5	2, 3, 6	- Advance hole w/ 3 1/4" Hollow Stem Auger.	Lt. Br. SILT (ML)
4.0	S-2B		3.5 – 4.5	17 / 90%		Lt. Br. poorly graded SAND w/ silt (5-15) (SP-SM)
	NS					NS
6.0	S-3		5.0 – 7.0	11, 14, 20, 18 / 70%		Lt. Br. poorly graded SAND w/ silt (5-15) (SP-SM)
	NS					NS
8.0	S-4		7.5 – 9.5	12, 16, 18, 21 / 80%		Lt. Br. silty (30-40) SAND (SM)
10.0	NS					NS

GENERAL REMARKS:

NED FORM MAR 71 58 (Test)

Boring No. FD94-12

Site	Boring No.	Page 2 of 2
Cranston, RI Sewer	FD94-12 (NP-9)	

DEPTH		CORE/SAMPLE NO.	SIZE	DEPTH RANGE	BLOWS PER FT. / CORE REC'VY	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
10.0		S-5		10.0 / 12.0	4 16 14 28 / 75%	Same as above	Lt. Br. Sandy (30-40) SILT (ML)
12.0		NS					NS
15.0		S-6		13.0 / 15.0	25 35 50 46 / 90%	Sample w/ 1 3/8" I.D. 2' long split spoon with a 140 lb hammer and a 30" drop. (SPT)	Lt. Br. Sandy (30-40) SILT (ML)
						END of Hole	

58A(Test)

Boring No. FD94-12

U. S. ARMY
CORPS OF ENGINEERS
NEW ENGLAND DIVISION

FIELD LOG OF TEST BORING

Site Cranston, RI Sewer Page 1 of 2 Pages

Boring No. FD94-13 Desig. NP-6 Diam. (Casing) _____

Co-ordinates: N _____ E _____

Elevation Top of Boring El. 81± [redacted]. Hammer Wt. 140 lb Boring Started 3/30/94

Total Overburden Drilled 14.0 Feet Hammer Drop 30" Boring Completed 3/30/94

Elevation Top of Rock El. 67± [redacted]. Casing Left -

Total Rock Drilled 5.0 Feet Subsurface Water Data 2.8 Page -

Elevation Bottom of Boring El. 62± [redacted]. Obs. Well -

Total Depth of Boring 19.0 Feet Drilled By ATL, Canton, NY

Core Recovered 90 % No. Boxes 1 Mfg. Des. Drill CME 75

Core Recovered 4.5 Ft: ____ Diam. 1 3/8 In. Inspected By: JAK

Soil Samples 1 3/8" In. Diam. ____ No. Classification By: JAK

Soil Samples _____ In. Diam. ____ No. Classification By: PJY

DEPTH	1"=2"	CORE/SAMPLE NO.	SIZE	DEPTH RANGE	BLOWS PER FT. / CORE REC'VY	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
		S-1		0 2.0	3 4 5 3 90%	- Sample w/ 1 3/8" I.D. 2' long split spoon w/ 140 lb. hammer (SPT)	5" Top Soil Lt. Br. SILT w/ sand (20-30) (ML)
2.0		NS					NS
		S-2		2.5 4.5	5 3 14 27 15%	- Advance hole w/ 3 1/4" I.D. HOLLOW STEM AUGER	Br. SILT w/ sand (10-20)
4.0		NS				- Bouncing refusal at 5.6 feet.	NS
		S-3		5.0 5.6	35 50 80%		Lt. Br. silty (20-30) SAND (SM)
6.0		NS				- Auger down from 5.6 to 6.5 through hardground - Hook up water and roller bit through boulder from 6.5 to 7.5' w/ 2 7/8" dia. roller bit.	NS Hardground + boulder
8.0		S-4		7.5 8.3	35 100 50%		Br. silty (20-30) SAND (SM)
10.0		NS				- Bouncing refusal at 8.3 feet	NS boulder

GENERAL REMARKS:

NED FORM 88 (Test) MAR 71

Boring No. FD94-13

Site	Boring No.	Page 2 of 2
CRANSTON, RI Sewer	FD94-13 NP-6	

DEPTH		CORE/SAMPLE NO.	SIZE	DEPTH RANGE	BLOWS PER FT. / CORE REC'VY	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
10.0		S-5		10.0 – 11.75	18 22 33 68 / 100%	-Roller bit through boulder from 8.3 to 10 feet w/ 2 7/8" RB.	Br. silty (10-20) SAND (SM)
12.0		NS				- sample w/ SPT - 2 7/8" Roller bit from 11.75' to 14' through rock.	NS
14.0		R-1		14.0 – 16.75		drill with AX diamond bit rock core for 14 minutes @ 500 PSI.	GNEISS: grey/white, high angle fracture at 2'10", 45° altered fractures at 7". RQD = 74.5% (FAIR)
16.0		R-2		16.75 – 19.0		drill with AX diamond bit rock core for 14 minutes @ 500 PSI.	
18.0						End of Hole	
20.0							

FIELD LOG OF TEST BORING IN ROCK

SITE Cranston, RI, Sewer ROLE NO. FD94-13 (NP-6) PAGE

DATE	DEPTH FT. FROM	DEPTH FT. TO	RUN FT.	RUN REC'V'Y FT.	REC'V'Y %	DRILLING BEHAVIOR: FEED	DRILLING BEHAVIOR: WATER	DRILLING BEHAVIOR: REASON FOR PULL	ACTUAL DRILLING TIME	BIT NO. SIZE AND TYPE	ADDITIONAL REMARKS
3/30/94	14.0	16.75	2.75	2.3	85	steady			14 min.	AX	
3/30/94	16.75	19.0	2.25	2.2	95	"			14 min.	AX	

TOTAL BED ROCK DRILLED 5.0 FEET

TOTAL BED ROCK RECOVERED 4.5 FEET

BED ROCK RECOVERY 90 PERCENT

DRILLER ATL, Canton NY

INSPECTOR JAK

NED FORM DEC 63 130

REPLACES EDITION OF APR 63 WHICH MAY BE USED UNTIL EXHAUSTED

U. S. ARMY
CORPS OF ENGINEERS
NEW ENGLAND DIVISION

FIELD LOG OF TEST BORING

Site Cranston, RI Sewer Page 1 of 2 Pages
Boring No. FD94-14 Desig. NP-5 Diam. (Casing) _____
Co-ordinates: N _____ E _____

Elevation Top of Boring El. 58± [redacted] Hammer Wt. 140 lb Boring Started 3/30/94
Total Overburden Drilled 15.0 Feet Hammer Drop 30" Boring Completed 3/30/94
Elevation Top of Rock – [redacted] Casing Left –
Total Rock Drilled – Feet Subsurface Water Data 8.5 ft. Page –
Elevation Bottom of Boring El. 43± [redacted] Obs. Well –
Total Depth of Boring 15.0 Feet Drilled By ATL, Canton, NY
Core Recovered – % No. Boxes – Mfg. Des. Drill CME 75
Core Recovered – Ft. – Diam. – In. Inspected By: JAK
Soil Samples 1 3/8" In. Diam. ___ No. Classification By: JAK
Soil Samples _____ In. Diam. ___ No. Classification By: _____

DEPTH		CORE/SAMPLE NO.	SIZE	DEPTH RANGE	BLOWS PER FT. / CORE REC'VY	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
	1"=2"						
		S-1		0	2 2 3 7	- Sample w/ 1 3/8" I.D. 2' long split spoon w/ 140 lb. hammer (SPT)	4" Top Soil — Lt. Br. silty (10-20) m-c SAND (SM)
2.0				2.0	50%		
		NS					NS
		S-2		2.5	5 7 9 8	- Advance hole w/ 3 1/4" I.D. HOLLOW STEM AUGER	Lt. Br. medium SAND w/ silt (5-15) (SP-SM)
4.0				4.5	80%		
		NS					NS
		S-3		5.0	3 3 8 17		NR
6.0				7.0	NR		
		NS					NS
		S-4		7.5	10 12 14 20		Green & Gr. SILT w/ rust spots (ML)
8.0				9.5	100%		
10.0		NS					NS

GENERAL REMARKS:

ED FORM MAR 71 58 (Test)

Boring No. FD94-14

Site	Boring No.	Page 2 of 2
Cranston, RI Sewer	FD94-14 (NP-5)	

DEPTH	1" = 2"	CORE/SAMPLE NO.	SIZE	DEPTH RANGE	BLOWS PER FT. / CORE REC'VY	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
10.0		S-5A		10.0 / 11.0	8 16 20	Same as above	Green & Gray SILT (ML)
		S-5B		11.0 / 12.0	21 90%		M-C poorly graded SAND w/ silt (5-15) & gravel (10-20) (SP-SM)
12.0		NS					NS
		S-6		13.0 / 15.0	5 16 32 62 90%	Sample w/ 1 3/8" I.D. 2' long split spoon with a 140 lb hammer and a 30" drop. (SPT)	M-C poorly graded SAND w/ silt (5-15) & gravel (10-20) & a cobble (SP-SM)
15.0						END of Hole	

U. S. ARMY
CORPS OF ENGINEERS
NEW ENGLAND DIVISION

FIELD LOG OF TEST BORING

Site Cranston, RI Sewer Page 1 of 2 Pages

Boring No. FD94-15 Desig. NP-4 Diam. (Casing) _____

Co-ordinates: N _____ E _____

Elevation Top of Boring El. 63± [redacted]. Hammer Wt. 140 lb Boring Started 3/31/94

Total Overburden Drilled 15.0 Feet Hammer Drop 30" Boring Completed 3/31/94

Elevation Top of Rock – [redacted]. Casing Left –

Total Rock Drilled – Feet Subsurface Water Data Dry Page –

Elevation Bottom of Boring El. 48± [redacted]. Obs. Well –

Total Depth of Boring 15.0 Feet Drilled By ATL, Canton, NY

Core Recovered – % No. Boxes – Mfg. Des. Drill CME 75

Core Recovered – Ft. ____ Diam. ____ In. Inspected By: JAK

Soil Samples 1 3/8" In. Diam. ____ No. Classification By: JAK

Soil Samples _____ In. Diam. ____ No. Classification By: _____

DEPTH 1"=2"	CORE/SAMPLE NO.	SIZE	DEPTH RANGE	BLOWS PER FT. / CORE REC'VY	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
	S-1		0 – 2.0	4, 11, 23, 17 / 20%	– Sample w/ 1 3/8" I.D. 2' long split spoon w/ 140 lb. hammer (SPT)	4" Top Soil — No recovery below top soil
2.0	NS					NS
	S-2		2.5 – 4.5	2, 4, 4, 7 / 60%	– Advance hole w/ 3 1/4" I.D. HOLLOW STEM AUGER	Lt. Br. poorly graded SAND w/ silt (5-15) (SP-SM)
4.0	NS					NS
	S-3		5.0 – 7.0	3, 3, 4, 5 / 90%		Lt. Br. m-f poorly graded SAND w/ silt (5-15) (SP-SM)
6.0	NS					NS
	S-4		7.5 – 9.5	3, 3, 4, 7 / 70%		SAME
8.0						
10.0	NS					NS

GENERAL REMARKS:

Site	Boring No.	Page 2 of 2
CRANSTON, RI Sewer	FD94-15 (NP-4)	

DEPTH		CORE/SAMPLE NO.	SIZE	DEPTH RANGE	BLOWS PER FT. / CORE REC'VY	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
10.0		S-5		10.0 / 12.0	2 5 8 10 / 75%	Same as above	SAME
12.0		NS					NS
15.0		S-6		13.0 / 15.0	7 10 10 12 / 75%	Sample w/ 1 3/8" I.D. 2' long split spoon with a 140 lb hammer and a 30" drop. (SPT)	SAME
						END of Hole	

FORM 58A(Test)

Boring No. FD94-15

U. S. ARMY
CORPS OF ENGINEERS
NEW ENGLAND DIVISION

FIELD LOG OF TEST BORING

Site Cranston, RI Sewer Page 1 of 2 Pages

Boring No. FD94-16 Desig. NP-3 Diam. (Casing) _____

Co-ordinates: N _____ E _____

Elevation Top of Boring El. 57± [redacted]. Hammer Wt. 140 lb Boring Started 3/31/94

Total Overburden Drilled 15.0 Feet Hammer Drop 30" Boring Completed 3/31/94

Elevation Top of Rock – [redacted]. Casing Left –

Total Rock Drilled _____ Feet Subsurface Water Data 14.7 Page –

Elevation Bottom of Boring El. 42± [redacted]. Obs. Well –

Total Depth of Boring 15.0 Feet Drilled By ATL, Canton, NY

Core Recovered – % No. Boxes – Mfg. Des. Drill CME 75

Core Recovered – Ft. _____ Diam. _____ In. Inspected By: JAK

Soil Samples 1 3/8" In. Diam. _____ No. Classification By: JAK

Soil Samples _____ In. Diam. _____ No. Classification By: _____

DEPTH 1"=2'	CORE/SAMPLE NO.	SIZE	DEPTH RANGE	BLOWS PER FT. / CORE REC'VY	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
	S-1		0 – 2.0	1 2 1 5 / 80%	– Sample w/ 1 3/8" I.D. 2' long split spoon w/ 140 lb. hammer (SPT)	Lt. Br. SILT w/ sand (20-30) (ML)
2.0	NS					NS
	S-2		2.5 – 4.5	3 7 7 8 / 100%	– Advance hole w/ 3 1/4" I.D. HOLLOW STEM AUGER	Lt. Br. SILT ML
4.0	NS					NS
	S-3		5.0 – 7.0	3 5 9 9 / 95%		Gr. SILT w/ rusting at bottom. (ML)
6.0	NS					NS
	S-4		7.5 – 9.5	6 6 11 9 / 90%		Interbedded Lt. Br. SAND and Gr. SILT (moist) (SP-SM & ML)
8.0	NS					NS
10.0						

GENERAL REMARKS:

Site	Boring No.	Page 2 of 2
Cranston, RI Sewer	FD94-16 (NP-3)	

DEPTH 1" = 2"	CORE/SAMPLE NO.	SIZE	DEPTH RANGE	BLOWS PER FT. / CORE REC'VY	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
10.0	S-5		10.0	6 10 12 13	Same as above	c-f lt. Br. poorly graded SAND w/ silt(5-15) & gravel (10-20) w/ rusting (SP-SM)
12.0	NS		12.0	75%		NS
	S-6		13.0	9 13 11 12	Sample w/ 1 3/8" I.D. 2' long split spoon with a 140 lb hammer and a 30" drop. (SPT)	m-c lt. Br. poorly graded SAND w/ silt(5-15) & gravel (10-20) (SP-SM)
15.0			15.0	60%	END of Hole	

U. S. ARMY
CORPS OF ENGINEERS
NEW ENGLAND DIVISION

FIELD LOG OF TEST BORING

Site Cranston, RI Sewer Page 1 of 2 Pages

Boring No. FD94-17 Desig. NP-2 Diam. (Casing) _____

Co-ordinates: N _____ E _____

Elevation Top of Boring El. 58± [redacted]. Hammer Wt. 140 lb Boring Started 3/31/94

Total Overburden Drilled 15.0 Feet Hammer Drop 30" Boring Completed 3/31/94

Elevation Top of Rock – [redacted]. Casing Left –

Total Rock Drilled – Feet Subsurface Water Data Dry Page –

Elevation Bottom of Boring El. 43± [redacted]. Obs. Well –

Total Depth of Boring 15.0 Feet Drilled By ATL, Canton, NY

Core Recovered – % No. Boxes –

Core Recovered – Ft: ____ Diam. ____ In. Mfg. Des. Drill CME 75

Soil Samples 1 3/8" In. Diam. ____ No. Inspected By: JAK

Soil Samples ____ In. Diam. ____ No. Classification By: JAK

Classification By: _____

DEPTH		CORE/SAMPLE NO.	SIZE	DEPTH RANGE	BLOWS PER FT. / CORE REC'VY	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
	1"=2"						
		S-1		0	2 2 3 4	- Sample w/ 1 3/8" I.D. 2' long split spoon w/ 140 lb. hammer (SPT)	4" Top Soil — Lt. Br. silty (10-20) SAND w/ rust stain at bottom. (SM)
2.0				2.0	90%		
		NS					NS
		S-2		2.5	4 6 5 7	- Advance hole w/ 3 1/4" I.D. HOLLOW STEM AUGER	Gr. SILT (ML)
4.0				4.5	95%		
		NS					NS
		S-3		5.0	6 7 10 11		Gr. SILT (ML)
6.0				7.0	95%		
		NS					NS
		S-4		7.5	6 7 7 8		Gr. SILT w/ rust spots 8.5-9.5 (ML)
8.0				9.5	95%		
10.0		NS					NS

GENERAL REMARKS:

Site	Boring No.	Page 2 of 2
CRANSTON, RI Sewer	FD94 – 17 (NP-2)	

DEPTH		CORE/SAMPLE NO.	SIZE	DEPTH RANGE	BLOWS PER FT. / CORE REC'VY	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
10.0		S-5		10.0 – 12.0	11 15 16 15 / 60%	Same as above	Lt. Br. silty (10-20) SAND w/ rusting. (SM)
12.0		NS					NS
		S-6		13.0 – 15.0	9 16 20 32 / 80%	Sample w/ 1 3/8" I.D. 2' long split spoon with a 140 lb hammer and a 30" drop. (SPT)	Lt. Br. poorly graded SAND w/ silt (5-15) (SP-SM)
15.0						END of Hole	

FORM 58A (Test)

Boring No. FD94 – 17

U. S. ARMY
CORPS OF ENGINEERS
NEW ENGLAND DIVISION

FIELD LOG OF TEST BORING

Site Cranston, RI Sewer Page 1 of 2 Pages

Boring No. FD94-18 Desig. NP-1 Diam. (Casing) _____

Co-ordinates: N _____ E _____

Elevation Top of Boring El. 58± [redacted]. Hammer Wt. 140 lb Boring Started 3/31/94

Total Overburden Drilled 15.0 Feet Hammer Drop 30" Boring Completed 3/31/94

Elevation Top of Rock – [redacted]. Casing Left –

Total Rock Drilled – Feet Subsurface Water Data 14.4 Page –

Elevation Bottom of Boring El. 43± [redacted]. Obs. Well –

Total Depth of Boring 15.0 Feet Drilled By ATL, Canton, NY

Core Recovered – % No. Boxes –

Mfg. Des. Drill CME 75

Core Recovered – Ft: ____ Diam. ____ In.

Inspected By: JAK

Soil Samples 1 3/8" In. Diam. ____ No.

Classification By: JAK

Soil Samples _____ In. Diam. ____ No.

Classification By: _____

DEPTH	1"=2"	CORE/SAMPLE NO.	SIZE	DEPTH RANGE	BLOWS PER FT. / CORE REC'VY	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
		S-1		0 – 2.0	3 9 10 7 / 70%	– Sample w/ 1 3/8" I.D. 2' long split spoon w/ 140 lb. hammer (SPT)	c-f poorly graded SAND w/ silt (5-15) & gravel (10-20) (SP-SM)
2.0		NS					NS
		S-2		2.5 – 4.5	8 10 11 9 / 80%	– Advance hole w/ 3 1/4" I.D. HOLLOW STEM AUGER	SAME (SP-SM)
4.0		NS					NS
		S-3		5.0 – 7.0	6 9 10 9 / 60%		Lt. Br. GRAVEL w/ c-f Sand (40-50) (GP-GM)
6.0		NS					NS
		S-4		7.5 – 9.5	5 9 6 6 / 60%		Lt. Br. poorly graded SAND w/ silt (5-15) (SP-SM)
8.0		NS					NS
10.0							

GENERAL REMARKS:

Site	Boring No.	Page 2 of 2
Cranston, RI Sewer	FD94-18 (NP-1)	

DEPTH		CORE/SAMPLE NO.	SIZE	DEPTH RANGE	BLOWS PER FT. / CORE REC'VY	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
	1" 2"						
10.0		S-5		10.0	3 5 4 7	Same as above	Lt. Br. silty (25-35) SAND (SM)
				12.0	90%		
12.0		NS					NS
		S-6		13.0	4 6 4 6	Sample w/ 1 3/8" I.D. 2' long split spoon with a 140 lb hammer and a 30" drop. (SPT)	Lt. Br. poorly graded SAND w/ silt (5-15) (SP-SM)
15.0				15.0	80%		
						END of Hole	

FORM 58A (Test)

Boring No. FD94-18

U. S. ARMY
CORPS OF ENGINEERS
NEW ENGLAND DIVISION

FIELD LOG OF TEST BORING

Site Cranston, RI Sewer Page 1 of 2 Pages

Boring No. FD94-19 Desig. TB-1 Diam. (Casing) _____

Co-ordinates: N _____ E _____

Elevation Top of Boring El. 50± [redacted]. Hammer Wt. 140 lb Boring Started 3/31/94

Total Overburden Drilled 15.0 Feet Hammer Drop 30" Boring Completed 3/31/94

Elevation Top of Rock – [redacted]. Casing Left –

Total Rock Drilled – Feet Subsurface Water Data 8.0' Page –

Elevation Bottom of Boring El. 35± [redacted]. Obs. Well –

Total Depth of Boring 15.0 Feet Drilled By ATL, Canton, NY

Core Recovered – % No. Boxes – Mfg. Des. Drill CME 75

Core Recovered – Ft. ____ Diam. ____ In. Inspected By: JAK

Soil Samples 1 3/8" In. Diam. ____ No. Classification By: JAK

Soil Samples ____ In. Diam. ____ No. Classification By: ____

DEPTH (1" = 2')	CORE/SAMPLE NO.	SIZE	DEPTH RANGE	BLOWS PER FT. / CORE REC'VY	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
	S-1		0 – 2.0	2 3 4 2 / 50%	– Sample w/ 1 3/8" I.D. 2' long split spoon w/ 140 lb. hammer (SPT)	3" Top Soil — Br. poorly graded SAND w/ silt (5-15) (SP-SM)
2.0	NS					NS
	S-2		2.5 – 4.5	2 1 2 1 / 50%	– Advance hole w/ 3 1/4" I.D. HOLLOW STEM AUGER	Lt. Br. poorly graded SAND w/ silt (5-15) (SP-SM)
4.0	NS					NS
	S-3		5.0 – 7.0	2 3 5 7 / 60%		Lt. Br. c-f poorly graded SAND (SP)
6.0	NS					NS
	S-4		7.5 – 9.5	4 5 4 5 / 70%		Lt. Br. m-c poorly graded SAND (SP)
8.0	NS					NS
10.0						

GENERAL REMARKS:

ED FORM MAR 71 58 (Test)

Boring No. FD94-19

Site	Boring No.	Page 2 of 2
Cranston, RI Sewer	FD94-19 (TB-1)	

DEPTH		CORE/SAMPLE NO.	SIZE	DEPTH RANGE	BLOWS PER FT. / CORE REC'VY	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
	1" 2"						
10.0		S-5A		10.0	4 4 4	Same as above	SAME (SP)
		S-5B		12.0	5 90%		Lt. Br. silty (20-30) f. SAND (SM)
12.0		NS					NS
		S-6		13.0 15.0	2 3 2 4 60%	Sample w/ 1 3/8" I.D. 2' long split spoon with a 140 lb hammer and a 30" drop. (SPT)	Lt. Br. m-f poorly graded SAND w/ silt (5-15) (SP-SM)
15.0						END of Hole	

FORM 58A (Test)

Boring No. FD94-19

U. S. ARMY
CORPS OF ENGINEERS
NEW ENGLAND DIVISION

FIELD LOG OF TEST BORING

Site Cranston, RI Sewer Page 1 of 2 Pages
Boring No. FD94-20 Desig. TB-2 Diam. (Casing) _____
Co-ordinates: N _____ E _____

Elevation Top of Boring El. 61 ± [redacted]. Hammer Wt. 140 lb Boring Started 3/31/94
Total Overburden Drilled 15.0 Feet Hammer Drop 30" Boring Completed 3/31/94
Elevation Top of Rock – [redacted]. Casing Left –
Total Rock Drilled – Feet Subsurface Water Data Dry Page –
Elevation Bottom of Boring El. 46 ± [redacted]. Obs. Well –
Total Depth of Boring 15.0 Feet Drilled By ATL, Canton, NY
Core Recovered – % No. Boxes – Mfg. Des. Drill CME 75
Core Recovered – Ft: ____ Diam. ____ in. Inspected By: JAK
Soil Samples 1 3/8" in. Diam. ____ No. Classification By: JAK
Soil Samples ____ in. Diam. ____ No. Classification By: ____

DEPTH	1"=2"	CORE/SAMPLE NO.	SIZE	DEPTH RANGE	BLOWS PER FT. / CORE RECV'Y	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
		S-1		0 / 2.0	1 1 1 2 / 20%	– Sample w/ 1 3/8" I.D. 2' long split spoon w/ 140 lb. hammer (SPT)	4" Top Soil — No recovery beneath top soil
2.0		NS					NS
		S-2		2.5 / 4.5	2 7 7 19 / 60%	– Advance hole w/ 3 1/4" I.D. HOLLOW STEM AUGER	Lt. Br. m-c poorly graded SAND w/ silt (5-15) (SP-SM)
4.0		NS					NS
		S-3		5.0 / 7.0	6 5 5 10 / 95%		Lt. Br. SILT (ML)
6.0		NS					NS
		S-4		7.5 / 9.5	6 6 20 50 / 90%		Gr. SILT (ML)
8.0		NS					NS
10.0							

GENERAL REMARKS:

ED FORM MAR 71 58 (Test)

Boring No. FD94-20

Site	Boring No.	Page 2 of 2
Cranston, RI Sewer	FD94-20 (TB-2)	

DEPTH	1" = 2"	CORE/SAMPLE NO.	SIZE	DEPTH RANGE	BLOWS PER FT. / CORE REC'VY	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
10.0		S-5		10.0 / 12.0	7 11 9 13 / 60%	Same as above	Lt. Br. poorly graded GRAVEL w/ sand (25-35) (GP)
12.0		NS					NS
		S-6		13.0 / 15.0	20 54 14 12 / 50%	Sample w/ 1 3/8" I.D. 2' long split spoon with a 140 lb hammer and a 30" drop. (SPT)	Lt. Br. m-c poorly graded SAND (SP)
15.0						END of Hole	

FORM 58A (Test)

Boring No. FD94-20

U. S. ARMY
CORPS OF ENGINEERS
NEW ENGLAND DIVISION

FIELD LOG OF TEST BORING

Site CRANSTON, RI Sewer Page 1 of 2 Pages
Boring No. FD94-21 Desig (TB-3) Diam. (Casing) _____
Co-ordinates: N _____ E _____

Elevation Top of Boring El. 59± [redacted]. Hammer Wt. 140 lb Boring Started 3/31/94
Total Overburden Drilled 15.0 Feet Hammer Drop 30" Boring Completed 3/31/94
Elevation Top of Rock — [redacted]. Casing Left —
Total Rock Drilled — Feet Subsurface Water Data 11.0' Page —
Elevation Bottom of Boring El. 44± [redacted]. Obs. Well —
Total Depth of Boring 15.0 Feet Drilled By ATL, Canton, NY
Core Recovered — % No. Boxes — Mfg. Des. Drill CME 75
Core Recovered — Ft: ___ Diam. ___ In. Inspected By: JAK
Soil Samples 1 3/8" In. Diam. ___ No. Classification By: JAK
Soil Samples ___ In. Diam. ___ No. Classification By: ___

DEPTH	1"=2"	CORE/SAMPLE NO.	SIZE	DEPTH RANGE	BLOWS PER FT. / CORE REC'VY	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
		S-1		0 / 2.0	3 19 15 12 / 55%	- Sample w/ 1 3/8" I.D. 2' long split spoon w/ 140 lb. hammer (SPT)	Lt. Br. silty (10-20) GRAVEL (GM)
2.0		NS					NS
4.0		S-2		2.5 / 4.5	5 6 5 31 / 50%	- Advance hole w/ 3 1/4" I.D. HOLLOW STEM AUGER	SAME (GM)
		NS					NS
6.0		S-3		5.0 / 7.0	15 30 10 10 / 55%		SAme w/ dk. br. stains & tr. organics (GM)
		NS					NS
8.0		S-4		7.5 / 9.5	5 9 9 9 / 55%		Lt. Br. silty (10-20) SAND (SM)
10.0		NS					NS

GENERAL REMARKS:

ED FORM 58 MAR 71 (Test)

Boring No. FD94-21

Site	Boring No.	Page 2 of 2
CRANSTON, RI Sewer	FD94-21 (TB-3)	

DEPTH		CORE/SAMPLE NO.	SIZE	DEPTH RANGE	BLOWS PER FT. / CORE REC'VY	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
10.0		S-5		10.0 / 12.0	4 6 6 9 / 55%	Same as above	SAME (SM)
12.0		NS					NS
15.0		S-6		13.0 / 15.0	3 3 5 9 / 80%	Sample w/ 1 3/8" I.D. 2' long split spoon with a 140 lb hammer and a 30" drop. (SPT)	Lt. Br. SILT w/ rust stains at bottom (ML)
						END of Hole	

FORM 58A(Test)

Boring No. FD94-21

U. S. ARMY
CORPS OF ENGINEERS
NEW ENGLAND DIVISION

FIELD LOG OF TEST BORING

Site Cranston, RI Sewer Page 1 of 2 Pages

Boring No. FD94-22 Desig. TB-4 Diam. (Casing) _____

Co-ordinates: N _____ E _____

Elevation Top of Boring El. 62± [redacted]. Hammer Wt. 140 lb Boring Started 3/31/94

Total Overburden Drilled 15.0 Feet Hammer Drop 30" Boring Completed 3/31/94

Elevation Top of Rock – [redacted]. Casing Left –

Total Rock Drilled – Feet Subsurface Water Data 7.0' Page –

Elevation Bottom of Boring El. 47± [redacted]. Obs. Well –

Total Depth of Boring 15.0 Feet Drilled By ATL, Canton, NY

Core Recovered – % No. Boxes –

Mfg. Des. Drill CME 75

Core Recovered – Ft. – Diam. – In. Inspected By: JAK

Soil Samples 1 3/8" In. Diam. – No. Classification By: JAK

Soil Samples _____ In. Diam. – No. Classification By: _____

DEPTH 1"=2"	CORE/SAMPLE NO.	SIZE	DEPTH RANGE	BLOWS PER FT. / CORE REC'VY	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
	S-1		0 – 2.0	1 3 7 8 / 55%	– Sample w/ 1 3/8" I.D. 2' long split spoon w/ 140 lb. hammer (SPT)	5" Top Soil — Br. silty (10-20) SAND (SM)
2.0	NS					NS
	S-2		2.5 – 4.5	7 7 8 5 / 20%	– Advance hole w/ 3 1/4" I.D. HOLLOW STEM AUGER	Br. SILT w/ gravel (10-20) (ML)
4.0	NS					NS
	S-3		5.0 – 7.0	3 1 4 3 / 50%		Br. SILT w/ tr. organics (ML)
6.0	NS					NS
	S-4		7.5 – 9.5	6 3 3 2 / 40%		Br. SILT w/ sand (10-20) (ML)
8.0	NS					NS
10.0						

GENERAL REMARKS:

Site	Boring No.	Page 2 of 2
Cranston, RI Sewer	FD94-22 (TB-4)	

DEPTH		CORE/SAMPLE NO.	SIZE	DEPTH RANGE	BLOWS PER FT. / CORE REC'VY	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
10.0		S-5A		10.0 / 11.0	2 16 12	Same as above	Dk. Br. SILT (ML)
		S-5B		12.0 / 12.0	32 80%		Br. c-f poorly grdd. SAND w/silt (5-15) (SP-SM)
12.0		NS					NS
		S-6		13.0 / 15.0	12 37 21 21 50%	Sample w/ 1 3/8" I.D. 2' long split spoon with a 140 lb hammer and a 30" drop. (SPT)	Lt. Br. c-f silty (10-20) SAND (SM)
15.0						END of Hole	

FORM 58A (Test)

Boring No. FD94-22

U. S. ARMY
CORPS OF ENGINEERS
NEW ENGLAND DIVISION

FIELD LOG OF TEST BORING

Site Cranston, RI Sewer Page 1 of 2 Pages

Boring No. FD94-23 Desig. TB-5 Diam. (Casing) 3 1/4" ID Hollow Stem Auger

Co-ordinates: N — E —

Elevation Top of Boring 65 ± [redacted]. Hammer Wt. 140 lb Boring Started 3/31/94

Total Overburden Drilled 15.0 Feet Hammer Drop 30" Boring Completed 3/31/94

Elevation Top of Rock — [redacted]. Casing Left None

Total Rock Drilled None Feet Subsurface Water Data 11.75' Page

Elevation Bottom of Boring 50 ± [redacted]. Obs. Well —

Total Depth of Boring 15.0 Feet Drilled By ATL, Canton, NY

Core Recovered — % No. Boxes — Mfg. Des. Drill CME-75

Core Recovered — Ft. — Diam. — In. Inspected By: JAK

Soil Samples 1 3/8" In. Diam. — No. Classification By: JAK

Soil Samples — In. Diam. — No. Classification By:

DEPTH	1"=2"	CORE/SAMPLE NO.	SIZE	DEPTH RANGE	BLOWS PER FT. / CORE REC'VY	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS	
		S-1A		0	1 1 1 4	- Sample w/ 1 3/8" I.D. 2' long split spoon w/ 140 lb. hammer (SPT)	4" Top Soil Br. poorly grad. SAND w/ silt (5-15) (SP-SM)	1.0
2.0		S-1B		2.0	60%		Br. SILT (ML)	2.0
		NS					NS	2.5
4.0		S-2		2.5 4.5	3 4 6 5 60%	- Advance hole w/ 3 1/4" I.D. HOLLOW STEM AUGER	SAME (ML)	4.5
		NS					NS	5.0
6.0		S-3		5.0 7.0	2 3 4 5 80%		SAME (ML)	7.0
		NS					NS	7.5
8.0		S-4		7.5 8.8	31 13 50 60%	- Bouncing refusal at 8.8 feet	white, silty (10-20) GRAVEL (GM)	8.8
10.0		NS					NS	

GENERAL REMARKS:

ED FORM MAR 71 58 (Test)

Boring No. FD94-23

Site	Boring No.	Page 2 of 2
Cranston, RI Sewer	FD94 – 23 TB-5	

DEPTH		CORE/SAMPLE NO.	SIZE	DEPTH RANGE	BLOWS PER FT. / CORE REC'VY	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
10.0		S-5		10.0 – 12.0	5 5 10 6 / 60%	Same as above	Br. silty (40-50) GRAVEL (moist) (GM)
12.0		NS					NS
		S-6		13.0 – 15.0	1 2 1 1 / 70%	Sample w/ 1 3/8" I.D. 2' long split spoon with a 140 lb hammer and a 30" drop. (SPT)	Br. SILT (ML)
15.0						END of Hole	

12.0

13.0

FORM 58A(Test)

Boring No. FD94 – 23

U. S. ARMY
CORPS OF ENGINEERS
NEW ENGLAND DIVISION

FIELD LOG OF TEST BORING

Site Cranston, RI Sewer Page 1 of 2 Pages

Boring No. FD94-24 Desig. C-1 Diam. (Casing) _____

Co-ordinates: N _____ E _____

Elevation Top of Boring El. 92± [redacted]. Hammer Wt. 140 lb Boring Started 3/31/94

Total Overburden Drilled 15.0 Feet Hammer Drop 30" Boring Completed 3/31/94

Elevation Top of Rock - [redacted]. Casing Left -

Total Rock Drilled - Feet Subsurface Water Data Dry Page -

Elevation Bottom of Boring El. 77± [redacted]. Obs. Well -

Total Depth of Boring 15.0 Feet Drilled By ATL, Canton, NY

Core Recovered -% No. Boxes - Mfg. Des. Drill CME 75

Core Recovered - Ft. ____ Diam. ____ In. Inspected By: JAK

Soil Samples 1 3/8" In. Diam. ____ No. Classification By: JAK

Soil Samples ____ In. Diam. ____ No. Classification By: ____

DEPTH 1"=2"	CORE/SAMPLE NO.	SIZE	DEPTH RANGE	BLOWS PER FT. / CORE REC'VY	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
	S-1		0	1 2 3 2	- Sample w/ 1 3/8" I.D. 2' long split spoon w/ 140 lb. hammer (SPT)	3" Top Soil — Br. silty (30-40) SAND (SM)
2.0			2.0	20%		
	NS					NS
	S-2		2.5	5 18 19 24	- Advance hole w/ 3 1/4" I.D. HOLLOW STEM AUGER	Br. GRAVEL w/ silt (20-30) (GM)
4.0			4.5	65%		
	NS					NS
	S-3		5.0	14 16 16 16		Br. gravelly (25-35) SILT (ML)
6.0			7.0	70%		
	NS					NS
	S-4		7.5	12 17 32 19		Br. silty (30-40) GRAVEL (GM)
8.0			9.5	60%		
10.0	NS					NS

GENERAL REMARKS:

Site	Boring No.	Page 2 of 2
CRANSTON, RI Sewer	FD94-24 (C-1)	

DEPTH		CORE/SAMPLE NO.	SIZE	DEPTH RANGE	BLOWS PER FT. / CORE REC'VT	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
	1" • 2"						
10.0		S-5		10.0	14 26 18 13	Same as above	Lt. Br. silty (30-40) SAND w/ gravel (20-30) (SM)
12.0				12.0	75%		
		NS					NS
		S-6		13.0	12 12 32 33	Sample w/ 1 3/8" I.D. 2' long split spoon with a 140 lb hammer and a 30" drop. (SPT)	Gr. SILT w/ gravel (10-20) & a weathered cobble (ML)
15.0				15.0	50%		
						END of Hole	

FORM 58A(Test)

Boring No. FD94-24

U. S. ARMY
CORPS OF ENGINEERS
NEW ENGLAND DIVISION

FIELD LOG OF TEST BORING

Site Cranston, RI Sewer Page 1 of 2 Pages
Boring No. FD94-25 Desig. C-2 Diam. (Casing) _____
Co-ordinates: N _____ E _____

Elevation Top of Boring El. 142± [redacted]. Hammer Wt. 140 lb Boring Started 3/31/94
Total Overburden Drilled 8.5 Feet Hammer Drop 30"
Elevation Top of Rock 134± [redacted]. Casing Left _____ Boring Completed 3/31/94
Total Rock Drilled 5.0 Feet Subsurface Water Data Dry Page _____
Elevation Bottom of Boring 128.5± [redacted]. Obs. Well _____
Total Depth of Boring 13.5 Feet Drilled By ATL, Canton, NY
Core Recovered 70 % No. Boxes _____ Mfg. Des. Drill CME 75
Core Recovered 3.5 Ft. AX Diam. ____ In. Inspected By: JAK
Soil Samples 1 3/8" In. Diam. ____ No. Classification By: JAK
Soil Samples _____ In. Diam. ____ No. Classification By: PJY

DEPTH 1"=2"	CORE/SAMPLE NO.	SIZE	DEPTH RANGE	BLOWS PER FT. / CORE REC'VY	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
	S-1		0 / 2.0	4 5 6 7 / 80%	- Sample w/ 1 3/8" I.D. 2' long split spoon w/ 140 lb. hammer (SPT)	4" Top Soil — Br. silty (40-50) SAND (SM)
2.0	NS					NS
	S-2A		2.5	4 11 32	- Advance hole w/ 3 1/4" I.D. HOLLOW STEM AUGER	Br. SILT (ML)
4.0	S-2B		4.5	15 / 90%		Br. m-f silty (10-20) SAND (SM)
	NS					NS
6.0	S-3		5.0 / 7.0	13 18 26 34 / 80%	- Auger bouncing at 7 feet, then soft to 8 feet, v. hard to 8.5 feet.	Br. stratified highly weathered bedrock
8.0	NS					NS
10.0	R-1		8.5 / 10.0		- set water up - AX core from 8.5' to 13.5 feet for 20 min at 300 PSI	GNEISS, GREY, high ANGLE ALTERED FRACTURES AT 1' AND 3', ALTERED FRACTURE ZONE AT APPROXIMATELY 2'3". RQD = 40.5% (Poor)

GENERAL REMARKS:

Site	Boring No.	Page 2 of 2
CRANSTON, RI Sewer	FD94-25 (C-2)	

DEPTH		CORE/SAMPLE NO.	SIZE	DEPTH RANGE	BLOWS PER FT. / CORE REC'VY	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
10.0		R-1 Cont'd		10.0		SAME	SAME
12.0				13.5			
14.0						END of HOLE	

FORM 58A(Test)

Boring No. FD94-25

FIELD LOG OF TEST BORING IN ROCK

SITE Cranston, RI, Sewer ROLL NO. FD94-25 (c-2) PAGE 3

DATE	DEPTH FT. FROM	DEPTH FT. TO	RUN FT.	RUN REC'V'Y FT.	REC'V'Y %	DRILLING BEHAVIOR: FEED	DRILLING BEHAVIOR: WATER	DRILLING BEHAVIOR: REASON FOR PULL	ACTUAL DRILLING TIME	BIT NO. SIZE AND TYPE	ADDITIONAL REMARKS
3/31/94	8.5	13.5	5.0	3.5	70	steady			20 min.	AX	300 PSI

TOTAL BED ROCK DRILLED 5.0 FEET

TOTAL BED ROCK RECOVERED 3.5 FEET

BED ROCK RECOVERY 70 PERCENT

DRILLER ATL Canton, NY

INSPECTOR JAK

NED FORM DEC 63 130

REPLACES EDITION OF APR 62 WHICH MAY BE USED UNTIL EXHAUSTED

U. S. ARMY
CORPS OF ENGINEERS
NEW ENGLAND DIVISION

FIELD LOG OF TEST BORING

Site Cranston, RI Sewer Page 1 of 2 Pages

Boring No. FD94-26 Desig. C-3 Diam. (Casing) _____

Co-ordinates: N _____ E _____

Elevation Top of Boring El. 151± [redacted]. Hammer Wt. 140 lb Boring Started 4/1/94

Total Overburden Drilled 15.0 Feet Hammer Drop 30" Boring Completed 4/1/94

Elevation Top of Rock – [redacted]. Casing Left –

Total Rock Drilled – Feet Subsurface Water Data 9.25' Page –

Elevation Bottom of Boring El. 136± [redacted]. Obs. Well –

Total Depth of Boring 15.0 Feet Drilled By ATL, Canton, NY

Core Recovered – % No. Boxes – Mfg. Des. Drill CME 75

Core Recovered – Ft: ____ Diam. ____ In. Inspected By: JAK

Soil Samples 1 3/8" In. Diam. ____ No. Classification By: JAK

Soil Samples ____ In. Diam. ____ No. Classification By: ____

DEPTH 1"=2"	CORE/SAMPLE NO.	SIZE	DEPTH RANGE	BLOWS PER FT. / CORE REC'VY	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
	S-1		0 – 2.0	1, 2, 50, 32 / 20%	– Sample w/ 1 3/8" I.D. 2' long split spoon w/ 140 lb. hammer (SPT) – Advance hole w/ 3 1/4" I.D. HOLLOW STEM AUGER	3" Top Soil — Br. silty (30-40) SAND w/a cobble (SM)
2.0	NS					NS
	S-2		2.5 – 4.5	3, 3, 4, 2 / 80%		Br. SILT w/ sand (20-30) (ML)
4.0	NS					NS
	S-3		5.0 – 7.0	1, 1, 2, 1 / 40%		SAME (ML)
6.0	NS					NS
	S-4		7.5 – 9.5	4, 3, 6, 19 / 50%		Gr. silty (20-30) f. SAND w/ gravel (10-20) (SM)
8.0	NS					NS
10.0						

GENERAL REMARKS: Sample S-6 was terminated at 1.0 foot due to the angle of the auger caused from the boulder at 12.5 feet.

Site	Boring No.	Page 2 of 2
CRANSTON, RI Sewer	FD94-26 (C-3)	

DEPTH	1" = 2"	CORE/SAMPLE NO.	SIZE	DEPTH RANGE	BLOWS PER FT. / CORE REC'VY	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
10.0		S-5		10.0 – 12.0	9 6 8 10 / 75%	Same as above - Auger veered to the side of a boulder from 12.5 to 13.5 feet.	Gr. silty (10-20) f. SAND (SM)
12.0						Sample w/ 1 3/8" I.D. 2' long split spoon with a 140 lb hammer and a 30" drop. (SPT)	NS
		S-6		15.0	15 30 / 60%		Br. silty (15-25) GRAVEL (GM)
15.0						END of Hole	

58A(Test)

Boring No. FD94-26

U. S. ARMY
CORPS OF ENGINEERS
NEW ENGLAND DIVISION

FIELD LOG OF TEST BORING

Site Cranston, RI Sewer Page 1 of 2 Pages

Boring No. FD94-27 Desig. C-4 Diam. (Casing) _____

Co-ordinates: N _____ E _____

Elevation Top of Boring El. 145.5 ± [redacted]. Hammer Wt. 140 lb Boring Started 4/1/94

Total Overburden Drilled 15.0 Feet Hammer Drop 30" Boring Completed 4/1/94

Elevation Top of Rock — [redacted]. Casing Left —

Total Rock Drilled — Feet Subsurface Water Data 8.0' Page —

Elevation Bottom of Boring El. 130.5 ± [redacted]. Obs. Well —

Total Depth of Boring 15.0 Feet Drilled By ATL, Canton, NY

Core Recovered — % No. Boxes — Mfg. Des. Drill CME 75

Core Recovered — Ft. — Diam. — In. Inspected By: JAK

Soil Samples 1 3/8" In. Diam. — No. Classification By: JAK

Soil Samples _____ In. Diam. — No. Classification By: _____

DEPTH	1"=2"	CORE/SAMPLE NO.	SIZE	DEPTH RANGE	BLOWS PER FT. / CORE REC'VY	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
		S-1		0 / 2.0	1 7 6 7 / 50%	- Sample w/ 1 3/8" I.D. 2' long split spoon w/ 140 lb. hammer (SPT)	4" Top Soil — Br. silty (30-40) GRAVEL (GM)
2.0		NS					NS
		S-2		2.5 / 4.5	4 5 7 3 / 25%	- Advance hole w/ 3 1/4" I.D. HOLLOW STEM AUGER	Br. silty (40-50) SAND (SM)
4.0		NS					NS
		S-3		5.0 / 7.0	25 28 11 9 / 50%		Br. poorly graded GRAVEL w/ sand (30-40) (GP)
6.0		NS					NS
		S-4		7.5 / 9.5	10 10 9 15 / 60%		Lt. Br. silty (20-30) SAND (SM)
8.0		NS					NS
10.0							

GENERAL REMARKS:

Site	Boring No.	Page 2 of 2
Cranston, RI Sewer	FD94-27 (C-4)	

DEPTH		CORE/SAMPLE NO.	SIZE	DEPTH RANGE	BLOWS PER FT. / CORE REC'VY	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
10.0		S-5		10.0 – 12.0	8, 11, 10, 9 / 90%	Same as above	Lt. Br. poorly graded c-f SAND w/ silt (5-15) (SP-SM)
12.0		NS					NS
		S-6		13.0 – 15.0	14, 11, 10, 13 / 90%	Sample w/ 1 3/8" I.D. 2' long split spoon with a 140 lb hammer and a 30" drop. (SPT)	Lt. Br. silty (10-20) f. SAND (SM)
15.0						END of Hole	

U. S. ARMY
CORPS OF ENGINEERS
NEW ENGLAND DIVISION

FIELD LOG OF TEST BORING

Site Cranston, RI Sewer Page 1 of 2 Pages

Boring No. FD94-28 Desig. C-5 Diam. (Casing) _____

Co-ordinates: N _____ E _____

Elevation Top of Boring El. 161± [redacted]. Hammer Wt. 140 lb Boring Started 4/1/94

Total Overburden Drilled 15.0 Feet Hammer Drop 30"

Elevation Top of Rock – [redacted]. Casing Left – Boring Completed 4/1/94

Total Rock Drilled – Feet Subsurface Water Data 3.0' Page –

Elevation Bottom of Boring El. 146± [redacted]. Obs. Well –

Total Depth of Boring 15.0 Feet Drilled By ATL, Canton, NY

Core Recovered – % No. Boxes – Mfg. Des. Drill CME 75

Core Recovered – Ft. – Diam. – In. Inspected By: JAK

Soil Samples 1 3/8" In. Diam. – No. Classification By: JAK

Soil Samples _____ In. Diam. _____ No. Classification By: _____

DEPTH 1"=2"	CORE/SAMPLE NO.	SIZE	DEPTH RANGE	BLOWS PER FT. / CORE REC'VY	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
	S-1A		0	hand dig	- Sample w/ 1 3/8" I.D. 2' long split spoon w/ 140 lb. hammer (SPT)	4" Top Soil — Br. poorly grdd. SAND w/ silt (5-15) (SP-SM)
2.0	S-1B		2.0	hand dig		Br. silty (40-50) SAND (SM)
4.0	NS				- Advance hole w/ 3 1/4" I.D. HOLLOW STEM AUGER	NS
6.0	S-2		5.0 / 7.0	8 16 16 12 / 95%		Lt. Br. silty (30-40) SAND (SM)
	NS					NS
8.0	S-3		7.5 / 9.5	25 29 20 29 / 95%		Gr. & Br. highly weathered Rock
10.0	NS					NS

GENERAL REMARKS:
From 0 – 5 feet was hand dug due to proximity to utilities. From 2-5 feet was not representative due to probing for utility line.

