Detailed Project Report
Salisbury Brook
Salisbury Plain River
Brockton, Massachusetts

Snagging and Clearing

March 1991

US Army Corps
of Engineers
New England Division

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DETAILED PROJECT REPORT

SNAGGING AND CLEARING
SALISBURY BROOK/SALISBURY PLAIN RIVER
BROCKTON, MASSACHUSETTS

U.S. ARMY CORPS OF ENGINEERS
NEW ENGLAND DIVISION

SYLLABUS

This Detailed Project Report was prepared under the special continuing authority contained in Section 208 of the 1954 Flood Control Act, as amended, to determine the need and feasibility of removing accumulated sediments and debris along Salisbury Brook and the Salisbury Plain River in the City of Brockton, Massachusetts. That accumulation is responsible for increases to the height and frequency of flood stages that affect the adjacent residential, commercial and industrial properties.

The investigation contained herein determined there is economic justification for removal of an estimated total of 4,500 cubic yards of sediment from the Salisbury Plain River from the Perkins Avenue area to the bridge at Plain Street and the removal of trees and brush that encroach on the streambed. All plans for local flood protection along Salisbury Brook were found to lack the economic justification required for Corps of Engineers participation.

The estimated stream discharges in the area of the proposed project do not meet all the requirements for Federal participation, specifically the local drainage criteria as stipulated by the engineering regulation ER-1165-2-21. An exception to that regulation was sought from the Corps' Office of the Chief of Engineers. That exception, however, was not approved. The estimated 10 year discharge in the vicinity of the proposed project is 650 cubic feet per second . Due to the flat channel gradient and the current high level of development in the watershed, projections for future conditions do not substantially increase the estimated 10 year discharge over the lifetime of the project. Consequently, the report concludes that Federal participation in this project is not possible under existing policy guidelines.

LOCAL FLOOD PROTECTION
SALISBURY BROOK/SALISBURY PLAIN RIVER
BROCKTON, MASSACHUSETTS
DETAILED PROJECT REPORT

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I. INTRODUCTION

1.. Introduction

The Water Resources Development Act (WRDA) of 1986, also known as Public Law 99-662, provided pre-construction authorization to carry out the planning, engineering, and design elements for a flood control project to protect the city of Brockton, Massachusetts (see Plate 1 for Project Vicinity Map). In 1988, the Army Corps of Engineers investigated alternatives for local flood protection in Brockton. Plans that featured combinations of floodwalls, dikes, floodproofing, and diversions were proposed, but none of these alternatives were found to be economically justified. Noteworthy among the Corps' findings and recommendations was the need to reduce or eliminate the many types of restrictions to channel flow. Some of the common problems identified were suspended utility pipes beneath the bridges, heavy accumulation of sediments and debris, and high concentrations of streamside vegetation. Many small bridge and culvert openings feature low decks and/or abutments that project out into the channel.

It was noted that these accumulated sediments and debris caused earlier and more frequent flooding than could be expected if the channel was "clean". Removal of the sediments, trees, and brush would reduce flood levels. In a letter dated November 22, 1988, Mayor Carl Pitaro of Brockton requested the Army Corps of Engineers to address the feasibility of channel cleaning.

This report presents the findings of the investigation of channel clearing and debris removal along Salisbury Brook and the Salisbury Plain River.

2. Study Authority

This report was prepared under the special continuing authority contained in Section 208 of the 1954 Flood Control Act, as amended. The objective is to reduce flood damage by removing accumulated snags and other debris, and cleaning and straightening the channel in streams and tributaries, when, in the opinion of the Corps of Engineers, such work is advisable. Section 208 projects must be economically feasible, complete within themselves, and require no additional work for effective flood control. The construction of Section 208 projects is cost shared 75% Federal and 25% non-Federal. The current cost limitation established under this authority for the Federal portion is $500,000 per project.

3. Study Purpose and Scope

The intent of this Detailed Project Report is to evaluate the economic, environmental and construction feasibility of snagging and clearing measures proposed for Salisbury Brook and the Salisbury Plain River in Brockton, Massachusetts. Other structural and non-structural flood control measures were evaluated during the 1988 investigation as a response to WRDA 1986. Those measures, were found not to be justified and have not been reevaluated within the scope of this study.

4. Prior Studies

In 1975, the Corps of Engineers evaluated a plan for local flood protection which consisted of a series of improvements intended to provide 100-year flood protection for several areas along Salisbury Brook and the Salisbury Plain River. The 1975 plan was found to be not economically justified.

In 1988, a Corps investigation authorized through the Water Resources Development Act of 1986 revised and updated the earlier studies as well as examined several other structural and non-structural alternatives for flood control. In each case, the annual costs of plan implementation exceeded the annual benefits attributed to that plan. The study was therefore terminated due to a lack of economic justification.

II. EXISTING CONDITIONS

1. Study Area Description

The city of Brockton, Massachusetts is located approximately 18 miles south of Boston and 25 miles northwest of Providence, Rhode Island (See Plate 1). The Salisbury Plain River Basin forms the northern edge of the Taunton River Watershed. The topography is generally flat with low rolling hills, most of which is at elevation 200 national geodetic vertical datum (NGVD) or less. Much of the drainage area of Salisbury and Trout Brooks is urban or suburban in character with a few scattered swampy areas, five small ponds, and a large park area that is contiguous with the Brockton Reservoir. The Salisbury Plain River watershed includes urban, commercial, industrial and underdeveloped areas. The river flows south into the town of West Bridgewater and its confluence with the Matfield River.

The bedrock of the region consists generally of schist, gneiss, quartzite and slate overlain by folded sedimentary rocks composed of conglomerate, shale, sandstone and tillite, which are interstratified with volcanic rocks.

2. Basin Description

The Salisbury Plain River and its main tributaries, Salisbury Brook and Trout Brook drain the central and southernmost areas of Brockton as well as portions of the towns of Stoughton, Avon, and Holbrook. The drainage area above the Meadow Lane bridge on the Salisbury Plain River is 16.4 square miles. The study area watershed is depicted in Plate 2.

The upper part of the watershed area is drained by Beaver Brook which flows into a series of ponds that are part of the D.W. Field Park: Brockton Reservoir, Waldo Lake, Upper Porter Pond, Lower Porter Pond, Thirty Acres Pond, Ellis Brett Pond, and Cross Pond. Lovett Brook drains the westernmost portion of the watershed, and its flow joins the above progression at Ellis Brett Pond.

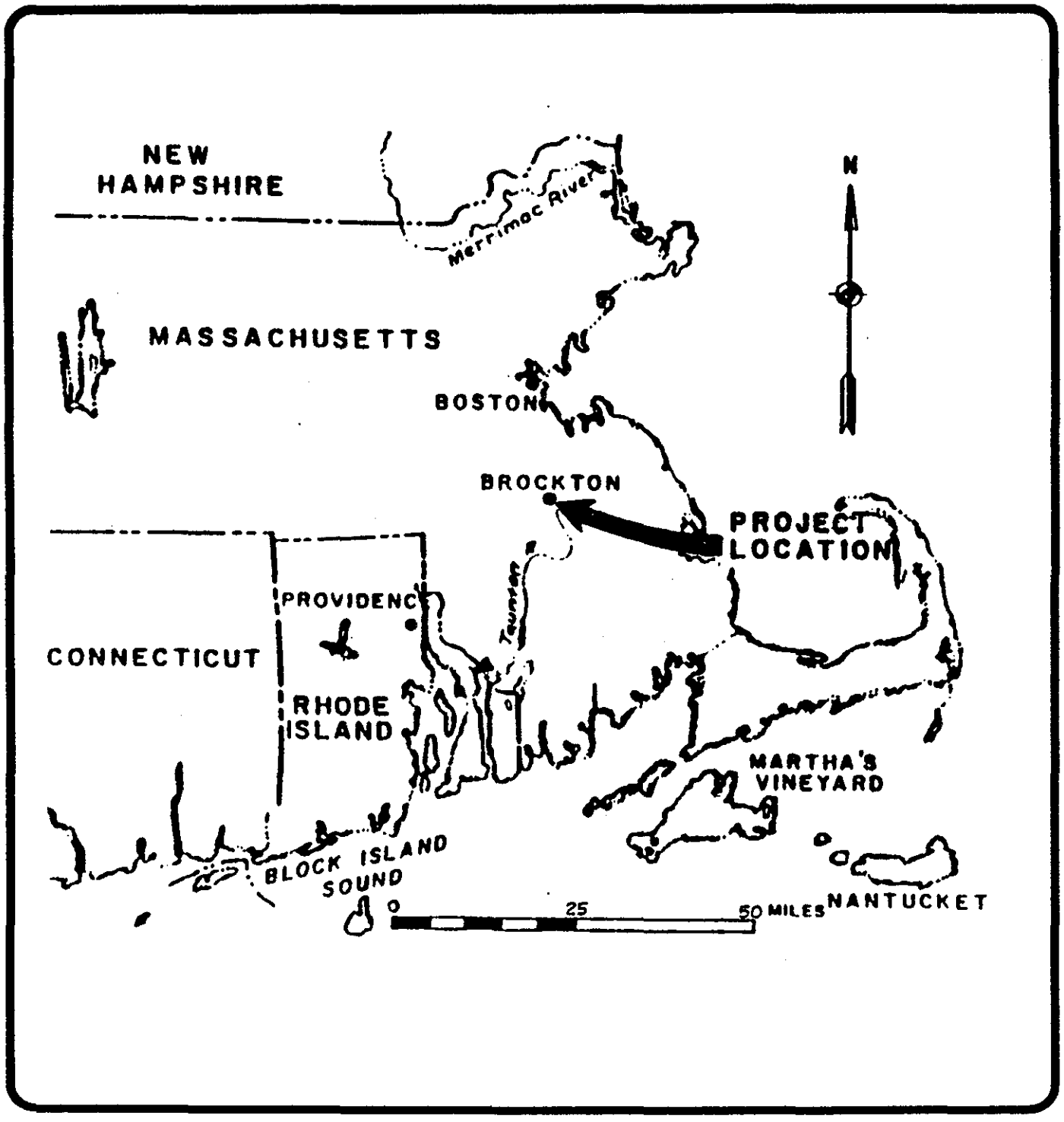


PLATE 1 PROJECT VICINITY MAP

New England Division

US Army Corps of Engineers

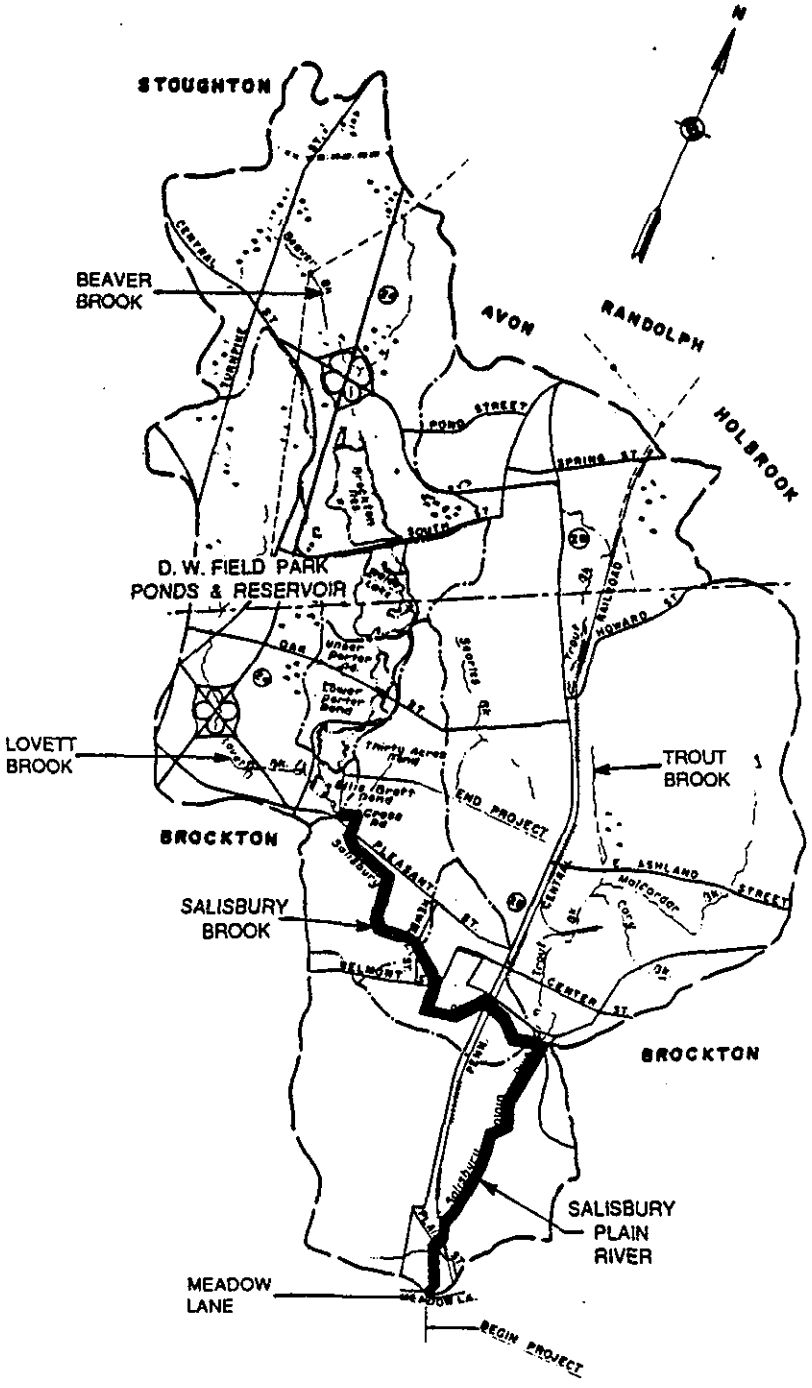


PLATE 2

DRAINAGE AREA MAP

Salisbury Brook / Salisbury Plain River

BROCKTON , MASSACHUSETTS

New England Division

US Army Corps of Engineers

From the Cross Pond outlet, Salisbury Brook (with a total drainage area of 7.7 square miles) flows in a general southeasterly direction from 2.6 miles through Brockton's west side. It joins Trout Brook (with a drainage area of 6.5 square miles) to become the Salisbury Plain River just southeast of the Brockton central business district. From that point, the Salisbury Plain River flows due south to the West Bridgewater town line.

3. Flood History

Of the many floods experienced in Brockton over the years, the floods that occurred in August 1955, March 1968, and March 1969 are considered to be the three most significant events in terms of flood level, duration, and damages. The 1955 storm represents the record rainfall for the area and may be equated with a 100-year flooding event in Brockton. The 100 year flood is the result of a storm that has a one percent chance of annual occurrence. Table 1 presents the estimated peak discharges associated with those three storms at two study area locations. Plate 3 depicts the limits of the 100 year flood plain along the Salisbury Brook and the Salisbury Plain River in Brockton.

TABLE 1
Estimated Peak Discharges (cubic feet per second)

Event	Salisbury Brook at Belmont Avenue	Salisbury Plain River at Perkins Avenue
1955 Flood	800	1500
1968 Flood	330	640
1969 Flood	450	820

Overbank flooding along portions of Salisbury Brook occurred more recently during 1984 and 1987. Recurring flood losses (1989 dollars) attributed to a 10-year event are $23,800 between Prospect Street and Carleton Street on Salisbury Brook and $139,300 between Perkins Avenue and Plain Street on the Salisbury Plain River. By comparison, the recurring flood losses attributed to a 100-year event for each of those reaches are $245,600 and $1,669,300 respectively (1989 dollars).

4. Rainfall Frequency/Development of Stage Frequencies

Rainfall frequency data was taken from "Rainfall Frequency Atlas of the United States, Technical Paper 40", U.S Weather Bureau, May 1961. Maximum rainfall in the vicinity of Brockton for durations of 1 to 24 hours for 1, 2, 5, 10, 25, 50, and 100-year recurrence intervals are shown in Table 2.

TABLE 2
Rainfall-Frequency Duration
Brockton, Massachusetts
(inches of rainfall)

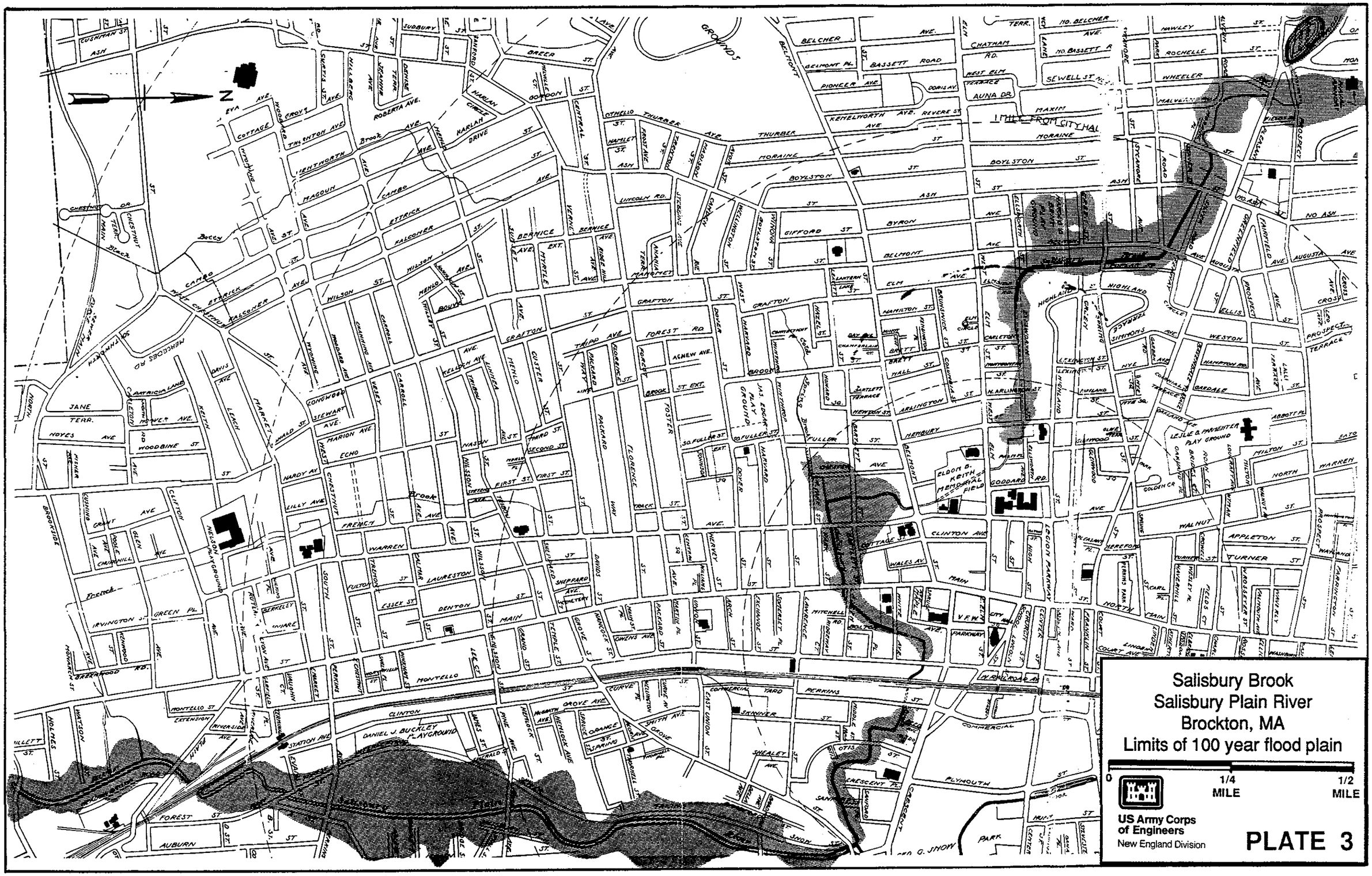
Recurrence Interval (years)	Duration (hours) 1	2	3	6	12	24
1	1.0	1.3	1.4	1.8	2.4	2.7
2	1.2	1.5	1.7	2.3	2.9	3.3
5	1.6	2.0	2.3	2.8	3.4	4.0
10	1.8	2.4	2.7	3.4	4.0	4.7
25	2.3	2.7	3.1	3.5	4.4	5.5
50	2.5	3.1	3.5	4.4	4.8	6.0
100	2.7	3.4	3.8	4.8	5.9	6.8

Stage-frequency curves for Salisbury Brook and the Salisbury Plain River were developed at several identified locations in Brockton. The curves shown in the hydrology appendix (Appendix B) were developed based on the adopted discharge frequencies and stage discharge relationships developed from flood profiles presented in the Brockton Flood Insurance Study. The 1955 flood is reported to be equal to that of a 100-year event. Also shown on the stage-frequency curves are the estimated modifying effects of the channel improvement plan.

5. Economic Setting

The city of Brockton had a 1985 population of 97,429. The population of Brockton has been growing steadily since 1950, and is projected to continue growing, with a 1995 population estimate of 120,978. Historically, Brockton was a manufacturing center dominated by the production of shoes and other leather products. Today, although manufacturing still is a major part of the Brockton economy, wholesale and retail trade and the service industry employ more workers in Brockton than manufacturing. In February, 1988, Brockton had a labor force of 49,335 and an unemployment rate of 5.2%. In general, Brockton has shared in the economic growth experienced by the entire greater Boston area in the 1980s, although manufacturing wages in Brockton tend to be slightly lower than the average Boston area manufacturing wage.

The upper reaches of Salisbury Brook are characterized by middle income residential areas. As Salisbury Brook approaches the central business district of Brockton the areas are characterized by lower income housing. The brook passes under bridges at Warren Avenue, Main Street, and Montello Street as it flows by the commercial center. Throughout its entire length there are many structures that are located adjacent to Salisbury Brook. Salisbury Plain River has extensive open land in its upper reaches, but several light industrial buildings are located in the reach between Perkins Avenue and Meadow Lane.


Salisbury Brook
Salisbury Plain River
Brockton, MA
Limits of 100 year flood plain
0
1/4 MILE
1/2 MILE
US Army Corps of Engineers
New England Division
PLATE 3
1 MILE FROM CITY HALL
N

6. Environmental Setting

Water Quality

Salisbury Brook and the Salisbury Plain River are classified by the State of Massachusetts as class "B" waters. Waters assigned to this class are designated for the uses of protection and propagation of fish, other aquatic life and wildlife, and for primary and secondary contact recreation.

Sedimentology

The bottom substrate of the Salisbury Brook and Salisbury Plain River is composed primarily of sands and sandy gravels interspersed with rock. Silty shoals occur near embankments in some locations, particularly near bridges. All reaches have accumulated some degree of trash (i.e., shopping carts, tires, miscellaneous scrap metal, appliances, batteries, waste wood, lawn clippings).

Biological Resources

Fish

Recent studies conducted in the Salisbury Plain River, upstream and downstream of the project area, indicate that the fish community is dominated by American eel. Other relatively common species include golden shiner, white sucker, and carp. No cold water species (i.e., trout) occur in the river.

Although no information is available for Salisbury Brook, the brook probably supports American eel, golden shiner, and most of the other species occurring in the Salisbury Plain River.

Submerged Vegetation

Salisbury Brook and the Salisbury Plain River support scattered stands of submerged aquatic macrophytes. Species noted are listed in the Environmental Assessment. Overall, percent cover was less than 3 percent in Salisbury Brook and about 20 percent in the Salisbury Plain River. Development of submerged aquatic vegetation is greatest in areas where the forest canopy is relatively open and light availability is high.

Riparian Vegetation

A diverse, well developed riparian community exists throughout much of the study area. Common trees and shrubs present include red maple, box elder, elm, European buckthorn, dogwoods, northern arrowwood, green ash, and sugar maple. Common herbaceous species

include Japanese knotweed, purple loosestrife, jewel-weed, false nettle, and various grasses. The brook is well shaded by shrubs and trees, and typically has an overstory cover of about 50 to 75 percent.

Wildlife

Little specific information is available concerning birds or other wildlife inhabiting the project area. A list of common bird species likely to occur in a riparian habitat in eastern Massachusetts is presented in the Environmental Assessment.

Small mammals characteristic of developed urban habitat likely to occur in the vicinity of the project area include gray squirrel, skunk, the eastern cottontail, raccoon, and the Norway rat.

7. Historic and Archaeological Resources.

The vicinity of the proposed project area is heavily developed. Many sections of the Salisbury Brook and the Salisbury Plain River have been channelized and straightened in the past. Portions of the brook and river may have archaeological potential. However, due to the extent of urban development and channel modifications, the potential for intact prehistoric or industrial archaeological sites is very low. The proposed snagging and clearing project would not effect any portions of the streambank. Therefore, the proposed project should have no effect upon any structure or site of historic, architectural or archaeological significance as defined by the National Historic Preservation Act of 1966, as amended. The Massachusetts Historical Commission, in a reply dated July 28, 1989, has concurred with this finding.

III. PROBLEM IDENTIFICATION

1. Problems and Opportunities

Prior studies have indicated that potential benefits would support only relatively low cost measures to reduce flooding. The Section 208 authority is an appropriate vehicle to both investigate and implement the removal of flow restrictions. Such a solution would minimize impacts to most abutters of Salisbury Brook and Salisbury Plain River while still providing a degree of flood protection. There are 274 residential properties, 56 commercial properties, 13 industrial properties, and 4 public buildings within the 100 year flood plain area of Salisbury Brook and the Salisbury Plain River in Brockton. By providing some flood level reduction, the project would serve to enhance the economic vitality and the safety of the people of Brockton.

2. Planning Constraints

There are over 20 bridges in the study area. Although many of these restrict flow and exacerbate flooding problems, their modification or replacement is a local responsibility. Two bridges in the study area have been rebuilt recently and others are earmarked for reconstruction. However, existing state and local plans for infrastructure improvements are likely to be delayed due to fiscal shortfalls in the Commonwealth of Massachusetts.

Straightening or widening channel segments within the study area was not considered practical due to the high costs associated with land-taking for rights of way. Therefore, the focus of this study was on the removal of restrictions located within the channel boundaries. The relocation of suspended utility pipes may be considered as a local responsibility.

3. Without Project Condition

If no measures are taken to improve the streamflow characteristics of Salisbury Brook and Salisbury Plain River, the frequency and severity of local flooding events are expected to increase. Trash that traps sediments will raise the channel bottom as it is buried, and maturing vegetation will add further flow restrictions to virtually every reach. Replacement of the following bridges are under consideration: Main Street Bridge on Salisbury Brook, Center Street Bridge on Trout Brook, and Perkins Avenue Bridge on the Salisbury Plain River. These plans, if implemented, would improve the flow condition near their immediate locations, though many other channel restrictions would remain.

2. Development of Alternative Plans

The snagging and clearing operation prescribed for Salisbury Brook and Salisbury Plain River would remove accumulated sediment to increase channel capacity and restore the slope of the channel invert and improve clearances under the bridges in the project area. Selected trees that infringe upon the channel would be removed.

A flood damage survey of the study area was used to assist in the selection of the work areas. Base elevations and invert profiles are from the City of Brockton Flood Insurance Study maps updated by an in-house survey of bridge to invert clearances performed during the winter of 1989. Bottom elevations of bridges, culverts and other structures over Salisbury Brook and Salisbury Plain River are from a 1974 survey of the study area.

The following guidelines were used to select the project work areas:

- areas with the highest annual flood damages.
- areas where minimal distance exists between the top of bank and normal water level.
- areas where the invert profile contributed to a flow restriction deemed to cause frequent backwater conditions in the area immediately upstream.

Four reaches were identified as candidate areas for the snagging and clearing; the stations given are measured in feet upstream from the corporate limit at West Bridgewater.

Area A- Salisbury Plain River from downstream limit at new Plain Street bridge (sta. 5980) to upstream of Perkins Avenue bridge (sta. 8360). See Plates 5 and 6.

Area B- Salisbury Brook from entrance to culvert at rear of courthouse parking lot (sta. 21110) to Newbury Street (sta. 21300). See Plates 7 and 8.

Area C- Salisbury Brook from Carleton Street (sta. 22100) to Ash Street (sta. 25200). See Plates 9 and 10.

Area D- Salisbury Brook from Ash Street (sta. 25420) to Prospect Street (sta. 27210). See Plates 11 and 12.

Proposed Work In Area A

Area A, located at the south end of the city, is heavily industrialized. For the 1955, 1968, and 1969 floods the highest damages reported in the city were from this area.

Increases to the channel width downstream of Perkins Avenue combine with several bends in the Salisbury Plain River to slow down normal flows. The result is significant shoaling in this area. Removal of these sediments would provide meaningful reductions to the expected flood damages in Area A. Photographs on the following pages depict the existing conditions in Area A.

Recent construction of a new overpass over the rail line also included a span over the Salisbury Plain River at Plain Street. That work was completed in the fall of 1988. Upstream of the bridge at Plain Street sediments would be removed in accordance with the plan and profile shown in Plates 5 and 6. The depth of excavation varies from 0 to 2.5 feet. The estimated volume of sediment to be removed is 4500 cubic yards. Since the disturbance to the channel bottom would encompass the entire reach, the creation of several pools of approximately 50 cubic yards displacement each would be required as a mitigation measure. The proposed work includes the removal of a steel girder bridge that spans the channel approximately 300 feet downstream of Forest Street. Several small trees and shrubs that encroach on the channel would be cleared from within Area A.

