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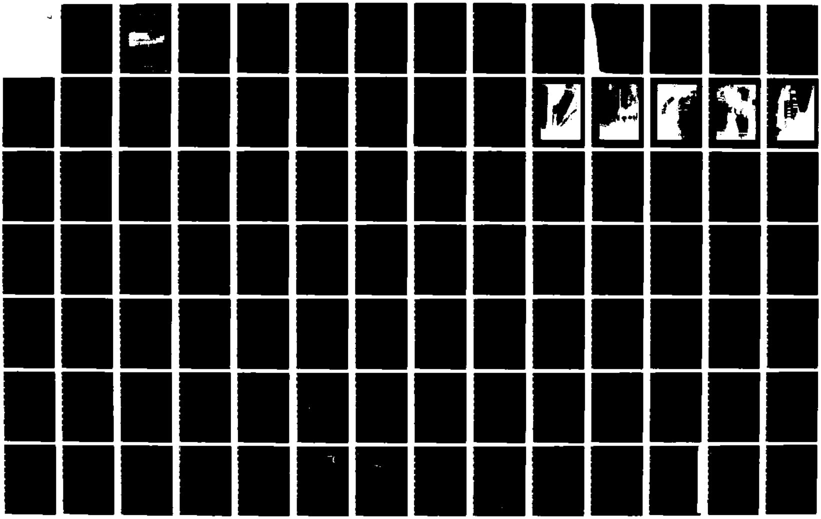

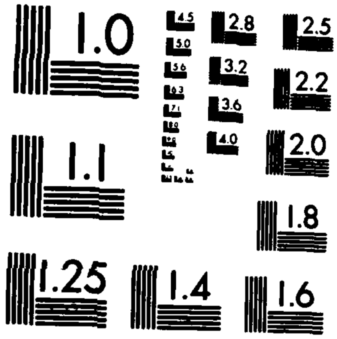
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AD-A143 397

PITTSFIELD LOCAL PROTECTION

WEST BRANCH AND SOUTHWEST BRANCH
HOUSATONIC RIVER

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DETAILED PROJECT REPORT

WATER RESOURCES DEVELOPMENT

PITTSFIELD, MASS.

OCTOBER 1980

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The report presents the results of an investigation into the feasibility of constructing flood control improvements along the West and Southwest Branches of the Housatonic River in Pittsfield Massachusetts. The report presents an array of alternative flood control plans and evaluates each plan for its economic feasibility and environmental acceptability. The report includes an Environmental Assessment and finding of no significant impact for a recommended plan of flood protection. The recommended plan calls for installing an auxiliary conduit under a railroad culvert on the Southwest branch and construction of a relief channel upstream from there to reduce flood flows upstream.

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PITTSFIELD LOCAL FLOOD PROTECTION

WEST BRANCH AND SOUTHWEST BRANCH
HOUSATONIC RIVER
PITTSFIELD, MASSACHUSETTS

DETAILED PROJECT REPORT

FOR

WATER RESOURCES DEVELOPMENT

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

OCTOBER 1980

LOCAL FLOOD PROTECTION PROJECT
WEST BRANCH AND SOUTHWEST BRANCH
HOUSATONIC RIVER
PITTSFIELD, MASSACHUSETTS
DETAILED PROJECT REPORT

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WEST BRANCH - HOUSATONIC RIVER

SOUTHWEST BRANCH - HOUSATONIC RIVER

PITTSFIELD, MASSACHUSETTS

DETAILED PROJECT REPORT

WATER RESOURCES DEVELOPMENT

INTRODUCTION

Recurring flood damages to property within the city of Pittsfield, Massachusetts has led to this examination of the alternatives available for implementing water resource improvements on the West and Southwest Branches of the Housatonic River. A reconnaissance study, completed in April 1978, determined that there was a Federal interest in assisting the city of Pittsfield with flood control under existing programs of the Corps of Engineers. It is the purpose of this study to provide sufficient information on the suggested alternatives to enable the final choice of a sound, economical flood control program for the city of Pittsfield.

Study Authority

Under authority contained in Section 205 of the 1948 Flood Control Act, as amended, detailed studies have been accomplished to determine the need and feasibility of providing local flood protection along the West and Southwest Branch tributaries of the Housatonic River in Pittsfield, Massachusetts. Federal assistance was requested by the Pittsfield Commissioner of Public Works, on behalf of the Mayor of Pittsfield. By 1st Indorsement, dated 3 May 1978, the Chief of Engineers authorized preparation of this Detailed Project Report.

Scope of the Study

Investigations have been made of water resources and related problems along the Housatonic River's tributaries in Pittsfield, Massachusetts. Commercial and residential areas of this city have periodically been subjected to flood damages resulting from major storms and insufficient discharge capacity of the West and Southwest Branches.

This report sets forth specific planning objectives to be addressed in the resolution of the flood problem. Hydrologic studies detailing the drainage characteristics of the river basin and the climatology of the region were used to determine the river stages during floods of different magnitudes. Detailed economic investigations have been performed to assess the extent of recurring losses and damages from various frequency floods as well as to derive benefits from alternative flood control solutions.

Each of these alternative plans was examined to determine the expected impact on the existing flood situation, the relationship of costs vs. benefits and the acceptance of the proposed improvements by public interests. A complete assessment of the environmental impacts of each alternative solution and existing economic, social and future conditions of Pittsfield has been included in this report to enable complete comparison of alternative plans.

Study Participants & Coordination

Coordination of investigations and water resources publications was maintained with Federal, State and local agencies, as well as with interested citizens, throughout the plan formulation process. Meetings and written communications were used to exchange information concerning the flood problems of Pittsfield and to establish the priorities in developing a solution.

A public meeting was held in Pittsfield on 29 August 1979 to determine the specific needs and desires of local interests. All Federal, State and local agencies having an interest in flood control improvements were notified of the meeting. A summary of the public meeting is included in Appendix 3 of this report.

The following State, Federal and local agencies were requested to comment on the proposed plan of flood control improvements for the West and Southwest Branches of the Housatonic River:

U.S. Dept. of Agriculture, Soil Conservation Service
U.S. Dept. of Interior, Fish & Wildlife Service
U.S. Environmental Protection Agency

U.S. Dept. of Housing & Urban Development
U.S. Dept. of Transportation
Mass. Dept. of Environmental Quality Engineering
Mass. Office of Environmental Affairs
Mass. Water Resources Commission
Mass. Dept. of Public Works
Mass. Division of Waterways
Mass. Division of Fisheries and Wildlife
Mass. Historic Commission
Office of State Planning
Berkshire County Regional Planning Commission
Mayor of Pittsfield
Pittsfield Dept. of Public Works
Pittsfield Planning Board

Their response to the proposed plan, in the form of letters of comment and/ concurrence, is included in Appendix 3. Because several of the respondent objected to the local flood protection proposal for the Southwest Branch, further coordination with fisheries and wildlife officials was necessary. T meetings were held to address the remaining questions regarding the prop d plan, and to develop a suitable alternative to the provisions for the South s Branch. A digest of these meetings is contained in Appendix 3. This conti d coordination throughout the formulation process has enabled the development of a plan acceptable to all parties involved.

Studies by Others and Prior Reports

The problems of water supply and flood potential of the Housatonic River have been the subject of several previous reports. In 1974 the Soil Conservation Service of the U.S. Department of Agriculture published a report entitled "Flood Hazard Analyses: Upper Housatonic River," which outlined the potential flood problems of the Housatonic River drainage basin within the city of Pittsfield and surrounding communities.

Two later reports published by the same department are entitled "Watershed Investigation Report for the Upper Housatonic River Watershed," published in 1976, and "Water and Related Land Resources of the Berkshire Region," published in 1977. The first report investigated several alternatives for flood plain management, ranging from no action to combinations of structural measures, land treatment and flood proofing. This report concluded that any of these three action alternatives could be developed into a viable project. The second report, on the water and related land resources of the Berkshire region, described the current resources of the area and the problems confronting their continued use. For each resource, the report outlined possible management measures which could be used to preserve and/or enhance these resources.

An investigation of the flood plains along the West Branch and Southwest Branch of the Housatonic River in Pittsfield was carried out by the U.S. Department of Housing and Urban Development (HUD) to convert Pittsfield from the emergency flood insurance program to the regular program. This report, published in 1977, outlined the limits of the 100-year and 500-year floods and set forth the criteria for Federal participation in flood insurance.

Other studies related to the Housatonic River include "Phase I Inspection Reports," prepared for the Army Corps of Engineers, concerning the safety of the dams at Pontoosuc Lake and Onota Lake. These reports were published in July 1978 and November 1978, respectively. They evaluate the structural integrity of the dam and the spillway capacity under certain hydraulic and hydrologic conditions. These reports also provide information on the operation and maintenance of the dams and the nature of their storage capacities.

The Corps of Engineers, in response to three Congressional resolutions, has undertaken a comprehensive basinwide study of the water resource problems of the entire Housatonic River watershed. The "Housatonic Urban Study," which will report the findings of this investigation, is scheduled for completion by October 1982. The urban study will investigate two major work items, water supply and flood control, for all communities included in the river basin. Short and long-range plans for water resources will be developed for the study area. The short-range plans will extend to the year 2000 and the long-range plans will extend to the year 2030. The report is not expected to develop alternative measures for flood control on the West and Southwest Branches of the Housatonic River in Pittsfield.

A Corps of Engineers reconnaissance report, dated 21 April 1978, indicated that flood control improvements to the West and Southwest Branches of the Housatonic River are economically feasible and within the scope of the Section 205 authority.

The Report and Study Process

This Detailed Project Report serves a dual purpose. It is the basis on which the Chief of Engineers approves a project for construction and also the basis for preparation of plans and specifications. The main report reflects the plan formulation process and contains technical and non-technical information, including discussions of alternatives and recommendations for local flood protection in Pittsfield. The report includes the same planning process considered for feasibility studies conducted under all program authorities and also demonstrates the rationale used in arriving at the selected plan for Federal participation. The appendices contain detailed technical reports which more readily facilitate engineering review. Also, a more detailed evaluation of alternative plans is contained in the appendices. In compliance with ER 1110-2-1150 the level of detail and extent of engineering work reflected in the design appendices is sufficient to proceed directly to preparation of final plans and specifications. However, more detailed geotechnical engineering information, including borings, would be required during preparation of plans and specifications.

The multi-objective planning process, as defined by the Water Resources Council Principles and Standards regulations, is used throughout the study. The problems and needs of the community have been addressed by meetings with Federal, State and local officials and at the public meeting. Planning objectives have been defined. Each of the plans given detailed consideration was analysed for its impacts on the project area as compared with the most probable future of Pittsfield in the event that no project were implemented. Flood plain management and wetlands protection studies have been performed to determine both short-range and long-range effects of project construction. Non-structural measures have been considered as a viable alternative method of local flood protection.

PROBLEM IDENTIFICATION

This section presents a discussion of the flood problem existing in the city of Pittsfield, Massachusetts and the objectives of the Federal Government in providing a solution. The facts which support this identification are presented in detail in Appendix 1.

National Objectives

The Principles and Standards procedures established by the Water Resources Council require that the alternative plans be examined to determine their effects on National Economic Development (NED), Environmental Quality (EQ), Social Well-Being (SWB), and Regional Development (RD) accounts. The preliminary investigations of the reconnaissance study indicate that these accounts would be enhanced by a solution to the flood problems of Pittsfield. In the preparation of this Detailed Project Report, a more definitive analysis was prepared and is presented herein.

The goals to be strived for in the solution of the flood problems of the West and Southwest Branches of the Housatonic River are as follows:

A net positive effect on the gross national product, including an estimation of average annual losses, benefits, and costs, should result from any proposed plan of improvements. The environmental conditions of the area should be enhanced for designation of an EQ plan, but at the least any potential adverse impacts should be offset by positive contributions to other accounts. Any solution which would reduce the potential for flooding in the area would be equated with an improvement in social welfare, in that the citizens formerly presented with the threat of flooding would be relieved of that concern. In addition, the position of the city from an economic standpoint would be improved with a positive contribution to the NED account.

Existing Conditions

Basin and Site Description

The city of Pittsfield is located in Berkshire County, approximately 6 miles east of the Massachusetts-New York border and about 40 miles northwest of Springfield, Massachusetts. The location of the drainage basin and project site is shown on Plate 1, attached to this report. Nestled between the Taconic Mountain Range on the west and the Berkshire Hills on the east, Pittsfield was developed at the confluence of the East, West and Southwest Branches of the Housatonic River. These rivers drain the heavily forested mountain ranges to the west and north of the city. In the course of their run to Pittsfield, the tributaries of the West and Southwest Branches fall approximately 1,900 feet in elevation. This drop in elevation, which for the West Branch and parts of the Southwest Branch is reasonably abrupt, means that there is very little storage capacity in the upper drainage basins. This characteristic would generally lead to a very concentrated period of runoff during storms, but the topography of each branch, as illustrated in the following paragraphs, tends to desynchronize high intensity runoff and lessen peak flow in the city.

The drainage area of the West Branch totals 36.1 square miles and contains two major impoundments, Pontoosuc and Onota Lakes. These lakes serve to diffuse storm runoff by providing surcharge storage, which slows runoff and reduces peak flows downstream. The main tributaries of the West Branch are Town and Onota Brooks. Town Brook drains into Pontoosuc Lake and the West Branch forms at the lake outlet. Onota Brook originates at the outlet from Onota Lake and flows southeasterly to its confluence with the West Branch. From this point the West Branch flows south through Wahconah Park a distance of 1.4 miles to the Tel-Electric Dam. The West-Southwest Branch confluence is located 4,300 feet downstream from the Tel-Electric Dam. Together, the West and Southwest Branches flow approximately one mile downstream to merge with the East Branch, forming the headwaters of the Housatonic River.

The Southwest Branch originates at the confluence of Shaker Brook and the discharge from Richmond Pond. It flows northeasterly and then easterly a distance of 5 miles to its confluence with the West Branch. The total drainage area of the Southwest Branch is 23.1 square miles. This stream tends to be hydrologically sluggish in its southern reaches, a characteristic of streams in New England that drain in a northerly direction. However, the main stream also receives water from the small mountain brooks, which drain almost due south from the northern portion of the watershed. These mountain streams rapidly drain storm runoff because of their relatively steep gradients and the poor basin storage capacities. Because of the two different drainage characteristics existing in the basin, runoff from the mountain streams reaches the West-Southwest Branch confluence earlier than runoff from the southern portions of the watershed. As a result, peak flows on the Southwest Branch are reduced in magnitude but are longer in duration than they would be if the stream did not have this desynchronizing characteristic.

Flood History

Flooding of the West and Southwest Branches has occurred several times in the past, most notably in March 1936, September 1938, December 1948, April 1969, and March 1977. Official records of these floods are limited. The only recording gauge in the Pittsfield area has been maintained by the U.S. Geological Service on the East Branch of the Housatonic River at Coltsville, 2 miles northeast of Pittsfield. The period of record, which dates back to 1936, indicates that the flood of record occurred on 21 September 1938, when the discharge of the East Branch was recorded at 6,400 cubic feet per second (cfs). The discharges of other floods on the East Branch were as follows:

6,000 cfs	18 March 1936
3,410 cfs	19 April 1939
5,700 cfs	31 December 1948
3,710 cfs	23 April 1969
3,220 cfs	14 March 1977

Based on high water marks and hydrologic analyses, record flows on the West and Southwest Branches are believed to have occurred on two different occasions from the East Branch. For the West Branch the flood of record occurred on 18 March 1936 when stream flows reached 2,500 cfs. This is estimated to have been a 30 to 40-year event. Peak flows on the Southwest Branch occurred on 31 December 1948 when it reached 2,500 cfs. This is also estimated to have been a 30 to 40-year event. Flows on the West Branch during this 1948 event would have been far greater if two upstream lakes had not been drawndown. As it was, they provided extensive surcharge storage and reduced flows in town to approximately 1,050 cfs.

During the flood of 14 March 1977, two areas of Pittsfield were inundated with high water. On the West Branch, flooding occurred upstream from Columbus Avenue through Wahconah Park to the mouth of Onota Brook, primarily due to the flat channel gradient within this reach. There is only a 1.6-foot difference in elevation between the top of the Tel-Electric Dam and the riverbed at Wahconah Park, located approximately 5,000 feet upstream. Wahconah Park is a large wetland area on the west bank and a large field, including a baseball stadium, on the east bank. Downstream from the park area approximately 60 houses, a bakery, a gas station, and the Linden Street bridge were flooded during the March 1977 storm.

Flooding also occurred on the Southwest Branch during March 1977, from the Conrail railroad culvert upstream approximately 3,000 feet to the Pittsfield Plaza (Big "N" Shopping Center). Because the existing stone arch culvert under the railroad embankment is unable to pass the entire river flow during periods of heavy rainfall, water backs up over the surrounding area. In March 1977, several residences, commercial buildings, 2 gas stations, a motel, diner, bank and parking lot were inundated. Most of these buildings are located along U.S. Route 20, which was closed to traffic during the March 1977 flood.

Local officials have stated that flooding on the East Branch was more prevalent 20 to 30 years ago, but since then high water on the West and Southwest Branches has been more of a problem. Based on estimated high-water marks from the March 1977 flood and coordination of elevation-frequency data taken from the Soil Conservation Service (SCS) 1974 "Flood Hazard Analyses Report," a 15-year frequency was assigned to the 1977 flood.[1] Statistically derived water levels in the 10-year event are at elevation 993.5 feet above mean sea level (msl) at the Linden Street bridge on the West Branch and 974 feet msl at the entrance of Maloy Brook on the Southwest Branch. These elevations translate into approximate depths of flooding of two and one feet, respectively. During the computed 100-year event, these same locations would experience approximately 7 and 12 feet in depth of flooding, respectively. During the March 1977 storm, floodwaters at Linden Street reportedly reached three and a half feet (to elevation 994.5 ft. msl), while at the confluence of Maloy Brook flood levels reached elevation 977 feet msl., or four feet above the banks.

A complete hydrologic and hydraulic report is contained in Appendix 4, "Engineering Investigations."

Human and Economic Resources

Pittsfield is the largest city in Berkshire County. As the center of commerce and industry in the region, it has the largest population. According to reports published by the SCS, the 1970 population of Pittsfield was 57,020, 1.5 percent less than the population of 1960. The 1975 population was 54,893. Projections published by the Office of State Planning show an expected decline in the Pittsfield population through the year 2000, when it is expected to be 53,000. Berkshire County experienced a population increase of 5 percent between 1960 and 1970, according to the same office, but between 1970 and 1975 it experienced a decrease of 0.3 percent.

In 1970, Pittsfield comprised 24 percent of Berkshire County's urban land. It is a center for manufacturing, which accounted for 44 percent of the county's total earnings in 1970. The presence of industry and commerce in the city is becoming more important as the use of land for agriculture is declining. However, some of the industry now located in Pittsfield was developed within

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[1]A frequency is assigned to different floods according to the probability of their occurrence, i.e., a 15-year frequency flood has a probability of occurring once in 15 years, or 6.6 percent probability of occurring in any single year.

the flood plain because of the need for hydropower. In the later expansion of these industries, it was found more economical to extend the existing facilities rather than to relocate. The result has been an increase in potential damageable property in the flood plain and a growth in the importance of these resources in the city.

A more detailed description of human and economic resources is contained in Appendix 1, "Problem Identification."

Without Project Conditions

In the event that no Federal flood control project is constructed in the city of Pittsfield, flooding will continue to plague the residential and commercial structures located along the West and Southwest Branches. At current price levels, these floods are estimated to cause $253,500 annually in damages. If a flood of 100-year magnitude were to occur, it would result in approximately $2,300,000 in losses on the West Branch and nearly $16,000,000 in losses on the Southwest Branch. Coupled with inflation, these losses would become increasingly burdensome on Pittsfield's economy.

While the past 25 years have been considerable development of the low-lying areas of Pittsfield, the likelihood of this continuing in the future has been reduced. With implementation of the U.S. Department of Housing and Urban Development (HUD) National Flood Insurance Program, now directed by the Federal Emergency Management Agency, and the Massachusetts Wetlands Protection Act, any future development of the designated 100-year floodway is to be carefully regulated to prevent further encroachment of the flood plain or increases in flood stages. While this policy is important in limiting future development and subsequent losses, it does not eliminate future losses to existing properties. Although the FEMA Program would help to mitigate losses to existing properties through insurance benefits, repairs to damaged structures would continue to absorb national funds. The without project condition of Pittsfield would be characterized by continued reliance on insurance to provide relief from flood damages, and in the long-run, would represent an undesirable impact on the nation's economy.

In the absence of a flood control project, the future environmental quality of the West and Southwest Branches is not expected to change significantly from the present condition. On the West Branch, where limited riparian habitat exists, erosion would persist. The wetlands and recreation grounds of Wahconah Park would most likely remain unchanged because of existing flood plain zoning laws and because pressure for development is not exerted in this area. Similarly, on the Southwest Branch the character of the floodplain is expected to remain static as a result of the zoning requirements of the regular flood insurance program. The Southwest Branch is expected to continue supporting a natural trout population which is annually enhanced by stocking operations.

Other projected characteristics of Pittsfield in the without project condition are described in Appendix 1.

Problems, Needs and Opportunities

Flood damages caused by inundation from the West and Southwest Branches in March 1977 illustrate the need for flood protection along these reaches in Pittsfield. Resolution of the flood problem is the primary need and concern of local officials. While an attempt has been made to determine if development of other related water resources could also meet regional and local needs, it was found that other problems were minimal or were beyond the scope of a Section 205 study.

Along the Southwest Branch it was reported that water levels during March 1977 threatened but did not inundate the floors of the buildings of the Pittsfield Plaza and that U.S. Route 20 was closed to traffic for more than 2 days when 3 feet of water covered the road. The closing of Route 20 necessitated an approximate 12-mile detour for trucks and a local side street detour for cars. Several roads on the detour routes were damaged by the increased traffic. Further damage was sustained by residences and commercial buildings in the surrounding area.