NED FORM 58 (Test) MAR 71

Boring No. FD94-28

Site	Boring No.	Page 2 of 2
Cranston, RI Sewer	FD94 – 28 (C-5)	

DEPTH	1" = 2"	CORE/SAMPLE NO.	SIZE	DEPTH RANGE	BLOWS PER FT. / CORE REC'VY	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
10.0		S-4		10.0 – 12.0	9, 12, 12, 10 / 95%	Same as above	Gr. & Br. silty (30-40) GRAVEL (GM)
12.0		NS					NS
		S-5A		13.0 – 13.5	7	Sample w/ 1 3/8" I.D. 2' long split spoon with a 140 lb hammer and a 30" drop. (SPT)	Br. poorly grd'd. SAND w/ silt (5-15) (SP-SM)
		S-5B		13.5 – 15.0	12, 13, 19 / 20%		Br. SILT w/ Sand (10-20) (ML)
15.0						END of Hole	

U. S. ARMY
CORPS OF ENGINEERS
NEW ENGLAND DIVISION

FIELD LOG OF TEST BORING

Site Cranston, RI Sewer Page 1 of 2 Pages

Boring No. FD94-29 Desig. C-6 Diam. (Casing) _____

Co-ordinates: N _____ E _____

Elevation Top of Boring El. 225± [redacted]. Hammer Wt. 140 lb Boring Started 4/1/94

Total Overburden Drilled 15.0 Feet Hammer Drop 30" Boring Completed 4/1/94

Elevation Top of Rock – [redacted]. Casing Left –

Total Rock Drilled – Feet Subsurface Water Data 10.0' Page _____

Elevation Bottom of Boring El. 210± [redacted]. Obs. Well –

Total Depth of Boring 15.0 Feet Drilled By ATL, Canton, NY

Core Recovered – % No. Boxes – Mfg. Des. Drill CME 75

Core Recovered – Ft: ____ Diam. ____ In. Inspected By: JAK

Soil Samples 1 3/8" In. Diam. ____ No. Classification By: JAK

Soil Samples _____ In. Diam. ____ No. Classification By: _____

DEPTH 1"=2"	CORE/SAMPLE NO.	SIZE	DEPTH RANGE	BLOWS PER FT. / CORE REC'VY	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
	S-1		0 – 2.0	2 7 3 2 / 50%	– Sample w/ 1 3/8" I.D. 2' long split spoon w/ 140 lb. hammer (SPT)	Lt. Br. silty (30-40) SAND (SM)
2.0	NS					NS
	S-2		2.5 – 4.5	1 2 3 2 / 75%	– Advance hole w/ 3 1/4" I.D. HOLLOW STEM AUGER	SAME w/ rust stains (SM)
4.0	NS					NS
	S-3		5.0 – 7.0	1 1 0.5 0.5 / NR	– bouncing refusal at 8.5 feet	NR
6.0	NS					NS
	S-4		7.5 – 8.5	25%	– 2 7/8" Roller bit through boulder 8.5 to 10.0	Lt. Br. silty (20-30) SAND w/ gr. rock chips at bottom (SM)
8.0	NS					NS (boulder)
10.0						

GENERAL REMARKS:

NED FORM 58 (Test) MAR 71

Boring No. FD94-29

Site	Boring No.	Page 2 of 2
Cranston, RI Sewer	FD94-29 (C-6)	

DEPTH		CORE/SAMPLE NO.	SIZE	DEPTH RANGE	BLOWS PER FT. / CORE REC'VY	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
10.0	1" = 2"	S-5		10.0	10 11 17 17	Same as above	Lt. Br. silty (10-20) m-c SAND (SM)
				12.0	75%		
12.0		NS					NS
		S-6		13.0	6 6 7 8	Sample w/ 1 3/8" I.D. 2' long split spoon with a 140 lb hammer and a 30" drop. (SPT)	Lt. Br. silty (20-30) f. SAND w/ stratified c. SAND (SM)
15.0				15.0	90%	END of Hole	

U. S. ARMY
CORPS OF ENGINEERS
NEW ENGLAND DIVISION

FIELD LOG OF TEST BORING

Site Cranston, RI Sewer Page 1 of 2 Pages

Boring No. FD94-30 Desig. C-7 Diam. (Casing) _____

Co-ordinates: N _____ E _____

Elevation Top of Boring El. 239± [redacted]. Hammer Wt. 140 lb Boring Started 4/1/94

Total Overburden Drilled 15.0 Feet Hammer Drop 30" Boring Completed 4/1/94

Elevation Top of Rock — [redacted]. Casing Left —

Total Rock Drilled — Feet Subsurface Water Data 9.0' Page —

Elevation Bottom of Boring El. 224± [redacted]. Obs. Well —

Total Depth of Boring 15.0 Feet Drilled By ATL, Canton, NY

Core Recovered — % No. Boxes — Mfg. Des. Drill CME 75

Core Recovered — Ft. — Diam. — In. Inspected By: JAK

Soil Samples 1 3/8" In. Diam. — No. Classification By: JAK

Soil Samples — In. Diam. — No. Classification By: —

DEPTH 1"=2"	CORE/SAMPLE NO.	SIZE	DEPTH RANGE	BLOWS PER FT. / CORE REC'VY	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
	S-1		0 – 2.0	1 5 4 6 / 70%	- Sample w/ 1 3/8" I.D. 2' long split spoon w/ 140 lb. hammer (SPT)	4" Top Soil — Br. silty (20-30) SAND w/ gravel (10-20) (SM)
2.0	NS					NS
	S-2		2.5 – 4.5	10 13 18 17 / 100%	- Advance hole w/ 3 1/4" I.D. HOLLOW STEM AUGER	Gr. silty (25-35) SAND w/ a weathered cobble (SM)
4.0	NS					NS
	S-3		5.0 – 7.0	9 14 24 18 / 100%		Gr. poorly graded m-c SAND w/ silt (5-15) (SP-SM)
6.0	NS					NS
	S-4		7.5 – 9.5	14 17 22 20 / 100%		Gr. poorly graded f. SAND (SP)
8.0	NS					NS
10.0						

GENERAL REMARKS:

NED FORM MAR 71 58 (Test)

Boring No. FD94-30

Site	Boring No.	Page 2 of 2
CRANSTON, RI Sewer	FD94-30 (C-7)	

DEPTH		CORE/SAMPLE NO.	SIZE	DEPTH RANGE	BLOWS PER FT. / CORE REC'VY	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
10.0		S-5		10.0	23 17 22 24	Same as above	SAME (SP)
				12.0	100%		
12.0		NS					NS
		S-6A		13.0	9 12	Sample w/ 1 3/8" I.D. 2' long split spoon with a 140 lb hammer and a 30" drop. (SPT)	SAME (SP)
				14.0	14		
		S-6B		14.0	17		Br. poorly graded c. SAND w/ gravel (10-20) (SP)
15.0				15.0	100%		
						END of Hole	

U.S. ARMY
CORPS OF ENGINEERS
NEW ENGLAND DIVISION

FIELD LOG OF TEST BORING

Site: Cranston, R.I. Sewer Page 1 of 1 pgs.
Boring No. FD94-31 Desig. C-8
Coordinates: N _____ E _____

Elevation Top of Boring El. 262± [redacted]
Total Overburden Drilled 15 Feet
Elevation Top of Rock — [redacted]
Total Rock Drilled — Feet
Elevation Bottom of Boring 247± [redacted]
Total Depth of Boring 15 Feet
Core Recovered — % No. of Boxes —
Core Recovered — Ft. Diam. — In.
1 3/8" Disturbed Samples 8 No.
3" Undisturbed Samples — No.

Hammer Wt. 140 lb. Boring Started 4/4/94
Hammer Drop 30" Boring Comp. 4/4/94
Casing Left — Casing Type —
Subsurface Water at 12.5 Feet
Time 1:15pm Date 4/4/94
Drilled By Atlantic Testing Laboratory
Mfg. Des. Drill CME 75
Inspected By Sheila Bergeron
Classification By Sheila Bergeron
Classification By _____

Depth 1"= 4'	Casing Blows Per Foot	Samples No.	Samples Depth Range	Samples Blows per 6"	Classification of Materials	Sampling and Coring Operations
		S-1A	2" 2"	2	Br. f. SAND w/silt and organics (SP-SM)	-Sampled using 1 3/8" I.D, 2" O.D. Split Spoon 2' Long
	11	S-1B		5 6 4	Br. poorly graded SAND w/silt (S-15) (SP-SM)	-85% Recovery -Cleaned to 2.5' w/ 3 1/4" I.D. Hollow Stem Auger
		NS	2'	—	NS	
	5	S-2	2.5' 4.5'	1 1 4 7	Br. silty (20-30) SAND (SM)	-Sampled as above -50% Recovery -Cleaned to 5.0' as above
5.0		NS		—	NS	
	61	S-3	5.0' 7.0'	11 24 37 21	Br. SAND w/gravel (15-25) (SP)	-Sampled as above -70% Recovery -Cleaned to 7.5' as above
		NS	7.5'	—	NS	
		S-4	7.8'	100+/3"	COBBLE	-Sampled as above -80% Recovery -Cleaned to 10.0' as above
		NS	10.0'	— — — —	NS	
10.0	40	S-5	10.0' 12.0'	11 16 34 18	Br. poorly graded SAND, (SP)	-Sampled as above -80% Recovery -Cleaned to 13.0' as above
		NS	12.0' 13.0'	— —	NS	
	39	S-6A	13.0' 14.5	14 23 16	Br. poorly graded SAND (SP)	-Sampled as above -70% Recovery
15.0		S-6B	15.0'	16	Br. f. silty (40-50) SAND (SM)	
						Bottom of boring 15.0'

GENERAL REMARKS:

U.S. ARMY
CORPS OF ENGINEERS
NEW ENGLAND DIVISION

FIELD LOG OF TEST BORING

Site: Cranston, R.I. Sewer Page 1 of 1 pgs.
Boring No. FD-94-32 Desig. C-9
Coordinates: N ____ E ____

Elevation Top of Boring El. 266± [redacted]
Total Overburden Drilled 15 Feet
Elevation Top of Rock —
Total Rock Drilled — Feet
Elevation Bottom of Boring El. 251± [redacted]
Total Depth of Boring 15 Feet
Core Recovered — % No. of Boxes —
Core Recovered — Ft. Diam. — In.
1 3/8" Disturbed Samples 7 No.
3" Undisturbed Samples — No.

Hammer Wt. 140 lb. Boring Started 4/4/94
Hammer Drop 30" Boring Comp. 4/4/94
Casing Left — Casing Type —
Subsurface Water at 10.8 Feet
Time 2:15 pm Date 4/4/94
Drilled By ATL, Ltd
Mfg. Des. Drill CME 75
Inspected By S. Bergeron
Classification By S. Bergeron
Classification By ____

Depth 1" = 4'	Casing Blows Per Foot	Samples No.	Depth Range	Blows per 6"	Classification of Materials	Sampling and Coring Operations
	16	S-1A	2"	2	Dk. Br. f. SAND (SP)	-Sampled using 1 3/8" I.D, 2" O.D. split spoon, 2' Long
		S-1B	2'	7 9 8	Br. m-f SAND, little c. Sand (SP)	-70% Recovery -Cleaned to 2.5' w/ 3¼" I.D. Hollow Stem Auger
		NS			NS	
	23	S-2	2.5' 4.5'	5 7 16 25	Br. Poorly graded med. dense SAND (SP)	-Sampled as above -70% Recovery -Cleaned to 5.0' as above
5.0		NS			NS	
	69	S-3	5.0' 7.0'	18 35 34 35	Br. Poorly graded SAND, little gravel (5-15) (SP)	-Sampled as above -85% recovery -Cleaned to 7.5' as above
		NS			NS	
	29	S-4	7.5' 9.5'	12 14 15 14	Br. f. SAND, little m-c sand (5-15) med. dense (SP)	-Sampled as above -100% Recovery -Cleaned to 10.0' as above
10.0		NS			NS	
	22	S-5	10.0' 12.0'	11 11 11 11	Br. poorly graded med. dense SAND (SP)	-Sampled as above -60% Recovery -Cleaned to 13.0' as above.
		NS			NS	
	30	S-6	13.0' 15.0'	9 13 17 23	Br. poorly graded dense SAND (SP)	-Sampled as above -80% Recovery
15.0						Bottom of boring 15.0'

GENERAL REMARKS:

U.S. ARMY
CORPS OF ENGINEERS
NEW ENGLAND DIVISION

FIELD LOG OF TEST BORING

Site: Cranston, R.I. Sewer. Page 1 of ___ pgs.
Boring No. FD94-33 Desig. C-10
Coordinates: N _____ E _____

Elevation Top of Boring El. 275± [redacted]
Total Overburden Drilled 15 Feet
Elevation Top of Rock ___ [redacted]
Total Rock Drilled — Feet
Elevation Bottom of Boring El. 260± [redacted]
Total Depth of Boring 15 Feet
Core Recovered — % No. of Boxes —
Core Recovered — Ft. Diam. — In.
1 3/8" Disturbed Samples 8* (5) No.
3" Undisturbed Samples — No.

Hammer Wt. 140 lb. Boring Started 4/4/94
Hammer Drop 30" Boring Comp. 4/4/94
Casing Left — Casing Type —
Subsurface Water at — Feet
Time — Date —
Drilled By ATL Hd
Mfg. Des. Drill CME 75
Inspected By S. Bergeron
Classification By S. Bergeron
Classification By ___

Depth 1"= 4'	Casing Blows Per Foot	Samples No.	Depth Range	Blows per 6"	Classification of Materials	Sampling and Coring Operations
	9	S-1A	2"	2	Dk. Br. f. SAND w/organics (SP)	-Sampled using 1 3/8" ID, 2" OD. split spoon 2' long
		S-1B	2"	4	Br. loose m-f SAND (SP)	-60% Recovery
				5		-Clean to 2.5' w/ 3 1/4" I.D. Hollow Stem Auger
			2'	5		
		NS			NS	
	18	S-2*	2.5'	5	Br. med. dense SAND w/silt (5-15) (SP-SM)	-Sampled as above
				10		-60% Recovery
				8		-Clean to 5.0' as above
			4.5'	2		
		NS			NS	
5.0	4	S-3A*	5.0'	6	Greyish br. silty (35-45) f. SAND (SM)	-Sample as above
			6.0'	2		-50% Recovery
		S-3B*	6.0'	1	Br. GRAVEL w/silt (5-15) and sand (25-35) (GP-GM)	-Clean to 7.5' as above.
			7.0'	6		
		NS			NS	
	36	S-4	7.5'	12	Grey dense silty (20-30) f. SAND (Saturated) (SM)	-Sample as above
				18		-70% Recovery
				18		-Clean to 10' as above
			9.5'	15		
		NS			NS	
10.0	27	S-5	10'	12	Br. silty (20-30) SAND w/gravel (10-20) (SM)	-Sample as above
				12		-70% Recovery
				15		-Clean to 12.5' as above
			12'	18		
		NS			NS	
	69	S-6	13'	19	v. dense br. silty (30-40) SAND (SM)	-Sample as above
				32		-60% Recovery
				37		
15.0			15'	100* /5"		Bottom of Boring 15.0'

GENERAL REMARKS:
* Boring went through an approx. 4' dia. corregated metal storm drain from 3.3' to approx. 7.3'. The three samples, S-2, S-3A, S-3B should be disregarded since they were obtained in this range

U. S. ARMY
CORPS OF ENGINEERS
NEW ENGLAND DIVISION

FIELD LOG OF TEST BORING

Site Cranston, RI. Sewer FD94-34 Page 1 of 2 Pages
Boring No. _____ Desig. S-10 Diam. (Casing) _____
Co-ordinates: N _____ E _____

Elevation Top of Boring El. 348 ± [redacted]. Hammer Wt. 140 lb Boring Started 4/4/94
Total Overburden Drilled 8.0 Feet Hammer Drop 30" Boring Completed 4/11/94
Elevation Top of Rock El. 341 ± [redacted]. Casing Left —
Total Rock Drilled 7.0 Feet Subsurface Water Data Dry Page —
Elevation Bottom of Boring El. 333 ± [redacted]. Obs. Well —
Total Depth of Boring 15.0 Feet Drilled By ATL, Canton NY
Core Recovered 25 % No. Boxes 1 Mfg. Des. Drill CME 75
Core Recovered 1.8 Ft: AX Diam. ___ In. Inspected By: S. Beraeron / L. Fraser
Soil Samples 1 3/8 In. Diam. ___ No. Classification By: S. Beraeron
Soil Samples _____ In. Diam. ___ No. Classification By: L. Fraser / PJY

DEPTH 1"=2'	CORE/SAMPLE NO.	SIZE	DEPTH RANGE	BLOWS PER FT. / CORE REC'VY	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
1.0	S-1		0 – 2.0	2, 10, 12, 8; 20%	Advanced hole w/ 3 1/4" ID hollow stem auger. - sampled w/ 1 3/8" ID 2 ft long split spoon w/ 140 lb hammer 30 in drop (SPT)	Dk. br. SAND w/organics (SP)
2.0	NS					NS
3.0	S-2A		2.5 – 3.8	11, 20, 52		Br. poorly graded SAND (SP)
4.0	S-2B		3.8 – 4.3	100+/3 1/2"; 85%		fractured cobbles
5.0	NS					NS
6.0	S-3		5.0 – 7.0	17, 20, 63, 115; 100%		H. br. c. SAND w/ few broken gravel pcs. (SP)
7.0	NS				Roller bit to 8.0' (2 7/8" RB)	NS
8.0 – 10.0	R-1				cored from 8.0'-13.0' depth for 17 minutes @ 300 PSI	· SEE PAGE 2 FOR ROCK CLASSIFICATION

GENERAL REMARKS: 4/4/94
- Hit telephone wires when augering from 0.5' to 5.0'
- stopped hole
4/11/94
- augered to 5.0' depth and finished hole to 15' depth

Site	Boring No.	Page 2 of 2
Cranston, RI	FD94-34	

DEPTH		CORE/SAMPLE NO.	SIZE	DEPTH RANGE	BLOWS PER FT. / CORE REC'VY	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
10.0						Advanced casing from 0' to 11' to keep the hole open	GRANITE, GREY, COARSE to FINE GRANITE CONTACT AT 6", SMALL 2" SEAM OF QUARTZITE AT APPROXIMATELY 1'. RQD = 0.0% (VERY POOR)
11.0		R-1					
12.0							
13.0						Cored w/ AX size for 15 min @ 300 PSI	
14.0		R-2					
15.0						END OF HOLE	

FIELD LOG OF TEST BORING IN ROCK

SITE Cranston RI sewer ROLE NO. FD94-34 (S-10) PAGE

DATE	DEPTH PT. FROM	DEPTH PT. TO	RUN PT.	RUN REC'V'Y PT.	REC'V'Y %	DRILLING BEHAVIOR: FEED	DRILLING BEHAVIOR: WATER	DRILLING BEHAVIOR: REASON FOR PULL	ACTUAL DRILLING TIME	BIT NO. SIZE AND TYPE	ADDITIONAL REMARKS
4/11/94	8.0	13.0	5.0'	1.4'	28%	steady			18 min	AX	
4/11/94	13.0	15.0	2.0	0.4'	20%	"			15 min	AX	

TOTAL BED ROCK DRILLED 7 FEET

TOTAL BED ROCK RECOVERED 1.8 FEET

BED ROCK RECOVERY 25 PERCENT

DRILLER ATL, Canton NY

INSPECTOR LCF

NED FORM DEC 63 130

REPLACES EDITION OF APR 63 WHICH MAY BE USED UNTIL EXHAUSTED

U.S. ARMY
CORPS OF ENGINEERS
NEW ENGLAND DIVISION

FIELD LOG OF TEST BORING

Site: Cranston, R.I. Sewer. Page 1 of 1 pgs.
Boring No. FD 94-35 Desig. S-11
Coordinates: N _____ E _____

Elevation Top of Boring El. 340± [redacted]
Total Overburden Drilled 15 Feet
Elevation Top of Rock —
Total Rock Drilled — Feet
Elevation Bottom of Boring El. 325± [redacted]
Total Depth of Boring 15 Feet
Core Recovered — % No. of Boxes —
Core Recovered — Ft. Diam. — In.
1 3/8" Disturbed Samples 6 No.
3" Undisturbed Samples — No.

Hammer Wt. 140 lb. Boring Started 4/5/94
Hammer Drop 30" Boring Comp. 4/5/94
Casing Left — Casing Type —
Subsurface Water at 11.7 Feet
Time 8:15 am Date 4/5/94
Drilled By ATL, Ltd.
Mfg. Des. Drill CME 75
Inspected By S. Bergeron
Classification By S. Bergeron
Classification By _____

Depth 1"= 4'	Casing Blows Per Foot	Samples No.	DEPTH RANGE	Blows per 6"	Classification of Materials	Sampling and Coring Operations
	5	S-1	0'	4	Br. m-f SAND w/gravel (15-25) (SP)	-Sampled using 1 3/8" I.D, 2" O.D. Split Spoon, 2' Long
				2		-25% Recovery
				3		-Cleaned to 2.5 w/ 3 1/4" I.D. Hollow Stem Auger
			2.0	3		
		NS			NS	
	21	S-2	2.5'	5	Lt. br. silty (25-35) f. SAND (SM)	-Sampled as above
				10		-85% recovery
				11		-Cleaned to 5' as above
			4.5'	18		
		NS			NS	
5.0	42	S-3	5.0'	13	Lt. br. dense sand w/silt (5-15) (SP-SM)	-Sampled as above
				21		-70% Recovery
				21		-Cleaned to 7.5 as above
			7.0'	24		
		NS			NS	
	30	S-4	7.5'	14	Lt. br. dense sand w/silt (5-15) (SP-SM)	-Sampled as above
				15		-70% Recovery
				15		-Cleaned to 10' as above
			9.5'	20		
		NS			NS	
10.0	27	S-5	10.0'	15	Lt. br. med. dense f. SAND w/silt (5-15) (SP-SM)	-Sampled as above
				14		-75% Recovery
				13		-Cleaned to 13' as above
			12.0'	22		
		NS			NS	
	31	S-6	13.0'	21	Br. med dense m-f SAND w/silt (5-15) (SP-SM)	-Sampled as above
				20		-75% Recovery
				11		
15.0			15.0'	18		
						Bottom of boring 15.0'

GENERAL REMARKS:

U.S. ARMY
CORPS OF ENGINEERS
NEW ENGLAND DIVISION

FIELD LOG OF TEST BORING

Site: Cranston, R.I. Sewer Page 1 of 1 pgs.
Boring No. ED94-36 Desig. S-12
Coordinates: N ____ E ____

Elevation Top of Boring El. 320 ± [redacted]
Total Overburden Drilled 15 Feet
Elevation Top of Rock —
Total Rock Drilled — Feet
Elevation Bottom of Boring El. 31 [redacted]
Total Depth of Boring 15 Feet
Core Recovered — % No. of Boxes —
Core Recovered — Ft. Diam. — In.
1 3/8" Disturbed Samples ____ No.
3" Undisturbed Samples — No.

Hammer Wt. 140 lb. Boring Started 4/5/94
Hammer Drop ____ Boring Comp. 4/5/94
Casing Left — Casing Type —
Subsurface Water at 12.0 Feet
Time 9:15 Date 4/5/94
Drilled By A.T.L. Ltd.
Mfg. Des. Drill CME 75
Inspected By S. Bergeron
Classification By S. Bergeron
Classification By ____

Depth 1" = 4'	Casing Blows Per Foot	Samples No.	DEPTH RANGE	Blows per 6"	Classification of Materials	Sampling and Coring Operations
	9	S-1	0'	1 3 6 14	Dk. br. Poorly graded loose SAND (SP)	-Sampled using 1 3/8" ID, 2" OD. split spoon, 2' Long -60% Recovery -Cleaned to 2.5' w/ 13 x 4" ID Hollow Stem Auger
		NS	2.0'		NS	
	33	S-2	2.5'	10 16 17 21	Lt. br. & reddish br. f. SAND w/silt (5-15) (SP-SM)	-Sampled as above -80% Recovery -Cleaned to 5' as above
		NS	4.5'		NS	
5.0	76	S-3	5.0'	28 40 36 53	Poorly graded br. SAND w/little gravel (5-15) (SP)	-Sampled as above -80% Recovery -Cleaned to 8' as above
		NS	7.0'		NS	
		NS	7.5'			
			8.0'		Br. SAND w/gravel and cobbles (40-50) (SP)	
	32	S-4	8.0'	16 15 19 24	Poorly graded br. m-f SAND (SP)	-Sampled as above -75% Recovery -Cleaned to 10' as above
10.0	59	S-5	10.0'	12 19 40 23	Poorly graded br. silty (20-30) SAND (SM)	-Sampled as above -65% Recovery -Cleaned to 13' as above
		NS	12.0'		NS	
	41	S-6	13'	23 20 21 21	Poorly graded br. SAND w/gravel (10-20) (SP)	-Sampled as above -55% Recovery
15.0			15'			Bottom of Boring 15.0'

GENERAL REMARKS:

U.S. ARMY
CORPS OF ENGINEERS
NEW ENGLAND DIVISION

FIELD LOG OF TEST BORING

Site: Cranston, R.I. Sewer Page 1 of 1 pgs.

Boring No. FD 94-37 Desig. S-13

Coordinates: N _____ E _____

Elevation Top of Boring El. 31.8± [redacted]
Total Overburden Drilled 15 Feet
Elevation Top of Rock —— [redacted]
Total Rock Drilled —— Feet
Elevation Bottom of Boring El. 30.3± [redacted]
Total Depth of Boring 15 Feet
Core Recovered —— % No. of Boxes ——
Core Recovered —— Ft. Diam. —— In.
1 3/8" Disturbed Samples 6 No.
3" Undisturbed Samples —— No.

Hammer Wt. 140 lb. Boring Started 4/5/94
Hammer Drop 30" Boring Comp. 4/5/94
Casing Left —— Casing Type ——
Subsurface Water ~~at~~ Dry ~~Feet~~
Time 10:15 Date 4/5/94
Drilled By A.T.L. Ltd.
Mfg. Des. Drill CME 75
Inspected By S. Bergeron
Classification By S. Bergeron
Classification By _____

Depth 1"= 4'	Casing Blows Per Foot	Samples No.	Samples DEPTH RANGE	Samples Blows per 6"	Classification of Materials	Sampling and Coring Operations
	11	S-1A	6"	2	Br. f SAND w/org & silt (5-15) (SP-SM)	-Sampled using 1 3/8" I.D., 2" O.D. split spoon, 2' long
		S-1B	20'	4, 7, 9	Br. f. SAND w/silt (5-15), trace gravel (SP-SM)	-70% Recovery -Cleaned to 2.5' w/ 3 1/4" I.D Hollow Stem Auger
		NS			NS	
	8	S-2	25'	6, 4	Br. f. SAND, little m-c sand (5-15) w/silt (5-15) (SP-SM)	-Sampled as above -60% Recovery -Cleaned to 5' as above
			45'	4, 4		
5.0					NS	
	4	NS	50'	2, 2	Dk. Br. silty (25-35) f. SAND (SM)	-Sampled as above -0% Recovery -Cleaned to 7.5' as above
			7.0'	2, 3		
					NS	
	25	S-3	7.5'	3, 9	Br. poorly graded SAND w/silt (5-15) (SP-SM)	-Sampled as above -65% Recovery -Cleaned to 10' as above
			9.5'	16, 37		
10.0		NS			NS	
	62	S-4	10.0'	15, 25	Reddish br., poorly graded SAND, trace broken cobble (5%) (SP)	-Sampled as above -80% Recovery -Cleaned to 13.0' as above
			12.0'	37, 38		
		NS				
	73	S-5	13.0'	23, 36	Br. poorly graded SAND (SP)	-Sampled as above -85% Recovery
15.0			15.0'	37, 56		
						Bottom of Boring 15.0'

GENERAL REMARKS:

U. S. ARMY
CORPS OF ENGINEERS
NEW ENGLAND DIVISION

FIELD LOG OF TEST BORING

Site Cranston RI Sewer — Page 1 of 2 Pages

Boring No. FD94-38 — Desig. S-14 — Diam. (Casing) _____

Co-ordinates: N _____ E _____

Elevation Top of Boring El. 312 ± [redacted]. — Hammer Wt. 140 lb — Boring Started 4/5/94

Total Overburden Drilled 15 Feet — Hammer Drop 30" — Boring Completed 4/5/94

Elevation Top of Rock — [redacted]. — Casing Left —

Total Rock Drilled — Feet — Subsurface Water Data Dry — Page —

Elevation Bottom of Boring El. 297 ± [redacted]. — Obs. Well —

Total Depth of Boring 15 Feet — Drilled By ATL, Canton NY

Core Recovered — % — No. Boxes — — Mfg. Des. Drill CME 75

Core Recovered — Ft: — Diam. — In. — Inspected By: S. Bergeron

Soil Samples 1 3/8 In. Diam. 2 No. — Classification By: S. Bergeron

Soil Samples _____ In. Diam. _____ No. — Classification By: _____

DEPTH		CORE/SAMPLE NO.	SIZE	DEPTH RANGE	BLOWS PER FT. / CORE REC'VY	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
		S-1A		0	1 3	-Sample with 1 3/8" I.D. 2 foot long split spoon with a 140 lb hammer and a 30" drop (SPT)	Br. poorly graded m-f SAND (SP)
1.0				1.0	6		
		S-1B		1.0	8		Br. poorly graded SAND (SP)
2.0				2.0	70%	-Advance hole with 3 1/4" I.D. Hollow Stem Auger	
		NS					NS
3.0		S-2		2.5	10 12		Br. poorly graded SAND w/gravel (10-20) (SP)
4.0				4.5	15 17 50%		
5.0		NS					NS
6.0		S-3		5.0	11 18 18 19		Br. poorly graded SAND (SP)
7.0				7.0	60%		
		NS					NS
8.0		S-4		7.5	12 10 10 14		Lt. Br. m-f SAND w/silt (5-15) (SP-SM)
9.0				9.5	70%		
10.0		NS					NS

GENERAL REMARKS:

Site	Boring No.	Page 2 of 2
Cranston, R.I.	FD94-38 (S-14)	

DEPTH		CORE/SAMPLE NO.	SIZE	DEPTH RANGE	BLOWS PER FT. / CORE REC'VY	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
10.0				10.0	6	Same as above	
					16		
11.0		S-5			20		Br. poorly graded SAND w/gravel (10-20)
					18		
				12.0	75%		(SP)
12.0		NS					NS
13.0				13.0	14		
					20		Br. poorly graded SAND
14.0		S-6			18		
					100%		(SP)
				14.9	95%		
15.0						End of Hole 14.9'	

FORM 58A (Test)

Boring No. FD 94-38

U. S. ARMY
CORPS OF ENGINEERS
NEW ENGLAND DIVISION

FIELD LOG OF TEST BORING

Site Cranston RI Sewer Page 1 of ___ Pages

Boring No. ED94-39 Desig. C-11 Diam. (Casing) ___

Co-ordinates: N ___ E ___

Elevation Top of Boring El. 276 ± [redacted]. Hammer Wt. 140 lb Boring Started 4/5/94

Total Overburden Drilled 15 Feet Hammer Drop 30" Boring Completed 4/5/94

Elevation Top of Rock — [redacted]. Casing Left —

Total Rock Drilled — Feet Subsurface Water Data 9.25' Page -

Elevation Bottom of Boring El. 261 ± [redacted]. Obs. Well -

Total Depth of Boring 15 Feet Drilled By ATL, Canton NY

Core Recovered — % No. Boxes - Mfg. Des. Drill CME 75

Core Recovered — Ft: ___ Diam. ___ In. Inspected By: S. Bergeron

Soil Samples 1 3/8 In. Diam. 8 No. Classification By: S. Bergeron

Soil Samples ___ In. Diam. ___ No. Classification By: ___

DEPTH		CORE/SAMPLE NO.	SIZE	DEPTH RANGE	BLOWS PER FT. / CORE REC'VY	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
		S-1A		0 0.5	3	-Sample with 1 3/8" I.D. 2 foot long split spoon with a 140 lb hammer and a 30" drop (SPT) -Advance hole with 3 1/4" I.D. Hollow Stem Auger	Dk.Br. P.G. SAND w/silt (5-15) (SP-SM)
1.0		S-1B		0.5 2.0	5 5 6 80%		Br. P.G. SAND w/silt (5-15) (SP-SM)
2.0		NS					NS
3.0		S-2		2.5 4.5	10 5 6 9 50%		Grey silty (20-30) f. SAND (SM)
5.0		NS					NS
6.0		S-3A		5.0 6.0	6 12		Grey silty (20-30) f. SAND (SM)
7.0		S-3B		6.0 7.0	13 34 70%		Grey P.G. SAND w/silt (5-15) (SP-SM)
		NS					NS
8.0 9.0		S-4		7.5 9.5	11 13 15 19 70%		Grey silty (15-25) SAND (SM)
10.0		NS		10.0			NS

GENERAL REMARKS:

Site	Boring No.	Page 2 of 2
Cranston, R.I. sewer	FD 94-39 (C-11)	

DEPTH		CORE/SAMPLE NO.	SIZE	DEPTH RANGE	BLOWS PER FT. / CORE REC'VY	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
10.0				10.0	19 19 16 16	Same as Above	Br. P.G. SAND w/silt (5-15) (SP-SM)
11.0		S-5					
12.0				12.0	60%		
		NS					NS
13.0				13.0	18 21 23 38		Br. P.G. SAND w/silt (5-15) (SP-SM)
14.0		S-6					
15.0				15.0	100%	End of Hole 15.0'	

FORM 58A (Test)

Boring No. _____

U. S. ARMY
CORPS OF ENGINEERS
NEW ENGLAND DIVISION

FIELD LOG OF TEST BORING

Site Cranston, RI Sewer FD 94-40 Page 1 of 2 Pages
Boring No. _____ Desig. C-13 Diam. (Casing) _____
Co-ordinates: N _____ E _____

Elevation Top of Boring El. 289 ± [redacted]. Hammer Wt. 140 lb Boring Started 4/5/94
Total Overburden Drilled 9.0 Feet Hammer Drop 30" Boring Completed 4/5/94
Elevation Top of Rock El. 280 ± [redacted]. Casing Left —
Total Rock Drilled 5.0 Feet Subsurface Water Date 4.5'* Page —
Elevation Bottom of Boring El. 276 ± [redacted]. Obs. Well —
Total Depth of Boring 14 Feet Drilled By ATL, Canton NY
Core Recovered 90 % No. Boxes 1 Mfg. Des. Drill CME 75
Core Recovered 4.5 Ft. Diam. 1 3/8" In. Inspected By: S. Bergeron
Soil Samples 1 3/8 In. Diam. 5 No. Classification By: S. Bergeron
Soil Samples _____ In. Diam. _____ No. Classification By: RJY

DEPTH		CORE/SAMPLE NO.	SIZE	DEPTH RANGE	BLOWS PER FT. / CORE REC'VY	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
		S-1A		0 / 0.5	3	-Sample with 1 3/8" I.D. 2 foot long split spoon with a 140 lb hammer and a 30" drop (SPT)	Dk. br. SAND w/silt (5-15) (SP-SM)
1.0		S-1B		0.5 / 2.0	8 10 11 / 90%		Dk. br. SAND w/silt (5-15) (SP-SM)
2.0		NS				-Advance hole with 3 1/4" I.D. Hollow Stem Auger	NS
3.0		S-2		2.5 / 4.5	6 5 5 6 / 70%	- Hit refusal at 8.9 feet. - Augered to 8.9 feet	Lt. br. silty (25-35) SAND (SM)
4.0						- Used 2 7/8" roller bit and water to 9.0 feet	
5.0		NS					NS
6.0		S-3		5.0 / 7.0	13 18 23 30 / 75%		Br. SAND w/little gravel (5-15) (SP)
7.0		NS					NS
8.0		S-4		7.5 / 8.9	15 23 100+/5"		Br. SAND w/little gravel (5-15) (saturated) (SP)
9.0		Run 1		9.0		Drilled with AX diamond bit rock core, 30 mins. @ 300 psi	GRANITE/GRANITE GNEISS, grey-brown to grey, slightly fractured in places, few alteration zones. RQD = 48.6% (Poor)
10.0							

GENERAL REMARKS:
* Water elevation recorded after water had been added for coring.

Site	Boring No.	Page 2 of 2
Cranston RI Sewer	FD94-40 (C-13)	

DEPTH		CORE/SAMPLE NO.	SIZE	DEPTH RANGE	BLOWS PER FT. / CORE REC'VY	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
10.0				10.0		Same as Above	
11.0							
12.0		Run 1 (cont.)					
13.0							
14.0				14.0		End of Hole 14.0'	

U. S. ARMY
CORPS OF ENGINEERS
NEW ENGLAND DIVISION

FIELD LOG OF TEST BORING

Site Cranston, RI Sewer FD 94-41 Page 1 of ___ Pages

Boring No. ___ Desig. C-12 Diam. (Casing) ___

Co-ordinates: N ___ E ___

Elevation Top of Boring El. 388 ± [redacted]. Hammer Wt. 140 lb Boring Started 4/5/94

Total Overburden Drilled 14.3 Feet Hammer Drop 30" Boring Completed 4/5/94

Elevation Top of Rock El. 385.5 ± [redacted]. Casing Left —

Total Rock Drilled 5 Feet Subsurface Water Data 10.5'* Page -

Elevation Bottom of Boring 380.5 ± [redacted]. Obs. Well -

Total Depth of Boring 19.5 Feet Drilled By ATL, Canton NY

Core Recovered 80 % No. Boxes - Mfg. Des. Drill CME 75

Core Recovered 4 Ft: ___ Diam. 1 3/8 In. Inspected By: S. Bergeron

Soil Samples 1 3/8 In. Diam. 7 No. Classification By: S. Bergeron

Soil Samples ___ In. Diam. ___ No. Classification By: PJY

DEPTH		CORE/SAMPLE NO.	SIZE	DEPTH RANGE	BLOWS PER FT. / CORE REC'VY	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
		S-1A		0 0.3		-Sample with 1 3/8" I.D. 2 foot long split spoon with a 140 lb hammer and a 30" drop (SPT)	Dk. Br. f. SAND w/silt & org. (SP-SM)
1.0		S-1B		0.3 2.0	2 4 9 9 90%		Br. f. SAND w/silt (S-15) (SP-SM)
2.0		NS				-Advance hole with 3 1/4" I.D. Hollow Stem Auger	NS
3.0		S-2		2.5 4.5	7 8 11 11 75%		Br. f. SAND w/silt (S-15) (SP-SM)
4.0							
5.0		NS					NS
6.0		S-3		5.0 7.0	9 11 13 14 70%		Br. SAND w/silt (S-15), little gravel (0-10) (SP-SM)
7.0		NS					NS
8.0		S-4		7.5 9.5	16 19 19 14 65%		Br. P.G. SAND w/gravel (20-30) (SP)
9.0							
10.0		NS		10.0			NS

GENERAL REMARKS:
*obtained after water had been adding for drilling.

FD FORM 58 (Test) Boring No. ___

Site	Boring No.	Page 2 of 2
Cranston R.I. Sewer	FD 94-41 (C-12)	

DEPTH	CORE/SAMPLE NO.	SIZE	DEPTH RANGE	BLOWS PER FT. / CORE REC'VY	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
10.0		10.0		8	Same as Above	
11.0	S-5			33 16 20		Br. P.G. SAND w/gravel (10-20) (SP)
12.0		12.0		70%		
	NS					NS
13.0		13.0		17		
14.0	S-6	14.3		32 100/4" 90%	Advanced to 14.5' with 2 7/8" RB and water	Br. PG SAND w/silt (5-15) and gravel (5-15) (SP)
15.0		14.5			Drilled with AX diamond bit core with 300psi for 25 mins.	GRANITE GNEISS, GREY, high angle FRACTURES AT Approximately 7" AND 3.1', NUMEROUS ALTERED SEAMS AT CORE BREAKS. RQD = 25.0% (VERY Poor)
16.0						
17.0	Run1					
18.0						
19.0		19.5				
					End of Hole 19.5'	

FORM 58A(Test)

Boring No. _____

U. S. ARMY
CORPS OF ENGINEERS
NEW ENGLAND DIVISION

FIELD LOG OF TEST BORING

Site Cranston, RI Sewer Page 1 of 2 Pages
Boring No. FD94-42 Desig. C-14 Diam. (Casing) _____
Co-ordinates: N _____ E _____

Elevation Top of Boring El. 288 ± [redacted]. Hammer Wt. 140 lb Boring Started 4/5/94
Total Overburden Drilled 13.8 Feet Hammer Drop 30" Boring Completed 4/5/94
Elevation Top of Rock El. 274 ± [redacted]. Casing Left —
Total Rock Drilled 5 Feet Subsurface Water Data _____ Page _____
Elevation Bottom of Boring El. 269 ± [redacted]. Obs. Well —
Total Depth of Boring 19 Feet Drilled By ATL, Canton NY
Core Recovered 97 % No. Boxes 1 Mfg. Des. Drill CME 75
Core Recovered 4.87 Ft. _____ Diam. 1 3/8 In. Inspected By: S. Bergeron
Soil Samples 1 3/8 In. Diam. 6 No. Classification By: S. Bergeron
Soil Samples _____ In. Diam. _____ No. Classification By: RSY

DEPTH		CORE/SAMPLE NO.	SIZE	DEPTH RANGE	BLOWS PER FT. / CORE REC'VY	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
		S-1A		0 / 0.5	4	-Sample with 1 3/8" I.D. 2 foot long split spoon with a 140 lb hammer and a 30" drop (SPT)	Dk. Br. Peat (PT)
1.0		S-1B		0.5 / 2.0	8 8 5 / 90%		Br. P.G. SAND w/silt (5-15) (SP-SM)
2.0		NS				-Advance hole with 3 1/4" I.D. Hollow Stem Auger	NS
3.0		S-2		2.5 / 4.5	4 3 4 4 / 50%		Br. P.G. SAND w/silt, little gravel (0-10) (SP-SM)
5.0		NS					NS
6.0		S-3		5.0 / 7.0	3 2 4 4 / 65%		Br. f. SAND, some c. sand w/silt (5-15) (SP-SM)
7.0		NS					NS
8.0		S-4		7.5 / 8.25	13 100+/3" / 70%		Br. PG SAND w/silt (5-15) (SP-SM)
9.0		NS		8.25 / 9.5		-Advance hole with 3 1/4" I.D. Hollow Stem Auger after hitting refusal.	
10.0		NS		10.0			

GENERAL REMARKS:

ED FORM MAR 71 58 (Test)

Boring No. _____

Site	Boring No.	Page 2 of 2
Cranston, RI Sewer	FO 94-42 (C-14)	

DEPTH		CORE/SAMPLE NO.	SIZE	DEPTH RANGE	BLOWS PER FT. / CORE REC'VY	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
10.0		NS		10.0	100+/6" 0%	Same as Above	NS
				10.5			
11.0		NS					NS
12.0							
13.0				13.0		2 7/8" Roller bit from 13.8' to 14.0'	
		S-5		13.0 / 13.8	41 100+/4" 90%		Br. PG SAND w/silt (S-15) (SP-SM)
14.0		NS Run 1		14.0		Drill with AX diamond bit core for 12 mins. @ 300 psi.	GRANITE GNEISS, GREY, OCCASIONAL ALTERED SEAMS AT CORE BREAKS, MOST OF ROCK CORE IS BROKEN INTO 1" to 2" SEGMENTS. RQD = 23.7% (VERY POOR)
15.0				15.1			
16.0		Run 2		15.1		Drill with AX diamond bit core for 23 mins at 300 psi.	
17.0							
18.0							
19.0				19.0		End of Hole 19.0'	

FORM 58A (Test)

Boring No. _____

U. S. ARMY
CORPS OF ENGINEERS
NEW ENGLAND DIVISION

FIELD LOG OF TEST BORING

Site Cranston RI Sewer Page 1 of 1 Pages

Boring No. FD 94-43 Desig. C-15 Diam. (Casing) _____

Co-ordinates: N _____ E _____

Elevation Top of Boring El. 300± [redacted]. Hammer Wt. 140 lb Boring Started 4/6/94

Total Overburden Drilled 1.5 Feet Hammer Drop 30" Boring Completed 4/6/94

Elevation Top of Rock El 298.5± [redacted]. Casing Left –

Total Rock Drilled 5 Feet Subsurface Water Data Dry Page –

Elevation Bottom of Boring El. 293.5± [redacted]. Obs. Well –

Total Depth of Boring 6.5 Feet Drilled By ATL, Canton NY

Core Recovered 83 % No. Boxes _____ Mfg. Des. Drill CME 75

Core Recovered 4.2 Ft: _____ Diam. 1 3/8 In. Inspected By: S. Bergeron

Soil Samples 1 3/8 In. Diam. 2 No. Classification By: S. Bergeron

Soil Samples _____ In. Diam. _____ No. Classification By: PJY

DEPTH		CORE/SAMPLE NO.	SIZE	DEPTH RANGE	BLOWS PER FT. / CORE REC'VY	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
		S-1A		0 0.5	2	Sample with 1 3/8" I.D. 2 foot long split spoon with a 140 lb hammer and 30" drop.	Dk. Br. SAND w/silt & org. (SP-SM)
1.0		S-1B		0.5 1.5	5 4 100+/- 90%		Br. mostly f. SAND w/silt (S-15) and gravel (SP-SM)
2.0		Run1		1.5		-Cleaned out with 3 1/4" I.D. Hollow Stem Auger and 2 7/8" roller bit -Drilled with AX diamond bit rock core for 35 minutes at 300 psi.	GRANITE; GREY, ALTERED ZONES AT TOP OF CORE, AT APPROXIMATELY 3', AND NEAR END OF CORE. RQD = 69.2% (FAIR)
3.0							
4.0							
5.0							
6.0				6.5			
						End of Hole 6.5'	

GENERAL REMARKS:

ED FORM MAR 71 58 (Test)

Boring No. FD 94-43

U. S. ARMY
CORPS OF ENGINEERS
NEW ENGLAND DIVISION

FIELD LOG OF TEST BORING

Site Cranston RI Sewer — Page 1 of 2 Pages

Boring No. FD94-44 Desig. S-2 Diam. (Casing) _____

Co-ordinates: N _____ E _____

Elevation Top of Boring El. 397 ± [redacted]. Hammer Wt. 140 lb Boring Started 4/7/94

Total Overburden Drilled 10.2 Feet Hammer Drop 30" Boring Completed 4/7/94

Elevation Top of Rock El. 387 ± [redacted]. Casing Left —

Total Rock Drilled 5 Feet Subsurface Water Data 7.0'* Page _____

Elevation Bottom of Boring El. 382 ± [redacted]. Obs. Well _____

Total Depth of Boring 15.5 Feet Drilled By ATL, Canton NY

Core Recovered 88 % No. Boxes 1 Mfg. Des. Drill CME 75

Core Recovered 4.4 Ft. _____ Diam. 1 3/4 In. Inspected By: S. Bergeron

Soil Samples 1 3/8 In. Diam. ____ No. Classification By: S. Bergeron

Soil Samples _____ In. Diam. ____ No. Classification By: RJY

DEPTH		CORE/SAMPLE NO.	SIZE	DEPTH RANGE	BLOWS PER FT. / CORE REC'VY	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
		S-1A		0 03	2	-Sample with 1 3/8" I.D. 2 foot long split spoon with a 140 lb hammer and a 30" drop (SPT)	Dk.Br. moist f. SAND w/silt & org (SP-SM)
1.0		S-1B		03 20	4 5 8 70%		Br. moist SAND w/silt (S-15) (SP-SM)
2.0		NS				-Advance hole with 3 1/4" I.D. Hollow Stem Auger	NS
3.0		S-2		25 45	4 13 2 2 40%		Br. moist SAND w/silt (S-15) (SP-SM)
5.0		NS					NS
6.0		S-3		50 70	2 2 2 2 40%		Br. & Bl. f. SAND, little c. sand (0-6) w/silt (S-15) (SP-SM)
7.0		NS					NS
8.0		S-4		75 9.4	4 18 30 100/4½"		Br. sat. SAND, little gravel (S-15) (wet) (SP)
9.0							
10.0		NS		100			NS

GENERAL REMARKS:
*Subsurface water determined after drilling had been done and may not be accurate.
-Encountered a 4" seam at 14' during drilling.