Proposed Work in Area B

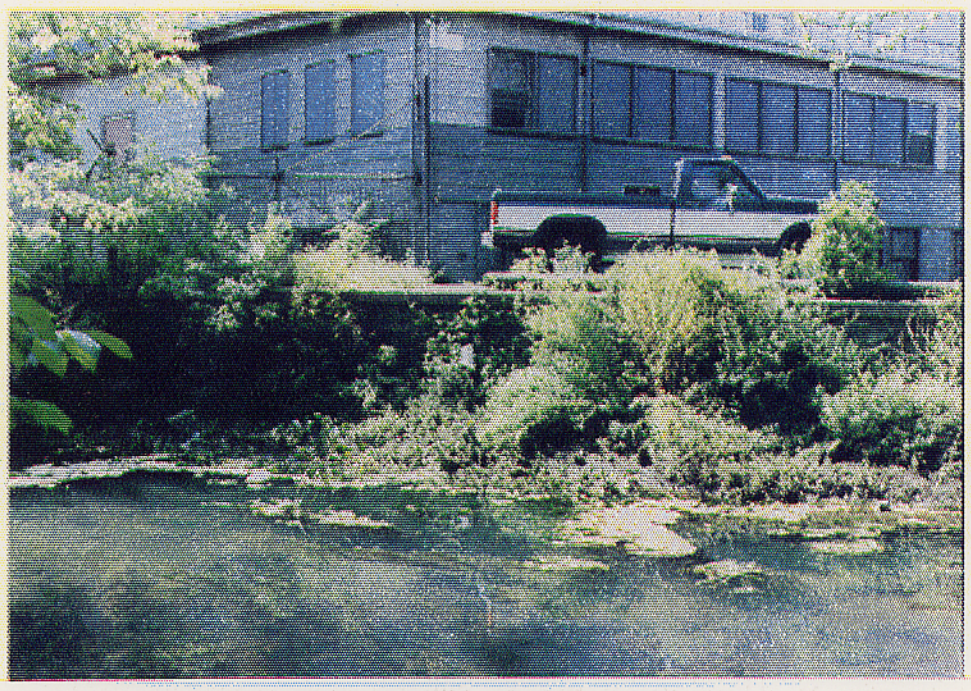
This reach of approximately 190 feet in length and shown on Plate 7, is located in an area that is primarily residential. The proposed channel work in this area would, in addition to reducing flooding, compensate for the poor alignment and narrow channel in this area. These restrictions are identified as a source of backwater that effects the upstream residential locations.

The concrete lip at the entrance to the box culvert would be lowered so that the full capacity of the culvert is realized. Invert excavation would be performed in accordance with the profile in Plate 8 to allow a smooth transition from the vicinity of Newbury Street to the modified culvert entrance. The maximum depth of excavation would be approximately two feet and the estimated volume of sediment to be removed would be 100 cubic yards. In order to accomplish this work, the garage that spans the channel just downstream from Newbury Street would require removal. Several trees that encroach on the channel area would also be removed.

Proposed Work in Area C

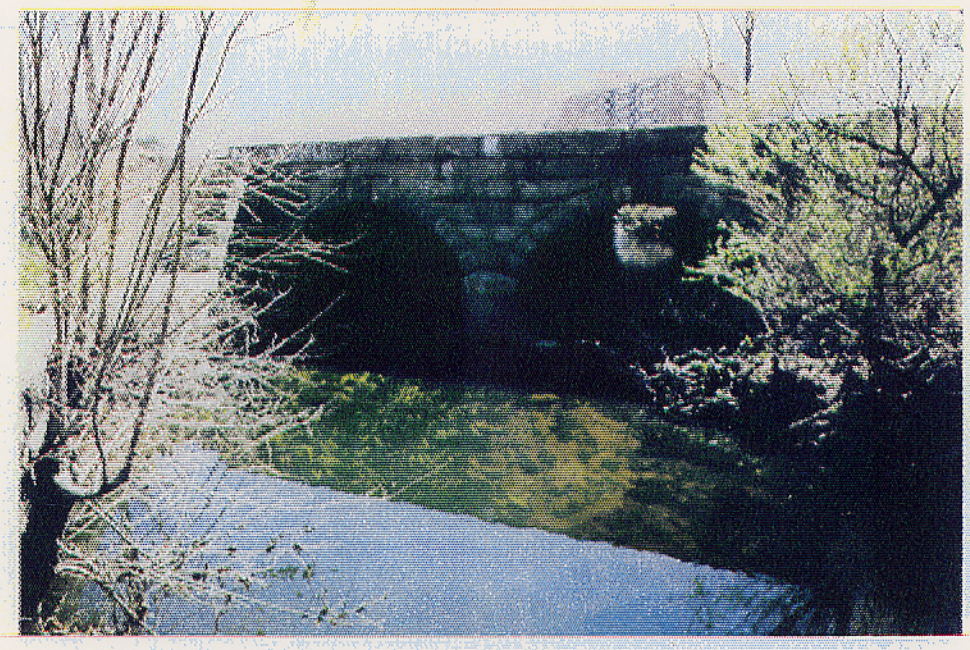
This residential area shown on Plate 9 is characterized by frequent nuisance flooding and suffered significant damages as a result of the 1955, 1968, and 1969 events. In many instances homes and garages are located less than twenty feet from the Salisbury Brook Channel. The minimum distance from the channel invert to top of banks in Area C is only 3.5 feet. The drainage characteristics are poor due to the very shallow slope of the channel invert.

SALISBURY PLAIN RIVER
Debris, sediments, trash, and encroaching vegetation combine to create favorable conditions for flooding of industrial buildings near Perkins Avenue.

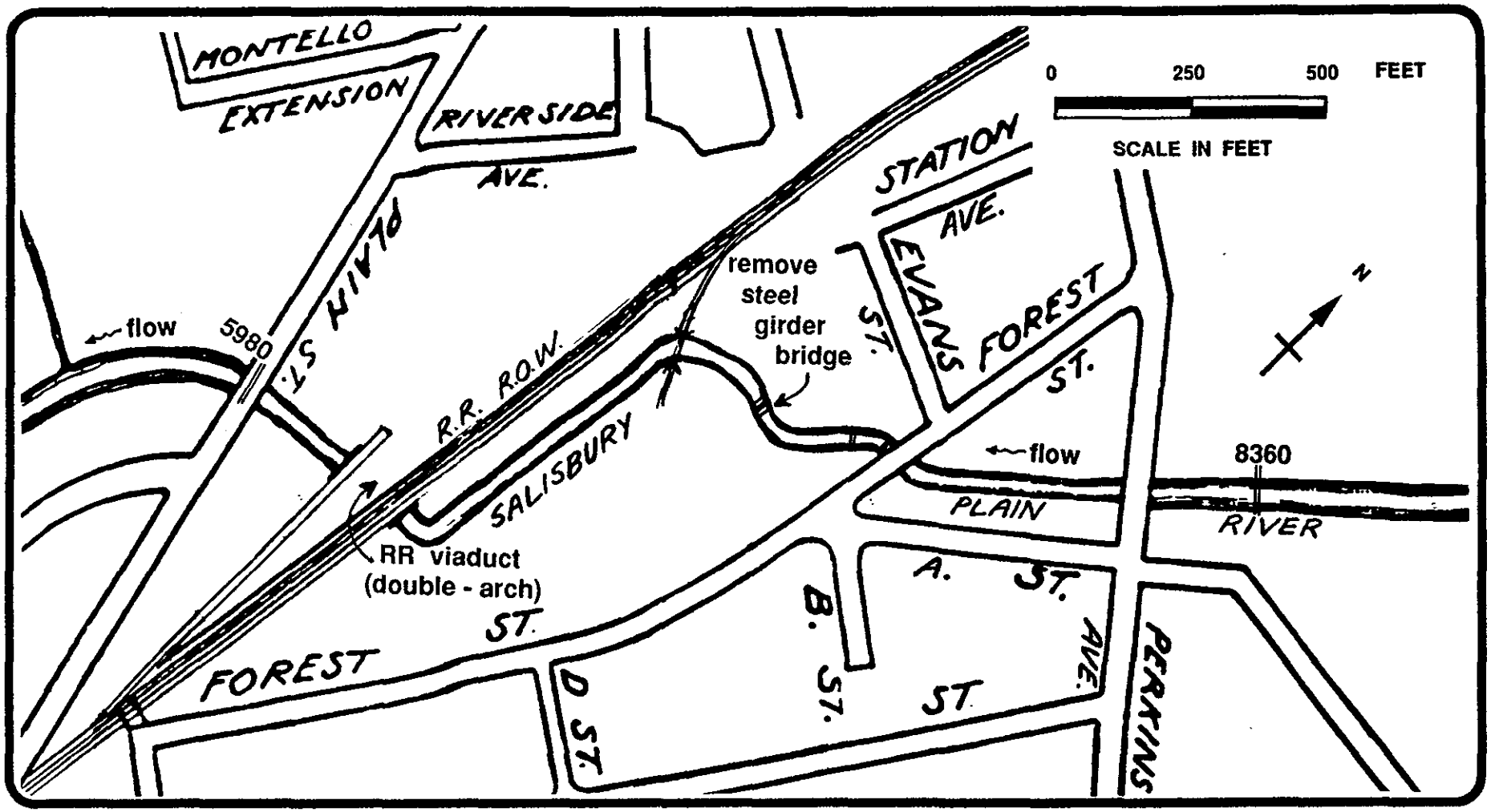


SALISBURY PLAIN RIVER
At this location between Perkins Avenue and Forest Street vegetation grows up from a mud bank to impede high flows and reduce overall channel capacity.

SALISBURY PLAIN RIVER
As the Salisbury Plain River channel widens south of Perkins Avenue, increases in shoaling and in-stream vegetation are evident.



SALISBURY PLAIN RIVER
In many instances the channel alignment contributes to sedimentation and shoaling. Here, a sharp bend upstream of the railroad viaduct near Plain Street has encouraged a significant build-up of vegetation along the right-hand wing wall. Enough sediments and debris have accumulated so that the lowest flows pass through the left-hand arch only.



PLAN FOR WORK AREA A

PLATE 5

(Perkins Ave. to Plain St.)

length = 2380 ft.

SECTION 208 INVESTIGATION ------ BROCKTON, MASSACHUSETTS

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New England Division

PLATE 5

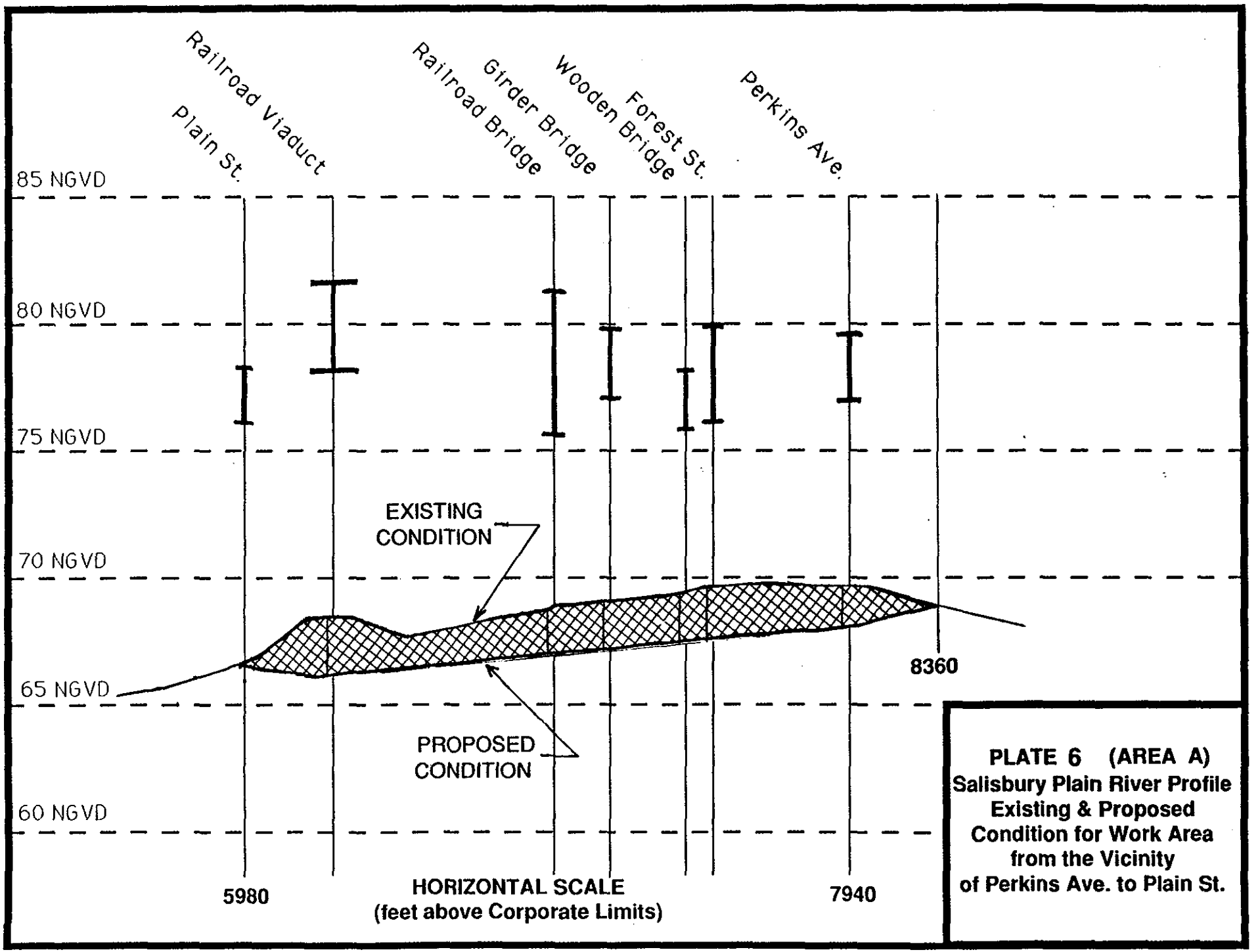
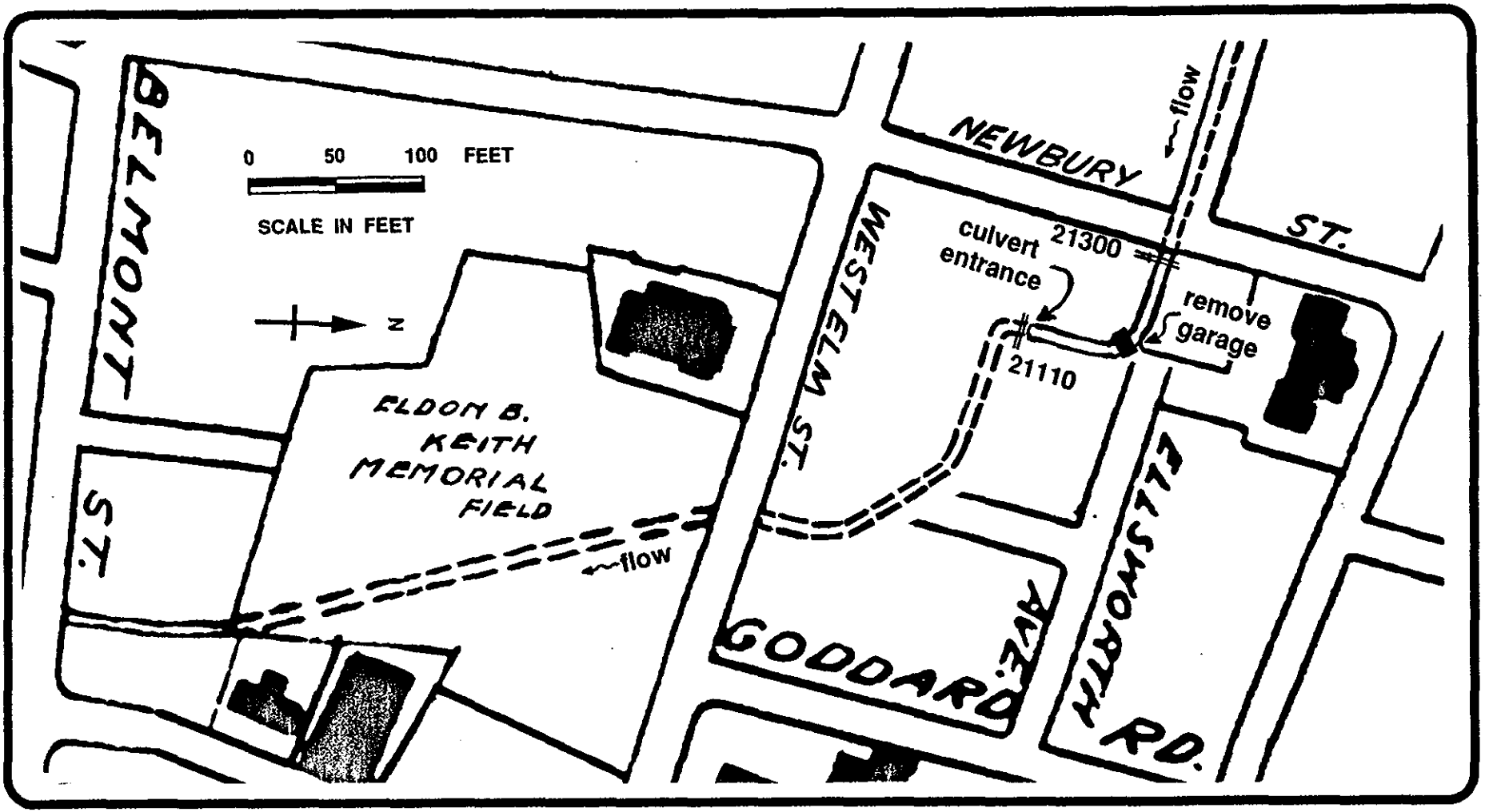


PLATE 6 (AREA A)
Salisbury Plain River Profile Existing & Proposed Condition for Work Area from the Vicinity of Perkins Ave. to Plain St.

PLATE 6



PLAN FOR WORK AREA B

PLATE 7

(Newbury St. to culvert entrance)

length = 190 ft.

SECTION 208 INVESTIGATION ----- BROCKTON, MASSACHUSETTS

US Army Corps of Engineers
New England Division

PLATE 7

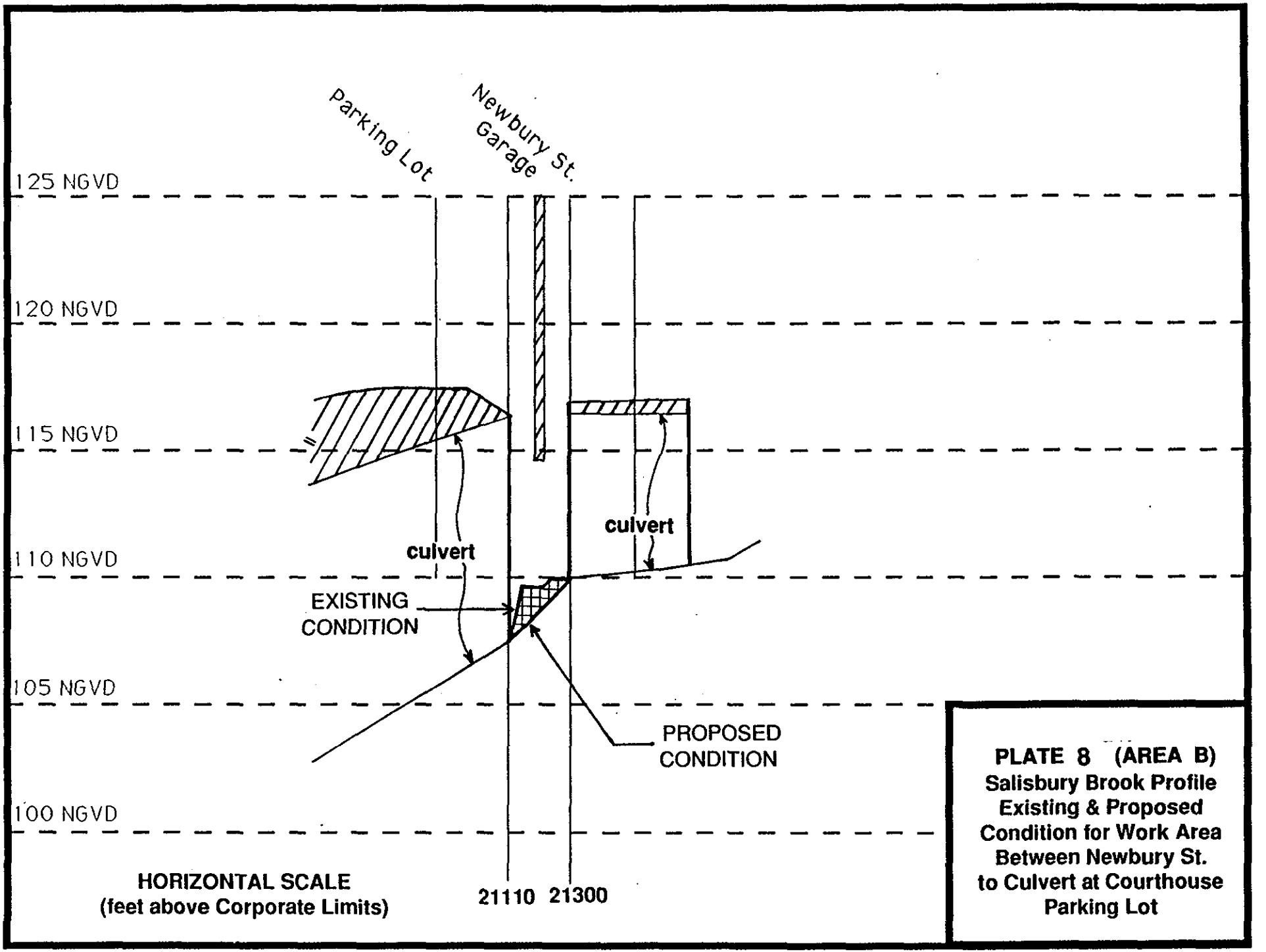


PLATE 8 (AREA B)
Salisbury Brook Profile Existing & Proposed Condition for Work Area Between Newbury St. to Culvert at Courthouse Parking Lot

PLATE 8

The proposed sediment removal would increase the capacity and improve the flow of Salisbury Brook in this area. Removal of sediments would be accomplished in accordance with the profile shown by Plate 10. The depth of excavation ranges from 0 to 2.6 feet. The estimated volume of sediment to be removed is 3000 cubic yards. Since the disturbance to the channel bottom would encompass the entire reach, the creation of several pools of approximately 50 cubic yards displacement each is required as a mitigation measure. Selective cutting of trees that encroach upon the Salisbury Brook channel would be performed. The following photos show existing conditions in Areas B and C.

Proposed Work in Area D

Work in area D is contingent upon the demolition of the 150 foot long concrete pad located just upstream of Moraine Street Channel sediments would then be removed in accordance with the profile shown in Plate 12. The depth of excavation varies from 0 to 1.5 feet. The estimated volume of sediment to be removed would be 1200 cubic yards. The disturbance to the channel bottom would encompass the entire reach so the creation of a pool or pools totaling 50 cubic yards displacement each is required as a mitigation measure. Some cutting of trees and brush is prescribed where such vegetation encroaches upon the channel. A plan of Area D is shown on Plate 11.

Four plans were developed. These include work in Area A (Plan 1), Areas B and C (Plan 2), Area C (Plan 3), and Area D (Plan 4). Plan 2 considers work in both Areas B and C because work in Area B would influence the flood stages in Area C.

The Area B work would include the effective enlargement of the culvert entrance by removal of the concrete lip and the trash and sediments behind it.

Construction cost estimates for work in Areas A, B, C, and D are presented in Table 3.

TABLE 3
Construction Cost Estimates For Proposed Work (by area)

	AREA A	AREA B	AREA C	AREA D
Sediment Removal				
-General				
Equipment Rental	22,300	*	13,000	4,500
Equipment Operators	11,100	2,000	9,600	4,500
Laborers	6,200	1,400	7,400	3,700
-Beneath Arched Railroad Viaduct				
Equipment Rental	500	---	---	---
Equipment Operator	500	---	---	---
Streamflow Diversion	2,000	---	---	---
Clearing	1,000	1,400	4,200	2,800
Anti-Siltation Measures	1,500	300	600	600
Environmental Mitigation	2,400	---	1,600	1,600
Demolition	3,000	2,000	---	7,000
SUBTOTAL	$50,500	$7,100	$36,400	$24,700
CONTINGENCY	12,600	1,800	9,100	6,200
TOTAL	$63,100	$8,900	$45,500	$30,900

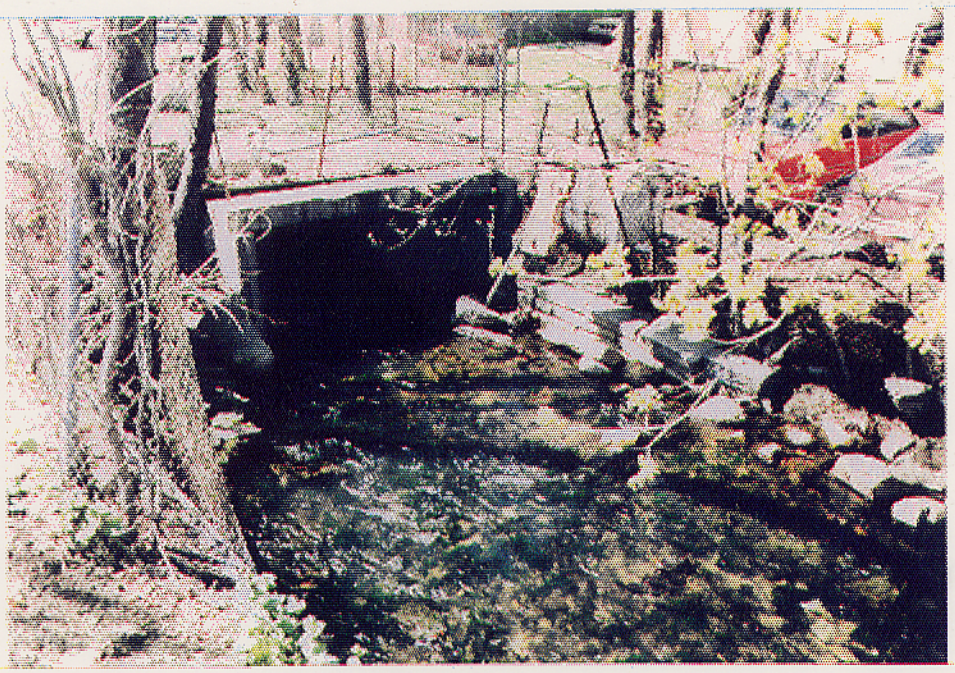
*This value is included in the cost for Area C.

3. Comparision of Alternative Plans

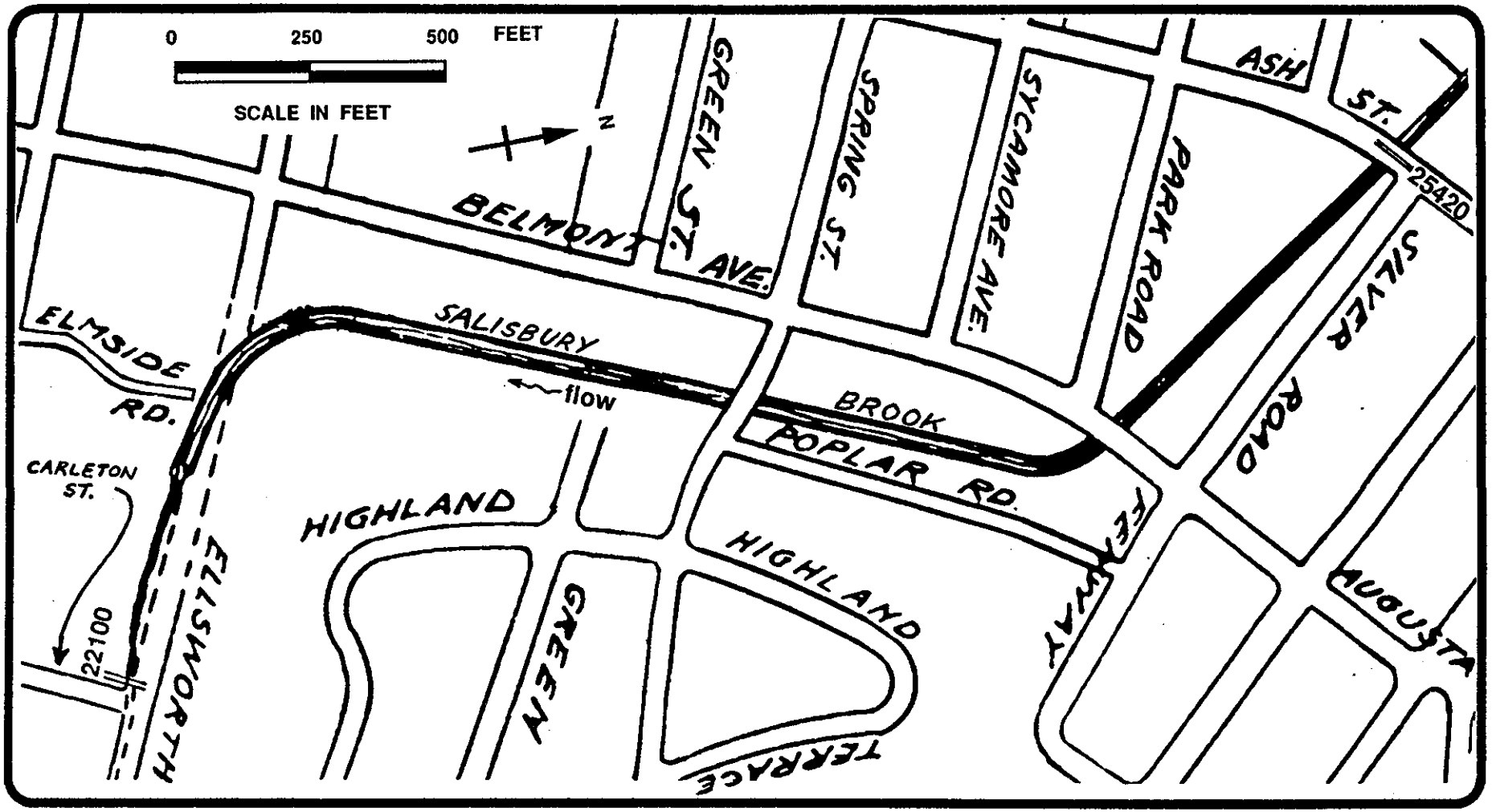
The estimated implementation costs of the alternative plans are presented in Table 4. Each of the totals includes contingencies that provide latitude for the following variables:

- construction delays due to bad weather
- variances in quantity estimates

SALISBURY BROOK
Looking upstream toward Belmont Avenue bridge. Accumulated sediments increase the frequency of overbank flooding in this residential area.



SALISBURY BROOK
The brook enters a box culvert behind the courthouse on West Elm Street. Removal of a concrete lip at the entrance to the box culvert in conjunction with the removal of material from the channel invert will create a more efficient flow and reduce a frequent backwater condition above this point.



PLAN FOR WORK AREA C

PLATE 9

(Ash St. to Carleton St.)

length = 3320 ft.