On the West Branch much of the flood damage occurred to nearby residential and commercial buildings. Up to 15 two-story, wood-framed structures in the vicinity of John Street and Dewey Avenue had flooded basements and 1 to 2 inches of water on the first floor. Twenty-four residences in the area of Turner and Francis Avenues had up to 1 foot of water on the first floor living area. The Linden Street bridge was closed to traffic for over 12 hours as West Branch flows overtopped the roadway by up to 12 inches. Several photographs illustrating the extent of flooding in Pittsfield during March 1977 are included at the end of this section.

The 1977 flood caused property damage, loss of heat and electricity, and losses to the economy from the disruption of work schedules. A flood damage survey performed by the Army Corps of Engineers in 1977 revealed that, under present conditions, losses from a recurring March 1977 flood would total $314,000. This would include $169,000 in losses on the West Branch and $145,000 in losses on the Southwest Branch. An assessment of these damages is contained in Appendix 5, "Economics."

These losses illustrate the need for flood control projects on the Housatonic River in Pittsfield. Without suitable flood control improvements, continued flooding will cause further economic hardship and possible loss of life. Plates 2 and 3 show the areal extent of flooding that would occur during the 100-year and Standard Project Floods on the West and Southwest Branches, respectively. In total, the 100-year flood would inundate 150 acres along the West Branch and 50 acres along the Southwest Branch, flooding 264 structures. During the Standard Project Flood, 332 structures would be inundated.

Discussions with local, State and Federal agency officials verified the need for a flood control program in Pittsfield. The notice to proceed with the Detailed Project Report has provided an opportunity to address these flooding problems and develop a solution that is acceptable to local citizens.

Planning Constraints

The principal constraint on providing a flood protection project for the city of Pittsfield is the extensive development of the Housatonic flood plain. Based on the computed elevations of the 100-year flood, approximately 202 structures are located within the flood plain of the West Branch and 62 structures are located within the flood plain of the Southwest Branch. In addition, the flood plain in the area below the West-Southwest Branch confluence, near South Street, is a densely settled residential area. The development of a flood protection program for Pittsfield should include efforts to minimize disruption of this urban environment.

Many of the citizens attending the 29 August 1979 public meeting expressed concern regarding the downstream impacts of a flood control project. Specific mention was made of the residents in the vicinity of South Street. Approximately 120 feet below the West-Southwest Branch confluence the Housatonic River is crossed by the South Street bridge. Also crossing the river at this location is a concrete encased sewer line underneath the bridge set on concrete piers about 3 feet above the riverbed. Although this sewer line does not obstruct normal river flows, during higher flow periods it traps debris and reduces the discharge capacity of the bridge opening. Behaving like a dam under these circumstances, this blockage causes water to backup into the upstream residential area, causing more damages in addition to those already experienced upstream. A solution to the flood problems on the West and Southwest Branches should minimize any potential stage increase to this area of Pittsfield.

Other constraints originate from the recreational use of the area. The Southwest Branch supports a substantial brown trout population which is stocked every year. The West Branch, in the Wahconah Park area, provides canoeing and some water recreation in the summer. In providing a flood protection project for Pittsfield, adverse effects on these recreational resources should be avoided.

Planning Objectives

The primary planning objective of this investigation, which would provide guidance in the formulation of a water resources project, and provide a standard for comparison in the evaluation of alternatives, is to reduce damages to properties, development, activities, etc., which occur as a result of flooding along the West and Southwest Branches of the Housatonic River in Pittsfield, Massachusetts, for a projected life of 50 years.

Other planning objectives include:

(1) Contribute to the social well-being of local residents through flood reduction measures.

(2) Enhance environmental quality by minimizing the adverse impacts of flooding on the West and Southwest Branches.

(3) Contribute to the value of the West and Southwest Branches for recreational purposes.

(4) Encourage economic growth of the community and the region through assurance of reducing flood losses.

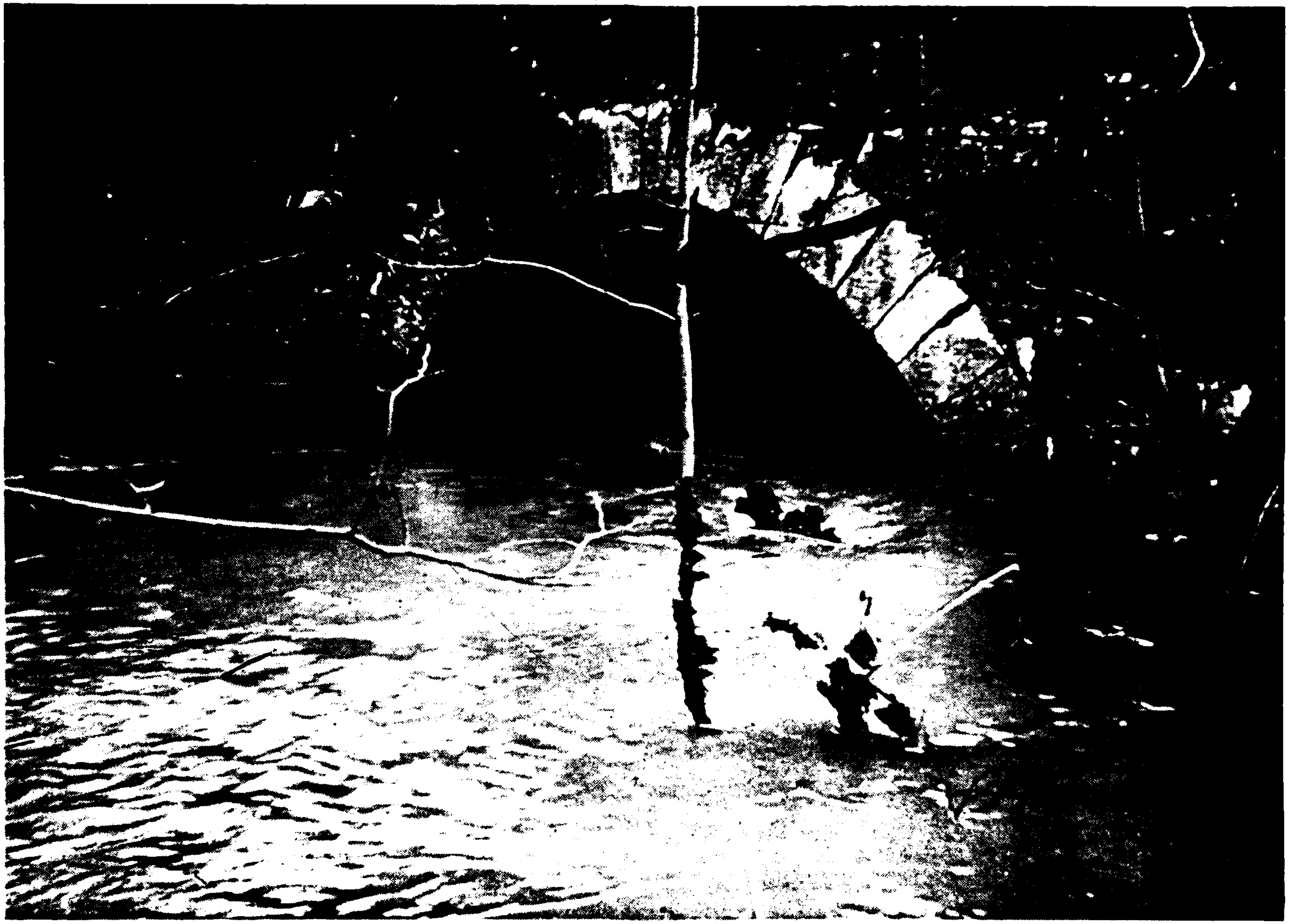
(5) Preserve any national or local historic sites within the existing flood plain lands.

(6) Contribute to the proper management of the flood plains to insure preservation of natural wetlands.

Other water resource development objectives for Pittsfield and other communities in the Housatonic River Basin are considered to be beyond the scope of this report but will be fully evaluated within the framework of the ongoing "Housatonic Urban Study," being prepared by the Army Corps of Engineers, New England Division.

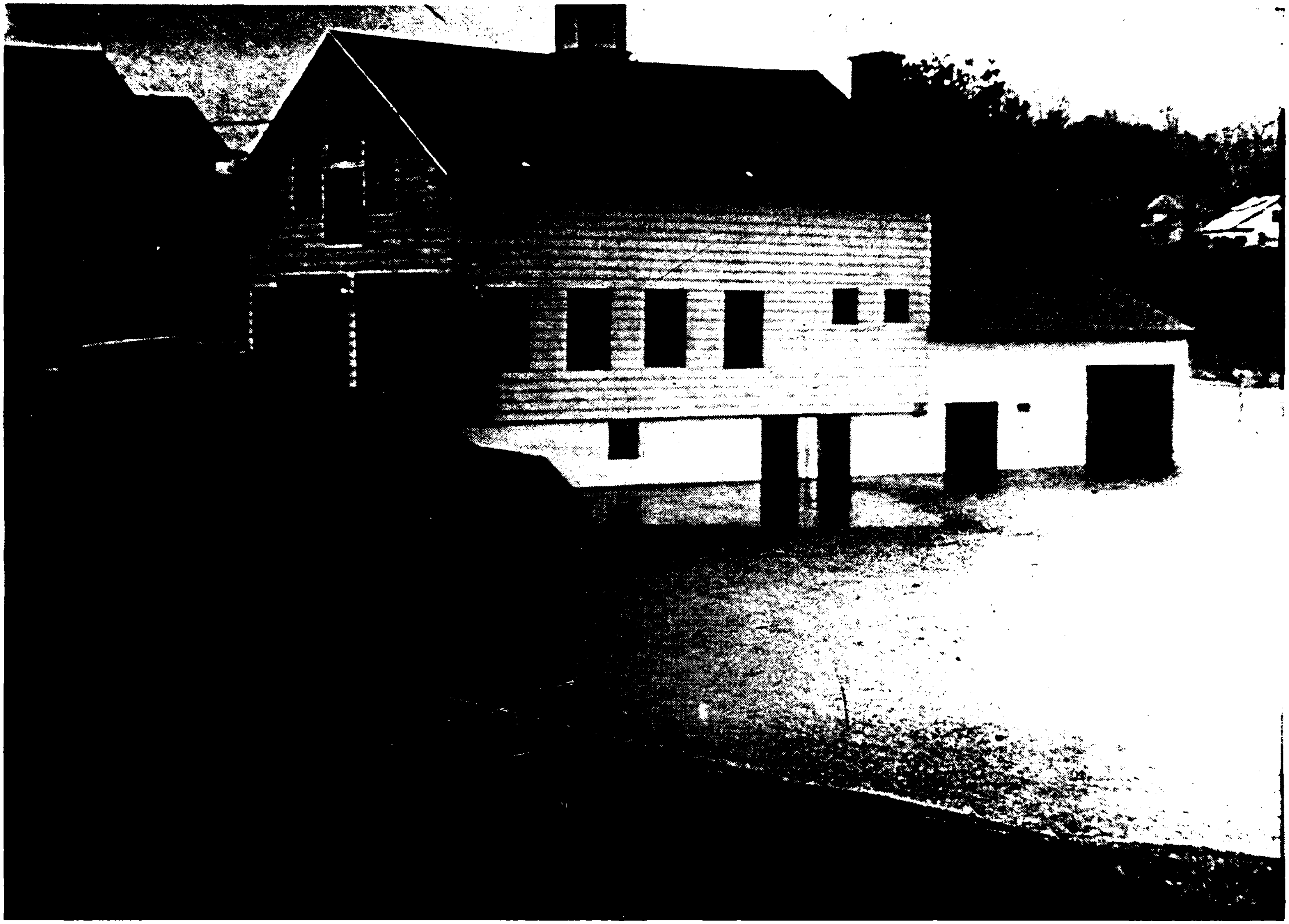
Tel-Electric Dam, West Branch

Linden Street Bridge. West Branch



Conrail Railroad Culvert, Southwest Branch

Southwest Branch, Upstream of Cadwell Road



SPCA Building on Cadwell Road, Southwest Branch

FORMULATION OF PRELIMINARY PLANS

Management Measures

The selection of a flood control program for the West and Southwest Branches of the Housatonic River required an assessment of all potential solutions to the problem. The management measures available for alleviating flood damages range from non-structural policies such as the National Flood Insurance Program, zoning, flood warning systems, flood proofing and total evacuation of the flood plain to structural methods which might include dams, dikes, new channels or diversion tunnels. A discussion of the applicability of each of these measures to the flood problems of Pittsfield is contained in this section of the report, in the paragraph entitled "Comparative Assessment of Preliminary Plans." At the conclusion of this section these measures are screened, according to the criteria outlined below, to determine which management measures are suitable for further detailed examination.

Plan Formulation Rationale

To enable a complete evaluation of the management measures available for controlling flooding along the Housatonic River in Pittsfield, two sets of criteria were developed for use in a multistage screening process. The first set dealt only with the feasibility of the protection measure while the second set consisted of technical, economic and environmental criteria developed in accordance with the U.S. Water Resources Council's "Principles, Standards, and Procedures for Water and Related Land Resources," which focus on development of a plan that best responds to the identified problems and needs of the community.

In determining the practicality of a given alternative, the following general criteria were used:

a. A method of flood control should be technically feasible and should provide a high degree of flood protection.

b. The method should be acceptable to the general public and meet economic and environmental concerns.

Following the determination of which proposals were feasible, these were screened in a second stage analysis to determine which plans would contribute most to the interests of the nation and the local community. The criteria for this screening process were as follows:

a. The selected plans should be implemented using acceptable engineering methods.

b. The benefit to cost ratio of the selected plans should be greater than unity.

c. The scope of the improvement should provide the maximum net benefits, unless additional justifiable costs are incurred to serve other objectives.

d. There should be no other more economical means, evaluated on a comparable basis, of accomplishing the objective.

e. The selected plans should preserve, enhance or restore the quality of the environment to a level greater than the "without project" condition.

f. The plans should be coordinated with interested Federal and non-Federal agencies, local groups and individuals through cooperative efforts, conferences, meetings and other procedures.

g. The selected plans should be consistent with State, regional, and local goals for growth and development in the area.

Plans of Others

The 1977 report "Water and Related Land Resources of the Berkshire Region," released by the U.S. Dept. of Agriculture, Soil Conservation Service (SCS), encouraged Pittsfield to apply for basin planning assistance, under authority of Public Law 83-566, provided there was sufficient public interest. Along with this proposal, the SCS suggested several alternatives for flood control management, both structural and non-structural. One of these involved flood damage prevention by reducing runoff from the drainage basin. It concluded that land treatment would serve to prevent erosion and reduce and delay runoff, so that the peak river discharge would be lessened. The report also suggested reservoir storage along the Southwest Branch to reduce peak flows. In response to this report, officials of Berkshire County submitted to the SCS an application for assistance under Public Law 83-566. However, at the time that SCS sought approval to study the basin in detail, authority had already been granted to the Army Corps of Engineers for the preparation of this Detailed Project Report. Through the course of several discussions between the Corps of Engineers and the SCS, it was determined that the Corps would continue its study and that the SCS would withdraw its request. This agreement was made primarily because the more localized scope of Section 205 projects would meet the needs of the city of Pittsfield by implementing flood control works in a shorter period of time than the PL 83-566 study. At the present time the SCS is working with two other agencies of the USDA, the Forest Service and the Economics, Statistics and Cooperatives Service, to cooperate with the Massachusetts Water Resources Commission in studying the Upper Housatonic River Basin again, under authority of PL 83-566. The objective of this study is to ". . . develop a National Resource Management Plan which is consistent with integrated growth policies and plans of communities in the basin." A draft "Plan of Study" for this project was released in November 1979 by the U.S. Department of Agriculture.

Following the March 1977 flood in Pittsfield the Office of Community and Economic Development of Pittsfield initiated a study to reduce flood damages along the West Branch. Their intention was to lower the Tel-Electric Dam and remove the rock ledge from the channel between the Tel-Electric Dam and Wahconah Park. The execution of these proposals was deferred following the determination that an Environmental Impact Statement would be necessary. When results of the Corps' reconnaissance study proved favorable for a Federally sponsored flood control program, the Pittsfield City Council, by letter dated 7 February 1979, notified the Corps that it would fully support a possible Section 205 project.

Upon completion of the HUD Flood Plain Information Report, the city of Pittsfield became eligible for the Federal Insurance Administration's (FIA) regular program of subsidized flood insurance. Under this program, structures located within the 100-year floodway are eligible for Federally subsidized insurance. This program utilizes zoning to restrict future encroachment of the flood plain, but it does not eliminate the flood hazard. At the present time, 143 flood insurance policies have been issued in Pittsfield at a value of $3.9 million. As properties change hands, new policies are issued, and the total number of policies in Pittsfield is expected to continue to rise in the future.

Current plans are being made by the Massachusetts Department of Public Works (MDPW) to reconstruct the Linden Street bridge. As this is located in the reach of the West Branch between the Tel-Electric Dam and Wahconah Park, every effort has been made to coordinate these plans with those of a flood control program. Information on the hydraulics of the West Branch and flood history of Pittsfield has been provided to the MDPW. Previous correspondence had described the Section 205 authority, in relation to the non-Federal responsibility for bridge replacement, so that further planning on the part of MDPW would not be preempted by the Corps study.

Comparative Assessment of Preliminary Plans

During the iterative process of developing solutions to the flooding problem in Pittsfield, initial design efforts were directed towards preventing flooding along both the West and Southwest Branches of the Housatonic River, where flooding is most prevalent. Plates 2 and 3 display the areal extent of flooding along both branches during the 100-year flood and the Standard Project Flood. Potential solutions include such structural measures as constructing dams, drawing down existing reservoirs, and diverting flood waters with bypass channels and tunnels. Failing the feasibility of these measures, consideration was given to those which, instead of preventing flooding, would prevent flood damages. Such measures may be structural, such as channel improvements which improve discharge capacity, walls and dikes which confine flooding to less damage-prone areas, or they may be non-structural, dealing directly with the property in the flood plain. Finally, failing the ability to prevent all damages, efforts were directed towards reducing flooding and related damages as much as possible, using combinations of the above measures.

The following discussion presents the preliminary screening of alternative measures to determine which could feasibly reduce the flooding problem in Pittsfield, Massachusetts. Depending on the measure considered, protected stream reaches were either selected because of the prevalence of damages in that reach, or because the zone of influence of the particular measure extended over a limited area.

Dams and Reservoirs

Several locations were considered for the temporary storage of floodflows upstream of Pittsfield. Of the locations studied, none would provide a significant flood stage reduction for the downstream flood-prone areas, primarily due to topographic constraints or the extent of uncontrolled intervening areas. The West Branch discharges from two major reservoirs that already provide some surcharge storage during all storms. Pontoosuc Lake is owned by Berkshire County and is utilized for recreation purposes, while Onota Lake is owned by the city of Pittsfield and is also utilized for recreation. It is estimated that during the record flood of September 1938, these lakes reduced peak watershed runoff by about 60 percent at Pontoosuc Lake and 75 percent at Onota Lake. Attempts to gain further flood reduction by lowering the lakes a small amount, either permanently or seasonally, would provide some added reduction during minor to moderate storm runoff, but would become less effective during the larger flood events. Providing added storage sufficient for highly reliable flood regulation over and above that already occurring would require lowering the lakes by 4 to 6 feet. This is considered impractical in light of the recreational value of these lakes and would be unacceptable to local officials.

On the Southwest Branch the only existing impoundment is at the outlet of Richmond Pond, which is too small to have a significant effect on the flood stages downstream. According to the SCS "1974 Flood Hazard Analyses" report, Richmond Pond would have to be drawn down 3 feet to obtain a stage reduction of 1.5 feet during a 100-year flood in the vicinity of the Pittsfield Plaza. River flows in this area would normally rise as much as 11 feet above the banks in the 100-year event.

One potential site for flood storage was identified in the drainage area of the Southwest Branch. Located at the junctions of May and Lilly Brooks (Jacoby Brook), it was determined that the impoundment would not control enough of the drainage basin to significantly reduce the flooding problems on the Southwest Branch. In addition, the prohibitive costs of real estate acquisitions and construction for the dam and reservoir area, estimated to exceed $2.5 million, would render this proposal economically infeasible.

Channel Diversions

Diversions, by either open channel or inverse syphon tunnel, were considered as a means to carry peak flows from the watershed above the flood area to either another watershed or a location downstream of the flood zone. All of the potential diversions investigated were found to be undesirable because of extremely high costs, or they would contribute to unacceptable stages within the receiving watershed, or would not significantly reduce the flood stages along the West and Southwest Branches in Pittsfield. This particular watershed does not lend itself to such a solution because in reaches where diversions would significantly alter the flood stages, the topography renders the solution too costly. Where the topography is suited to such a proposal, the effects of diversion would be negligible.

Channel Improvement

Actions that would direct a larger stream discharge away from the flood-prone areas involve the reduction or elimination of restrictions to flows by widening existing channels or by constructing new channels.

On the West Branch there are several locations in which channel improvements could be effective in reducing overbank flows. In general the gradient of the river between Wahconah Park and the Tel-Electric Dam is very shallow and the river flow is sluggish. One improvement which would help increase these flows would be a reduction in the height of the Tel-Electric Dam. By cutting down the height of this dam by several feet, the gradient of the river would be increased substantially and upstream flood stages would be reduced.

A second location at which channel improvements could relieve flooding would be at the West Street bridge. This concrete arched bridge has too small an opening to pass river flows of substantial volume, causing floodwaters to back up behind this structure. The construction of a new bridge having a width equal to the upstream channel width could substantially relieve flooding problems along this branch.