NED FORM MAR 71 58 (Test)

Boring No. FD-94-44

Site	Boring No.	Page 2 of 2
Cranston, R.I. Sewer	FD 94-44 (S-2)	

DEPTH		CORE/SAMPLE NO.	SIZE	DEPTH RANGE	BLOWS PER FT. / CORE REC'VY	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
		2-5		100	100% 100%	same as above	Br. silty (15-25) sat SAND (SM)
10.0		NS		102		- 2 7/8" Roller bit to 10.5'	NS
				105		- Drill with AX diamond bit rock core for 24 minutes @ 300 psi	GRANITE GNEISS, TAN to GREY, heavily FRACTURED with ALTERATION ZONES INTERSPERSED throughout CORE.
11.0							
12.0							
13.0		Run 1					RQD = 16.7% (Very Poor)
14.0							
15.0				155		End of Hole 15.5'	

U. S. ARMY
CORPS OF ENGINEERS
NEW ENGLAND DIVISION

FIELD LOG OF TEST BORING

Site Cranston RI Sewer FD94-45 Page 1 of 2 Pages

Boring No. _____ Desig. S-3 Diam. (Casing) _____

Co-ordinates: N _____ E _____

Elevation Top of Boring El. 428 ± [redacted]. Hammer Wt. 140lb Boring Started 4/7/94

Total Overburden Drilled 15 Feet Hammer Drop 30" Boring Completed 4/7/94

Elevation Top of Rock — [redacted]. Casing Left —

Total Rock Drilled — Feet Subsurface Water Data 1.5'* Page _____

Elevation Bottom of Boring El. 413 ± [redacted]. Obs. Well _____

Total Depth of Boring 15 Feet Drilled By ATL, Canton NY

Core Recovered 30 % No. Boxes 1 Mfg. Des. Drill CME 75

Core Recovered 0.6 Ft. _____ Diam. 1 3/8 in. Inspected By: S. Bergeron

Soil Samples 1 3/8 in. Diam. 7 No. Classification By: S. Bergeron

Soil Samples _____ in. Diam. _____ No. Classification By: ATY

DEPTH		CORE/SAMPLE NO.	SIZE	DEPTH RANGE	BLOWS PER FT. / CORE REC'VY	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
		S-1A		0 – 0.8	1 4	-Sample with 1 3/8" I.D. 2 foot long split spoon with 140 lb hammer and a 30" drop. -Advance hole with 3 1/4" I.D. Hollow Stem Auger	Dk. br. f. SAND w/silt & org. (SP-SM)
1.0		S-1B		0.8 – 2.0	3 2 90%		Br. moist f. SAND w/silt (5-15) (SP-SM)
2.0		NS					NS
3.0		S-2		2.5 – 4.5	3 4 5 5 75%		Red, Gr. Blue & Dk. Br. f. SAND w/silt (5-15) (SP-SM)
4.0							
5.0		NS					NS
		S-3A		5.0 – 6.0	10 19 28		Br. silty (15-25) f. SAND (SM)
6.0		S-3B		6.0 – 6.75	100+/3" 70%		Lt. br. m-f SAND, little c. sand (SP)
7.0		Run1		6.75 – 8.75	30%	-Cleaned with 2 7/8" RB to 6.75 -Drilled with AX diamond bit core for 15 minutes @ 300 psi	BOULDER GRANITE, grey. RQD NOT PERFORMED
9.0		NS		8.75 – 10.0		Advance hole with 3 1/4" I.D hollow stem Auger	NS
10.0							

GENERAL REMARKS:
* Subsurface water determined after drilling had been completed and may not be accurate

NED FORM MAR 71 58 (Test)

Boring No. FD-94-45

Site	Boring No.	Page 2 of 2
Cranston, RI Sewer	FD 94-45 (S-3)	

DEPTH		CORE/SAMPLE NO.	SIZE	DEPTH RANGE	BLOWS PER FT. / CORE REC'VY	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
10.0				10.0	13	- Sample with 1 3/8" I.D. 2 foot long split spoon with 140 lb hammer and 30" drop	
					15		
11.0		S-4			16		Grey f. SAND w/silt (S-15)
					13		
12.0				12.0	95%	- Advance hole with 3 1/4" I.D. Hollow Stem Auger	(SP-SM)
		NS					NS
13.0				13.0	14		
					17		
14.0		S-5			22		Grey f. SAND w/silt (S-15)
					89		
15.0				15.0	90%		(SP-SM)
						End of hole 15.0'	

U. S. ARMY
CORPS OF ENGINEERS
NEW ENGLAND DIVISION

FIELD LOG OF TEST BORING

Site Cranston RI Sewer — Page 1 of 2 Pages

Boring No. FD94-46 Desig. S-4 Diam. (Casing) _____

Co-ordinates: N _____ E _____

Elevation Top of Boring El. 438 ± [redacted]. Hammer Wt. 140 lb Boring Started 4/7/94

Total Overburden Drilled 145 Feet Hammer Drop 30" Boring Completed 4/7/94

Elevation Top of Rock El. 423 ± [redacted]. Casing Left —

Total Rock Drilled 5 Feet Subsurface Water Date 1.3'* Page _____

Elevation Bottom of Boring El. 418 ± [redacted]. Obs. Well _____

Total Depth of Boring 195 Feet Drilled By ATL, Canton NY

Core Recovered 85 % No. Boxes 1 Mfg. Des. Drill CME 75

Core Recovered 4.25 Ft. _____ Diam. 1 3/8 In. Inspected By: S. Bergeron

Soil Samples 1 3/8 In. Diam. 6 No. Classification By: S. Bergeron

Soil Samples _____ In. Diam. _____ No. Classification By: RTY

DEPTH		CORE/SAMPLE NO.	SIZE	DEPTH RANGE	BLOWS PER FT. / CORE REC'VY	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
				0	3 5 13 6	-Sample with 1 3/8" I.D. 2 foot long split spoon with a 140 lb hammer and a 30" drop (SPT)	Br. to Dk. br. f. SAND w/silt (5-15) (SP-SM)
1.0		S-1					
				2.0	60%	-Advance hole with 3 1/4" I.D. Hollow Stem Auger	
2.0		NS					NS
				2.5	10 21 26 28		Grey f. SAND w/silt (5-15) and gravel (5-15) (SP-SM)
3.0		S-2					
4.0				4.5	60%		
5.0		NS					NS
				5.0	8 22 25 30		Lt. br. f. SAND w/silt (5-15) (SP-SM)
6.0		S-3					
7.0				7.0	80%		
		NS					NS
				7.5	10 8		Br. c-m SAND (SP)
8.0		S-4A		8.5			
				8.5	7 11		Grey f. SAND w/silt (5-15) (SP-SM)
9.0		S-4B		9.5	70%		(SAT)
10.0		NS		10.0			NS

GENERAL REMARKS:
*Subsurface water determined after drilling had been completed and may not be accurate.

NED FORM MAR 71 58 (Test) Boring No. FD94-46

Site	Boring No.	Page 2 of 2
Cranston, RI Sewer	FD94-46 (S-4)	

DEPTH		CORE/SAMPLE NO.	SIZE	DEPTH RANGE	BLOWS PER FT. / CORE REC'VY	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
10.0				10.0	15	Same as Above	
					23		
11.0		S-5			31		Grey silty (15-25) SAND
					21		
				12.0	15%		(SM)
12.0		NS					NS
				13.0			
13.0		NS			21		NR
				13.8	100+/4" 0%		
14.0		NS		14.5		2 7/8" Roller bit from 13.8 to 14.5' after hitting refusal	NS
				14.5		- Drilled with AX diamond bit rock core at 300psi for 20 minutes	GRANITE GNEISS, TAN to GREY, HEAVILY FRACTURED CORE WITH ALTERATION ZONES, MOST OF CORE IS IN 1" to 2" SEGMENTS, HEAVILY ALTERED ZONE between 2.5' AND 3'. RQD = 20.0% (Very Poor)
15.0							
16.0							
17.0		Run1			85%		
18.0							
19.0				19.5			
						End of hole 19.5'	

...dA(Test)

Boring No. FD-94-46

U. S. ARMY
CORPS OF ENGINEERS
NEW ENGLAND DIVISION

FIELD LOG OF TEST BORING

Site Cranston, RI Sewer — Page 1 of 2 Pages

Boring No. FD 94-47 Desig. S-5 Diam. (Casing) _____

Co-ordinates: N _____ E _____

Elevation Top of Boring El. 416 ± [redacted]
Total Overburden Drilled 15 Feet
Elevation Top of Rock – [redacted]
Total Rock Drilled – Feet
Elevation Bottom of Boring El. 401 ± [redacted]
Total Depth of Boring 15 Feet
Core Recovered – % No. Boxes –
Core Recovered – Ft. ____ Diam. ____ In.
Soil Samples 1 3/8 In. Diam. 7 No.
Soil Samples ____ In. Diam. ____ No.

Hammer Wt. 140 lb Boring Started 4/7/94
Hammer Drop 30" Boring Completed 4/7/94
Casing Left –
Subsurface Water Data Dry Page –
Obs. Well –
Drilled By ATL, Canton NY
Mfg. Des. Drill CME 75
Inspected By: S. Bergeron
Classification By: S. Bergeron
Classification By: _____

DEPTH		CORE/SAMPLE NO.	SIZE	DEPTH RANGE	BLOWS PER FT. / CORE REC'VY	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
		S-1A		0.3		-Sample with 1 3/8" I.D. 2 foot long split spoon with a 140 lb hammer and a 30" drop (SPT)	Dk. Br. silty (30-40) SAND w/org (SM)
1.0		S-1B		0.3 / 2.0	3 4 4 3 / 75%	-Advance hole with 3 1/4" I.D. Hollow Stem Auger	Red + Dk. br. silty (30-40) SAND (SM)
2.0		NS					NS
3.0		S-2		2.5 / 4.5	12 16 18 24 / 75%		Lt. br. f. SAND, trace c. Sand (SP)
5.0		NS					NS
6.0		S-3		5.0 / 7.0	10 15 15 12 / 95%		Lt. br. silty (20-30) f. SAND, trace c. sand (SM)
7.0		NS					NS
8.0		S-4		7.5 / 9.5	3 7 13 18 / 80%		Lt. br. silty (20-30) f. SAND, trace gravel (SM)
9.0							
10.0		NS		10.0			NS

GENERAL REMARKS:

NED FORM MAR 71 58 (Test)

Boring No. FD-94-47

Site	Boring No.	Page 2 of 2
Cranston, R.I. Sewer	FD 94-47 (S-5)	

DEPTH		CORE/SAMPLE NO.	SIZE	DEPTH RANGE	BLOWS PER FT. / CORE REC'VY	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
10.0				10.0	15	Same as Above	
					29		
11.0		S-5			23		Lt. br. f. SAND w/silt (S-15)
					36		
12.0				12.0	85%		(SP-SM)
		NS					NS
13.0				13.0	39		
					58		
14.0		S-6			58		Lt. br. f. SAND w/silt (S-15) trace. c. sand & gravel
					70		
				15.0	90%		(SP-SM)
15.0						End of Hole 15.0'	

Boring No. FD-94-47

U. S. ARMY
CORPS OF ENGINEERS
NEW ENGLAND DIVISION

FIELD LOG OF TEST BORING

Site Cranston, RI Sewer FD 94-48 Page 1 of 2 Pages

Boring No. _____ Desig. S-6 Diam. (Casing) _____

Co-ordinates: N _____ E _____

Elevation Top of Boring El. 396 ± Hammer Wt. 140 lb Boring Started 4/7/94

Total Overburden Drilled 15 Feet Hammer Drop 30" Boring Completed 4/7/94

Elevation Top of Rock - Casing Left —

Total Rock Drilled — Feet Subsurface Water Data 12.5' Page -

Elevation Bottom of Boring El. 381 ± Obs. Well _____

Total Depth of Boring 15 Feet Drilled By ATL, Canton NY

Core Recovered - % No. Boxes - Mfg. Des. Drill CME 75

Core Recovered - Ft. _____ Diam. _____ In. Inspected By: S. Bergeron

Soil Samples 1 3/8 In. Diam. 7 No. Classification By: S. Bergeron

Soil Samples _____ In. Diam. _____ No. Classification By: _____

DEPTH		CORE/SAMPLE NO.	SIZE	DEPTH RANGE	BLOWS PER FT. / CORE REC'VY	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
		S-1A		0 0.25	1	-Sample with 1 3/8" I.D. 2 foot long split spoon with a 140 lb hammer and a 30" drop (SPT)	Dk. Br. f. SAND w/silt & org. (SP-SM)
1.0		S-1B		0.25 2.0	5 6 20 70%		Dk. Br. f. SAND w/silt (5-15) and little c. sand (5-15) (SP-SM)
2.0		NS				-Advance hole with 3 1/4" I.D. Hollow Stem Auger	NS
3.0		S-2		2.5 4.5	4 7 8 8 80%		Br. Gr. & Blk. f. SAND w/silt (5-15) and wood (SP-SM)
4.0							
5.0		NS					NS
6.0		S-3		5.0 7.0	9 9 9 8 70%		Lt. Br. f. SAND (SP)
7.0		NS					NS
8.0		S-4		7.5 9.5	4 5 5 4 90%		Lt. Br. f. SAND (SP)
9.0							
10.0		NS		10.0			NS

GENERAL REMARKS:

NED FORM MAR 71 58 (Test)

Boring No. FD-94-48

Site	Boring No.	Page 2 of 2
Cranston, RI Sewer	FD 94-48 (S-6)	

DEPTH		CORE/SAMPLE NO.	SIZE	DEPTH RANGE	BLOWS PER FT. / CORE REC'VY	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
10.0				10.0	2	Same as Above	
					2		
11.0		S-5			2		P.G. Gravel w/f SAND (25-35)
					2		
12.0				12.0	10%		(GP)
		NS					NS
13.0				13.0	2		
					14		
14.0		S-6			46		Lt. br. f. SAND w/silt (5-15) and trace c. sand (SP-SM)
					69		
				15.0	75%		
15.0						End of Hole 15.0'	

U. S. ARMY
CORPS OF ENGINEERS
NEW ENGLAND DIVISION

FIELD LOG OF TEST BORING

Site Cranston RI Sewer FD 94-49 Page 1 of 2 Pages
Boring No. _____ Desig. S-8 Diam. (Casing) _____
Co-ordinates: N _____ E _____

Elevation Top of Boring El. 360± [redacted]. Hammer Wt. 140 lb Boring Started 4/7/94
Total Overburden Drilled 8 Feet Hammer Drop 30" Boring Completed 4/8/94
Elevation Top of Rock El. 352± [redacted]. Casing Left —
Total Rock Drilled 5 Feet Subsurface Water Data 5'* Page —
Elevation Bottom of Boring El. 347± [redacted]. Obs. Well —
Total Depth of Boring 13 Feet Drilled By ATL, Canton NY
Core Recovered 97 % No. Boxes 1 Mfg. Des. Drill CME 75
Core Recovered 4.8 Ft: ____ Diam. 1 3/8 In. Inspected By: S. Beraeron
Soil Samples 1 3/8 In. Diam. 5 No. Classification By: S. Beraeron
Soil Samples ____ In. Diam. ____ No. Classification By: RTY

DEPTH		CORE/SAMPLE NO.	SIZE	DEPTH RANGE	BLOWS PER FT. / CORE REC'VY	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
		S-1A		0.3		-Sample with 1 3/8" I.D. 2 foot long split spoon with a 140 lb hammer and a 30" drop (SPT) -Advance hole with 3 1/4" I.D. Hollow Stem Auger	Dk. br. f. SAND w/silt & org. (SP-SM)
1.0		S-1B		0.3 / 2.0	2 4 3 4 / 80%		Red. br. silty (15-25) f. SAND (SM)
2.0		NS					NS
3.0		S-2A		2.5 / 3.5	11 26		Lt. br. silty (20-30) SAND (SM)
4.0		S-2B		3.5 / 4.5	29 37 / 75%		P.G. SAND w/gravel (10-20) (SP)
5.0		NS					NS
6.0		Run1		5.0 / 7.0	67%	-Cleaned w/2 7/8" Roller bit to 5.0 -Drilled with AX diamond tip rock core @ 300 psi for 20 minutes until seam was hit	BOULDER GRANITE GNEISS. RQD NOT PERFORMED
7.0		S-3**		7.8	67%	-Advanced 3" I.D. casing and 2" I.D. diamond rock core to 5'. Cored w/2" I.D. diamond rock core to 7'. -Sampled 7.0-7.8' with 1 1/2" I.D split spoon 2' long -Cleaned w/2 7/8" RB. -Drilled w/1 3/8" diamond rock core, 300 psi, 50 minutes 8'-13'	P.G. Br. SAND (SP)
8.0		NS					NS
9.0		Run2		8.0 / 10.0	97%		'GRANITE GNEISS', GREY, WITH FEW ALTERED SEAMS AT 4" AND 3.6'. RQD = 77.5% (GOOD)
10.0							

GENERAL REMARKS:
* Subsurface water determined after drilling had been completed and may not be accurate
** Tried to use a different hole to avoid boulder and couldn't. Beyond 7' a new hole 3' West of the old one was created starting 4/8/94

NED FORM 58 (Test) MAR 71 Boring No. FD-94-49

Site	Boring No.	Page 2 of 2
Cranston, RI. Sewer	FD 94-49 (S-8)	

DEPTH		CORE/SAMPLE NO.	SIZE	DEPTH RANGE	BLOWS PER FT. / CORE REC'VY	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
10.0				10.0		Same as Above	
11.0		Run 2 (cont.)				↓	
12.0							
13.0				13.0		End of Hole 13.0'	

U. S. ARMY
CORPS OF ENGINEERS
NEW ENGLAND DIVISION

FIELD LOG OF TEST BORING

Site Cranston, RI Sewer Page 1 of 1 Pages
Boring No. FD 94-50 Desig. S-9 Diam. (Casing) _____
Co-ordinates: N _____ E _____

Elevation Top of Boring El. 342 ± [redacted]
Total Overburden Drilled 4 Feet
Elevation Top of Rock El. 338 ± [redacted]
Total Rock Drilled 5 Feet
Elevation Bottom of Boring El. 333 ± [redacted]
Total Depth of Boring 9 Feet
Core Recovered 93 % No. Boxes 1
Core Recovered 4.7 Ft : ____ Diam. 1 3/8 In.
Soil Samples 1 3/8 In. Diam. 2 No.
Soil Samples _____ In. Diam. ____ No.

Hammer Wt. 140 lb Boring Started 4/8/94
Hammer Drop 30" Boring Completed 4/8/94
Casing Left —
Subsurface Water Data 5' Page —
Obs. Well —
Drilled By ATL, Canton NY
Mfg. Des. Drill CME 75
Inspected By: S. Bergeron
Classification By: S. Bergeron
Classification By: DJY

DEPTH	1" =	CORE/SAMPLE NO.	SIZE	DEPTH RANGE	BLOWS PER FT. / CORE REC'VY	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
1.0		S-1		0 / 2.0	4 5 6 11 / 35%	-Sample with 1 3/8" I.D. 2' long split spoon -Advance hole with 3 1/4" I.D. Hollow Stem Auger.	Br. f. SAND w/silt (5-15) (SP-SM)
2.0		NS					NS
3.0		S-2		2.5 / 3.8	7 13 100/3 1/2 / 67%		Lt. br. silty (30-40) f. SAND (SM)
4.0		NS		4.0		-Cleaned to 4.0' with 2 7/8" Roller bit. -Drilled 4.0' to 9.0' with AX diamond bit rock core at 300psi for 50 minutes	GRANITE GNEISS, GREY, slight to MODERATE FRACTURES IN VICINITY OF SOME OF the ALTERED SEAMS. ALTERATION ZONES AT 8", 10.5", 24", 36," AND 54", MOST OF CORE BROKEN INTO 0.5" to 2" SEGMENTS. RQD = 26.7% (Poor)
5.0							
6.0		Run1			93%		
7.0							
8.0							
9.0				9.0			

GENERAL REMARKS:

NED FORM 58 MAR 71 (Test)

Boring No. FD-94-50

U. S. ARMY
CORPS OF ENGINEERS
NEW ENGLAND DIVISION

FIELD LOG OF TEST BORING

Site Cranston, RI Sewer — Page 1 of 2 Pages

Boring No. FD94-51 — Desig. T-11 — Diam. (Casing) _____

Co-ordinates: N _____ E _____

Elevation Top of Boring El. 82± [redacted]. — Hammer Wt. 140 lb — Boring Started 4/11/94

Total Overburden Drilled 15.0 Feet — Hammer Drop 30" — Boring Completed 4/11/94

Elevation Top of Rock — [redacted]. — Casing Left —

Total Rock Drilled — Feet — Subsurface Water Data: Dry — Page -

Elevation Bottom of Boring El. 67± [redacted]. — Obs. Well —

Total Depth of Boring 15 Feet — Drilled By ATL, Canton NY

Core Recovered - % — No. Boxes - — Mfg. Des. Drill CME 75

Core Recovered - Ft: ____ Diam. ____ in. — Inspected By: LCF

Soil Samples 1 3/8" in. Diam. ____ No. — Classification By: LCF

Soil Samples ____ in. Diam. ____ No. — Classification By: ____

DEPTH (1"=2')	CORE/SAMPLE NO.	SIZE	DEPTH RANGE	BLOWS PER FT. / CORE REC'VY	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
1.0, 2.0	S-1		0 – 2.0	1, 3, 3, 2 / 50%	· Sample with 1 3/8" ID 2ft long split spoon w/ 140 lb hammer 30" drop (SPT)	4 inches topsoil; br. c. SAND w/ organics (SP)
	NS					NS
3.0, 4.0	S-2		2.5 – 4.5	10, 6, 4, 5 / 25%	- Advanced hole w/ 3 1/4" I.D. hollow stem auger	br. f-c SAND w/ 1 gravel pc. (SP)
5.0	NS					NS
6.0, 7.0	S-3		5.0 – 7.0	3, 2, 2, 2 / 40%		Dk. br. m-c SAND w/ few gravel pcs. (SP)
	NS					NS
8.0, 9.0	S-4		7.5 – 9.5	2, 4, 5, 5 / 45%		same as S-3 (SP)
10.0	NS					NS

GENERAL REMARKS:

Site	Boring No.	Page 2 of 2
Cranston, RI	FD94-51 (T-11)	

DEPTH ft	DEPTH 1"=2'	CORE/SAMPLE NO.	SIZE	DEPTH RANGE	BLOWS PER FT. / CORE REC'VY	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
10				10.0	4	Same as above	br. c. SAND w/3-1" cobbles (SP)
					6		
11.0		S-5			8		
					7		
12.0				12.0	50%		
		NS					NS
13.0				13.0	4		moist lt. br. m. SAND w/gravel (5-15) (SP)
					2		
					3		
14.0		S-6			4		
15.0				15.0	75%		
						END OF HOLE	

U. S. ARMY
CORPS OF ENGINEERS
NEW ENGLAND DIVISION

FIELD LOG OF TEST BORING

Site Cranston, RI Sewer Page 1 of 2 Pages

Boring No. FT94-52 Desig. NP-8 Diam. (Casing) _____

Co-ordinates: N _____ E _____

Elevation Top of Boring El. 269 ± [redacted] Hammer Wt. 140 lb Boring Started 4/11/94

Total Overburden Drilled 15.0 Feet Hammer Drop 30" Boring Completed 4/11/94

Elevation Top of Rock — [redacted] Casing Left _____

Total Rock Drilled — Feet Subsurface Water Data 9.0' Page 1

Elevation Bottom of Boring El. 254 ± [redacted] Obs. Well _____

Total Depth of Boring 15.0 Feet Drilled By ATL, Canton, NY

Core Recovered — % No. Boxes _____ Mfg. Des. Drill CME 75

Core Recovered — Ft: _____ Diam. _____ In. Inspected By: LCF

Soil Samples 1 3/8" In. Diam. _____ No. Classification By: LCF

Soil Samples _____ In. Diam. _____ No. Classification By: _____

DEPTH ft	DEPTH 1"=2'	CORE/SAMPLE NO.	SIZE	DEPTH RANGE	BLOWS PER FT. / CORE REC'VY	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
0				0.0	2	Sample w/ 1 3/8" ID	topsoil 4"
					4	2 ft long split spoon	br. SAND.
1.0		S-1			5	w/140 lb hammer	(SP)
					2	30 in drop	
2.0				2.0	50%		
		NS					NS
				2.5	4	(SPT)	tan-red SILT
3.0					6		w/f. sand (10-20)
		S-2			6		and layer of c. sand
4.0					14	- Advanced hole	(ML)
				4.5	100%	w/ 3 1/4" ID hollow	
		NS				stem auger	NS
5.0				5.0	12		5.0
					35		same as S-2
6.0		S-3			BR		(ML) 6.0
							layers of br-red c. SAND
				7.0	75%		and gravel pcs. (SP) 7.0
7.0		NS					NS
				7.5	24		
8.0					16		moist grey m-c. SAND
		S-4			26		w/few gravel pcs,
9.0					19		(SP)
				9.5	90%		
10.0		NS					NS

GENERAL REMARKS:

ED FORM MAR 71 58 (Test)

Boring No. FT94-52 (NP-8)

Site	Boring No.	Page 2 of 2
Cranston, RI	FD94-52 (NP-8)	

DEPTH		CORE/SAMPLE NO.	SIZE	DEPTH RANGE	BLOWS PER FT. / CORE REC'VY	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
10.0				10.0	11	Same as above	wet grey m-f SAND w/ silt (5-15) (SP-SM)
					15		
11.0		S-5			15		
					30		
				12.0	100%		
12.0		NS					NS
13.0				13.0	22	Sample w/ 1 3/8" I.D. 2' long split spoon w/ 140 # hammer and 18" drop.	Wet tan dense silty (40-50) C. SAND. (SM)
					27		
14.0		S-6			53		
					98		
15.0				15.0	100%		
						END OF HOLE	

FORM 58A (Test)

Boring No. FD94-52

U. S. ARMY
CORPS OF ENGINEERS
NEW ENGLAND DIVISION

FIELD LOG OF TEST BORING

Site Cranston, RI Sewer — Page 1 of 4 Pages

Boring No. FD94-53 Desig. WPS-1 Diam. (Casing) ____

Co-ordinates: N ____ E ____

Elevation Top of Boring 45± [redacted]. Hammer Wt. 140 lb Boring Started 4/12/94

Total Overburden Drilled 55.0 Feet Hammer Drop 30 in Boring Completed 4/12/94

Elevation Top of Rock — [redacted]. Casing Left ____

Total Rock Drilled — Feet Subsurface Water Data 10' Page ____

Elevation Bottom of Boring -10.0± [redacted]. Obs. Well ____

Total Depth of Boring 55.0 Feet Drilled By ATL, Canton NY

Core Recovered ____ % No. Boxes ____ Mfg. Des. Drill CME 75

Core Recovered ____ Ft: ____ Diam. ____ In. Inspected By: LCF

Soil Samples 1 3/8" In. Diam. ____ No. Classification By: LCF

Soil Samples ____ In. Diam. ____ No. Classification By: ____

DEPTH (1"=2')	CORE/SAMPLE NO.	SIZE	DEPTH RANGE	BLOWS PER FT. / CORE REC'VY	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
0.0	S-1		0.0	5 4 3 5	Sample w/ 1 3/8" ID 2-ft long split spoon w/ 140 lb hammer & 30 in drop (SPT)	top soil 3" br. poorly graded SAND w/ silt (5-15) (SP-SM)
2.0			2.0	50%		
	NS					NS
			2.5 3.0	2 9		same as S-1
	S-2			15 15	-Advanced hole with 3 1/4" ID hollow stem auger	Lt. Br. SILT (75.7) (ML)
4.0			4.5	60%		
	NS					NS
	S-3		5.0	7 13 7 6		Dk. Br. poorly graded Coarse SAND w/ silt (5-15) (SP-SM)
6.0			7.0	70%		
	NS					NS
	S-4		7.5	2 3 5 9		Dk. Br. silty (15.4) SAND w/ gravel (33.2) (SM)
8.0			9.5	25%		
10.0	NS					NS

GENERAL REMARKS:

Site	Boring No.	Page 2 of 4
Cranston, RI	FD94-53 (WPS-1)	

DEPTH	CORE/SAMPLE NO.	SIZE	DEPTH RANGE	BLOWS PER FT. / CORE REC'VY	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
10.0	5A		10.0	8 9 5		Dk. Br. c. Poorly graded SAND w/ silt (5-15) (SP-SM)
	5B		12.0	8 75%		Reddish Br. silty (14.5) SAND w/ gravel (2-9) (SM)
12.0	NS					NS
	S-6A		12.5 / 14.0	11 9 6 4	same as above	Gr. silty (10-20) SAND (SM)
14.0	S-6B		14.5	75%		Gr. SILT w/ sand (10-20) (ML)
	NS					NS
16.0	S-7		15.0 / 17.0	2 3 4 3 70%	retrieved 15' of auger advanced 4" OD casing to 17.5 ft.	grey SILT (74.3) w/ sand (15.5) (ML)
	NS					NS
18.0	S-8		17.5 / 19.5	3 2 3 4 100%	- Advanced hole with casing and washing with water	grey SILT w/ sand (10-20) (ML)
	NS					NS
20.0	S9		20.0 / 22.0	3 2 2 1 100%		grey-green SILT w/ sand (10-20) (ML)
22.0	NS					NS
24.0	S-10		22.5 / 24.5	4 2 1 2 100%		grey-green SILT (74.1) w/ sand (17.2) (ML)
	NS					NS
26.0	S-11		25.0 / 27.0	0 3 4 3 100%		gray SILT w/ sand (10-20) (ML)
27.0						

Site	Boring No.	Page 3 of 4
Cranston, RI	FD94-53 (WPS-1)	

DEPTH 1"=2"	CORE/SAMPLE NO.	SIZE	DEPTH RANGE	BLOWS PER FT. / CORE REC'VY	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
27.0	NS					NS
	S-12A		27.5	6		Gr. SILT w/sand (10-20) (ML)
28.0	S-12B		28.0 – 29.5	9 9 9 / 50%		Lt. Br. c. poorly graded SAND w/ silt (5-15) & gravel (30-40) (SP-SM)
	NS					NS
30.0	S-13		30.0 – 32.0	7 6 7 7 / 75%	-Roller bitted to clear mat'l in casing from 30.0-32.5'	Gr. c-f poorly graded SAND (52.9) w/ silt (8.5) and gravel (38.6) (SP-SM)
32.0	NS					NS
34.0	S-14		32.5 – 34.5	3 6 8 8 / 50%		Gr. c-f poorly graded SAND w/ silt (5-15) and gravel (30-40) (SP-SM)
	NS					NS
36.0	S-15		35.0 – 37.0	10 10 10 10 / NR		No recovery
	NS					NS
38.0	S-16		37.5 – 39.5	11 9 11 13 / NR	-No water return during advance of casing from 37.5-40.0' -RB out mat'l in casing	No recovery
	NS					NS
40.0	S-17		40.0 – 42.0	5 14 11 10 / 20%		Gr. c-f poorly graded SAND w/ silt (5-15) (SP-SM)
	NS					NS
44.0	S-18		42.5	4 6 10 9 / NR		No recovery

Site	Boring No.	Page 4 of 4
Cranston, RI	FD94-53 (WPS-1)	

DEPTH	CORE/SAMPLE NO.	SIZE	DEPTH RANGE	BLOWS PER FT. / CORE REC'VY	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
44.0	S-18				Same as above	No recovery (con't)
	NS					NS
46.0	S-19A		45.0	6 11 13 18	- casing advanced to 45! Casing filling w/ material. - Advanced hole using roller bit and drilling mud.	Lt. Br. poorly graded SAND w/ silt (5-15) (SP-SM)
	S-19B		47.0	100%		lt. br. SILT w/tr. sand ML
	NS					NS
48.0	S-20A		47.5	13 17 23 40		Lt. Br. poorly graded SAND (79) w/ silt (10) (SP-SM)
	S-20B		49.5	60%		gray SILT w/sand (10-20) (ML)
50.0	NS					NS
	S-21A		50.0	22 12 10 9		black weathered rock
	S-21B		52.0	75%		Lt. Br. SILT (72.1) w/ sand (15) (ML)
52.0	NS					NS
54.0	S-22		53.0	6 7 5 11		Lt. Br. SILT w/ sand (10-20) (ML)
55.0			55.0	100%	END OF HOLE	

ATTACHMENT C-2

Providence Water Supply Board Logs

American Drilling & Boring Co., Inc.

54 WATER STREET EAST PROVIDENCE, R. I.

TO C. A. Maguire	ADDRESS Providence, R. I.	SHEET 1 OF 1	
PROJECT NAME	LOCATION	DATE	
REPORT SENT TO	PROJ. NO.	HOLE NO 74A	
SAMPLES SENT TO	OUR JOB NO. 65-140	LINE & STA.	
		OFFSET	

GROUND WATER OBSERVATIONS

At 13' after ½ Hours

13'6" of casing

At _____ after _____ Hours

Hole caved in at 10'

	CASING	SAMPLER	CORE BAR.
Type		S/S	
Size I.D.	2 1/2"	1 3/8"	
Hammer Wt.	300#	140#	BIT
Hammer Fall	24"	30"	

SURFACE ELEV. 48.0
DATE STARTED 8-20-65
DATE COMPL. 8-20-65
BORING FOREMAN S. Roderick
INSPECTOR
SOILS ENGR.

LOCATION OF BORING:

DEPTH	Casing Blows per foot	Sample Depths From - To	Type of Sample	Blows per 6" on Sampler From 0-6	To 6-12	To 12-18	Moisture Density or Consist	Strata Change Elev	SOIL IDENTIFICATION Remarks include color, gradation, Type of soil etc. Rock-color, type, condition, hardness, Drilling time, seams and etc	SAMPLE No	Pen	Rec
	8	0'-1'6"	D	5	8	10	Moist M-Dense		Brown fine to medium SAND, little silt & fine gravel	1	18"	15"
	10											
	14											
	17											
	16							5'0"				
	10	5'-6'6"	D	7	6	8	Moist M-Dense		Brown fine to medium SAND some fine to medium gravel trace silt	2	18"	16"
	14											
	18											
	26											
	29							10'0"				
10	12	10'-11'6"	D	6	8	8	Moist M-Dense		Brown fine to coarse SAND some fine gravel trace silt	3	18"	14"
	15											
	20											
	12/6											
		13'6"-15'	D	7	8	10	Moist M-Dense	15'0"	" " "	4	18"	14"
									Bottom of boring 15'0"			
20												

GROUND SURFACE TO 13'6" USED 2 1/2" CASING: THEN S/S to 15'

Sample Type
D=Dry C=Cored W=Washed
UP=Undisturbed Piston
TP=Test Pit A=Auger V=Vane Test
UT=Undisturbed Thinwall

Proportions Used	
trace	0 to 10%
little	10 to 20%
some	20 to 35%
and	35 to 50%

140 lb Wt. x 30" fall on 2" O.D. Sampler

Cohesionless Density		Cohesive Consistency	
0-10	Loose	0-4	Soft
10-30	Med. Dense	4-8	M/Stiff
30-50	Dense	8-15	Stiff
50 +	Very Dense	15-30	V-Stiff
		30 +	Hard

SUMMARY:
Earth Boring 15
Rock Coring
Samples 4

HOLE NO. 74A

American Drillin' & Boring Co., Inc.

54 WATER STREET EAST PROVIDENCE, R. I.

TO C. A. Maguire
ADDRESS Providence, R. I.
PROJECT NAME
LOCATION
REPORT SENT TO
PROJ. NO.
SAMPLES SENT TO
OUR JOB NO. 65-140

SHEET 1 OF 1
DATE
HOLE NO. 75
LINE & STA
OFFSET

GROUND WATER OBSERVATIONS
At 15' after ½ Hours
23'6" of casing
At 16'3" after ½ Hours
15' of casing

	CASING	SAMPLER	CORE BAR.
Type		S/S	
Size I.D.	2 1/2"	1 3/8"	
Hammer Wt.	300#	140#	BIT
Hammer Fall	24"	30"	

SURFACE ELEV
DATE STARTED 8-20-65
DATE COMPL. 8-20-65
BORING FOREMAN S. Roderick
INSPECTOR
SOILS ENGR.

LOCATION OF BORING

DEPTH	Casing Blows per foot	Sample Depths From - To	Type of Sample	Blows per 6" on Sampler From 0-6	6-12	12-18	Moisture Density or Consist	Strata Change Elev	SOIL IDENTIFICATION Remarks include color, gradation, Type of soil etc. Rock-color, type, condition, hardness, Drilling time, seams and etc	SAMPLE No	Pen	Rec
	8	0'-1'6"	D	8	8	10	Moist M- Dense		Brown fine to medium SAND some medium to fine gravel trace silt	1	18"	14"
	12							3'0"				
	13											
	18											
	26											
	14	5'-6'6"	D	12	17	21	Dry Dense		Light gray medium to fine SAND, some fint to coarse gravel, trace silt, cobbles	2	18"	13"
	20											
	28											
	73							8'6"				
	26											
10	10	10'-11'6"	D	8	10	11	Dry M-Dense		Brown fine SAND, trace silt	3	18"	15"
	15											
	18											
	18							13'0"				
	22											
	14	15'-16'6"	D	10	12	13	"		Brown fine to med SAND, little fine to medium gravel, trace silt	4	18"	14"
	20											
	28											
	26											
	28											
20	13	20'-21'6"	D	11	10	12	"		" " "	5	18"	15"
	21											
	29											
	14/6						Wet M-Dense					
		23'6"-25'	D	12	14	13		25'0"	" " "	6	18"	15"
									Bottom of boring 25'0"			
30												

GROUND SURFACE TO 23'6" USED 2½ "CASING: THEN S/S to 25'

Sample Type
D=Dry C=Cored W=Washed
UP=Undisturbed Piston
TP=Test Pit A=Auger V=Vane Test
UT=Undisturbed Thinwall

Proportions Used
trace 0 to 10%
little 10 to 20%
some 20 to 35%
and 35 to 50%

140# Wt. x 30" fall on 2" O.D. Sampler

Cohesionless Density		Cohesive Consistency		
0-10	Loose	0-4	Soft	30 + Hard
10-30	Med. Dense	4-8	M/Stiff	
30-50	Dense	8-15	Stiff	
50 +	Very Dense	15-30	V-Stiff	

SUMMARY:
Earth Boring 25'
Rock Coring
Samples 6

HOLE NO 75

American Drilling & Boring Co., Inc.

54 WATER STREET EAST PROVIDENCE, R. I.

TO C. A. Maguire | ADDRESS Providence, R. I.
PROJECT NAME | LOCATION
REPORT SENT TO | PROJ. NO.
SAMPLES SENT TO | OUR JOB NO. 65-140

SHEET 1 OF 1
DATE
HOLE NO. 76
LINE & STA.
OFFSET

GROUND WATER OBSERVATIONS
At 4'4" after ½ Hours
18'6" of casing
At 5'0" after ½ Hours
10' of casing

	CASING	SAMPLER	CORE BAR.
Type		S/S	
Size I.D.	2 1/2"	1 3/8"	
Hammer Wt.	300#	140#	BIT
Hammer Fall	24"	30"	

SURFACE ELEV. 45.0
DATE STARTED 8-23-65
DATE COMPL. 8-23-65
BORING FOREMAN E. Roderick
INSPECTOR
SOILS ENGR.

LOCATION OF BORING

DEPTH	Casing Blows per foot	Sample Depths From – To	Type of Sample	Blows per 6" on Sampler From 0-6	To 6-12	12-18	Moisture Density or Consist	Strata Change Elev	SOIL IDENTIFICATION Remarks include color, gradation, Type of soil etc. Rock-color, type, condition, hardness, Drilling time, seams and etc	SAMPLE No	Pen	Rec
	6	0'-1'6"	D	5	8	7	Moist M-Dense		Brown loamy fine to medium SAND	1	18"	14"
	8							42.0				
	10											
	12											
	14											
	2	5'-6'6"	D	6	8	10	Wet M-Dense	1	Brown coarse to fine SAND, little fine gravel, trace silt	2	18"	14"
	13											
	15											
	18											
	21											
	10	10'-11'6"	D	5	7	9	"		" " "	3	18"	15"
	15											
	18											
	21											
	23											
	12	13'-14'6"	D	8	8	10	"		" " "	4	18"	14"
	18											
	24											
	13/6											
		8'6"-20'	D	4	9	10	"	25.0	" " "	5	18"	14"
									Bottom of boring 25'0"			

GROUND SURFACE TO 18'6" USED 2½ "CASING" THEN 8/8 to 20'

Sample Type
D=Dry C=Cored W=Washed
UP=Undisturbed Piston
TP=Test Pit A=Auger V=Vane Test
UT=Undisturbed Thinwall

Proportions Used
trace 0 to 10%
little 10 to 20%
some 20 to 35%
and 35 to 50%

140 lb Wt. x 30" fall on 2" O.D. Sampler

Cohesionless Density		Cohesive Consistency		
0-10	Loose	0-4	Soft	30+ Hard
10-30	Med. Dense	4-8	M/Stiff	
30-50	Dense	8-15	Stiff	
50+	Very Dense	15-30	V-Stiff	

SUMMARY:
Earth Boring
Rock Coring 20'
Samples 5

HOLE NO. 76

American Drillin & Boring Co., Inc.

54 WATER STREET EAST PROVIDENCE, R. I.

TO C. A. Maguire & Assoc. | ADDRESS Providence, R. I.
PROJECT NAME | LOCATION
REPORT SENT TO | PROJ. NO.
SAMPLES SENT TO Above | OUR JOB NO. 65-140

SHEET 1 OF 1
DATE
HOLE NO. 76A
LINE & STA
OFFSET

GROUND WATER OBSERVATIONS
At 2' after 3½ Hours
At 1'6" after 17 Hours
No casing

	CASING	SAMPLER	CORE BAR.
Type		S/S	
Size I.D.	2 1/2"	2"	
Hammer Wt.	300#	140#	BIT
Hammer Fall	24"	30"	

SURFACE ELEV.
DATE STARTED 9-2-65
DATE COMPL. 9-3-65
BORING FOREMAN C. Parents
INSPECTOR
SOILS ENGR.