SECTION 208 INVESTIGATION —— BROCKTON, MASSACHUSETTS

US Army Corps of Engineers
New England Division

PLATE 9

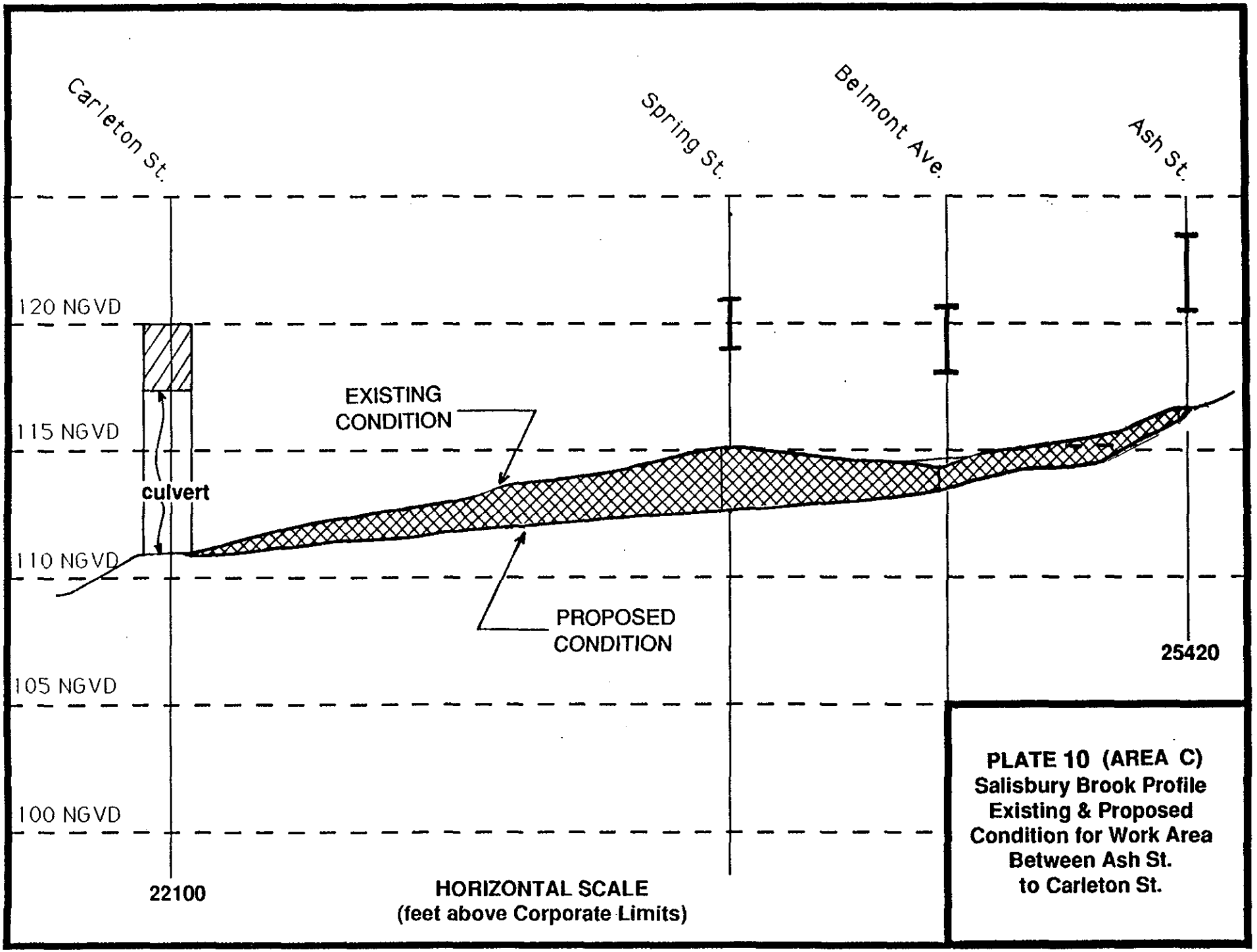
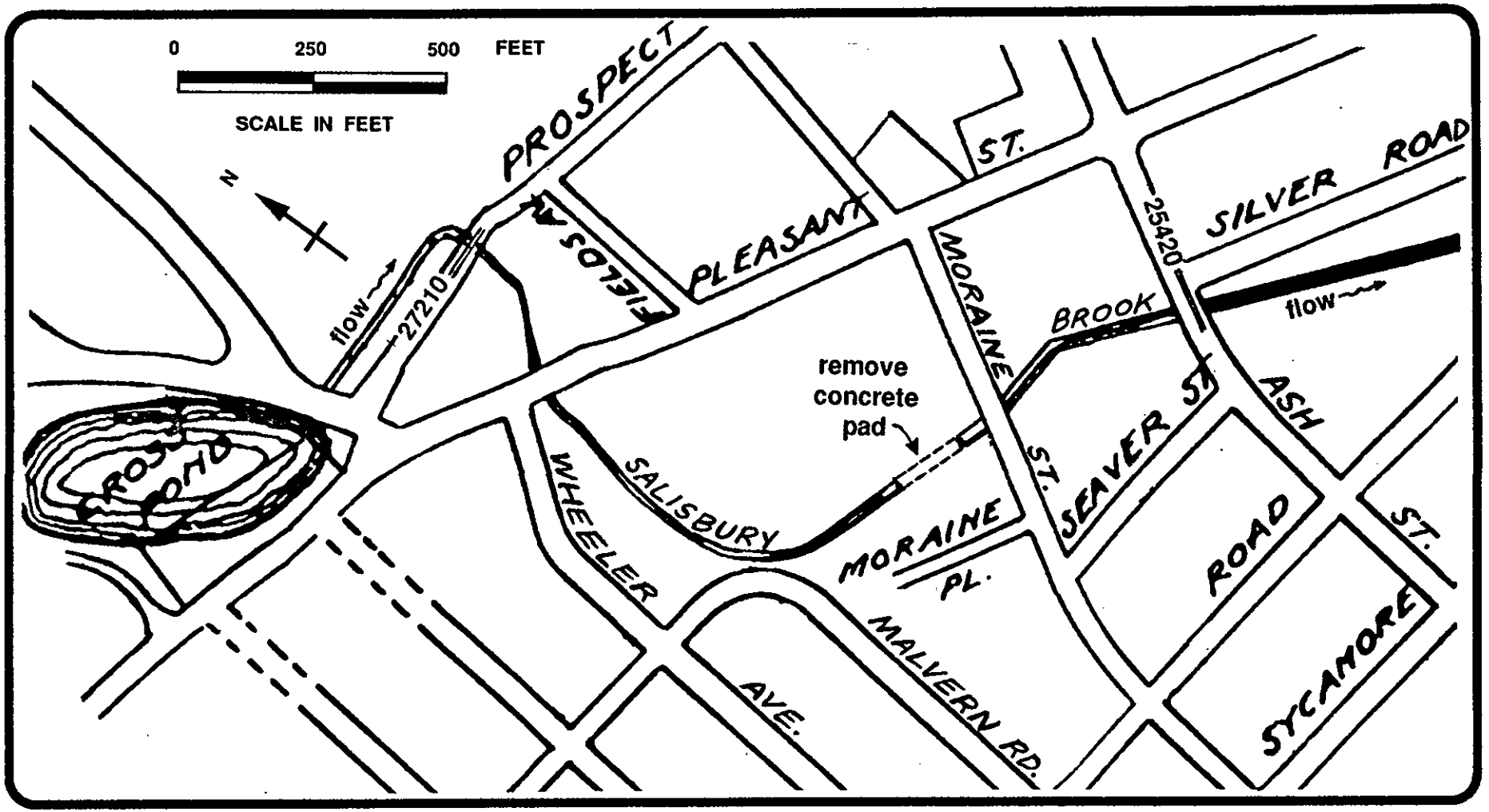


PLATE 10 (AREA C)
Salisbury Brook Profile Existing & Proposed Condition for Work Area Between Ash St. to Carleton St.

PLATE 10



PLAN FOR WORK AREA D

PLATE 11

(Prospect St. to Ash St.)

length = 1790 ft.

SECTION 208 INVESTIGATION ----- BROCKTON, MASSACHUSETTS

US Army Corps
of Engineers
New England Division

PLATE 11

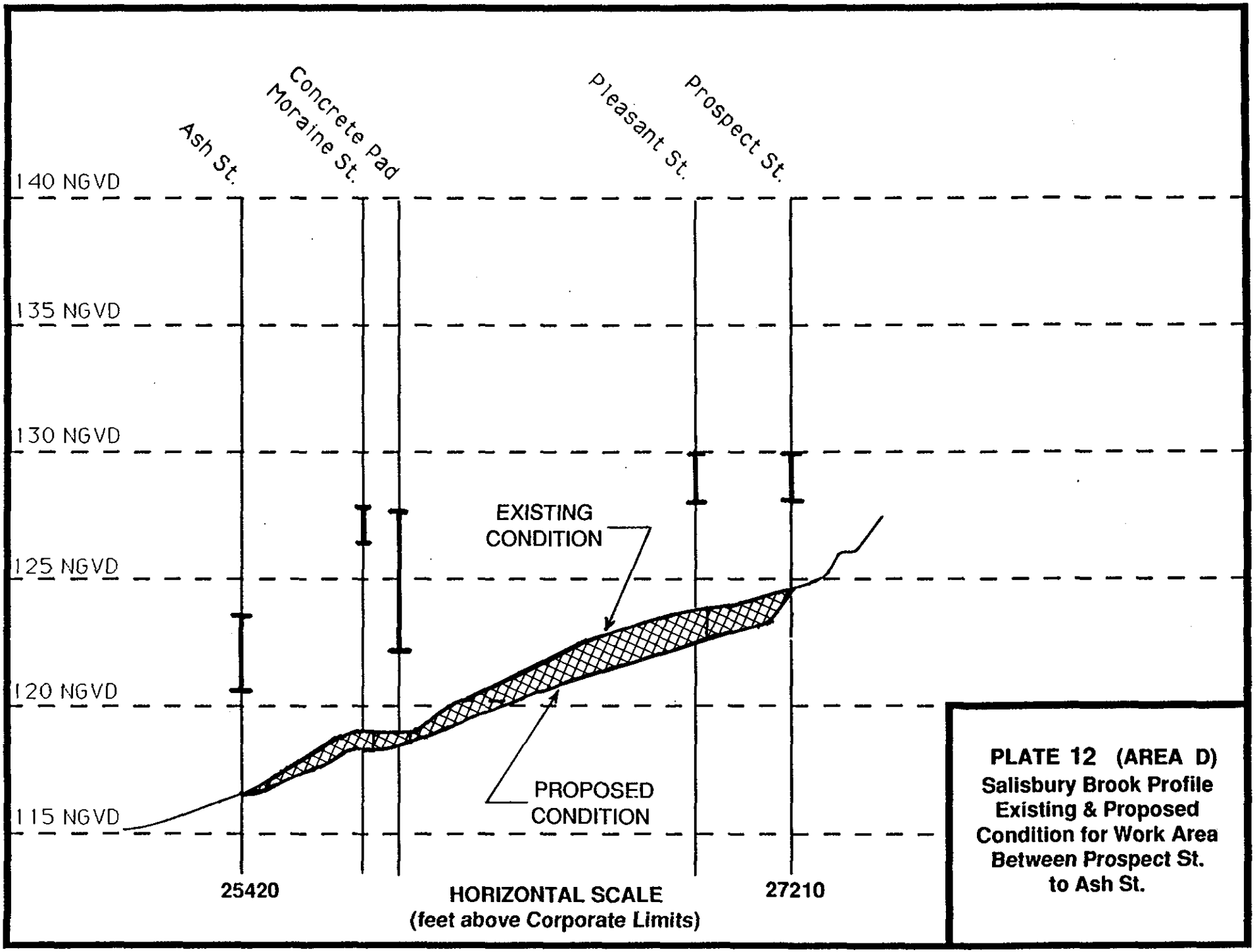


PLATE 12 (AREA D)
Salisbury Brook Profile Existing & Proposed Condition for Work Area Between Prospect St. to Ash St.

PLATE 12

TABLE 4
Estimate of First Costs for The Alternative Plans

	Plan 1 Area A	Plan 2 Areas B&C	Plan 3 Area C	Plan 4 Area D
Construction Cost	$50,500	$43,500	$36,400	$24,700
Contingency	12,600	10,900	9,100	6,200
Subtotal	63,100	54,400	45,500	30,900
Engineering & Design (25%)	30,500	30,500	30,500	30,500
Supervision & Admin. (15%)	7,500	7,500	7,500	7,500
Subtotal	101,100	92,400	83,500	68,900
Lands, Easements, Rights of way, say 20%	20,900	18,600	16,500	14,100
Disposal	110,000	31,000	30,000	12,000
TOTAL	$232,000	$142,000	$130,000	$95,000

The computation of project benefits for each area was performed as follows:

Recurring losses were developed from the area flood damage survey and the stage frequency curve for the existing condition.

Annual flood losses were also computed for the existing or natural (without project) condition and the modified (with project) condition. The annual benefits for each plan are equal to the sum of the differences between the natural annual losses and the modified annual losses for the areas that are included in that plan. Refer to the Economic Analysis (Appendix A) for a more detailed explanation of the benefit computation and comparison of the alternatives.

A comparison summary of the four plans is found in Table 5. Plan 1, representing work in the industrial area between Plain Street and Perkins Avenue, has a benefit to cost ratio of 1.3. The plans that involve work in Areas B, C, and D are not economically justified; all having benefit to cost ratios less than unity.

TABLE 5
Comparison Summary of the Alternative Plans

	Plan 1	Plan 2	Plan 3	Plan 4
Plan Description	Work in Area A Sediment Removal and disposal 4,500cy Tree & Brush Removal Construct Pools	Work in Areas B&C Sediment Removal and disposal 3100cy Tree & Brush Removal Garage Demolition Remove Steel Girder Bridge	Work in Area C Sediment Removal and disposal 3,000cy Tree Brush Removal Construct Pools Construct Pools	Work in Area D Sediment Removal and disposal 1,200cy Tree and Brush Removal Culvert Demolition Construct Pools
Estimated First Cost	$232,000	$142,000	$130,000	$95,000
Estimated Annual O&M Cost	$3,000	$2,000	$1,500	$1,000
Annual Cost (includes O&M)*	$28,200	$17,400	$15,600	$11,300
Annual Benefit	$37,800	$4,400	$4,200	$1,800
Net Benefit	$ 9,600	--	---	---
Benefit to Cost Ratio	1.3 to 1	0.3 to 1	0.3 to 1	0.2 to 1

Notes:

* Annual charges are based on a 20 year project life and an 8 7/8 percent interest rate.

4. Environmental Considerations

Soil samples were collected from the stream invert at various locations within the proposed areas for sediment removal. Lab testing of these samples yielded results that exceeded Massachusetts Department of Environmental Quality Engineering (DEQE) Class I Sludge Criteria. Additional testing of excavated sediments will be required prior to the project's construction phase.

If the material is found to be Class I or Class II Sludge under Massachusetts guidelines it would be suitable for disposal at the Thatcher Street Landfill in Brockton. This site is operated by the City of Brockton and managed by Massachusetts DEQE. One stipulation at this site is that enough Class I material be available to cover the Class II material deposited on a daily basis. Preliminary tests suggest that most of the sediment to be removed is suitable for disposal here.

If the material fails to meet Class II guidelines an EP toxicity test would probably be required by the Department of Environmental Protection. If the material passes the EP toxicity test, it would still be considered to be a solid waste, and could be disposed of at the Thatcher Street Landfill in East Bridgewater. That site is operated by Browning Ferris Industries. Material sent there would be subject to a much higher tipping fee than that for the site in Brockton. If the material failed the EP toxicity test (unlikely), it would be considered a hazardous waste, and would have to be disposed of at an approved site.

Efforts should be made to minimize removal of riparian vegetation. Trees, shrubs, and overhanging branches would be selected for removal only when they clearly have the potential to impede channel capacity.

During the project construction phase several "pools" would be located within the affected reaches in an effort to encourage growth of the native fish population after the work is completed. This mitigation measure is expected to displace approximately 50 cubic yards for each pool with the total additional excavation being less than 350 cubic yards over the four areas. Refer to the Environmental Assessment for a more detailed discussion of the recommended mitigation measures.

V. THE SELECTED PLAN

1. Description

Plan 1, which features removal of sediments and brush from the Salisbury Plain River channel between Perkins Avenue and Plain Street is the selected plan. A significant portion of all benefits from flood damage reduction in Salisbury Brook/Salisbury Plain River watershed occur in this area. For a 10 year discharge the level of the Salisbury Plain River at Perkins Avenue could be reduced by 1.1 feet from the existing condition. Work as proposed in Area A can be accomplished for an estimated cost of $232,000. This includes site mitigation measures that will construct three "pools" of up to 50 C.Y. displacement. The excavated material (assumed to contain some Class II sludge) can be placed at the nearby Thatcher Street (Brockton) landfill when covered daily with Class I material. The estimated volume of material to be removed is 4,500 cubic yards. In the event that tests of sediment samples during the plans and specficiations phase reveal a presence of a substance or substances that do not meet the Class II sludge criteria, that material would likely be accommodated at another landfill in nearby East Bridgewater.

The following are locations from which construction access may be required for Area A:

Plain Street to R. R. viaduct - from east bank off Meadowbrook Road just downstream from Plain Street; cut down embankment for temporary access; remove some brush.

R. R. viaduct to Forest Street - from west bank adjacent to RR main line just downstream from RR siding/or just upstream from RR viaduct; cut down embankment for temporary access; remove some brush.

Forest Street to Perkins Avenue upstream - from west bank at Walkover Club driveway/or east bank from N.E. MacIntosh building near Perkins Avenue; cut down embankment for temporary access; remove some brush.

Streambank access in this area is available from Churchill Linen Company property and the parking lot of King Size, Incorporated.

2. Estimated of First Costs and Annual Charges

An estimate of Federal and non-Federal first costs appears in Table 6 below. The lands and easements required for the construction and maintenance of the project are owned by either the City of Brockton or private interests. Annual maintenance costs are estimated at $3,000.

TABLE 6
Estimate of First Costs for Plan 1

Sediment Removal, general	$39,600
Sediment Removal, beneath arched RR viaduct	3,000
Clearing	1,000
Anti-siltation measures	1,500
Environmental Mitigation	2,400
Demolition	3,000
Construction contingency	12,600
Engineering & Design	30,500
Supervision & Admin.	7,500
Lands, Easements, & Rights of Way	20,900
Disposal	*110,000
Total First Cost	$232,000
Federal Share (75%)	$174,000
Non-Federal Share(25%)	$ 58,000

* Assume a total of 3,500 cubic yards of sediment is suitable for disposal at the Thatcher Street, Brockton landfill. Assume a total of 1,000 cubic yards of sediment is suitable for disposal only at Thatcher Street, East Bridgewater landfill (BFI).

3. Estimates of Benefits and Benefit to Cost Ratio

Benefits due to the snagging and clearing activity equal the flood damages prevented as a result of the project's implementation. For Plan 1, the annual benefits were estimated at $37,800.

The annualized flood damages prevented exceed the annual cost of channel clearing for the selected plan . The plan's net benefit is equal to the difference between the annual benefit and the annual cost. The plan that maximizes net benefits is selected. (Refer to Table 5 on page 15). In this instance, Plan 1 is the most favorable to the national economic development with net annual benefits of $9,600 and a benefit to cost ratio of 1.3. For a more detailed explanation of the derivation of annual benefits refer to Appendix A.

4. Requirements of Local Cooperation

State and local officials are aware of the requirements of local cooperation for participation in a snagging and clearing project along the Salisbury Plain River in Brockton, Massachusetts. Officials of the Commonwealth of Massachusetts reviewed the draft Local Cooperation Agreement and indicated that they will provide the following assurances in support of a Federal project:

1. Provide without cost to the United States, all lands, easements, rights-of-way, and utility relocations necessary for project construction.

2. Hold and save the United States free from damages due to the construction, operation and maintenance of the project, except where such damages are due to the fault or negligence of the United States or its contractors.

3. Maintain and operate the project after completion without cost to the United States in accordance with regulations prescribed by the Secretary of the Army.

4. Contribute 25 percent of actual cost of construction and preparation of Plans and Specifications. A minimum cash contribution of 5 percent of these costs is required.

5. Assume the responsibility for all costs in excess of the Federal cost limitation of $500,000.

6. Prevent future encroachment which might interfere with proper functioning of the project.

VI. CONCLUSIONS

This study finds that construction of a plan for removal of sediments, trees, and brush would provide a meaningful reduction of flood related damages to a 2,380 foot reach of the Salisbury Plain River, however, the local drainage criteria for minimum 10 year and 100 year discharges, that is a requirement for Federal participation according to the existing policy provided by ER 1165-2-21, was not met within the project area.

New England Division requested an exception to the local drainage criteria to allow for the construction of an economically justified project on the Salisbury Plain River. The request for an exception was denied based on insufficient potential for increased stream flow over the anticipated twenty year project life. The projected increase in flow was not enough to bring the present value for the 10 year discharge of 650 cubic feet per second (cfs) up to the threshold of 800 cfs as stipulated by ER 1165-2-21. Therefore, no Federal participation is possible under existing Corps' policy guidelines.

ACKNOWLEDGEMENTS

This report was prepared by the New England Division of the United States Army Corps of Engineers, under the general direction of Colonel Daniel M. Wilson, Division Engineer, Project Supervision was provided by Mr. F. William Swaine, Chief, Project Development Branch, Mr. Nicholas E. Avtges, Chief, Plan Formulation Division and Mr. Joseph L. Ignazio, Director of Planning.

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Appreciation is extended to those local officials who participated in the study process:

Carl D. Pitaro, Mayor of Brockton
George Cataldo, Mayor's Office
Nancy Stack Savoie, City Planner
Caroline Stone, Conservation Commission
Robert Cyr, Director of Operations
Maynard Spekin, Superintendant of Public Works
Howard Newton, City Engineer

ENVIRONMENTAL ASSESSMENT

Including Finding of No Significant Impact and Section 404 (b) (1) Evaluation

ENVIRONMENTAL ASSESSMENT

Finding of No Significant Impact
and
Section 404(b)(1) Evaluation

Section 208

Snagging and Clearing

Salisbury Brook and Salisbury Plain River
Brockton, MA

Prepared by:

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January 1990

New England Division
U.S. Army Corps of Engineers
Waltham, Massachusetts

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I. INTRODUCTION

A. Purpose and Need

This report provides an assessment of the potential environmental affects of a proposed snagging and clearing flood control project in Brockton, Massachusetts (Figure 1). The proposed project would increase channel capacity of the Salisbury Plain River in order to reduce the risk of flooding damages to commercial and light industrial properties.

B. Project Authority

This report was prepared under the special continuing authority contained in Section 208 of the 1954 Flood Control Act (as amended).

II. PROJECT DESCRIPTION

A. Selected Plan

The proposed project involves the removal of sediments, debris, and selected trees and shrubs from a 2,360 foot section of the Salisbury Plain River. The work area would extend from the Plain St. Bridge to about 100 feet upstream of the Perkins Ave. Bridge. The proposed project would improve flow capacity by deepening stream channels and reducing channel "roughness".

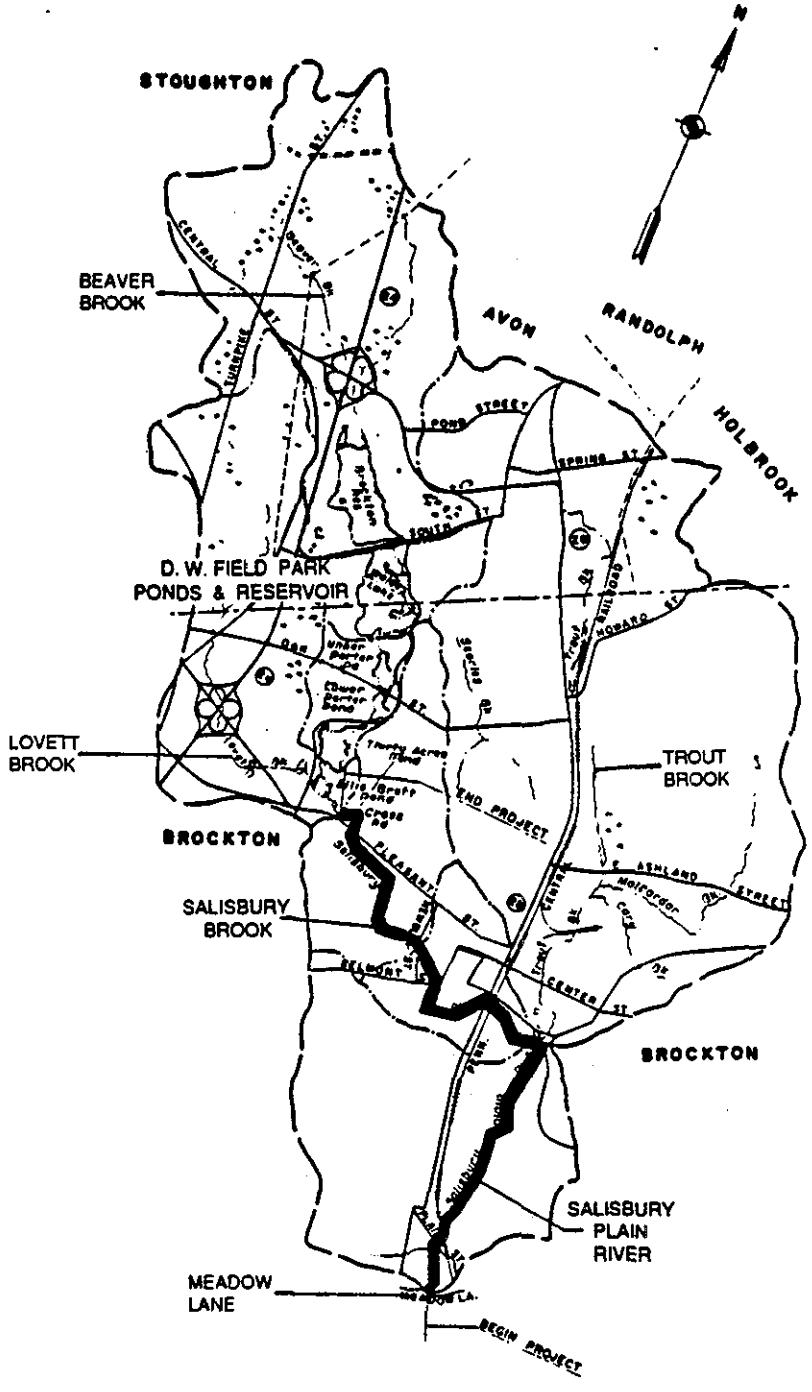
Plans call for excavating approximately 4,500 cubic yards of material from the project area. If dredged material meets Massachusetts Type "I" or "II" sludge standards for upland disposal of dredged sediments (see 310 CMR 32.00) it would be disposed of at the Thatcher Street landfill in Brockton. If the material is unsuitable for disposal at the Thatcher Street site, an alternate site approved by the Massachusetts Department of Environmental Protection (D.E.P.) would be selected.

Material would be removed from the river using small bulldozers, a bucket loader, and a dump truck. Dredged material would be dewatered at the disposal site. Some hand excavation of material from underneath bridges would also probably be required. The depth of excavated material would range from approximately 0 to 2.5 feet. To avoid undermining walls or embankments no excavations would occur near channel margins. A number of deeper pools would be dredged in the river to enhance fisheries habitat.

Selected trees and shrubs growing in the river at the base of the channel would be removed. All trees to be removed would be flagged prior to the work to avoid any unnecessary cutting. Overhanging branches of trees and shrubs growing along the top of the embankment would also be removed on a selective basis. Some clearing of vegetation might also be required at access points.

Figure 1: General Location Map

BROCKTON QUADRANGLE
MASSACHUSETTS
7.5 MINUTE SERIES (TOPOGRAPHIC)



DRAINAGE AREA MAP

Salisbury Brook / Salisbury Plain River

BROCKTON, MASSACHUSETTS

New England Division

US Army Corps of Engineers

Ancillary work to improve channel capacity would include the relocation of utility pipes situated underneath the Forest Street and Perkins Avenue Bridges.

Dredging would be conducted during the low flow season (July through August) to minimize water quality impacts and facilitate the work. A double row of siltation barriers consisting of silt cloth and hay bales would typically be employed to minimize downstream water quality impacts.

Clearing the river of debris, sediments, and encroaching vegetation has an expected effective project life of not more than 20 years.

B. Alternatives

1. No Action

If no action is taken sediments, trash and vegetation in the river would continue to limit channel capacity during flood events. Occasional overtopping of embankments would continue to occur, with accompanying damage to commercial and light industrial properties.

2. Additional Work Areas

The potential benefits and environmental effects of similar channel work in several reaches of Salisbury Brook was also considered. Although this work was not found to be economically justified, information concerning the environmental resources of these areas, and potential environmental impacts is included in this report.

Potential work areas on Salisbury Brook included:

Area "B": A 185 foot reach from where the brook enters an underground conduit near the District courthouse upstream to the Newbury Street Bridge.

Area "C": A 3200 foot reach from the Carleton Street Culvert upstream to the Ash Street Bridge.

Area "D": An 1720 foot reach from Ash Street to Prospect Street (work on this section is contingent upon removal of a 150 foot long concrete pad than spans the brook just upstream of Moraine Street).

Plans called for excavating about 4,700 cubic yards of material from these areas. The depth of excavated material would have ranged from approximately 0 to 2.0 feet at Area B and 0 to 1.5 feet at Area D. Selected trees and shrubs growing in the river at the base of stream channel would have been removed.

Proposed ancillary work included: 1) removal of a garage spanning Salisbury Brook at Area B., 2) modification of a concrete weir-like structure constricting flow at Area B.

3. Alternative Flood Control Measures

A previous plan calling for increased channelization and diversion of stream waters was not economically justified. Similarly, construction of dikes, floodwalls, or the relocation of structures are not considered a practical and/or economically justified solution. Flood proofing is not a viable option since many structures in flood prone areas are older buildings with stone foundations.

III. ENVIRONMENTAL RESOURCES

A. General Setting

Brockton is situated about 20 miles southeast of Boston, Massachusetts, and 30 miles north of Providence, Rhode Island. The topography of the area is generally flat, with occasional rolling hills, most of which have an elevation less than 200 msl. Normal annual precipitation is about 41 inches (Gibney, 1984), with most falling as rain during the spring.

1. Salisbury Brook

The Salisbury Brook watershed can be divided into four primary zones (U.S. Army Crops of Engineers 1972).