A third method of channel improvement along the West Branch might include a large scale effort to widen the channel and deepen it to provide capacity for the 100-year flood. This would involve the complete channel length between Wahconah Park and the Tel-Electric Dam, in addition to modifications to the dam and bridges along this reach. Such a project could eliminate all damages from floods of 100-year magnitude or less.

On the Southwest Branch there exist two locations for possible channel improvement. The most noticeable restriction of flood flows occurs at the Consolidated Railroad Corporation (Conrail) embankment. The culvert through this railroad embankment has only a 15-foot diameter and was the cause of floodwater backup during the March 1977 storm. The enlargement of this culvert to double its discharge capacity would significantly reduce upstream flood stages.

The second location for possible channel improvement would be upstream of the Conrail culvert where the Southwest Branch takes on a wide meander in a wetland. The complete elimination of this meander or the construction of a bypass for flood flows would effectively reduce upstream river stages during minor storms. This meander could be eliminated by constructing a new channel cutting across the existing ox-bow turn. Such a channel would increase the gradient of the stream by decreasing its length, and as such it would increase river flows and reduce floodwater backup. This measure was considered valuable only when considered in conjunction with widening the Conrail culvert.

Dikes and Floodwalls

Structural measures that could be provided in flood-prone areas include earth dikes and/or concrete floodwalls, combined with the use of pumps for drainage behind these structures. Dikes and floodwalls are essentially a channelization effort in that these structures confine the flow to a certain area. Where these structures are implemented in urban areas, it is a policy of the Corps to design for the Standard Project Flood, or as a minimum the 100-year flood. On the Southwest Branch, dikes and floodwalls constructed along U.S. Route 20, to protect commercial property, and along Cadwell road, to protect residential property, would have to be at least 5,000 feet in length and 20 feet in height to provide SPF protection. With these structures in place, extensive pumping facilities would be required to discharge interior drainage occuring behind the structures, particularly in Maloy Brook, which would require a pressure conduit.

Construction of this local protection would require a considerable expense which could not be justified by annual flood reduction benefits.

On the West Branch, consideration was given to an earth dike constructed in the vicinity of Wahconah Park, but, downstream of the park floodwalls would be required to extend the protection as far as the Tel-Electric dam due to space restriction. In total, 8,200 feet of 10-foot high dikes and 8,600 feet of 15-foot high walls would be required. Again, neither of these elements would be economically justified by flood reduction benefits.

Non-Structural Measures

Non-structural methods of flood protection are directed towards providing flood protection without installing large and costly projects that would cause major alterations to the use of the natural state of the stream channel and adjacent lands. Remedies of this nature are combinations of efforts to reduce the cost of current damages and to prevent any direct increase in potential damages in the future.

Programs which insure personal safety involve preliminary warning systems to alert citizens of imminent flood hazard. Such a system is important, but would be more beneficial when used in combination with other, more encompassing programs. Furthermore, a system such as this is not easily applied to the Pittsfield drainage basin because of the rapid runoff and the short duration for accumulating peak flows, leaving little warning time for evacuation of the flood plain.

Some non-structural methods considered for reducing flood losses in Pittsfield include flood proofing buildings, treatment of land to prevent runoff, subsidies from flood insurance and tax relief. Flood proofing would be the most effective of these methods. It involves sealing foundations of many buildings and raising those that cannot be sealed. In Pittsfield an analysis of the feasibility and cost of flood proofing was made using the assumption that buildings with flooding over 3 feet above the first floor would require relocation or demolition. Other methods of flood proofing could range from waterproofing basements to elevating structures above the elevation of the design flood.

The HUD Flood Insurance Program has been accepted by the city of Pittsfield, but this does not provide relief from flood damages. Flood insurance is important, however, as are local ordinances in restricting further development in the flood plain and as such, holding future damages to the current level.

Finally, while not entirely non-structural, there is the option of evacuation. By relocating all of the 265 structures now located in the 100-year flood plain to higher grounds, the threat presented by flooding is eliminated. This option was considered impractical and uneconomical because of the large number of buildings that would be involved.

Conclusions of Initial Screening

The following plans for local flood protection in Pittsfield were eliminated from the study following the initial screening for feasibility, acceptability and economic justification.

Upstream surcharge storage to be provided by the existing Pontoosuc and Onota Lakes on the West Branch and Richmond Pond on the Southwest Branch was determined to be unacceptable because of the extensive drawdown necessary for significant flood stage reduction in the damage prone zones of Pittsfield.

Surcharge storage at potential reservoir sites was determined to be technically infeasible because no site would control enough of the drainage basin to reduce flood damages sufficiently to justify the construction and land acquisition costs.

Diversion of floodwaters away from the damage-prone areas of Pittsfield by open channel or syphon tunnel was determined to be technically infeasible or lacking economic justification.

Dikes or floodwalls constructed along the flood-prone area of U.S. Route 20 on the Southwest Branch were eliminated from further analysis because of the excessive cost of protecting against a 100-year flood or greater. In addition, this plan would leave other residential areas along Cadwell Road outside the flood protected area.

A dike constructed along the West Branch through Wahconah Park was eliminated from further consideration when it was determined that proposed improvements by the MDPW would provide a similar degree of protection.

The non-structural alternatives of flood warning systems, land treatment and complete evacuation of the flood plain were dismissed from further consideration because they were either too broad in scope, too costly or, particularly with flood plain evacuation, unattractive to local officials.

Measures on the West Branch which were considered to be worthy of more detailed analysis included major channel reconstruction, replacement of the West Street bridge, and lowering the crest elevation of the Tel-Electric Dam to increase the gradient of the river.

On the Southwest Branch the measures which were considered further included widening the culvert under the Conrail embankment or installing an auxiliary culvert at this location, and straightening the river channel above the Conrail culvert to eliminate the ox-bow meander of this branch.

Finally, flood proofing was considered as the only feasible and acceptable non-structural plan for both branches of the Housatonic. It was examined as an independent project as well as in combination with other structural measures listed above.

Revised 5/81

DESCRIPTION, ASSESSMENT AND EVALUATIC OF DETAILED PLANS

In accordance with the interdisciplinary planning framework of the Principles and Standards procedures, the initial screening of alternatives distinguished several flood control plans for Pittsfield that were considered feasible and suitable for further, more comprehensive investigations.

Alternative plans considered for the West Branch are:

Plan A - Lower Tel-Electric Dam.

Plan B - Lower Tel-Electric Dam and replace West Street bridge.

Plan C - Lower Tel-Electric Dam, replace West Street bridge and provide channel enlargement between Wahconah Park and the Tel-Electric Dam.

Plan D - Flood proofing, demolition and/or relocation.

Plan E - Lower Tel-Electric Dam plus non-structural measures.

Plan F - Lower Tel-Electric Dam, replace West Street bridge plus non-structural measures.

Alternative plans considered for the Southwest Branch are:

Plan A - Double the capacity of the Conrail culvert and clear brush for an overflow channel.

Plan B - Double the capacity of the Conrail culvert and channel excavation upstream of Barker Road bridge.

Plan C - Triple the capacity of Conrail culvert.

Plan D - Flood proofing, demolition and/or relocation.

Plan E - Double the capacity of Conrail culvert, brush clearing, plus non-structural measures.

Plan F - Triple the capacity of Conrail culvert plus non-structural measures.

The evaluation of alternative plans involved the following two criteria: (1) the extent to which they fullfilled the planning objectives, and (2) their contributions to the system of National Accounts. The evaluation of alternative plan impacts on specific characteristics of the project area have been discussed in compliance with ER-1105-2-240. A benefit/cost ratio is summarized for each plan as are its contributions to the EQ and SWB accounts. Tables summarizing these contributions and comparing the alternative plans for each branch of the Housatonic have been presented in the "Conclusion" of this report.

West Branch Alternative Plans

Plan A - Lower Tel-Electric Dam

Plan Description

This plan addresses the problem of the relatively flat gradient of the river channel between Wahconah Park and the Tel-Electric Dam. There is only a 1.6-foot drop in elevation from the channel invert at Wahconah Park downstream to the spillway of the Tel-Electric Dam, a distance of approximately 5,000 feet. Because of this flat gradient, floodwaters overtop the low banks of the river in this reach and during the 100-year event would inundate approximately 150 acres.

Plan A improvements consider lowering the spillway of the Tel-Electric Dam by 3 feet. This run-of-river dam is a 19-foot high concrete structure 40 feet in width (see photo at the conclusion of Problem Identification). The present spillway elevation is 986.7 feet msl, and the impounded pool contains 8 acre-feet of storage. Normal river flows are discharged by an overflow weir at the left dam abutment into an old penstock. The crest elevation of the 15-foot long weir is 985.2 feet. In the past, the dam provided water power to a nearby industrial plant, but it has not been used for this purpose for many years. The dam does not provide any surcharge storage during flooding conditions.

The provisions of this plan include:

1. Removing about 3.5 feet off the top section of the spillway structure.

2. Placing a concrete cap approximately 6 inches in thickness to bring the final spillway elevation to up 983.7.

Lowering the spillway by more than 3 feet would require considerable modifications to the Conrail railroad bridge piers and abutments, which are located approximately 80 feet upstream. Although the exact depth of these foundations is not available from the Conrail corporation, a reduction of more than three feet in the spillway elevation may cause scour and undermining of these piers.

Impact Assessment

The primary impact of Plan A would be an increase in stream velocity and a subsequent stage reduction of 1.0 to 1.5 feet during the 100-year flood. This reduction would mostly be effective in the reach of the channel between the Tel-Electric Dam and the West Street bridge, owing to the restrictive opening at West Street. Reductions in the 100-year flood level at Linden Street would be about one foot.

An economic assessment of this plan reveals an average annual reduction in flood losses equal to $12,000. This amount is a function of reduced flood damages as well as a reduction in flood-related service costs, and it translates into the plan's average annual benefit.

The environmental impacts of this project are those associated with the temporary implementation phase of the project. The West Branch downstream of the Tel-Electric Dam would experience an increase in turbidity resulting from some loss of the silt behind the dam and from the discharge of some concrete particles during the lowering of the dam. The wetland at Wahconah Park is not expected to be adversely impacted by this plan as normal stream levels in this area would not be reduced.

The impacts of this plan on properties located downstream of the dam are expected to be minimal. At the South Street bridge, located on the Housatonic River approximately 5,000 feet downstream of the Tel-Electric Dam, there would only be a minimal increase in the stage of the 100-year flood. However, because this stage increase could produce additional flooding to this property, it was determined that some action should be taken to mitigate this impact. Consideration was given to requiring property owners to purchase additional flood insurance, but further investigation established that the stage increases of Plan A could be offset by other means. Specifically, at the present time there is a sewer conduit which crosses the Housatonic River underneath the South Street bridge. Because this conduit is set on piers above the streambed, it decreases the bridge's discharge capacity, particularly during flood periods when it traps debris. By lowering this conduit below the streambed or by removing it altogether, river stages during the 100-year flood would be reduced by approximately 7 inches, more than offsetting the stage increase affected by Plan A. Further details of this plan and the alternative means of mitigation are presented under Plan A for the Southwest Branch, because that plan's improvements would produce more serious stage increases at South Street.

Other impacts of the plan would include the noise associated with the construction works.

Plan Evaluation

This plan does not satisfy the planning objective of providing a high degree of flood protection. Complete protection would be afforded only against the 5-year flood in the immediate vicinity upstream of the Tel-Electric Dam, and less than that in the Wahconah Park area.

Only 28 out of 202 structures located within the 100-year stage flood plain would be protected by this plan and the fields upstream at Wahconah Park would not experience an increase in recreational potential. The plan contributions to the environmental quality of the West Branch are negligible, although lowering the dam would have some minor temporary adverse impacts on the environment. The wetlands in this area, although preserved, would continue to experience disruptive flooding during the less frequent events. Three structures in Pittsfield have been designated as historically significant, but none of these would be impacted by any of the improvement proposals for the West Branch.

The first cost of this project is estimated to total $29,600, of which $3,500 are real estate costs. Because the scope of this improvement plan is limited to lowering the dam and providing only 5-year protection, the 100-year flood would continue to cause extensive damage throughout the flood plain. Specifically, residual losses occurring with implementation of Plan A would total $63,800 annually, which is more than five times the value of annual benefits. Because of the limited degree of protection provided by Plan A, the action of lowering the dam is considered to be on the scale of a local drainage improvement effort, and it therefore considered to be a non-Federal cost responsibility. Furthermore, because annual flood losses remain so high, it is essential that the citizens impacted by flooding on the West Branch be informed that this plan would not eliminate their problems, so as not be develop a false sense of security. Including the cost of maintaining the spillway and penstock free of debris, the amortized cost of this plan would average $3,200 annually. When compared with a $12,000 annual reduction in flood losses, the ratio of benefits to costs is 3.75 to 1.00.

In conclusion, the economic and environmental contributions of lowering the spillway of the Tel-Electric Dam render this plan an economic alternative for flood protection on the West Branch, but the high residual losses realized in the 100-year flood preclude participation by the Federal Government.

Public Views

During the public meeting held 29 August 1979 several parties commented on the loss of storage which has occurred on the West and Southwest Branches over the past few years. Siltation and the breaching of dams were cited as the causes of this storage loss, and it was suggested that the Corps, should institute a program of silt removal from behind the dam, rather than lower the dam three feet. It was pointed out that the Tel-Electric dam was a run-of-the-river dam which provides no surcharge storage during flood periods. As such, the removal of silt would not increase the surcharge storage capacity of this dam, nor would lowering the dam decrease this capacity. Finally, the Pittsfield Planning Board registered disappointment that this plan did not improve the flooding conditions of Turner Avenue and Wahconah Park.

This plan was carried as the recommended plan in the letters of coordination sent to various Federal and State agencies by the Corps in January 1980. There were no objections to this plan provided that the wetland area of Wahconah Park would not be drained.

Plan B - Lower Tel-Electric Dam and replace West Street bridge

Plan Description

The provisions of this plan address two channel restrictions located along the West Branch of the Housatonic River. In addition to improving the relatively flat gradient of the West Branch, which was addressed by Plan A, this plan would also replace the West Street bridge. This concrete arch bridge is located approximately 1,300 feet upstream of the Tel-Electric Dam and has a flow area of about 180 square feet. The average width of the channel upstream of this bridge is 45 to 50 feet, whereas the width of the bridge opening is only 32 feet. During periods of high flow, water backs up behind this bridge because of its restrictional flow capacity (see flood profile - Plate 2 attached to this report), causing overbank flooding as far upstream as Wahconah Park and inundation of approximately 202 structures during the 100-year flood.

Plan B would:

1. Lower the spillway of the Tel-Electric Dam from El. 986.7 feet msl to approximately El. 983.7 feet msl.

2. Replace the West Street bridge over the West Branch Housatonic River with a reinforced concrete bridge having a 50-foot width between abutments and a low chord elevation of at least 993 feet msl.

Impact Assessment

Lowering the Tel-Electric Dam and replacing the West Street bridge would reduce the stage of the 100-year flood at the West Street bridge approximately 5 feet and 2.5 feet upstream at Linden Street.

Approximately 69 houses would no longer be inundated by the 100-year flood and 133 would be threatened to a lesser extent. The benefits associated with this plan are expected to average $33,300 annually.

The long-range environmental impacts of Plan B are negligible. Increasing the downstream discharge by the provisions of this plan will induce less than a 5 inch increase in the stage of the 100-year flood at the location of the South Street bridge. In a recurrence of the 1938 flood, the stage of this 30-year event would be increased by less than 2.5 inches at the same location. Below the South Street bridge, the Housatonic River enters a very extensive flood plain storage reach which would not be adversely impacted by the provisions of Plan B.

The temporary impacts associated with Plan B include the inconvenience caused by closing the West Street bridge to traffic during the construction period as well as the noise and dust related to construction. There would be a temporary increase in the turbidity of the West Branch during construction of both improvements.

For the most part, however, the social and environmental impacts of this plan are beneficial. There would be less overbank flooding and an increase in security to the residents of approximately 69 structures no longer threatened by the 100-year flood and 133 threatened to a lesser degree.

Plan Evaluation

Plan B has the following effects on the planning objectives: it substantially reduces the stage of the 100-year flood, and eliminates damages from the 10-year flood in the vicinity of the West Street bridge. In providing this stage reduction, approximately 69 out of 202 structures located in the 100-year flood plain would be protected against further damages, but the wetlands below Wahconah Park would not be drained. Upstream of the wetlands the recreation fields would continue to be inundated, although less frequently, and bank erosion would continue during the rare events.

The estimated benefits from reduced flood damages are $33,300 annually. First costs for the total project are anticipated to be $384,900. Amortized over a 50-year life, at an interest rate of 7-1/8 percent currently applied to Federal projects, this first cost would average $29,300 annually. A comparison of benefits to costs reveals a benefit/cost ratio of 1.14 to 1.00, which is economically feasible. As with Plan A, the total cost of this project would be a non-Federal responsibility owing to the limited scope of lowering the dam and because the Section 205 authority does not provide for replacement of bridges at Federal expense.

The social and environmental contributions of this project favor its implementation. Sixty-eight structures would no longer be threatened by the 100-year flood and all structures in the reach between West Street bridge and Columbus Street bridge would be safe from the 10-year event. The stages of all floods at the South Street bridge below the West-Southwest Branch confluence would be only minimally increased by the provisions of this plan and would be offset in time from any increases effected by improvements on the Southwest Branch.

In conclusion, while Plan B does not maximize net benefits, it does provide protection against urban flooding. However, the implementation of this Plan B would be dependent on the assurance of local finance.

Public Views

Response to this proposal at the 29 August 1979 public meeting was mostly positive. The exception was an expressed concern for the downstream impacts that might result from increasing the flow capacity of the West Street bridge. Two other related issues raised during the meeting were the potential foundation problems related to lowering the water table and the possibility of using seasonal drawdown of upstream lakes for surcharge storage.

Plan C - Lower Tel-Electric Dam, replace West Street bridge and provide channel enlargement between Wahconah Park and the Tel-Electric Dam

Plan Description

This plan of improvement for the West Branch addresses all of the channel restrictions along the reach between Wahconah Park and the Tel-Electric Dam. Basically, the plan calls for widening and deepening the river channel from the lower end of Wahconah Park to the Tel-Electric dam, a distance of 4,300 feet, so that it will convey the 100-year flood discharge of approximately 3,000 cfs. The channel would be widened to 40 feet and deepened to increase the slope of the river from the existing .03 percent to .25 percent. In accomplishing this channel work, the West Street bridge would have to be replaced with a larger opening, and the Tel-Electric dam would have to be lowered to obtain the steeper gradient. Under the local cooperation agreements of a Section 205 project, the replacement of the West Street bridge would be a non-Federal cost responsibility.

Although there are no records of the river regime prior to construction of the Tel-Electric dam, it is believed that the removal of the dam would cause a significant drop in the upstream water table, and drain the wetland at Wahconah Park. To avoid this adverse impact, consideration was given to installing a bascule gate in place of the dam. Installed to a top elevation of 983.7 ft. msl., 3 feet below the existing spillway elevation of the dam, this gate would be capable of maintaining existing upstream water levels while providing sufficient gradient and discharge capacity, when lowered, to convey the 100-year flood.

The final element of Plan C would consist of modifications to the railroad bridge piers located 80 to 150 feet upstream of the dam. Although detailed plans of these bridge footings are not available from the Conrail Corporation, it is believed that these were constructed after the dam was built, and that they do not penetrate the streambed sufficiently to remain stable following the implementation of channel improvements.

In conclusion, Plan C would:

1. Modify the Tel-Electric Dam to include an 8-foot high bascule gate installed to elevation 983.7 feet msl.

2. Perform necessary modifications to the railroad bridges located upstream of the Tel-Electric Dam to accommodate the deeper channel.

3. Widen and deepen the river channel along the 4,300-foot reach between the lower end of Wahconah Park and the Tel-Electric Dam. Widen to 40 feet and excavate to a slope of 0.0025 to accommodate the 100-year flood.

4. Replace the West Street bridge with a bridge having a 50-foot span and a low chord elevation of at least 993 feet msl to pass the modified 100-year flood.

Impact Assessment

The major impact of Plan C would be the elimination of future damages from floods up to the 100-year event. This plan would lower the stage of the 100-year flood by 11 feet in the vicinity of the West Street bridge and by about 5 feet at Wahconah Park. As such, the 100-year flood would be confined to the modified channel, eliminating the losses associated with this event. However, the major impacts of this proposal include high implementation costs and extensive adverse impacts on the environment. The first costs required to implement this project are estimated to be $2,500,000, averaging $186,300 annually over an estimated economic life of 50 years. Under the Section 205 continuing authority, local interests, in addition to fulfilling the normal cooperation agreements, are responsible for Federal first costs in excess of $2 million (or $3 million in designated Federal disaster areas). In this plan, non-Federal interests would be required to finance approximately $430,000 for replacement of the West Street bridge and the provision of lands and easements, normally required as items of local cooperation. In addition, they would also be required to finance the $65,500 by which Federal first costs exceed $2 million.

The environmental impacts of Plan C discourage its implementation. Modifying the Tel-Electric Dam to include a bascule gate would first require dredging the sediment material behind the dam. Channel modification work would also disrupt the aquatic ecosystem and greatly affect vegetation along the reach.

Plan C would also negatively affect the town by disrupting traffic circulation during construction. Noise and dust pollution would occur throughout the construction period.

Finally, the downstream impacts of the channelization effort would be adverse in the vicinity of the South Street bridge, where some properties would experience additional flooding. Downstream of the South Street bridge the wetlands would be able to store the extra discharge.

Plan Evaluation

Plan C would fulfill the following planning objectives: flood damages would be eliminated for all structures located within the 100-year flood plain and the subsequent reduction in economic losses would stimulate the city's economy. The recreation area of Wahconah Park would be more accessible following periods of rain, but the wetlands below the park would experience some reduction in the water table. The adverse environmental impacts of overbank flooding would be eliminated and water quality of the stream would most likely improve. However, because this channelization for the West Branch would totally disrupt the existing aquatic environment, there would be a net detrimental impact on the environmental character of the river.