LOCATION OF BORING:

DEPTH	Casing Blows per foot	Sample Depths From – To	Type of Sample	Blows per 6" on Sampler From 0-6	To 6-12	To 12-18	Moisture Density or Consist.	Strata Change Elev	SOIL IDENTIFICATION Remarks include color, gradation, Type of soil etc. Rock-color, type, condition, hardness, Drilling time, seams and etc.	SAMPLE No	Pen	Rec
	PUSH	0'-1'6"	D	PUSH		7	Wet Loose	3'0"	Brown PEAT	1	18"	15"
	9											
	10											
	13											
	22											
	20	5'-6'6"	D	11	12	11	Moist M-Dense	7'0"	Brown fine to coarse SAND, some fine to medium gravel	2	18"	13"
	28											
	19											
	18											
	17											
10	16	10'-11'6"	D	6	4	5	Wet Loose		Gray fine SAND, some silt	3	18"	14"
	19											
	21'											
	16											
	15											
	13	15'-16'6"	D	6	6	4	"		" " "	4	18"	13"
	16											
	17											
	17											
	19											
20	19	20'-21'6"	D	5	6	7	"		" " "	5	18"	14"
	22											
	26											
	27											
	30											
	30	25'-26'6"	D	11	6	5	"		" " "	6	18"	13"
	32											
	35											
	39											
	50							30'0"				
30		30'-31'6"	D	22	24	23	Moist Dense		Brown & gray fine to medium SAND, some fine gravel	7	18"	12"
		35'-36'6"	D	22	16	18	"	36'6"	" " "	8	18"	12"
									Bottom of boring 36'6"			
40												

GROUND SURFACE TO 30'0" USED 2½" CASING: THEN 2" OD to 36'6"

Sample Type
D=Dry C=Cored W=Washed
UP=Undisturbed Piston
TP=Test Pit A=Auger V=Vane Test
UT=Undisturbed Thinwall

Proportions Used	
trace	0 to 10%
little	10 to 20%
some	20 to 35%
and	35 to 50%

140 lb Wt. x 30" fall on 2" O.D. Sampler

Cohesionless Density		Cohesive Consistency	
0-10	Loose	0-4	Soft
10-30	Med. Dense	4-8	M/Stiff
30-50	Dense	8-15	Stiff
50 +	Very Dense	15-30	V-Stiff
		30 +	Hard

SUMMARY:
Earth Boring 36'6"
Rock Coring
Samples 8

HOLE NO 76A

American Drilling & Boring Co., Inc.

54 WATER STREET EAST PROVIDENCE, R. I.

TO C. A. Maguire | ADDRESS Providence, R. I.
PROJECT NAME | LOCATION
REPORT SENT TO | PROJ. NO.
SAMPLES SENT TO | OUR JOB NO. 65-140

SHEET 1 OF 1
DATE
HOLE NO. 77
LINE & STA
OFFSET

GROUND WATER OBSERVATIONS
At 14' after ½ Hours
13'6" of casing
At after Hours
Hole ~~[illegible]~~ caved in

	CASING	SAMPLER	CORE BAR.
Type		S/S	
Size I.D.	2 1/2"	1 3/8"	
Hammer Wt.	300#	140#	BIT
Hammer Fall	24"	30"	

SURFACE ELEV. 44.0
DATE STARTED 8-23-65
DATE COMPL. 8-23-65
BORING FOREMAN S. Roderick
INSPECTOR
SOILS ENGR.

LOCATION OF BORING:

Elev.	Casing Blows per Foot	Sample Depths From - To	Type of Sample	Blows per 6" on Sampler From 0-6	6-12	12-18	Moisture Density or Consist	Strata Change Elev.	SOIL IDENTIFICATION Remarks include color, gradation, Type of soil etc. Rock-color, type, condition, hardness, Drilling time, seams and etc	SAMPLE No	Pen	Rec
	6	0'-1'6"	D	5	6	6	Moist		Brown coarse to fine SAND,	1	18"	15"
	8						M-Dense		some fine gravel, trace silt			
	10											
	12											
	14											
	9	5'-6'6"	D	7	8	8	"		" " "	2	18"	14"
	14											
	17											
	18											
	18a											
10	11	10'-11'6"	D	5	8	9	"		" " "	3	18"	14"
	15											
	18											
	10/6											
		13'6"-15'	D	8	10	9	"	29.0	" " "	4	18"	14"
									Bottom of boring 15'0"			
20												

GROUND SURFACE TO 13'6" USED 2 ½ "CASING. THEN S/S to 15'

Sample Type
D=Dry C=Cored W=Washed
UP=Undisturbed Piston
TP=Test Pit A=Auger V=Vane Test
UT=Undisturbed Thinwall

Proportions Used
trace 0 to 10%
little 10 to 20%
some 20 to 35%
and 35 to 50%

140 lb Wt. x 30" fall on 2" O.D. Sampler

Cohesionless Density		Cohesive Consistency	
0-10	Loose	0-4	Soft
10-30	Med Dense	4-8	M/Stiff
30-50	Dense	8-15	Stiff
50 +	Very Dense	15-30	V-Stiff
		30 +	Hard

SUMMARY:
Earth Boring 15'
Rock Coring
Samples 4

HOLE NO 77

ATTACHMENT C-3

Tutela Engineering Logs

W-21

Allstate Drilling Co.

EAST PROVIDENCE, R.I. 02915

HAMMER

CASING WT. 300 FALL 24

SAMPLER WT. 140 FALL 30

CLIENT: Tutela Engineering

PROJECT: Pump Station/Plainfield Pike

SHEET 1 OF 1

LOCATION Cranston

HOLE NO. B-2

LINE & STA.

OFFSET

INSPECTOR

DRILLER: R. Cook, Jr.

HELPER: B. Burns

SAMPLER I. D. 1 3/8"

CASING I. D. 4"

ALLSTATE NO. W-719

DATE START 01/06/93

DATE FINISH 01/07/93

GROUND ELEVATION

GROUND WATER DEPTH 7.7'

DEPTH BELOW SURFACE	CASING BLOWS PER FOOT	SAMPLE NO. DEPTHS	TYPE OF SAMPLE	PENETRATION BLOWS PER 6 INCHES	DENSITY OR CONSIST	PROFILE CHANGE DEPTH	FIELD IDENTIFICATION OF SOILS, REMARKS (REMARKS INCLUDE COLOR GRADATION TYPE OF SOIL ETC ROCK COLOR TYPE CONDITION HARDNESS DRILLING TIME SEAMS ETC)	
0	4	0-2.0	D-1	1-3-4-4		0.3	Topsoil	
	9				Loose		F-C LT BR SAND AND F-C GRAVEL,	
	13						little silt and cobbles	
	31							
	21							
	23	5-7.0	D-2	12-21-30-27	Very			
	100				Dense		Roller bit through cobbles from	
	120						8.5 to 15.0 then drove casing	
	200							
10	115						(no sample taken at 10.0' -	
	67	------	---	----------			cobbles)	
	33							
	34							
	37							
	200					15.0		
		15 to	C-1	Cored 60"			Lt grey - white-pr granite-	10
		20.0		Rec. 56"			bedrock, fractured	11
				% Rec. 93%				11
				Rqd. 83%				10
20						20.0		10
							End of Boring	
							Note: B-1 eliminated by client.	
30								
40								

GROUND SURFACE TO 15 FT. USED HW CASING: THEN Cored 20.0'

HOLE NO. B-2

Summary

Earth Boring 15.0'

Rock Coring 5.0'

Samples D-2, C-1

Type of Sample: D = Dry, C = Cored, W = Washed, UP = Undisturbed Piston, TP = Test Pit, A = Auger, US = Undisturbed Shelby, V = Vane Test

Proportion Used: trace 0 to 10%, little 11 to 20%, some 21 to 35%, and 36 to 50%

Cohesionless Density: 0-4 Very Loose, 5-9 Loose, 10-29 Medium Dense, 30-49 Dense, 50 - Very Dense

Cohesive Consistency: 0-2 Very Soft, 3-4 Soft, 5-8 Med/Stiff, 9-15 Stiff, 16-30 V-Stiff, 31 + Hard

W-21

Allstate Drilling Co.

EAST PROVIDENCE, R.I. 02915

HAMMER

CASING: WT. 300 FALL 24

SAMPLER: WT. 140 FALL 30

CLIENT: Tutela Engineering

PROJECT: Pump Station/Plainfield Pike

SHEET 1 OF 1

LOCATION Cranston

HOLE NO. B-3

LINE & STA.

OFFSET

INSPECTOR:

DRILLER: R. Cook, Jr.

HELPER: B. Burns

SAMPLER I. D. 1 3/8"

CASING I. D. 4"

ALLSTATE NO. W-719

DATE START 12/21/92

DATE FINISH: 01/06/93

GROUND ELEVATION

GROUND WATER DEPTH 7.7'

DEPTH BELOW SURFACE	CASING BLOWS PER FOOT	SAMPLE NO. DEPTHS	TYPE OF SAMPLE	PENETRATION BLOWS PER 6 INCHES	DENSITY OF CONSIST	PROFILE CHANGE DEPTH	FIELD IDENTIFICATION OF SOILS, REMARKS (REMARKS INCLUDE COLOR, GRADATION, TYPE OF SOIL, ETC. ROCK COLOR, TYPE, CONDITION, HARDNESS, DRILLING TIME, SEAMS, ETC.)	
0	1	0-2.0	D-1	1-3-6-21		1.3	Topsoil	
	3				Loose		F-C DK BR SAND AND F-C GRAVEL, little silt and cobbles and boulders-fill	
	7							
	9							
	10							
	6	5-7.0	D-2	4-5-5-6	Med. Dense			
	21							
	27							
	61							
10	31					10.0		
		10-11.5	D-3	24-44-120	Very Dense	12.5	F-C LT BR SAND AND F-C GRAVEL, and silt and cobbles	
		12.5 to 17.5	C-1	Cored 60" Rec. 49" % Rec. 82% Rqd. 60%			Lt br-gr-white grante-bedrock -fractured w/seams	9 10 10 9 10
						17.5		
20							End of Boring	
30								
40								

GROUND SURFACE TO 12.5 FT. USED HW CASING: THEN Cored to 17.5' HOLE NO. B-3

Type of Samples: D = Dry, C = Cored, W = Washed, UP = Undisturbed Piston, TP = Test Pit, A = Auger, US = Undisturbed Shelby, V = Vane Test

Proportions Used: trace 0 to 10%, little 11 to 20%, some 21 to 35%, and 36 to 50%

Penetration Resistance: 140 lb. Wt falling 30" on 1" O.D. Sampler

Cohesionless Density: 0-4 Very Loose, 5-9 Loose, 10-29 Med Dense, 30-49 Dense, 50 – Very Dense

Cohesive Consistency: 0-2 Very Soft, 3-4 Soft, 5-8 Med Stiff, 9-15 Stiff, 16-30 V. Stiff, 31 – Hard

Summary: Earth Boring 12.5', Rock Cored 5.0', Samples D-3; C-1

ATTACHMENT C-4

Meshanticut Valley Sewer System Logs

AMERICAN DRILLING CO., INC.
94 WATER STREET EAST PROVIDENCE, R.I.

SHEET 50 OF 91
DATE
HOLE NO. 47
LINE & STA.
OFFSET

TO Same as # 1
PROJECT NAME
REPORT SENT TO
SAMPLES SENT TO
ADDRESS
LOCATION
PROJ. NO.
OUR JOB NO.

GROUND WATER OBSERVATIONS
At 21' after Hours
At after Hours

	CASING	SAMPLER	CORE BAR.
Type			
Size I.D.	Same as # 1		
Hammer Wt.			BIT
Hammer Fall			

SURFACE ELEV. 69.5
DATE STARTED 4/7/60
DATE COMPL. "
BORING FOREMAN J. Klang
INSPECTOR
SOILS ENGR.

LOCATION OF BORING:

DEPTH	Casing Blows per foot	Sample Depths From – To	Type of Sample	Blows per 6" on Sampler From 0-6	To 6-12	12-18	Moisture Density or Consist.	Strata Change Elev	SOIL IDENTIFICATION Remarks include color, gradation, Type of soil etc. Rock-color, type, condition, hardness, Drilling time, seams and etc.	SAMPLE No	Pen	Rec.
0	15	0'-1'6"	D	5	4	4	moist loose	2'0"	Brown fine sand	1	18"	18"
	30											
	45						moist med. dense		Brown fine sand Some medium to fine gravel			
	56											
	130											
	42	5'-6'6"	D	19	14	12				2	18"	12"
	41											
	45											
	44							9'0"				
	36											
0	12	10'-11'6"	D	15	17	15	wet dense		Gray brown fine to coarse sand-Some medium to fine gravel-- Trace silt	3	18"	10"
	40											
	45											
	51							14'0"				
	95											
	81	15'-16'6"	D	23	38	46	moist very dense		Gray brown fine sand Some silt & fine gravel	4	18"	8"
	76							17'0"				
	94								Brown fine sand Little fine gravel			
	101											
	107											
0		20'-21'	D	18	12	..	dry med. dense	21'0"		5A	12"	12"
		21'-21'6"	D	-	..	9	moist med. dense		Brown fine sand	5B	6"	6"
								23'6"				
		23'6"-25'	D	40	55	71	moist v.dense	25'0"	Till-- Gray fine sand w/ some silt & f/grvl, cemented	6	18"	16"
									Bottom of Boring 25'0"			
0												

GROUND SURFACE TO 20' USED 2 1/2" CASING: THEN Split Spoon to 25'

Sample Type
D-Dry C-Cored W-Washed

Proportions used
trace 0 to 10%

140 lb Wt. x 30" fall on 2" O.D. Sampler
Cohesionless Density | Cohesive Consistency

SUMMARY:
Earth Boring 25'

AMERICAN DRILLING CO., INC.
94 WATER STREET EAST PROVIDENCE, R.I.

SHEET 51 OF 91
DATE
HOLE NO 48
LINE & STA
OFFSET

TO Same as # 1
PROJECT NAME
REPORT SENT TO
SAMPLES SENT TO
ADDRESS
LOCATION
PROJ. NO.
OUR JOB NO.

GROUND WATER OBSERVATIONS
At _____ after _____ Hours
No water
At _____ after _____ Hours

	CASING	SAMPLER	CORE BAR.
Type			
Size I.D.	Same as # 1		
Hammer Wt.			BIT
Hammer Fall			

SURFACE ELEV 71.2
DATE STARTED 4/7/60
DATE COMPL. "
BORING FOREMAN J. Klang
INSPECTOR
SOILS ENGR.

LOCATION OF BORING:

DEPTH	Casing Blows per foot	Sample Depths From - To	Type of Sample	Blows per 6" on Sampler From 0-6	To 6-12	12-18	Moisture Density or Consist.	Strata Change Elev	SOIL IDENTIFICATION Remarks include color, gradation, Type of soil etc. Rock-color, type, condition, hardness, Drilling time, seams and etc.	SAMPLE No	Pen.	Rec.
0	7	0'-1'6"	D	1	5	6	moist		Brown sandy topsoil	1	18"	18"
	36						m. dense	2'0"	Trace fine gravel			
	71								Brown fine sand			
	86								Little medium to fine			
	94						dry		gravel			
	60	5'-6'6"	D	30	30	32	very			2	18"	18"
	135						dense					
	124							8'0"				
	195						moist		Gray fine to coarse sand			
10	202						very		Coarse to medium gravel			
		10'-11'6"	D	20	21	80	dense			3	18"	16"
		11'6"-11'7"	D**	100/1"				11'7"				
									Refusal @ 11'7"			
20												
0												

GROUND SURFACE TO 10' USED 2 1/2" CASING THEN S/S to 11'6"-then OER to Refusal

Sample Type
D=Dry C=Cored W=Washed
UP=Undisturbed Piston

Proportions Used
trace 0 to 10%
little 10 to 20%

140 lb Wt. x 30" to 1 or 2" O.D. Sampler
Cohesionless Density | Cohesive Consistency
0-4 Soft 30+ Hard

SUMMARY
Earth Boring 11'7"
Rock Boring

AMERICAN DRILLING CO., INC.

94 WATER STREET EAST PROVIDENCE, R.I.

TO: Same as # 1
ADDRESS:
PROJECT NAME:
LOCATION:
RT SENT TO:
PROJ. NO.:
LES SENT TO:
OUR JOB NO.:

SHEET 52 OF 91
DATE:
HOLE NO. 48-A
LINE & STA:
OFFSET:

GROUND WATER OBSERVATIONS
At _____ after _____ Hours
No water
At _____ after _____ Hours

	CASING	SAMPLER	CORE BAR.
Type			
Size I.D.	Same as # 1		
Hammer Wt.			BIT
Hammer Fall			

SURFACE ELEV. 71.3
DATE STARTED 4/7/60
DATE COMPL. 4/8/60
BORING FOREMAN J. Klang
INSPECTOR
SOILS ENGR.

LOCATION OF BORING:

DEPTH	Casing Blows per foot	Sample Depths From - To	Type of Sample	Blows per 6" on Sampler From 0-6	To 6-12	To 12-18	Moisture Density or Consist.	Strata Change Elev.	SOIL IDENTIFICATION Remarks include color, gradation, Type of soil etc. Rock-color, type, condition, hardness, Drilling time, seams and etc.	SAMPLE No.	Pen.	Rec.
0	3	0'-1'6"	D	2	6	7	moist		Brown fine sand	1	18"	17"
	20						med.		Some medium to fine			
	40						dense		gravel			
	49											
	84						moist					
	76	5'-6'6"	D	20	18	22	dense			2	18"	16"
	94											
	117							8'0"				
	160								Gray brown coarse to			
	172						med.		medium sand-Some coarse			
10	101	10'-11'6"	D	11	10	12	dense		to medium gravel- Trace		18"	0"
	97								silt			
	114	11'6"-13'	D	17	15	18	moist			3	18"	15"
	155						dense					
	198											
	95	15'-16'6"	D	14	12	14	moist			4	18"	12"
	81						med.					
	110						dense					
	98							19'0"				
	96								Gray brown fine sand			
20		20'-21'6"	D	9	14	12	"		Some coarse to medium	5	18"	18"
									gravel-Trace silt			
		23'6"-25'	D	15	19	21	moist			6	18"	12"
							dense	25'0"				
									Bottom of Boring 25'0"			
30												

GROUND SURFACE TO 20' USED 2 1/2 CASING: THEN Split Spoon to 25'

Sample Type
D=Dry C=Cored W=Washed

Proportions Used
trace 0 to 10%

140 lb Wt. x 30" fall on 2" O.D. Sampler
Cohesionless Density | Cohesive Consistency

SUMMARY:
Earth Boring 25'

AMERICAN DRILLING CO., INC.
94 WATER STREET EAST PROVIDENCE, R.I.

TO: Same as 1
PROJECT NAME:
REPORT SENT TO:
SAMPLES SENT TO:
ADDRESS:
LOCATION:
PROJ. NO.:
OUR JOB NO.:

SHEET 2 OF 22
DATE 2/29/60
HOLE NO. 2
LINE & STA.:
OFFSET:

GROUND WATER OBSERVATIONS
18' after 1/2 Hours
casing @ 20'
At _____ after _____ Hours

	CASING	SAMPLER	CORE BAR.
Type	Same as 1		
Size I.D			
Hammer Wt.			BIT
Hammer Fall			

SURFACE ELEV. 68.2
DATE STARTED 2/22/60
DATE COMPL. 2/22/60
BORING FOREMAN R. Faria
INSPECTOR:
SOILS ENGR.:

LOCATION OF BORING:

DEPTH	Casing Blows per foot	Sample Depths From - To	Type of Sample	Blows per 6" on Sampler From 0-6	To 6-12	12-18	Moisture Density or Consist.	Strata Change	SOIL IDENTIFICATION Remarks include color, gradation, Type of soil etc. Rock-color, type, condition, hardness, Drilling time, seams and etc.	SAMPLE No.	Pen	Rec.
0	7	0'- 1'6"	D	2	2	2	moist loose	1'6"	Brown loamy fine SAND	1	18"	16"
	6											
	8								Light brown fine SAND			
	10						moist med dense					
	10											
	8	5'- 6'6"	D	8	10	10				2	18"	12"
	12											
	14											
	16											
	18							10'-0"				
10	98	10'-11'6"	D	20	8	10	"		Brown very fine SAND Little silt and fine gravel	3	18"	12"
	67											
	68											
	78											
	80							15'-0"				
	34	15'- 16'6"	D	16	20	21	moist dense		Gray-brown medium to fine SAND- some coarse to medium gravel- trace silt /	4	18"	12"
	88											
	110							18'-0"				
	120											
	130											
20	89	20'-21'6"	D	18	22	24	"		Gray-brown fine SAND Some fine gravel Trace silt	5	18"	12"
	160											
	210											
	300	@24'	D**	100	no pen.			24'-0"				
									Refusal 24'-0"			
30									D** denotes used 300# wt on open end A Rod sampler.			
0												

GROUND SURFACE TO 24' USED _____ "CASING: THEN Refusal

Sample Type
y, C=Cored W=Washed
UP=Undisturbed Piston
TP=Test Pit A=Auger V=Vane Test
UT=Undisturbed Thinwall

Proportions Used
trace 0 to 10%
little 10 to 20%
some 20 to 35%
and 35 to 50%

140 lb Wt. x 30" fall on 2" O.D. Sampler

Cohesionless Density		Cohesive Consistency	
0-10	Loose	0-4	Soft
10-30	Med. Dense	4-8	M/Stiff
30-50	Dense	8-15	Stiff
50+	Very Dense	15-30	V-Stiff
		30+	Hard

SUMMARY:
Earth Boring 24'
Rock Coring -
Samples 5

HOLE NO. 2

94 WATER STREET EAST PROVIDENCE, R.I.

TO Same as 1
PROJECT NAME
REPORT SENT TO
SAMPLES SENT TO

ADDRESS
LOCATION
PROJ. NO.
OUR JOB NO.

SHEET — OF —
DATE
HOLE NO. 3
LINE & STA.
OFFSET

GROUND WATER OBSERVATIONS
At Water after Hours
At after Hours

	CASING	SAMPLER	CORE BAR.
Type	Same as 1		
Size I.D			
Hammer Wt.			BIT
Hammer Fall			

SURFACE ELEV. 80.5
DATE STARTED 2/23/60
DATE COMPL. 2/23/60
BORING FOREMAN Faria
INSPECTOR
SOILS ENGR.

LOCATION OF BORING:

DEPTH	Casing Blows per foot	Sample Depths From-To	Type of Sample	Blows per 6" on Sampler From 0-6	To 6-12	To 12-18	Moisture Density or Consist.	Strata Change Elev.	SOIL IDENTIFICATION Remarks include color, gradation, Type of soil etc. Rock-color, type, condition, hardness, Drilling time, seams and etc.	SAMPLE No.	Pen.	Rec.
0	8	0'-1'6"	D	4	4	5	moist loose	2'-0"	Black top-brown fine sand, fine gravel- FILL	1	18"	12"
	6											
	24								Brown medium to fine SAND Some coarse gravel and boulders			
	48											
	58											
	29	5'-6'6"	D	28	36	48	moist very dense	8'-0"		2	18"	12"
	68											
	89											
	42											
	40								Brown fine SAND Some fine gravel			
10	30	10'-11'6"	D	8	10	9	moist med dense			3	18"	12"
	44											
	46											
	26 /6"											
		13'6"-15'	D	9	11	12	"	15'-0"		4	18"	12"
									Bottom of Boring 15'-0"			
20												
0												
0												

GROUND SURFACE TO 13'6" USED 2 1/2 "CASING: THEN S/S to 15'

Sample Type
C=Cored W=Washed
U=Undisturbed Piston
TP=Test Pit A=Auger V=Vane Test
UT=Undisturbed Thinwall

Proportions Used	
trace	0 to 10%
little	10 to 20%
some	20 to 35%
and	35 to 50%

140 lb Wt. x 30" fall on 2" O.D. Sampler

Cohesionless Density		Cohesive Consistency	
0-10	Loose	0-4	Soft
10-30	Med. Dense	4-8	M/Stiff
30-50	Dense	8-15	Stiff
50+	Very Dense	15-30	V-Stiff
		30+	Hard

SUMMARY:
Earth Boring 15'
Rock Coring -
Samples 4

HOLE NO. 3

ATTACHMENT C-5

DiPrete Engineering Logs

SOIL EXPLORATION AND GROUND WATER TABLE DETERMINATIONS

NOTE: All soil exploration and water table test holes must be indexed by an appropriate reference number. The location of each such test hole and the index reference number must be shown to scale on the subdivision plan. A four inch diameter perforated standpipe must be set in each ground water determination hole. Each standpipe must be paint labeled in the field with the corresponding index reference number.

LOT NO.	TEST HOLE NO.	DATE EXCVTD.	TOTAL DEPTH	SOIL DESCRIPTION BY STRATA	DEPTH TO WATER		
					DATE 1/7/87	DATE 1/13/87	DATE* 3/14/87
1	1	11/86	10'	0-29" top and subsoil, 29"-120" G,2MS, SR, GREY	38"	36"	3.0'
2	2	11/86	10'	0-32" Top & subsoil, 32"-120" G,2MS,SR Lt. Brn.	42"	41"	3.0'
3	3	11/86	10'	0-31" top & subsoil, 31"-120" G,2MS,RB MC, BRN.	38"	37"	3.0'
5	6	11/86	10'	0-32" top & subsoil, 32"-52" G,2CL,MS, SR 52"-120" G,2MS,SR,BRN grey	24"	24"	2.0'
6	7	11/86	10'	0-30"top & subsoil, 30"-120" G,2MS,1CL, SR, LT.BRN.	43"	42"	3.0'
7	8	11/86	10'	0-29" top & subsoil, 29"-120" G,2MS,SR Lt. Brn.	50"	48"	3.5'
8	20	12/86	10'	0-30" top & subsoil, 30"-120" g,2MS,SR, grey	45"	45"	3.5'
12	27	12/86	10'	0-30" top & subsoil, 30"-50" MS,CL,SR, grey, 50"-120" G,2MS,RB,BRN	26"	24"	2.0'
13	29	12/86	10'	0-31" top & subsoil, 31"-60" MS,CL,SR, GREY 60"-120" G,2MS,RB,BRN	41"	40"	3.0'
18	22	12/86	10'	0-30" top & subsoil, 30"-120" G,2MS,SR BRN.	42"	41"	3.0'
19	35	12/86	10'	0-30" top & subsoil, 30"-60" MS,CL,SR, GREY 60"-120" G,2MS,SR,BRN	79"	76"	6.0'
20	36	12/86	10'	0-29" top & subsoil, 29"-55" MS,CL,SR GREY 55"-120" G,2MS,SR,BRN	36"	36"	2.5'
22	46	12/86	10'	0-28" top & subsoil, 28"-120" G,2MS, SR, BRN	82"	80"	6.6'
23	42	12/86	10'	0-31" top & subsoil, 31"-120" G,2MS,SR BRN	28"	26"	2.0'
24	41	12/86	10'	0-33" top & subsoil, 33"-120" G,2MS,SR BRN	42"	40"	3.0'
25	52	12/86	10'	0-36" top & subsoil, 36"-120" G,2MS,RB Brn.	35"	33"	2.5'

Where more space is required continue on additional forms.

*W8707-51 D.E.M. Verification 3/14/87

CERTIFICATION BY ENGINEER OR SURVEYOR:

I, Christopher A. DuHamel, P.E. Title Project Manager

of DiPrete-Marchionda & Assoc. do hereby certify that the percolation soil exploration and water table tests were made according to the procedures prescribed in "Rules and Regulations Establishing Minimum Standards Relating to Location, Design, Construction, and Maintenance of Individual Sewage Disposal System" and that the findings reported and the accompanying plans and submittals are true and accurate.

Date..... Signature.....

REGISTRATION SEAL

SOIL EXPLORATION AND GROUND WATER TABLE DETERMINATIONS

NOTE: All soil exploration and water table test holes must be indexed by an appropriate reference number. The location of each such test hole and the index reference number must be shown to scale on the subdivision plan. A four inch diameter perforated standpipe must be set in each ground water determination hole. Each standpipe must be paint labeled in the field with the corresponding index reference number.

LOT NO.	TEST HOLE NO.	DATE EXCVTD.	TOTAL DEPTH	SOIL DESCRIPTION BY STRATA	DEPTH TO WATER		
					DATE 1/7/87	DATE 1/13/87	DATE 3/14/87*
26	50	12/86	10'	0-34" top & subsoil, 34"-120" G,2MS,SR Brn.	34"	33"	3.0'

Where more space is required continue on additional forms.

*W8707-51 DEM Verification 3/14/87

CERTIFICATION BY ENGINEER OR SURVEYOR:

I, Christopher A. DuHamel, P.E., Title Project Manager

of DiPrete-Marchionda & Assoc. do hereby certify that the percolation soil exploration and water table tests were made according to the procedures prescribed in "Rules and Regulations Establishing Minimum Standards Relating to Location, Design, Construction, and Maintenance of Individual Sewage Disposal System" and that the findings reported and the accompanying plans and submittals are true and accurate.

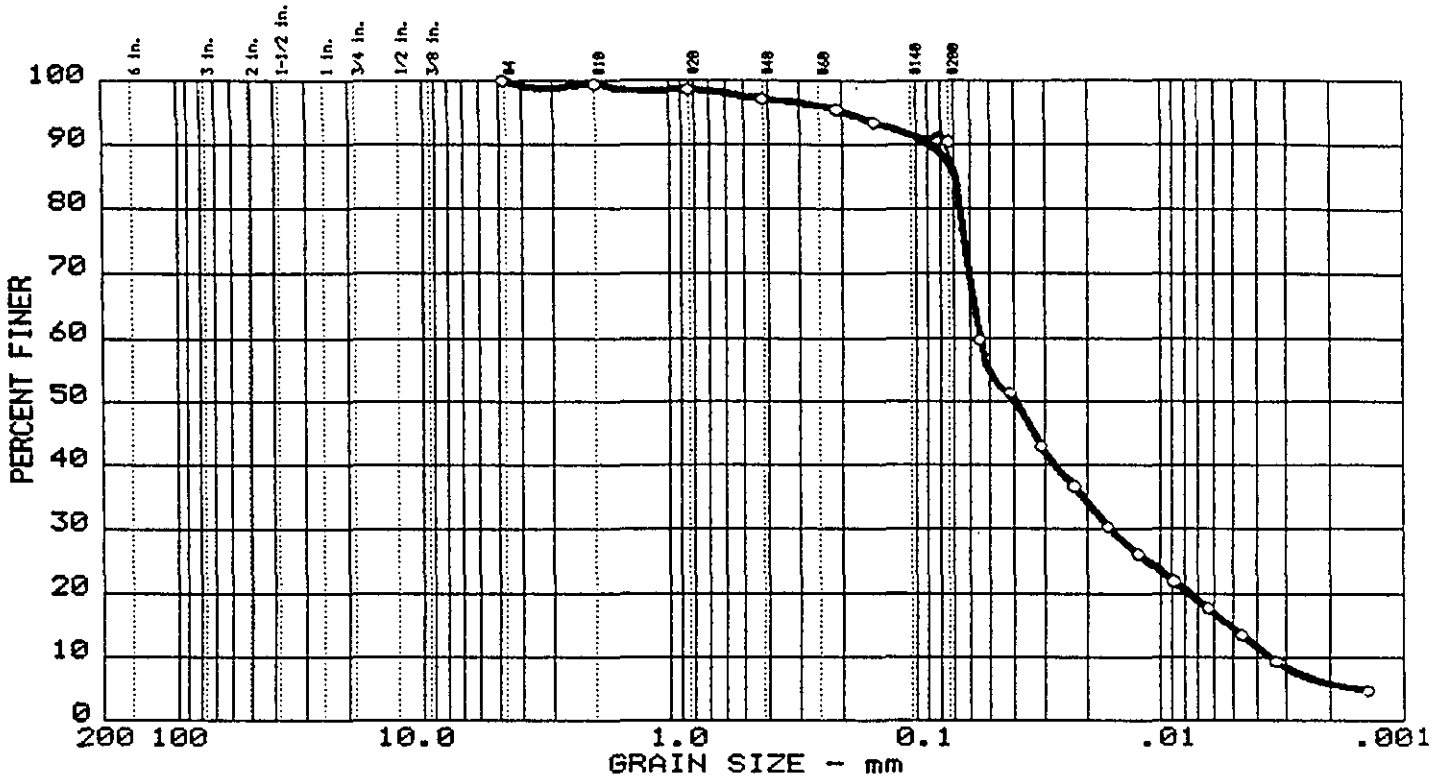
Date.....Signature.....

REGISTRATION SEAL

ATTACHMENT C-6

U.S. Army Corps of Engineers
Laboratory Test Results

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
o	1	0.0	0.0	9.6	75.7	14.7

	LL	PI	D_{75}	D_{60}	D_{50}	D_{30}	D_{25}	D_{10}	C_c	C_u
o					0.04	0.016	0.0112	0.0035	1.36	16.0

MATERIAL DESCRIPTION	USCS	AASHTO
o SILT	ML	

Project No.: 129-1-1
Project: CRANSTON , R.I. SEWER STUDY AREA
o Location: FD 94-53 , SAMPLE NO. "S-2"

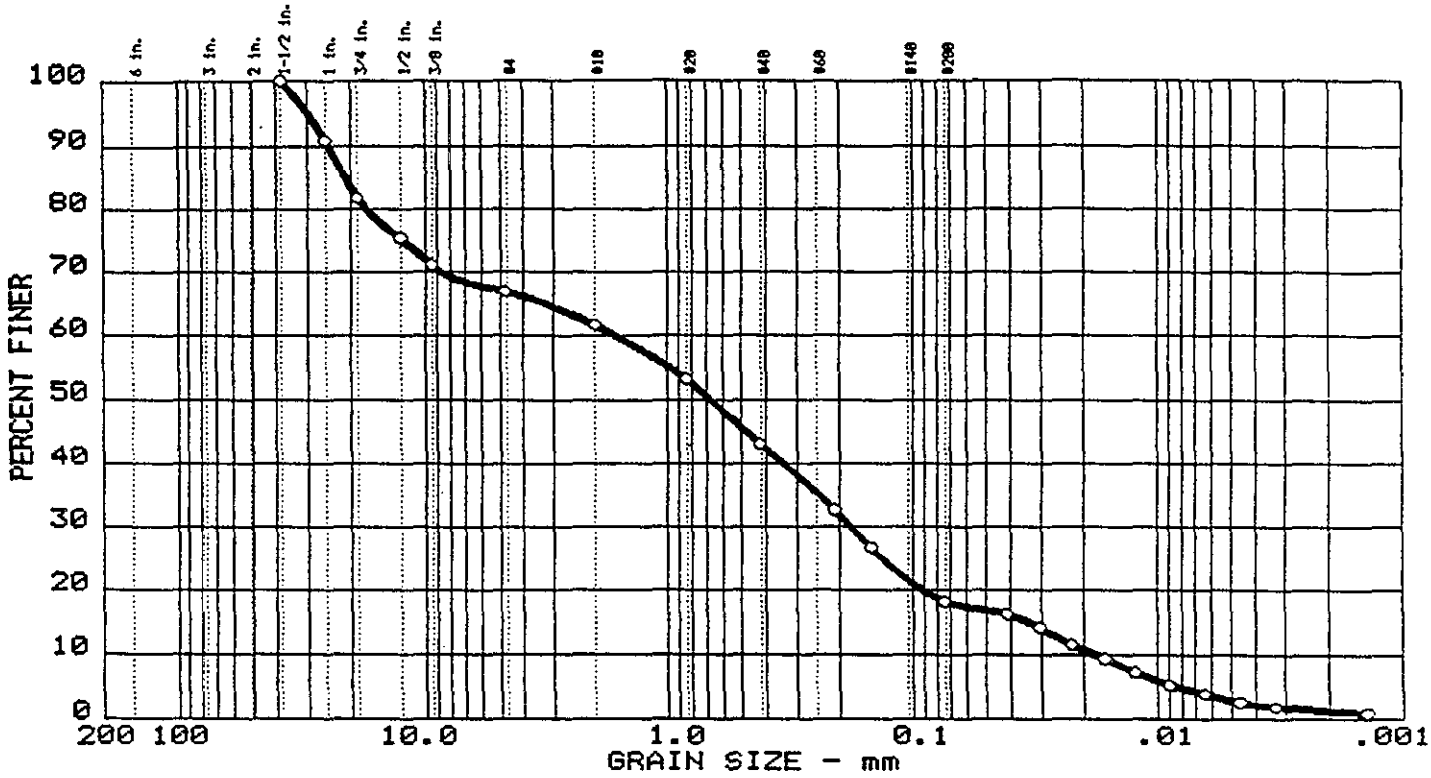
Date: 5-13-94

Remarks:
SOIL "BORING" SAMPLE
COLOR: LT. TO MED. BROWN
SAMPLE TAKEN AT DEPTH OF
2.5 FT. TO 4.5 FT.

GRAIN SIZE DISTRIBUTION TEST REPORT
CORPS OF ENGINEERS - NEW ENGLAND

Fig. No. 1

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
○	2	0.0	33.2	48.6	15.4	2.8

	LL	PI	D_{75}	D_{60}	D_{50}	D_{30}	D_{25}	D_{10}	C_c	C_u
○			12.30	1.62	0.66	0.180	0.1334	0.0178	1.12	91.2

MATERIAL DESCRIPTION	USCS	AASHTO
○ SILTY SAND WITH GRAVEL	SM	

Project No.: 129-1-2
Project: CRANSTON , R.I. SEWER STUDY AREA
○ Location: FD 94-53 , SAMPLE NO. "S-4"

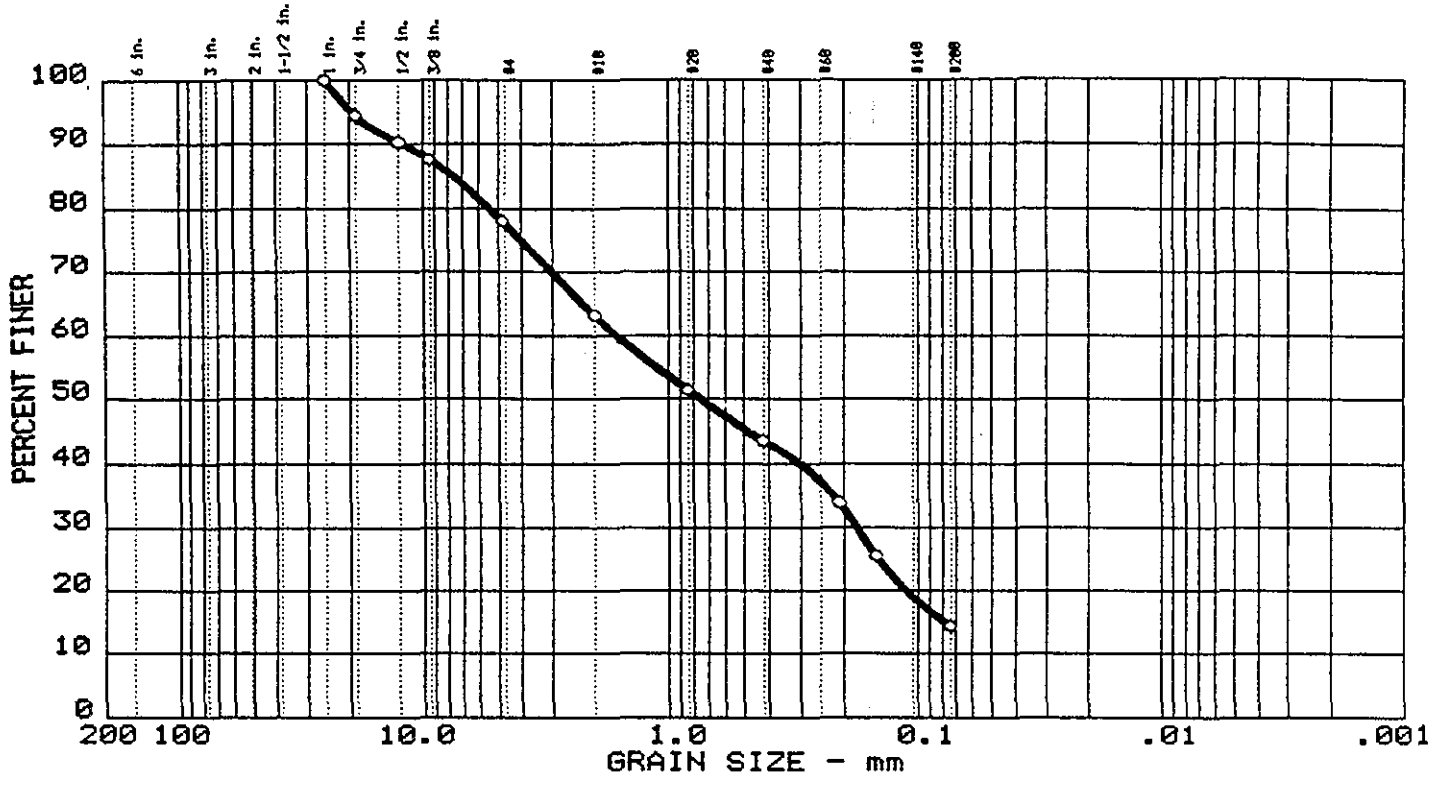
Date: 5-13-94

Remarks:
SOIL "BORING" SAMPLE
COLOR: DARK OLIVE BROWN
SAMPLE TAKEN AT DEPTH OF
7.5 FT. TO 9.5 FT.

GRAIN SIZE DISTRIBUTION TEST REPORT
CORPS OF ENGINEERS - NEW ENGLAND

Fig. No. 2

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
○	3	0.0	21.9	63.6	14.5	

	LL	PI	D_{75}	D_{60}	D_{50}	D_{30}	D_{25}	D_{10}	C_c	C_u
○			3.94	1.62	0.74	0.178	0.1462			

MATERIAL DESCRIPTION	USCS	AASHTO
○ SILTY SAND WITH GRAVEL	SM	

Project No.: 129-1-3
Project: CRANSTON , R.I. SEWER STUDY AREA
○ Location: FD 94-53 , SAMPLE NO. "S-5B"

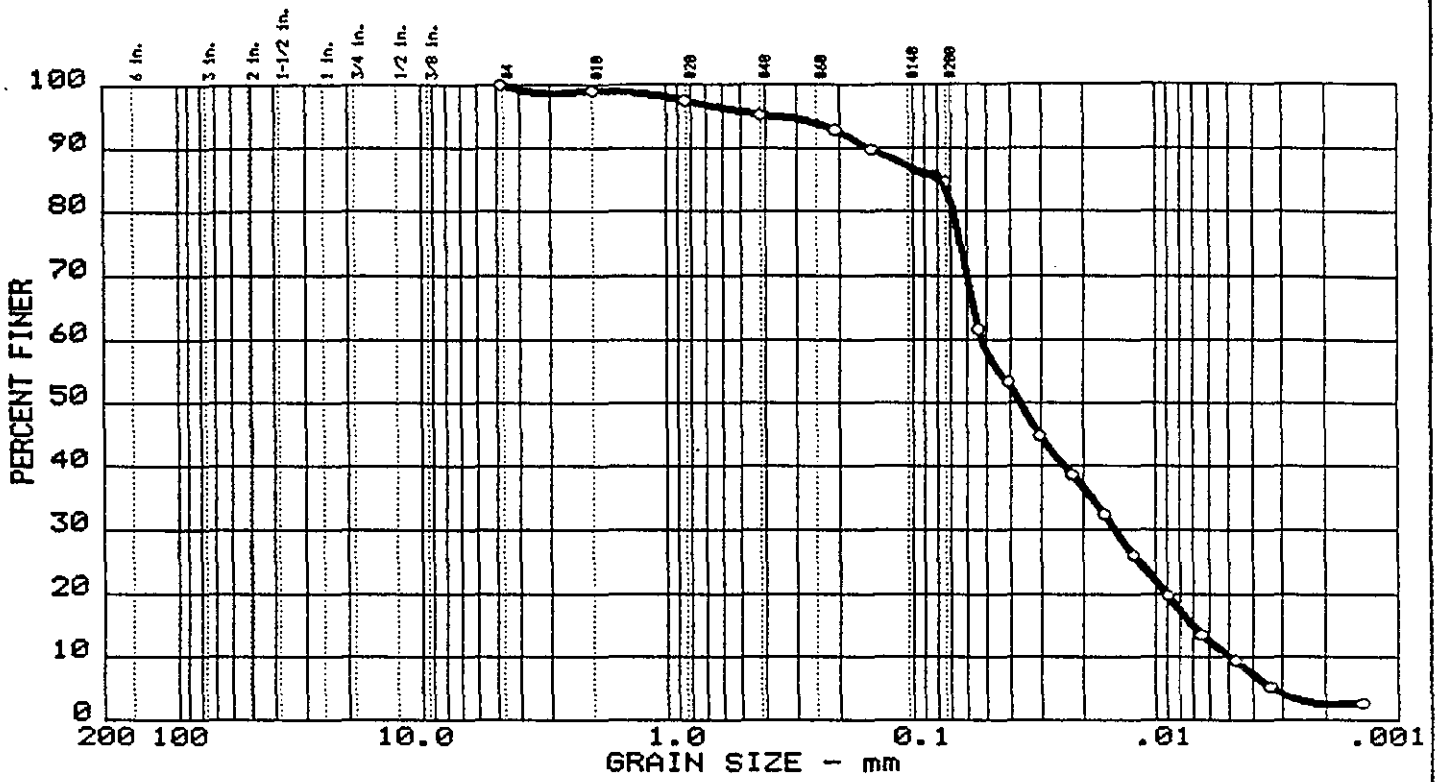
Date: 5-13-94

Remarks:
SOIL "BORING" SAMPLE
COLOR: DK. REDDISH BROWN
SAMPLE TAKEN AT DEPTH OF
11.0 FT. TO 12.0 FT.