Zone "1" consists of 2,431 acres of mostly undeveloped lands located upstream of Thirty Acres Pond. This area includes the Beaver Brook watershed (which drains into the Brockton Reservoir), and a park (Field Park). The Brockton Reservoir and a series of ponds in Field Park provide substantial flood storage potential in this area.

Zone "2" consists of the Lovett Brook watershed (1,376 acres) which drains into Cross Pond, just upstream of Salisbury Brook. Substantial development has occurred in this zone in recent recent years, including the construction of a large shopping mall complex.

Zone "3" consists of a 704 acre drainage area situated between the outlet of Salisbury Brook at Cross Pond and Newbury

Street, in downtown Brockton. This area is about 90 percent developed, primarily with residential properties. The bulk of the proposed work area in Salisbury Brook (Areas I and D) is situated in this zone.

Zone "4" consists of a 416 acre drainage area situated from Newbury Street downstream to the confluence with Trout Brook. This area is entirely developed with a mix of residential commercial and industrial properties. Area B is situated in this zone.

A substantial portion of Salisbury Brook between Cross Pond and Trout Brook is channelized. Along this reach, the brook passes underneath about 20 road bridges and culverts and through six conduits of varying size. Many of the bridges and a 150 foot wide culvert spanning the brook just upstream of the Moraine Street Bridge pose severe hydraulic constrictions during flood events.

2. Salisbury Plain River

The Salisbury Plain River is formed by the junction of Salisbury Brook and Trout Brooks in Brockton. It flows south-southeasterly for about 5 miles until the junction of Meadow Brook where it becomes the Matfield River. Trout Brook originates north of Brockton and drains an area of about 4,160 acres. More than 60 % of the Trout Brook basin is developed, primarily with residential properties (U.S. Army Corps of Engineers, 1972). The Salisbury Plain River watershed from Trout Brook to the Meadow Street Bridge (just downstream of the project area) has an area of about 1,408 acres and is heavily developed, primarily with residential properties. The vicinity of the main project area (between the Perkins and Plain Street Bridges) is heavily commercialized and industrialized.

B. Aquatic Habitat

1. General Channel Morphology

Salisbury Brook ranges in width from about 15 feet near the upstream limit of the project area to 21 feet at the downstream limit. Approximately 20 percent of the brook within the project area has been channelized with concrete or rock walls. Embankments and walls range in height from about 2 to 10 feet, with most ranging between 4 and 6 feet high. Additional sections are riprapped. Undercut embankments and sandy or gravely shoals are present in several locations.

The brook has an average slope of 0.4 % along the 2.5 mile reach between Cross Pond and Trout Brook. Water depth during low flow periods in mid summer (August) ranges from about 1 foot in riffles to about 3 feet in pools.

Within the project area the Salisbury Plain River ranges in width from about 28 to 36 feet. Approximately one-third of this reach is channelized with high concrete walls. Low flow depth ranges from about 1 to 4 feet. The average slope of the river is about 0.1 % from the confluence of Trout and Salisbury Brooks to the Meadow Street Bridge, below the project area.

2. Water Quality

Salisbury Brook and the Salisbury Plain River are classified by the State of Massachusetts as class "B" waters (Judy Perry, pers. commun.). Waters assigned to this class are designated for the uses of protection and propagation of fish, other aquatic life and wildlife, for primary and secondary contact recreation (MA Div. Water Pollut. Control, 314 CMR 4.01). Specific criteria for Class B waters are presented in Appendix A.

Both Salisbury Brook and the Salisbury Plain River receive runoff from a large number of storm drains. During a heavy rainstorm in August an oily sheen was present on the Salisbury Plain River throughout much of the project area. Apparent industrial effluents were noted being discharged into the Salisbury Plain River just upstream of the Forest Street Bridge.

Data collected by the Massachusetts Department of Environmental Quality in the summer of 1989 indicate that morning dissolved oxygen levels in Salisbury Brook and the Salisbury Plain River (near the work area) rang from about 60 to 80 % of saturation values (R.M. Nuzzo, pers. commun.).

3. Sedimentology

The bottom substrate of the Salisbury Brook and Salisbury Plain river is composed primarily of sands and sandy gravels interspersed with rock. Silty shoals occur near embankments in some locations, particularly near bridges. Estimates of percent cover of rocky substrate for various reaches of the river are presented in Table 1. All reaches have accumulated some degree of trash (i.e. shopping carts, tires, miscellaneous scrap metal, appliances, batteries, waste wood, lawn clippings). Heaviest accumulations of trash were at the Courthouse site on Salisbury Brook (Area B) and downstream of the railroad overpass on the Salisbury Plain River (Area A). Substantial amounts of trash has also accumulated under many of the bridges.

Sediment samples (tube cores or surface grab samples) were collected for analysis from several locations within Salisbury Brook and the Salisbury Plain River (see Appendix B). Results of the analysis are summarized in Table 2.

Table 1: Selected Characteristics of Salisbury Brook and the Salibury Plain River Study Area.

Reach	Length (feet)	% Cover Cobble or Rock	Canopy Cover (%)	Submerged Veg. (% Cover)
Salisbury Brook				
Prospect to Pleasant St.	320	25 - 50	50 - 75	< 1
Pleasant to Moraine St.	1080	50	50 - 75	< 5
Moraine to Ash St.	400	50 - 75	50 - 75	< 1
Ash to Belmont St.	800	25 - 50	50 - 75	< 1
Belmont to Spring St.	640	25	> 75	< 1
Spring to Carleton St.	1680	< 25	50	< 5
Newbury St. to Conduit	185	50 - 75	50 - 75	< 1
Salisbury Plain River				
Perkins to Forest St.	920	< 10	25 - 50	10
Forest to RR Bridge	520	< 10	< 5	10
RR Bridge to RR Underpass	720	< 10	25	10
RR Underpass to Plain St.	200	< 10	25	10

Table 2: Summary of Bulk Sediment and Grain Size Analysis of Sediment Samples from Salisbury Brook and the Salisbury Plain River.

Parameter	Sample Location[a]									
	A	B	B	C	D	D	D	E	E	F
Sample Depth (inches)	0-20	0-16	0-14	sur.	0-4	4-10	4-10	0-10	0-10	sur.
(number of cores)	(1)	(1)	(1)	-	(3)	(2)	(1)	(2)	(1)	-
% Fines	2		7	< 1	< 1			9	< 1	< 1
Classification[b]	S		S/S	S	S	S*	S/S*	G/S	S/G	
% Volatile Solids										
EPA		13.7				5.5		6.0		12.8
NED		10.3				2.3		3.8		8.5
Oil and Grease (ppm)		302				1383	3607	1446		1457
Mercury (ppm)		< 0.05				0.12	0.17	0.17		0.30
Lead (ppm)		41				210	291	384(II)		580(II)
Zinc (ppm)		84				144	128	199		290
Arsenic (ppm)		8.3				7.3	1.7	3.8		4.2
Cadmium (ppm)		< 3				< 3	3(II)	3		4(II)
Chromium (ppm)		11				33	20	41		32
Copper (ppm)		23				37	33	44		78
Nickel (ppm)		26				< 21	< 21	< 21		< 21
PCB (ppb)		< 20				< 20	< 20	< 20	< 20	< 20

a: See Figure 1 for sample locations (samples A, B, and C are from Salisbury Brook). Samples were collected on May 23, 25, and 26, 1989 (see Appendix B for sample locations). Core sampels collected to refusal depth using 2.75" diameter plexiglass cores.

b. S: poorly graded sand; S/S: poorly graded sand with silt; G/S: well graded gravel with sand; S/G: poorly graded sand with gravel. See Appendix C for grain size analysis curves.

c. subsample with well defined "tar" layer.

II: Sediments meet Massachusetts Type "II" sludge limits but exceed Type "I" sludge limits.

Samples were generally sands or sandy gravels with low silt content. Several samples from the Salisbury Plain River had well defined "tar" layers and contained elevated levels of oil and grease. Samples D, E, and F from the Salisbury Plain River contain elevated levels of cadmium and lead and are classified as Massachusetts Type "II" Sludge.

C. Biological Resources

1. Aquatic Invertebrates

The benthic invertebrate communities of Salisbury Brook and the Salisbury Plain River were sampled qualitatively using a kick screen and by inspecting rocks, leaf packs and debris. A summary of the results are summarized in Table 3.

Case building caddisflies (*Hydropsyche* sp.) were the most abundant invertebrates on rocky substrates in both Salisbury Brook and the Salisbury Plain River. Scuds (*Gammarus lacustris*) were the most common on sandy or gravelly substrates. Fishfly larvae were common in Salisbury Plain River, but not noted in Salisbury Brook.

Most of the invertebrates encountered are tolerant of a wide range of water quality conditions. Taxa generally indicative of good water quality such as stoneflies (PLECOPTERA) were absent.

2. Fish

Recent electrofishing studies conducted in the Salisbury Plain River, upstream and downstream of the project area, indicate that the fish community is dominated by American eel (Table 4). Other relatively common species include golden shiner, white sucker, and carp. No cold water species (i.e. trout) occur in the river.

Although no information is available for Salisbury Brook, the brook probably supports American eel, golden shiner, and most of the other species occurring in the Salisbury Plain River. Species adapted to quiet water habitat such as largemouth bass, bluegills, and carp are not likely to be common in Salisbury Brook.

Table 3: Aquatic invertebrates noted in Salisbury Brook and the Salisbury Plain River.

Taxa	Occurrence S Brook	Occurrence SP River
ANNELIDA		
Oligochaeta	x	x
Hirudinea (leach)		x
ISOPODA		
Asellus sp. (sow bug)		x
AMPHIPODA		
Gammarus lacustris (scud)	x	x
MEGALOPTERA		
Nigronia sp. (fishfly)	x	
TRICOPTERA		
Hydropsyche sp. (caddisfly)	x	x
ODONATA		
Anax sp. (dragonfly)		x
cf. Calopteryx maculata (adults) (black-winged damselfly)	x	x
HEMIPTERA		
Gerris sp. (water strider)	x	x
COLEOPTERA		
Psephenus sp. (riffle beetle)		x
DIPTERA		
Chironomidae (blood worm)	x	x
GASTROPODA		
cf. Gyraulus sp. (planorbid snail)	x	

taxonomy is according to Pennak, 1978

Table 4: Results of electrofishing studies conducted by the Massachusetts D.E.P. in the Salisbury Plain River (R.M. Nuzzo, pers. commun.).

Species	Station and Number of Fish Caught			
	A	B	I	D
Anguilla rostrata (American eel)	40	49	72	70
Notemigonus crysoleucas (golden shiner)	23	4	2	
Lepomis macrochirus (bluegill)	1	1		2,2j
Micropterus salmoides (largemouth bass)		2j	1	
Catostomus commersoni (white sucker)		3	5j	2
Cyprinus carpio (carp)		2		
Etheostoma olmstedi (tessellated darter)				1
sampling distance (m)	150	200	200	150

Samples collected during late July and early August, 1989.

Stations: A: near confluence of Trout Brook and Salisbury Brook; B: near Pine Avenue; I: 0.5 miles upstream of Brockton Waste Water Treatment Plant (WWTP); D: near Pleasant Street, 1.6 miles downstream of WWTP

j: juveniles

3. Submerged Vegetation

Salisbury Brook and the Salisbury Plain River support scattered stands of submerged aquatic macrophytes. Species noted include wild celery (Vallisneria americana), water starwort (Callitriche sp.), pondweed (Potamageton sp.), slender spikerush (Eleocharis acicularis), common elodea (Elodea canadensis), and pickerelweed (Pontederia cordata). Percent cover of submerged aquatic vegetation in mid August is summarized in Table 1. Overall, percent cover was less than 3 percent in Salisbury Brook and about 20 percent in the Salisbury Plain River. Development of submerged aquatic vegetation is greatest in areas where the forest canopy is relatively sparse and light availability is high.

4. Riparian Vegetation

A diverse, well developed riparian community exists along Salisbury Brook throughout much of the study area. Common trees and shrubs present include red maple, box elder, elm, European buckthorn, dogwoods, northern arrowwood, green ash, and sugar maple (Table 4). Common herbaceous species include Japanese knotweed, purple loosestrife, jewel-weed, false nettle, and various grasses. The brook is well shaded by shrubs and trees, and typically has a overstory cover of about 50 to 75 percent (see Table 1).

A well developed riparian community exists along about 75 % of the Salisbury Plain River study area. Species noted are similar to those along Salisbury Brook (see Table 5). Overstory cover ranges from about 25 to 50 percent (Table 1). A 500 foot reach of the river from Forest Street downstream to a narrow wooden railroad bridge passes through a highly developed industrial area, and is largely devoid of riparian vegetation.

5. Wildlife

Little specific information is available concerning birds or other wildlife inhabiting the project area. A list of common bird species likely to occur in riparian habitat in eastern Massachusetts is presented in Table 6. Many of these species may occur in the project area, at least as transients. American robins, a kingfisher, and mallards where observed during site visits.

Small mammals characteristic of developed urban habitat likely to occur in the vicinity of the project area include gray squirrel (Sciurus carolinensis), skunk (Mephitis memphitis), the eastern cottontail (Sylvilagus floridanus), raccoon (Procyon lotor), and the Norway rat (Rattus norvegicus).

Table 5: Riparian Vegetation Growing Along Salisbury Brook and the Salisbury Plain River.

Common Name	Scientific Name	Occurence S Brook	Occurence SP River
Trees, Shrubs and Vines			
American elm	Ulmus americanus	x	x
aspen	Populus tremuloides	x	x
black cherry	Prunus serotina	x	x
black oak	Quercus velutina		x
boxelder	Acer negundo	x	x
burning bush	Euonymus atropurpureus	x	
button bush	Cephalanthus occidentalis		x
common catalpa	Catalpa bignonioides	x	x
common lilac	Syringa vulgaris	x	
common privet	Ligustrum vulgare	x	
crab apple	Pyrus malus	x	
eastern cottonwood	Populus deltoides		x
eastern hemlock	Tsuga canadensis	x	
elderberry	Sambucus pubens	x	
european buckthorn	Rhamnus frangula	x	x
flowering dogwood	Cornus florida	x	x
green ash	Fraxinus pennsylvanica	x	x
hackberry	Celtis occidentalis	x	
hop tree	Ptelea trifoliata	x	
Japanese barberry	Berberis thunbergii	x	
Japanese knowtweed	Polygonum cuspidatum	x	x
nightshade	Solanum dulcamara	x	
northern arrowwood	Viburnum recognitum	x	
poison ivy	Rhus radicans	x	
raspberry	Ribes sp.	x	
red maple	Acer rubrum	x	x
red-osier dogwood	Cornus stolinifera	x	
red-panicled dogwood	Cornus racemosa	x	
silky dogwood	Cornus amomum	x	
silver maple	Acer saccharinum	x	x
slippery elm	Ulmus rubra	x	x
smooth alder	Alnus serrulata	x	
sugar maple	Acer saccharum	x	x
sweet pepperbush	Clethera alnifolia	x	
Virginia Creeper	Parthenocissus quinquefolia	x	
water willow	Decodon verticillatus	x	
weeping willow	Salix babylonica	x	x
wild grape	Vitis sp.	x	
willow	Salix sp.		x

Table 5: continued.

Common Name	Scientific Name	Occurence S Brook	Occurence SP River
<u>Common Grasses and Herbs</u>			
bindweed	Polygonum sp.	x	x
false nettle	Boehmeria cylindrica	x	x
goldenrod	Solidago sp.	x	x
swamp milkweed	Asclepias incarnata	x	
mint	Mentha sp.		x
pickerelweed	Pontederia cordata	x	x
purple loosestrife	Lythrum salicaria	x	x
reed canary grass	Phalaris arundinacea	x	x
sensitive fern	Onoclea sensibilis	x	x
touch me not	Impatiens biflora	x	x
woodfern	Dryopteris spinulosa	x	x

Table 6: Birds Likely to Occur in Riparian Habitats in Eastern Massachusetts.

Great Blue Heron	Gray Catbird
Mallard	American Robin
Black Duck	Veery
Wood Duck	Ruby-crowned Kinglet
Common Merganser	Cedar Waxwing
Screech Owl	Starling
Belted Kingfisher	Solitary Vireo
Hairy Woodpecker	Red-eyed Vireo
Common Flicker	Yellow Warbler
Downy Woodpecker	Ovenbird
Eastern Kingbird	Common Yellowthroat
Great-crested Flycatcher	American Redstart
Eastern Phoebe	Red-winged Blackbird
Tree Swallow	Northern Oriole
Blue Jay	Rusty Blackbird
Black-capped Chickadee	Common Grackle
Tufted Titmouse	Brown-headed Cowbird
Northern Junco	Northern Cardinal
White-breasted Nuthatch	Purple Finch
Brown Creeper	American Goldfinch
House Wren	White-throated Sparrow
	Song Sparrow

based on general information contained in Brinson et al. (1981), Farrand (1983), and Peterson (1980).

F. Threatened and Endangered Species

No rare, threatened, or endangered species are known to exist in the project area (see letters from Gordon Beckett, United States Fish and Wildlife Service, April 14, 1989; and Jay Copeland, Massachusetts Natural Heritage Program, April 18, 1989).

G. Historic and Archaeological Resources

1. Prehistoric Period

Although the area would have had the potential for sustaining a small native population along the various small brooks, streams and marshes, there are no known prehistoric sites within the proposed project area. Due to the extent of urban development in the vicinity of the proposed project area the potential for intact prehistoric sites is very low.

2. Historic Period

The tract of land which includes what is now the city of Brockton was purchased from the Massasoit Indians in 1649. This area was purchased by the freeholders of Duxbury Plantation and was named Bridgewater. Settlement began around 1700 in the North Parish of Bridgewater. In 1821 the parish was separated from Bridgewater and was incorporated as the town of North Bridgewater. The population at this time was 1480. The name of the town was changed to Brockton in 1874.

Although the economic base for the area during the late 18th through the early 19th centuries was mainly agricultural, there were several small industries established to meet local needs. One of the first mills constructed in Brockton was a saw mill located south of the city in Campello. This was followed by several other saw mills and grist mills. One grist mill was situated on Belmont Street while a second, owned by the Bridgewater Manufacturing Company was located on the south side of Crescent Street near the river. Other early industries included a foundry, a woolen and cotton factory and a small fulling and carding mill situated on the Salisbury Plain River. A waterpower on the Salisbury Brook just south of Pleasant Street was developed, and a factory established for the manufacture of hay and manure forks.

A tannery was first established in the area in East Bridgewater in 1650. By 1821, leather working was the dominant industry in the Brockton area. There were several tanneries in Campello and one tannery owned by a Major Daniel Cary located south of Belmont Street near Salisbury Brook.

A shoe industry was established in Brockton shortly after the Revolutionary War, and by 1837 the city was producing 79,000 pairs of boots and 22,300 pairs of shoes per year, and employed 1125 people in shoe manufacturing. The opening of the railroad to Brockton in 1846 by the Randolph and Bridgewater Railroad Corporation, increased the town's access to the markets of Boston and New York and led to increased production. In 1865 over one million pairs of shoes were manufactured in Brockton by 1267 employees. There were 30,000 workers employed in various aspects of shoe manufacturing in 60 factories as late as 1921. The decline of the industry in Brockton occurred before World War II.

The area of the city of Brockton under investigation for the proposed project is a heavily developed urban environment. Portions of the Salisbury Brook and the Salisbury Plain River could contain industrial archaeological sites. However, due to the extent of channel modifications in the past, the potential is low for intact archaeological sites to be present in the area.

H. Socio-Economic Resources

The population of Brockton in 1980 was 95,172 (U.S. Census). Median 1980 family and per capita incomes were $18,606 and $6,132, respectively.

The city has a mixed economy, with governmental, service, retail trade, and manufacturing sectors accounting for large shares of the total work force and annual payroll (Gibney, 1984). Principle manufacturing industries include leather and leather products, textiles, printing and publishing, and metal products.

Flood prone areas along Salisbury Brook are primarily residential neighborhoods with aging single and multiple family homes.

Flood prone areas along the Salisbury Plain River support a number of commercial or manufacturing facilities. These include:

- Offices of a mail order retail company specializing in oversized clothes (King Size Inc.).
- Offices and operational facilities for a linen rental company (Churchill Linen).
- A distribution warehouse for a retail building supply company (Isam Mitchell Co.).

IV. ENVIRONMENTAL EFFECTS

A. Aquatic Habitat

1. Channel Morphology and Sedimentology

The proposed snagging and clearing project would not alter the general alignment of the Salisbury Plain River. Excavations or selective cutting of vegetation would not undermine the stability of existing embankments and walls.

Proposed removal of rock, trash, and snags would decrease habitat diversity within the project area. Excavation of deeper pools at several locations within the Salisbury Plain River is proposed as mitigation for this impact.

2. Water Quality

The proposed project would temporarily increase levels of suspended sediments and possibly other contaminants (i.e. oil and grease and heavy metals) downstream of the work area. Short term reductions in dissolved oxygen levels would also probably occur. Given the coarse nature of bottom sediments and various mitigation measures (see Section V) adverse water quality impacts would probably be limited to within several hundred yards downstream of the work area. This conclusion is conditional upon further testing of bottom sediments to full project depth during the "Plans and Specifications" study phase. If further testing was to detect higher levels of contaminants, potential water quality impacts would need to be reevaluated.

The proposed project should have no significant adverse longterm impacts on water quality in the Salisbury Plain River.

B. Biological Resources

1. Aquatic Invertebrates

Construction activities would severely disrupt the existing aquatic invertebrate community in the Salisbury Plain River. Most invertebrates inhabiting the work areas would be killed during dredging operations. Additional individuals immediately downstream would suffer sublethal, or possibly lethal, affects from prolonged exposure to elevated levels of suspended sediments and siltation. Temporary elimination of submerged macrophytes beds would probably greatly reduce populations of scuds, amphipods, and other invertebrates.

The longterm impact of the project on stream invertebrate communities is difficult to assess. It is likely that impacted areas would be slowly recolonized by aquatic invertebrates over a period of several years. Recolonization would occur via expansion of remnant populations, downstream drift from unaffected upstream populations, and deposition of eggs by winged adults. Changes in stream habitat (i.e. removal of snags, rocks, and vegetation) would alter invertebrate productivity and community composition. In general, stream invertebrate productivity and diversity is greater in rocky habitat (rubble) than on coarse gravel, sand, or silt (Hynes, 1970; Wesche, 1985). Also, vegetated sands/silts are typically more productive than unvegetated stream bottom.

2. Fish

Construction activities in the Salisbury Plain River or Salisbury Brook would substantially disrupt the existing fish communities. Some adult fish would probably be killed by construction equipment or be impaired by exposure to high suspended sediment levels. Such impacts would be greatest on small, relatively sensitive species such as shiners. American eel, the most common species in the Salisbury Plain River, are quite tolerant of adverse water quality conditions.

Fish eggs and larvae would be especially vulnerable to disruption, and it is likely that most individuals of the current year-class of all warm water species present would be lost. Spawning habitat for golden shiners and other species which tend to deposit eggs over submerged aquatic vegetation would be severely reduced for a number of years. Reproduction of American eel, a catadromus species which spawns in the Atlantic Ocean, would not be impacted.

Over time, fish populations would recover via expansion of remnant populations and migration from unaffected reaches. Rocks, snags, and trash provide important cover for fish, however, and removal of this material could lead to a long-term reduction in fish abundance, and possibly diversity in the project area.

Fisheries habitat for species such as largemouth bass and bluegills would be enhanced by construction of several pools at selected locations within the project area (see Section V).

3. Submerged Vegetation

The proposed dredging would destroy a large proportion of the submerged aquatic macrophytes growing in the project area. Although the macrophytes would eventually recolonize the dredged area, productivity would be greatly depressed for several years.

4. Riparian Vegetation

The proposed work involves cutting about 10 trees (DBH > 2") growing along the Salisbury Plain River. Removal of 35 addtional trees would have been required for work along Salisbury Brook. Predominant species to be cut include red maple, sugar maple, box elder, green ash, and elm. In addition, overhanging branches of numerous other small trees and shrubs rooted on top of embankments would be trimmed. Predominant species overhanging into the river include various dogwoods and European buckthorn. Measures would be taken to insure that no unnecessary cutting of riparian vegetation occurs (see Section V).

Riparian vegetation serves a variety of functions. These include: moderation of water temperature through shading, production of leaf litter to support aquatic food webs, bank stabilization, and provision of wildlife habitat. The proposed work should not have a significant impact on these functions along the Salisbury Plain River. On average, less than 1 tree (DBH < 2") per 150 linear feet of stream would be removed. Existing canopy cover would remain largely unaffected, except for several small areas where a number of trees growing in close proximity would be removed. Trimming of shrubs and trees in the subcanopy should have little impact on shading, since in many areas a well developed overstory is also in place. Adequate leaf litter should be available to maintain aquatic food webs. Bank stability should not be significantly impacted since only trees or shrubs at the base of embankments would be removed.

5. Wildlife

The proposed project should have no significant impact on bird or mammal populations occurring near the work area. Minor potential impacts include increased dispersal related mortality of animals disturbed by construction activities and the possible abandonment of eggs or nestlings. Impacts on nestlings should be largely avoided, because work is likely to occur in July or August, after most species have fledged.

C. Threatened and Endangered Species

This project would have no impact on any species considered threatened or endangered by the U.S. Fish and Wildlife Service or the State of Massachusetts (see correspondence from Gordon Beckett, U.S. F.W.S., April 14 1989; and Jay Copeland, Massachusetts Natural Heritage Program, April 15, 1989).

D. Historic and Archaeological Resources.

The vicinity of the proposed project area is heavily developed. Many sections of the Salisbury Brook and the Salisbury Plain River have been channelized and straightened in the past. Portions of the brook and river may have archaeological potential. However, due to the extent of urban development and channel modifications, the potential for intact prehistoric or industrial archaeological sites is very low. The proposed snagging and clearing project will not effect any portions of the streambank. Therefore, we feel that the proposed project should have no effect upon any structure or site of historic, architectural or archaeological significance as defined by the National Historic Preservation Act of 1966, as amended. The Massachusetts Historic Commission in a reply dated July 28, 1989 has concurred with this finding.

E. Socio-Economic Resources

The proposed project would reduce potential economic losses due to flooding in a long established commercial/ light industrial area in Brockton. The proposed work has a benefits: cost ratio of 6.5:1.

Potential negative socio-economic affects include short-term construction related aesthetic and noise impacts, and potential traffic congestion problems at some work sites.

V. ACTIONS TAKEN TO MINIMIZE ENVIRONMENTAL EFFECTS

1. Water quality impacts would be minimized to the maximum practical extent by employing the following measures:

a) work would occur during low flow periods (probably July and August).

b) siltation barriers would be placed across the river immediately downstream of the work area (a double row of siltation barriers consisting of silt cloth and hay bales is suggested).

c) to minimize discharge of effluent into the river dredged material would be placed into closed bed trucks and dewatered at the disposal site.

d) any areas disturbed by construction equipment would be seeded and mulched to minimize erosion and sedimentation.

2. Efforts would be made to minimize removal of riparian vegetation. Trees, shrubs, and overhanging branches will be removed only when they clearly have the potential to impede channel capacity. Trees (> 2" DBH) to be removed will be flagged prior to the work to avoid unnecessary cutting by the contractor. This work will be monitored by a Corps biologist.

3. In order to enhance fisheries habitat several deep pools would be excavated in the Salisbury Plain River. Pools would be 2 to 4 feet deeper than project depth and have an area of about 200 square feet. Pool locations would be determined with the assistance of the Massachusetts Division of Fisheries and Wildlife (Southeast Wildlife District) during than "Plans and Specifications" study phase. The work would require the excavation of an additional 350 cubic yards of material at a cost of about $ 2,400.

4. Dredged material would be disposed of at a suitable, state approved landfill. Any Type "II" material would be covered on a daily basis with clean fill. Other operational procedures stipulated in the approved Massachusetts Department of Environmental Protection plan for the proposed disposal site would be adhered to.

5. Further testing to characterize bottom sediments in the Salisbury Plain River to full project depth would be conducted during the "Plans and Specifications" study phase. An EP toxicity test would be required for any material failing to meet Massachusetts Type "II" dredged material criteria for upland disposal. Material meeting EP test guidelines as solid waste would be disposed of at a state approved clay-lined landfill in East Bridgewater.

6. Small trees and branches should be chipped and provided to the city of Brockton for mulch wherever possible.

7. Traffic control would be provided as required to minimize potential congestion caused by construction operations.

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VII. COORDINATION

A. Letters Received

Gordon Beckett (U.S. Fish and Wildlife Service)

April 14, 1989: Indicated no threatened or endangered species are known to exist at project area.

August 14, 1989: Outlined general concerns regarding potential project impacts.

Jay Copeland (Massachusetts Natural Heritage Program)

April 18, 1989: Indicated that no known rare plants, animals or natural communities exist at the project area.

Louis Hambly (Mass. Division of Fisheries and Wildlife)

August 14, 1989: Suggested mitigation measures to minimize impacts and enhance fisheries habitat in project area.

Robert Nuzzo (Massachusetts Dept. Environmental Protection)

August 24, 1989: Provided information concerning the fisheries resources and/or water quality of Salisbury Brook and the Salisbury Plain River.

Valerie Talmage (Massachusetts Historic Commission)

July 12, 1989: Concurred with the Corps determination that the proposed project would be unlikely to have a significant impact on historic, architectural or archeological resources.

B. Personnel Communications and Site Visits

Greg Hunt (Mass. Department of Environmental Protection)

July 10, and August 29, 1989: Provided information on Thatcher Street Landfill, indicated that dredged material from the Salisbury Plain river would have to be tested to project depth prior to disposal at approved landfill. Indicated the availability of a landfill for solid waste in East Bridgewater (material failing Type II standards but passing EP toxicity test).

Eddy Krause (Mass. Division of Fisheries and Wildlife)

August 1, 1989: Joint site visit with NED

August 21, 1989: Provided information on design of fish habitat enhancement pools.

Judy Perry (Mass. Division of Water Pollution Control)

August 10, 1989: Indicated that Salisbury Brook and the Salisbury Plain Rivers are Class "B" waters.

Nancy Savoy (Brockton City Planner)

July 6, 1989: Provided information on status of Thatcher Street Landfill.

Carolin Stone (Brockton Conservation Comm. Administrator)

July 27, 1989: Provided information on industrial history of the Salisbury Plain River area.

Mike Tehan (U.S. Fish and Wildlife Service)

July 19, 1989: Joint site visit with NED.