While this plan fulfills many of the planning objectives, the average annual costs resulting from this project are higher than estimated economic benefits. Anticipated annual benefits from these channel improvements are $70,800. When compared with the average annual costs of $186,300, the resulting benefit/cost ratio is 0.38 to 1.00. In addition, approximately $500,000 in first costs would be a non-Federal responsibility under the Section 205 authority.

The plan contribution to the environmental quality account would also be adverse. While some effects could be mitigated, there would be no outstanding contribution to this account which would outweigh the economic deficit. Social benefits of this project would be substantial in spite of the inconvenience associated with the construction phase. Finally, this proposal is not as flexible as is desired of a flood protection project. The plan would be difficult to alter once implemented, owing to the excavaton of the larger channel. As such, the benefits derived from Plan C are not sufficient to justify the costs and environmental impacts of this project.

Public Views

Because this plan does not have a favorable benefit-cost ratio, it was not presented as a desirable plan at the public meeting in August 1979. However, citizens attending this meeting did propose blasting away the rock ledge located in the bed of the West Branch, an action similar to the channelization measure of this plan. The major objections to this plan were the potential downstream impacts of increased flow capacity and the negative impacts of draining the Wahconah Park wetlands.

Plan D - Flood proofing, demolition and/or relocation

Plan Description

The fourth alternative involves flood proofing the structures located in the flood plain against the 100-year event. This proposal is a non-structural alternative. All structures standing within the boundaries of the 100-year flood were examined to assess the extent of flood proofing required for protection. The methods of flood proofing ranged from placing a drainage trench around the perimeter of the basement (including a sump pump), to evacuation and demolition of some structures. Seven classes of flood proofing were delineated, depending on the condition and use of basements and the extent of inundation. These procedures are described in detail in Appendix 2. In the event that the 100-year flood would inundate the first floor, the entire structure would be raised 3 feet. However, if more than 3 feet of water would inundate the first floor, the structure would be razed or relocated. Under the parameters of this investigation, which are outlined in Appendix 2, 295 structures were identified as lying within the 100-year flood plain. Of these structures, 93 were found not to be threatened by the 100-year flood; 159 would require modifications to the foundations and drainage installation in the basements; 33 would need the foundation raised above the elevation of the 100-year flood and 10 would be razed or relocated. The total first cost of this program is estimated to be $2,370,000.

Impact Assessment

Implementation of this non-structural improvement plan would not eliminate overbank flooding in the 100-year event, but it would reduce related physical losses. Non-physical losses such as profits reduction during flooding and the cost for emergency services would continue to occur. The annual benefit of this improvement plan is estimated to be $61,200, compared with an annual cost of $174,400.

The environmental impacts of flood proofing are related to the overbank flooding which would continue to occur under this plan. Scouring and subsequent sedimentation would continue during floods, causing damage to riparian vegetation similar to that experienced under the "without project condition." Net social impacts would be adverse. While structures would no longer be inundated, yards and streets would continue to be inaccessible unless these were also filled. Furthermore, there would be a negative response to the relocation necessary for the 10 structures requiring evacuation, and for the temporary displacement of the owners of 33 structures which would be raised to an elevation above the 100-year flood stage.

Plan Evaluation

Plan D satisfies part of the planning objectives by eliminating $61,200 in annual flood losses. This benefit would result from reduction in physical damages, however, non-physical losses would continue to occur. As such, regional growth would not be stimulated by this plan. In addition, the adverse environmental impacts associated with flooding would continue to occur, including inundation of the recreation areas at Wahconah Park. The evacuation of 10 structures by this plan would be contrary to the objective of contributing to community cohesion.

The average annual cost of this project would be at least equal to $174,400, giving a benefit/cost ratio of 0.35 to 1.00. In addition, Section 280.7 of ER 1165-2-122 states in part that "...flood proofing measures that would leave occupied buildings inaccessible during a flood, thereby extending the public commitment for continuing emergency assistance, will not be recommended." The flood proofing plan outlined for Pittsfield would not eliminate costs associated with emergency services. Furthermore, because the flood plain is so extensively developed in Pittsfield, it was considered impractical and too expensive to relocate all activities.

In conclusion, the non-structural alternative of using flood proofing to eliminate flood damages is not easily applicable to Pittsfield and has adverse impacts which discourage its implementation.

Public Views

Plan D was described at the public meeting in Pittsfield, but it was not widely discussed because of the unfavorable ratio of benefits to costs. It is believed that this plan would not be acceptable to the residents of Pittsfield because of the significant number of houses that would be relocated under this plan, and because inundation of the flood plain would persist.

Plan E - Lower Tel-Electric Dam plus non-structural measures

Plan Description

This plan combines the structural measure of lowering the Tel-Electric Dam with flood proofing to provide protection against the 100-year flood. Under this plan of protection, 174 structures remaining within the limits of the 100-year flood plain, as modified by Plan A, would require flood proofing. Most of these would only require waterproofing the outside of the basement wall, in addition to placing drainage trenches and a sump pump in the basement floor. Under this combination plan, 9 structures would be relocated from the flood plain.

Impact Assessment

This project would increase the benefits resulting from either a completely non-structural plan or a limited structural plan. The first costs would include $1,953,000 for flood proofing in addition to the non-Federal provision of $29,600 required to lower the Tel-Electric Dam. The benefits ensuing from such a plan would total $63,600, including a $3,400 reduction in Federal subsidies to flood insurance.

Such a project's individual components would cause other impacts. By lowering the dam, the increased stream discharges over this dam would reduce stages upstream in future floods. The temporary impacts of construction would also occur, as would the inconvenience resulting from flood proofing operations. Any rainfall during project implementation would increase erosion in these areas, and overbank flooding would continue during events greater than the 5-year flood. However, the social well-being of the community would be improved under this plan. Not only would the 100-year flood plain be reduced by Plan A, leaving 28 structures free from inundation, but 165 other structures within the modified flood plain would also be protected against physical loss by flood proofing. This would contribute greatly to the peace of mind of residents during a flood.

Plan Evaluation

Plan E would satisfy the following objectives: all structures located in the 100-year flood plain would be protected against future damages. Continued overbank flooding, however, would prevent regional growth and improvement of environmental quality, but the wetlands would be preserved by this plan.

The annual cost of this plan would total $147,000, and the benefit/cost ratio of Plan E would equal 0.43 to 1.00. While this protection plan would not eliminate floods greater in magnitude than the 5-year event, the addition of flood proofing to the structural measure of lowering the Tel-Electric Dam would provide better protection to the residents of Pittsfield. However, continued overbank flooding would cause persistent non-physical losses, requiring local and Federal expenditures for emergency services. Because ER 1165-2-22 requires that non-structural plans eliminate the need for emergency services, this plan does not meet the criteria of completeness.

Public Views

This plan was not presented as an alternative at the August public meeting in Pittsfield, nor was it presented in the letters or coordination to public agencies. For this reason, there is no available documentation of the prevailing opinion regarding this plan.

Plan F - Lower Tel-Electric Dam, replace West Street bridge plus non-structural measures

Plan Description

This plan combines flood proofing with the provisions of Plan B, lowering the Tel-Electric Dam and replacing the West Street bridge, to provide protection against the 100-year flood. The modified stage of the 100-year flood resulting from these structural provisions would necessitate flood proofing 133 structures along the West Branch. Most of those structures needing flood proofing would require sealed foundations and drainage trenches leading to sump pumps placed in the basement. Under this protection plan no structures would be relocated from the flood plain.

Impact Assessment

This plan would reduce physical losses to 133 structures located within the modified flood plain, and protect another 69 structures located outside the modified 100-year flood plain. Economic benefits from this reduction in flood damages would total $46,100. However, the costs associated with Plan E would total $1,642,000 averaging $122,000 annually when amortized over 50 years at an interest rate of 7-1/8 percent. Again the financial responsibility for replacing the West Street bridge and lowering the dam would be non-Federal.

Environmental impacts of this project would be similar to those of Plans B and D. Stream turbidity would temporarily increase with the replacement of the West Street bridge and the lowering of the dam spillway elevation. Continued overbank flooding would cause scouring and disruption of riparian habitat along the Wahconah Park area during rare flood events, but there would be no significant increase in the stage of the 100-year flood at properties near the South Street bridge.

Plan Evaluation

While this plan would provide considerable relief from 100-year flood damages, its completeness would be dependent upon the replacement of the West Street bridge. The ratio of benefts to costs would equal 0.38 to 1.00, so this plan is not recommended for further consideration.

Briefly, this plan has the following effect on the planning objectives: 202 structures located in the flood plain would be protected from the 100-year event, and 69 of these would not experience flooding of their property. Community cohesion would be improved but regional growth would not be stimulated because of the continued overbank flooding. Environmental quality and recreational potential would not be improved by this plan.

Public Views

This plan was not among the alternatives presented at the public meeting or in the coordination letters sent to public agencies in January 1980. As such, there is no account of the public opinion of this alternative.

Southwest Branch Alternative Plans

Plan A - Double the capacity of the Conrail culvert and clear brush for an overflow channel

Plan Description

This protection plan addresses the inadequate discharge capacity of the Conrail culvert on the Southwest Branch. This culvert is located approximately 2,200 feet upstream of the West-Southwest Branch confluence, where the Canaan Secondary (L.C. 4-2-20, M.P. 85.97) of the Conrail Corporation crosses the Southwest Branch. The culvert is of stone-brick arch construction and has an approximate flow area of 130 square feet. The earth embankment is about 30 feet high. During major storms, water backs up behind the culvert because of its inadequate discharge capacity, and inundates the areas upstream to Cadwell Road. In the 100-year event approximately 50 acres and about 62 structures would be inundated by this backup. The plan proposes a second culvert through the bank to one side of the existing stone-arch culvert. The new culvert would be of corrugated metal multiplate construction with a 15-foot diameter and a net flow area of about 150 square feet. The culvert would be about 80 feet long with concrete aprons and wing walls at both the entrance and outlet. The invert of the pipe would be at elevation 963 feet msl, the same as the existing channel invert, but the approach apron would be at elevation 966 feet msl, to allow only floodflows to pass through the structure. This auxiliary conduit should be installed during off-peak rail traffic hours to minimize the disturbance to Conrail operations. However, a plan of temporary bridging would allow for uninterrupted rail traffic.

In addition to installing the auxiliary culvert through the Conrail embankment, this plan includes cutting brush and trees to allow for more expedient passage of the more frequent floodflows. In the reach above Barker Road bridge, the Southwest Branch meanders considerably and has a nearly complete oxbow turn, causing the river to be sluggish. Plan A would clear away the swamp growth for a 30-foot width in a virtually straight alignment between Barker Road and the Maloy Brook outlet thereby eliminating the stream meander during flood flows. This cleared area would allow overbank flows a primary path to the relatively straight channel downstream from Barker Road. As the scope of this brush clearing is limited to protection against minor floods, the annual cost of brush-clearing is a non-Federal responsibility estimated to total $1,000.

Impact Assessment

This plan of protection would save an average of approximately $100,200 annually in reduced flood damages. The reduction in the stage of the 100-year flood would total 7 to 7.5 feet, relieving approximately 22 houses from the threat of this flood. This benefit would mostly be derived from the installation of the auxiliary culvert. However, clearing away the swamp growth from the flood plain upstream of Barker Road would also serve to reduce the stages of intermediate floods. These floods would be more quickly discharged downstream as a result of the cleared path because debris would not get caught in the brush and retard the flow.

Few adverse environmental impacts would result from this project. There would be no adverse impacts on stream level upstream of the Conrail embankment because flow through the additional culvert would only occur during flood events. Brush clearing would eliminate approximately half an acre of wildlife habitat from the area upstream of Barker Road, but this constitutes only 5% of the wetland in that reach of the Southwest Branch.

The most significant environmental impact of this plan would be an increase in the flood threat to properties located downstream. During the 100-year event the properties in the vicinity of South Street, below the West-Southwest Branch confluence, would experience a 5-inch increase in the river stage. In the 30-year event the stage increase would be about 2.5 inches. This increase would occur earlier than augmented flows resulting from West Branch improvements. Although many of these properties would already experience flooding during these events, there would be some increase in damages resulting from the higher stages. These additional losses are estimated to average $300 annually. Although this figure appears insignificant in comparison to $100,200 in prevented losses upstream on the Southwest Branch, these downstream impacts must be mitigated.

Aside from these impacts, the effects of this plan on the environment would only be temporary. During installation of the auxiliary culvert, the turbidity level of the stream would increase. There would also be temporary noise associated with driving sheet piles for this same operation.

Plan Evaluation

This plan would provide a significant contribution to the plan objective of protecting structures in the flood plain. Out of 62 structures inundated by the 100-year flood in the natural condition, 22 would be completely protected. With respect to the other planning objectives, regional growth and social well-being would be slightly improved by this plan, and the wetland upstream of Barker Road would remain intact. The recreational value of the stream would not be altered by this plan and there are no historical structures identified along the Southwest Branch. The cost of this project would average $33,500 annually, including an annual non-Federal maintenance cost of $1,000 to prevent regrowth in the cleared overflow channel. This project would have a benefit/cost ratio of 2.99 to 1.00.

With respect to downstream impacts at South Street, several alternatives have been identified as a means of mitigating losses from stage increases. The first of these would be the relocation of the concrete encased sewer line presently located underneath the South Street bridge. Lowering this conduit to a position beneath the river bed would decrease the 100-year flood stage by approximately 7 inches. This action would offset the 5-inch increase caused by the additional culvert installed on the Southwest Branch, and it would also eliminate the debris-related flood problems already being experienced near South Street. The first cost for relocating this sewer line is a non-Federal responsibility and is estimated to total $50,000. Amortized over a 50-year project life at an interest rate of 7-1/8 percent, this cost would average $3,700 annually.

The second alternative would be the purchase of flood insurance to cover the increase in losses to properties near South Street. Approximately 25 structures in the subsections upstream of South Street would be impacted by the natural 100-year flood, and a 5-inch increase in this flood would impact 10 additional structures. Flood insurance costs for this area of Pittsfield are dependent on several factors including the difference in elevation, to the nearest foot, between the base flood (the 100-year flood) and the first floor. An increase of 5 inches in the stage of the 100-year flood is expected to raise the flood insurance factors of most of the structures involved by one category above their present classification. The annual cost of supplementary flood insurance costs incurred as a result of the 5-inch stage increase would total approximately $3,700 per year. However, if none of these structures were already covered by a flood insurance policy, the total cost of flood insurance for all structures located within the modified 100-year flood plain would cost $12,300 annually.

The third alternative would be the relocation of all structures susceptible to the 100-year flood. This alternative is considered impractical because of its expense and because it represents a far more encompassing plan than the mitigation of a 5-inch increase in the stage of the 100-year flood.

Of these alternatives, the optimum plan for mitigation of the downstream impacts would be the relocation of the concrete encased sewer line. Because of the variable nature of debris entrapment by this sewer line, the losses experienced upstream of this barrier are unpredictable and probably more frequent in occurrence than stream models indicate. By relocating this sewer to a position underneath the streambed, the adverse impacts of the supplementary culvert on the Southwest Branch would be mitigated, and the occurrence of debris-related floods would be reduced to a minimum. In effect, this plan would provide the residents near South Street with flood damage reduction beyond that required for the mitigation of the project impacts.

The first cost of this relocation would be a non-Federal responsibility estimated to total $50,000. At an annual cost of $3,700, this mitigation plan would raise the annual cost of Plan A to $37,200 and lower the benefit cost ratio to 2.69 to 1.00.

Public Views

Plan A originally called for installation of the auxiliary conduit only. At the time of the public meeting, however, there was some concern regarding the potential downstream impacts of this plan. Coordination of the proposed plans with Federal, State, and local agencies revealed a preference for this plan over any other proposal for the Southwest Branch. In response to this expressed preference, exhibited in letters in Appendix 3, brush clearing was added to the provisions of this plan and Plan A was offered as the recommended plan in subsequent meetings. However, while further coordination with the Berkshire County Regional Planning Commission and the Pittsfield Planning Board revealed this plan to be acceptable in regard to the trout habitat, it was apparent that without a mitigation plan for downstream impacts, this plan would not meet public approval. Plan A has subsequently been revised to meet the constraints identified through this coordination process, including a complete plan of mitigation of downstream impacts. It is expected that this plan will meet the approval of all parties involved.

Plan B - Double capacity of Conrail culvert - channelization upstream of Barker Road bridge

Plan Description

This plan addresses the two areas of channel constriction described in Plan A. The inadequate flow capacity of the Conrail culvert would be remedied in the same manner as Plan A, by installing an additional 150 square feet of discharge capacity through the bank to one side of the river. The other channel effort would be upstream of the Barker Road bridge, where the stream meander retards floodflows. This plan would excavate a 40-foot wide channel over a 1,300-foot distance of wetland to bypass the river where it meanders. This channel would be grass lined except in areas of high velocity, where it would be stone lined.

Impact Assessment

Under this plan of improvement, the reduction in the stage of the 100-year flood would be no different from that realized by Plan A. However, the channelization effort of this plan, versus the brush clearing floodpath of Plan A, would result in a larger reduction in floods of less than 25-year magnitude because these smaller floods are partly a function of the meander in the stream above the Barker Road bridge. The annual damages prevented by this channelization would be approximately $800, bringing annual benefits to a total of $101,000.

Plan B would have several adverse impacts on the environment as a result of the channelization effort. Currently, the Southwest Branch provides an excellent spawning and feeding habitat for brown trout. Channelization of this reach of the river would greatly disrupt this population because trout require small pools of water for breeding. Channelization would alter the gradient of this reach by shortening and straightening the channel, leaving less chance for these pools to develop. Furthermore, studies performed by the U.S. Fish and Wildlife Service have shown that channelization typically destroys trout populations.

In addition to these impacts, channelization of the Southwest Branch might cause more erosion than is currently typical of the river. Silts later deposited downstream could fill storage areas and alter the course of the stream with a potentially hazardous result.

Other environmental impacts of this project would result from installing the culvert through the Conrail embankment. Most significant would be the downstream stage increases described in Plan A. These impacts would be mitigated in the same manner as described under that plan. Other impacts would be temporary, such as increasing the turbidity of the stream during excavation.

Plan Evaluation

The effects of Plan B on the planning objectives are similar to those of Plan A. Twenty-two of 62 structures located in the 100-year flood plain would be completely protected and elsewhere the stage of this flood would be reduced by 7 feet. As such, the social well-being of these residents would be improved and there would be an increased potential for regional growth. The value of the Southwest Branch as a recreational resource would be destroyed along with the trout habitat of the stream, but the negative impacts of overbank flooding would be reduced.

Mitigation of the downstream impacts would add a non-Federal annual cost of $3,700, bringing the total annual cost to $65,600. With annual benefits totaling $101,000 this plan would have a benefit/cost ratio of 1.54 to 1.00.

While this plan has a favorable benefit/cost ratio, the increase in benefits realized by the channelization measure of this plan is less than the increment in costs. Specifically, the incremental benefit/cost ratio of this plan is 0.03 to 1.00, resulting from an increase of $28,400 in the annual cost of this project to provide channelization. Therefore, although the plan is economically justified, it is not incrementally justified, and it does not maximize excess benefits. Furthermore, there would be a net adverse impact on the account of Environmental Quality under this plan of protection. The disruption and possible elimination of the valuable trout habitat of the Southwest Branch under this plan of protection is unacceptable to Federal and State fish and wildlife agencies. The social benefits derived from the high level of flood protection provided by Plan B are not sufficient to overcome this disruption of environmental quality.

Public Views

This alternative was carried as the proposed plan at the public meeting in August 1979 and in letters of coordination sent to Federal and State agencies in January 1980.

At the public meeting there was much discussion of the loss of storage experienced on the Southwest Branch in the past, and the similar effects of increasing the capacity of the Conrail culvert. It was suggested that existing upstream reservoirs be used for surcharge storage instead of reducing this storage even further.

Response to the January coordination letters revealed firm opposition to Plan B as the recommended plan. Several letters of objection are exhibited in Appendix 3; these either cited the loss of trout habitat, the potential downstream impacts of the plan, or the lack of incremental economic justification as a reason of objection. As a result of this opposition, Plan B was dropped from further consideration as the recommended plan.

Plan C - Triple the capacity of the Conrail culvert

Plan Description

This plan addresses the inadequate discharge capacity of the Conrail culvert. The culvert is currently the major constriction to flow along the Southwest Branch, backing water up to Cadwell Road during major storms. This plan would triple the capacity of the Conrail culvert by installing two additional 150-square foot conduits through the Conrail embankment on each side of the river. The two structures would be as described for the single culvert in Plan A.

Impact Assessment

Increasing the flow area of the Conrail culvert by 300 square feet would reduce the stage of the 100-year flood by 8.5 feet. Overbank flooding would continue to occur during the more frequent events because this is more a function of the river meander upstream of Barker Road bridge. Under this protection plan, the number of houses threatened by the 100-year flood would be reduced to 34 from the 62 structures that would be flooded in the most probable future of Pittsfield without a project. Other structures remaining within the flood plain would be subject to less damages from all floods because of the reduced stages.

This benefit to the communities of west Pittsfield would total $120,300 annually in reduced damages from all frequency floods.

The principal environmental impact of this project would be a stage increase of approximately 6 inches at South Street during the 100-year flood. This downstream impact could be mitigated as in Plan A, by relocation of the concrete encased sewer line located under the South Street bridge. This relocation would be a non-Federal responsibility estimated to cost $3,700 annually. Other environmental impacts of this plan would be related to the construction phase of the project and would only be temporary.