GRAIN SIZE DISTRIBUTION TEST REPORT
CORPS OF ENGINEERS - NEW ENGLAND

Fig. No. 3

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
o	4	0.0	0.0	15.5	74.3	10.2

	LL	PI	D_{75}	D_{60}	D_{50}	D_{30}	D_{25}	D_{10}	C_c	C_u
o					0.04	0.015	0.0117	0.0049	0.84	10.9

MATERIAL DESCRIPTION	USCS	AASHTO
o SILT WITH SAND	ML	

Project No.: 129-1-4
Project: CRANSTON , R.I. SEWER STUDY AREA
o Location: FD 94-53 , SAMPLE NO. "S-7"

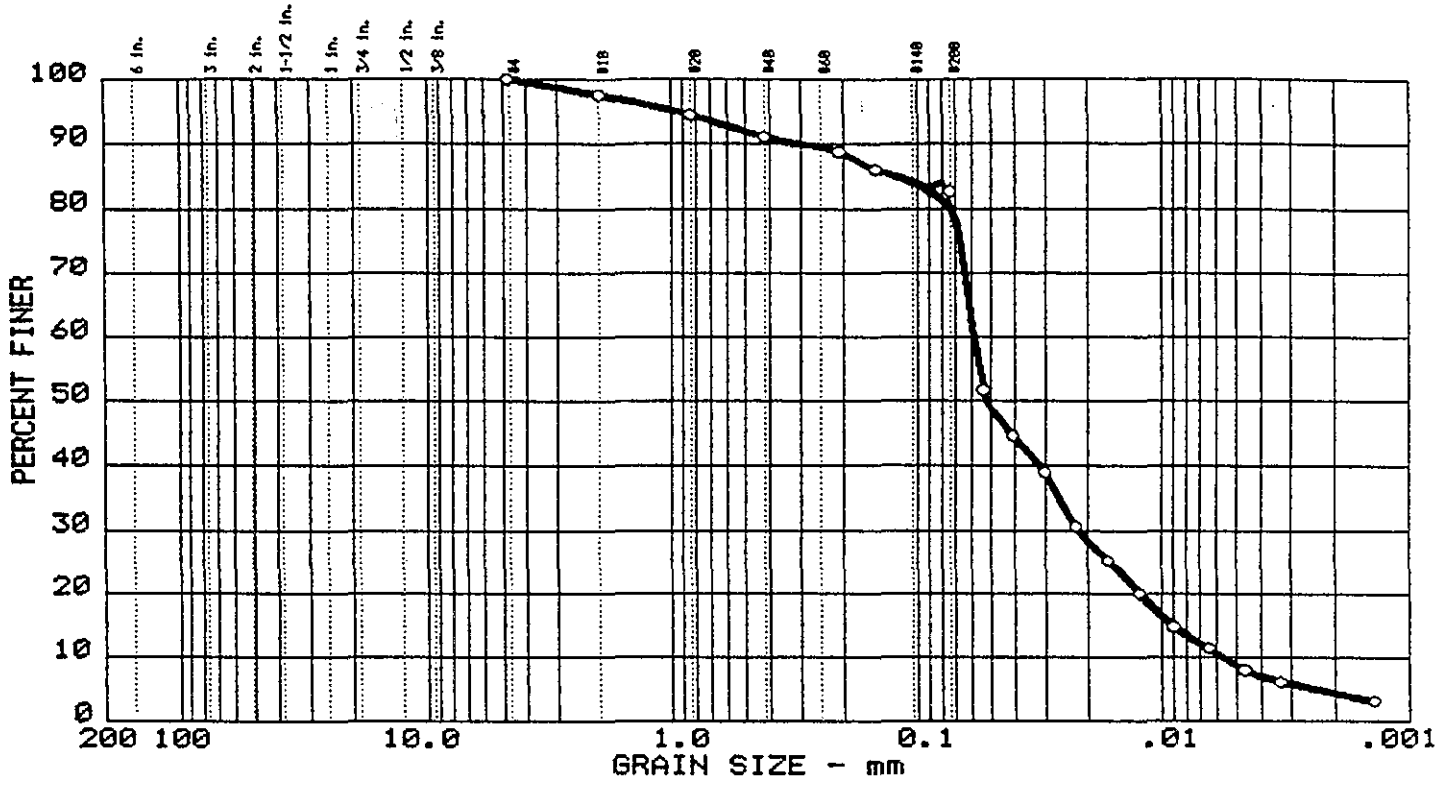
Date: 5-13-94

Remarks:
SOIL "BORING" SAMPLE
COLOR: LT. TO MED. GREY
SAMPLE TAKEN AT DEPTH OF
15.0 FT. TO 17.0 FT.

GRAIN SIZE DISTRIBUTION TEST REPORT
CORPS OF ENGINEERS - NEW ENGLAND

Fig. No. 4

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
o	5	0.0	0.0	17.2	74.1	8.7

	LL	PI	D_{75}	D_{60}	D_{50}	D_{30}	D_{25}	D_{10}	C_c	C_u
o					0.05	0.022	0.0160	0.0056	1.44	10.5

MATERIAL DESCRIPTION	USCS	AASHTO
o SILT WITH SAND	ML	

Project No.: 129-1-5
Project: CRANSTON , R.I. SEWER STUDY AREA
o Location: FD 94-53 , SAMPLE NO. "S-10"

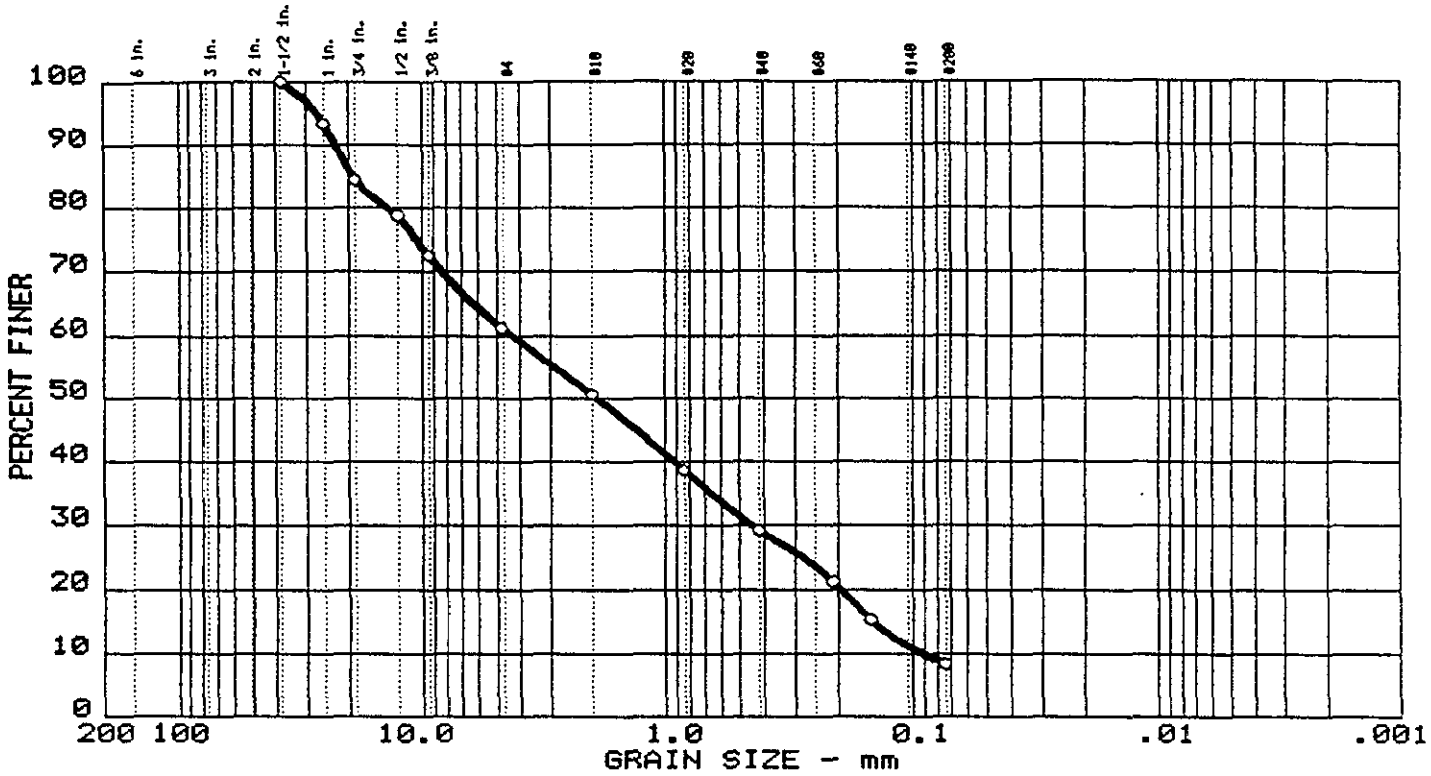
Date: 5-13-94

Remarks:
SOIL "BORING" SAMPLE
COLOR: LT. TO MED. BROWN
SAMPLE TAKEN AT DEPTH OF
22.5 FT. TO 24.5 FT.

GRAIN SIZE DISTRIBUTION TEST REPORT
CORPS OF ENGINEERS - NEW ENGLAND

Fig. No. 5

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
○	6	0.0	38.6	52.9	8.5	

	LL	PI	D_{75}	D_{60}	D_{50}	D_{30}	D_{25}	D_{10}	C_c	C_u
○			10.59	4.22	1.91	0.447	0.2786	0.0902	0.52	46.8

MATERIAL DESCRIPTION	USCS	AASHTO
○ POORLY GRADED SAND WITH SILT AND GRAVEL	SP-SM	

Project No.: 129-1-6
Project: CRANSTON , R.I. SEWER STUDY AREA
○ Location: FD 94-53 , SAMPLE NO. "S-13"

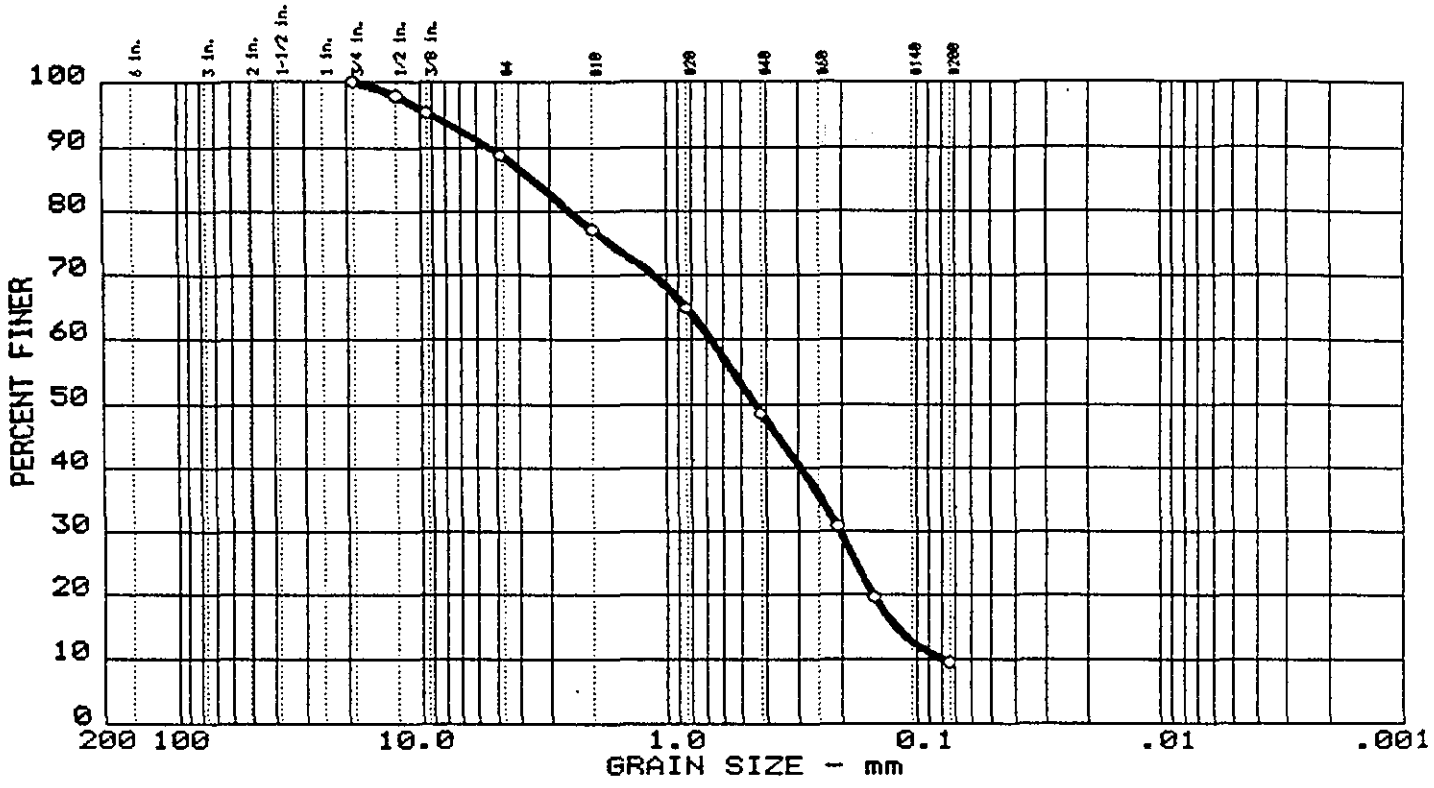
Date: 5-13-94

Remarks:
SOIL "BORING" SAMPLE
COLOR: LT. TO MED. BROWN
SAMPLE TAKEN AT DEPTH OF
30.0 FT. TO 32.0 FT.

GRAIN SIZE DISTRIBUTION TEST REPORT
CORPS OF ENGINEERS - NEW ENGLAND

Fig. No. 6

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
o	7	0.0	11.1	79.3	9.6	

	LL	PI	D_{75}	D_{60}	D_{50}	D_{30}	D_{25}	D_{10}	C_c	C_u
o			1.68	0.67	0.44	0.204	0.1766	0.0780	0.80	8.6

MATERIAL DESCRIPTION	USCS	AASHTO
o POORLY GRADED SAND WITH SILT	SP-SM	

Project No.: 129-1-7
Project: CRANSTON , R.I. SEWER STUDY AREA
o Location: FD 94-53 , SAMPLE NO. "S-20"

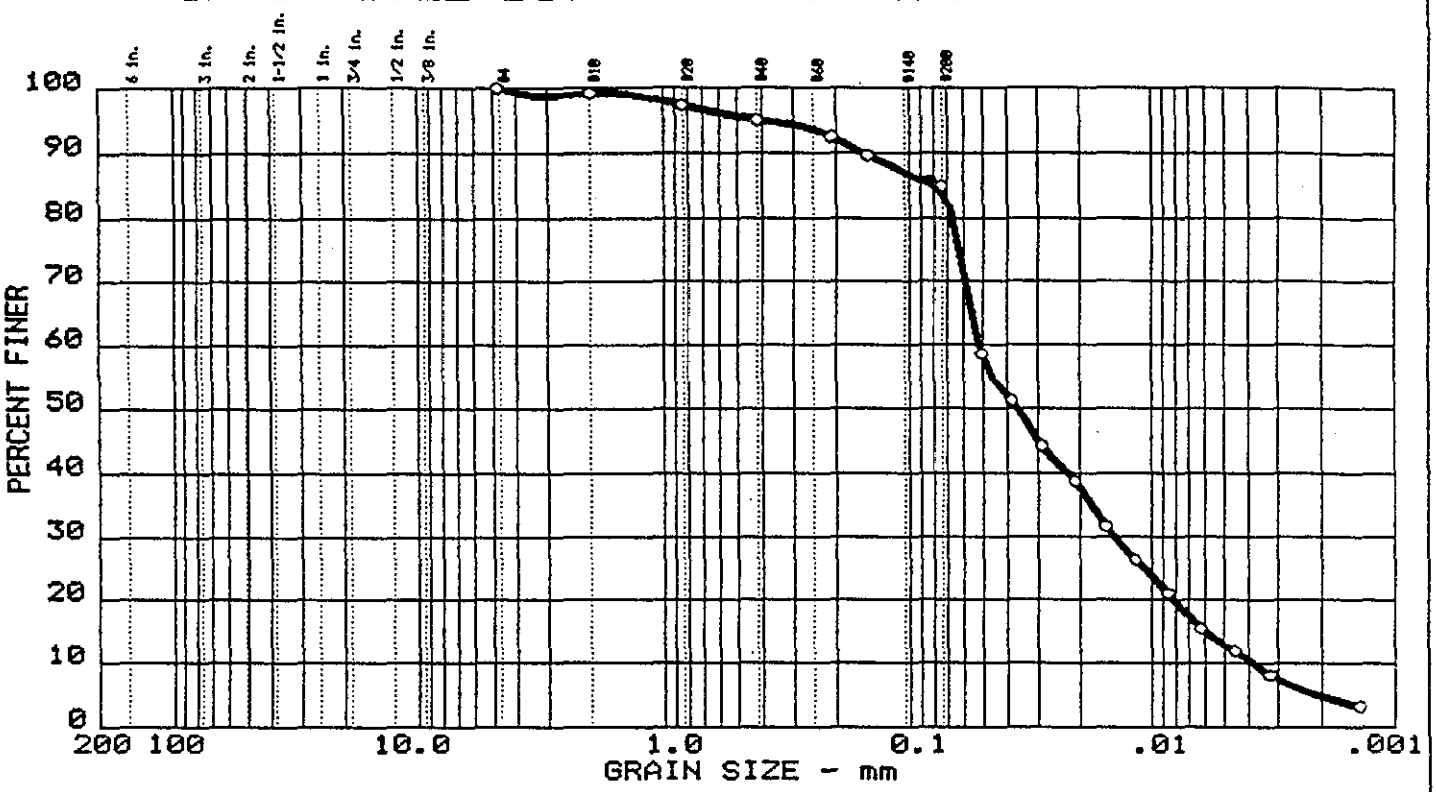
Date: 5-13-94

Remarks:
SOIL "BORING" SAMPLE
COLOR: LT. TO MED. BROWN
SAMPLE TAKEN AT DEPTH OF
47.5 FT. TO 49.5 FT.

GRAIN SIZE DISTRIBUTION TEST REPORT
CORPS OF ENGINEERS - NEW ENGLAND

Fig. No. 7

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
○	8	0.0	0.0	14.9	72.1	12.9

	LL	PI	D_{75}	D_{60}	D_{50}	D_{30}	D_{25}	D_{10}	C_c	C_u
○					0.04	0.014	0.0108	0.0038	1.04	13.6

MATERIAL DESCRIPTION	USCS	AASHTO
○ SILT WITH SAND	ML	

Project No.: 129-1-8
Project: CRANSTON , R.I. SEWER STUDY AREA
○ Location: FD 94-53 , SAMPLE NO. "S-22"

Date: 5-13-94

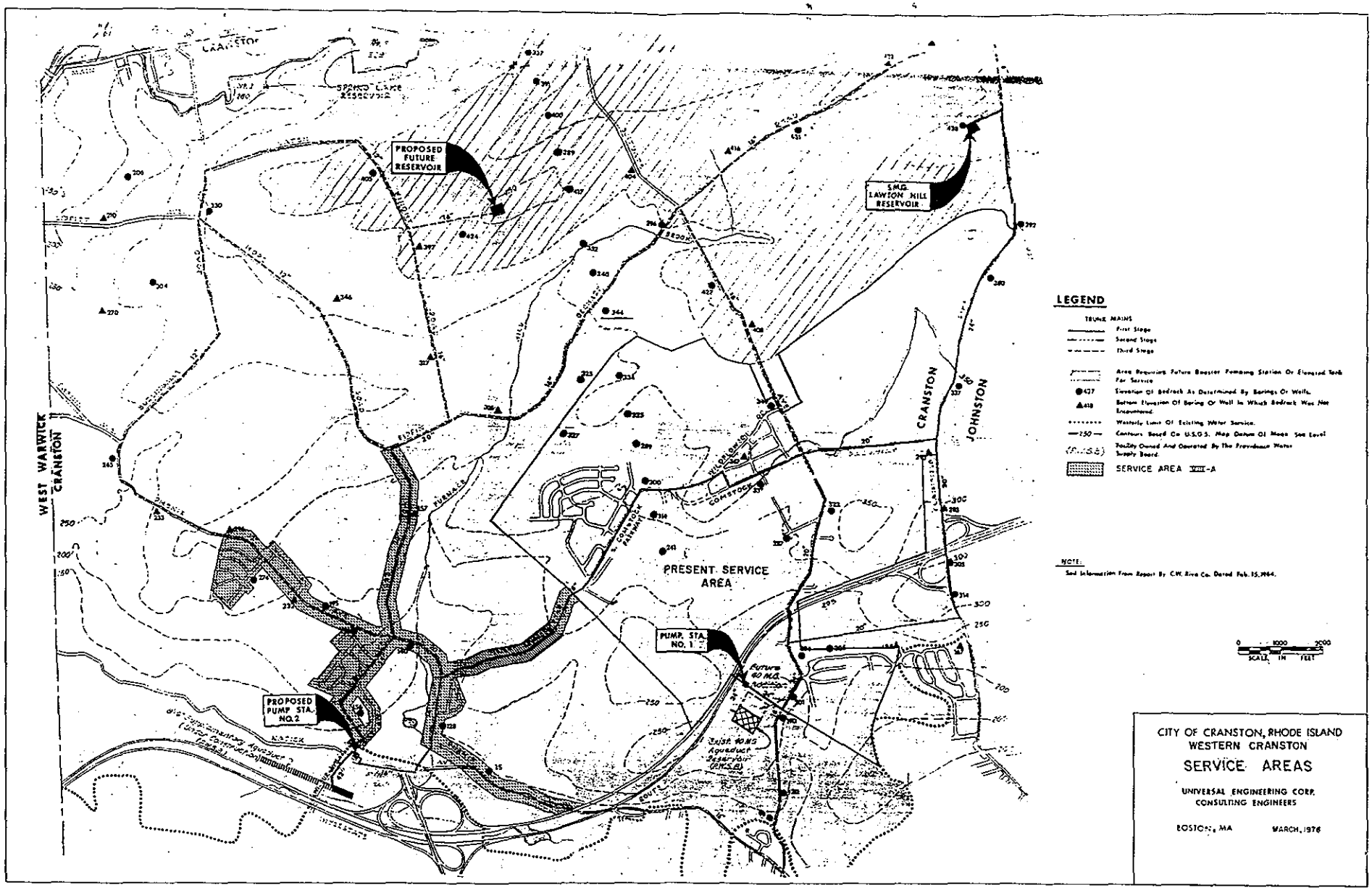
Remarks:
SOIL "BORING" SAMPLE
COLOR: LT. TO MED. BROWN
SAMPLE TAKEN AT DEPTH OF
53.0 FT. TO 55.0 FT.

GRAIN SIZE DISTRIBUTION TEST REPORT
CORPS OF ENGINEERS - NEW ENGLAND

Fig. No. 8

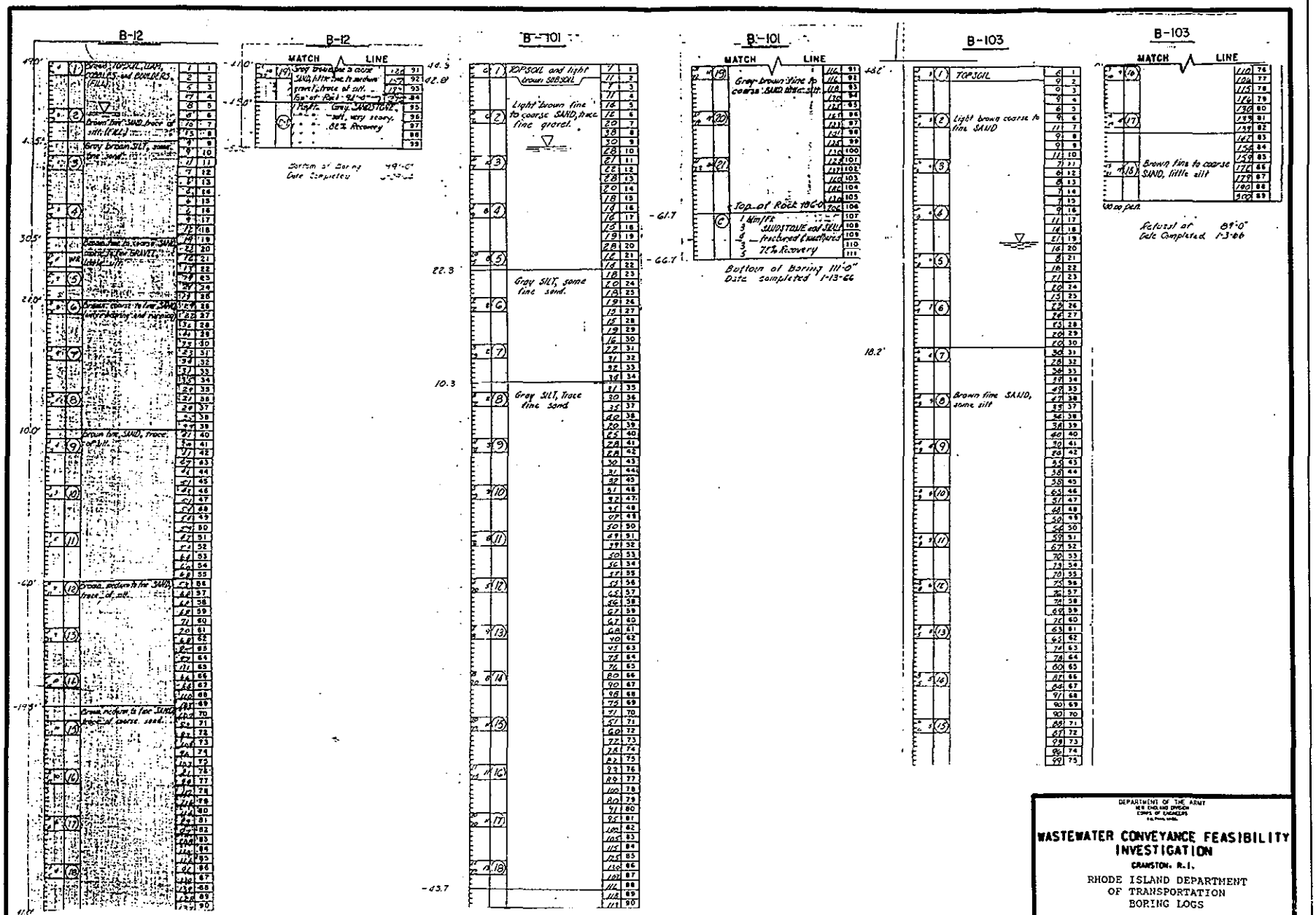
ATTACHMENT C-7

Universal Engineering Bedrock Depths


PROPOSED FUTURE RESERVOIR
S.M.G. LAWSON HILL RESERVOIR
PRESENT SERVICE AREA
PUMP. STA. NO. 1
PROPOSED PUMP STA. NO. 2
WEST WARWICK
CRANSTON
CRANSTON
JOHNSTON
LEGEND
TRUNK MAINS
First Stage
Second Stage
Third Stage
Area Requiring Future Booster Pumping Station Or Elevated Tank For Service
Elevation Of Bedrock As Determined By Borings Or Wells.
Bottom Elevation Of Boring Or Well In Which Bedrock Was Not Encountered.
Westerly Limit Of Existing Water Service.
Contours Based On U.S.G.S. Map Datum Of Mean Sea Level
Facility Owned And Operated By The Providence Water Supply Board.
SERVICE AREA VIII-A
NOTE:
See Information From Report By C.W. Rice Co. Dated Feb. 15, 1964.
SCALE IN FEET
CITY OF CRANSTON, RHODE ISLAND
WESTERN CRANSTON
SERVICE AREAS
UNIVERSAL ENGINEERING CORP.
CONSULTING ENGINEERS
BOSTON, MA
MARCH, 1976

ATTACHMENT C-8

Rhode Island Department of Transportation
Boring Logs

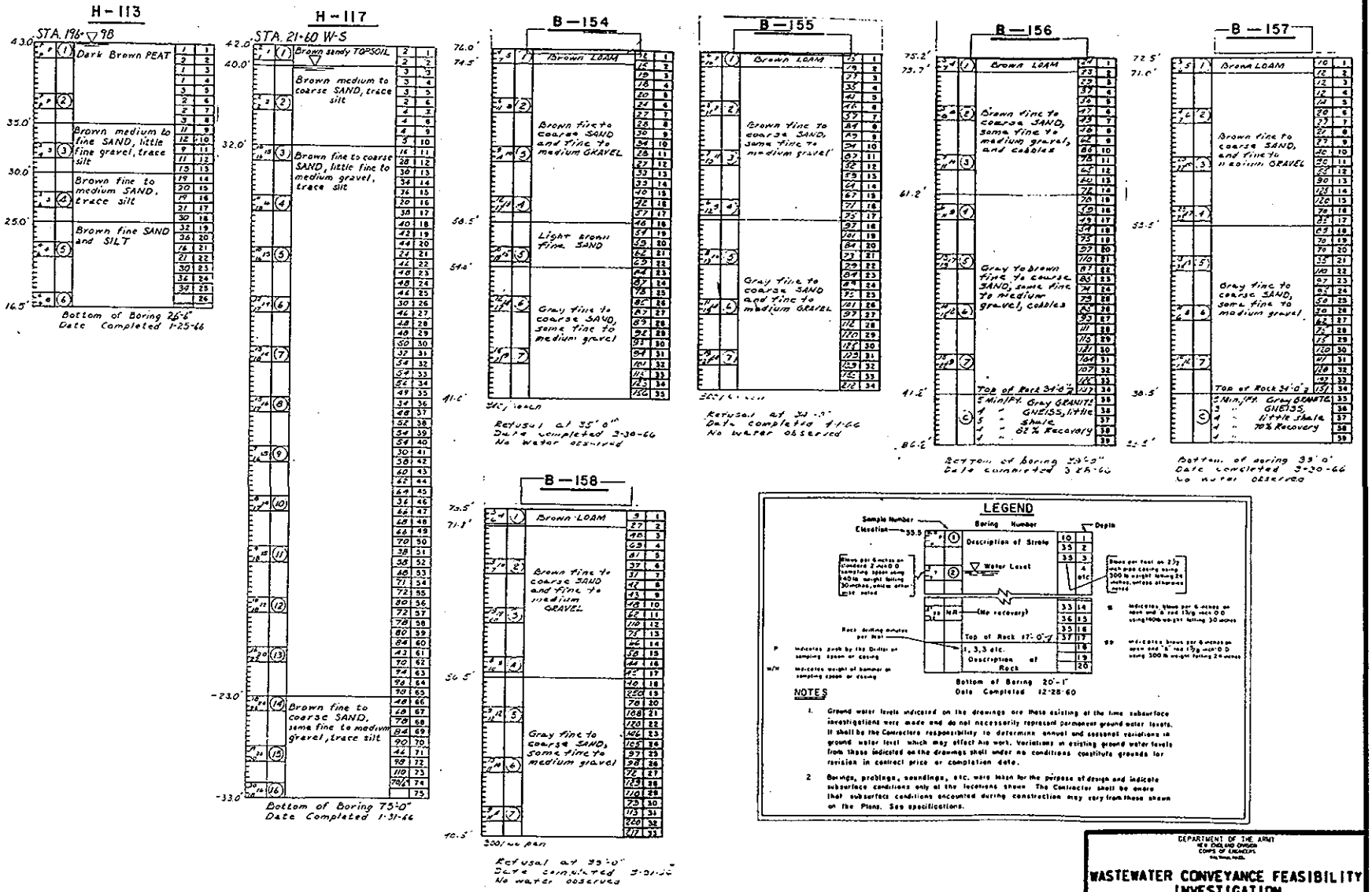


DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
U.S. Post Office

WASTEWATER CONVEYANCE FEASIBILITY INVESTIGATION

CRANSTON, R.I.

RHODE ISLAND DEPARTMENT OF TRANSPORTATION
BORING LOGS



DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.

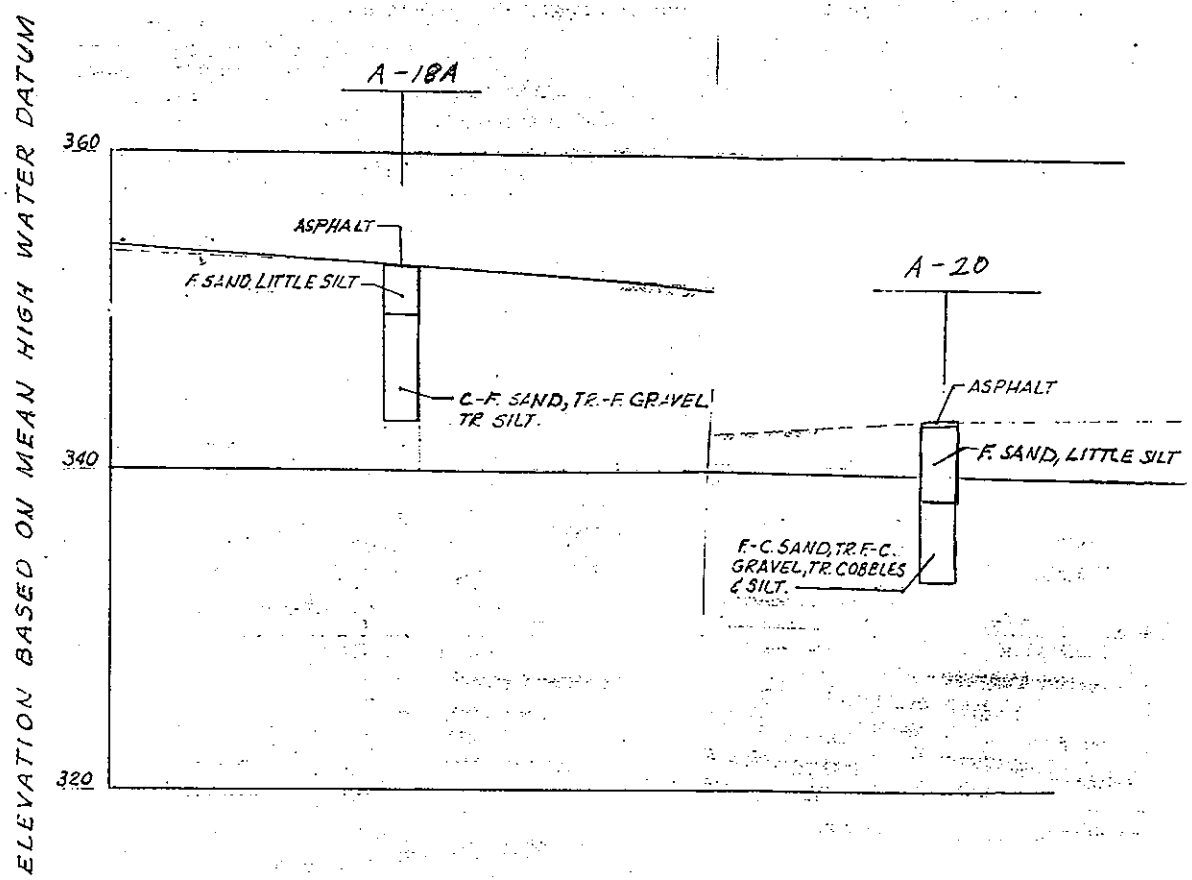
WASTEWATER CONVEYANCE FEASIBILITY INVESTIGATION

CRANSTON, R.I.

RHODE ISLAND DEPARTMENT OF TRANSPORTATION
BORING LOGS

ATTACHMENT C-9

Cranston Department of Public Works
Boring Logs



DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
Waltham, Mass.

WASTEWATER CONVEYANCE FEASIBILITY INVESTIGATION
CRANSTON, R.I.

CRANSTON DEPARTMENT
OF PUBLIC WORKS
BORING LOGS

APPENDIX D

Task 12c - Proposed Project, Pumping Stations and Sewers, Civil Engineering Design

APPRAISAL REVIEW

PROJECT: Wastewater Interceptor Feasibility Study

OWNER: Various Owners

LOCATION: Cranston, Rhode Island

EFFECTIVE DATE: August 1994

VALUATION SUMMARY: Total Estimated Real Estate Costs

1.	Scituate Pumping Station:	$208,000
2.	Scituate 6-Inch Force Main/VGS:	$ 28,000
3.	Wilbur Pumping Station:	$ 39,000
4.	Wilbur Force Main:	$ 9,000
5.	Improve Sockanosset Interceptor, Add Gravity Sewer:	$114,000
6.	Brookdale Trunk Sewer, Gravity Sewer:	$123,000
7.	Tilcon Trunk Sewer, Gravity Sewer:	$ 25,000
8.	Natick Phenix Trunk Sewer:	$ 84,000
9.	Comstock/Furnace Hill Trunk Sewer, Gravity Sewer:	$324,000

1. I have not physically inspected the property being appraised.

2. The comparable real estate sales used in estimating the value of the lands in this project are in the Appraisal Division files.

3. The data and analysis in the report are adequate for a preliminary estimate.

4. The report has been reviewed and is approved in the amounts shown above.

CERTIFICATION:

I certify that, to the best of my knowledge and belief:

- The facts and data reported by the review appraiser and used in the review process are true and correct.

- The analyses, opinions and conclusions in the review are limited only by the assumptions and limiting conditions stated in this review report, and are my personal, unbias, professional analyses, opinions, and conclusions.

- I have no present or prospective interest in the property that is the subject of this report and I have no personal interest or bias with respect to the parties involved.

Section 117, Cranston Rhode Island
Wastewater Conveyance Feasibility Investigation

APPENDIX D

TASK 12c - Proposed Project, Pumping Stations and Sewers, Civil Engineering Design

Department of the Army
Corps of Engineers, New England Division
Waltham, Mass

March 1995

TABLE OF CONTENTS

NARRATIVE

Subject	Page
1. Introduction	D-1
2. Scope	D-2
3. Sources of Information	D-3
4. Project Design	D-4
5. Descriptions of Project Features	D-7
6. Quantity Estimates	D-14
7. Additional Studies Required for Further Design	D-15

LIST OF QUANTITY ESTIMATES

Subject	Page
Service Area 1	
Proposed Scituate Pumping Station (504 GPM) Pippin Orchard Road	D-17
Proposed 6" Scituate Force Main/Variable Grade Sewer Proposed Scituate P.S. to I-295 P.S. Length: 12290 LF	D-18
Resurfacing of State Route 12/Scituate Avenue Pippin Orchard Road to Comstock Avenue Length: 6300 LF Width: 38 FT	D-19
Service Area 2	
Proposed Natick Trunk Sewer Length: 4655 LF	D-20
Proposed Comstock Trunk Sewer Length: 14160 LF	D-21

LIST OF QUANTITY ESTIMATES (CON'T)

Subject	Page
Proposed Tilcon Trunk Sewer Length: 2595 LF	D-22
Proposed Brookdale Trunk Sewer Length: 2065 LF	D-23
Proposed Wilbur Pumping Station (5660 GPM) Wilbur Avenue - I-295 Median at Existing Sewer Sleeve	D-24
Proposed 16" Wilbur Force Main Proposed Wilbur P.S. to Existing Sockanosset Interceptor Length: 9000 LF	D-25
Modifications to Existing Sockanosset Interceptor Supplemental 24" Gravity Sewer: Sta. 23+97.5 to Sta. 39+51.3 (1554 LF)	D-26
Replacement of Existing 16" R.C.P.P. Siphon with 24" R.C.P.P. Siphon Inlet Chamber (Sta. 20+34.3) To Existing Drain Chamber (Sta. 7+86.3) - 1248 LF	D-27

LIST OF PLATES

Plate No.	Title
PLATE D-1	PROPOSED SCITUATE PUMPING STATION PLAN AND SECTIONS
PLATE D-2	PROPOSED NATICK TRUNK SEWER PLAN AND PROFILE NO. 1
PLATE D-3	PROPOSED NATICK TRUNK SEWER PLAN AND PROFILE NO. 2
PLATE D-4	PROPOSED COMSTOCK TRUNK SEWER PLAN AND PROFILE NO. 1
PLATE D-5	PROPOSED COMSTOCK TRUNK SEWER PLAN AND PROFILE NO. 2
PLATE D-6	PROPOSED COMSTOCK TRUNK SEWER PLAN AND PROFILE NO. 3
PLATE D-7	PROPOSED COMSTOCK TRUNK SEWER PLAN AND PROFILE NO. 4
PLATE D-8	PROPOSED COMSTOCK TRUNK SEWER PLAN AND PROFILE NO. 5
PLATE D-9	PROPOSED TILCON TRUNK SEWER PLAN AND PROFILE
PLATE D-10	PROPOSED BROOKDALE TRUNK SEWER PLAN AND PROFILE
PLATE D-11	PROPOSED WILBUR PUMPING STATION PLAN AND PROFILE
PLATE D-12	TYPICAL TRENCH SECTION IN EARTH
PLATE D-13	TYPICAL TRENCH SECTIONS IN BEDROCK

SECTION 117
WASTEWATER CONVEYANCE FEASIBILITY INVESTIGATION
CRANSTON, RHODE ISLAND

TASK 12 - PRELIMINARY DESIGN OF PROPOSED PROJECT
PUMPING STATIONS AND SEWERS - CIVIL

1. Introduction

a. Proposed Project

The proposed project provides for the conveyance of wastewater flows from western Cranston to the City of Cranston Wastewater Treatment Facility (WWTF) through the year 2045 through construction of gravity sewers, pumping stations and force mains/variable grade sewers. Listed by the geographical service areas defined in the main report, project features are as follows:

Service Area 1

Proposed Scituate Pumping Station (504 GPM)
Pippin Orchard Road

Proposed 6" Scituate Force Main/Variable Grade Sewer
Proposed Scituate P.S. to I-295 P.S.
Length: 12290 LF

Service Area 2

Proposed Natick Trunk Sewer
Length: 4655 LF

Proposed Comstock Trunk Sewer
Length: 14160 LF

Proposed Tilcon Trunk Sewer
Length: 2595 LF

Proposed Brookdale Trunk Sewer
Length: 2065 LF

Proposed Wilbur Pumping Station
Wilbur Avenue - I-295 Median at Existing
Sewer Sleeve

Proposed 16" Wilbur Force Main
Proposed Wilbur P.S. to Existing Sockanosset
Interceptor
Length: 9000 LF

b. Associated Construction

Depending on the timeframe of construction of the proposed Scituate Force Main/Variable Grade Sewer, the following State of Rhode Island, Department of Transportation requirement may apply:

Resurfacing of State Route 12/Scituate Avenue
Pippin Orchard Road to Comstock Avenue
Length: 6300 LF Width: 38 FT

c. Improvements to Existing Conveyance System

Construction of the proposed project features in western Cranston will require modifications to existing sewer system components in eastern Cranston which will receive increased flows from the sewer service areas on route to the WWTF. These improvements are based on providing sufficient system capacity using projected flows for the years 2015 and 2045. In order to fully assess the impacts of the proposed project, the following modifications have been identified and evaluated as part of the preliminary design.

Modifications to Existing Sockanosset Interceptor
Supplemental 24" Gravity Sewer: Sta. 23+97.5 to Sta. 39+51.3 (1554 LF)

Replacement of Existing 16" R.C.P.P. Siphon with 24" R.C.P.P.
Siphon Inlet Chamber (Sta. 20+34.3) to Drain Chamber (Sta. 7+86.3) - 1248 LF

2. Scope

This appendix presents sources of information, design criteria and assumptions used to develop designs and quantity estimates for the proposed project features and associated improvements required for the existing sewer system. A brief description and quantity estimate of each project feature and required sewer system modification, and plans, profiles and sections of proposed pumping stations and gravity sewers are included herein.

Due to the study's large geographical area and limits of available funding, a detailed study of existing utilities and a hazardous and toxic waste evaluation were not included. Due to their significant potential construction cost and schedule impacts, these investigations should be included in future project design.

3. Sources of Information

The following information was used to identify existing features and general requirements associated with construction of new pumping stations and sewer lines.

(1) *TR-16, Guides for the Design of Wastewater Treatment Works*, 1980 Edition, prepared by the Technical Advisory Board of the New England Interstate Water Pollution Control Commission.

(2) Specifications for Highways Covering Residential and Industrial Developments, Cranston Department of Public Works, January 1987, Revised November 1988, City of Cranston, Engineering Division, Cranston, Rhode Island.

(3) City of Cranston, Rhode Island, Sewer Use Ordinance, DRAFT, Revised: February 21, 1992.

(4) City of Cranston base sewer system mapping, Scale: 1"=600'.

(5) Sewer plans (design and record drawings) along proposed pipe routes, Scale: 1"=40', City of Cranston, Rhode Island, Public Works Department, Sewer Division.

(6) Aerial topographic mapping prepared by Sewall Company, Old Town, Maine, from aerial photographs dated 12-09-93, Scale: 1"=100', Contour Interval: 2 feet.

(7) Aerial topographic map of Western Cranston, photographed April 29, 1972 by Moss & Associates Photogrammetrists, Inc. Scale: 1"=200', Contour Interval: 5 feet.

(8) General plans, Drainage and Utility Plan, Interstate Route 295 - Cranston, Wilbur Ave to Ralph's Pond, Scale 1"=50'.

(9) Projected Sewer Plan, Northwest Cranston, City of Cranston, Rhode Island Wastewater Facility Plan Amendment, Tutela Engineering Associates, Inc., Scale 1"=600'.

(10) Design drawings for three-mile 14" force main/variable grade sewer from I-295 Pumping Station, Tutela Engineering Associates, Inc.

(11) Design Drawings for the Providence Water Supply 102" diameter Aqueduct.

(12) Site visits to proposed work areas, 1993 and 1994.

4. Project Design

a. Basis of Design

(1) General. Information developed during Task 7, Feasibility Design, was used as the basis for preliminary design. Task 7 analysis of existing topography identified contributory areas for the pumping stations and gravity sewers located within the Cranston Service Area. Locations and sizes of pumping stations and sewer lines were modified during preliminary design based on detailed topographic survey performed in December 1993 and Task 12 hydraulic, geotechnical, environmental and archeological studies. Further hydraulic analysis and external study coordination during Task 12 identified the need to replace the existing sewer siphon at the WWTF. Project features and requirements were further developed during Task 12 preliminary design through coordination with the State of Rhode Island, the City of Cranston and it's consultant, Tutela Engineering Associates.

Engineering design of pumping stations and sewers incorporated information from the following sources.

(2) Topographic Mapping. Aerial topographic mapping prepared by James W. Sewall Company, Old Town, Maine, from aerial photographs dated 12-09-93 (Scale 1"=100", Contour Interval: 2 feet), was obtained to support preliminary design of gravity sewers in western Cranston and the Wilbur Pumping Station. Aerial topographic mapping of western Cranston prepared by Moss & Associates, Photogrammetrists, Inc. in 1972 (Scale: 1"=200', Contour Interval: 5'), which was used as the basis for layout of all project features in western Cranston for Task 7, was also used for determining requirements for the proposed Scituate Pumping Station and Scituate Force Main/Variable Grade Sewer in Service Area 1. While some development has occurred in this area since 1972, existing site topography and features in the area of proposed project features remains essentially unchanged. City sewer mapping along Amflex Drive and Sailor Way were used to determine street layouts and ground elevations for sewer alignment in this area. Existing sewer mapping was similarly used as the basis for design of the Wilbur Force Main, modifications to the Sockanosset Interceptor and replacement of the 16" sewer siphon in the vicinity of the WWTF. All elevations

refer to the City of Cranston Survey Datum (Mean High Water).

(3) Hydraulic Analysis. Hydraulic studies determined requirements for pipe sizes and slopes for the gravity trunk sewers, required sizes for force mains and variable grade sewers, improvements to the Sockanosset Interceptor, and requirements for replacement of the existing sewer siphon.

(4) Geotechnical Studies. Results of subsurface investigations were used to determine the nature and extent of bedrock and boulders to be included in rock excavation quantities, including appropriate contingencies in each reach. Expected groundwater levels were used to determine the type of earth support system and the amount of dewatering required. Typical pipe trench sections required earth support systems, pipe backfill requirements and pavement design. For results of subsurface investigations and geotechnical engineering studies, see Appendix C.