VIII. COMPLIANCE WITH ENVIRONMENTAL FEDERAL STATUTES AND EXECUTIVE ORDERS

Federal Statutes

1. Preservation of Historic and Archaeological Data Act of 1974, as amended, 16 U.S.C. 469 et seq.

Compliance: Consultation with the State Historic Preservation Office and the Advisory Council on Historic Preservation concerning mitigation of historic and/or archaeological resources will signify compliance.

2. Clean Air Act, as amended, 42 U.S.C. 7401 et seq.

Compliance: Public notice of the availability of this report to the Environmental Protection Agency signifies compliance pursuant to Sections 176c and 309 of the Clean Air Act

3. Clean Water Act of 1977 (Federal Water Pollution Control Act Amendments of 1972) 33 U.S.C. 1251 et seq.

Compliance: A Section 404(b)(1) Evaluation and Compliance Review have been incorporated into this report. An application shall be filed for State Water Quality Certification pursuant to Section 401 of the Clean Water Act.

4. Coastal Zone Management Act of 1972, as amended, 16 U.S.C. 1431 et seq.

Compliance: A CZM consistency determination shall be provided to the State for review and concurrence that the proposed project is consistent with the approved State CZM program.

5. Endangered Species Act of 1973, as amended, 16 U.S.C. 1531 et seq.

Compliance: Coordination with the U.S. Fish and Wildlife Service (see letter dated April 14, 1989) has yielded no formal consultation requirements pursuant to Section 7 of the Endangered Species Act.

6. Estuarine Areas Act, 16 U.S.C. 1221 et seq.

Compliance: Not applicable.

7. Federal Water Project Recreation Act, as amended, 16 U.S.C. 4601-12 et seq.

Compliance: Public notice of the Availability of this report to the National Park Service (NPS) and the Office of Statewide Planning relative to the Federal and State comprehensive outdoor recreation plans signifies compliance with this Act.

8. Fish and Wildlife Coordination Act, as amended, 16 U.S.C. 661 et seq.

Compliance: Coordination with the FWS, Massachusetts Division of Fish and Wildlife, Massachusetts Department of Environmental Protection, and the Massachusetts Natural Heritage Program signifies compliance with the Fish and Wildlife Coordination Act.

9. Land and Water Conservation Fund Act of 1965, as amended, 16 U.S.C. 4601-4 et seq.

Compliance: Public notice of the availability of this report to the National Park Service (NPS) and the Office of Statewide Planning relative to the Federal and State comprehensive outdoor recreation plans signifies compliance with this Act.

10. Marine Protection, Research, and Sanctuaries Act of 1972, as amended, 33 U.S.C. 1401 et seq.

Compliance: Not Applicable.

11. National Historic Preservation Act of 1966, as amended, 16 U.S.C. 470 et seq.

Compliance: Coordination with the State Historic Preservation Office determined that no historic or archaeological resources would be affected by the proposed project (see July 29, 1989 letter from Valerie Talmage).

12. National Environmental Policy Act of 1969, as amended, 42 U.S.C. 4321 et seq.

Compliance: Preparation of this report signifies partial compliance with NEPA. Full compliance shall be noted at the time the Finding of No Significant Impact is issued.

13. Rivers and Harbors Act of 1899, as amended, 33 U.S.C. 401 et seq.

Compliance: No requirements for Corps' projects or programs authorized by Congress. The proposed shoreline stabilization project is pursuant to the Congressionally-approved continuing authority program: Section 14 of the 1946 Flood Control Act.

14. Watershed Protection and Flood Prevention Act, as amended, 16 U.S.C. 1001 et seq.

Compliance: Not applicable.

15. Wild and Scenic Rivers Act, as amended, 16 U.S.C. 1271 et seq.

Compliance: Not Applicable.

Executive Orders

1. Executive Order 11988, Floodplain Management, 24 May 1977 amended by Executive Order 12148, 20 July 1979.

Compliance: Not Applicable.

2. Executive Order 11990, Protection of Wetlands, 24 May 1977.

Compliance: Circulation of this report for public review fulfills the requirements of Executive Order 11990, Section 2(b).

3. Executive Order 12114, Environmental Effects Abroad ofMajor Federal Actions, 4 January 1979.

Compliance: Not Applicable.

Executive Memorandum

1. Analysis of Impacts on Prime or Unique Agricultural Lands in Implementing NEPA, 11 August 1980.

Compliance: Not Applicable.

APPENDIX A: Massachusetts Water Quality Criteria.

The following minimum criteria are adopted and shall be applicable to all waters of the Commonwealth.

A. These minimum criteria are applicable to all waters of the Commonwealth, unless criteria specified for individual classes are more stringent.

	Parameter	Criteria
1.	Aesthetics	All waters shall be free from pollutants in concentrations or combinations that: (a) Settle to form objectionable deposits; (b) Float as debris, scum or other matter to form nuisances; (c) Produce objectionable odor, color, taste or turbidity; or (d) Result in the dominance of nuisance species.
2.	Radioactive Substances	Shall not exceed the recommended limits of the United States Environmental Protection Agency's National Drinking Water Regulations.
3.	Tainting Substances	Shall not be in concentrations or combinations that produce undesirable flavors in the edible portions of aquatic organisms.
4.	Color, Turbidity, Total Suspended Solids	Shall not be in concentrations or combinations that would exceed the recommended limits on the most sensitive receiving water use.
5.	Oil and Grease	The water surface shall be free from floating oils, grease and petrochemicals and any concentrations or combinations in the water column or sediments that are aesthetically objectionable or deleterious to be biota are prohibited. For oil and grease of petroleum origin the maximum allowable discharge concentration is 15 mg/1.

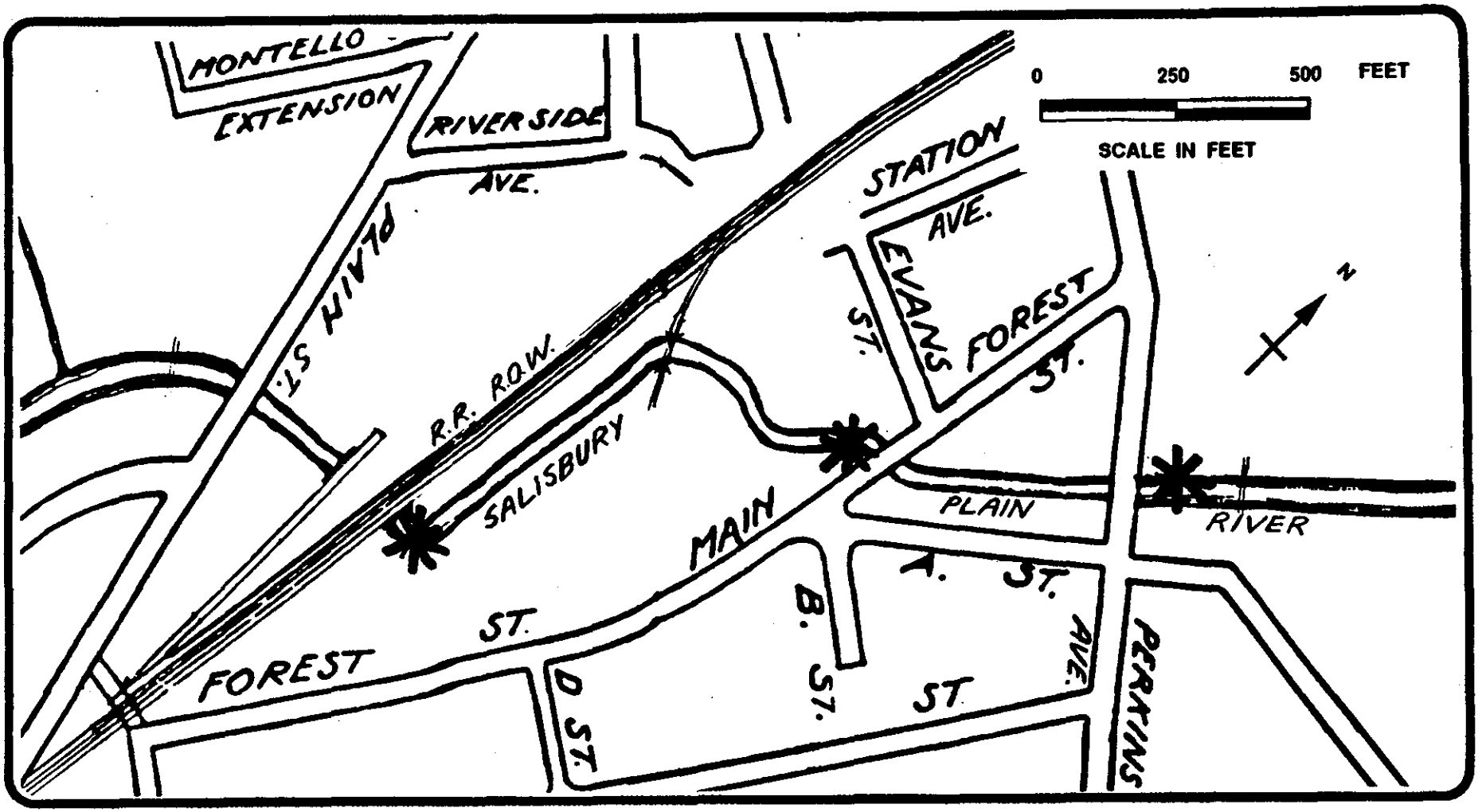
Parameter	Criteria
6. Nutrients	Shall not exceed the site-specific limits necessary to control accelerated or cultural eutrophication.
7. Other Constituents	Waters shall be free from pollutants in concentrations or combinations that (a) Exceed the recommended limits on the most sensitive receiving water use; (b) Injure, are toxic to, or produce adverse physiological or behavioral responses in humans or aquatic life; or (c) Exceed site-specific safe exposure levels determined by bioassay using sensitive resident species.

The following additional minimum criteria are applicable to inland water classifications.

For Class B waters:

Parameter	Criteria
1. Dissolved Oxygen	Shall be a minimum of 5.0 mg/1 in warm water fisheries and a minimum of 6.0 mg/1 in cold water fisheries.
2. Temperature	Shall not exceed 83°F (28.3°C) in warm water fisheries or 68°F (20°C) in cold water fisheries, nor shall the rise resulting from artificial origin exceed 4.0°F (2.2°C).
3. pH	Shall be in the range of 6.5 - 8.0 standard units and not more than 0.2 units outside of the naturally occurring range.
4. Fecal Coliform Bacteria	Shall not exceed a log mean for a set of samples of 200 per 100 ml, nor shall more than 10% of the total samples exceed 400 per 100 ml during any monthly sampling period, except as provided in 314 CMR 4.02(1).

Appendix B: Sediment Sampling Locations

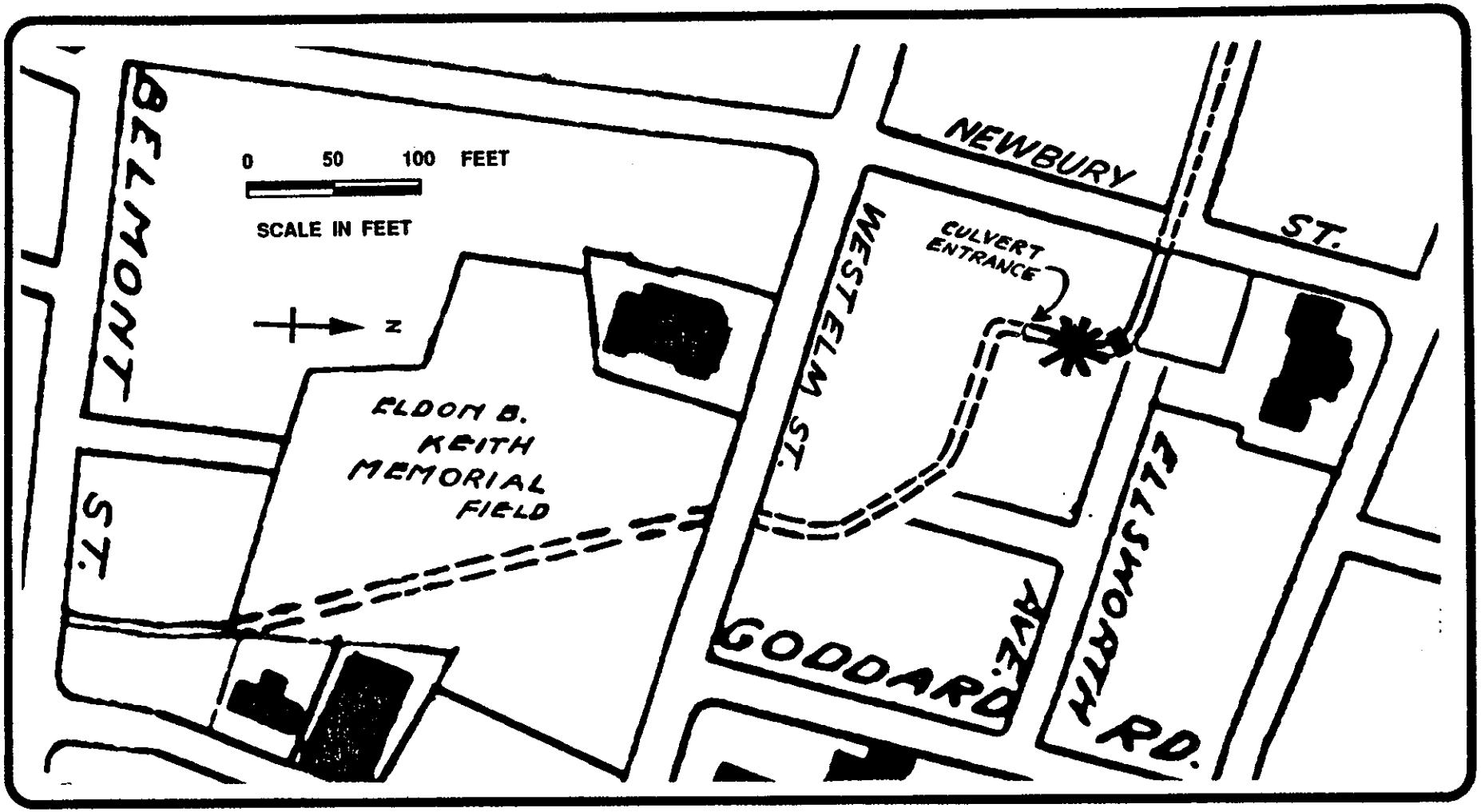


SEDIMENT SAMPLING LOCATIONS, AREA A

(Perkins Ave. to Plain St.)

SECTION 208 INVESTIGATION —— BROCKTON, MASSACHUSETTS

US Army Corps of Engineers
New England Division

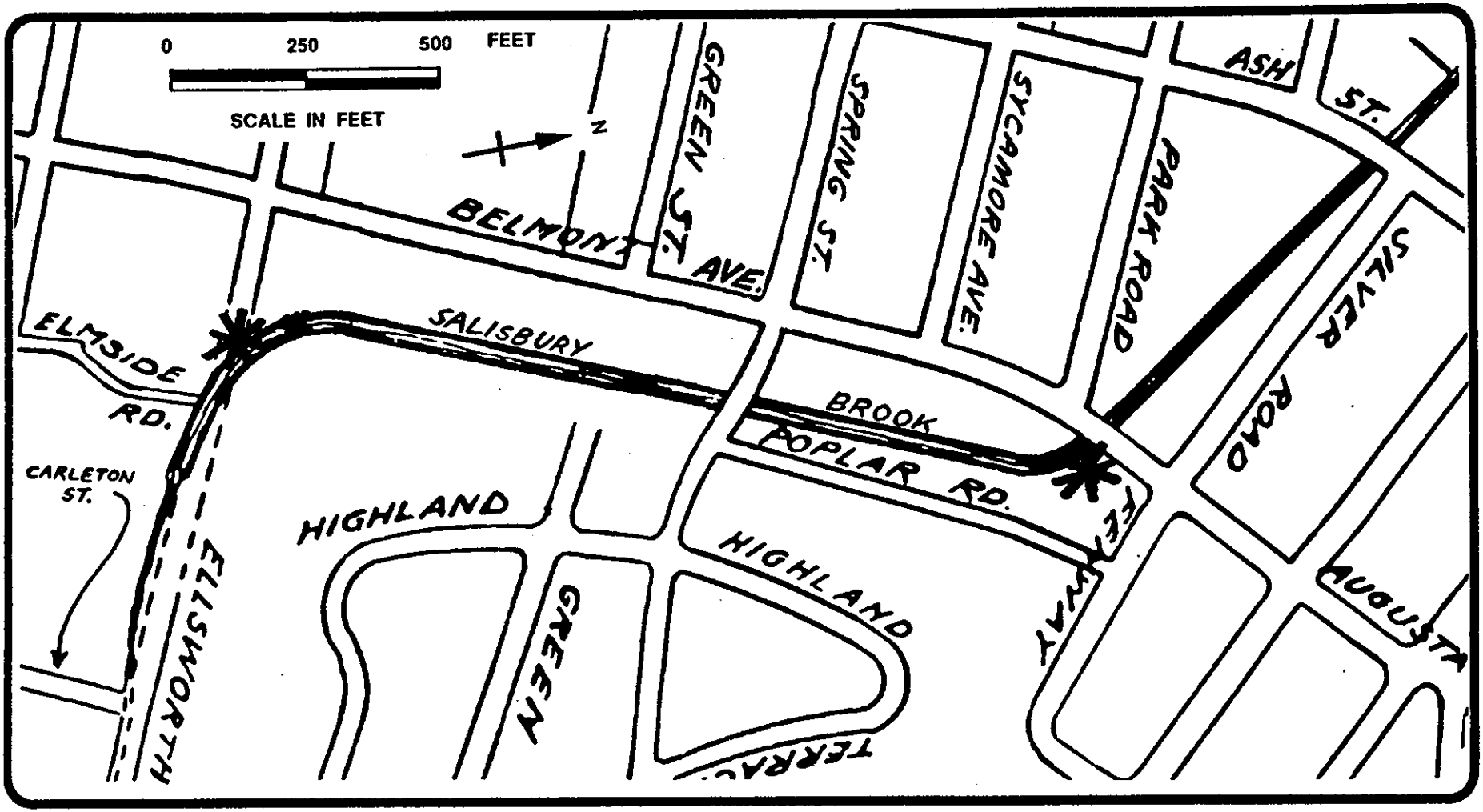


SEDIMENT SAMPLING LOCATION, AREA B

(Newbury St. to culvert entrance)

SECTION 208 INVESTIGATION —— BROCKTON, MASSACHUSETTS

US Army Corps
of Engineers
New England Division



SEDIMENT SAMPLING LOCATIONS, AREA C

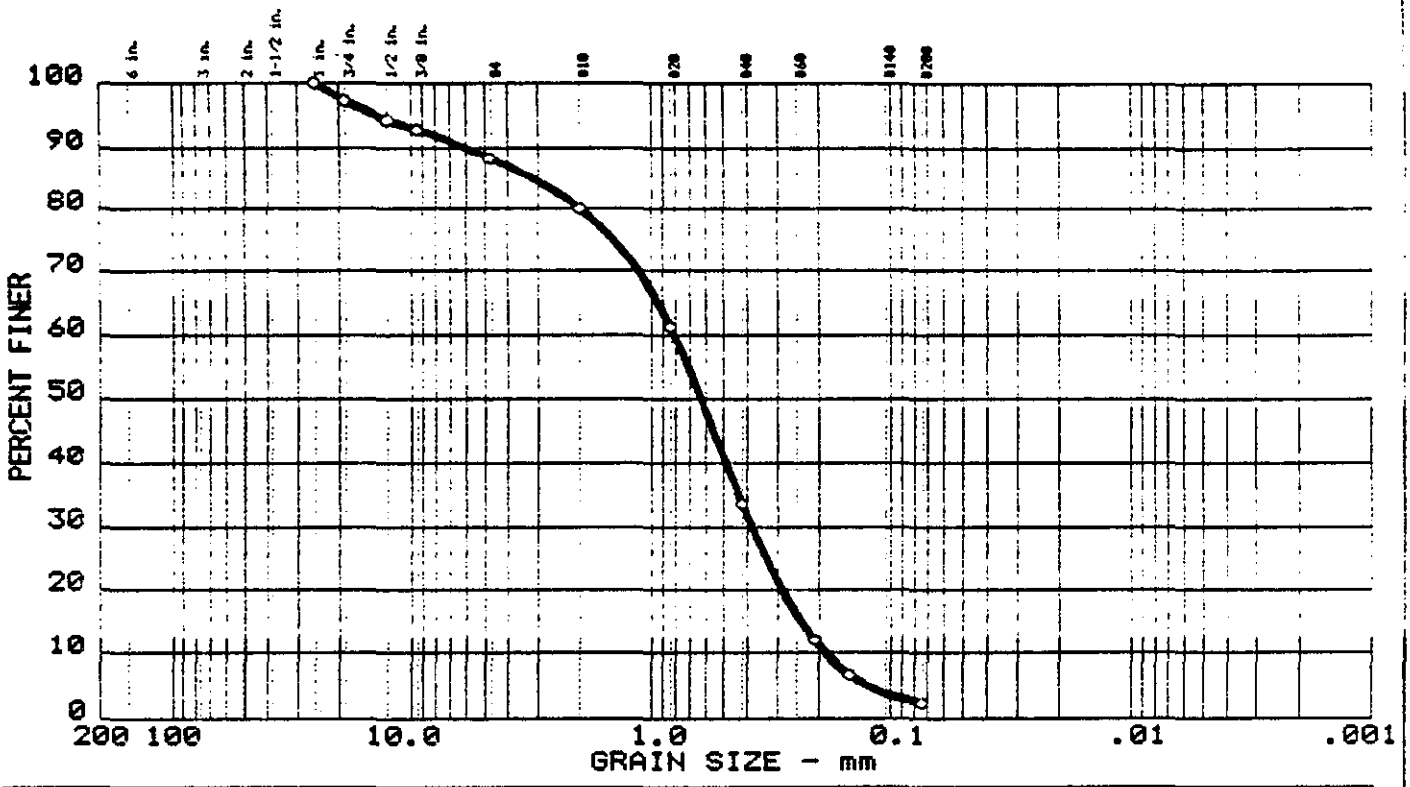
(Ash St. to Carleton St.)

SECTION 208 INVESTIGATION —— BROCKTON, MASSACHUSETTS

US Army Corps
of Engineers
New England Division

Appendix C: Grain Size analysis Curves

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
○	1	0.0	11.8	85.8	2.4	

	LL	PI	D_{75}	D_{60}	D_{50}	D_{30}	D_{25}	D_{10}	C_c	C_u
○			1.43	0.80	0.62	0.382	0.3327	0.1871	0.97	4.3

MATERIAL DESCRIPTION	USCS	AASHTO
○ SAMPLE "T-2" (TUBE SAMPLE)	SP	

Project No.: 100-503-2

○ Location: SAMPLE "A", DEPTH: 0.0 FT. TO 1.7 FT.

Salisbury Brook

Date: 6-27-89

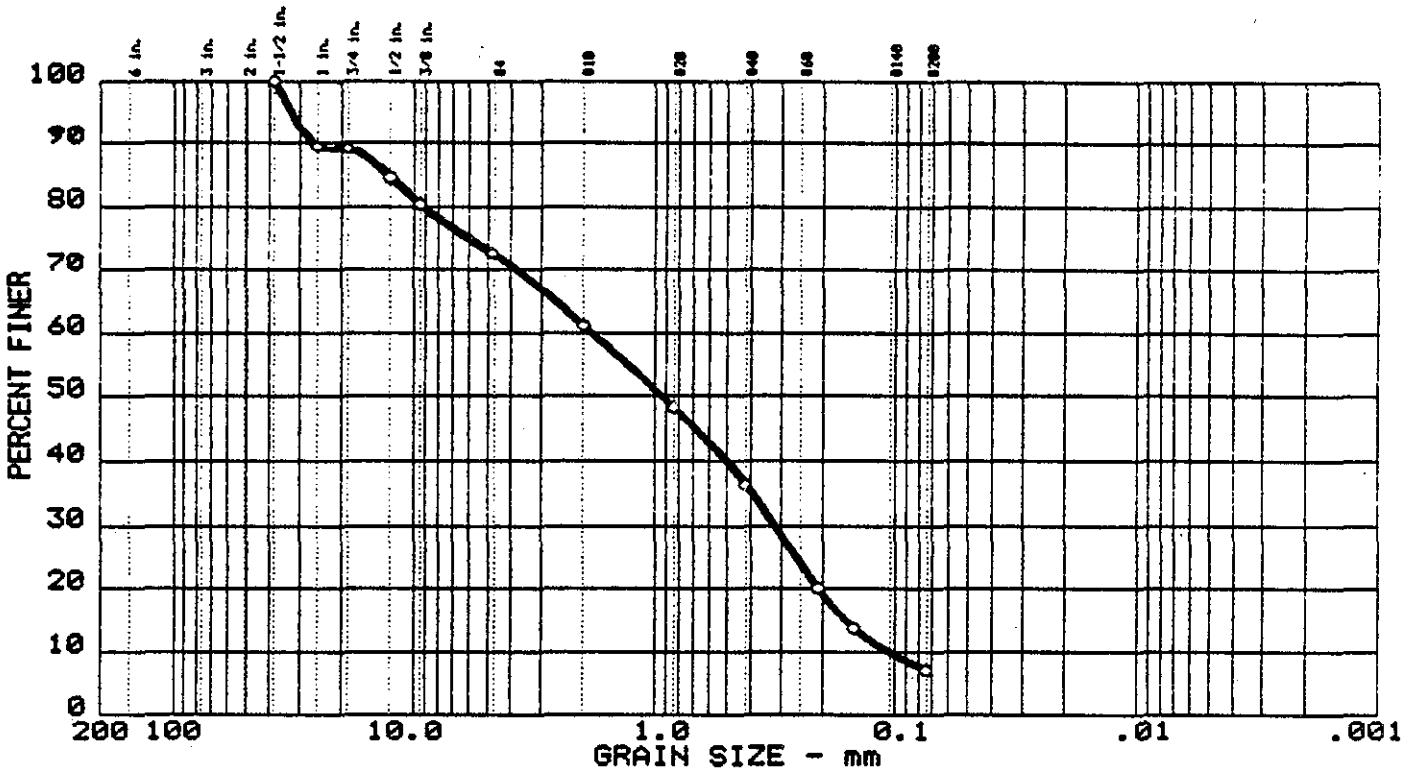
Remarks:
POORLY GRADED SAND
COLOR: GREY

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	27.2	65.6	7.1	

	LL	PI	D_{75}	D_{60}	D_{50}	D_{30}	D_{25}	D_{10}	C_c	C_u
○			5.82	1.84	0.93	0.320	0.2600	0.1047	0.53	17.6

MATERIAL DESCRIPTION	USCS	AASHTO
○ SAMPLE "T-2" (TUBE SAMPLE)	SP-SM	

Project No.: 100-503-5

○ Location: SAMPLE "B", DEPTH: 0.0 FT. TO 1.2 FT.