Plan Evaluation

This plan would significantly reduce the stage of the 100-year flood. The primary objective of protecting structures along the Southwest Branch would be partially satisfied by Plan C. 34 of 62 structures would no longer be inundated during the 100-year flood and others located in the flood plain would experience less inundation. Regional growth and social welfare would improve, and the environment of the flood plain would experience less disruption during flood periods. Under Plan C the wetlands upstream of Barker Road would be preserved.

The average annual cost of this project would be $50,600, including the cost of mitigation, yielding a favorable benefit/cost ratio of 2.38 to 1.00. Plan C would provide a significant improvement over the most probable future of Pittsfield in the absence of a project. It would provide positive contributions to the accounts of National Economic Development and Social Well-Being.

Public Views

Plan C was presented as an alternative plan at the public meeting in August 1979, but it was not carried as a recommended plan in the letters of coordination sent in January 1980. However, in light of the higher ratio of benefits to costs of this plan over that of Plan B, several of the responses to the January letters expressed preference for this plan. For the most part, this plan would be acceptable to the residents in Pittsfield provided there would be no adverse impacts on downstream properties.

Plan D - Flood proofing, demolition and/or relocation

Plan Description

Flood proofing was considered as a viable non-structural alternative for reducing flood damages along the Southwest Branch. This protection plan involves modification of building foundations and basements to eliminate inundation during flood periods. In more severe cases of inundation by the 100-year flood, structures whose first floors were inundated by less than 3 feet would have to be raised to an elevation above the 100-year flood stage. Structures that would be inundated by more than 3 feet above the first floor would require demolition and/or relocation. Under this protection plan for the Southwest Branch, 19 structures would be given foundation improvements to prevent inundation, 7 structures would be raised 3 feet to above the elevation of the 100-year flood, and 35 structures would be either demolished or relocated. One building, the WBEC Radio Station, would be provided with a dike and interior drainage to protect it from 2 feet of inundation under the 100-year flood condition. The total cost of these provisions for the Southwest Branch is estimated to be $5,120,000.

Impact Assessment

The savings in physical flood losses reduced by this project would amount to approximately $52,600 annually. Other benefits resulting from evacuation of the flood plain would bring this total to $174,100 a year. While inundation of the flood plain would continue to occur under this protection plan, the 62 structures located within the flood plain would either be structurally safe or else relocated from the area. However, relocation of 35 structures would cause undue disruption to the development along West Housatonic Street (U.S. Route 20). There would be financial loss to commercial firms resulting from the relocations necessary under this plan, a loss which was not included in the first costs cited above nor in annual benefits.

Overbank scouring would continue to harm the environment of the flood plain, and high stream flows would disrupt the trout habitat along the Southwest Branch.

The disruption to community cohesion under Plan D would be severe, because more than half of the structures located in the flood plain would be relocated. Persons whose structures were modified would be inconvenienced by this construction. The social welfare accrued to the residents of the 27 structures given foundation modifications would not offset the loss to the owners of the 35 structures relocated under this plan.

Plan Evaluation

Plan D would have the following effect on the planning objectives: 27 of the structures located in the 100-year flood plain would be protected against flood damages, but the relocation of 35 others would severely disrupt community cohesion, social well-being and regional growth. Continued overbank flooding would disrupt the environment along the Southwest Branch, but there would be no change in the present condition of the wetlands and trout fisheries of this Branch.

Average annual costs of this protection plan are estimated to be $376,800. When compared with an annual benefit of $174,100 this project would have a ratio of benefits to costs of 0.46 to 1.00. Although this project would provide a substantial degree of protection against the 100-year flood, it would not provide a net benefit to the account of National Economic Development. In comparison to the most probable future of Pittsfield without a project there would be no substantial difference in the environmental quality of the drainage basin because overbank flooding would continue to occur at the same rate.

Finally, the plan contribution to social welfare would not be sufficient to outweigh the economic considerations because the displacement and evacuation required for the completeness of this plan would be highly disruptive to the community along West Housatonic Street.

Public Views

Although this plan has an unfavorable benefit-cost ratio it was presented at the public meeting in Pittsfield as a non-structural proposal. However, throughout the coordination program this plan did not receive public attention. It is believed that owing to persistent inundation of the flood plain, this plan would not be acceptable to public interests.

Plan E - Double Conrail culvert, brush clearing, plus non-structural measures

Plan Description

This plan combines the structural plan of installing an additional culvert through the Conrail embankment and clearing a half acre of flood plain upstream of Barker Road with the non-structural measure of flood proofing to provide protection against the 100-year flood. Under this protection plan a 15-foot diameter culvert would be installed through the Conrail culvert as described in Plan A, and a half-acre strip of flood plain would be cleared of brush and vegetation to allow floodflows an unrestricted overbank discharge path downstream. In addition, approximately 40 of 62 structures located in the natural flood plain would require flood proofing to be protected against the 100-year flood. Thirty-two structures would have their foundations waterproofed, two would be raised to an elevation above the modified 100-year flood stage and six would be relocated from the flood plain.

Impact Assessment

This project would increase the benefits resulting from either a completely non-structural plan or a limited structural plan. The first cost of this project would include $1,127,000 for flood proofing and $491,200 for the structural measures of Plan A. The annual benefits derived from this plan would total $132,100.

The impacts of both the structural and non-structural plans of A and D would result from this alternative. The stage of the 100-year flood would be reduced by up to 7.5 feet and 40 structures remaining within this modified flood plain would be protected from inundation. Six of these structures, however, would be relocated from the flood plain altogether, a negative social impact.

The environmental impacts of this alternative would be minor and similar to those of Plan A. Continued overbank flooding would cause less scouring than that occurring in the without project condition, but the downstream discharge resulting from the auxiliary culvert would require mitigation by the same proposal carried in Plan A, relocation of the sewer line under South Street bridge. In addition, there would be a loss of vegetation in 5 percent of the flood zone upstream of the Barker Road bridge as a result of the channel clearing proposed in Plan A.

Plan Evaluation

This plan would satisfy the primary planning objective of contributing to the preservation of structures along the Southwest Branch. Regional growth would be hindered, however, by the relocation of commercial buildings from the flood plain. The recreational value of the Southwest Branch would be preserved but not enhanced by Plan E, and the reduction of flood stages along the river would enhance the environmental quality of this reach. The cutting of an overland flow path for the flood flows upstream of Barker Road would only disturb one half acre of wetland.

The annual cost of this protection plan would total approximately $120,100 when the non-Federal costs of brush clearing and downstream mitigation are included. Compared with an annual benefit of $132,100, Plan E would have a benefit/cost ratio of 1.10 to 1.00. While this plan would provide structures with protection against floods up to the 100-year magnitude, there would continue to be some non-physical losses resulting from overbank flooding of streets and parking lots. Socially and environmentally this plan would translate into an improvement over the most probable future of Pittsfield without a water resources project, but its completeness would depend on maintenance of a cleared area through the wetlands and relocation of the sewer line at South Street, both of which are non-Federal responsibilities. In addition, Section 280.7 of ER 1165-2-122 states in part that "...flood proofing measures that would leave occupied buildings inaccessible during a flood, thereby extending the public commitment for continuing emergency assistance, will not be recommended."

Public Views

Public opinion of this proposal has not been documented as it was not carried as a plan at the public meeting in August 1979.

Plan F - Triple Conrail culvert plus non-structural measures

Plan Description

This alternative combines the structural plan of tripling the capacity of the Conrail culvert with the non-structural plan of flood proofing the buildings remaining in the modified flood plain. Protection to the downstream properties at South Street is also included in this plan. Under this plan of improvements, 28 structures would require flood proofing of which 6 would require relocation from the flood plain. The first cost of this project would total approximately $1,767,700, including a first cost of $682,500 to install the additional culverts and to mitigate the downstream impacts.

Impact Assessment

This protection plan would provide approximately $147,800 in annual benefits by reducing the 100-year flood stage and protecting from inundation approximately 22 structures remaining in the flood plain. The number of structures removed from the flood plain in this plan is identical to Plan E. The incremental reduction of 1 foot in the modified 100-year flood stage under the structural measures of Plan C would not be sufficient to provide alternative means of protection to these six structures. The stage of the 100-year flood, as a result of installing the two culverts, would be reduced by approximately 8.5 feet at the entrance of Maloy Brook, while downstream at the South Street bridge the stage of the same flood would be increased by approximately 6 inches. Property owners in this downstream area would be provided protection against this increment in flood stage through the relocation of the sewer line that traverses the river underneath the South Street bridge. This would be a non-Federal responsibility with a first cost of $50,000, as described in Plan A. Other impacts of this project would include the temporary impacts of the excavation and installation of the auxiliary culverts at the Conrail embankment, including the noise of this operation.

Socially, approximately 90 percent of the structures threatened by the 100-year flood in the without project condition would be relieved of this threat. However, the remaining 10 percent comprised mostly of commercial buildings located along West Housatonic Street (U.S. Route 20), would have to be relocated from the flood plain. This action would be disruptive to the community already developed along the Southwest Branch and U.S. Route 20.

Plan Evaluation

Plan F would contribute to the planning objectives in the same way as Plan E, except for the wetland which would be undisturbed. Six structures evacuated from the flood plain would depress opportunities for regional growth but social well-being related to a structure's safety would be enhanced.

The benefit/cost ratio of Plan F is 1.13 to 1.00. This represents a positive contribution to the account of National Economic Development and an improvement over the conditions of the Southwest Branch in the absence of a water resource project. However, this plan's completeness would be dependent upon the non-Federal cost sharing of flood proofing, relocation from the flood plain of the commercial buildings located along U.S. Route 20 and relocation of the sewer line beneath South Street. As this plan would have no beneficial contributions to the account of Environmental Quality and it would have moderate adverse impacts on the account of Social Well-Being, its ratio of benefits to costs would be the only impact favoring implementation.

Public Views

Public opinion of this proposal has not been documented as it was not carried as a plan at the public meeting in August 1979.

COMPARISON OF DETAILED PLANS

This section summarizes the comparison analysis of detailed plans that led to the selection of recommended plans for flood control improvements on the West and Southwest Branches of the Housatonic River. A more detailed analysis, which illustrates the differences between the alternative plans and explains the rationale for selection of the recommended plan, is contained in Appendix 2. Emphasis has been placed on the differences and performance of those plans which meet the planning objectives.

Comparison of Detailed Plans

The plans discussed in the previous section, "Description, Assessment, and Evaluation of Detailed Plans," evolved from several iterations of the planning process. There are distinct differences in their performance, efficiency in meeting one or more of the planning objectives, and in their justification in terms of beneficial versus adverse contributions. A summary comparison of alternative plans is presented in the Conclusion of the report, while the System of Accounts table, quantifying the plan contributions to the NED, EQ and SWB accounts, is presented in Appendix 2. These tables provide a comparison of the detailed plans, and the basis for final selection of a recommended plan for local flood protection along the West and Southwest Branches of the Housatonic River.

West Branch

Of the final detailed plans for the West Branch, Plan C (major channel project) provides the highest degree of flood protection. However, this plan is also the most expensive and the most damaging to the environment. Its costs are far from justified when compared with estimated flood reduction benefits, and excavating a channel between the Tel-Electric Dam and Columbus Avenue would destroy the aquatic life of this reach. Of the remaining structural proposals, Plan B (dam modifications plus bridge replacement) affords more protection against the 100-year flood than Plan A (dam modifications only). It reduces the stage of this flood 3.5 to 4 feet more than the reduction of Plan A. However, the costs and impacts of Plan B are more severe. The replacement of the West Street bridge under Plan B would tend to increase the volume of runoff from Wahconah Park to downstream areas. In addition, Plan B is only marginally justified with a benefit-cost ratio of 1.14 to 1.00 and residual losses totaling $42,500 annually. Under Section 205 authority, the replacement of the West Street bridge is a non-Federal responsibility. In addition, because lowering the Tel-Electric dam will only reduce flood stages by a relatively small amount, leaving high residual annual losses, this element of Plans A and B is considered to be a local drainage improvement measure, and a non-Federal responsibility. Consequently, implementation of either Plan A or B would be a local responsibility. Of these, Plan A is the more economically feasible, with a benefit-cost ratio of 3.75 to 1.0 and excess benefits maximized at $8,800 annually. However, although this may be the case, it is recommended that if Plan A is implemented, city and State officials explore plans to replace the West Street bridge at a later date. Finally, a comparison of Plan A and the non-structural proposals of Plan D (flood proofing, relocation) reveals that again Plan A provides the highest excess benefits of the two plans. In fact, the benefits associated with flood proofing do not justify the costs of implementing Plan D. Furthermore, the implementation of the non-structural plans would have residual adverse impacts associated with the continued inundation of the flood plain. Under Plan A, lowering the dam 3 feet would permit continued inundation of some areas of the flood plain depending on the severity of the flood event, but the estimated reduction of damages associated with this limited degree of protection does justify the project costs. This is not the case with flood proofing. Finally, the plans combining structural and non-structural elements would not provide positive contributions to the NED account.

Southwest Branch

On the Southwest Branch the comparison of proposals that meet the planning objectives is similar to that for the West Branch, in that the difference between plans lies primarily in the degree of flood protection provided rather than in the method of achieving flood protection. None of the plans would eliminate the 100-year flood problems of properties along U.S. Route 20, including the Pittsfield Plaza (see Plate 3 attached to report). A detailed analysis of non-structural protection, Plan D, is included in Appendix 2 and indicates a lack of economic justification. Aside from being too costly, this non-structural proposal has the residual adverse social impact of continued inundation of the flood plain and relocation of several buildings from the flood plain. The same is true for the combination Plans E and F. The remaining possibilities for flood protection on the Southwest Branch exist in the first three structural proposals. Each of these plans would have similar impacts on the properties located downstream of the proposed improvements. Because these properties at South Street would experience an additional 5 to 6 inches of flood stage during the 100-year event as a result of these plans, each of the plans includes a proposal to mitigate these potential losses through relocaton of the utility conduit presently located under South Street bridge.

Of the three structural proposals, Plan A has the highest benefit-cost ratio and it substantially reduces the stage of the 100-year flood. Plan A also contains provisions to reduce the stage of smaller floods by clearing the heavy growth out of the flood plain in a direct overland path from Maloy Brook to the Barker Road bridge. Plan B, by relocating the entire channel, instead of clearing an overland path, would provide slightly greater benefits ($1,000 annually) than Plan A. However, this added benefit would not justify the incremental costs of the channel relocation, and could only be derived at great expense to the environment, i.e. the detrimental effects of channelization on the exceptional fishery habitat of this reach. For these reasons, Plan B is the least acceptable structural plan. Plan C, which would double the capacity of the installed culvert, is the economically preferred plan because it maximizes net benefits. However, although it would reduce 100-year flood stages by an additional foot beyond the reduction of Plan A, floods of lesser frequency would not be eliminated by this plan, (it would not include straightening the channel or clearing under brush from the flood plain). Because of this, Plan C would not provide as diverse protection as that desired by the local community, leaving Plan A as the only popular alternative meeting the "acceptability" criterion.

Rationale for Designation of NED Plans

On the West Branch the plan which provides the maximum contribution to the NED account is Plan A. This plan maximizes net economic benefits and also provides positive contributions to other accounts. The rationale for selecting this plan as the NED plan was simplified by the determination that this was the only formulated plan of flood protection having more than marginal economic justification. On the Southwest Branch, Plan C is designated the NED plan because it also maximizes net economic benefits.

Rationale for Designation of EQ Plans

The EQ plans are those which provide the greatest contribution to the environmental quality of the project area. Each plan's contribution is evaluated relative to the planning objectives of the investigation and in terms of significant impacts to other components of the EQ account. Because the principal objective of this study was to reduce flood damages along the West and Southwest Branches, no plans were specifically formulated to enhance environmental quality. However, because flooding was identified as being detrimental to the existing quality of the project area, each flood control plan is considered to provide some beneficial contribution to the environment while some of the alternatives would induce extreme adverse impacts, offsetting the benefits of reduced flooding, two plans have been identified which provide maximum net positive benefits to the EQ account. On the West Branch, Plan B is designated as the EQ Plan, because it provides the greatest reduction in flood stages without impacting significant adverse impacts to the stream or wetland environment. On the Southwest Branch, Plan A has been designated as the EQ plan. Although it does not reduce flooding as much as Plan C, it would provide relief from a broader range of floods, without inducing the adverse impacts of the channelization proposed by Plan B.

Rationale for Selected Plans

The plans selected for implementation in the local flood protection project of Pittsfield are Plan A on the West Branch and Plan A on the Southwest Branch.

On the West Branch, lowering the Tel-Electric Dam is the only plan that is economically feasible. While Plan B has marginal economic justification, there is no indorsement by non-Federal sponsors for funding a replacement of the West Street bridge at this time. Plan A also provides net positive benefits to the NED, SWB and RD accounts and has been indorsed by the public for implementation. However, because the scope of improvements in Plan A is limited to altering an existing dam, the total first costs of this project are a non-Federal expense of $29,600.

On the Southwest Branch, Plan A is the recommended plan for several reasons. While it is not the NED plan, Plan A does have the highest benefit cost ratio. In addition, the two measures of Plan A accomplish nearly equal flood damage reduction as the measure in Plan B, but with far less disruption to the environment. Finally, without the advantage of a complete survey of the property located downstream at South Street, Plan A (with one culvert) becomes preferred over Plan C (2 culverts) because of the lesser flow being transferred downstream. Coordination with local interests indicates that Plan A is the only acceptable plan.

CONCLUSIONS

This section of the report contains the Statement of Findings, which substantiates the concern for serving the public interest. It summarizes factors which influenced a decision on the proposed actions and recommendations, based upon environmental, social, engineering and economic disciplines. Also included in this section are the summary comparison tables for each branch as required by ER 1105-2-921. Specific impacts which must be addressed to comply with Section 122 of PL 91-611 have been denoted with an asterisk in these tables.

Statement of Findings

All plan formulation data concerning the proposed actions and the stated views of other interested agencies and individuals have been reviewed and evaluated. In accordance with interdisciplinary planning within the multi-objective framework of Principles and Standards, various practicable alternatives for providing flood control improvements for Pittsfield were investigated. Alternatives have been evaluated for environmental, social well-being and economic effects, including regional and national development and engineering feasibility. During plan formulation, the following points were considered pertinent:

. The project should provide a high degree of flood protection for potential flood damage areas in Pittsfield.

. The project should be sized at the optimum economic capacity, be functionally adequate and economically justified.

. Care should be taken to minimize adverse environmental effects.

The proposed actions, as developed in the "Description Assessment and Evaluation of Detailed Plans" and "The Recommended Plan" sections of the report is based on thorough analysis and evaluation of various practicable alternative courses of action for achieving the stated objectives. The selected plans meet the evaluation criteria, i.e., acceptability, completeness, effectiveness, efficiency, certainty, geographic scope, NED benefit-cost ratio, reversibility and stability. The selected plans are consonant with national policy, statutes and administrative directives, and the total public interest would be served by implementation of the selected plan.

TABLE 1
WEST BRANCH
SUMMARY COMPARISON OF FINAL ALTERNATIVE PLANS

	BASE CONDITIONS (1979-80)	WITHOUT CONDITION NO ACTION ALTERNATIVE	WITH CONDITION PLANS PLAN A (NED)	PLAN B (EQ)	PLAN C	PLAN D NON-STRUCTURAL
A. PLAN DESCRIPTION			Dam Modification	Dam Modification and Bridge Replacement	Major Channel Mod. Bascule Gate Install. Bridge Replacement	Flood proofing, Raising, Acquisition, Relocation of structures in 100-year flood plain.
1. Major Features	Primarily flood-prone residential properties located between Tel-Electric Dam and Wahconah Park.	Continued threat of flooding to properties.	Lower Tel-Electric Dam crest 3 Feet.	Lower Tel-Electric Dam 3 feet; replace existing stone arch West Street bridge with twin 25-foot wide openings.	Lower Tel-Electric Dam 11 feet. Install an 8-foot high Bascule gate top of dam. Widen channel to 40 feet between the dam and Wahconah Park. Modify railroad bridge abutment and piers. Replace West St. bridge.	Floodproofing, raise building foundation where flood proofing not feasible. Demolition or relocation if design flood 3 feet or greater over first floor.
2. Land Taking Requirements	150 acres of flood-prone land exist.	No land taking required.	Acquisition of private dam by city of Pittsfield.	Acquisition of dam and land related to bridge replacement.	Major land taking required for channel widening, acquisition of dam and land related to bridge replacement and mod. of railroad piers.	Conversion of about 5 acres to "green-belt" resulting from relocations.
B. IMPACT ASSESSMENT						
1. National Economic Development (NED)						
*a. Regional Growth	Limited by economic conditions (inflation).	Slow growth.	No impact on regional growth.	Limited impact.	Would allow all development and expansion.	Limited impact.
*b. Tax Revenues	Substantial municipal budget.	Tax rate increases expected each year.	Slight increase in tax revenues.	Small increase in tax revenues.	Large increase in tax base.	Relocation encourages expansion, increasing tax revenues.
*c. Property Values	Generally low values of buildings in flood plain.	Continued deterioration of properties.	Limited increase.	Greater increase in property values due to lower flood profile.	Substantial increase.	Limited increase in value of flood proofed buildings.
*d. Business Activity	A few small businesses located in flood zone.	Unable to expand business due to flood threat.	Limited business expansion.	Proportionately greater chance for expansion.	Unlimited opportunities.	Disruption of customers during relocation.