(5) Mechanical Analysis. Mechanical engineering analysis determined pump station building and site layout requirements, force main material, and air release valve locations for the force main and force main/variable grade sewer.

(6) Environmental Assessment. Delineations of buffer limits for watercourses and required actions to minimize environmental impacts, including soil handling and trench backfill requirements, have been incorporated.

(7) Archeological Investigation. The location of the Wilbur Pumping Station was determined to be within the limits of the Oaklawn District. Two designated historic properties on Natick Avenue were also identified on topographic base mapping. These properties will not be impacted by construction of the proposed Natick Trunk Sewer.

b. Siting of Project Features

(1) Background. Proposed pumping station locations and sewer alignments were based on locations developed during Task 7, Feasibility Design of Alternatives. Task 7 pumping station locations considered primarily the availability of currently undeveloped parcels in areas which would allow for gravity flows from the contributory areas. Selection of force main and force main/variable grade sewer routes was based on the most direct alignment to minimize length and located adjacent to existing gravity sewers and within existing roads wherever possible. Gravity sewer alignments were determined based on considering

cost of pipe installation, locations of future local sewer lateral connections, ease of construction, traffic impacts, especially on primary roads, and required modifications to existing utilities. Gravity sewers generally followed the topography which allows for collection of flows from lateral sewers at a minimum pipe depth. Topography in many areas was assumed since substantial development had occurred in western Cranston since the 1972 base mapping was prepared.

(2) Pumping Stations. Further analysis during preliminary design has resulted in resiting of both the Scituate and Wilbur Pumping Stations. The Scituate Pumping Station (504 GPM) was resited from the Task 7 location, which was approximately 400 feet south of Scituate Avenue along Pippin Orchard Road. The new location, approximately 30 feet lower in elevation and 500 feet farther south on Pippin Orchard Road, would allow for gravity flow of wastewater to the pumping station from residential developments south of the previous location. Due to real estate considerations, the Wilbur Pumping Station has been resited in the I-295 median. Task 7 considered locations on privately-owned property both east and west of the highway. The median site is within the 100-yr floodplain for Meshanticut Brook.

Wastewater pumping stations have been sited to prevent physical damage by the 100-yr flood and to be accessible during the 25-yr flood. Stations have been located off public roads, and driveways have been provided with bituminous concrete pavement to facilitate vehicle access and reduce maintenance.

(3) Sewers. Selected portions of sewer lines have been relocated within existing roadways based on new topographic mapping and the presence of the 102" diameter Providence Water Supply Aqueduct, which parallels the west side of the northbound I-295 embankment. A portion of the proposed Comstock Trunk Sewer has been aligned to follow the centerline of proposed streets within the approved subdivision located on the east side of Phenix Avenue at Furnace Hill Brook.

c. Design Criteria

(1) Pumping Stations. Site layout includes a 24'-wide bituminous driveway for clearance around one side and to the rear of the building for access by large service and emergency vehicles. Sites have been provided with six-foot-high chain link fencing enclosure around the building and appurtenant exterior structures for safety and site security. Landscaping has been

included at the front of the site to screen facilities from the road.

(2) Sewers. Gravity sewers have been laid in a straight alignment and at a uniform slope between manholes. The required depth of installation was determined from estimations of the lowest basement elevations from topographic mapping. The depth of the sewer allowed for drainage of basement fixtures to service connections exiting the building one foot above the basement floor elevation except where noted. A five-foot minimum cover over the top of the pipe was assumed to protect facilities from freezing. Manholes have been located at a 300' maximum spacing, at all intersections and at all changes in grade, size or alignment. Drop manholes have been provided where sewers enter the manhole at 24 inches or more above the manhole invert. Concrete encasement of sewer lines was included in quantity estimates where crossings under existing water lines were likely and where Rhode Island Department of Environmental Management criteria for 18" vertical separation criteria could not likely be met.

Force mains and variable grade sewers have been laid with a minimum of five feet of cover to prevent freezing. Air relief valves have been included at locations identified by mechanical engineering analysis. Air release manholes have been provided with vent caps containing potassium permanganate for odor control. Drain valves have been included at all relative low points in the force mains and variable grade sewers. Connections to existing gravity sewers have been assumed where sewers are adjacent. Cleanout manholes have been included in areas not currently served by sewers.

Typical trench sections used to develop quantity estimates are shown on Plates D-12 and D-13. A 25-foot wide area was assumed for estimating work limits and quantities associated with site clearing and restoration.

5. Descriptions of Project Features

Descriptions of proposed project features, associated construction and improvements to the existing conveyance system are described below.

Plates D-1 through D-11, showing plans and sections of pumping stations and plans and profiles of gravity sewers, are included at the end of this section.

a. Service Area 1

The project features associated with conveying flows from northwest Cranston including the city's proposed Village Center to the I-295 Pumping Station currently under construction include the following:

(1) Proposed Scituate Pumping Station. Plate D-1

Location: West side of Pippin Orchard Road, approximately 900 feet south of State Route 12/Scituate Avenue
Capacity: 504 GPM
Building Dimensions: 16 feet by 23 feet
Site Dimensions: 100 feet by 130 feet
Site Area: 0.3 AC

The proposed Scituate Pumping Station is located approximately 900 feet south of Scituate Avenue on the west side of Pippin Orchard Road . The station has been sited, based on a 100-foot buffer classification for Furnace Hill Brook, approximately 100 feet north and west of the brook. Furnace Hill Brook was not included in flood insurance mapping covering the City of Cranston, indicating that the area around the brook is not subject to inundation during significant flooding events. The floor elevation has been estimated to be El. 371, based on 5' photogrammetric mapping contours. The vegetated, undeveloped site is located in a low-density residential area.

(2) Proposed Scituate 6" Force Main/Variable Grade Sewer.

From: Proposed Scituate Pumping Station
To: I-295 Pumping Station under construction
Length: 12290 LF
Pipe diameter/type: 6" SDR 18 PVC
Force main: Sta. 0+00 to Sta. 36+00
Variable grade Sewer: Sta. 36+00 to Sta. 122+90

A 6" force main/variable grade sewer is proposed from the Scituate Pumping Station to the I-295 Pumping Station under design and construction by the City of Cranston, a distance of approximately 12,290 feet. The pipe has been located within Pippin Orchard Road, the paved shoulder along the south side of Scituate Avenue/State Route 12, within Comstock Avenue, Amflex Drive and Sailor Way, and off-road within the Plainfield Pike

right-of-way (See City of Cranston base sewer mapping included in the main report). Based on a valve manufacturer's analysis of the pump station and sewer profile, air/vacuum valves have been included at high, intermediate and down turn points along the sewer alignment. Cleanout manholes have been included at low points occurring at either end of 6300 LF reach along State Route 12/Scituate Avenue. The cleanout at the intersection of Comstock Avenue may be replaced by a connection to future local gravity sewers contributing to the proposed Comstock Trunk Sewer. The 6" sewer alignment parallels the existing off-road gravity sewer in order to reduce construction costs associated with roadway construction, maintain gravity flow and eliminate the need for a cleanout and air release manhole near the intersection of Amflex Drive and Sailor Way. It has been assumed that the existing sewer easement would have to be increased from 20 to 25 feet for a distance of 550 feet to accommodate construction and maintenance of the proposed 6"sewer through this reach.

(3) Resurfacing of State Route 12/Scituate Avenue.

From: Pippin Orchard Road
To: Comstock Avenue
Length: 6300 LF
Width: 38 FT
Pavement design: 2" bituminous concrete surface course

The Rhode Island Department of Transportation, Division of Maintenance, has indicated that a utility permit would be required to install the sewer within the shoulder along a 6300-LF reach of State Route 12/Scituate Avenue, from Pippin Orchard Road to Comstock Avenue. Additionally, if the sewer was constructed within five years of resurfacing of the roadway (currently scheduled for 1994), they would require that the road be resurfaced to it's full width with a 2" bituminous surface course and restriping of the roadway surface within the 6300-foot reach of pavement disturbance.

b. Service Area 2

Proposed project features associated with conveying flows within the western Cranston service area south of State Route 12/Scituate Avenue to the WWTF include the following.

(1) Proposed Natick Trunk Sewer
Plates D-2 and D-3

Length: 4655 LF

From: Natick Avenue, 700'+/- south of Comfort Drive
To: Proposed Wilbur Pumping Station inlet
Gravity sewer sizes: 12" and 18"

The 3500' reach adjacent to Meshanticut Brook has been relocated from Task 7 to Locust Glen and Hornbeam Drives, due to new topography in the Natick Village subdivision and the presence of the 102" diameter Providence Water Supply Aqueduct. Based on topographic mapping, approximately four homes in the subdivision adjacent to the brook are too low to be serviced at the sewer invert elevation shown. The sewer would have to be lowered in excess of four feet for a 2000' reach in order to service these homes by gravity, significantly impacting construction costs. Depending on the actual basement elevations, servicing these homes may not be feasible since the resultant gravity sewer invert elevation may be below the existing sewer sleeve. Homes could be served at the sewer depth shown by installation of individual ejector stations. The sewer crosses under the 102" diameter aqueduct at Sta. 1+20±, with approximately 18 inches of clearance between two pipes.

Revisions in topography and pipe alignment in the Natick Village area have resulted in changes to the pipe slopes and sizes assumed in Task 7. Task 7 analysis determined 12", 15" and 24" diameter pipe sizes would be required in this area. Hydraulic analysis during preliminary design has determined that an 18" diameter pipe throughout the reach would provide sufficient capacity.

Based on the new topography south of Natick Village between Natick Avenue and the I-295 northbound embankment, this area is too low to be served by gravity flow to the proposed Natick Trunk Sewer. Flows from this area could be pumped into the sewer or alternatively flow by gravity to the existing sewer sleeve south of Valley View Circle and into existing conveyance facilities east of I-295.

The 4000' reach west of Natick Avenue, which included a 2500' reach up an undeveloped hillside, has been eliminated due to construction, access, maintenance and real estate concerns. Flows from the existing housing development at the end of the former alignment off Phenix Avenue, which were previously included in the proposed Natick/Phenix Trunk Sewer design, could be diverted to the Proposed Comstock Trunk Sewer via a small pumping station, force main and gravity sewer along Phenix Avenue. These features have not been investigated further. The additional flow capacity has been provided for in the design of the Comstock Trunk Sewer.

(2) Proposed Comstock Trunk Sewer
Plates D-4 through D-8

Length: 14160 LF
From: South end of Council Rock Road
To: Intersection of Natick Avenue and Herod Street
Gravity sewer sizes: 12", 15", 18" and 24"

More detailed preliminary design has resulted in revisions to pipe sizes determined in Task 7 analysis. Approximately 2300 feet of sewer at the upstream limit on Council Rock Road, where required pipe size has been reduced from 12" to 8", has been eliminated from the proposed project. The required pipe sizes in the reach between the upstream limit and Phenix Avenue, which was previously 15", is now 12", 15" and 18". Approximately 2000 feet of the sewer has been realigned along Kimberly Lane (North) from adjacent to the brook to the roadway. Due to the steepness of the lower portion of Kimberly Lane, several drop manholes are now required.

The lower 4100' reach of the proposed Comstock Trunk Sewer below Phenix Avenue remains 24" in diameter. The sewer in this reach has been designed to carry flows from the upper portion of the former Natick/Phenix Trunk Sewer. The 2200-foot reach immediately downstream of Phenix Avenue has been realigned away from Furnace Hill Brook due to new topographic mapping and proposed and existing site development. The pipe route follows the proposed High Meadow and Spring Meadow Courts located just south of Phenix Avenue, travels off road for approximately 400 feet, then continues along Hines Farm Road 1000 feet, rejoining the previous Task 7 alignment. Several drop manholes are required in the 1500' reach upstream of Natick Avenue, where the pipe invert drops in excess of 60 feet.

(3) Proposed Tilcon Trunk Sewer
Plate D-9

Length: 2595 LF
From: 300' northeast of Phenix Avenue on Natick Avenue
To: Intersection of Natick Avenue and Herod Street
Gravity sewer sizes: 18"and 24"

The Tilcon Trunk Sewer has been terminated at Sta. 25+95 along Natick Avenue. Task 7 evaluated extending the sewer through the existing quarry along "paper streets" to a terminus at Sta. 62+50. Due to the uncertainties associated with the future use and development of the quarry site, more detailed design could not be accomplished in this area.

More detailed preliminary design has identified the need to relocate approximately 300 feet of sewer off road to maintain gravity flow under Furnace Hill Brook. The remainder of the sewer remains within Natick Avenue.

Hydraulic analysis for preliminary design of required pipe size has revised the Task 7 requirement for a 900' reach of 30" pipe at the downstream limit of the sewer to 24" pipe.

(4) Proposed Brookdale Trunk Sewer
Plate D-10

Length: 2065 LF
From: Intersection of Phenix Avenue and Herod Street
To: Proposed Wilbur Pumping Station inlet
Gravity sewer size: 24"

Hydraulic analysis for preliminary design revised the 30" and 36" pipe requirements for the Brookdale Trunk Sewer to 24" diameter. The Task 7 alignment has been retained.

Research associated with subsurface investigations revealed the presence of the 102" diameter Providence Water Supply Aqueduct which parallels the west side of the I-295 northbound embankment. According to Tutela Engineering Associates, the aqueduct is not currently in service. As shown on Plate D-10, the aqueduct crosses the proposed sewer alignment at the intersection of Herod, Dwight and Ionia Streets. Due to the depth of the aqueduct, the sewer must cross over the aqueduct. A concrete cradle extending 15 feet either side of the centerline of the aqueduct has been included to adequately support the sewer in this area.

(5) Proposed Wilbur Pumping Station.
Plate D-11

Location: North side of Wilbur Avenue in I-295 Median at Existing Sewer Sleeve
Building dimensions: 35 feet by 45 feet
First floor elevation: 49 - one foot above 100-yr flood elevation of 48 (51 NGVD City of Cranston Datum is 2.85' higher)
Bottom elevation: 13.0
Site Dimensions: 110 feet by 170 feet (average)
Site Area: 0.5 AC

In order to minimize the loss of flood plain and the resulting requirement to provide for equivalent flood plain compensation, the station has been located at higher ground to the rear of the site. Existing grades at the front of the site have been maintained, while grades to the rear of the station have been lowered to level the site and provide to compensate for the loss of flood storage created by the structure. Retaining walls near the toe of the highway embankments are required to provide adequate clearance for construction and permanent access around the pumping station. A concrete-capped steel sheet pile wall (6'-high average), anchored with tie-backs into the existing highway embankments, has been assumed for preliminary design. Construction of the pumping station to a 35-foot depth will require an extensive earth support system. In order to minimize costs associated with site dewatering, the sheeting has been extended to an existing silt layer encountered at El. -7 to cut off the flow of groundwater into the excavation. The preliminary design for the station and associated site work should be reviewed by the Department of Transportation to fully evaluate design and construction requirements.

Site selection and design has considered its location within the Oaklawn District. The station has been resited from previous locations considered in Task 7 which included sites in residential areas both east and west of the median. Pumping station siting allows for an approximate 70-foot setback from the edge of the road, minimizing visual and noise impacts.

(6) Proposed Wilbur Force Main.

From: Proposed Wilbur Pumping Station
To: Existing Sockanosset Interceptor at intersection of Surrey and Belvedere Drives
Length: 9000 LF
Pipe diameter/type: 16" SDR 18 PVC

In order to minimize traffic control requirements, potential utility relocations and impacts with construction in residential areas, the reach of the force main previously located in Turner Avenue has been revised to follow Vinton Avenue.

More detailed preliminary design has reduced the required force main diameter from 18" to 16". Mechanical analysis of the force main under operation has indicated that three air release valves are required along the 9000' route.

(7) Modifications to Existing Sockanosset Interceptor.

From: Sta. 23+97.5
To: Sta. 39+51.3
Length: 1554 LF
Gravity sewer size: 24"

Modifications to a 1554-foot reach, between Sta. 23+97.5 to Sta. 39+51.3, are required to mitigate surcharge conditions which develop by receipt of additional flows from the Wilbur Force Main under the year 2045 design condition. Proposed modifications consist of placing a supplemental 24" gravity sewer parallel to and south of the existing 30" sewer, adjacent to the existing 100-foot easement for the 42" City of Providence water main.

(8) Replacement of Existing 16" Siphon.

From: Siphon Inlet Chamber - Sta. 20+34.3
To: Drain Chamber - Sta. 7+86.3
Length: 1248 LF
Pipe size: 24"

Approximately 350' downstream of the proposed supplemental 24" gravity sewer at Sta. 20+42, flows from the Sockanosset Interceptor enter the siphon inlet chamber near the intersection of Pettaconsett Avenue and Webb Street. From this point a sewer siphon, consisting of a 27" and 16" reinforced concrete pressure pipe (R.C.P.P.), carries flows 1248 feet to the existing drain chamber at the WWTF. Hydraulic analysis of the capacity of the 16" R.C.P.P. has indicated that with the addition of flows from the proposed Wilbur Force Main, the pipe does not meet Rhode Island Department of Environmental Management (RIDEM) criteria requiring sufficient capacity to handle projected average daily flows for either the year 2015 or 2045. Replacement of the 16" R.C.C.P. with a 24" R.C.P.P. provides sufficient capacity for the year 2045 average daily flows.

It is proposed to remove the existing 16" R.C.P.P. and lay the new 24" R.C.P.P. in the widened trench. The pipe is located entirely within existing roadways, including Pettaconsett Avenue, Webb Street, Glen Road and the access road to the WWTF.

6. Quantity Estimates

In order to adequately define the project scope and associated construction costs, detailed quantity estimates were prepared for each proposed project feature, associated

construction and improvement to the existing conveyance system. Quantity estimates were based on the plans, profiles and typical sections developed for each proposed project feature and as-built drawings of existing sewer system components investigated. Estimates reflect required site work indicated by existing above-ground features which would be encountered during construction and new work associated with pumping station and sewer construction. Typical trench sections in earth and rock used in computing quantities associated with sewer construction are shown on Plates D-12 and D-13.

Due to the uncertainties at this stage of preliminary design with specific requirements for traffic control, environmental protection, protection and modification of existing utilities and control and diversion of water required for construction of project features, larger contingencies should be included in costs for these items.

Quantity estimates for each of the proposed project features, associated construction and modifications to existing sewer conveyance components described in Section 5 are included on Pages D-16 through D-26.

7. Additional Studies Required for Further Design.

As stated in the introduction, a detailed study of existing utilities and a hazardous and toxic waste (HTRW) evaluation were not included in preliminary project design. Due to their significant potential construction cost and schedule impacts, these investigations should be included in future project design occurring prior to the preparation of plans and specifications. Utility investigations should include coordination with utility companies providing service through or within the limits of project construction, focusing on large, primary features. Where large-scale service disruptions would result or the cost of utility relocation would be prohibitive, relocation of project features would be required. While proposed project features are primarily located within existing roadways and undeveloped parcels in residential areas, the potential for encountering contaminated material during project construction remains. Adequate investigations should be conducted to identify potentially contaminated sites, establish the type and extent of HTRW contamination, if any, and determine required remedial measures. General soil and water analyses should also be performed to determine the corrosion potential characteristics of the soil and water for proper pipe selection.

Additional surveying and mapping will be required for

design, preparation of plans and specifications, construction and operation and maintenance of proposed project features. It is recommended that detailed topographic mapping at a scale of 1"=40',with a 1-foot contour interval, be obtained for additional sewer design. The survey should locate all utilities, including invert elevations of below grade features where accessible. First floor and basement elevations of structures to be served should also be included. Detailed topographic surveys at a scale of 1"=20',with a one-foot contour interval, should be obtained at proposed pumping station locations.

Due to the site restrictions present at I-295 median site for the proposed Wilbur Pumping Station, the depths of required excavations adjacent to the highway embankments, and lack of specific DOT design requirements at this study stage, further design should be performed prior to preparation of plans and specifications to fully evaluate requirements for design.

Hydrologic analysis of the drainage basins should be performed to determine appropriate levels of cofferdams and requirements for diversion of flows within and adjacent to watercourses.

FILE: CR12.1SPS

DATE: 1 JUL 1994
REV 1:

SERVICE AREA 1
PROPOSED SCITUATE PUMPING STATION (504 GPM)
PIPPIN ORCHARD ROAD

SITE WORK

SITE PREPARATION	1	JOB	L.S.
TRAFFIC CONTROL	1	JOB	L.S.
ENVIRONMENTAL PROTECTION	1	JOB	L.S.
PROTECTION/MODIFICATION OF EXISTING UTILITIES	1	JOB	L.S.
CLEARING & GRUBBING	0.3	AC	
CONTROL & DIVERSION OF WATER	1	JOB	L.S.
ROCK EXCAVATION	130	CY	
EXCAVATION	320	CY	
SITE DRAINAGE	1	JOB	L.S.
FOUNDATION WATERPROOFING	1200	SF	
COMPACTED GRAVEL BORROW	100	CY	
18" GRAVEL BASE	540	SY	
1 1/2" BIT. CONCRETE SURFACE COURSE	540	SY	
1 1/2" BIT. CONCRETE BINDER COURSE	540	SY	
SAW CUT EXISTING PAVEMENT	40	LF	
TACKCOAT	10	SF	
PRECAST CONCRETE PARKING BUMPERS	2	EA	
6' CHAIN LINK FENCING INCL.	310	LF	
1 - 26'-WIDE DBL LF VEHICLE GATE			
UTILITIES			
WATER	90	LF	
UNDERGROUND ELECTRIC	90	LF	
UNDERGROUND TELEPHONE	90	LF	
LANDSCAPING	1	JOB	L.S.
6" TOPSOIL, SEEDED	600	SY	

FILE: CR12.1SF DATE: 1 JUL 1994

SERVICE AREA 1
PROPOSED SCITUATE 6" FORCE MAIN/VARIABLE GRADE SEWER
PROPOSED SCITUATE P.S. TO I-295 P.S.
LENGTH: 12290 FT

SITE PREPARATION	1	JOB	L.S.
TRAFFIC CONTROL	1	JOB	L.S.
ENVIRONMENTAL PROTECTION	1	JOB	L.S.
PROTECTION/MODIFICATION OF EXIST. UTILITIES	1	JOB	L.S.
CLEARING & GRUBBING	0.5	AC	
EXISTING PAVEMENT REMOVAL (5")	5400	SY	
CONTROL & DIVERSION OF WATER	1	JOB	L.S.
TEMPORARY EARTH SUPPORT SYSTEM	21000	SF	
TRENCH BOX	11000	LF	
EXCAVATION	7400	CY	
ROCK EXCAVATION	1000	CY	
6" SDR 18 PVC PIPE	12290	LF	
6" GATE VALVE AND BOX	4	EA	
CLEANOUT MANHOLE	2	EA	
AIR RELEASE MANHOLE	6	EA	
COMPACTED RANDOM FILL	3400	CY	
GRAVEL BORROW	1800	CY	
PIPE BEDDING	700	CY	
18" GRAVEL BASE	4200	SY	
TEMPORARY PAVEMENT (2")	5400	SY	
REMOVAL OF TEMPORARY PAVEMENT	5400	SY	
SAW CUT PAVEMENT *	23000(0)	LF	
TACKCOAT *	5900(2900)	SF	
2" BIT. CONCRETE SURFACE COURSE *	6700(0)	SY	
2" BIT. CONCRETE BINDER COURSE	6700	SY	
CONCRETE IN THRUST BLOCKS	30	CY	
CONCRETE ENCASEMENT (60 LF)	5	CY	
6" TOPSOIL, SEEDED	2600	SY	

* DELETE OR REDUCE ITEM TO FIGURE IN PARENTHESIS IF CONCURRENT RESURFACING OF ROUTE 12/SCITUATE AVENUE IS REQUIRED.

FILE: CR12.1SAR DATE: 1 JUL 1994

SERVICE AREA 1
RESURFACING OF STATE ROUTE 12/SCITUATE AVENUE
PIPPIN ORCHARD ROAD TO COMSTOCK AVENUE
LENGTH: 6300 LF WIDTH: 38 FEET

SITE PREPARATION	1	JOB	L.S.
TRAFFIC CONTROL	1	JOB	L.S.
ENVIRONMENTAL PROTECTION	1	JOB	L.S.
PROTECTION/MODIFICATION OF EXISTING UTILITIES (INCL> RAISING UTILITY COVERS 2")	1	JOB	L.S.
PAVEMENT RESURFACING - INCLUDES 10% ADJUSTMENT FOR TIE-INS TO EXISTING STREETS AND DRIVEWAYS			
TACKCOAT	22000	SY	
SAW CUT EXISTING PAVEMENT	500	LF	
2" BIT. CONCRETE SURFACE COURSE	29000	SY	
4" DOUBLE YELLOW LINE	6300	LF	
4" SOLID WHITE LINE	12600	LF	

NOTE: STATE DOT REQUIRES RESURFACING OF ROADWAY TO FULL WIDTH OF PAVEMENT IF DISTURBED WITHIN FIVE YEARS OF STATE RESURFACING (CURRENTLY SCHEDULED FOR 1994)

FILE: CR12.2DR

DATE: 1 JUL 1994
REV: 28 SEP 1994

SERVICE AREA 2
PROPOSED NATICK TRUNK SEWER
LENGTH: 4655 LF

SITE PREPARATION	1	JOB	L.S.
TRAFFIC CONTROL	1	JOB	L.S.
ENVIRONMENTAL PROTECTION	1	JOB	L.S.
PROTECTION / MODIFICATION OF EXISTING UTILITIES (INCL. 8.5' DIA PWS AQUEDUCT)	1	JOB	L.S.
CLEARING & GRUBBING	0.4	AC	
CONTROL & DIVERSION OF WATER	1	JOB	L.S.
PAVEMENT REMOVAL (3")	2200	SY	
TEMPORARY EARTH SUPPORT SYSTEM	10000	SF	
PERMANENT EARTH SUPPORT SYSTEM	0	SF	
TRENCH BOX	4200	LF	
EXCAVATION	7600	CY	
ROCK EXCAVATION	740	CY	
18" R.C. PIPE	3910	LF	
12" R.C. PIPE	745	LF	
SANITARY SEWER MANHOLE	29	EA	
SANITARY SEWER DROP MANHOLE	1	EA	
COMPACTED RANDOM FILL	4200	CY	
GRAVEL BORROW	1600	CY	
PIPE BEDDING	480	CY	
18" GRAVEL BASE	1800	SY	
CONCRETE IN ENCASEMENT/CRADLE	4	CY	
TEMPORARY PAVEMENT (2")	2200	SY	
REMOVAL OF TEMPORARY PAVEMENT	2200	SY	
SAW CUT PAVEMENT	8000	LF	
TACKCOAT	2000	SF	
1 1/2" BIT. CONCRETE SURFACE COURSE	2600	SY	
1 1/2" BIT. CONCRETE BINDER COURSE	2600	SY	
6" TOPSOIL, SEEDED	1900	SY	

FILE: CR12.2DR

DATE: 1 JUL 1994
REV: 28 SEP 1994

SERVICE AREA 2
PROPOSED COMSTOCK TRUNK SEWER
LENGTH: 14160LF

SITE PREPARATION	1	JOB	L.S.
TRAFFIC CONTROL	1	JOB	L.S.
ENVIRONMENTAL PROTECTION	1	JOB	L.S.
PROTECTION / MODIFICATION OF EXISTING UTILITIES (INCL. PWS PIPELINE)	1	JOB	L.S.
CLEARING & GRUBBING	2.5	AC	
CONTROL & DIVERSION OF WATER (INCL. ONE SMALL BROOK CROSSING)	1	JOB	L.S.
PAVEMENT REMOVAL (3")	5100	SY	
TEMPORARY EARTH SUPPORT SYSTEM	115000	SF	
PERMANENT EARTH SUPPORT SYSTEM	0	SF	
TRENCH BOX	8500	LF	
EXCAVATION	27000	CY	
ROCK EXCAVATION	7100	CY	
12" R.C. PIPE	1645	LF	
15" R.C. PIPE	3380	LF	
18" R.C. PIPE	4840	LF	
24" R.C. PIPE	4295	LF	
SANITARY SEWER MANHOLE	63	EA	
SANITARY SEWER DROP MANHOLE	15	EA	
COMPACTED RANDOM FILL	16000	CY	
GRAVEL BORROW	4400	CY	
PIPE BEDDING	1400	CY	
18" GRAVEL BASE	5100	SY	
CONCRETE ENCASEMENT	32	CY	
TEMPORARY PAVEMENT (2")	6100	SY	
REMOVAL OF TEMPORARY PAVEMENT	6100	SY	
SAW CUT PAVEMENT	18000	LF	
TACKCOAT	4500	SF	
1 1/2" BIT. CONCRETE SURFACE COURSE	7100	SY	
1 1/2" BIT. CONCRETE BINDER COURSE	7100	SY	
6" TOPSOIL, SEEDED	12000	SY	

FILE: CR12.2DR

DATE: 8 JUN 1994
REV : 28 SEP 1994

SERVICE AREA 2
PROPOSED TILCON TRUNK SEWER
LENGTH: 2595 LF

SITE PREPARATION	1	JOB	L.S.
TRAFFIC CONTROL	1	JOB	L.S.
ENVIRONMENTAL PROTECTION (INCL. FURNACE HILL BROOK CROSSING)	1	JOB	L.S.
PROTECTION / MODIFICATION OF EXISTING UTILITIES	1	JOB	L.S.
CLEARING & GRUBBING	0.2	AC	
CONTROL & DIVERSION OF WATER (INCL. FURNACE HILL BROOK CROSSING)	1	JOB	L.S.
PAVEMENT REMOVAL (3")	1600	SY	
TEMPORARY EARTH SUPPORT SYSTEM	24000	SF	
PERMANENT EARTH SUPPORT SYSTEM	2700	SF	
TRENCH BOX	1700	LF	
EXCAVATION	5500	CY	
ROCK EXCAVATION	280	CY	
18" R.C. PIPE	1470	LF	
24" R.C. PIPE	1125	LF	
SANITARY SEWER MANHOLE	11	EA	
SANITARY SEWER DROP MANHOLE	1	EA	
COMPACTED RANDOM FILL	4900	CY	
GRAVEL BORROW	860	CY	
PIPE BEDDING	290	CY	
18" GRAVEL BASE	540	SY	
CONCRETE IN ENCASEMENT/CRADLE	24	CY	
TEMPORARY PAVEMENT (2")	1300	SY	
REMOVAL OF TEMPORARY PAVEMENT	1300	SY	
SAW CUT PAVEMENT	4600	LF	
TACKCOAT	1200	SF	
1 1/2" BIT. CONCRETE SURFACE COURSE	1600	SY	
1 1/2" BIT. CONCRETE BINDER COURSE	1600	SY	
6" TOPSOIL, SEEDED	700	SY	

FILE: CR12.2DR

DATE: 13 JUN 94
REV : 28 SEP 94

SERVICE AREA 2
PROPOSED BROOKDALE TRUNK SEWER
LENGTH: 2065 LF

SITE PREPARATION	1	JOB	L.S.
TRAFFIC CONTROL	1	JOB	L.S.
ENVIRONMENTAL PROTECTION	1	JOB	L.S.
PROTECTION / MODIFICATION OF EXISTING UTILITIES (INCL. 8.5' D PWS AQUEDUCT)	1	JOB	L.S.
CLEARING & GRUBBING	0.8	AC	
CONTROL & DIVERSION OF WATER	1	JOB	L.S.
PAVEMENT REMOVAL (3")	520	SY	
TEMPORARY EARTH SUPPORT SYSTEM	28000	SF	
PERMANENT EARTH SUPPORT SYSTEM	0	SF	
TRENCH BOX	985	LF	
EXCAVATION	3800	CY	
ROCK EXCAVATION	190	CY	
24" RC PIPE	2065	LF	
SANITARY SEWER MANHOLE	10	EA	
COMPACTED RANDOM FILL	2000	CY	
GRAVEL BORROW	750	CY	
PIPE BEDDING	260	CY	
18" GRAVEL BASE	360	SY	
CONCRETE IN ENCASEMENT/ CRADLE	20	CY	
TEMPORARY PAVEMENT (2")	440	SY	
REMOVAL OF TEMPORARY PAVEMENT	440	SY	
SAW CUT PAVEMENT	1400	LF	
TACKCOAT	360	SF	
1 1/2" BIT. CONCRETE SURFACE COURSE	520	SY	
1 1/2" BIT. CONCRETE BINDER COURSE	520	SY	
6" TOPSOIL, SEEDED	3700	SY	

FILE: WILBURPS

DATE: 21 JUN 1994
REV: 10 AUG 1994

SERVICE AREA 2
PROPOSED WILBUR PUMPING STATION
WILBUR AVE - I-295 MEDIAN AT EXISTING SEWER SLEEVE

SITE WORK			
SITE PREPARATION	1	JOB	L.S.
ENVIRONMENTAL PROTECTION	1	JOB	L.S.
TRAFFIC CONTROL	1	JOB	L.S.
PROTECTION/MODIFICATION OF EXISTING UTILITIES	1	JOB	L.S.
CLEARING & GRUBBING	0.3	AC	
CONTROL & DIVERSION OF WATER	1	JOB	L.S.
(MESHANTICUT BROOK CROSSING/DEWATERING)			
TEMPORARY EARTH SUPPORT SYSTEM (BRACED CUT)	11000	SF	
PERMANENT EARTH SUPPORT SYSTEMS			
BROOK CROSSING	1800	SF	
RETAINING WALL WITH TIE-BACKS	4700	SF	
REMOVE EXIST. 60" SEWER SLEEVE	45	LF	
EXCAVATION	3700	CY	
SITE DRAINAGE	1	JOB	L.S.
FOUNDATION WATERPROOFING	6000	SF	
30" PVC PIPE WITHIN SLEEVE (GROUTED IN PLACE)	180	LF	
30" RCP	56	LF	
CONCRETE IN ENCASEMENT/CRADLE/PLUG	36	CY	
CONCRETE IN RETAINING WALLS	100	CY	
PAVEMENT REMOVAL	33	SY	
SAW CUT PAVEMENT	75	LF	
TACKCOAT	18	SF	
1 1/2" BIT. CONCRETE SURFACE COURSE	740	SY	
1 1/2" BIT. CONCRETE BINDER COURSE	740	SY	
BITUMINOUS CONCRETE SWALE	270	LF	
18" GRAVEL BASE	740	SY	
CONCRETE IN STAIRWAY	20	CY	
METAL HANDRAIL	55	LF	
COMPACTED RANDOM FILL	250	CY	
COMPACTED GRAVEL BORROW	810	CY	
GRAVEL BORROW	30	CY	
PIPE BEDDING	10	CY	
PRECAST CONCRETE PARKING BUMPERS	2	EA	
COMPACTED GRAVEL FILL	550	CY	
SCREENED GRAVEL BACKFILL	50	CY	
6' CHAIN LINK FENCING/GATES	440	LF	
UTILITIES			
WATER	100	LF	
UNDERGROUND ELECTRIC	130	LF	
UNDERGROUND TELEPHONE	130	LF	
LANDSCAPING	1	JOB	L.S.
6" TOPSOIL, SEEDED	1100	SY	

FILE: CR12.2C

DATE: 1 JUL 1994
REV 1:

SERVICE AREA 2
PROPOSED 16" WILBUR FORCE MAIN: PROPOSED WILBUR P.S. TO
EXISTING SOCKANOSSET INTERCEPTOR
LENGTH: 9000 LF

SITE PREPARATION	1	JOB	L.S.
TRAFFIC CONTROL	1	JOB	L.S.
ENVIRONMENTAL PROTECTION	1	JOB	L.S.
PROTECTION/MODIFICATION OF EXISTING UTILITIES	1	JOB	L.S.
CONTROL & DIVERSION OF WATER	1	JOB	L.S.
PAVEMENT REMOVAL (3")	5500	SY	
TEMPORARY EARTH SUPPORT SYSTEM	5700	SF	
PERMANENT EARTH SUPPORT SYSTEM	0	SF	
TRENCH BOX	8700	LF	
EXCAVATION	7500	CY	
ROCK EXCAVATION	700	CY	
16" SDR 18 PVC PIPE	9000	LF	
12" DI PIPE	40	LF	
16" GATE VALVE & BOX	5	EA	
12" GATE VALVE & BOX	5	EA	
AIR RELEASE MANHOLE	3	EA	
COMPACTED RANDOM FILL	2600	CY	
GRAVEL BORROW	2100	CY	
PIPE BEDDING	740	CY	
18" COMPACTED GRAVEL BASE	3500	SY	
TEMPORARY PAVEMENT (2")	4500	SY	
REMOVAL OF TEMPORARY PAVEMENT	4500	SY	
SAW CUT PAVEMENT	18000	LF	
TACKCOAT	4500	SF	
1 1/2" BIT CONCRETE SURFACE COURSE	5500	SY	
1 1/2" BIT CONCRETE BINDER COURSE	5500	SY	
CONCRETE IN THRUST BLOCKS/PIPE ENCASEMENT	110	CY	
6" TOPSOIL, SEEDED	0	SY	

FILE: CR12.2C

DATE: 5 JUL 1994
REV 1:

SERVICE AREA 2
MODIFICATIONS TO EXISTING SOCKANOSSET INTERCEPTOR
SUPPLEMENTAL 24" GRAVITY SEWER: STA. 23+97.5 TO
STA 39+51.3 (1554 LF)

SITE PREPARATION	1	JOB	L.S.
TRAFFIC CONTROL	1	JOB	L.S.
ENVIRONMENTAL PROTECTION	1	JOB	L.S.
PROTECTION/MODIFICATION OF EXISTING UTILITIES (MINOR-NO SERVICE INTERRUPTIONS/PUMPING OF FLOWS REQ'D)	1	JOB	L.S.
CLEARING & GRUBBING	0.8	AC	
CONTROL & DIVERSION OF WATER	1	JOB	L.S.
PAVEMENT REMOVAL	110	SY	
TEMPORARY EARTH SUPPORT SYSTEM	6800	SF	
TRENCH BOX	1200	LF	
EXCAVATION	2800	CY	
ROCK EXCAVATION	100	CY	
24" RC PIPE	1554	LF	
SANITARY SEWER MANHOLE	8	EA	
COMPACTED RANDOM FILL	1900	CY	
GRAVEL BORROW	570	CY	
PIPE BEDDING	190	CY	
18" COMPACTED GRAVEL BASE	75	SY	
TEMPORARY PAVEMENT (2")	92	SY	
REMOVAL OF TEMPORARY PAVEMENT	92	SY	
SAW CUT PAVEMENT	300	LF	
TACKCOAT	75	SF	
1 1/2" BIT. CONCRETE SURFACE COURSE	110	SY	
1 1/2" BIT. CONCRETE BINDER COURSE	110	SY	
6" TOPSOIL SEEDED	3900	SY	

FILE: CR12.2C DATE: 6 JUL 1994

SERVICE AREA 2
REPLACEMENT OF EXISTING 16" R.C.P.P. SIPHON
WITH 24" R.C.P.P.: SIPHON INLET CHAMBER (STA. 20+34.3) TO
DRAIN CHAMBER (STA. 7+86.3) - 1248 LF

SITE PREPARATION	1	JOB	L.S.
TRAFFIC CONTROL (MINOR LAST 350 LF - WWTF)	1	JOB	L.S.
ENVIRONMENTAL PROTECTION	1	JOB	L.S.
PROTECTION/MODIFICATION OF EXISTING UTILITIES (NO PUMPING OF FLOWS/SERVICE CONNECTIONS)	1	JOB	L.S.
CLEARING & GRUBBING	0	AC	
CONTROL & DIVERSION OF WATER (SURFACE FLOWS ONLY)	1	JOB	L.S.
PAVEMENT REMOVAL	910	SY	
TEMPORARY EARTH SUPPORT SYSTEM	0	SF	
TRENCH BOX	1248	LF	
EXCAVATION	1800	CY	
ROCK EXCAVATION	14	CY	
REMOVAL OF EXISTING 16" RCPP	1248	LF	
24" RC PRESSURE PIPE	1248	LF	
COMPACTED RANDOM FILL	680	CY	
GRAVEL BORROW	650	CY	
PIPE BEDDING	150	CY	
18" COMPACTED GRAVEL BASE	630	SY	
TEMPORARY PAVEMENT (2")	770	SY	
REMOVAL OF TEMPORARY PAVEMENT	770	SY	
SAW CUT PAVEMENT	2500	LF	
TACKCOAT	630	SF	
1 1/2" BIT. CONCRETE SURFACE COURSE	910	SY	
1 1/2" BIT. CONCRETE BINDER COURSE	910	SY	
6" TOPSOIL SEEDED	0	SY	

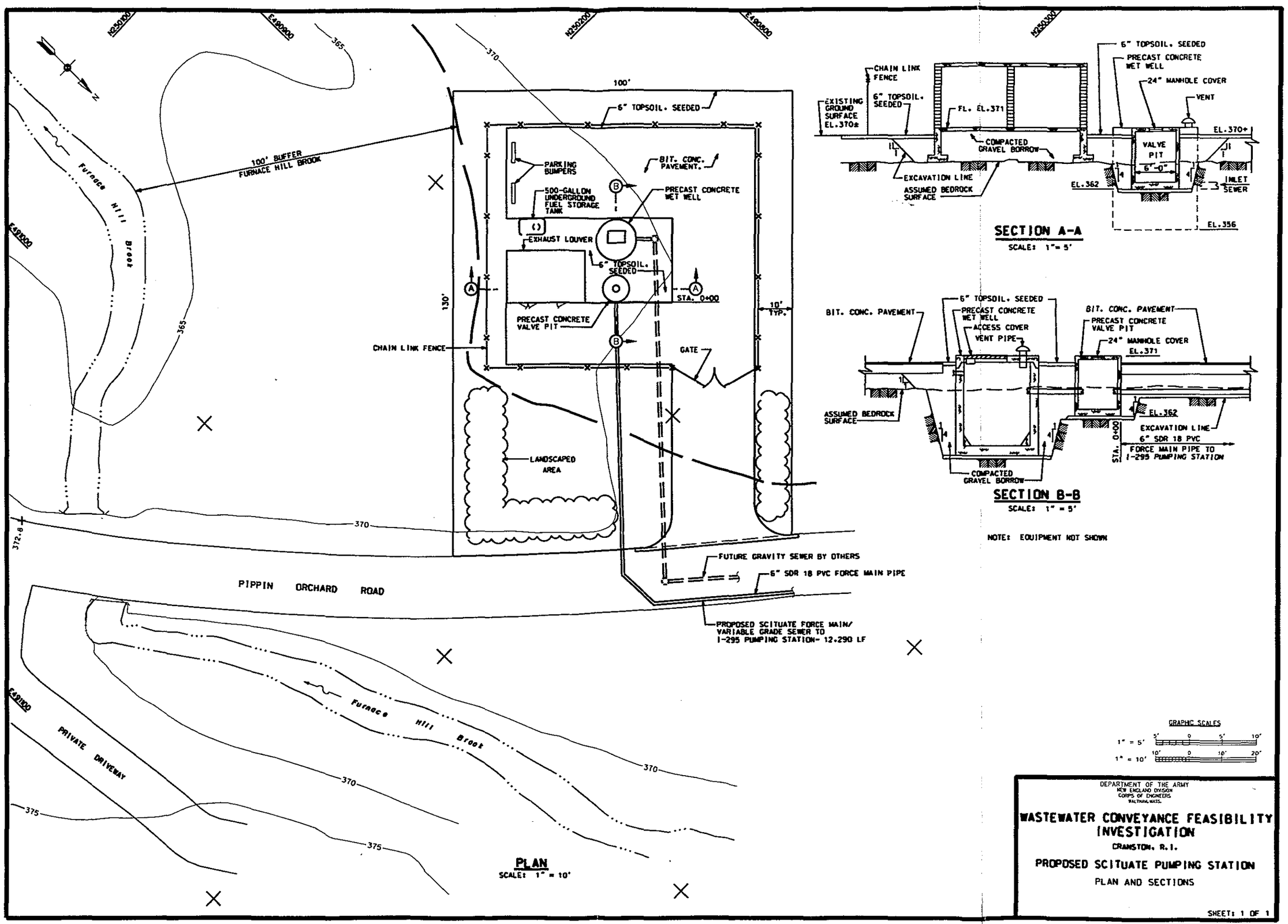
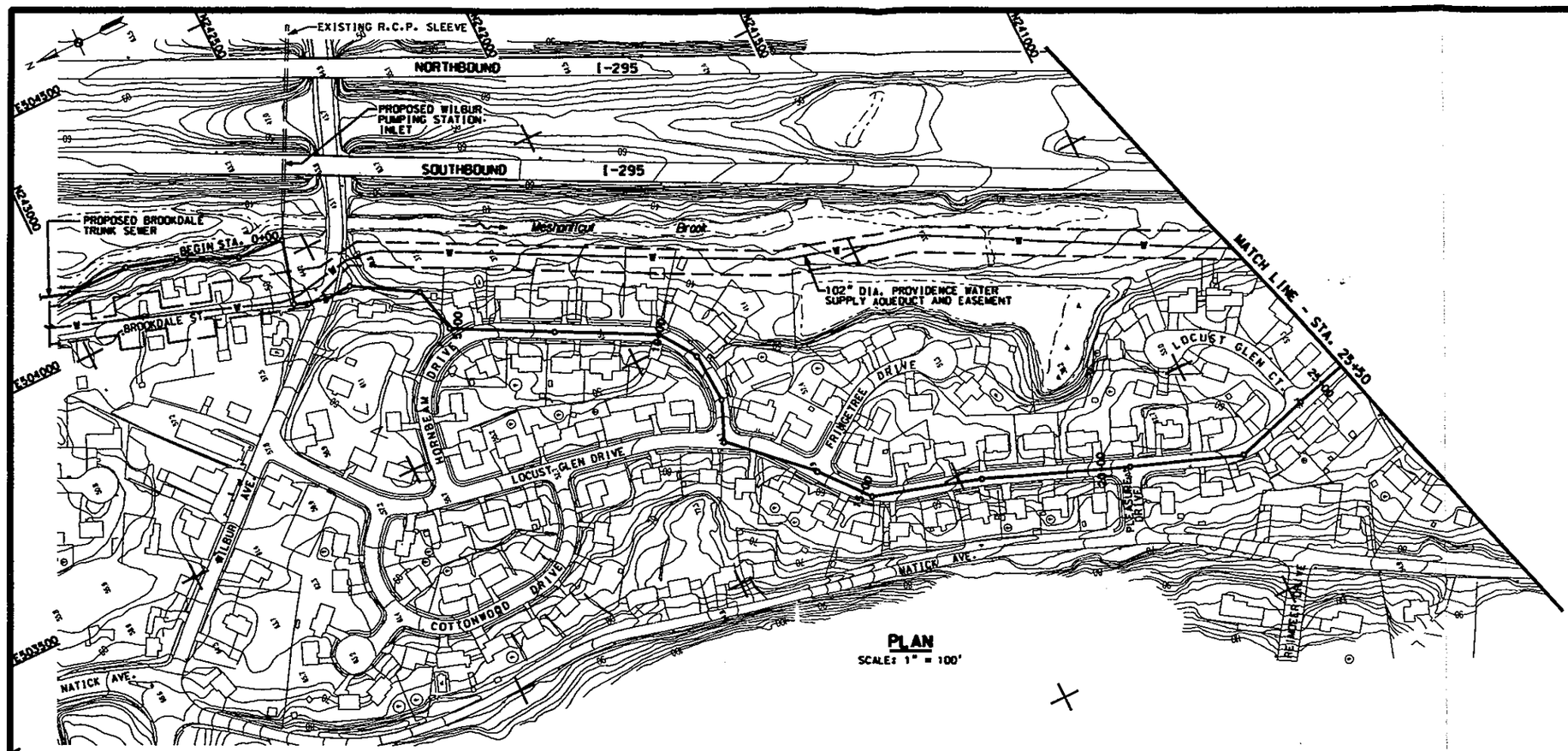
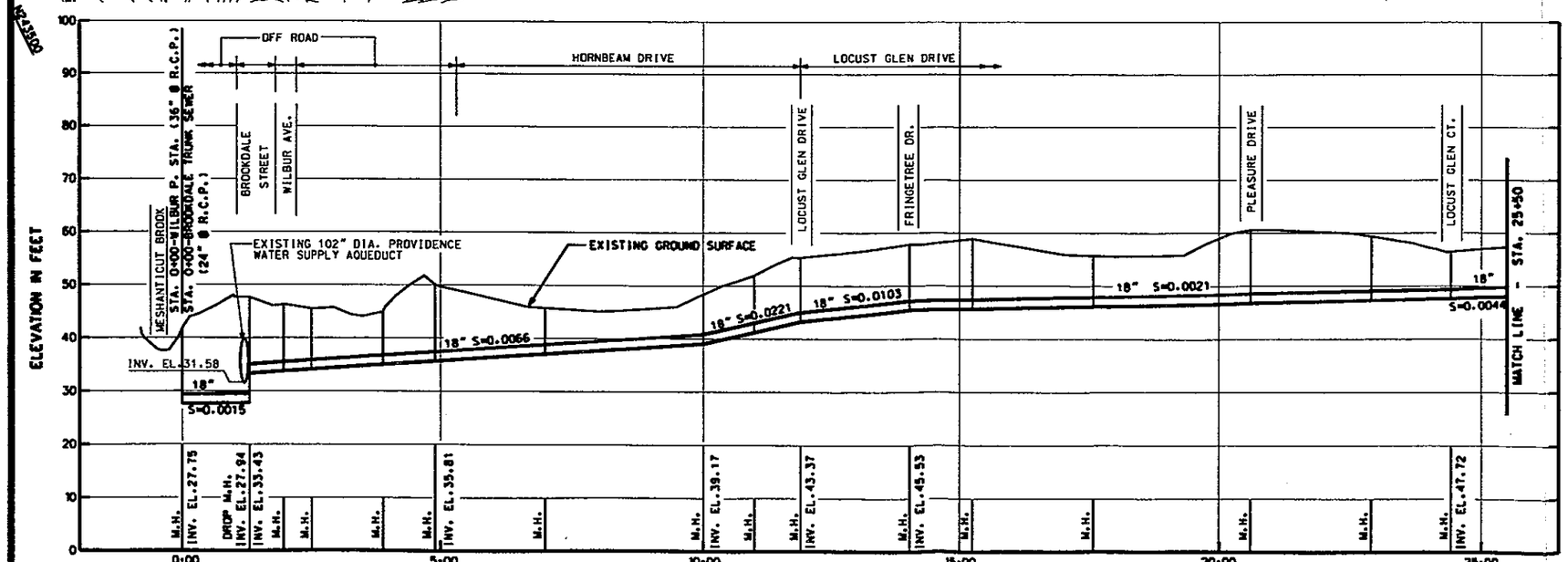

N250100
E490900
N250200
E490800
N250300
365
370
100'
6" TOPSOIL. SEEDED
100' BUFFER
FURNACE HILL BROOK
Furnace Hill Brook
PARKING BUMPERS
BIT. CONC. PAVEMENT.
500-GALLON UNDERGROUND FUEL STORAGE TANK
PRECAST CONCRETE WET WELL
EXHAUST LOUVER
6" TOPSOIL. SEEDED
STA. 0+00
130'
10' TYP.
PRECAST CONCRETE VALVE PIT
CHAIN LINK FENCE
GATE
LANDSCAPED AREA
372.8
PIPPIN ORCHARD ROAD
FUTURE GRAVITY SEWER BY OTHERS
6" SDR 18 PVC FORCE MAIN PIPE
PROPOSED SCITUATE FORCE MAIN/ VARIABLE GRADE SEWER TO I-295 PUMPING STATION- 12,290 LF
E491000
PRIVATE DRIVEWAY
Furnace Hill Brook
375
PLAN
SCALE: 1" = 10'
CHAIN LINK FENCE
EXISTING GROUND SURFACE EL.370±
6" TOPSOIL. SEEDED
FL. EL.371
COMPACTED GRAVEL BORROW
EXCAVATION LINE
ASSUMED BEDROCK SURFACE
6" TOPSOIL. SEEDED
PRECAST CONCRETE WET WELL
24" MANHOLE COVER
VENT
EL.370+
VALVE PIT
6'-0"
EL.362
INLET SEWER
EL.356
SECTION A-A
SCALE: 1" = 5'
BIT. CONC. PAVEMENT
6" TOPSOIL. SEEDED
PRECAST CONCRETE WET WELL
ACCESS COVER
VENT PIPE
BIT. CONC. PAVEMENT
PRECAST CONCRETE VALVE PIT
24" MANHOLE COVER
EL.371
ASSUMED BEDROCK SURFACE
EL.362
EXCAVATION LINE
6" SDR 18 PVC
STA. 0+00
FORCE MAIN PIPE TO I-295 PUMPING STATION
COMPACTED GRAVEL BORROW
SECTION B-B
SCALE: 1" = 5'
NOTE: EQUIPMENT NOT SHOWN
GRAPHIC SCALES
1" = 5'
1" = 10'
DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.
WASTEWATER CONVEYANCE FEASIBILITY INVESTIGATION
CRANSTON, R.I.
PROPOSED SCITUATE PUMPING STATION
PLAN AND SECTIONS
SHEET: 1 OF 1

PLATE D-1



PLAN
SCALE: 1" = 100'



PROFILE
SCALE: HOR. 1" = 100'
VER. 1" = 10'

GRAPHIC SCALES
1" = 100' 100' 0 100' 200'
1" = 10' 10' 0 10' 20'

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.