Salisbury Brook

Date: 6-27-89

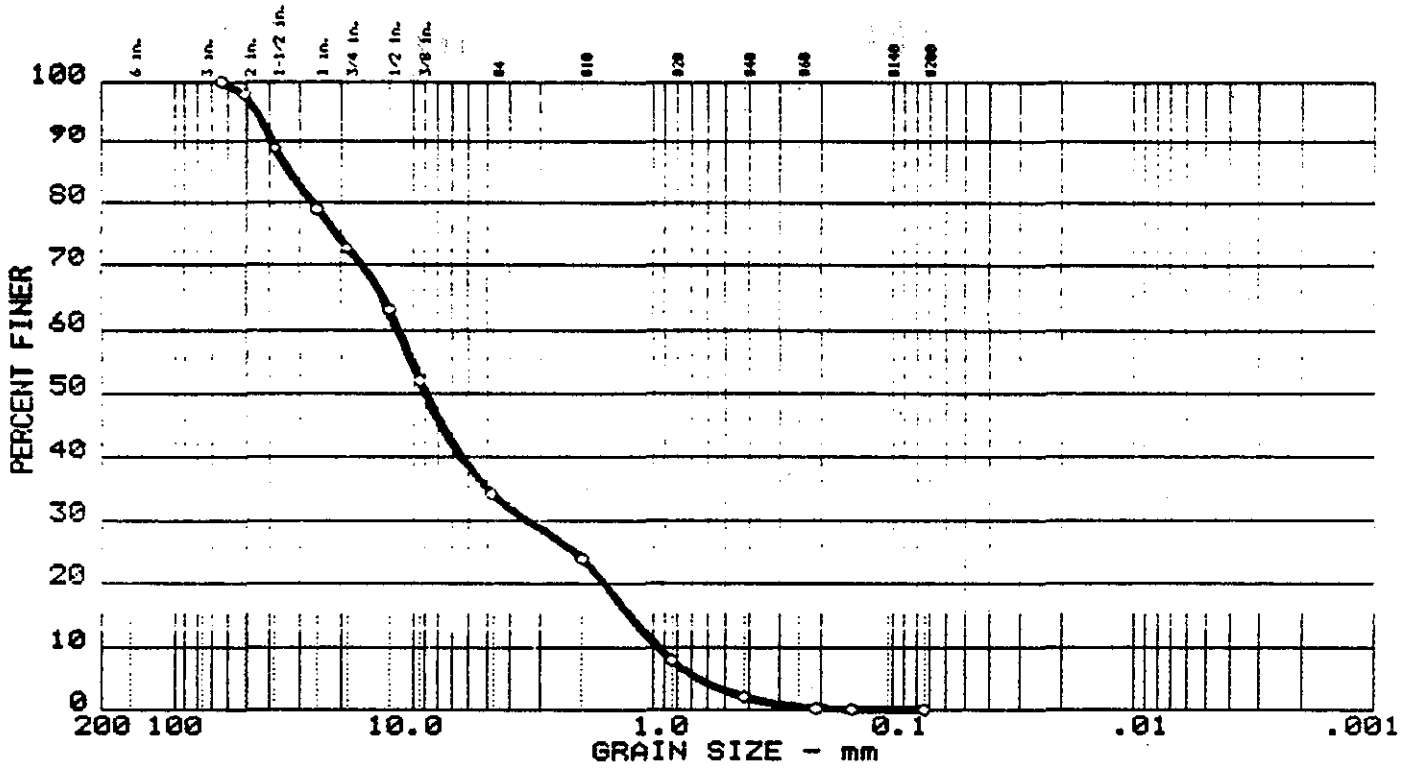
Remarks:
POORLY GRADED SAND
WITH SILT AND GRAVEL
COLOR: TWO LAYERS , DARK
BROWN AND DARK GREY

GRAIN SIZE DISTRIBUTION TEST REPORT

CORPS OF ENGINEERS - NEW ENGLAND

Fig. No. 2

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
o	15	0.0	65.7	34.2	0.0	

	LL	PI	D_{75}	D_{60}	D_{50}	D_{30}	D_{25}	D_{10}	C_c	C_u
o			21.11	11.60	8.98	3.377	2.1802	0.9517	1.03	12.2

MATERIAL DESCRIPTION	USCS	AASHTO
o SAMPLE "B-1" (BUCKET SAMPLE)	GW	

Project No.: 100-503-6

o Location: SAMPLE "C" , DEPTH: SURFACE
Salisbury Brook

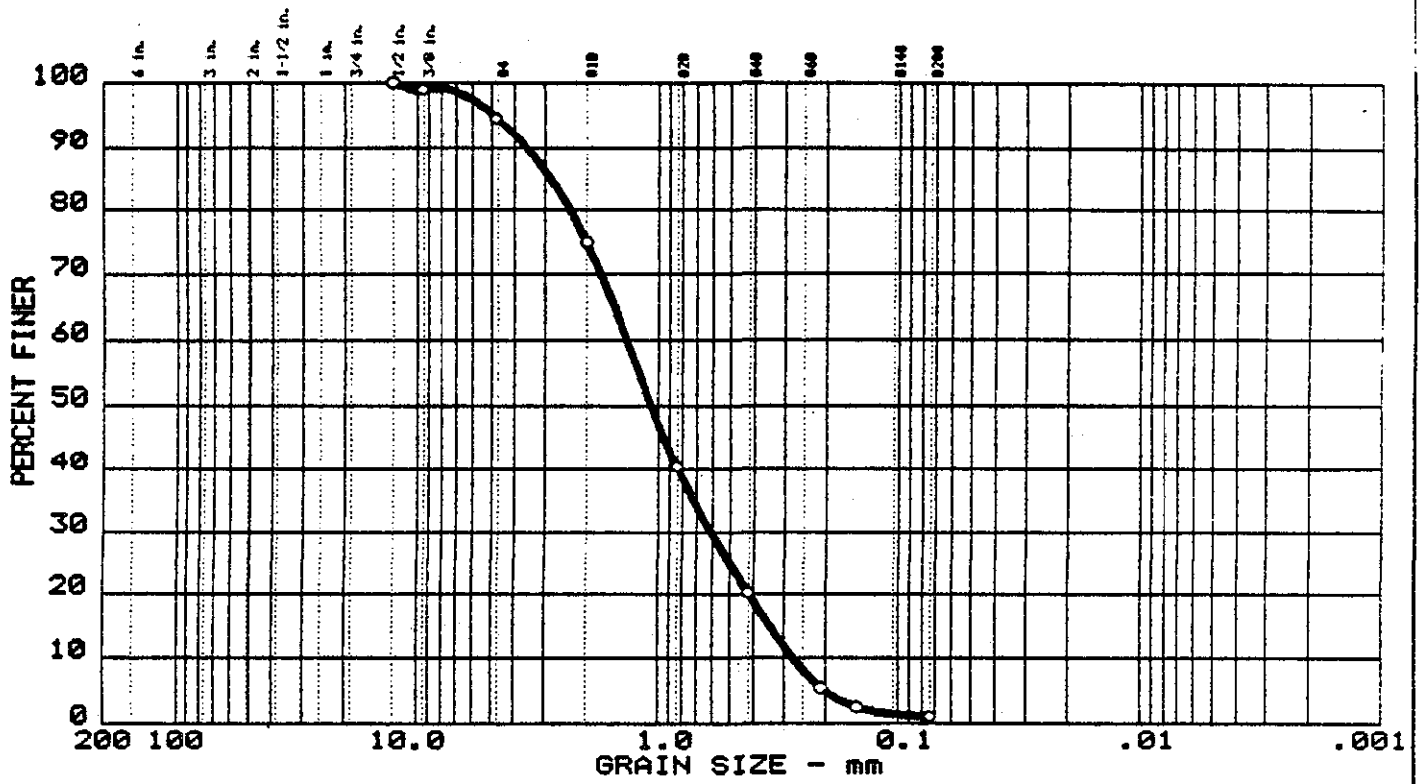
Date: 6-27-89

Remarks:
WELL-GRADED GRAVEL
WITH SAND
COLOR: BROWN , CONTAINS
MANY PIECES OF GLASS

GRAIN SIZE DISTRIBUTION TEST REPORT
CORPS OF ENGINEERS - NEW ENGLAND

Fig. No. 15

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
o	16	0.0	5.3	93.7	1.0	

	LL	PI	D_{75}	D_{60}	D_{50}	D_{30}	D_{25}	D_{10}	C_c	C_u
o			2.00	1.36	1.07	0.602	0.5047	0.2710	0.98	5.0

MATERIAL DESCRIPTION	USCS	AASHTO
o SAMPLE "T-1" (TUBE SAMPLE) T-2 Combined T-3	SP	

Project No.: 100-503-8,9,10 (combined)

o Location: SAMPLE "D", DEPTH: 0.0 FT. TO 0.3 FT.

Salisbury Plain River

Date: 6-27-89

Remarks:

POORLY GRADED SAND

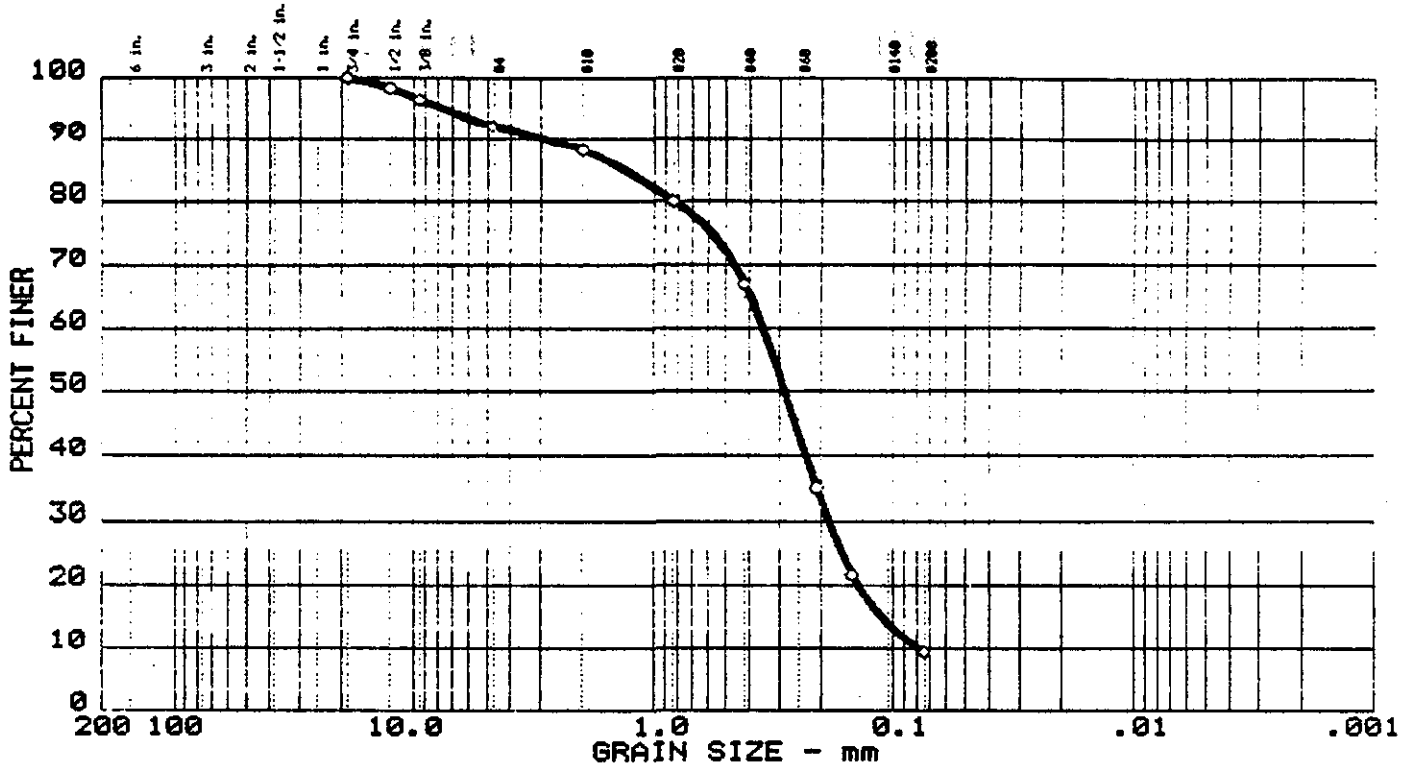
COLOR: BROWNISH-GREY

GRAIN SIZE DISTRIBUTION TEST REPORT

CORPS OF ENGINEERS - NEW ENGLAND

Fig. No. 16

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
o	19	0.0	7.8	82.7	9.4	

	LL	PI	D_{75}	D_{60}	D_{50}	D_{30}	D_{25}	D_{10}	C_c	C_u
o			0.58	0.35	0.28	0.187	0.1646	0.0779	1.28	4.5

MATERIAL DESCRIPTION	USCS	AASHTO
o SAMPLE "T-1" (TUBE SAMPLE) T-3 Combined	SP-SM	

Project No.: 100-503-11,13 (combined)

o Location: SAMPLE "E", DEPTH: 0.0 FT. TO 0.85 FT
Salisbury Plain River

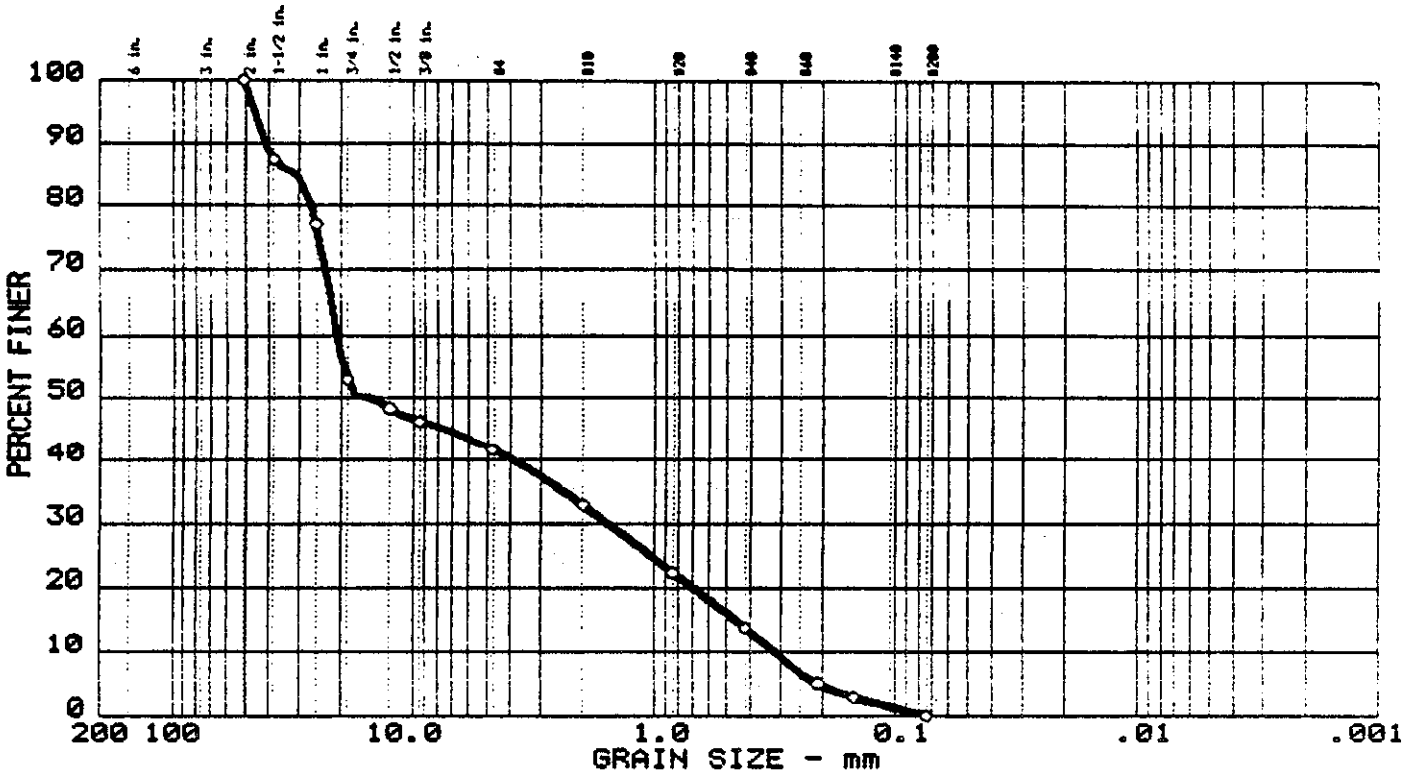
Date: 6-27-89

Remarks:
POORLY GRADED SAND WITH SILT , COLOR: GREY-BLACK
VOLATILES E.P.A.: 5.98%
VOLATILES N.E.D.: 3.78%

GRAIN SIZE DISTRIBUTION TEST REPORT
CORPS OF ENGINEERS - NEW ENGLAND

Fig. No. 19

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
o	3	0.0	58.3	41.7	0.1	

	LL	PI	D_{75}	D_{60}	D_{50}	D_{30}	D_{25}	D_{10}	C_c	C_u
o			24.69	21.01	16.88	1.558	1.0411	0.3181	0.36	66.1

MATERIAL DESCRIPTION	USCS	AASHTO
o SAMPLE "T-2" (TUBE SAMPLE)	GP	

Project No.: 100-503-12

o Location: SAMPLE "E", DEPTH: 0.0 FT. TO 0.85 FT
Salisbury Plain River

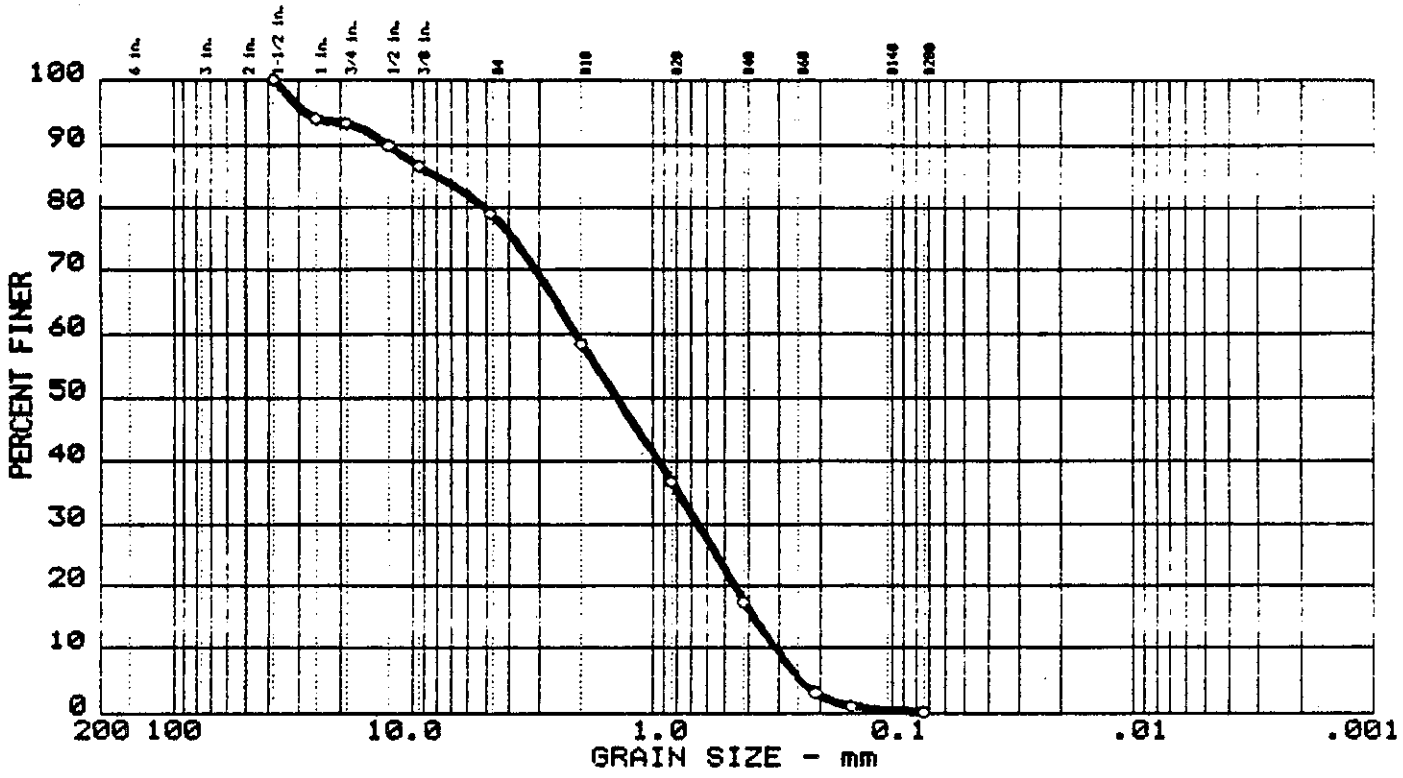
Date: 6-27-89

Remarks:
POORLY GRADED GRAVEL
WITH SAND
COLOR: GREY-BLACK
OILY ODOR WHEN WET

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	20.9	78.8	0.2	

	LL	PI	D_{75}	D_{60}	D_{50}	D_{30}	D_{25}	D_{10}	C_c	C_u
o			3.85	2.11	1.42	0.655	0.5489	0.3119	0.65	6.8

MATERIAL DESCRIPTION	USCS	AASHTO
o SAMPLE "B-1" (BUCKET SAMPLE)	SP	

Project No.: 100-503-14

o Location: SAMPLE "F" , DEPTH: SURFACE
Salisbury Plain River

Date: 6-27-89

Remarks:
POORLY GRADED SAND
WITH GRAVEL
COLOR: BROWN
CONTAINS MANY ORGANICS

GRAIN SIZE DISTRIBUTION TEST REPORT
CORPS OF ENGINEERS - NEW ENGLAND

Fig. No. 4

Appendix D: Pertinent Correspondence

United States Department of the Interior

FISH AND WILDLIFE SERVICE
400 RALPH PILL MARKETPLACE
22 BRIDGE STREET
CONCORD, NEW HAMPSHIRE 03301-4901

Mr. Joseph L. Ignazio, Chief
Planning Division
U.S. Army Corps of Engineers
424 Trapelo Road
Waltham, Massachusetts 02254

April 14, 1989

ATTN: Impact Analysis Branch

Dear Mr. Ignazio:

This responds to your request, dated April 4, 1989, for information on the presence of Federally listed and proposed endangered or threatened species in accordance with a proposed Section 208 snagging and clearing project in Salisbury Brook and the Salisbury Plain River in Brockton, Massachusetts.

No Federally listed or proposed threatened and endangered species under our jurisdiction are known to occur in the project area, with the exception of occasional transient individuals. However, you may wish to contact the Massachusetts Natural Heritage Program, 100 Cambridge Street, Boston, Massachusetts, at 617-727-9194, for information on state listed species. No Biological Assessment or further consultation is required with us under Section 7 of the Endangered Species Act. Should project plans change, or additional information on listed or proposed species becomes available, this determination may be reconsidered.

This response relates only to endangered species under our jurisdiction. It does not address other legislation or our responsibilities under the Fish and Wildlife Coordination Act. Those issues will be addressed at a later date.

A list of Federally designated endangered and threatened species in Massachusetts is inclosed for your information. Thank you for your cooperation and please contact Susi von Oettingen of this office at 603-225-1411 if we can be of further assistance.

Sincerely yours,

Gordon E. Beckett

Gordon E. Beckett
Supervisor
New England Area

Inclosure

FEDERALLY LISTED ENDANGERED AND THREATENED SPECIES IN MASSACHUSETTS

Common Name	Scientific Name	Status	Distribution
FISHES:			
Sturgeon, shortnose*	Acipenser brevirostrum	E	Connecticut River & Atlantic Coastal Waters
REPTILES:			
Turtle, green*	Chelonia mydas	T	Oceanic straggler in Southern New England
Turtle, hawksbill*	Eretmochelys imbricata	E	Oceanic straggler in Southern New England
Turtle, leatherback*	Dermochelys coriacea	E	Oceanic summer resident
Turtle, loggerhead*	Caretta caretta	T	Oceanic summer resident
Turtle, Atlantic ridley*	Lepidochelys kempii	E	Oceanic summer resident
Turtle, Plymouth red-bellied	Chrysemys rubriventris bangsi	E	Plymouth & Dukes Counties
BIRDS:			
Eagle, bald	Haliaeetus leucocephalus	E	Entire state
Falcon, American peregrine	Falco peregrinus anatum	E	Entire state-reestablishment to former breeding range in progress
Falcon, Arctic peregrine	Falco peregrinus tundrius	E	Entire state migratory-no nesting
Plover, Piping	Charadrius melodus	T	Atlantic coast
Roseate Tern	Sterna dougallii dougallii	E	Atlantic Coast
MAMMALS:			
Cougar, eastern	Felis concolor couguar	E	Entire state-may be extinct
Whale, blue*	Balaenoptera musculus	E	Oceanic
Whale, finback*	Balaenoptera physalus	E	Oceanic
Whale, humpback*	Megaptera novaeangliae	E	Oceanic
Whale, right*	Eubalaena spp. (all species)	E	Oceanic
Whale, sei*	Balaenoptera borealis	E	Oceanic
Whale, sperm*	Physeter catodon	E	Oceanic
MOLLUSKS: NONE			
PLANTS:			
Small Whorled Pogonia	Isotria medeoloides	E	Hampshire, Essex Hampden, Worcester Middlesex Counties
Gerardia, Sandplain	Agalinus acuta	E	Barnstable County

* Except for sea turtle nesting habitat, principal responsiblity for these species is vested with the National Marine Fisheries Service

Rev. 1/20/89

Massachusetts
Natural Heritage
Program

18 April 1989

Joseph L. Ignazio
Corps of Engineers
Planning Division
Impact Analysis Branch
424 Trapelo Road
Waltham, MA 02254-9149

Re: Salisbury Brook and
Salisbury Plain River
Brockton

Dear Mr. Ignazio:

Thank you for contacting the Natural Heritage and Endangered Species Program regarding rare species and ecologically significant natural communities in the vicinity of Salisbury Brook and the Salisbury Plain River in Brockton, as described in your 4 April 1989 inquiry.

At this time, we are not aware of any rare plants or animals or natural communities in the area of the proposed site.

If your project plans change, or if additional fieldwork and research results in an update of our data base, this evaluation may require reconsideration.

Thank you, again, for consulting with us on this project. We greatly appreciate the opportunity to provide our input on projects being reviewed by the Corps.

Sincerely,

Jay Copeland
Environmental Reviewer

JC/jc

cc: town file, chrono file

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM, MASSACHUSETTS 02254

REPLY TO
ATTENTION OF

July 10, 1989

Planning Division
Impact Analysis Branch

RECEIVED
JUL 12 1989
MASS. HIST. COMM.

Valerie Talmage
Executive Director
Massachusetts Historic Commission
80 Boylston Street
Boston, Massachusetts 02116

Subject: Salisbury Brook, Brockton, MA, Reconnaissance Study

Dear Ms. Talmage:

The Army Corps of Engineers is preparing an environmental assessment for a proposed project along the Salisbury Brook and the Salisbury Plain River in Brockton, Massachusetts (Figure 1). The proposed project will involve removal of sediment material from certain areas of Salisbury Brook and the Salisbury Plain River (Figure 2), and the removal of a number of trees to reduce flood stages and consequent flood damages along these waterways.

This area of the city of Brockton is heavily developed. Many sections of the brook have been channelized and straightened in the past (Photographs enclosed). Portions of the Salisbury Brook and the Salisbury Plain River may have archaeological potential. However, due to the extent of urban development, and channel modifications the potential for intact prehistoric or industrial archaeological sites is very low.

This proposed snagging and clearing project will not effect any portions of the streambank. Rather, the removal of material and trees will be take place only in the stream itself. Therefore, we feel that the proposed project of sediment and tree removal should have no effect upon any structure or site of historic, architectural or archaeological significance as defined by the National Historic Preservation Act of 1966, as amended. We would appreciate your concurrence.

If you have any questions, feel free to contact Ms. Kate Atwood of my staff, at (617)-647-8796.

Sincerely,

Joseph L. Ignazio
Chief, Planning Division

Enclosure

CONCURRENCE: Bruce Simon DSHPO
July 28, 1989 for VALERIE A. SALMADI
EXECUTIVE DIRECTOR
MASSACHUSETTS
HISTORICAL COMMISSION

Commonwealth of Massachusetts

Division of Fisheries & Wildlife

Richard Cronin, *Director*

August 14, 1989

Michael Penko
Corps of Engineers
Div. 424
Trapello Road
Waltham, MA 02154

Dear Mr. Penko:

Thank you for asking the Southeast District of the Mass. Division of Fisheries and Wildlife to review the Salisbury River Project with you on August 8, 1989.

This office suggests (1), that as much of the tree and brush canopy be left along the banks as possible and (2), that many holes from 3 to 5 feet deeper than the main stream be dug to enhance the fisheries habitat in the work area.

Your truly,

Louis S. Hambly
District Manager

LSH/kt

Southeast Wildlife District
195 Bournedale Road, Buzzards Bay, Massachusetts 02532 (617) 759-3406
An Agency of the Department of Fisheries, Wildlife & Environmental Law Enforcement

The Commonwealth of Massachusetts
Executive Office of Environmental Affairs
Department of Environmental Quality Engineering
Division of Water Pollution Control
Technical Services Branch
Westview Building, Lyman School
Westborough, MA 01581

DANIEL S. GREENBAUM
Commissioner

24 August 1989

DEQE
NOW IS
THE DEPARTMENT OF
ENVIRONMENTAL PROTECTION

Mike Penko
Impact Analysis Branch
U.S. Army Corps of Engineers
424 Trapelo Road
Waltham, MA 02173

Dear Mike:

Enclosed is a copy of a memo providing a synopsis of the recent water quality survey we conducted on Salisbury Brook, Trout Brook, Salisbury Plain River and Matfield River. The chemical and biological data will be forthcoming. I have also enclosed a copy of Greg DeCesare's notes on the results of the sampling he conducted as part of this program.

As I mentioned in our telephone conversation, we would like to be included in the environmental review of your proposed dredging work on Salisbury Brook and the Salisbury Plain River. One of our concerns, of course, is the removal of habitat in the affected areas. I will probably be away on vacation during the review dates, but I would appreciate it if you would send a notice to Arthur S. Johnson, Biology Program Manager, at this office.

Sincerely,

Robert M. Nuzzo

Robert M. Nuzzo
Aquatic Ecologist

cc: A.N. Cooperman
A.S. Johnson

NEW ENGLAND DIVISION
U.S. ARMY CORPS OF ENGINEERS, WALTHAM, MA
SECTION 404(b)(1) EVALUATION

PROJECT: Brockton Section 208 Snagging and Clearing Project

PROJECT MANAGER: Dave Larsen EXT. 617-647-7113

FORM COMPLETED BY: Michael Penko EXT. 617-647-8139

PROJECT DESCRIPTION:

The proposed project involves the removal of sediments, debris, and selected trees and shrubs from a 2,360 foot section of the Salisbury Plain River. The work area would extend from the Plain St. Bridge to about 100 feet upstream of the Perkins Ave. Bridge. The proposed project would improve flow capacity by deepening stream channels and reducing channel "roughness".

Plans call for excavating approximately 4,500 cubic yards of material from the project area. If dredged material meets Massachusetts Type "I" or "II" sludge standards for upland disposal of dredged sediments (see 310 CMR 32.00) it would be disposed of at the Thatcher Street landfill in Brockton. If the material is unsuitable for disposal at the Thatcher Street site, an alternate site approved by the Massachusetts Department of Environmental Protection (D.E.P.) would be selected.

Material would be removed from the river using small bulldozers, a bucket loader, and a dump truck. Dredged material would be dewatered at the disposal site. Some hand excavation of material from underneath bridges would also probably be required. The depth of excavated material would range from approximately 0 to 2.5 feet. To avoid undermining walls or embankments no excavations would occur near channel margins. A number of deeper pools would be dredged in the river to enhance fisheries habitat.

Selected trees and shrubs growing in the river at the base of the channel would be removed. All trees to be removed would be flagged prior to the work to avoid any unnecessary cutting. Overhanging branches of trees and shrubs growing along the top of the embankment would also be removed on a selective basis. Some clearing of vegetation might also be required at access points.

Ancillary work to improve channel capacity would include the relocation of utility pipes situated underneath the Forest Street and Perkins Avenue Bridges.

Dredging would be conducted during the low flow season (July through August) to minimize water quality impacts and facilitate the work. A double row of siltation barriers consisting of silt cloth and hay bales would typically be employed to minimize downstream water quality impacts.

Clearing the river of debris, sediments, and encroaching vegetation has an expected effective project life of not more than 20 years.