TABLE 1
WEST BRANCH (Cont'd)

	BASE CONDITIONS (1979-80)	WITHOUT CONDITION NO ACTION ALTERNATIVE	WITH CONDITION PLANS PLAN A (NED)	PLAN B (EQ)	PLAN C	PLAN D NON-STRUCTURAL
e. Unemployment	Average	No change	Temporary employment increase.	More labor than Plan A.	More labor than Plan B.	Increase labor market.
f. Land Use	Flood plain primarily developed by residences except wetland near Wahconah Park.	Without adequate zoning wetland may be filled.	Little land use change.	Little land use change.	Lowered channel invert would drain wetlands. Increase in development.	Additional land required for relocated structures. Loss of high use of flood plain.
2. Environmental Quality (EQ)						
*a. Man-made Resources	Tel-Electric Dam, Wahconah Park	Filling of park land above the flood plain.	Lower the dam 3 feet. City may fill park land.	Lower the dam 3 feet. City may fill park land.	Lower the dam 11 feet. City may fill park land.	No change at dam site. City may fill park land.
*b. Natural Resources	Large wetland opposite Wahconah Park.	Filling of park land could affect wetland hydrology.	Less frequent flooding of wetland experienced.	Further reduction of impact on wetland.	Channel project could adversely effect wetland hydrology.	Increase open space available after relocation.
*c. Water Quality	Designated Class C by Massachusetts Division of Water Pollution Control. Suitable for secondary water contact recreation.	Not expected to change.	Temporary reduction during construction.	Same as Plan A.	Channel protection would inhibit channel siltation after construction.	No change in water quality.
d. Ecosystems	Macroflora and microfauna in basin.	No change in ecosystems.	Minor change.	Same as Plan A.	Same as Plan A.	No change in ecosystems.
e. Cultural Resources	Three historical sites identified.	In the future, other sites may be designated as having historical value.	No impact.	Same as Plan A.	Potential for disturbing sites along the river.	No change.
f. Fish & Wildlife	No fish resource in river.	Fish may be stocked if pollution controlled.	No impact on potential fish resource.	Same as Plan A.	Channelization has negative impacts on future fish resource.	No impact.

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TABLE 1
WEST BRANCH (Cont'd)

	BASE CONDITIONS (1979-80)	WITHOUT CONDITION NO ACTION ALTERNATIVE	WITH CONDITION PLANS PLAN A (NED)	PLAN B (EQ)	PLAN C	PLAN D NON-STRUCTURAL
3. Social Well-Being (SWB)						
*a. Displacement	N/A	None	None	None	None	Excessive
*b. Aesthetics	Generally depressed residential areas.	Some renovation of older buildings.	Same as "without" condition.	Same as Plan A.	Cleaner channel and emphasis on aesthetic improvements.	Some improved appearance of structures.
*c. Noise	N/A	No change in noise levels.	Some noise incurred during construction only at one site.	Increase in noise owing to working at two sites.	Greater increase in noise levels owing to increase in scope of project.	Largest noise increase working closer to and adjacent to all developed properties.
*d. Community Cohesion	Primarily urban setting of residential neighborhood.	City plans to promote cohesion and proximity to shopping center.	Small promotion.	Larger promotion than Plan A.	Improvements would bring neighbors closer together.	General fracture of neighborhoods.
e. Transportation	Several city streets across river and in flood zone.	Disruption of traffic during floods.	Some increase in truck traffic during construction.	Same as Plan A plus bridge closed, detour required.	Major increase in truck traffic during construction.	Increased truck traffic and equipment moving through developed area and major disruption during relocations.
f. Health & Safety	Threat of disease spread and loss of life during flood periods.	Continued threat to disease spread and loss of life.	Limited reduction in disease spread and threat of loss of life.	More reduction than Plan A.	Potential disease spread and flood threat eliminated.	Possible false sense of security and slight decrease in potential disease spread.
4. Regional Development (RD)						
*a. Taxes	State, local, and Federal, sales, gas, real estate etc.	Continued high tax.	Reduction in emergency expenditures.	Further reduction in emergency cost.	Elimination of emergency costs.	Continued costs to taxpayers for emergency services.
*b. Community Growth	Growth dependent on tax base and Federal aid.	Slow growth.	No impact on growth.	Little impact on growth.	Allows for urban development of flood plain.	Disrupts growth.
*c. Employment & Income	Central city for labor market area (SMSA).	No increase in income decline relative to U.S.	Provides wages for regional labor.	Same as Plan A.	Provides wages for an extended period. No loss of income due to flooding.	Provides wages for an extended period. Some loss of income due to flooding of streets.

TABLE 1
WEST BRANCH (Cont'd)

	BASE CONDITIONS (1979-80)	WITHOUT CONDITION NO ACTION ALTERNATIVE	WITH CONDITION PLANS PLAN A (NED)	PLAN B (EQ)	PLAN C	PLAN D NON-STRUCTURAL
C. PLAN EVALUATION						
1. Contribution to Planning Objectives.						
a. Preservation of Buildings	Periodic flood damages to 202 residential and commercial properties.	Continuation of flood conditions.	Approximately 28 structures completely protected. Reduction of flood damages; 1' to 1.5' reduction in stage of 100-year flood.	Approximately 69 structures completely protected. Further reduction in flood damages; 5' reduction in stage of 100-year flood.	Protection of all structures in flood plain. Elimination of flood damages up to the 100-year flood.	Prevention of inundation in all structures remaining in flood plain. Flooding continues. Less property damage but continued threat to public health and safety.
b. Enhance Environmental Quality	Flooding causes disruption of environmental reginine. (siltation, debris etc.)	Continued adverse impacts on environment.	Reduction of flood threat.	Additional reduction in flood levels.	No disruption during flood periods.	Continued adverse impacts on flood prone lands.
c. Contribute to Recreation Potential	Limited recreation available at Wahconah Park (baseball stadium).	Periodic flooding of baseball stadium.	Reduction of flood threat.	Additional reduction in flood levels.	Increased opportunity to provide more facilities at Wahconah Park.	Periodic flooding of land continues.
d. Encourage Economic Growth	Limited developable land available.	Not reasonable to expect improvement to property.	Limited enhancement possibilities.	Some property owners may perform improvements.	Increases potential for economic growth.	Limited growth expected.
e. Preserve National or Historic Sites	Two historic sites identified in flood plain.	No change.	No change.	No change.	Possible sites may develop from excavation process.	No change.
f. Contribute to Flood Plain Management	Zoning requires building above the 100-year flood elevation.	Pittsfield on regular flood insurance policy.	No change.	No change.	No change.	No change.
2. Net (With vs. Without) Beneficial						
a. National Economic Development (NED)	Generally depressed area of the city.	Very little upgrading and improvement, some urban development.	Average annual benefits - $12,000.	Average annual benefits - $33,300.	Average annual benefits - $70,800.	Average annual benefits - $61,200.

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TABLE 1
WEST BRANCH (Cont'd)

	BASE CONDITIONS (1979-80)	WITHOUT CONDITION NO ACTION ALTERNATIVE	WITH CONDITION PLANS PLAN A (NED)	PLAN B (EQ)	PLAN C	PLAN D NON-STRUCTURAL
b. Environmental Quality (EQ)	Urban environmental setting.	No contribution.	Minor contribution.	Greater contribution than Plan A.	Channelization would disrupt habitat.	Increase open space.
c. Social Well-Being (SWB)	Primarily residential neighborhood.	Threat of disease and loss of life.	Some beneficial contribution.	Increased beneficial contribution.	Highest beneficial contribution.	Continued potential spread of disease and threat to loss of life and neighborhood disruption.
d. Regional Development (RD)	Principal city in western Massachusetts.	No contribution.	Minor contribution.	Same as Plan A.	Allows for individual property improvements and development.	Lowers tax base because of relocations.
3. Plan Response to Associated Evaluation Criteria						
a. Acceptability	Needs flood control improvements.	Not desirable.	Favored by majority of citizens and F&W officials.	Large local cost for bridge replacement, otherwise favorable.	Not acceptable to F&W and downstream residents.	Generally favorable.
b. Effectiveness		No change.	Reduces flooding. No impact on downstream areas.	More effective than Plan A. Slight impact on downstream areas.	Provides 100-year protection.	Flooding of area continues.
c. Certainty			Implementation contributes to NED & EQ accounts.	Less contribution to the NED account.	Negative contribution to EQ account.	No change to EQ account.
d. NED Benefit/Cost Ratio			3.75	1.14	0.38	0.35
e. Reversibility			Plan can be restored to "without" condition.	Bridge cannot be restored.	Channel reconstruction would be inexpensive.	Not reversible. Zoning requirements.
4. Rankings of Planned Contributions						
a. NED Objectives			Greatest contribution.	Less contribution.	Least contribution.	Same as Plan C.
b. EQ Objective			Minor contribution.	Greatest contribution.	Least contribution.	Minor contribution.

TABLE 1
WEST BRANCH (Cont'd)

	BASE CONDITIONS (1979-80)	WITHOUT CONDITION NO ACTION ALTERNATIVE	WITH CONDITION PLANS PLAN A (NED)	PLAN B (EQ)	PLAN C	PLAN D NON-STRUCTURAL
c. SWB Account			Least contribution of structural plans.	Positive contribution.	Major contribution except for negative impact on downstream areas.	Detrimental contribution.
d. RD Account			No contribution.	Same as Plan A.	Greatest contribution, i.e., highest costs for labor and materials.	Less contribution than Plan C.
D. IMPLEMENTATION RESPONSIBILITY						
Federal First Cost		0	$0	$0	$2,065,500	$1,898,000
Federal Annual Cost		0	$0	$0	$152,000	$139,700
Non-Federal First Cost		0	$29,600	$384,900	$431,400	$472,000
Non-Federal Annual Cost		0	$3,200	$29,300	$34,300	$34,700
Non-Federal Requirements			Modific[illegible] of dam, project lands, easements and rights-of-way. Utility relocations. Hold and save harmless. Maintain and operate.	Same as Plan A plus bridge replacement costs.	Same as Plan B.	25% of total first cost.
Flood Plain Regulations (EO 11988)		Prohibits development within flood plain limits, continue compliance with FIA (Regular Program).	Prevent encroachment on channel.	Same as Plan A.	Same as Plan A.	Same as Plan A.
Protection of Wetlands (EO 11990)		Comply with Federal and State Wetland Acts.	No wetland areas impacted.	Same as Plan A.	Prevention of wetland inundation during flood periods.	Increase open space to supplement existing wetlands.

TABLE 2
SOUTHWEST BRANCH
SUMMARY COMPARISON OF FINAL ALTERNATIVE PLANS

	BASE CONDITIONS (1979-80)	WITHOUT CONDITION NO ACTION ALTERNATIVE	WITH CONDITION PLANS PLAN A (EQ)	PLAN B	PLAN C (NED)	PLAN D NON-STRUCTURAL
A. PLAN DESCRIPTION			Additional culvert (150 sf.) under Conrail embankment plus channel clearing.	Additional culvert (150 sf.) under Conrail embankment plus channel excavation.	2 additional culverts (300 sf.) under Conrail embankment.	Flood proofing, raising, acquisition, relocation of structures in 100-year flood.
1. Major Features	Primarily commercial properties along a major highway (U.S. Rt. 20). Also residential properties within small subdivision.	Continued threat of flooding to properties.	15' diameter metal pipe through earth fill embankment. 1,000' channel clearing upstream from Barker Road.	15' diameter metal pipe. 1,000' channel excavation and stone protection.	(2)-15' diameter metal pipes at railroad embankment.	Floodproofing, raise building foundations where flood proofing not feasible. Demolition or relocation if design flood 3 feet deep over first floor.
2. Land Taking Requirements	Approximately 50 acres of flood-prone land exist.	No land taking required.	Obtain easement from Conrail and from private owner (approx. 1 acre).	Same as Plan A.	Obtain easement from Conrail only.	Acquistion of land where buildings demolished or relocated .
B. IMPACT ASSESSMENT						
1. National Economic Development (NED)						
*a. Regional Growth	Limited by economic conditions (inflation).	Slow growth.	Allows for expansion and development along major roadway (U.S. Rte. 20).	Same as Plan A.	Some increased potential for growth over Plan A.	Limited impact.
*b. Tax Revenues	Substantial municipal budget.	Tax rate increases each year.	Additional revenues expected from commercial expansion.	Same as Plan A.	Minor increase over Plan A.	Relocation encourages expansion outside of flood plain, increasing tax revenues.
*c. Property Values	Declining due to loss of tenants at shopping center.	Continued decline.	Property values will rise substantially.	Same as Plan A.	Further increase in values.	Increase in value of flood proofed buildings.
*d. Business Activity	Gas stations, motel, fast food restaurants shopping center.	Some business may relocate or close.	Incentive for increased activity.	Same as Plan A.	Further incentive for increased activity.	Disruption to business during relocation.

TABLE 2
SOUTHWEST BRANCH (Cont'd)

	BASE CONDITIONS (1979-80)	WITHOUT CONDITION NO ACTION ALTERNATIVE	WITH CONDITION PLANS PLAN A (EQ)	PLAN B	PLAN C (NED)	PLAN D NON-STRUCTURAL
e. Unemployment	Closed stores account for some unemployment.	Continues.	Employment increase with expansion and store openings.	Same as Plan A.	Same as Plan A.	No long-range impact on employment.
f. Land Use	Flood plain includes primary highway and roadside development.	Zoning could control further expansion within flood plain.	Would increase potential for further roadside expansion without impacting on wetland.	Same as Plan A.	Same as Plan A.	Additional land required for relocated structures.
2. Environmental Quality (EQ)						
*a. Man-made Resources	U.S. Route 20, Pittsfield Plaza Commercial buildings.	Continued deterioration of structures.	Increase preservation of resources.	Same as Plan A.	Same as Plan A.	Preserves some buildings.
*b. Natural Resources	Wetland area upstream from Barker Road.	No change.	Preserves wetland area.	Destroys a part of the wetland by channelization.	Same as Plan A.	Increased open space available for "green belts"
*c. Water Quality	Designated Class C by Massachusetts Division of Water Pollution Control.	State may attempt to increase quality standards.	Temporary reduction during construction.	Same as Plan A.	Same as Plan A.	No change.
d. Ecosystems	Microflora and Microfauna in basin.	No change.	Minor change.	Disruption of ecosystems.	Same as Plan A.	No change.
e. Cultural Resources	None identified.	No change expected.	No impact.	May find artifacts during channel excavation.	No impact.	No impact.
f. Fish & Wildlife	Major brown trout habitat.	Continued stocking of river.	Minor impact.	Major disruption of brown trout resource.	Same as Plan A.	No impact.
g. Downstream Impacts	Sewer conduit underneath South Street bridge blocks debris, causing flooding.	Continued flooding.	5-inch increase in stage of 100-year flood at South Street.	Same as Plan A.	Larger increase than Plan A, approx. 6 inches.	No impact.

TABLE 2
SOUTHWEST BRANCH (Cont'd)

	BASE CONDITIONS (1979-80)	WITHOUT CONDITION NO ACTION ALTERNATIVE	WITH CONDITION PLANS PLAN A (EQ)	PLAN B	PLAN C (NED)	PLAN D NON-STRUCTURAL
3. Social Well-Being (SWB)						
*a. Displacement	Families relocated during flood periods.	Continued displacement during floods.	Considerably reduced.	Same as Plan A.	Same as Plan A.	Excessive displacement for demolished or relocated buildings.
*b. Aesthetics	Commercial area and generally depressed residential area.	Slow building deterioration.	Owners will improve property.	Same as Plan A.	Same as Plan A.	Improved appearance of some structures.
*c. Noise	Normal roadway and railroad noise.	No change.	Temporary increase during construction, increase in truck traffic.	Same as Plan A.	Same as Plan A.	Increased truck traffic and equipment moving through developed area and major disruption during relocation.
*d. Community Cohesion	Small subdivision near Cadwell Road.	No change.	Allows for closer community planning.	Same as Plan A.	Same as Plan A.	Disrupts cohesion.
e. Transportation	Major East-West highway (U.S. Route 20).	Disrupted during flood periods.	Only disrupted during major floods.	Additional flood protection.	Further reduction of flood frequency.	Continued frequent disruption of traffic during floods.
f. Health & Safety	Threat of loss of life and disease spread during flood.	Continued threat.	Reduced threat to loss of life and spread of disease.	Additional threat reduction.	Greater than Plan B.	Continued threat of loss of life, spread of disease.
4. Regional Development (RD)						
*a. Taxes	High tax burden.	Continued.	Increased revenue from improved properties.	Same as Plan A.	Same as Plan A.	Continued cost to the tax payers for emergency services.
*b. Community Growth	General decline of local business community.	Continued decline.	Allows for growth turn-around.	Increased growth.	Same as Plan B.	May disrupt growth.
*c. Employment & Growth	General decline.	Decline relative to United States.	Provides wages for regional labor.	Same as Plan A.	Same as Plan A.	More costly than structural plans. Provides wages for an extended period. Some loss of income due to flooding of streets.

TABLE 2
SOUTHWEST BRANCH (Cont'd)

	BASE CONDITIONS (1979-80)	WITHOUT CONDITION NO ACTION ALTERNATIVE	WITH CONDITION PLANS PLAN A (EQ)	PLAN B	PLAN C (NED)	PLAN D NON-STRUCTURAL
C. PLAN EVALUATION						
1. Contribution to Planning Objectives.						
a. Preservation of Buildings	Periodic flooding of highway and 62 residential and commercial properties.	Continued flooding.	Approximately 22 structures protected. 100-year flood level reduced approx. 7'.	Same as Plan A. Further reduction of floods more frequent than once in 25 years.	Approximately 34 structures protected. 100-year flood level reduced approx. 8.5'.	Prevention of inundation of all structures remaining in flood plain. Flooding continues; less property damage than without condition.
b. Enhance Environmental Quality	Flooding causes adverse environmental impacts.	Continued adverse impacts.	Reduction of flooding increases environmental quality.	Additional reduction of flood threat.	Further reduction of flood threat.	Continued adverse impacts on flood-prone areas.
c. Contribute to Recreation Potential	Fishing is major recreation feature in flood area.	Continued limited recreation.	No impact on fishing potential.	Would reduce fishing.	Same as Plan A.	Possible "greenbelt" acquisition along river, owing to relocations.
d. Encourage Economic Growth	Limited developable land available (i.e., exclude wetland).	No encouragement for growth.	Substantial growth can occur.	Same as Plan A.	Same as Plan A.	Some growth can be expected.
e. Preserve National or Historic Sites	No known historic sites in this area.	No change.	No change.	Some artifacts may be found with channel excavation.	No change.	No change.
f. Contribute to Flood Plain Management	Present enforcement of zoning regulations.	Continued enforcement.	No change.	No change.	No change.	No change.

TABLE 2
SOUTHWEST BRANCH (Cont'd)

	BASE CONDITIONS (1979-80)	WITHOUT CONDITION NO ACTION ALTERNATIVE	WITH CONDITION PLANS PLAN A (EQ)	PLAN B	PLAN C (NED)	PLAN D NON-STRUCTURAL
2. Net (With vs. Without) Beneficial						
a. National Economic Development (NED)	Retail stores and general commercial zone.	Curtailed economic development.	Encourages NED. Average annual benefits $100,200	Same as Plan A. Average annual benefits $101,000.	Same as Plan A. Average annual benefits $120,300.	Does not promote NED. Average annual benefits $174,100.
b. Environmental Quality (EQ)	Commercial and residential urban setting.	No change.	Minor contribution.	Negative contribution.	Same as Plan A.	Increase in open space.
c. Social Well-Being (SWB)	Houses have periodic flood damages.	Threat of disease and loss of life.	Substantial benefical contribution.	Same as Plan A.	Same as Plan A.	Continued threat of disease and loss of life.
d. Regional Development (RD)	Principle city in western Massachusetts.	No change.	Net beneficial impact.	Same as Plan A.	Same as Plan A.	Lowers tax base.
3. Plan Response to Associated Evaluation Criteria						
a. Acceptability	Needs flood control improvements.	Not desirable. No change.	Favored by majority of residents and city officials.	Unacceptable to Mass. Fish and Wildlife Service.	Generally acceptable.	Not as acceptable to city officials as structural plans.
b. Effectiveness			Substantial flood reduction.	More effective plan for low frequency floods.	More effective than Plan A.	Flooding of areas continues.
c. Certainty			Implementation contributes to NED and EQ accounts.	Net environmental loss.	Less contribution to accounts than Plan A.	No change to EQ account.
d. NED Benefit/Cost Ratio			2.69	1.54	2.38	0.46
e. Reversibility			Reversible.	Not reversible.	Reversible.	Not reversible.

TABLE 2
SOUTHWEST BRANCH (Cont'd)

	BASE CONDITIONS (1979-80)	WITHOUT CONDITION NO ACTION ALTERNATIVE	WITH CONDITION PLANS PLAN A (EQ)	PLAN B	PLAN C (NED)	PLAN D NON-STRUCTURAL
4. Rankings of Planned Contributions						
a. NED Objectives			Good contribution.	Lesser contribution.	Greatest contribution.	Least contribution.
b. EQ Objective			Greatest contribution.	No contribution.	Minor contribution.	Minor contribution.
c. SWB Account			Major contribution.	Major contribution.	Major contribution.	Detrimental contribution.
d. RD Account			Minor contribution.	Greater contribution.	Highest contribution.	Least contribution.
D. IMPLEMENTATION RESPONSIBILITY						
Federal First Costs			$433,200	$820,700	$625,900	$4,080,000
Federal Annual Costs			$31,900	$60,400	$46,100	$300,300
Non-Federal First Cost			$58,000	$57,000	$56,600	$1,040,000
Non-Federal Annual Cost			$5,300	$5,200	$4,500	$76,500
Non-Federal Requirements			Clearing of brush in flood plain. Project lands, easements and rights of way utility relocations. Hold and save harmless. Maintain and operate.	Same as Plan A. No brush clearing required.	Same as Plan A. No brush clearing required.	25% of total first cost.
Flood Plain Regulations (EO 11988)		Prohibit development within flood plain limits. Continue compliance with FIA (regular program).	Prevent encroachment on channel.	Same as Plan A.	Same as Plan A.	Same as Plan A.
Protection of Wetlands (EO 11990)		Comply with Federal and State Wetland Acts.	10 acres of wetland privately owned-restricted use.	Same as Plan A.	Same as Plan A.	Same as Plan A.