WASTEWATER CONVEYANCE FEASIBILITY INVESTIGATION

CRANSTON, R.I.

PROPOSED NATICK TRUNK SEWER

PLAN AND PROFILE NO. 1

SHEET: 1 OF 2

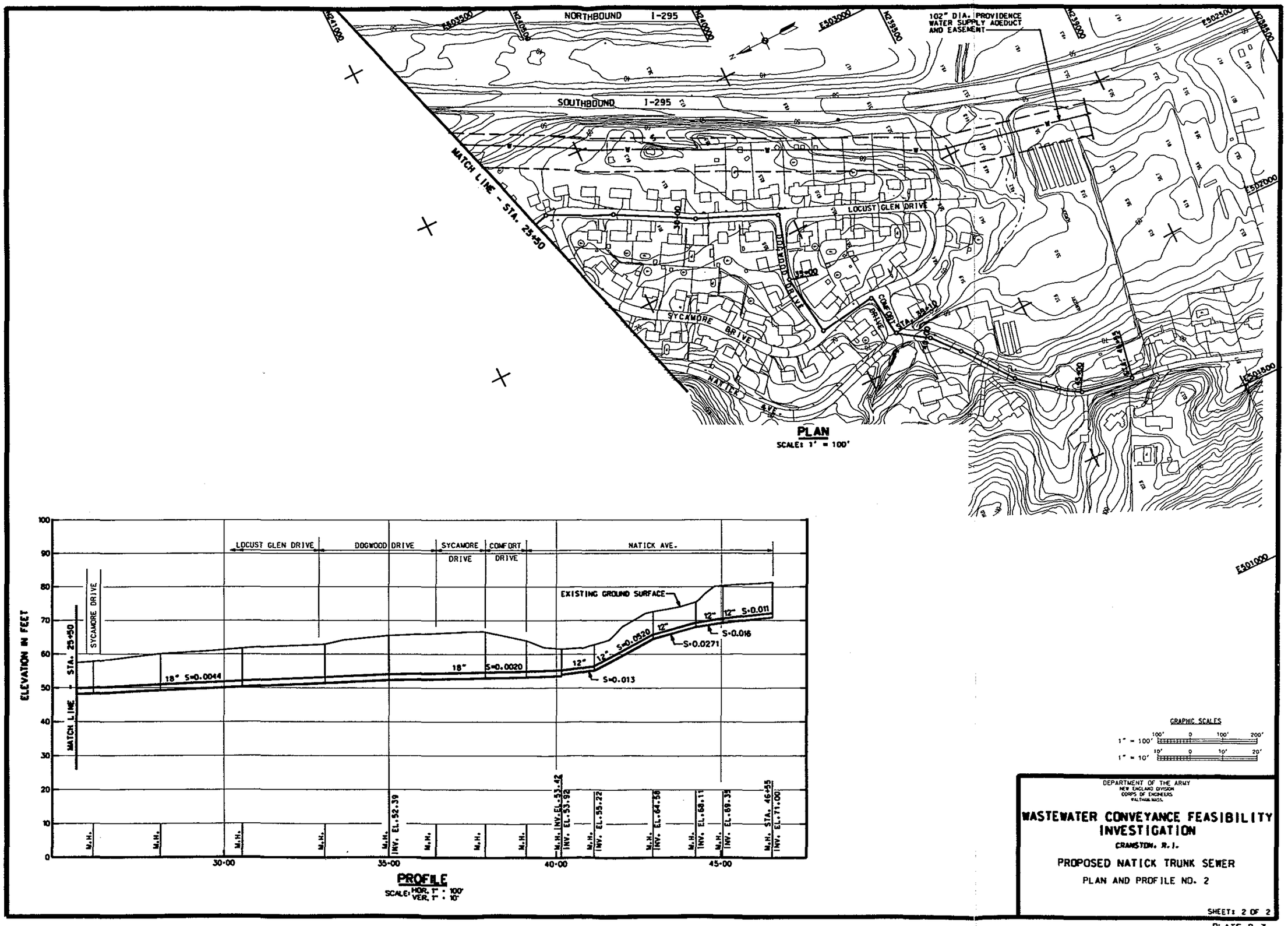
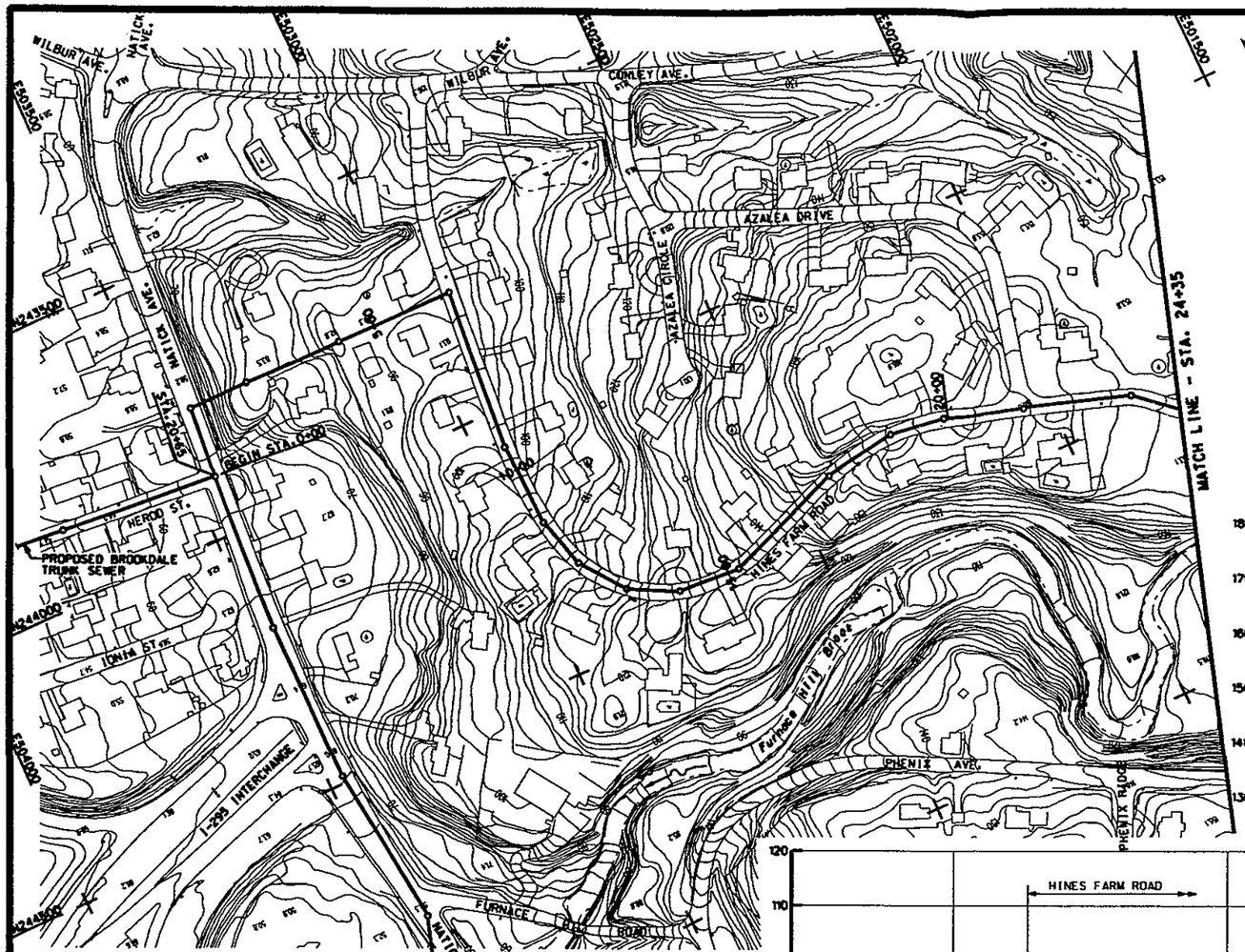
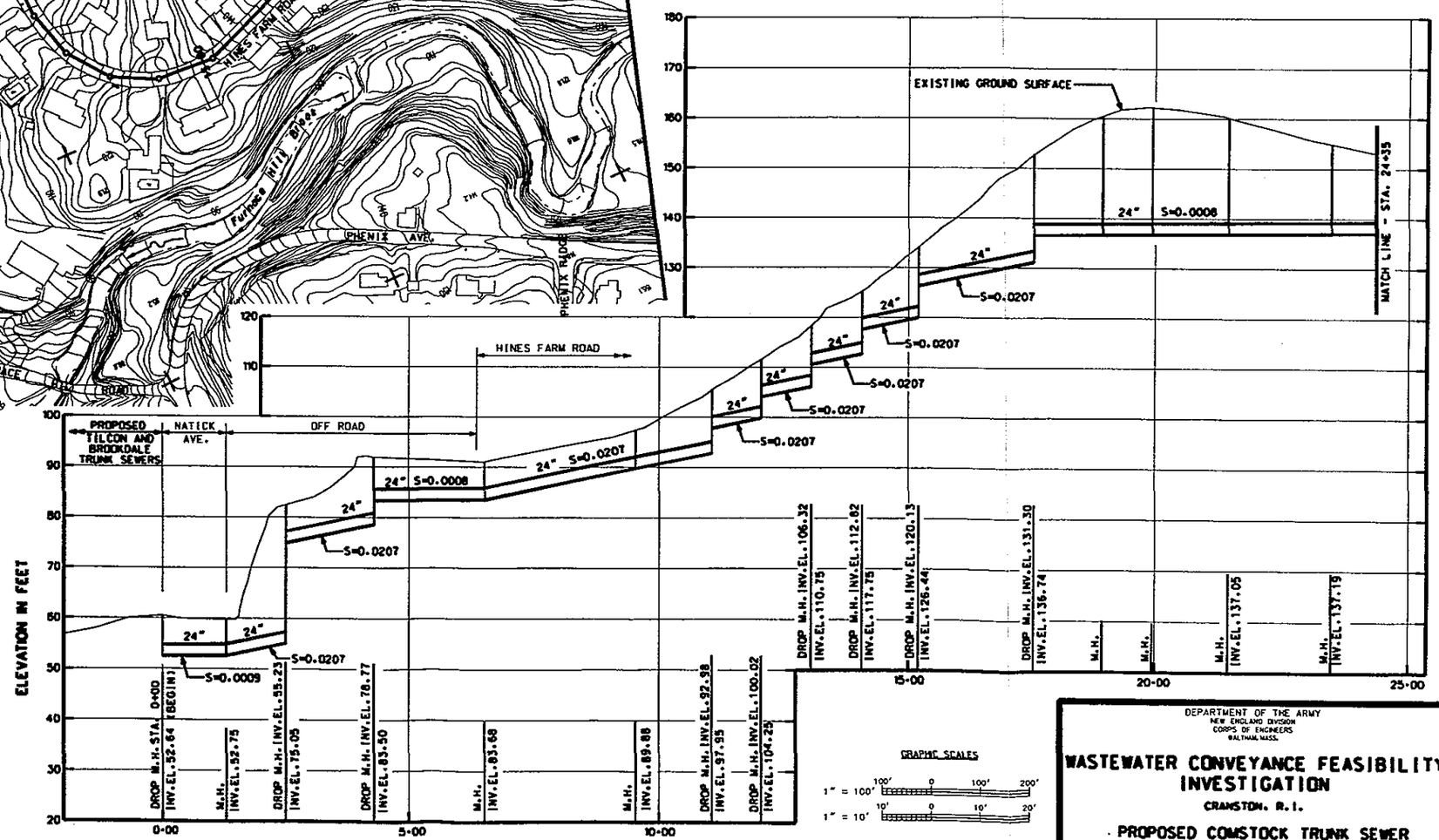

NORTHBOUND I-295
SOUTHBOUND I-295
102" DIA. PROVIDENCE WATER SUPPLY ADEDUCT AND EASEMENT
MATCH LINE - STA. 25+50
LOCUST GLEN DRIVE
DOGWOOD DRIVE
SYCAMORE DRIVE
COMFORT DRIVE
NATICK AVE.
PLAN
SCALE: 1" = 100'
ELEVATION IN FEET
EXISTING GROUND SURFACE
18" S=0.0044
18" S=0.0020
12" S=0.013
12" S=0.0320
12" S=0.0271
12" S=0.016
12" S=0.011
M.H. INV. EL.52.39
M.H. INV. EL.53.42
M.H. INV. EL.53.92
M.H. INV. EL.55.22
M.H. INV. EL.64.58
M.H. INV. EL.68.11
M.H. INV. EL.69.35
M.H. STA. 46+45 INV. EL.71.00
30+00
35+00
40+00
45+00
PROFILE
SCALE: HOR. 1" = 100' VER. 1" = 10'
GRAPHIC SCALES
1" = 100'
1" = 10'
DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.
WASTEWATER CONVEYANCE FEASIBILITY INVESTIGATION
CRANSTON, R.I.
PROPOSED NATICK TRUNK SEWER
PLAN AND PROFILE NO. 2
SHEET: 2 OF 2

PLATE D-3



PLAN
SCALE: 1" = 100'



PROFILE
SCALE: HOR. 1" = 100'
VER. 1" = 10'

GRAPHIC SCALES
1" = 100' 100' 0 100' 200'
1" = 10' 10' 0 10' 20'

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.

WASTEWATER CONVEYANCE FEASIBILITY INVESTIGATION

CRANSTON, R.I.

PROPOSED COMSTOCK TRUNK SEWER

PLAN AND PROFILE NO. 1

SHEET: 1 OF 5

PLATE D-4

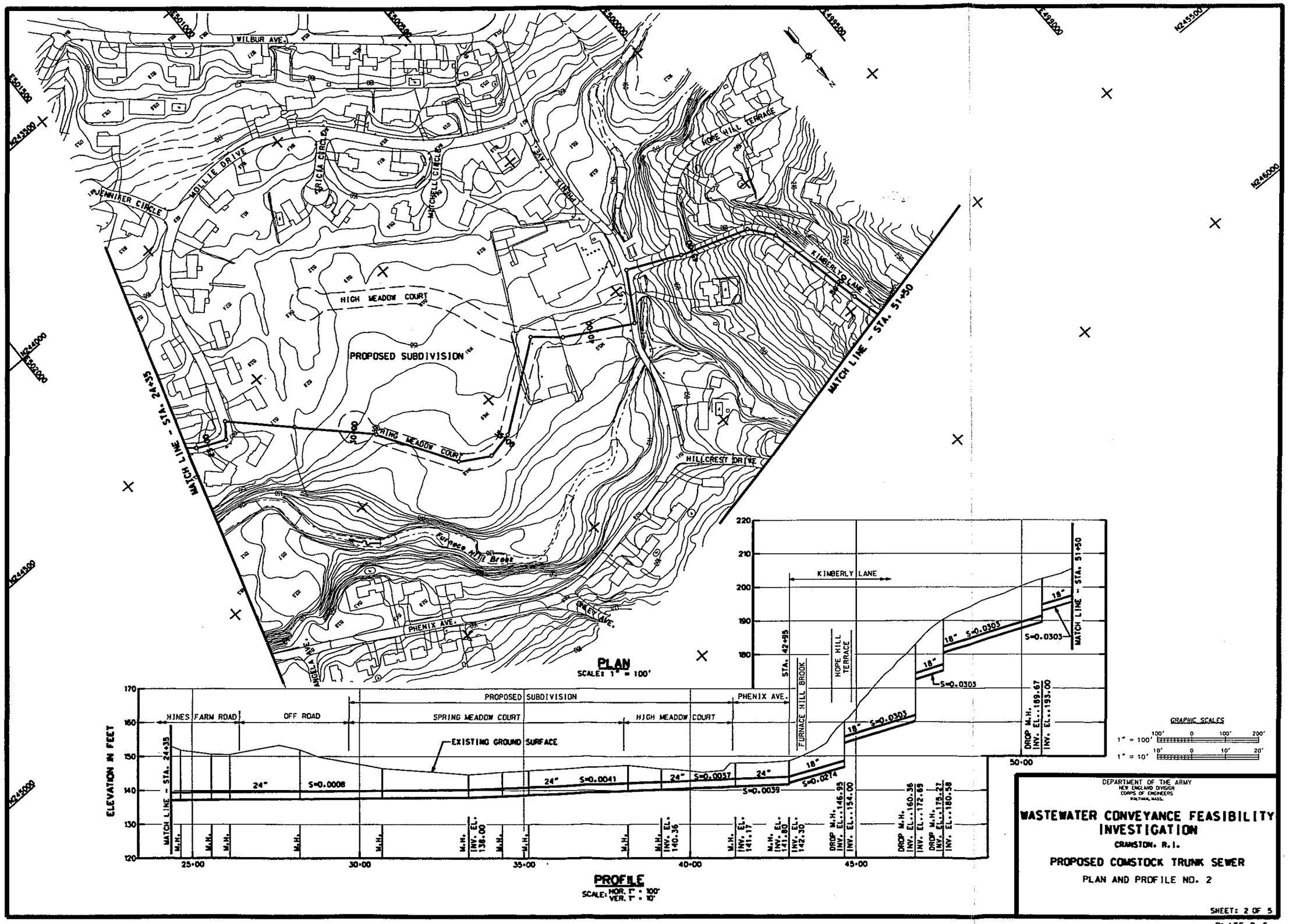

WILBUR AVE.
MOLLIE DRIVE
JENNIFER CIRCLE
ERICA CIRCLE
MITCHELL CIRCLE
HOPE HILL TERRACE
KIMBERLY LANE
HIGH MEADOW COURT
PROPOSED SUBDIVISION
SPRING MEADOW COURT
HILLCREST DRIVE
MATCH LINE - STA. 24+35
MATCH LINE - STA. 51+50
Furnace Hill Brook
PHENIX AVE.
ANGELA AVE.
PLAN
SCALE: 1" = 100'
ELEVATION IN FEET
HINES FARM ROAD
OFF ROAD
PROPOSED SUBDIVISION
SPRING MEADOW COURT
HIGH MEADOW COURT
PHENIX AVE.
EXISTING GROUND SURFACE
FURNACE HILL BROOK
HOPE HILL TERRACE
KIMBERLY LANE
STA. 42+95
S=0.0008
S=0.0041
S=0.0037
S=0.0039
S=0.0274
S=0.0303
DROP M.H. INV. EL.=189.67
INV. EL.=193.00
DROP M.H. INV. EL.=146.93
INV. EL.=154.00
DROP M.H. INV. EL.=160.36
INV. EL.=172.69
DROP M.H. INV. EL.=179.27
INV. EL.=180.58
PROFILE
SCALE: HOR. 1" = 100'
VER. 1" = 10'
GRAPHIC SCALES
DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.
WASTEWATER CONVEYANCE FEASIBILITY INVESTIGATION
CRANSTON, R.I.
PROPOSED COMSTOCK TRUNK SEWER
PLAN AND PROFILE NO. 2
SHEET: 2 OF 5

PLATE D-5

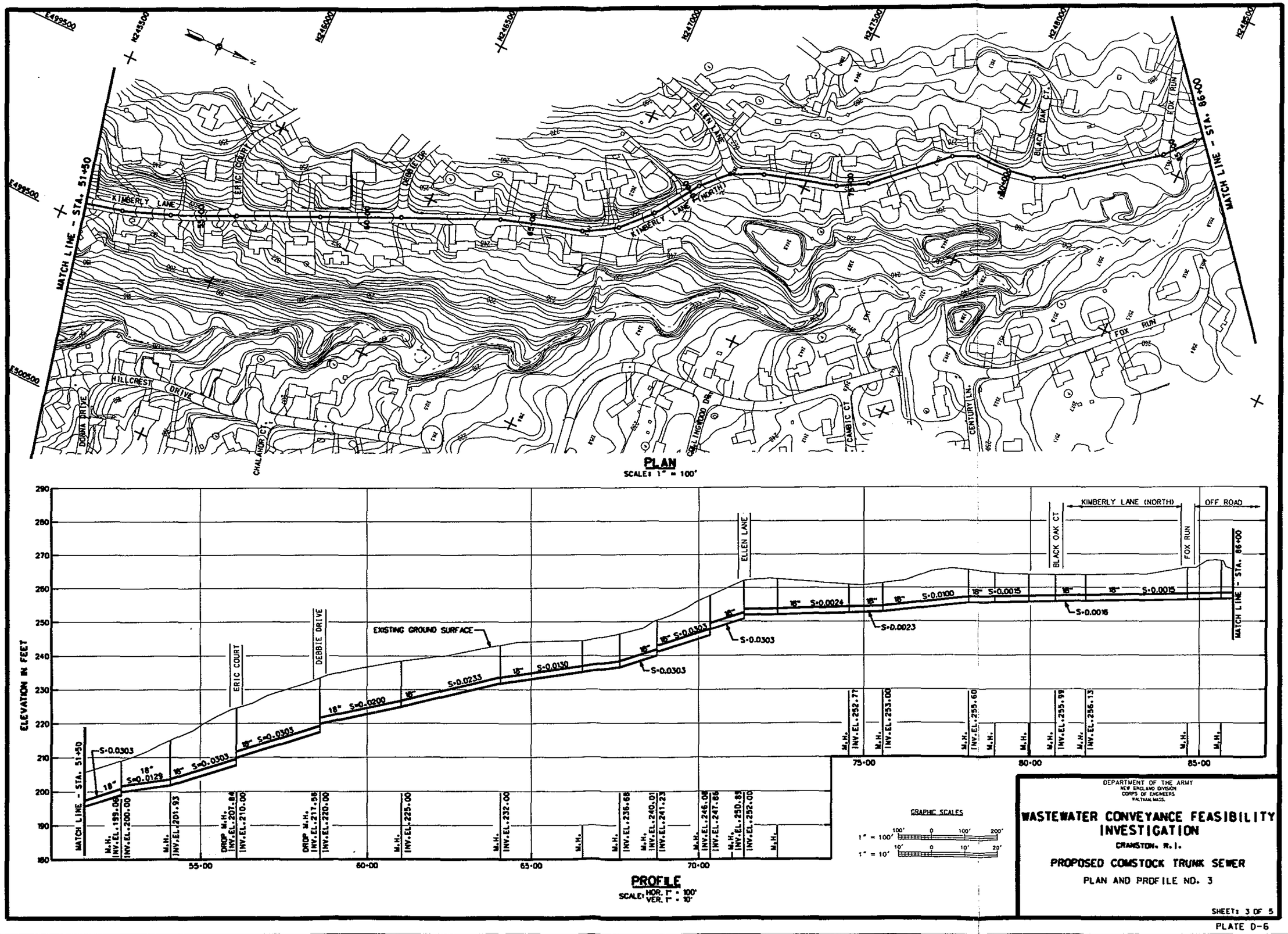
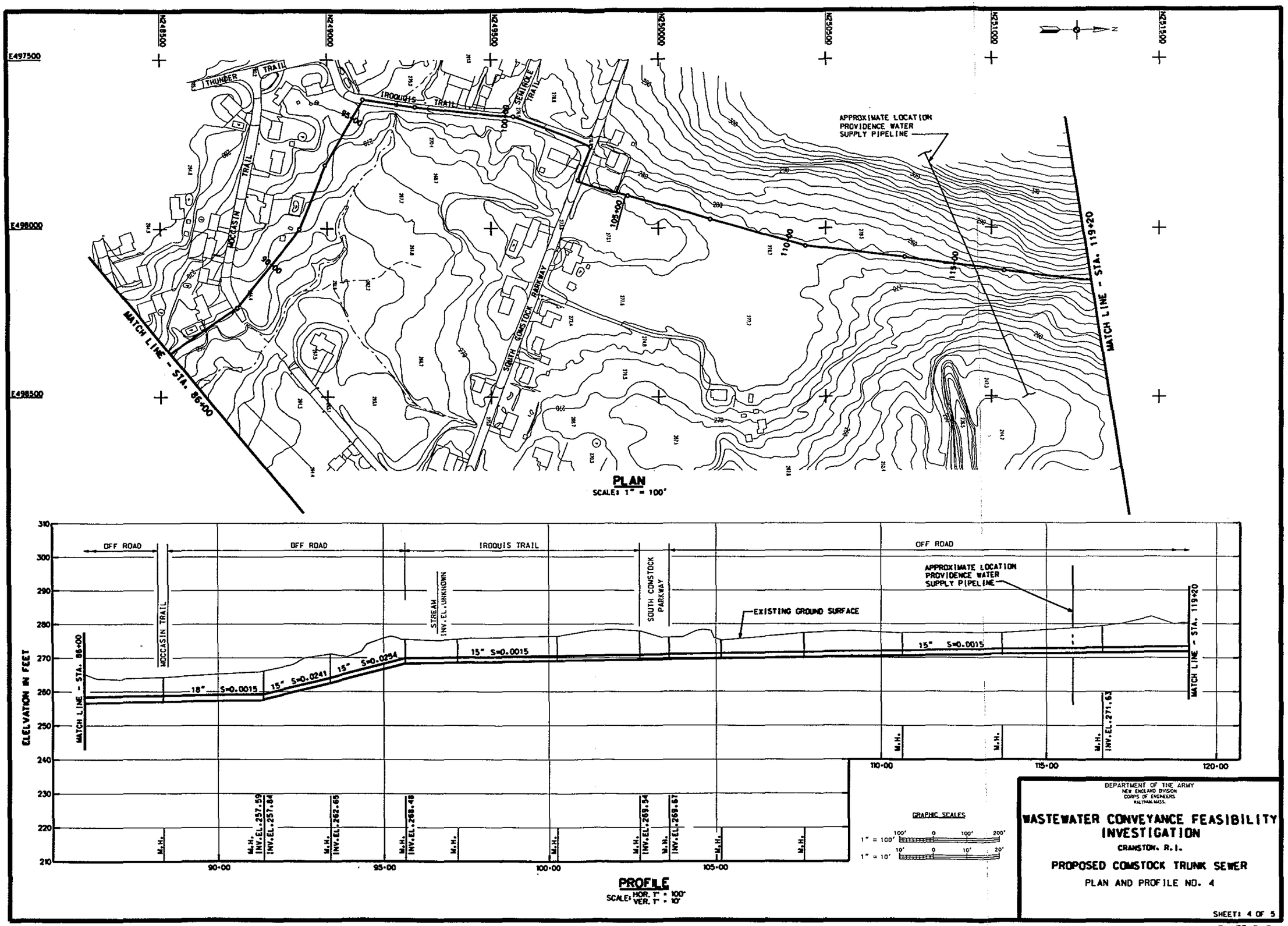

MATCH LINE - STA. 51+50
MATCH LINE - STA. 86+00
KIMBERLY LANE
KIMBERLY LANE (NORTH)
ERIC COURT
DEBBIE DR.
ELLEN LANE
BLACK OAK CT.
FOX RUN
HILLCREST DRIVE
DONNA DRIVE
CHALMOR CT.
COLLINGWOOD DR.
CAMBIC CT.
CENTURY LN.
PLAN
SCALE: 1" = 100'
ELEVATION IN FEET
EXISTING GROUND SURFACE
KIMBERLY LANE (NORTH)
OFF ROAD
S=0.0303
S=0.0129
S=0.0303
S=0.0303
S=0.0200
S=0.0233
S=0.0130
S=0.0303
S=0.0303
S=0.0303
S=0.0024
S=0.0023
S=0.0100
S=0.0015
S=0.0016
S=0.0015
M.H. INV.EL.199.06
INV.EL.200.00
M.H. INV.EL.201.93
DROP M.H. INV.EL.207.84
INV.EL.210.00
DROP M.H. INV.EL.217.58
INV.EL.220.00
M.H. INV.EL.225.00
M.H. INV.EL.232.00
M.H. INV.EL.236.68
M.H. INV.EL.240.01
INV.EL.241.23
M.H. INV.EL.246.06
INV.EL.247.86
M.H. INV.EL.250.85
INV.EL.252.00
M.H. INV.EL.252.77
M.H. INV.EL.253.00
M.H. INV.EL.255.60
M.H. INV.EL.255.99
M.H. INV.EL.256.13
PROFILE
SCALE: HOR. 1" = 100'
VER. 1" = 10'
GRAPHIC SCALES
1" = 100'
1" = 10'
DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.
WASTEWATER CONVEYANCE FEASIBILITY INVESTIGATION
CRANSTON, R.I.
PROPOSED COMSTOCK TRUNK SEWER
PLAN AND PROFILE NO. 3
SHEET: 3 OF 5

PLATE D-6



DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.

WASTEWATER CONVEYANCE FEASIBILITY INVESTIGATION

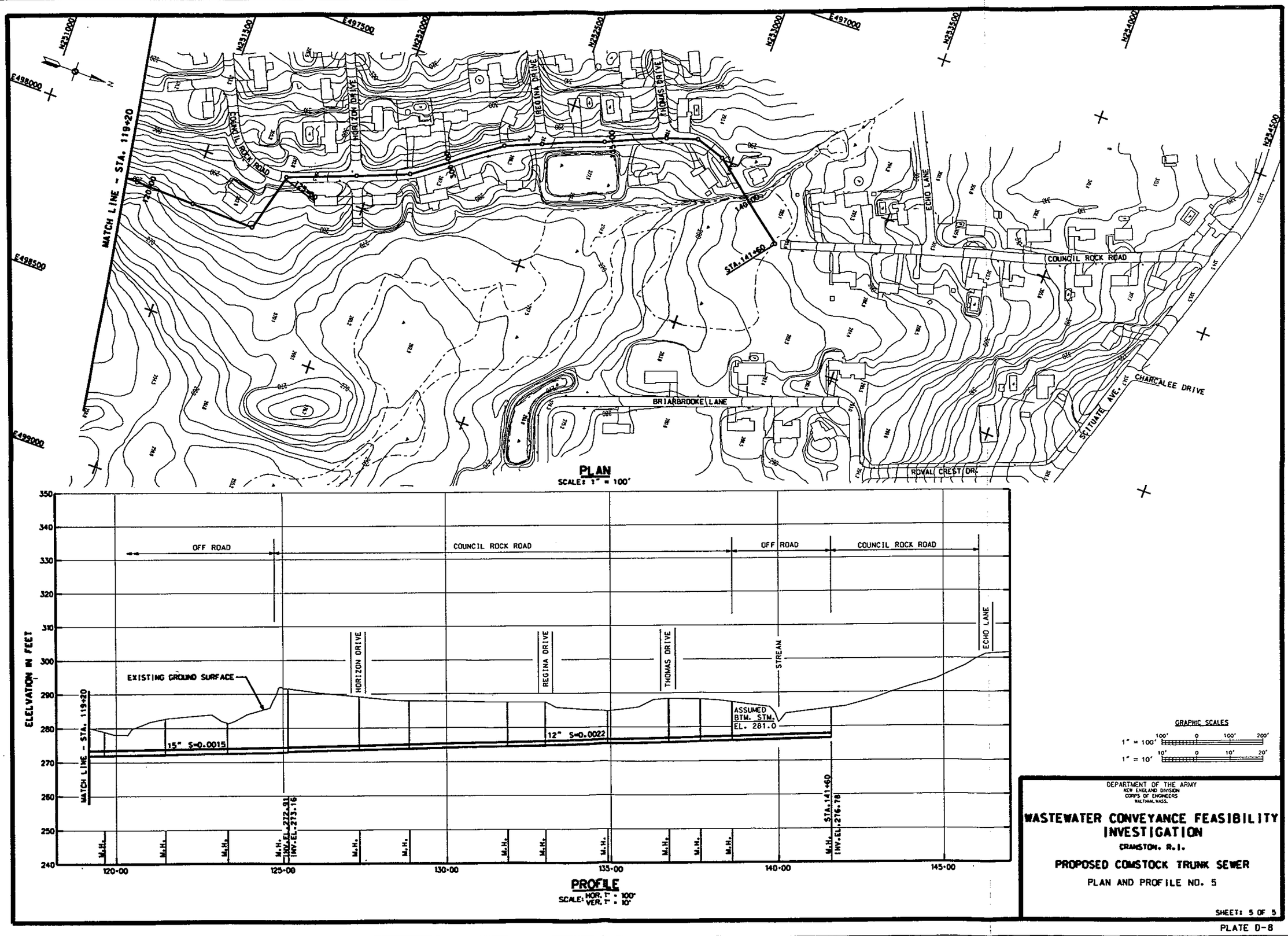
CRANSTON, R.I.

PROPOSED COMSTOCK TRUNK SEWER

PLAN AND PROFILE NO. 4

SHEET: 4 OF 5

PLATE D-7



DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.

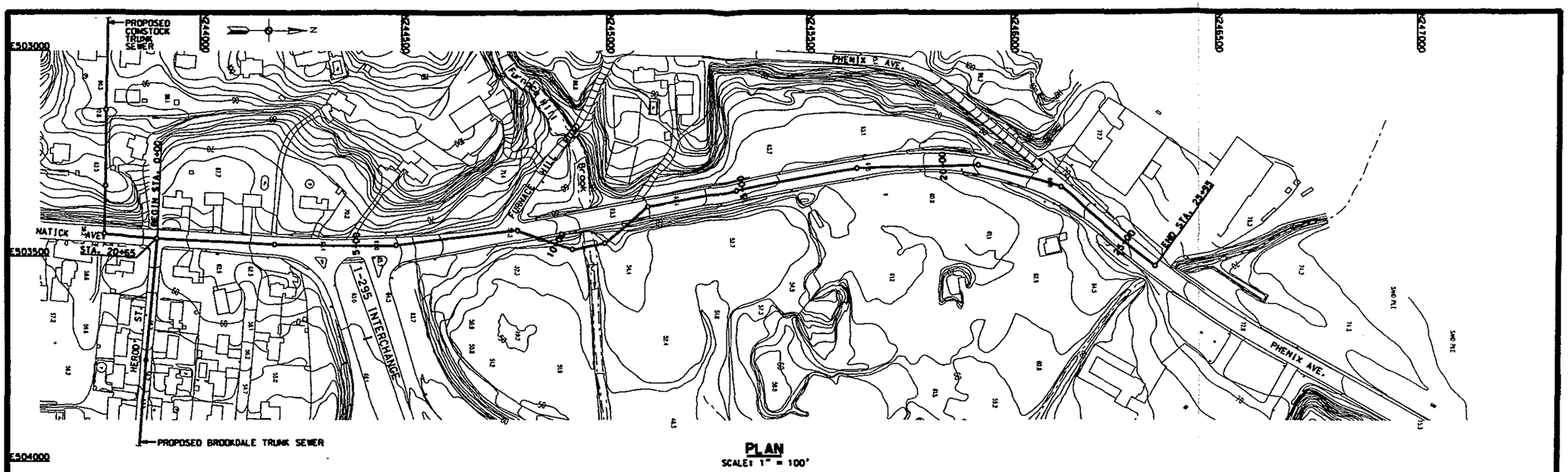
WASTEWATER CONVEYANCE FEASIBILITY INVESTIGATION

CRANSTON, R.I.

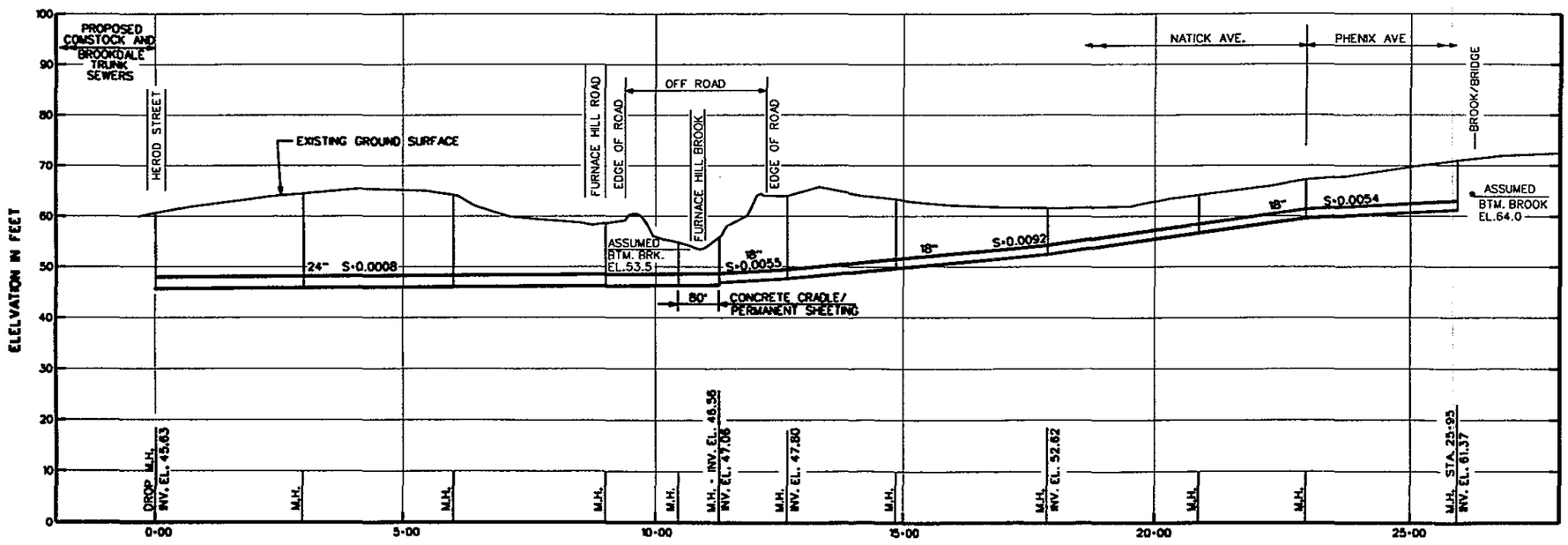
PROPOSED COMSTOCK TRUNK SEWER

PLAN AND PROFILE NO. 5

SHEET: 5 OF 5



PLAN
SCALE: 1" = 100'



PROFILE
SCALE: HOR. 1" = 100' VER. 1" = 10'

GRAPHIC SCALES

1" = 100' 100' 0 100' 200'

1" = 10' 10' 0 10' 20'

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.

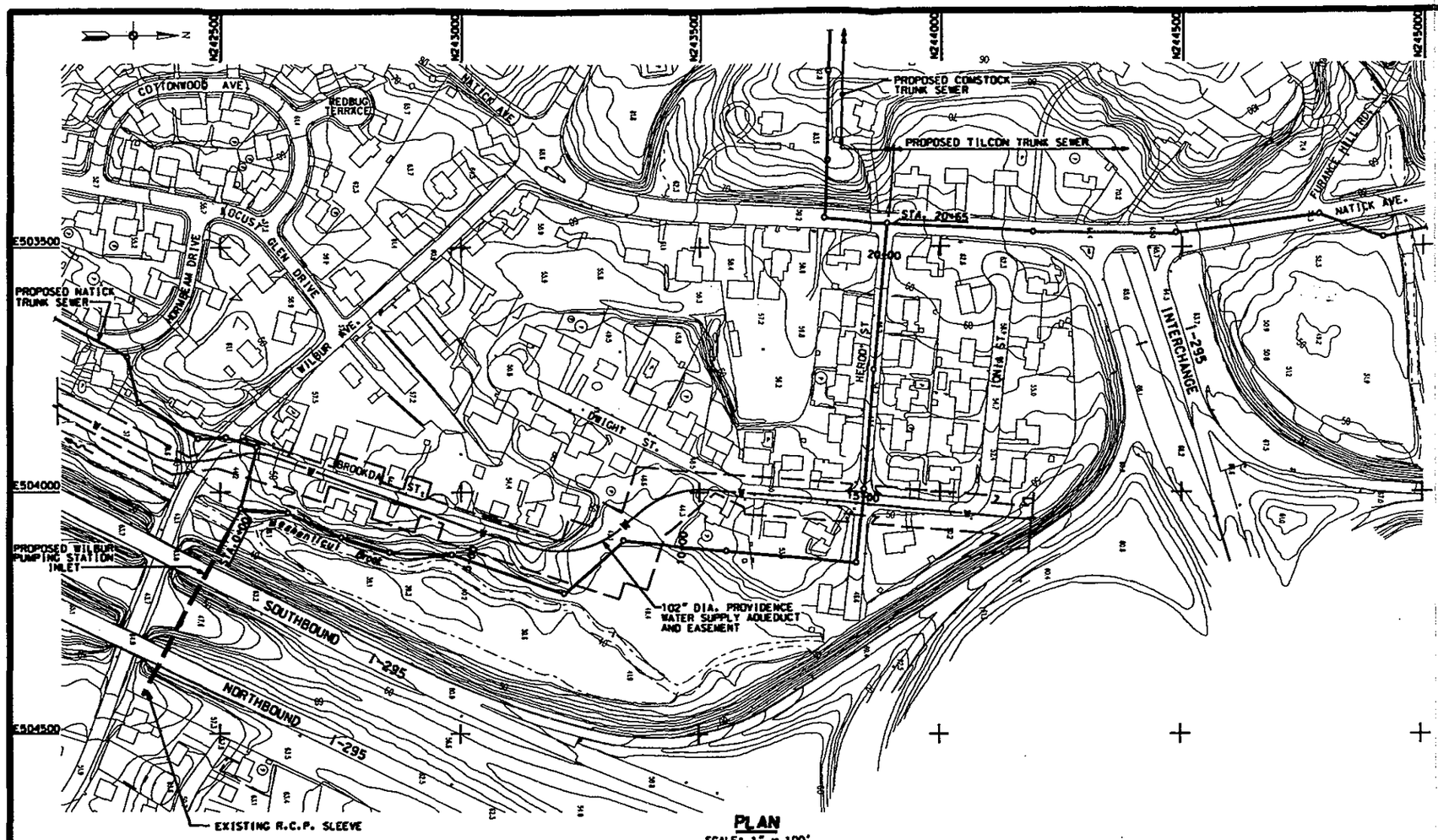
WASTEWATER CONVEYANCE FEASIBILITY INVESTIGATION

CRANSTON, R.I.