NEW ENGLAND DIVISION
U.S. ARMY CORPS OF ENGINEERS, WALTHAM, MA

PROJECT: Brockton Section 208 Snagging and Clearing Project

Evaluation of Section 404(b)(1) Guidelines

1. Review of Compliance (Section 230.10(a)-(d)).

a. The discharge represents the least environmentally damaging practicable alternative and if in a special aquatic site, the activity associated with the discharge must have direct access or proximity to, or be located in the aquatic ecosystem to fulfill its basic purpose;

[X] YES [ ] NO

b. The activity does not appear to: 1) violate applicable state water quality standards or effluent standards prohibited under Section 307 of the CWA; 2) jeopardize the existence of Federally listed threatened and endangered species or their critical habitat; and 3) violate requirements of any Federally designated marine sanctuary check responses from resource and water quality certifying agencies);

[X] YES [ ] NO

c. The activity will not cause or contribute to significant degradation of waters of the U.S. including adverse effects on human health, life stages of organisms dependent on the aquatic ecosystem, ecosystem diversity, productivity and stability, and recreational, aesthetic, and economic values;

[X] YES [ ] NO

d. Appropriate and practicable steps have been taken to minimize potential adverse impacts of the discharge on the aquatic ecosystem

[X] YES [ ] NO

2. <u>Technical Evaluation Factors (Subparts C-F).</u>

	N/A	Not Signif-icant	Signif-icant
a. Potential Impacts on Physical and Chemical Characteristics of the Aquatic Ecosystem (Subpart C).			
1) Substrate.		X	
2) Suspended particulates/turbidity.		X	
3) Water.		X	
4) Current patterns and water circulation.		X	
5) Normal water fluctuations.	X		
6) Salinity gradients.	X		
b. Potential Impacts on Biological Characteristics of the Aquatic Ecosystem (Subpart D).			
1) Threatened and endangered species.	X		
2) Fish, crustaceans, mollusks and other aquatic organisms in the food web.		X	
3) Other wildlife.		X	
c. Potential Impacts on Special Aquatic Sites (Subpart E).			
1) Sanctuaries and refuges.	X		
2) Wetlands.		X	
3) Mud flats.	X		
4) Vegetated shallows.	X		
5) Coral reefs.	X		
6) Riffle and pool complexes.		X	
d. Potential Effects on Human Use Characteristics (Subpart F).			
1) Municipal and private water supplies.	X		
2) Recreational and Commercial fisheries.		X	
3) Water-related recreation.		X	
4) Aesthetics.		X	
5) Parks, national and historic monuments, national seashores, wilderness areas, research sites, and similar preserves.	X		

3. Evaluation and Testing (Subpart G).

a. The following information has been considered in evaluating the biological availability of possible contaminants in dredged or fill material. (Check only those appropriate.)

1) Physical characteristics..... [X]
2) Hydrography in relation to known or anticipated sources of contaminants..... [X]
3) Results from previous testing of the material or similar material in the vicinity of the project..... [ ]
4) Known, significant sources of persistent pesticides from land runoff or percolation..... [ ]
5) Spill records for petroleum products or designated hazardous substances (Section 311 of CWA)..... [ ]
6) Public records of significant introduction of contaminants from industries, municipalities, or other sources..... [ ]
7) Known existence of substantial material deposits of substances which could be released in harmful quantities to the aquatic environment by man-induced discharge activities..... [ ]
8) Other sources (specify)..... [X]

List appropriate references.

see Enivornmental Assessment completed for this project.

b. An evaluation of the appropriate information in 3a above indicates that there is reason to believe the proposed dredge or fill material is not a carrier of contaminants, or that levels of contaminants are substantively similar at extraction and disposal sites and not likely to require constraints. The material meets the testing exclusion criteria. [X] YES [ ] NO

4. Disposal Site Delineation (Section 230.11(f)).

a. The following factors, as appropriate, have been considered in evaluating the disposal site.

1) Depth of water at disposal site..... [ ]
2) Current velocity, direction, and variability at disposal site..... [ ]
3) Degree of turbulence..... [ ]
4) Water column stratification..... [ ]
5) Discharge vessel speed and direction..... [ ]
6) Rate of discharge..... [ ]
7) Dredged material characteristics (constituents, amount, and type of material, settling velocities)..... [X]
8) Number of discharges per unit of time..... [ ]
9) Other factors affecting rates and patterns of mixing (specify)..... [ ]

List appropriate references.

Information concerning the disposal site and material to be removed from the river is presented in the EA.

b. An evaluation of the appropriate factors in 4a above indicates that the disposal site and/or size of mixing zone are acceptable..... [X] YES [ ] NO

5. Actions To Minimize Adverse Effects (Subpart H).

All appropriate and practicable steps have been taken, through application of recommendation of Section 230.70-230.77 to ensure minimal adverse effects of the proposed discharge..... [X] YES [ ] NO

List actions taken.

see the Environmental Assessment prepared for this project.

Further analysis of samples obtained from the Salisbury Plain River to project depth will be conducted during the "Plans and Specifications" study phase to insure that signifcant levels of contaminants are not present in river sediments.

6. Factual Determination (Section 230.11).

A review of appropriate information as identified in items 2 - 5 above indicates that there is minimal potential for short or long term environmental effects of the proposed discharge as related to:

a. Physical substrate (review sections 2a, 3, 4, and 5 above). YES [X] NO [ ]

b. Water circulation, fluctuation and salinity (review sections 2a, 3, 4, and 5). YES [X] NO [ ]

c. Suspended particulates/turbidity (review sections 2a, 3, 4, and 5). YES [X] NO [ ]

d. Contaminant availability (review sections 2a, 3, and 4). YES [X] NO [ ]

e. Aquatic ecosystem structure, function and organisms(review sections 2b and c, 3, and 5) YES [X] NO [ ]

f. Proposed disposal site (review sections 2, 4, and 5). YES [X] NO [ ]

g. Cumulative effects on the aquatic ecosystem. YES [X] NO [ ]

h. Secondary effects on the aquatic ecosystem. YES [X] NO [ ]

7. Findings of Compliance or non-compliance.

a. The proposed disposal site for discharge of dredged or fill material complies with the Section 404(b)(1) guidelines.....[X]

APPENDIX A: ECONOMIC ANALYSIS

Economic Appendix
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Salisbury Brook and Salisbury Plain River
Economic Appendix

Methodology

The purpose of this study is to determine the benefits to removing sediment and debris from portions of Salisbury Brook and Salisbury Plain River in Brockton, Massachusetts. The original flood damage survey for the Brockton study was performed in 1969 and was updated and refined in 1972, 1974, and 1988. This economic analysis is based on the flood damage survey as updated and refined in 1988, with dollar values for flood damages updated to the August, 1989 price level.

Economic Setting

The city of Brockton is 20 miles south of Boston and had a 1985 population of 97,429. The population of Brockton has been growing steadily since 1950, and is projected to continue growing, with a projected 1995 population of 120,978. Historically, Brockton was a manufacturing center dominated by the production of shoes and other leather products. Although manufacturing still is a major part of the Brockton economy, today the wholesale and retail trade sector and the service sector employ more workers in Brockton than manufacturing. In February, 1988, Brockton had a labor force of 49,335 and an unemployment rate of 5.2%. In general, Brockton has shared in the economic growth experienced by the entire greater Boston area in the 1980s, although manufacturing wages in Brockton tend to be slightly lower than the average Boston area manufacturing wage.

Flood Damage Zones

In this analysis, four areas on Salisbury Brook and Salisbury Plain River were identified as experiencing flooding damages which could be decreased by the removal of sediment and debris from the river. The four areas correspond with Area A, Area B, Area C and Area D as identified in the main report of this study. Area A is the damage area on the Salisbury Plain River from Plain Street to Perkins Avenue. Areas B, C and D lie on Salisbury Brook, Area B from Newbury Street to Carleton Street, Area C from Carleton Street to Ash Street, and Area D from Ash Street to Prospect Street. Area A is an industrial area, consisting of industries including machine manufacturing, shoe and apparel manufacturing, and manufacturing supplies. Areas B, C and D are primarily residential neighborhoods, consisting of single family and two to six family residences.

Recurring Losses

Recurring losses are those potential flood related losses which are expected to occur at specific stages of flooding under current development conditions without the project. Recurring losses for various flood events for each area examined in this study are shown below in Table E1.

Table E1
Recurring Losses
(August, 1989 price level)

Area	10 yr	25 yr	50 yr	100 yr
A	$139,300	$770,600	$1,435,200	$1,669,300
B	$ 0	900	6,600	23,600
C	$ 16,300	$ 48,500	$ 93,900	$ 134,900
D	$ 7,500	$ 28,300	$ 54,900	$ 110,700
Total	$163,100	$848,300	$1,590,600	$1,938,500

Annual Losses - Natural

Estimated natural annual flood losses were calculated by combining recurring losses (stage/damage data) with hydrologic stage frequency data for the existing conditions. The losses reflect existing conditions, or the without project condition. The natural annual losses for each area examined in this study are shown below in Table E2.

Table E2
Annual Losses - Natural
(August, 1989 price level)

Area	Annual Losses - Natural (without project)
A	$90,500
B	$ 1,000
C	$ 7,800
D	$ 4,300
Total	$103,600

Annual Losses - Modified

The modified annual flood losses were calculated based on the modified hydrologic conditions which would exist with the the proposed removal of sediment and debris from the river. The modified losses reflect the reduced flood stages which would occur in each area examined in this study, the with project condition, and are shown below in Table E3.

Table E3
Annual Losses - Modified
(August, 1989 price level)

Area	Annual Losses - Modified (with project)
A	$52,700
B	$ 800
C	$ 3,600
D	$ 2,500
Total	$59,600

Annual Benefits

The annual benefits for removing sediment and debris from each area examined equal the difference between the natural annual losses (without project condition) and the modified annual losses (with project condition) for each area. The calculation of the annual benefits attributable to performing the proposed work in each area are shown below in Table E4.

Table E4
Annual Benefits

Area	Natural Annual Losses	Modified Annual Losses	ANNUAL BENEFITS
A	$90,500	$52,700	$37,800
B	$ 1,000	$ 800	$ 200
C	$ 7,800	$ 3,600	$ 4,200
D	$ 4,300	$ 2,500	$ 1,800
Total	$103,600	$59,600	$44,000

Alternative Plans Examined

Four alternative plans for removing sediment and debris were examined. Plan 1 consists of work in Area A. Plan 2 consists of work in Areas B and C. Plan 3 consists of work in Area C only. Plan 4 consists of work in Area D. Annual benefits for each plan equal the annual benefits calculated in Table E4, above, for the respective area or areas. Annual benefits for Plan 1 equal $37,800, annual benefits for Plan 2 equal $4,400, annual benefits for Plan 3 equal $4,200, and annual benefits for Plan 4 equal $1,800.

Construction Costs

Annual contruction costs for each alternative plan examined are calculated from the total first construction costs and the expected annual operation and maintenance costs. Total first costs are annualized based on a federal interest rate of 8 7/8% and a project life of 20 years. Total first costs, annualized first costs, operation and maintenance costs, and total annual costs for each alternative plan are shown below in Table E5. Detail on construction costs is contained in the engineering appendix.

Table E5
Construction Costs

Plan	Total First Cost	Amortized First Cost	Annual O&M Costs	Total Annual Costs
1	$231,400	$25,200	$3,000	$28,200
2	$141,900	$15,400	$2,000	$17,400
3	$130,200	$14,100	$1,500	$15,600
4	$ 94,700	$10,300	$1,000	$11,300

Economic Summary

In order for a plan to be considered economically justified, the benefit-cost ratio must be equal to 1 or greater. The benefit cost ratio equals the total annual benefits divided by the total annual costs. The total annual benefits, total annual costs, benefit-cost ratio, and net annual benefits for each alternative plan are shown below in Table E6, the Economic Summary.

Table E6
Economic Summary

Plan	Total Annual Benefits	Total Annual Costs	Benefit-Cost Ratio	Net Annual Benefits
1 (Area A)	$37,800	$28,200	1.3	$ 9,600
2 (Areas B & C)	$ 4,400	$17,400	0.3	negative
3 (Area C)	$ 4,200	$15,600	0.3	negative
4 (Area D)	$ 1,800	$11,300	0.2	negative

APPENDIX B : HYDROLOGY

HYDROLOGIC INFORMATION

Method of Analysis

Following field reconnaissance, preliminary damage surveys and a review of past flood control investigations, potential snagging and clearing operations were considered in the following locations: Salisbury Brook from Carleton Street to Prospect Street, and along the Salisbury Plain River downstream of Plain Street to Perkins Avenue. Study areas 1 and 2 are shown on attachment 1.

Peak discharge-frequencies were previously developed by this office for Salisbury Brook and Salisbury Plain River while screening potential flood control improvements during FY88. The discharge-frequencies were developed, based on analysis of streamflow data at two nearby USGS gages and are shown on attachment 2. For more information on watershed description and discharge-frequency development, refer to Engineering Division memo data 16 September 1988, subject: Salisbury Brook/Salisbury Plain River, Brockton, Massachusetts. This memo also presented stage-frequency information along Salisbury Brook and Salisbury Plain River. Estimated flood stage reductions attributable to a channel improvement plan proposed by Fenton Keyes Associates in the 1970's was also shown in the memo.

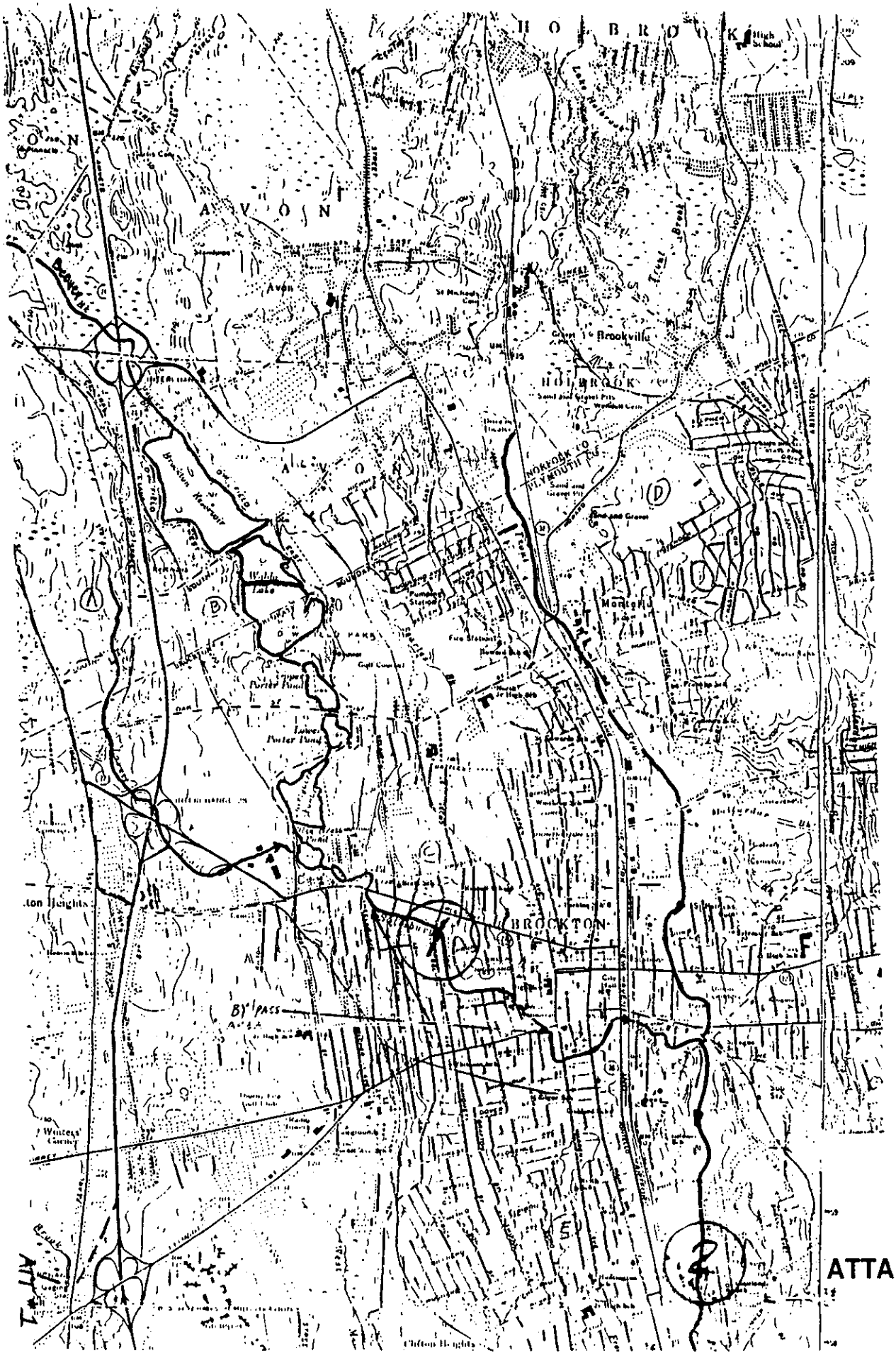
During this Section 208 investigation, additional hydraulic analysis was made. Channel cross sections were developed based on measuring bridge openings and channel bottom widths. This process was aided by topographic mapping and survey information on various structures obtained from the Fenton Keyes studies. These cross sections and bridge geometry information were then input into the HEC-2 "Water Surface Profiles" computer program for Salisbury Brook from Carleton Street to Prospect Street, a total stream distance of about 5,000 feet. In addition, a HEC-2 computer model was also developed from Plain Street to Perkins Avenue along the Salisbury Plain River, a distance of about 2,000 feet.

Existing Conditions The 2, 10, 50, and 100 year discharges were input to the HEC-2 model and a series of flood profiles were computed. Along Salisbury Brook's existing condition, Manning's "n" coefficients of 0.055 for the channel and 0.080 for overbank areas were assumed. Computed profiles were in general agreement with profiles presented in the FEMA Brockton Flood Insurance Study, dated September 1978. Computed flood elevations were used to develop discharge rating curves at pertinent locations along Salisbury Brook. These curves were used along with adopted discharge-frequencies to develop stage-frequency curves at Spring Street (attachment 3), Belmont Avenue (attachment 4), Ash Street (attachment 5), and Prospect Street (attachment 6). The 2, 10, 50, and 100 year peak discharge were also input to the developed HEC-2 model for Salisbury Plain River and a series of flood profiles were computed. Manning's "n" coefficients were 0.055 for the channel and 0.080 for overbank areas. The computed profiles were also in close agreement with profiles presented in the Brockton Flood Insurance Study. These profiles were used to develop a discharge rating curve which was used with adopted discharge-frequencies to develop the stage frequency curve at Perkins Avenue, shown on attachment 7.

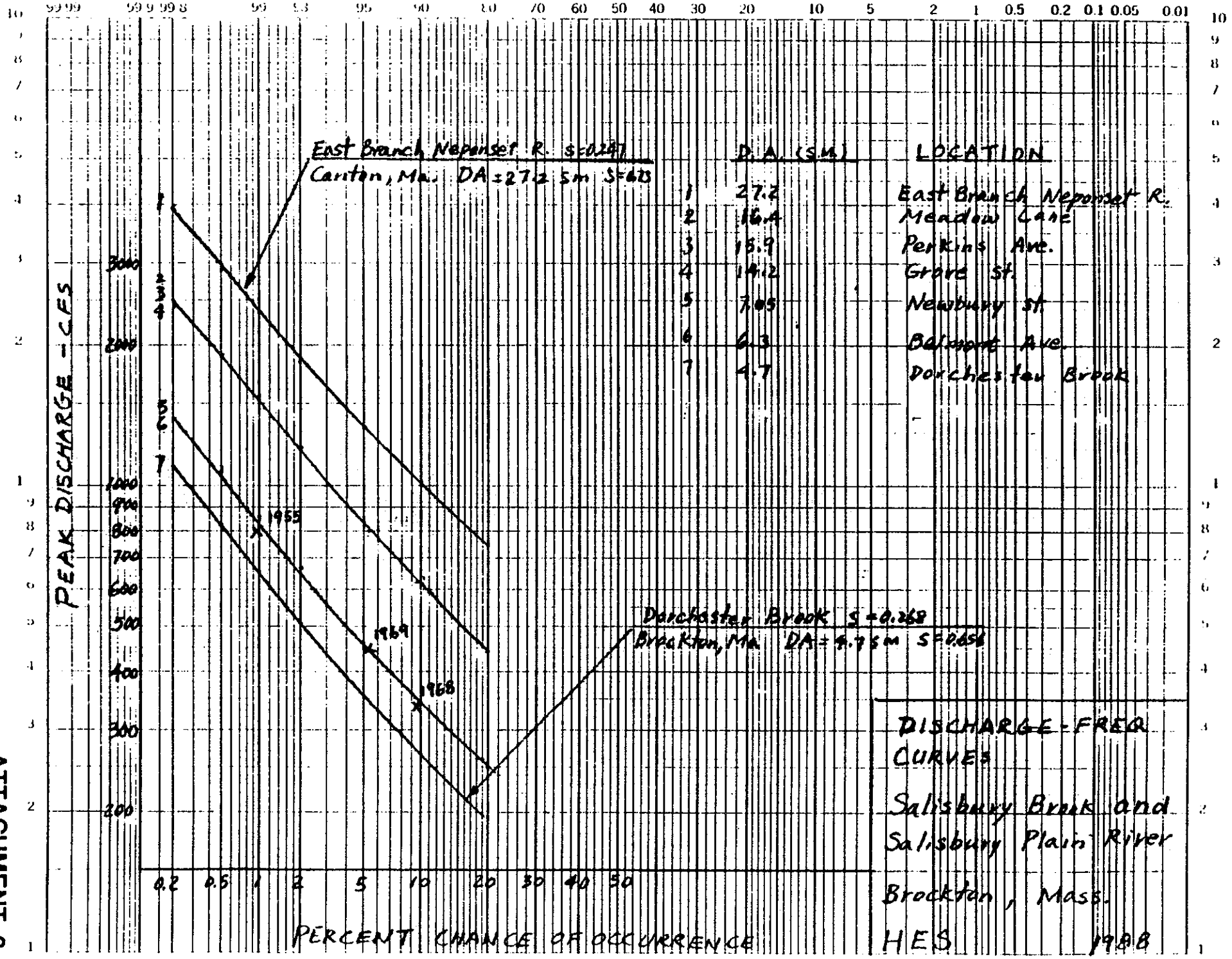
Improved Conditions

a. Salisbury Brook. Improvements assumed along Salisbury Brook were to lower the concrete inlet to the Keith Field culvert, and channel excavation and debris clearing between the Keith Field culvert and Newbury Street, and from Carleton Street to upstream of Prospect Street. Existing and proposed channel inverts are shown on the attached profile (attachments 8, 9, and 10). Existing cross sections were modified to reflect the lowered channel and the HEC-2 program was reexecuted with starting water surface elevations based on improved flow conditions into the Keith Field culvert. Manning's "n" coefficient of 0.035 for the channel was assumed for the improved conditions. Discharge-rating curves were developed and used to develop the modified stage-frequency curves shown on attachments 3 thru 6. One final improvement was assumed along Salisbury Brook. Removal of the concrete pad upstream of Moraine Street was investigated. This obstruction was deleted from the HEC-2 computer model improved condition and the program was reexecuted. This improvement resulted in stage reductions for the 100 year flood of about 2.0 feet between the concrete pad and Pleasant Street, a distance of 1,000 feet; however, it had little impact upstream of Pleasant Street. It has been reported that historically little flood damage has been reported between the concrete pad and Pleasant Street.

b. Salisbury Plain River. Improvements assumed along Salisbury Plain River were to excavate the channel of debris and sediment from downstream of Plain Street to upstream of Perkins Avenue as shown on the attached profile (attachment 11). Also it was assumed that the steel girder bridge located about 300 feet downstream of the Forest Street bridge would be removed. The cross sections input to the HEC-2 model were modified to reflect the assumed improved channel condition and the program was reexecuted assuming a Manning's "n" coefficient of 0.035 for the channel. The improvements resulted in the stage reductions shown on the modified stage-frequency curve on attachment 7.



ATTACHMENT 1



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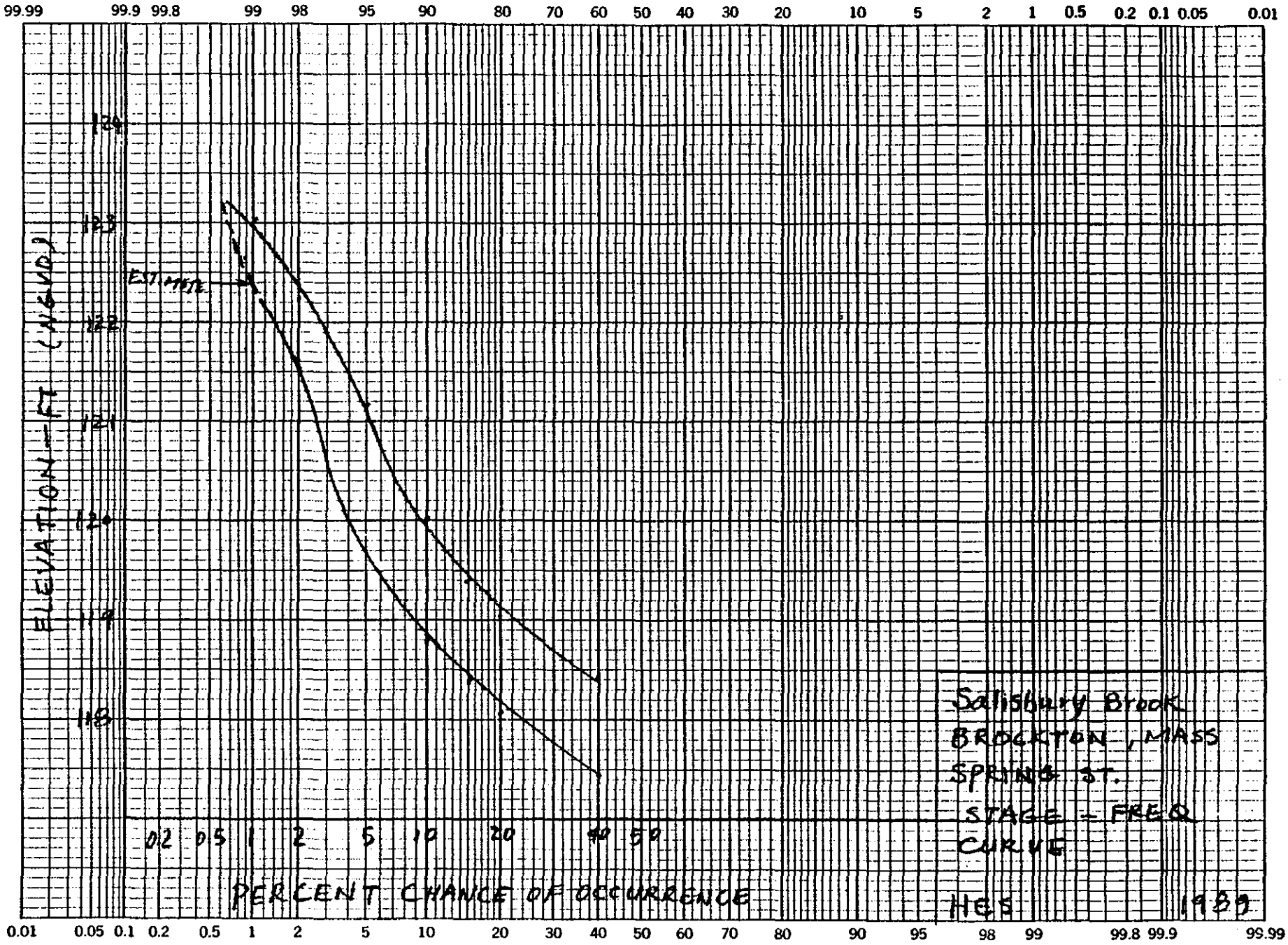

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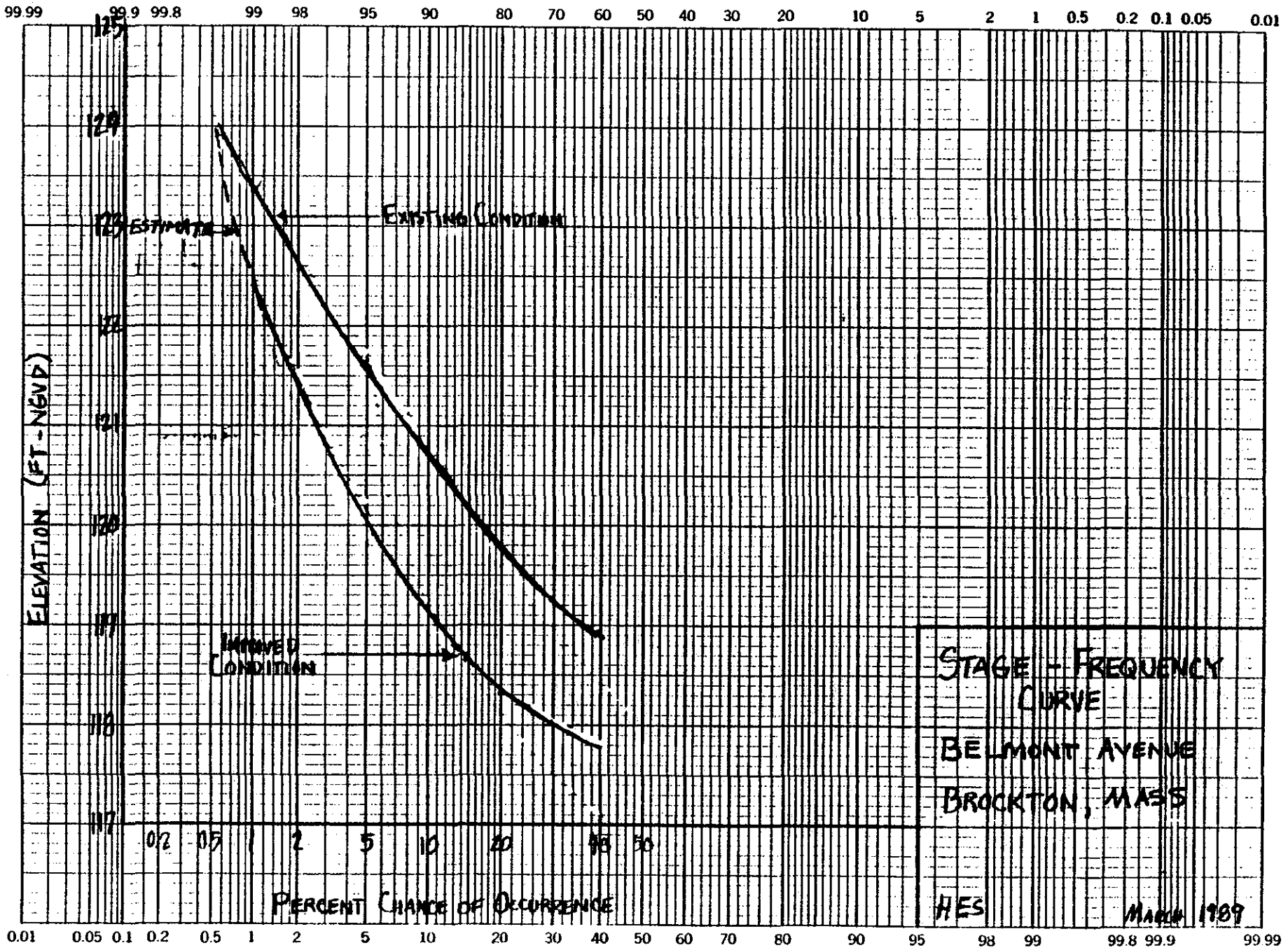