RECOMMENDED PLAN

The preceding sections summarized and compared the alternative plans for flood control in Pittsfield. Out of this comparison, the designated Plan A alternative investigated in both analyses was selected for implementation on the West Branch and the Southwest Branch. A description of these plans and their costs is presented in this section of the report. The location of the proposed protection projects for the West and Southwest Branches is shown on the Basin Map of Plate 1.

Plan Description

West Branch

The most practical plan for flood control on the West Branch is Plan A which calls for lowering the crest of the existing Tel-Electric Dam by 3 feet. This action would increase the gradient of the channel upstream of this point and allow better discharge of storm water from Wahconah Park. The general plan and profile of the stream channel between these two points is shown on Plate 2. A detailed description of this plan is contained in Appendix 4.

Southwest Branch

The provisions of Plan A for the Southwest Branch include the installation of an additional 150 square feet of discharge capacity through the embankment of the Conrail Railroad, and the clearing of approximately 30,000 square feet of wetlands to provide an unrestricted overbank flow path.

Mitigation of the losses resulting from the transfer of the flood stage to downstream properties is outlined under plan accomplishments.

The additional discharge capacity installed through the railroad embankment would be achieved by placing a 15-foot diameter corrugated metal pipe of #8 gauge to one side at the existing stone arch. The installation of this conduit, with no disruption to Conrail traffic, could be carried out as follows:

A temporary support structure for the rail lines would have to be installed on a weekend. Two rows of sheet piles, approximately 20 feet apart, would be driven through the embankment. Timber abutments would be placed on the outside of these sheet piles, and four girders placed along the rail centerlines would rest on these abutments, providing support for the rail lines. The railroad tracks would be placed directly over these girders for continued rail operation during construction.

Following completion of the support structure, excavation between the sheet piles could proceed for installation of the culvert. Following proper backfilling and installation of the inlet and outlet structures, the temporary bridge would be removed. Backfilling to final grade and replacement of the rails would be accomplished without interrupting scheduled rail traffic.

This concept is not a final plan and only serves as a guideline for the development of such a plan. Appendix 4 contains a detailed analysis of construction methods for the culvert installation.

The wetland clearing upstream of the Barker Street bridge would be located across the meander that currently exists in that reach. Trees and brush lying in this path would be razed but not uprooted. This cleared path would allow faster discharge of overbank flows away from the point of entry of Maloy Brook, eliminating small flood events which have previously been caused by the sluggish nature of this reach.

A profile of the Southwest Branch between the Cadwell Road bridge, and the railroad embankment is shown on Plate 3. Detailed plans showing the design of the culvert and the location of the clearing operations are displayed on Plate 5.

Plan Accomplishments

West Branch

Plan A on the West Branch would reduce the 100-year flood stage by 1 to 1.5 feet. This would provide maximum relief in the reach between the Tel-Electric Dam and the West Street bridge. Upstream of this point the effects of lowering the dam would not be as beneficial as the flood problems of this area are more a product of the insufficient flow area of the West Street bridge. The profile of the West Branch on Plate 2 illustrates the reduction in flood stage effected by lowering the dam 3 feet. Plate 2 also delineates the areal extent of flooding that would occur during the 100-year and the Standard Project floods. Neither of these floods would be significantly modified by the recommended plan, therefore the areal extent of flooding is assumed to remain essentially the same. Velocities during the Standard Project Flood would vary from O-1 feet per second (fps) at the outer flood limits on the left bank, and from 1.5 to 7.5 fps over the right bank. At the channel centerline the velocity would vary from 1 to 4 fps. These velocities would not be altered by implementation of the recommended plan. Depths of inundation would reach as high as 12 feet over the banks of the channel at Linden Street and up to 10 feet over the banks at West Street. The expected duration of SPF river flows exceeding 3,000 cfs (estimated 100-year flood discharge) is 24 hours. The warning time between peak rainfall and peak flooding is estimated to be 12 hours. Estimated damages as a result of a Standard Project Flood would total $4,511,400 without the project and $4,375,700 with implementation of the recommended plan. Because the flood protection offered by this proposal would be far less than the flood of record, and because of the extent of residual losses, the improvements of this plan are considered to be a local drainage effort and a non-Federal cost responsibility. Plate 4 provides a general plan of the Tel-Electric Dam and the railroad bridges located immediately upstream.

Southwest Branch

Plate 3 illustrates the reduction of the 100-year flood profile that will be effected by Plan A. Installation of an additional 150 square feet of discharge capacity through the Conrail embankment would reduce the 100-year flood stage by 7 to 7.5 feet. Clearing the flood plain channel upstream of the Barker Road bridge would not influence the 100-year flood. It would, however, reduce the stage of the more frequent floods to eliminate some of the periodic inundation of West Housatonic Street and the Pittsfield Plaza parking lot.

Plate 3 also delineates the areal extent of flooding that would occur along the Southwest Branch during the 100-year and the Standard Project Floods. In addition, it delineates the extent by which the SPF would be modified by the recommended plan. As Plate 3 illustrates, the areal extent of SPF flooding would not be appreciably smaller following implementation of the recommended plan. Nevertheless, the modified flood would have a stage reduction of approximately 6 to 8 feet, with depths of flooding reduced to range from 7 to 15 feet over the banks. Velocities would not be greatly modified by the recommended plan, although they would be slightly increased along the right bank. Under present conditions velocities would range from 0 to 2 fps at the outer limits of flooding and from 0.5 to 1.0 fps at the channel centerline. Modified by the recommended plan the velocities at the same locations would range from 0 to 3 fps and from 1 to 1.5 fps, respectively. Peak discharges on the Southwest Branch during the SPF would not be reduced by the recommended plan because it does not include provisions for upstream storage or for runoff reduction. For the same reason, the warning time of an SPF event would not be altered by the recommended plan. This warning time is approximately 12 hours. Because the recommended plan would improve the discharge capacity of the Conrail culvert, however, the duration of peak flows during the SPF would be reduced. Under present conditions the length of time during which river discharges exceed 3,000 cfs (estimated 100-year flood) is about 16 hours.

Economic losses resulting from one occurrence of the Standard Project Flood would total $6,976,900 under existing conditions and $6,628,700 following implementation of the recommended plan. In summary, because the recommended plan would only reduce SPF losses by $338,200 during any single occurrence, it is important that the flood plain residents realize the continued threat to their personal safety and to their property from these rare flood events.

Finally, because the additional discharge capacity of the Conrail culvert will increase stream stages at South Street by as much as 5 inches during the 100-year flood, a plan to mitigate the resulting losses is included. The mitigation of these losses through the relocation of the sewer line presently located under the South Street bridge would be a non-Federal responsibility. It is estimated that the first cost of this mitigation plan would be $50,000, resulting in an annual cost of $3,700.

Economics of the Selected Plans

The itemized costs for the plans of improvement on the West and Southwest Branches are shown in Tables 3 and 4. That portion of costs which is a non-Federal responsibility is distinguished in these tables. Table 5 presents a summary comparison of the average annual costs and anticipated average annual benefits. The benefit/cost ratio resulting from this comparison is also shown.

TABLE 3
ESTIMATES OF FIRST COSTS AND ANNUAL CHARGES
LOCAL PROTECTION, WEST BRANCH
PITTSFIELD, MASSACHUSETTS
PLAN A
(January 1980 Price Levels)

FIRST COST Non-Federal Item	Quantity	Unit	Unit Price	Amount
Site Preparation	1	JOB	L.S.	$ 1,000
Mobilization/Demob.	1	JOB	L.S.	1,000
Control of Water	1	JOB	L.S.	8,500
Concrete Removal	720	C.F.	4.00	2,880
Concrete Disposal	720	C.F.	1.00	720
Concrete Cap	6	C.Y.	250.00	1,500
Clean-up	1	JOB	L.S.	500
Subtotal				$ 16,100
Contingencies				3,420
TOTAL CONSTRUCTION COST				$ 19,340
Engineering and Design				4,250
Supervision and Administration				2,510
SUBTOTAL				$26,100
Lands and Damages				$ 3,500
TOTAL ESTIMATED NON-FEDERAL FIRST COST				$29,600
TOTAL ESTIMATED PROJECT FIRST COST				$ 29,600

ANNUAL CHARGES

Non-Federal	
Interest and Amortization (.0736 x $29,600)	$ 2,200
Operation and Maintenance	1,000
TOTAL ANNUAL COST	$ 3,200

TABLE 4
ESTIMATES OF FIRST COSTS AND ANNUAL CHARGES
LOCAL PROTECTION, SOUTHWEST BRANCH
PITTSFIELD, MASSACHUSETTS
PLAN A
(January 1980 Price Levels)

FIRST COSTS

Federal

Item	Quantity	Unit	Unit Price	Amount
Site Preparation	1	JOB	L.S.	$ 2,000
Mobilization/demob.	1	JOB	L.S.	2,000
Steel Sheet Piling	10,000	SG	8.50	85,000
Steel Wales & Bracing	82,000	LBS	0.50	41,000
Temporary Bridge	1	JOB	L.S.	30,000
Excavation	2,900	C.Y.	6.00	17,400
15' dia. Corr. Metal Pipe (plate #8 gauge)	40,000	LBS	0.70	28,000
Compacted Gravel Fill	2,400	C.Y.	10.00	24,000
Concrete Fill	20	C.Y.	200.00	4,000
Concrete (Headwall, Wingwall, Apron)	150	C.Y.	250.00	37,500
Stone Protection	250	C.Y.	30.00	7,500
Subtotal				$278,400
Contingencies				55,900
TOTAL CONSTRUCTION COST				$334,300
Engineering and Design				$ 60,300
Supervision and Administration				38,600
TOTAL ESTIMATED FEDERAL FIRST COST*				$433,200

Non-Federal

	Quantity	Unit	Unit Price	Amount
Mitigation	1	Job	L.S.	$ 50,000
Brush Clearing	0.5	Acre	2,000	1,000
Lands and Damages				7,000
TOTAL ESTIMATED NON-FEDERAL FIRST COST				$58,000
TOTAL ESTIMATED PROJECT FIRST COST				$491,200

ANNUAL CHARGES

Federal	
Interest and Amortization (.0736 x 433,200)	$ 31,900
Non-Federal	
Interest and Amortization (.0736 x 58,000)	$ 4,300
Operation and Maintenance (Brush Clearing)	1,000
TOTAL ANNUAL COST	$ 37,200

*Does not include $122,500 spent in pre-authorization studies.

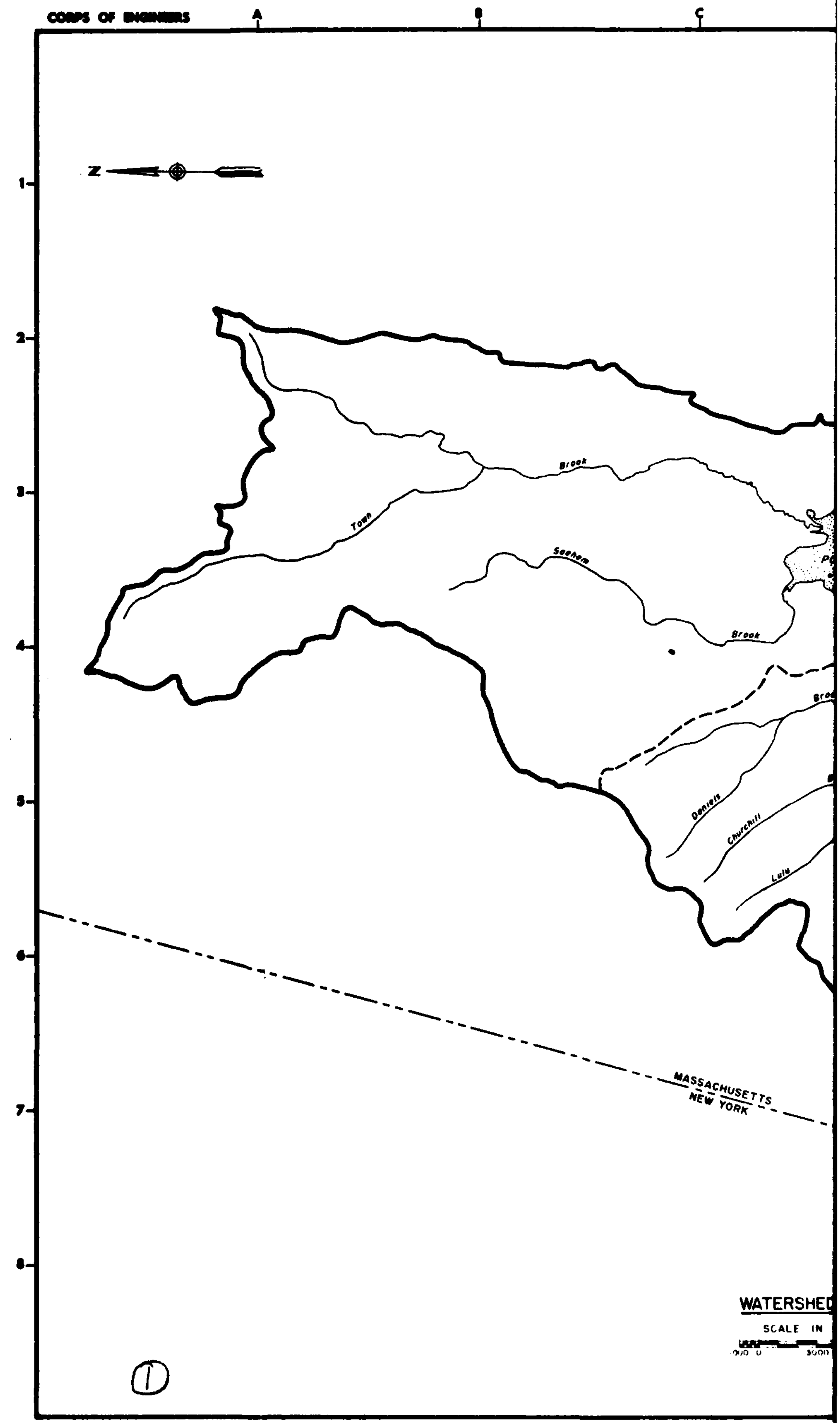
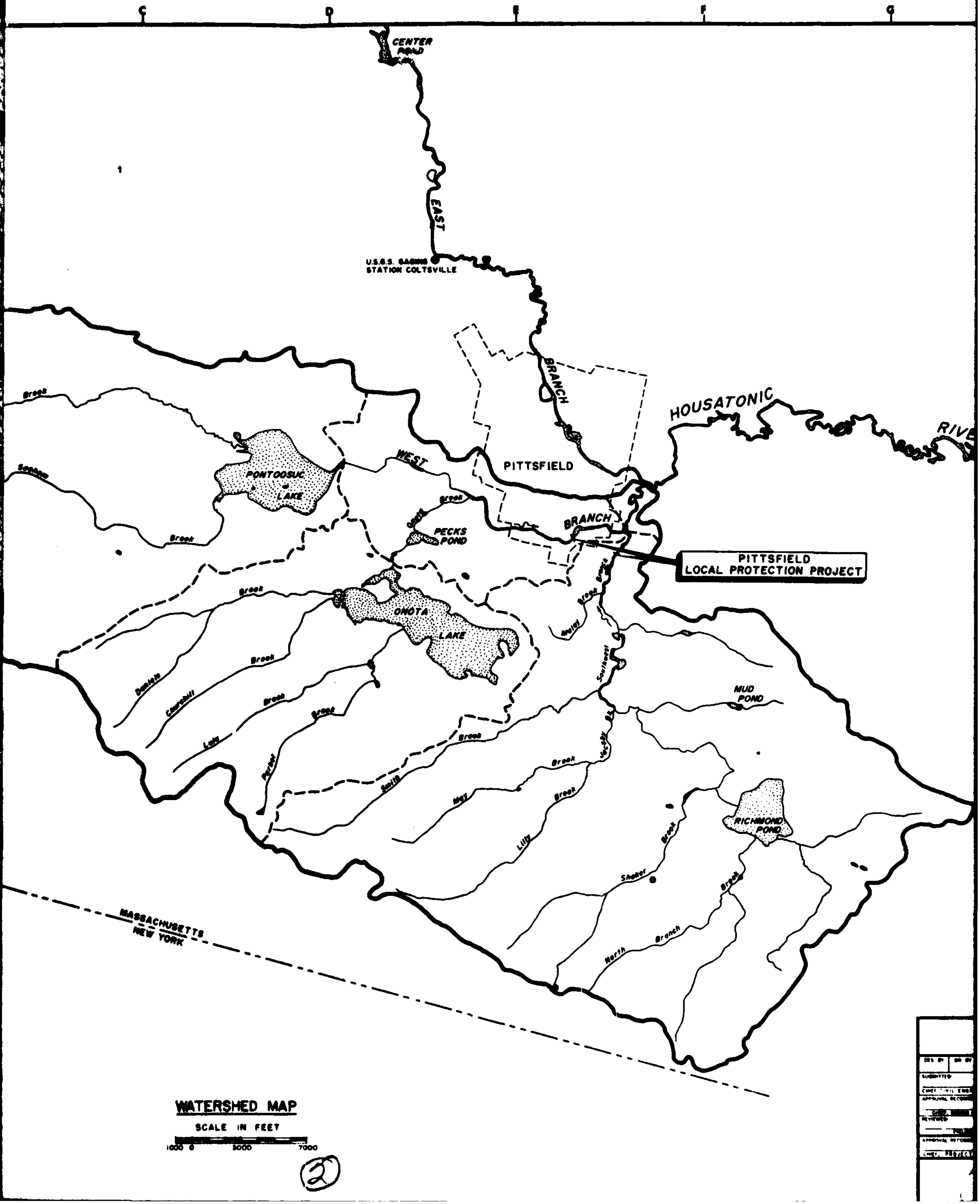

CORPS OF ENGINEERS
Town
Brook
Sachem
Brook
Daniels
Churchill
Lulu
MASSACHUSETTS
NEW YORK
WATERSHED
SCALE IN

PLATE 1

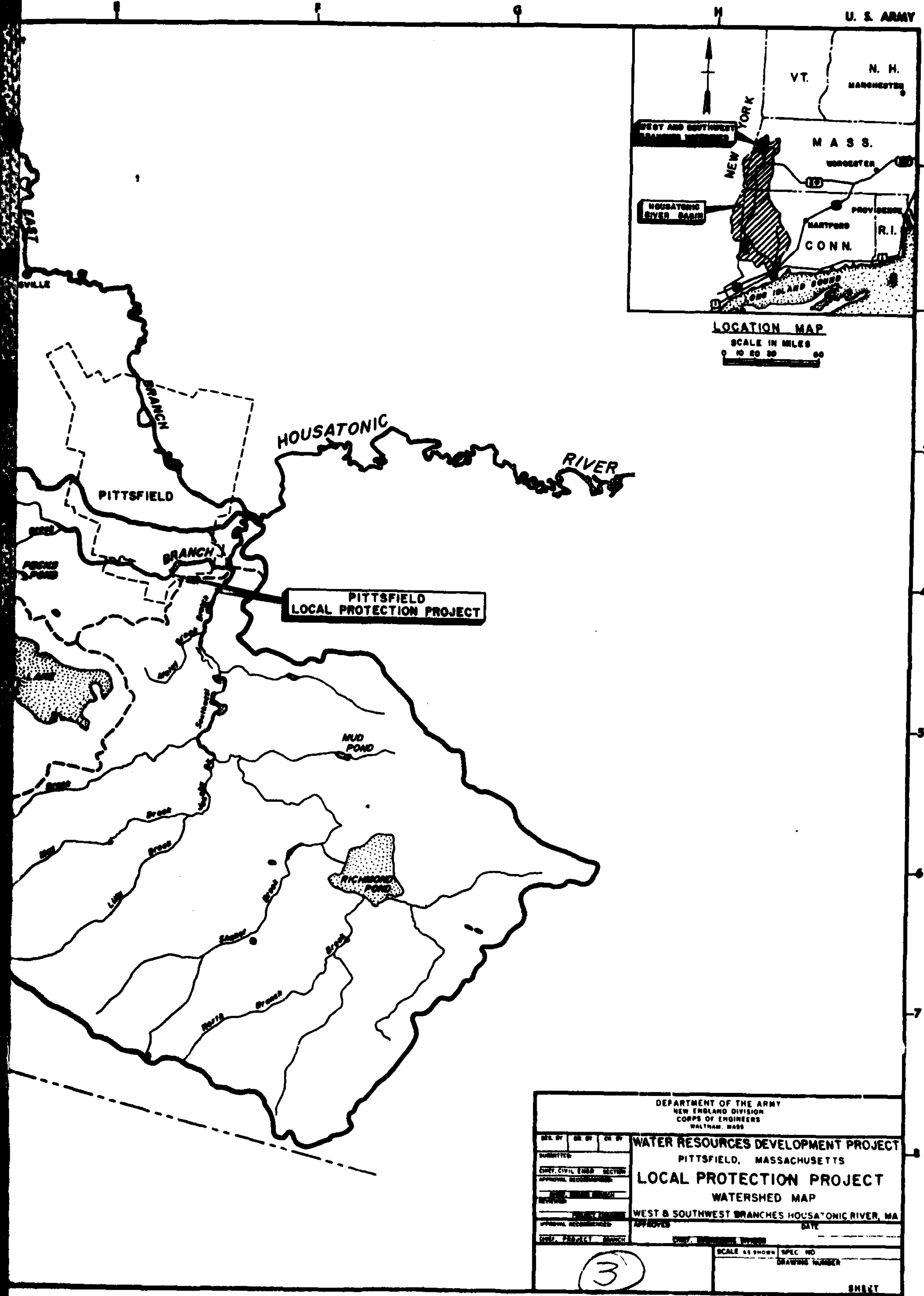


WATERSHED MAP

SCALE IN FEET

1000 0 3000 7000

2



U. S. ARMY
E
F
G
H
VT.
N. H.
MANCHESTER
NEW YORK
MASS.
WORCESTER
HOUSATONIC RIVER BASIN
HARTFORD
PROVIDENCE
CONN.
R.I.
LOCATION MAP
SCALE IN MILES
0 10 20 30 60
EAST
BRANCH
HOUSATONIC
RIVER
PITTSFIELD
BRANCH
PITTSFIELD
LOCAL PROTECTION PROJECT
MUD POND
RICHMOND POND
North Branch
1
2
3
4
5
6
7
8
DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS
WATER RESOURCES DEVELOPMENT PROJECT
PITTSFIELD, MASSACHUSETTS
LOCAL PROTECTION PROJECT
WATERSHED MAP
WEST & SOUTHWEST BRANCHES HOUSATONIC RIVER, MA
APPROVED
DATE
SCALE AS SHOWN
SPEC NO
DRAWING NUMBER
SHEET
3