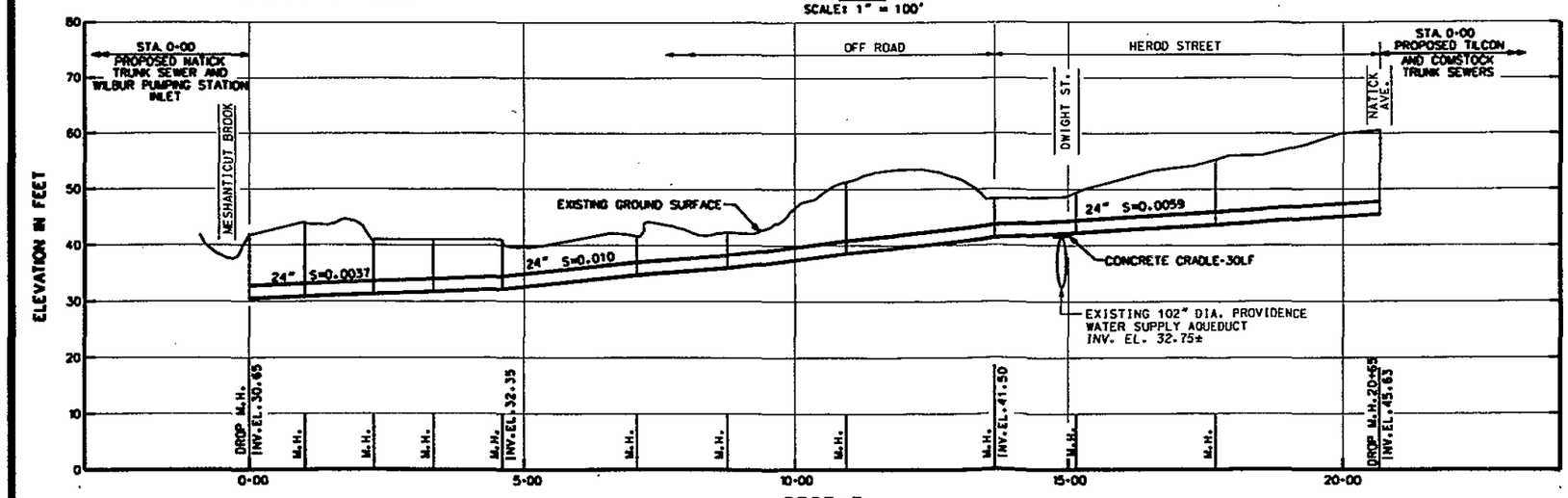
PROPOSED TILCON TRUNK SEWER

PLAN AND PROFILE

SHEET: 1 OF 1



PLAN
SCALE: 1" = 100'



PROFILE
SCALE: HOR. 1" = 100'
VER. 1" = 10'

GRAPHIC SCALES
1" = 100' 100' 0 100' 200'
1" = 10' 10' 0 10' 20'

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.

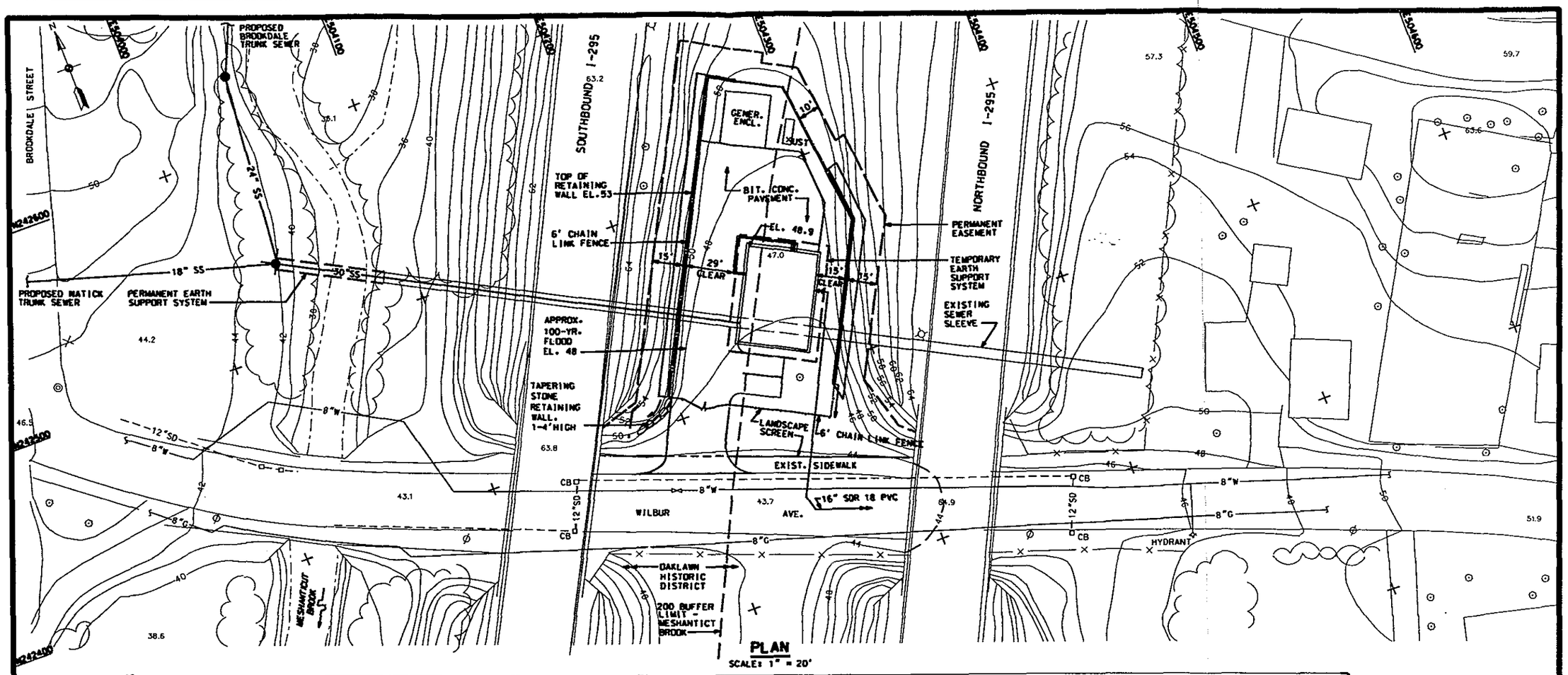
WASTEWATER CONVEYANCE FEASIBILITY INVESTIGATION

CRANSTON, R.I.

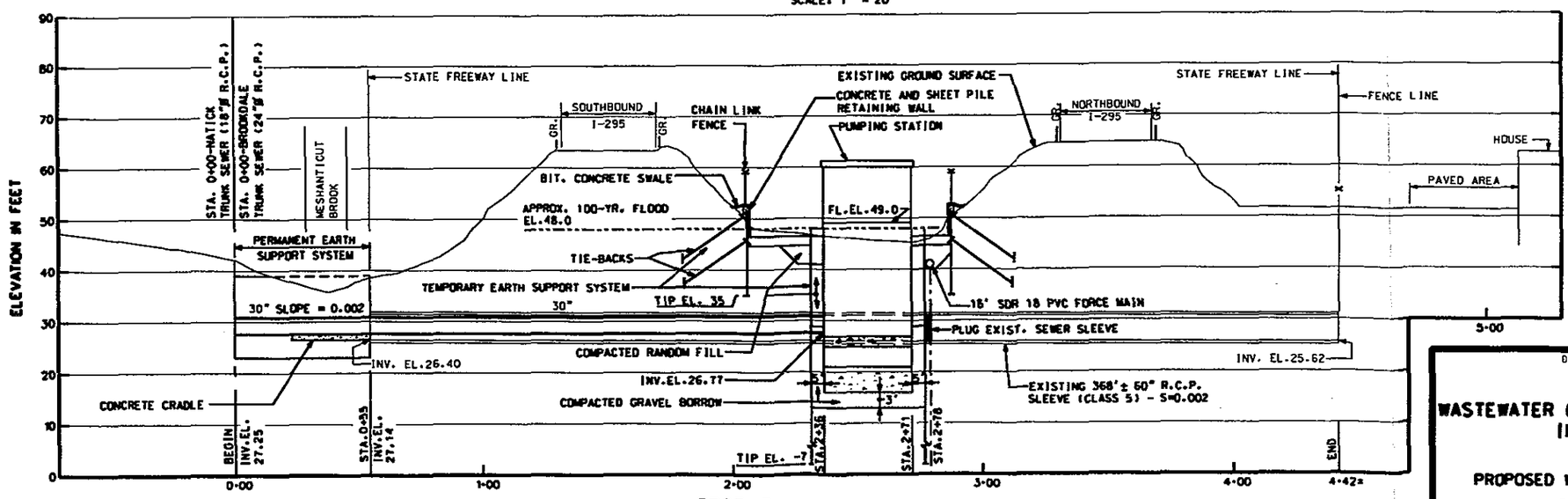
PROPOSED BROOKDALE TRUNK SEWER

PLAN AND PROFILE

SHEET: 1 OF 1



PLAN
SCALE: 1" = 20'



PROFILE
SCALE: HOR. 1" = 20'
VER. 1" = 10'

GRAPHIC SCALES
1" = 20' 20' 0 20' 40'
1" = 10' 10' 0 10' 20'

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.

WASTEWATER CONVEYANCE FEASIBILITY INVESTIGATION

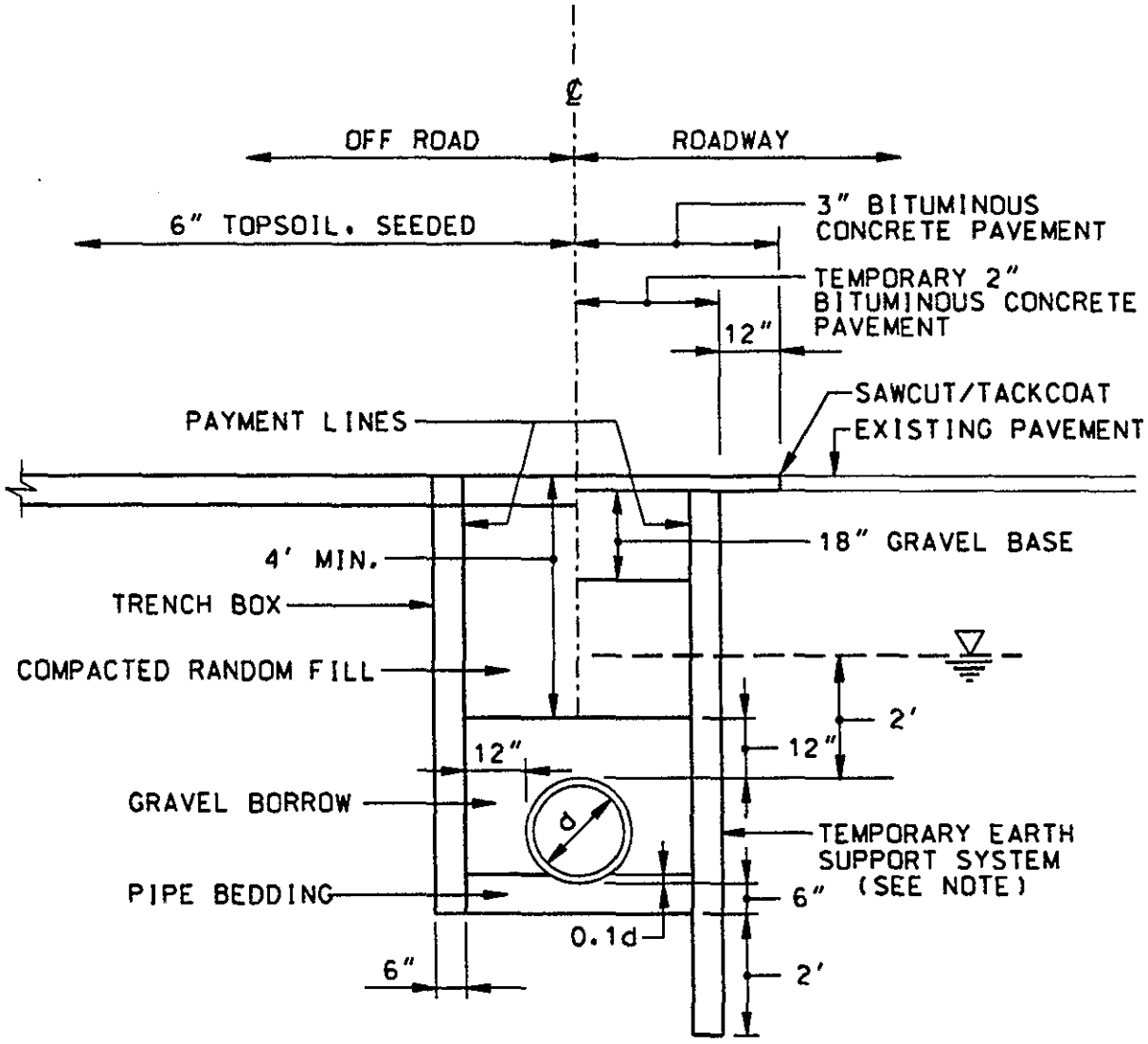
CRANSTON, R.I.

PROPOSED WILBUR PUMPING STATION

PLAN AND PROFILE

SHEET: 1 OF 1

PLATE D-11



TYPICAL SUPPORTED TRENCH IN EARTH

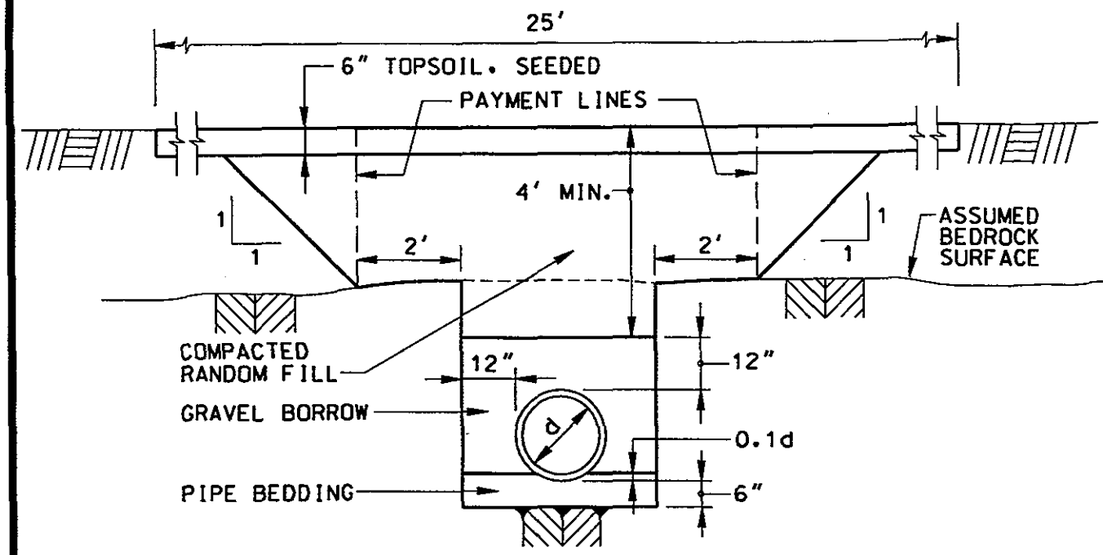
NOTE:
TEMPORARY EARTH SUPPORT SYSTEM SHALL BE USED IF GROUNDWATER IS 2 FEET OR MORE ABOVE THE TOP OF THE PROPOSED PIPE LOCATION

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.

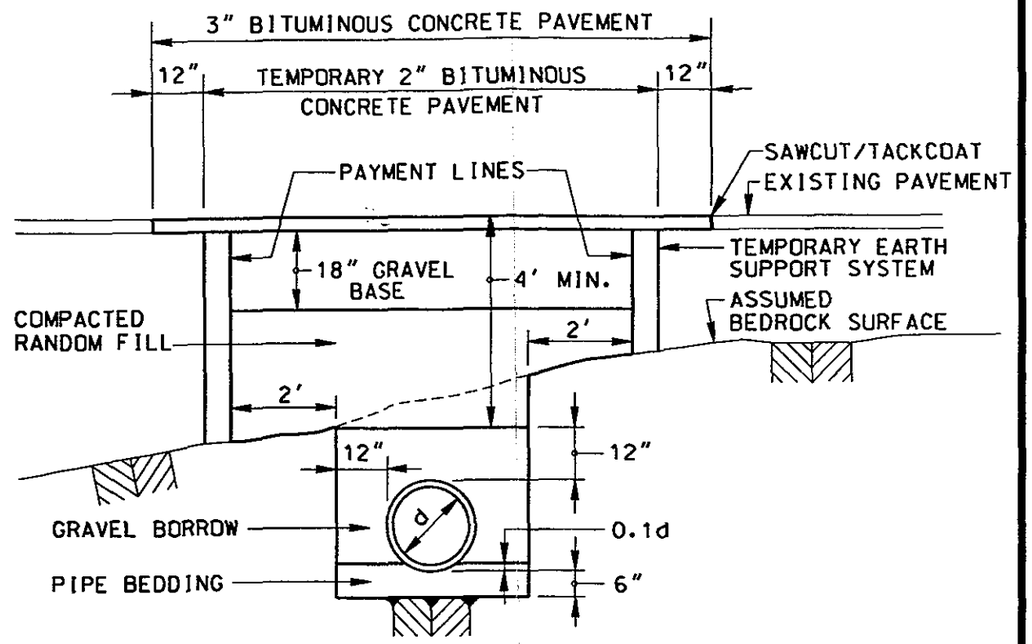
WASTEWATER CONVEYANCE FEASIBILITY INVESTIGATION

CRANSTON, R.I.

TYPICAL TRENCH SECTION IN EARTH



TYPICAL UNSUPPORTED TRENCH
IN BEDROCK (OFF ROAD)



TYPICAL SUPPORTED TRENCH
IN BEDROCK (ROADWAYS)

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.

WASTEWATER CONVEYANCE FEASIBILITY INVESTIGATION

CRANSTON, R.I.

TYPICAL TRENCH SECTIONS
IN BEDROCK

APPENDIX E

Task 13b - Proposed Project, Real Estate Costs

Section 117, Cranston Rhode Island
Wastewater Conveyance Feasibility Investigation

APPENDIX E

TASK 13b - Proposed Project, Real Estate Costs

Department of the Army
Corps of Engineers, New England Division
Waltham, Mass

March 1995

APPRAISAL REVIEW

PROJECT: Wastewater Interceptor Feasibility Study

OWNER: Various Owners

LOCATION: Cranston, Rhode Island

EFFECTIVE DATE: August 1994

VALUATION SUMMARY: Total Estimated Real Estate Costs

1.	Scituate Pumping Station:	$208,000
2.	Scituate 6-Inch Force Main/VGS:	$ 28,000
3.	Wilbur Pumping Station:	$ 39,000
4.	Wilbur Force Main:	$ 9,000
5.	Improve Sockanosset Interceptor, Add Gravity Sewer:	$114,000
6.	Brookdale Trunk Sewer, Gravity Sewer:	$123,000
7.	Tilcon Trunk Sewer, Gravity Sewer:	$ 25,000
8.	Natick Phenix Trunk Sewer:	$ 84,000
9.	Comstock/Furnace Hill Trunk Sewer, Gravity Sewer:	$324,000

1. I have not physically inspected the property being appraised.

2. The comparable real estate sales used in estimating the value of the lands in this project are in the Appraisal Division files.

3. The data and analysis in the report are adequate for a preliminary estimate.

4. The report has been reviewed and is approved in the amounts shown above.

CERTIFICATION:

I certify that, to the best of my knowledge and belief:

- The facts and data reported by the review appraiser and used in the review process are true and correct.

- The analyses, opinions and conclusions in the review are limited only by the assumptions and limiting conditions stated in this review report, and are my personal, unbias, professional analyses, opinions, and conclusions.

- I have no present or prospective interest in the property that is the subject of this report and I have no personal interest or bias with respect to the parties involved.

- My compensation is not contingent on an action or event resulting from the analyses, opinions or conclusions in, or the use of this report.

- My analyses, opinions and conclusions were developed and this review report was prepared in conformity with the Uniform Standards of Professional Appraisal Practice.

- I am most familiar with the subject property of the report under review.

- No one has provided significant professional assistance to the person signing this review report.

23 August 1994

WILLIAM D. BROWN
Reviewing Appraiser
Chief, Appraisal Division

DEPARTMENT OF THE ARMY

NEW ENGLAND DIVISION

424 TRAPELO ROAD

WALTHAM, MASSACHUSETTS 02254-9149

PRELIMINARY ESTIMATE OF REAL ESTATE COSTS

CITY OF CRANSTON, RHODE ISLAND

SECTION 117

WASTEWATER CONVEYANCE FEASIBILITY INVESTIGATION

SEPTEMBER 1993

UPDATED AUGUST 1994

PREPARED BY

ROBERT P. ABBOTT, ASA
Senior Staff Appraiser

REVIEWED &
APPROVED BY

WILLIAM D. BROWN
Chief, Appraisal Branch

TABLE OF CONTENTS

ITEM	PAGE NO.
AUTHORITY	E-1
PURPOSE	E-1
INSPECTION OF THE REAL ESTATE	E-1
COMMUNITY DESCRIPTION	E-1
WASTEWATER TREATMENT FACILITY	E-2
STUDY AREA	E-2
MAP OF PROJECT	E-3
TOPOGRAPHY	E-4
GOVERNMENT OWNED FACILITIES	E-4
PROTECTION AND ENHANCEMENT OF CULTURAL ENVIRONMENT	E-4
ENDANGERED SPECIES	E-4
ZONING	E-4,5
RIGHTS TO BE ACQUIRED	E-6
FEE ACQUISITION	E-6
PERMANENT EASEMENTS	E-6
TEMPORARY EASEMENTS	E-6
CONTINGENCIES	E-6
ACQUISITION COSTS	E-7
RELOCATION COSTS	E-7
SEVERANCE DAMAGES	E-8
EVALUATION AND CONCLUSION	E-8
SUMMARY OF REAL ESTATE COSTS	E-13

AUTHORITY

Legislation that was passed in the Water Resource Development Act of 1990, SECTION 117, authorizes the U.S. Army Corps of Engineers to conduct a feasibility study of wastewater treatment options for transporting contamination from the Central Landfill site and other sources of pollutants in Cranston, Rhode Island.

PURPOSE

This report provides a preliminary reconnaissance estimate of real estate costs of different alignments to assist the City of Cranston in their formulation and evaluation of subject project.

This preliminary report is based solely on existing data and available information obtained from the City of Cranston, Rhode Island.

INSPECTION OF THE REAL ESTATE

The properties affected by the proposed project were viewed by the appraiser in the field during the week of 20 September 1993.

COMMUNITY DESCRIPTION

The City of Cranston is located in central Rhode Island southwest of Providence and abuts this city as well as the communities of Johnson, Scituate, Coventry, West Warwick and Warwick.

Cranston has a current population of 76,000 and occupies a land area of 17,747 acres. Two major highways aligned on a north to south axis through the City provide automobile and truck access to the City, Interstate 295 in the west and Interstate 95 in the east. Route 37 runs west to east and connects these two roadways.

Most of the City is provided with public water supply and the areas east of Interstate 295 and along portions of Plainfield Pike are provided with City sewers. Existing land use includes residential, commercial, industrial, institutional development and farmland. The major potential growth area in the City lies west of Interstate 295.

WASTEWATER TREATMENT FACILITY

The current Wastewater Treatment Facility (WWTF) uses an activated sludge process for removal of pollutants and consists of headworks, primary settling tanks, aeration tanks, final clarifiers, and chlorination. Sludge disposal is by on-site incineration. Discharge of treated wastewater is to the Pawtuxet River.

Discharge from the WWTF is regulated by Rhode Island Pollutant Discharge Elimination System (RIPDES) permit from the Rhode Island Department of Environmental Management Division of Water Resources, dated May 1989, which sets effluent limits and monitoring requirements, and a "Judicial Consent Decree for Advanced Wastewater Treatment", dated 20 March 1990, that sets forth the program the City is to undertake to attain compliance with advanced treatment permit limits.

STUDY AREA

The study includes land in the community of Cranston, Rhode Island which stretches form the Pawtuxet River in the southeast to the Central Landfill in the west (See Figure 1, General Map of Proposed Project). The study sites identified by the City of Cranston include:

- The Central Landfill just north of Cranston corporate boundary in the town of Johnston.
- The zoned industrial area in the Western Cranston adjacent to Plainfield Pike and Interstate 295.
- The Vinagro site on Green Hill Avenue south of Central Landfill.
- The Tilcon/Gammino gravel operation west of Interstate 295.
- Existing and future residential & Commercial Development in west Cranston.
- The State's Howard Center and associated lands in southern Cranston adjacent to Route 37.
- The Howard Industrial Park in South Cranston.
- The Capuano Landfill in southern Cranston adjacent to the Pawtuxet River.

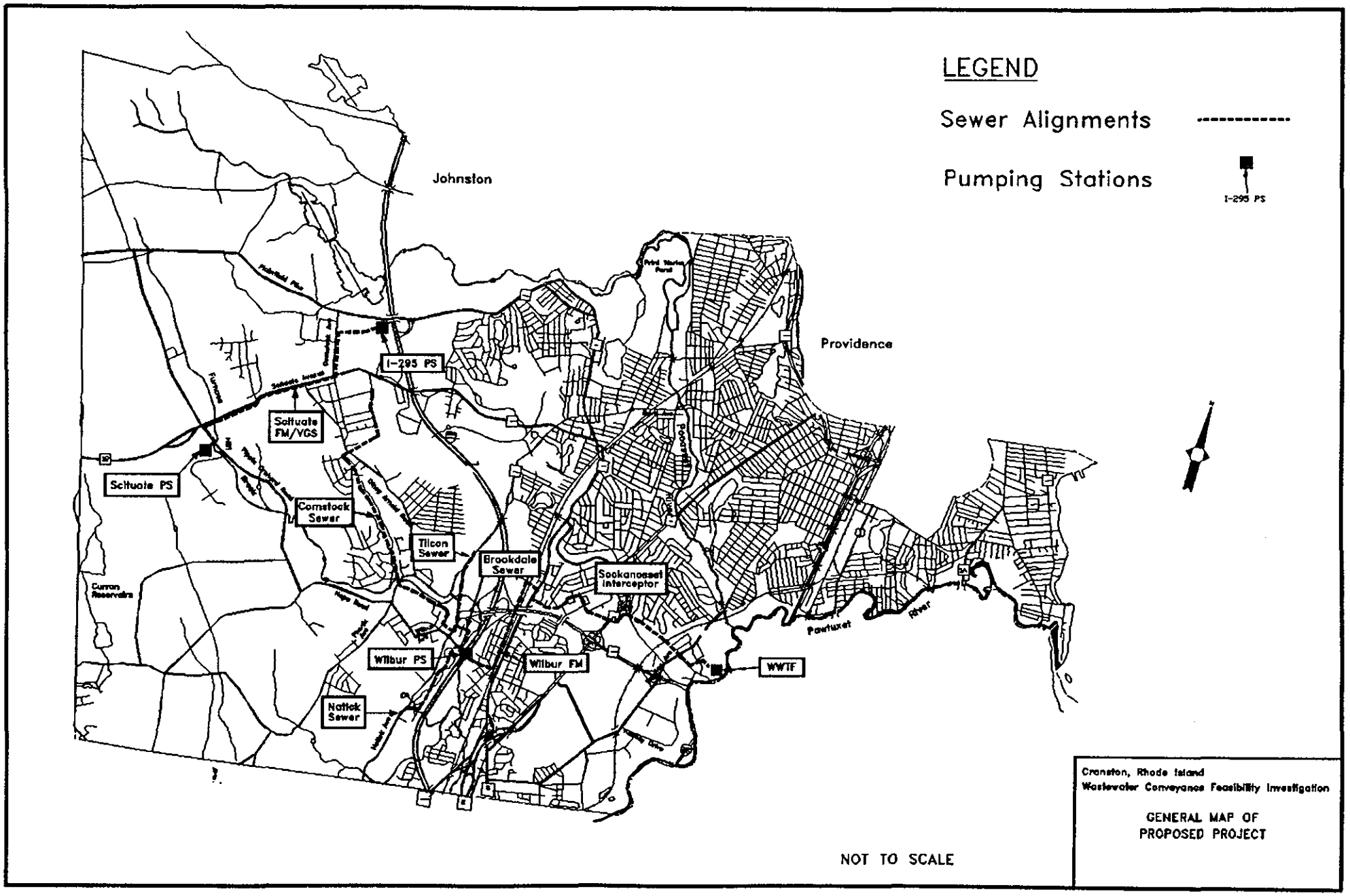

LEGEND
Sewer Alignments
Pumping Stations
I-295 PS
Johnston
Providence
I-295 PS
Scituate FM/VGS
Scituate PS
Comstock Sewer
Tilcon Sewer
Brookdale Sewer
Sockanosset Interceptor
Wilbur PS
Wilbur FM
Natick Sewer
WWTF
Pawtuxet River
Curran Reservoirs
NOT TO SCALE
Cranston, Rhode Island
Wastewater Conveyance Feasibility Investigation
GENERAL MAP OF
PROPOSED PROJECT

FIGURE 1

The study area is in the drainage area for the main stem of the Pawtuxet River which flows south to east along the easterly boundary of Cranston and empties into the Pawtuxet Cove adjacent to the Providence River.

TOPOGRAPHY

Topography in the study area ranges from rolling uplands in Western Cranston to glacial outwash plains adjacent to the Pawtuxet River. Water resources in the area include tributaries to the Pocasset River in central Cranston and Meshanticut Brook in Western Cranston. Both the Meshanticut and Pocasset are tributaries to the Pawtuxet. The Scituate Reservoir, a large water supply reservoir for the State of Rhode Island, is located on the North Branch of the Pawtuxet River, approximately 2.5 miles from the study area.

GOVERNMENT-OWNED FACILITIES

Section III of the Act of Congress approved 8 July 1958. (PL 85-500) authorized the protection, realteration, reconstruction, relocation or replacement of municipally-owned facilities. A preliminary inspection of the property area indicated no Government-owned facilities are affected.

PROTECTION AND ENHANCEMENT OF CULTURAL ENVIRONMENT

In accordance with instruction set forth in teletype DA (DAEN) R 191306A, dated October 1971, Subject: "E011593, 13 May 1971, Protection and Enhancement of Cultural Environment"; a study has been made in the subject areas. The study revealed that no local, State, Federally owned nor Federally controlled property of historical significance would fall within the provisions of E011593.

ENDANGERED SPECIES

No Federally listed, threatened or endangered species are known to occur in the project area, with the exception of occasional transient endanged bald eagles (Haliaeetus Leucocephalus) or peregrine falcons (Falco peregrinus anatum) (USFWS, 1991). At this time, three populations of rare or ecologically significant natural communities occur in Cranston or Johnston south of Route 6 to Route 14 (RIDEM, 1991). The Location of these communities are beyond the proposed project boundries. Therefore, it is unlikely that the proposed plans will have an effect on Rhode Island significant natural communities.

ZONING

The zoning regulations presently in effect for the proposed wastewater control project are as follows:

Cranston City Code

Sec. 30-19. Schedule of Intensity Regulations

	District	Minimum Lot Area (sq.ft.)*	Minimum Lot Width & Frontage (ft.)	Minimum Yards (ft.)			Maximum Lot Coverage (%)	Maximum Building Height (ft.)
				Front	Rear*	Side*		
SINGLE FAMILY	S-1, A-80	80,000	200	40	100	20	10	35
SINGLE FAMILY	A-20	20,000	125	30	30	15	20	35
	A-12	12,000	100	25	20	10	30	35
	A-8	8,000	80	25	20	10	30	35
	A-6	6,000	60	25	20	8	30	35
MULTI FAMILY	B-1	6,000	60	25	20	8	35	35
	B-2	6,000	60	25	20	8	50	35
COMMERCIAL	C-1	6,000	60	25	20	8	60	35
	C-2	6,000	60	25	20	8	60	30
	C-3	6,000	60	0	20	0	100	35
	C-4	12,000	120	40	20	8	50	35
	C-5	10,000	80	30	20	8	60	35
INDUSTRIAL	M-1	30,000	150	40	30	20	60	-
	M-2	60,000	200	40	30	25	60	-

RIGHTS TO BE ACQUIRED

Local interests will be required to provide all lands and easements necessary for project purposes.

FEE ACQUISITION

An absolute ownership in Real Estate.

PERMANENT EASEMENT AREAS

An interest in perpetuity of land less than the fee estate.

Permanent easements for construction and maintenance purposes are necessary. The easement areas vary in width from 20 to 30 feet throughout the project areas.

Preliminary investigations indicate that after the imposition of the permanent easement interest, the highest and best use of the remainders of the properties affected will not be materially affected. However, it is historically known that the mere knowledge and existence of the imposition infers a restrictive aspect. Therefore, the cost to acquire the permanent easement interest would be less than the underlying fee value. However, lands would remain in their private ownerships to maintain conformity of their existing lot areas. The estimated costs for the easement rights are predicated on the assumption that construction methods will be of the excavation and placement methods and would not adversely affect surface or near-surface improvements. If it is determined and found that selected methods of construction would cause damage to the surface of the near-surface improvements, then the estimated costs for easement rights would not remain valid and a new in-depth real estate study of the proposed taking would be required.

TEMPORARY CONSTRUCTION EASEMENTS

An interest of temporary nature less than the fee estate in Real Property.

The land areas to be encumbered by temporary easements require approximately one acre of land for each staging area and are available in the immediate vicinity.

CONTINGENCIES

A contingency allowance of **25 percent** is considered to be reasonably adequate to provide for possible appreciation of property values for possible minor property line adjustments or for additional hidden ownerships which may be developed by refinement to taking lines, for adverse condemnation awards and to allow for practical and realistic negotiations.

ACQUISITION COSTS

Acquisition costs will include costs for **mapping, surveying, legal description, title evidence, appraisals, negotiations, closing and administrative costs** for possible condemnations. The acquisition costs are based upon this office's experience in similar civil works projects in the general area and are estimated at $7,000.00 per ownership. A number of ownerships will be affected by the different alignments.

RELOCATION COSTS

Public Law 91-646, Uniform Relocations Assistance Act of 1970, provided for uniform and equitable treatment of persons displaced from their homes, businesses, or farms by a Federally Assisted Program. It also established uniform and equitable land acquisition policies for these projects. Included among the items under PL 91-646 are following:

a. Moving Expenses

b. Relocation Allowance (Business)

c. Replacement Housing (Tenants)

d. Relocation Advisory Services.

e. Recording Fees

f. Transfer Taxes

g. Mortgage Prepayment Costs

h. Real Estate Tax Refunds (Pro-Rata)

There are a number of ownerships affected by the permanent easement interests. Preliminary investigations indicate that none of the

ownerships will require relocation. Therefore, the estimates included are for planning purposes and are limited to expenses incidental to the recording of real estate interests.

Should the existing preliminary taking lines be changed to include improvements then the taking authority must certify that there will be available, in areas generally not less desirable and at rents/prices within the financial means of the tenants that would be displaced, decent and safe sanitary facilities, equal in number to the number of, and available to, such displaced persons who require such dwellings and reasonably accessible to their places of employment.

SEVERANCE DAMAGES

Severance damages usually occur when partial takings are acquired which restrict the remaining portion from full economic development. The severance damages are measured and estimated on the basis of a "Before" and "After" appraisal method and will reflect actual value loss incurred to the remainder as a result of partial acquisition. Detailed appraisals will reflect these losses.

EVALUATION AND CONCLUSION

A careful and thorough search of the City of Cranston's records was made to obtain sales data. Those sales considered to be similar in nature and character to the properties which will be affected by the proposed project are maintained in the Appraisal Division file. Considerable effort was made to interview either grantor or grantee to establish the authenticity of each transaction. The sales were inspected in the field. Real Estate appraisers, broker's and knowledgeable officials of the City of Cranston were interviewed to obtain sales data used in arriving at the estimated values for this study.

SUMMARY OF REAL ESTATE COSTS

The following are preliminary estimates of the real estate costs for the interests being considered for the Section 117, Wastewater Conveyance Feasibility Investigation Report.

REAL ESTATE REQUIREMENTS

	length (ft)	width (ft)	Total area (SF)
SCITUATE PUMPING STATION			
land for pump station (fee acquistion)	100	130	13,000
temp PS construction easement	25	130	3,250

REAL ESTATE REQUIREMENT - SCITUATE PUMPING STATION

FEE ACQUISITION:		
(1 Ownerships)		
(13,000 SF x $2.00 PSF)	$ 26,000	
SEVERANCE DAMAGES		
(67,000 SF x $2.00)	$134,000	
TEMPORARY EASEMENTS		
(1 Ownerships)		
(3,250 SFx $2.00 PSF x 10% Return:)	$ 650	
TOTAL FEE & EASEMENT COSTS	**$160,650**	
CONTINGENCY: (25%)	$ 40,163	
SUBTOTAL		$200,813
ACQUISITION COSTS		
(1 Ownerships @ $7,000 each)		$7,000
RELOCATION COSTS		
(1@ $200)		$200
TOTAL REAL ESTATE COST:		$208,013
	CALL	**$208,000**

	length (ft)	width (ft)	Total area (SF)
SCITUATE 6-INCH FORCE MAIN VGS			
off road existing city easement 20 ft width expand to 30 ft width	600	10	6,000
off road new easement	-	-	-
temp staging area easement (use land at pump station)	-	-	-

REAL ESTATE REQUIREMENT - SCITUATE 6-INCH FORCEMAIN VGS

PERMANENT EASEMENTS		
(2 Ownerships)		
(6000 SF x $2.00 PSF x 90% Return:)	$10,800	
CONTINGENCY: (25% of above)	$ 2,700	
SUBTOTAL		$13,500
ACQUISITION COSTS		
(2 Ownerships @ $7,000 each)		$14,000
RELOCATION COSTS		$ 400
(2 @ $200)		
SEVERANCE DAMAGES		$ 0
None		
TOTAL REAL ESTATE COST:		$27,900
	CAll	**$28,000**

REAL ESTATE REQUIREMENTS

WILBUR PUMPING STATION	length (ft)	width (ft)	Total area (SF)
land for pump station	110	170	18,700
temp construction easement	50	60	3,000

REAL ESTATE REQUIREMENT - WILBUR PUMPING STATION

PERMANENT EASEMENTS			
(1 Ownership)			
(18,700 SF x $1.50 X 90% Return)	$25,245		
TEMPORARY EASEMENTS			
(1 Ownerships)			
(3,000 SF x $1.50 PSF x 10% Return:)	$ 450		
TOTAL FEE & EASEMENT COSTS	**$25,695**		
CONTINGENCY: (25% of Above)	$ 6,424		
SUBTOTAL		$32,119	
ACQUISITION COSTS			
(1 Ownerships @ $7,000 each)		$ 7,000	
RELOCATION COSTS			
(1 @ $200)		$ 200	
SEVERANCE DAMAGES			
None		$ 0	
TOTAL REAL ESTATE COST:		$39,319	
	CALL	**$39,000**	

WILBUR FORCE MAIN	length (ft)	width (ft)	Total area (sf)
on-road (all in city streets)	-	-	-
temp staging area	400	20	8,000

REAL ESTATE REQUIREMENT - WILBUR

TEMPORARY EASEMENTS			
(1 Ownerships)			
(8,000 SF x $1.50 x 10% Return:)	$ 1,200		
CONTINGENCY: (25% of above)	$ 300		
SUBTOTAL		$1,500	
ACQUISITION COSTS			
(1 Ownerships @ $7,000 each)		$7,000	
RELOCATION COSTS			
None		$0	
SEVERANCE DAMAGES			
None		$ 0	
TOTAL REAL ESTATE COST:		$8,500	
	CALL	**$9,000**	

REAL ESTATE REQUIREMENTS

IMPROVE SOCKANOSSET INTERCEPTOR, REPLACE OR ADD GRAVITY SEWER	length (ft)	width (ft)	Total area (SF)
off-road existing city sewer easement 25 ft width expand to 30 ft	1200	5	6000
temp staging area	-	-	-

REAL ESTATE REQUIREMENT - IMPROVE SOCKANOSSET INTERCEPTOR, REPLACE OR ADD GRAVITY SEWER

PERMANENT EASEMENTS			
(14 Ownerships)			
(6000 SF x $2.00 PSF x 90% Return:)	$10,800		
CONTINGENCY: (25% of above)	$ 2,700		
SUBTOTAL			$ 13,500
ACQUISITION COSTS			
(14 Ownerships @ $7,000 each)			$ 98,000
RELOCATION COSTS			
(14 @ $200)			$ 2,800
SEVERANCE DAMAGES			
None			$ 0
TOTAL REAL ESTATE COST:			$114,300
		CALL	**$114,000**

BROOKDALE TRUNK SEWER, GRAVITY SEWER	length (ft)	width (ft)	Total area (SF)
off road (new easement between Herod St. and Brookdale Ave.)	1400	30	42,000
temp staging area	1400	20	28,000

REAL ESTATE REQUIREMENT - BROOKDALE TRUNK SEWER, GRAVITY SEWER

PERMANENT EASEMENTS			
(3 Ownerships)			
(42,000 SF x $2.00 PSF x 90% Return:)	$75,600		
TEMPORARY EASEMENTS			
(28,000 SF x 2.00 x 10%)	$ 5,600		
TOTAL EASEMENT COSTS	**$81,200**		
CONTINGENCY: (25% of above)	$20,300		
SUBTOTAL			$101,500
ACQUISITION COSTS			
(3 Ownerships @ $7,000 each)			$ 21,000
RELOCATION COSTS			
(3 @ $200)			$ 600
SEVERANCE DAMAGES			
None			$ 0
TOTAL REAL ESTATE COST:			$123,100
		CALL	**$123,000**

REAL ESTATE REQUIREMENTS

TILCON TRUNK SEWER, GRAVITY SEWER	length (ft)	width (ft)	Total area (SF)
off road (new easement)	200	30	6,000
temp staging area	200	20	4,000

REAL ESTATE REQUIREMENT - TILCON TRUNK SEWER, GRAVITY SEWER

PERMANENT EASEMENTS			
(2 Ownerships)			
(6,000 SF x $1.50 PSF x 90% Return:)	$ 8,100		
TEMPORARY EASEMENTS			
(2 Ownerships)			
(4,000 SF x $1.50 PSF x 10% Return:)	$ 600		
TOTAL EASEMENT COSTS$	**$ 8,700**		
CONTINGENCY: (25%)	$ 2,175		
SUBTOTAL		$10,875	
ACQUISITION COSTS			
(2 Ownerships @ $7,000 each)		$14,000	
RELOCATION COSTS			
(2 @ $200)		$ 400	
SEVERANCE DAMAGES			
None		$ 0	
TOTAL REAL ESTATE COST:		$25,275	
	CALL	**$25,000**	

NATICK PHENIX TRUNK SEWER	length (ft)	width (ft)	Total area (SF)
off road new	500	30	15,000
adjacent to Natick Village Complex	-	-	-
temp staging area	-	-	2.0± Acres

REAL ESTATE REQUIREMENT - NATICK PHENIX TRUNK SEWER.

PERMANENT EASEMENTS			
(4 Ownerships)			
(15,000 SF x $2.00 PSF x 90% Return:)	$27,000		
TEMPORARY EASEMENTS			
(4 Ownerships)			
(87,120 SF x $2.00 PSF x 10% Return:)	$17,424		
TOTAL EASEMENT COSTS	**$44,424**		
CONTINGENCY: (25%)	$11,106		
SUBTOTAL		$55,530	
ACQUISITION COSTS			
(4 Ownerships @ $7,000 each)		$28,000	
RELOCATION COSTS			
(4 @ $200)		$ 800	
SEVERANCE DAMAGES			
None		$ 0	
TOTAL REAL ESTATE COST:		$84,330	
	CALL	**$84,000**	

REAL ESTATE REQUIREMENTS

COMSTOCK\FURNACE HILL TRUNK SEWER, GRAVITY SEWER	length (ft)	width (ft)	Total area (SF)
off road (new easement)	4,500	30	135,000
temp staging area	4,500	20	90,000

REAL ESTATE REQUIREMENT - COMSTOCK\FURNACE HILL TRUNK SEWER, GRAVITY SEWER

PERMANENT EASEMENTS		
(11 Ownerships)		
(135,000 SF x $1.50 PSF x 90% Return:)	$182,250	
TEMPORARY EASEMENTS		
(11 Ownerships)		
(90,000 SF x $1.50 PSF x 10% Return:)	$ 13,500	
TOTAL EASEMENT COSTS	**$195,750**	
CONTINGENCY: (25%)	$ 48,938	
SUBTOTAL		$244,688
ACQUISITION COSTS		
(11 Ownerships @ $7,000 each)		$ 77,000
RELOCATION COSTS		
(11 @ $200)		$ 2,200
SEVERENCE DAMAGES		
None		$ 0
TOTAL REAL ESTATE COST:		$323,888
	CALL	**$324,000**