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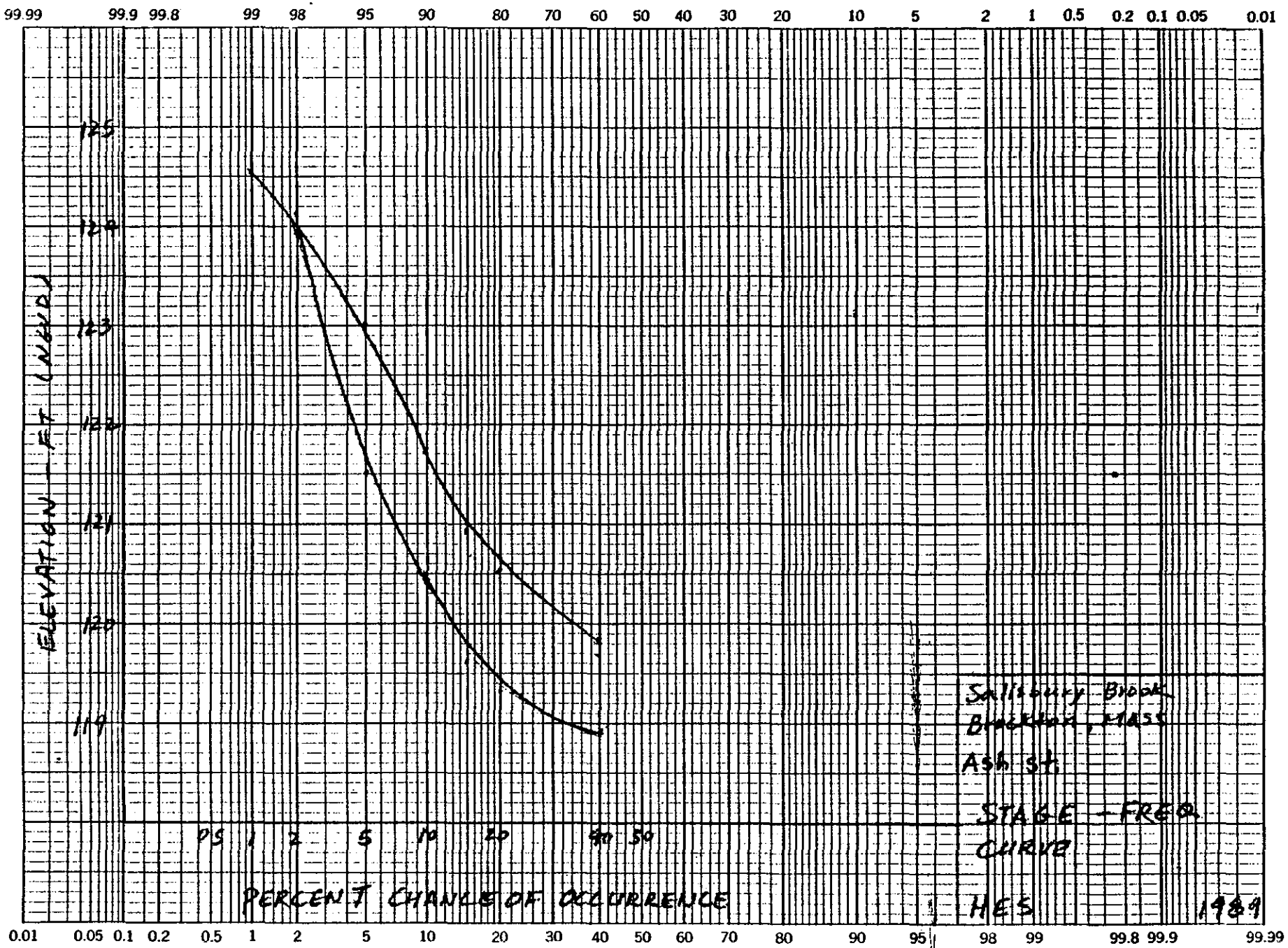

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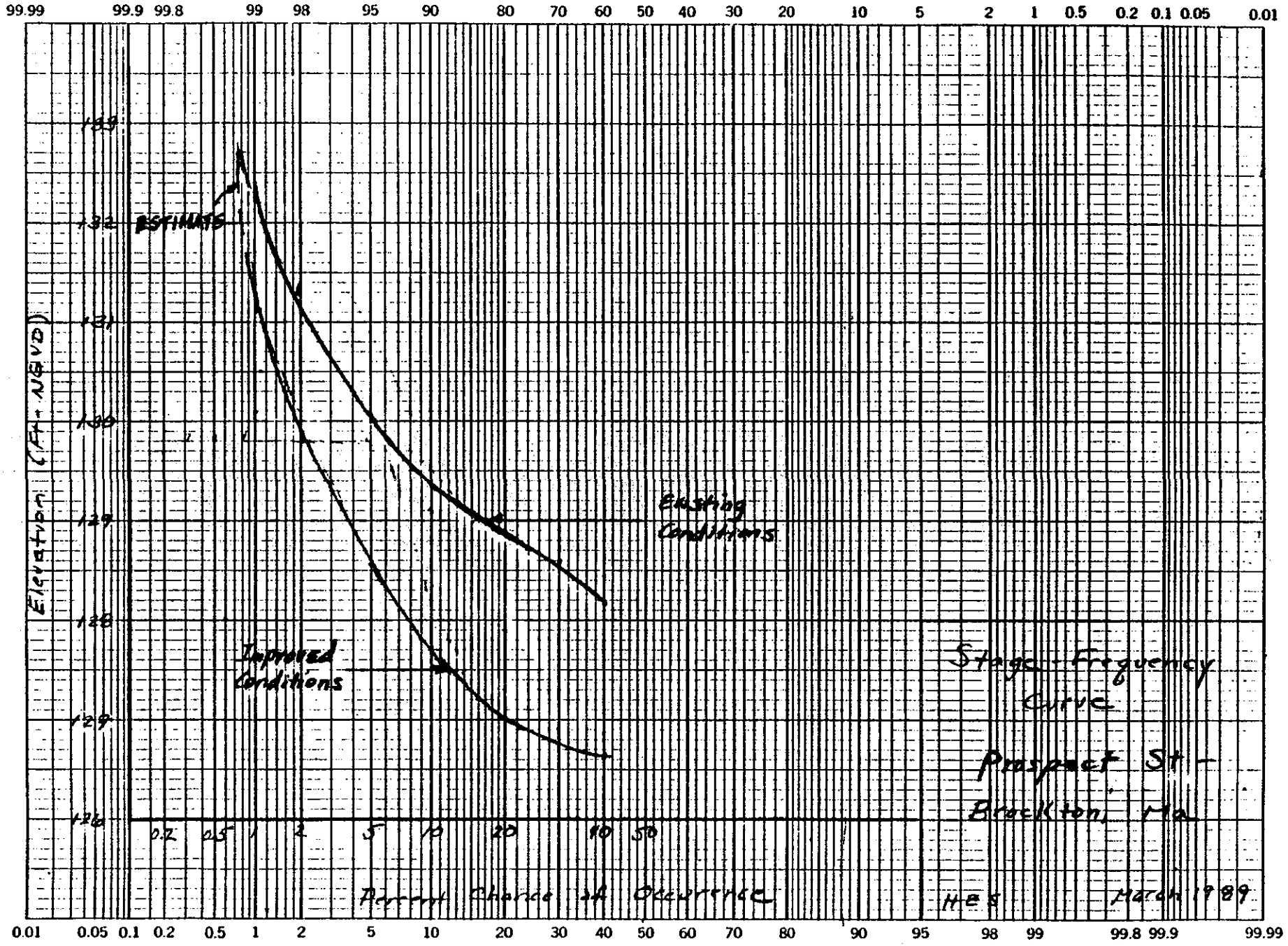

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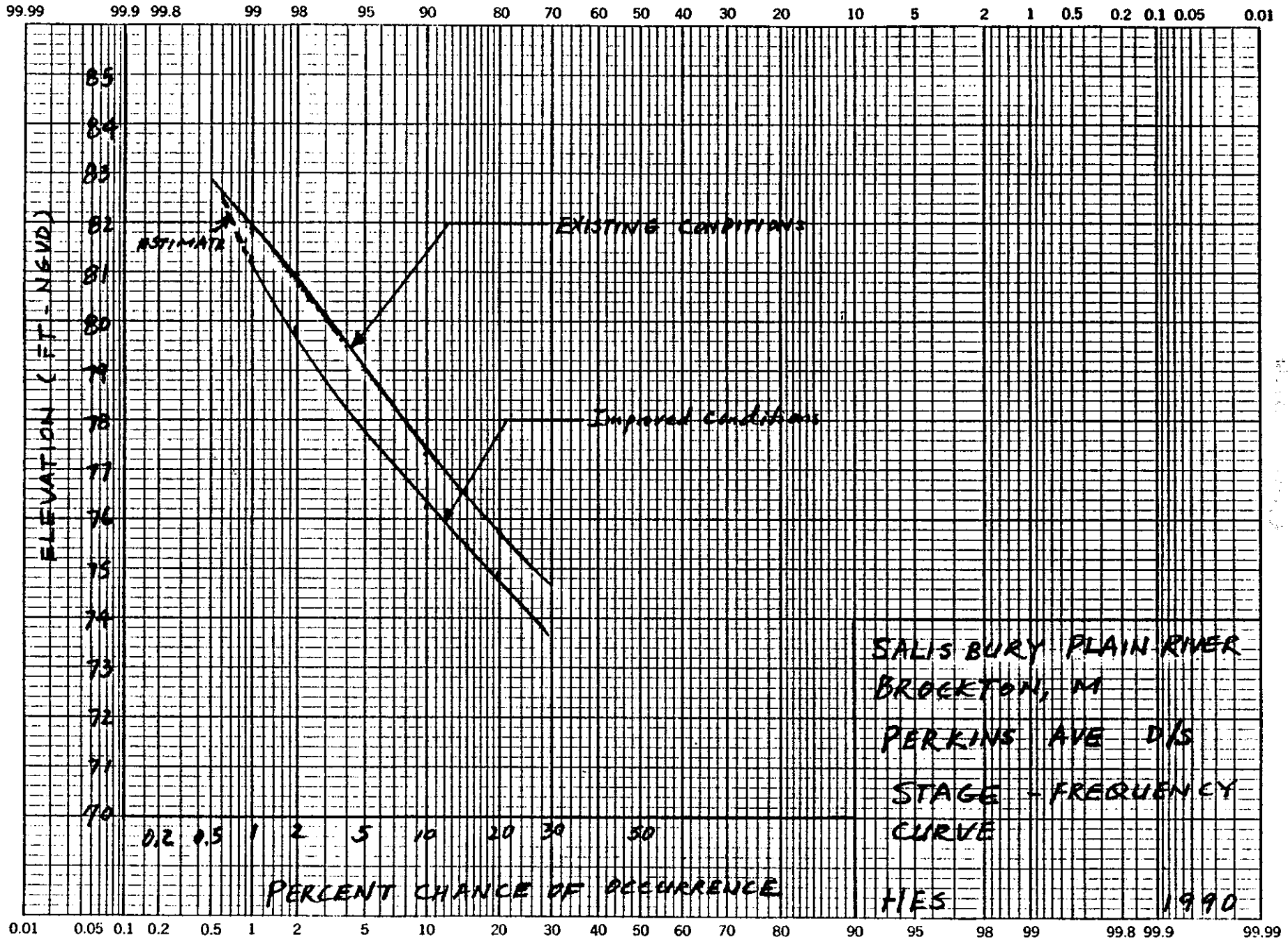

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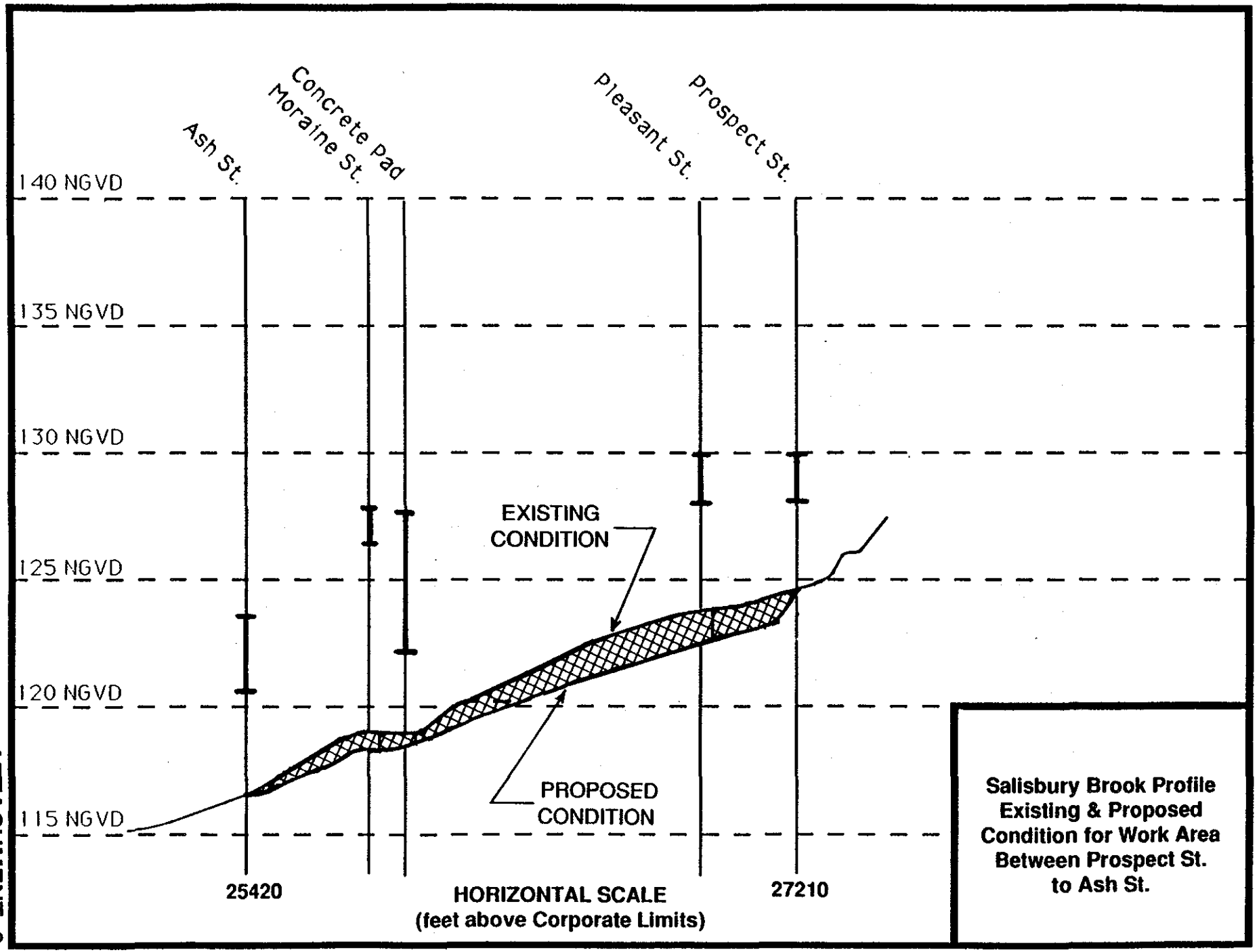
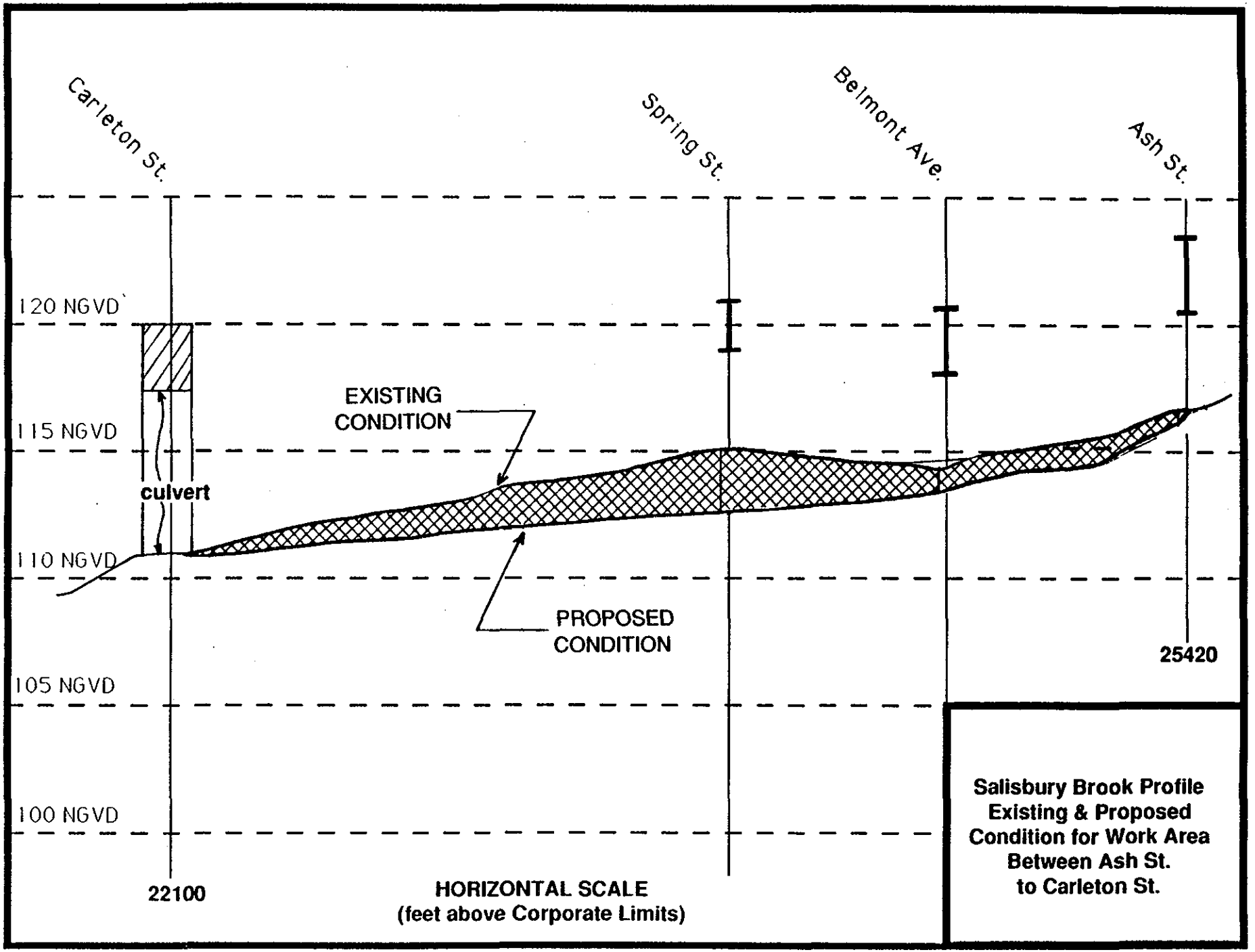


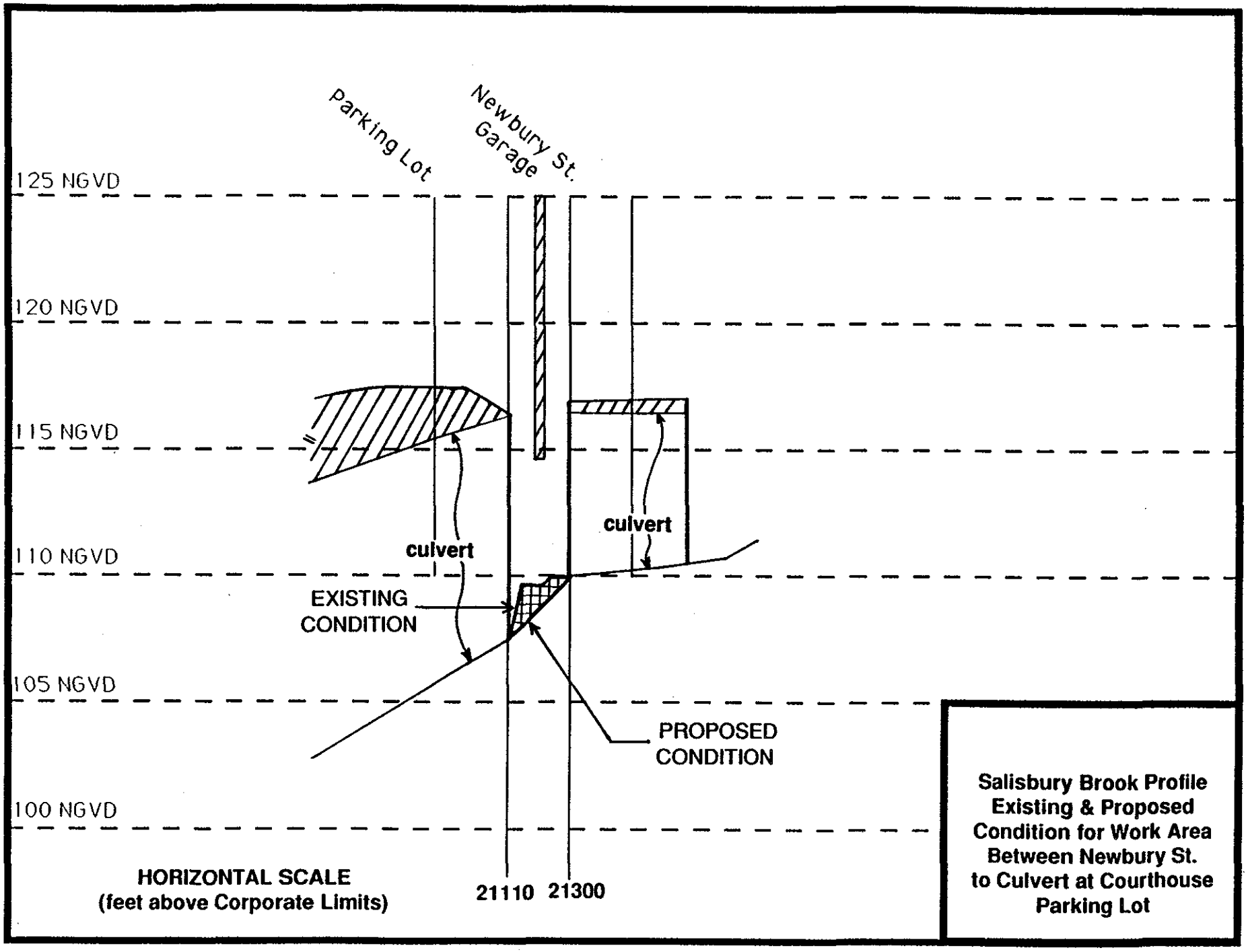
Salisbury Brook Profile Existing & Proposed Condition for Work Area Between Prospect St. to Ash St.

ATTACHMENT 8



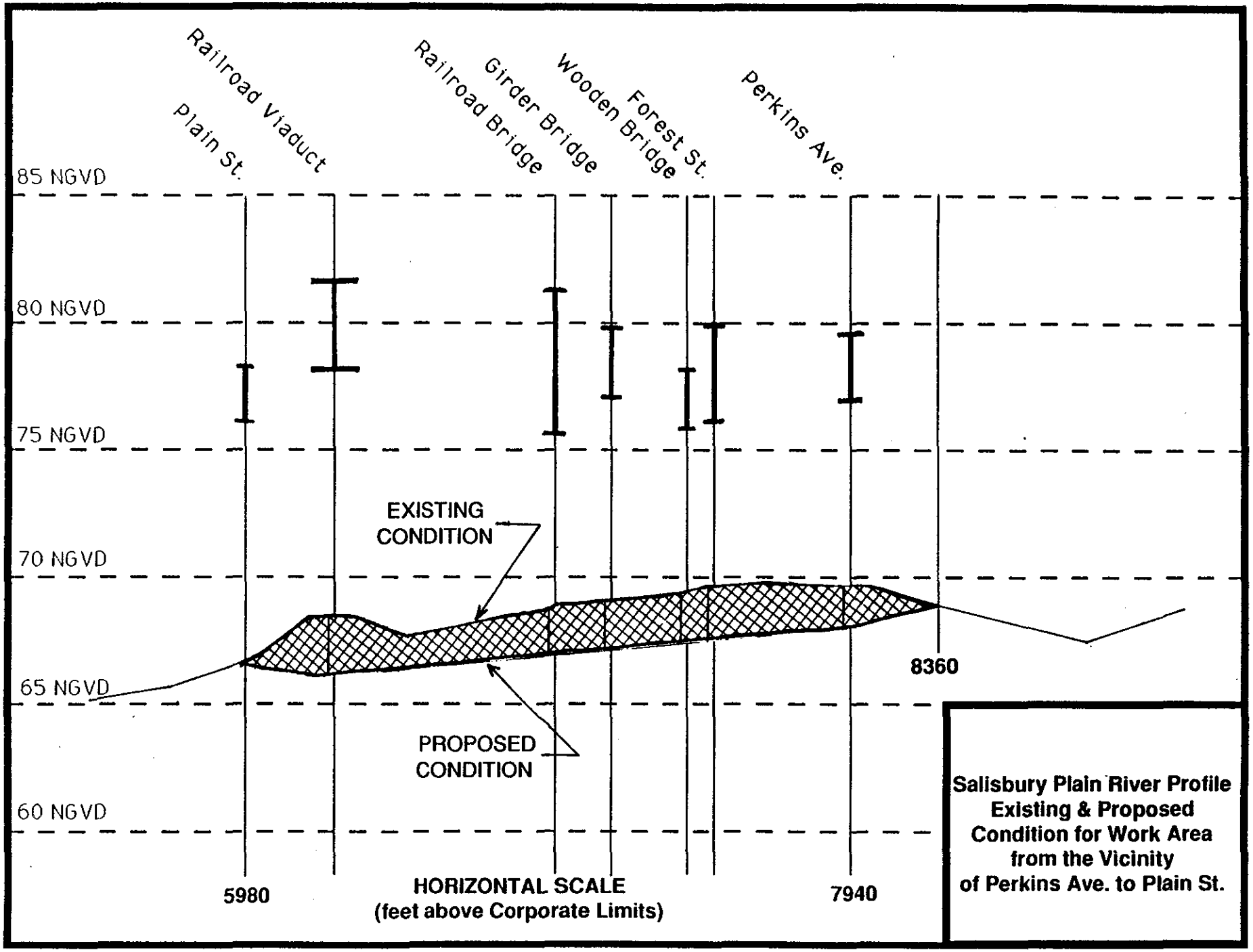
Salisbury Brook Profile Existing & Proposed Condition for Work Area Between Ash St. to Carleton St.

ATTACHMENT 9



Salisbury Brook Profile Existing & Proposed Condition for Work Area Between Newbury St. to Culvert at Courthouse Parking Lot

ATTACHMENT 10



Salisbury Plain River Profile Existing & Proposed Condition for Work Area from the Vicinity of Perkins Ave. to Plain St.

ATTACHMENT 11

APPENDIX C: PUBLIC CORRESPONDENCE RECORD

City of Brockton Massachusetts
Office of the Mayor
Carl D. Pitaro, MAYOR, CITY HALL, BROCKTON, MA 02401 617/580-1100

November 22, 1988

Colonel Daniel M. Wilson
Division Engineer
U.S. Army Engineers
New England Division
424 Trapelo Road
Waltham, MA 02254-9149

Dear Colonel Wilson:

The City of Brockton requests assistance of the Army Corps of Engineers for the clean up of the Salisbury Plain River and Salisbury Brook within the limits of Brockton, MA.

Significant reduction to the capacities of these waterways exists due to trees and shrubs that have blocked the channel as well as silt deposits in many areas and refuse that has accumulated in virtually every reach. These restrictions contribute to frequent flooding of several residential and industrial areas adjacent to the waterways.

Is there any program that would address this request and provide some relief from these problems? Please direct your response to Ms. Nancy Stack Savoie, City Planner, City of Brockton, 45 School Street, Brockton, MA 02401

Very truly yours,

Carl D. Pitaro

CARL D. PITARO, MAYOR

CDP/ds

City of Brockton Massachusetts
Office of the Mayor
Carl D. Pitaro, MAYOR, CITY HALL, BROCKTON, MA 02401 508/580-7123

May 10, 1990

Colonel Daniel M. Wilson
U.S. Army Corps of Engineers
New England Division
424 Trapelo Road
Waltham, MA 02254-9149

RE: Salisbury Plain River Sec. 208
Snagging and Clearing

Dear Colonel Wilson;

As Chief Executive Officer for the City of Brockton, I am pleased to learn of the favorable report pertaining to the above referenced project in Brockton.

I would like to take this opportunity to inform you that the City of Brockton has requested the assistance of the Commonwealth of Massachusetts Division of Waterways with the funding of the non-federal share of the project cost.

Should you have any questions, please feel free to contact City Planner Nancy Stack Savoie at (508) 580-7113.

Thank you for your cooperation and assistance.

Sincerely,

Carl D. Pitaro
Mayor

CDP/NSS/ec

Commonwealth of Massachusetts
Executive Office of Environmental Affairs
Department of Environmental Management

DIVISION OF WATERWAYS
349 Lincoln Street
Bldg. #45
Hingham, MA 02043
(617) 740-1600

May 11, 1990

Colonel Daniel M. Wilson
Corps of Engineers
New England Division
424 Trapelo Road
Waltham, MA 02254-9149

Re: Federal Flood Protection Project
Salisbury Plain River
BROCKTON

Dear Colonel Wilson:

The Division has reviewed the Corps of Engineers Preliminary Analysis Report for flood protection along the Salisbury Plain River in Brockton, Massachusetts. We have also discussed the project with local interests and Corps representatives, and are prepared to enter into the local cooperation agreement for project construction. At this time we have not received a formal request to cost share the local contribution with the city, but have been assured by the city that such an application will be made within a few days.

Although we cannot presently predict a schedule for funding, we estimate that by the time of completion of project plans and specifications our program will be at a more normal level of activity and funds available. Should the city determine that they have sufficient funds to commence the project earlier, we are prepared to expedite the local cooperation agreement accordingly.

If you have any questions, please contact me at (617) 740-1602.

Very truly yours,

Eugene F. Cavanaugh
Director and Chief Engineer

LRL/mel

cc: Mayor Carl D. Pitaro
Senator Michael Creedon