PLATE I

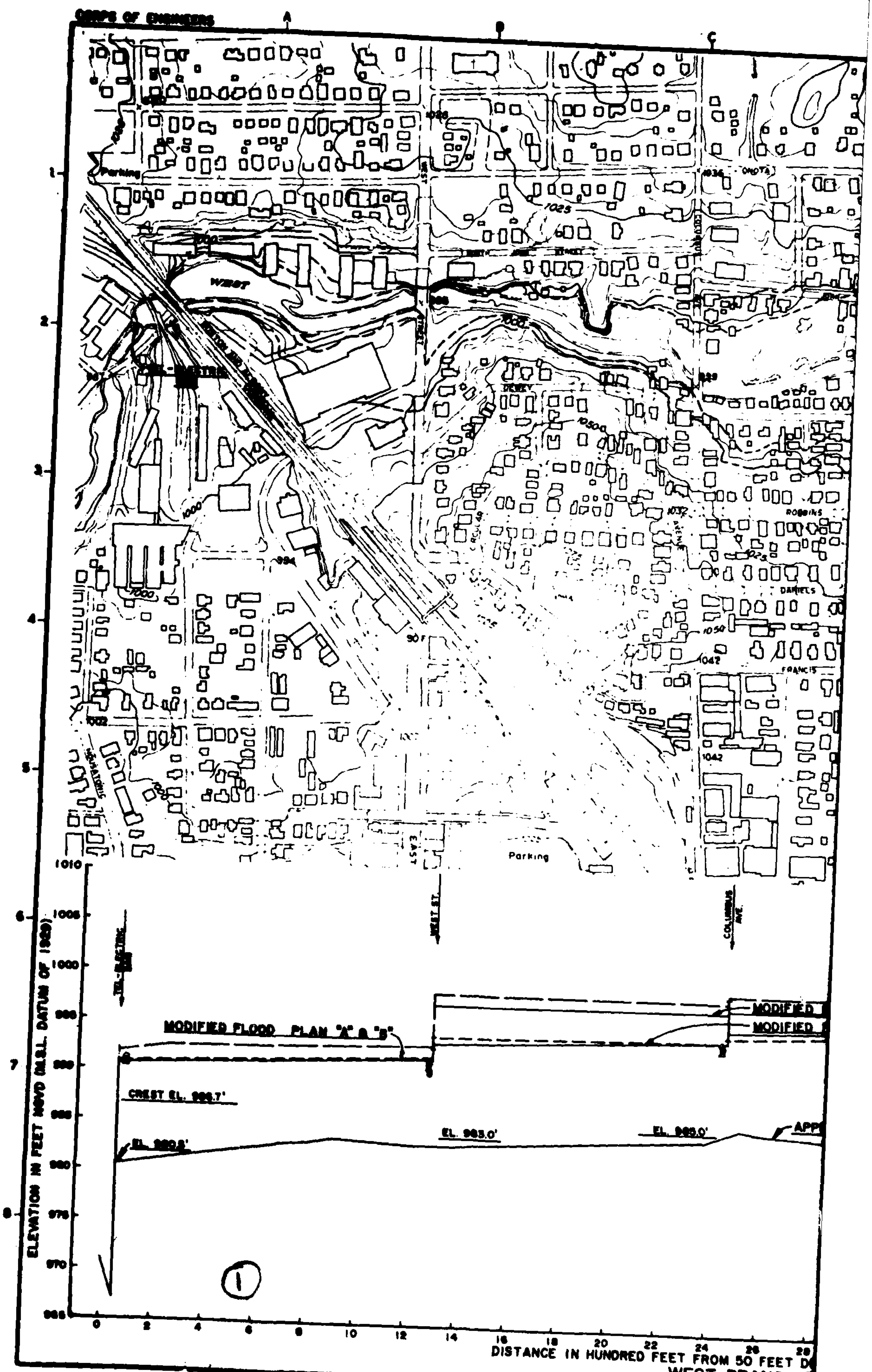
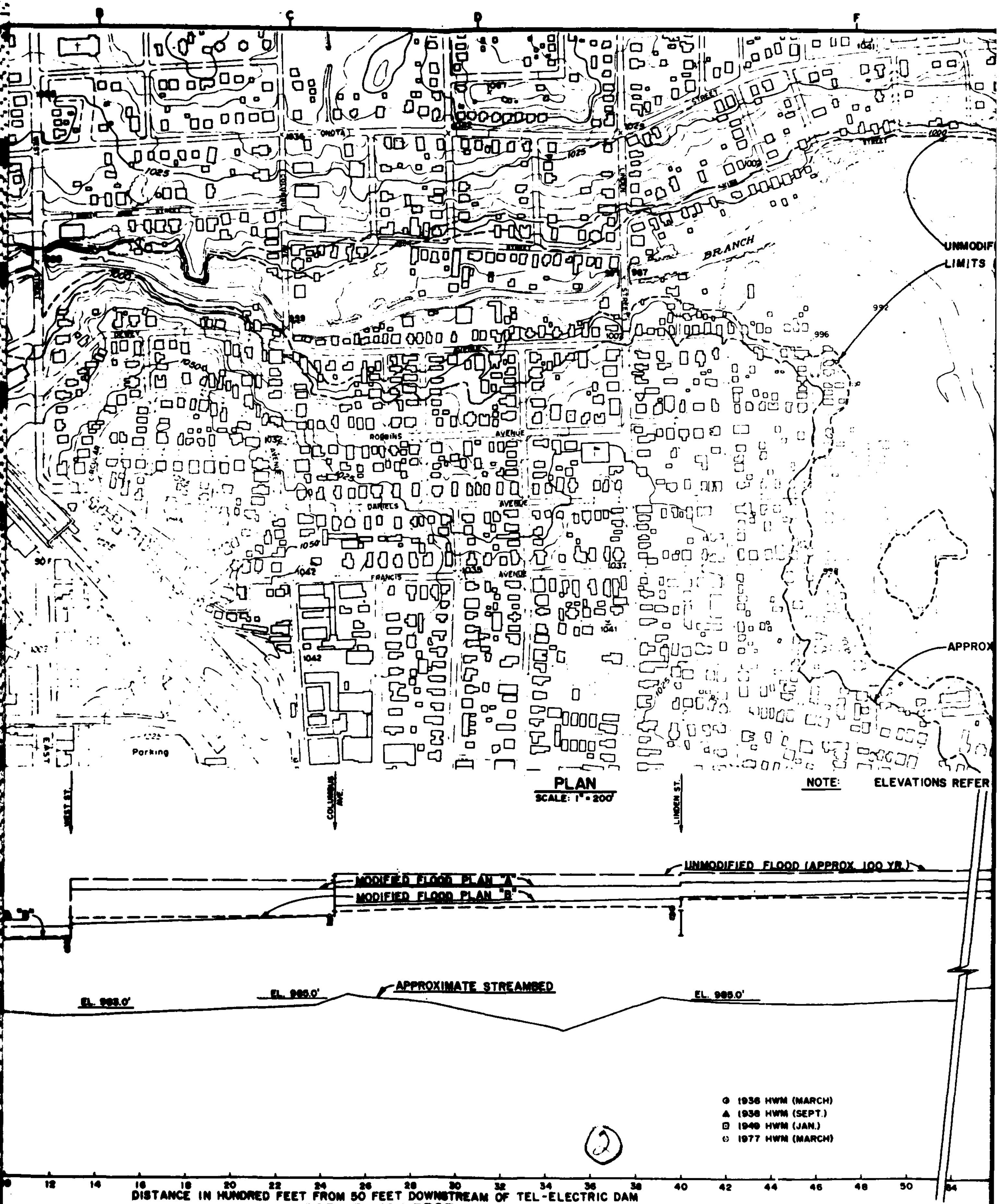
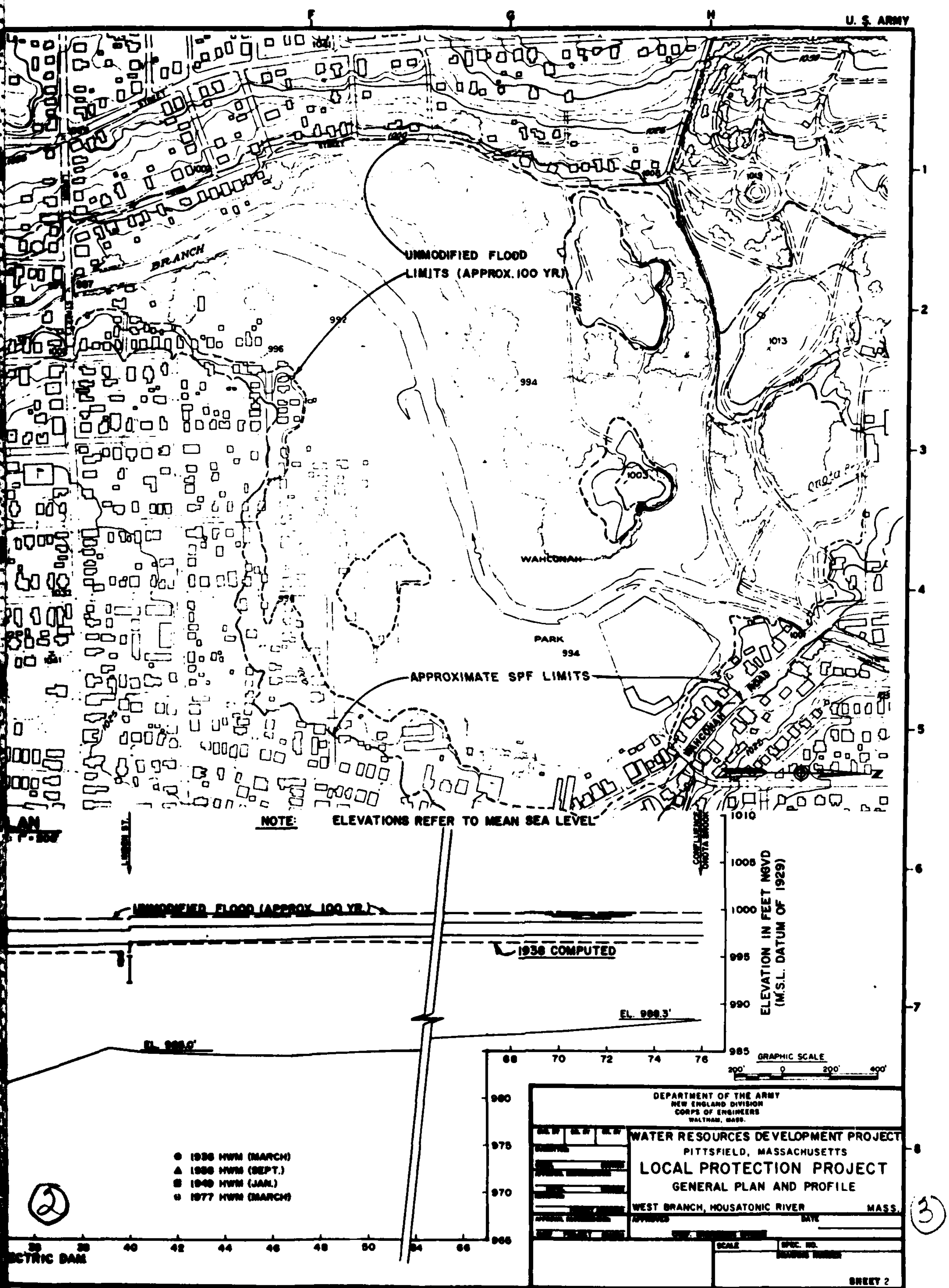

CORPS OF ENGINEERS
A
B
C
WEST
Parking
DEWEY
ROBBINS
DANIELS
FRANCIS
EAST
WEST ST.
COLUMBUS AVE.
MODIFIED FLOOD PLAN "A" & "B"
MODIFIED
CREST EL. 986.7'
EL. 980.5'
EL. 985.0'
EL. 985.0'
ELEVATION IN FEET NGVD (M.S.L. DATUM OF 1929)
DISTANCE IN HUNDRED FEET FROM 50 FEET D
WEST BRANCH

PLATE 2



WEST BRANCH PROFILE

(2)



U. S. ARMY
F
G
H
BRANCH
UNMODIFIED FLOOD LIMITS (APPROX. 100 YR)
992
996
994
1003
1013
1019
WAHCONAH
PARK
994
APPROXIMATE SPF LIMITS
ROAD
WAHCONAH
NOTE: ELEVATIONS REFER TO MEAN SEA LEVEL
UNMODIFIED FLOOD (APPROX. 100 YR.)
1938 COMPUTED
EL. 988.3'
ELEVATION IN FEET NGVD (M.S.L. DATUM OF 1929)
1010
1005
1000
995
990
985
980
975
970
965
68
70
72
74
76
38
40
42
44
46
48
50
54
56
GRAPHIC SCALE
200' 0 200' 400'
1938 HWM (MARCH)
1955 HWM (SEPT.)
1949 HWM (JAN.)
1977 HWM (MARCH)
CTRIC DAM
②
DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.
WATER RESOURCES DEVELOPMENT PROJECT
PITTSFIELD, MASSACHUSETTS
LOCAL PROTECTION PROJECT
GENERAL PLAN AND PROFILE
WEST BRANCH, HOUSATONIC RIVER MASS.
SHEET 2
1
2
3
4
5
6
7
8
③

PLATE 2

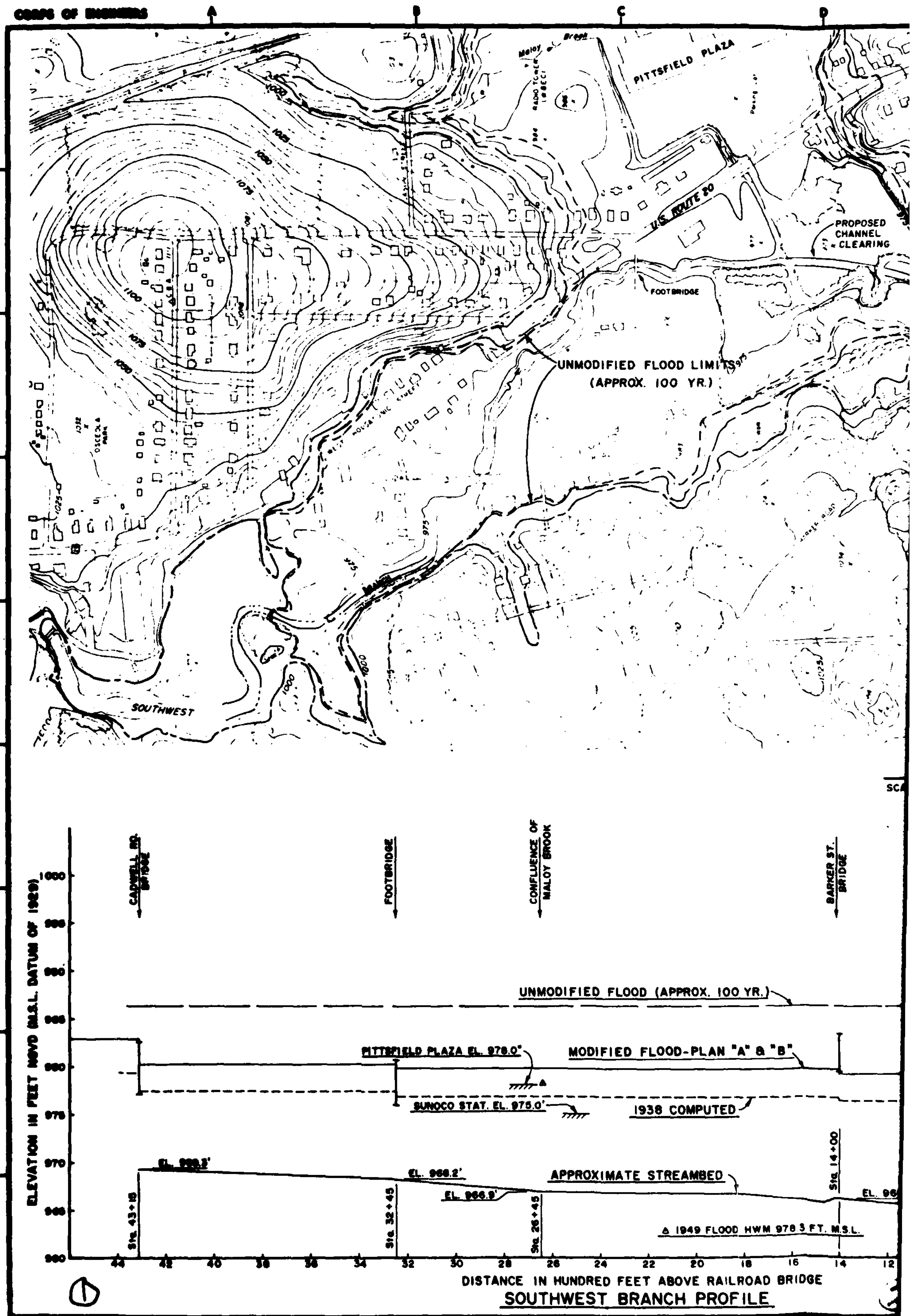
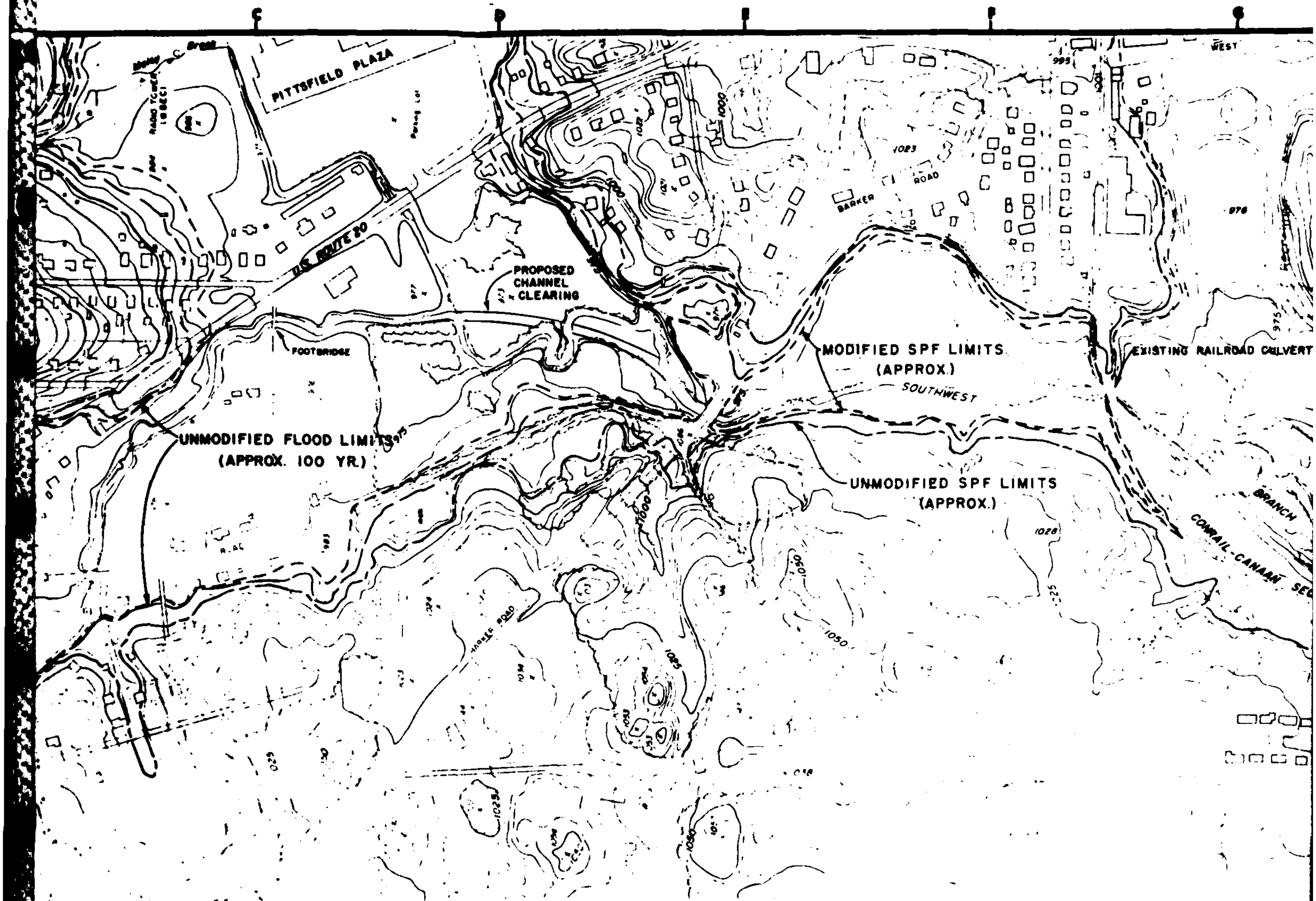
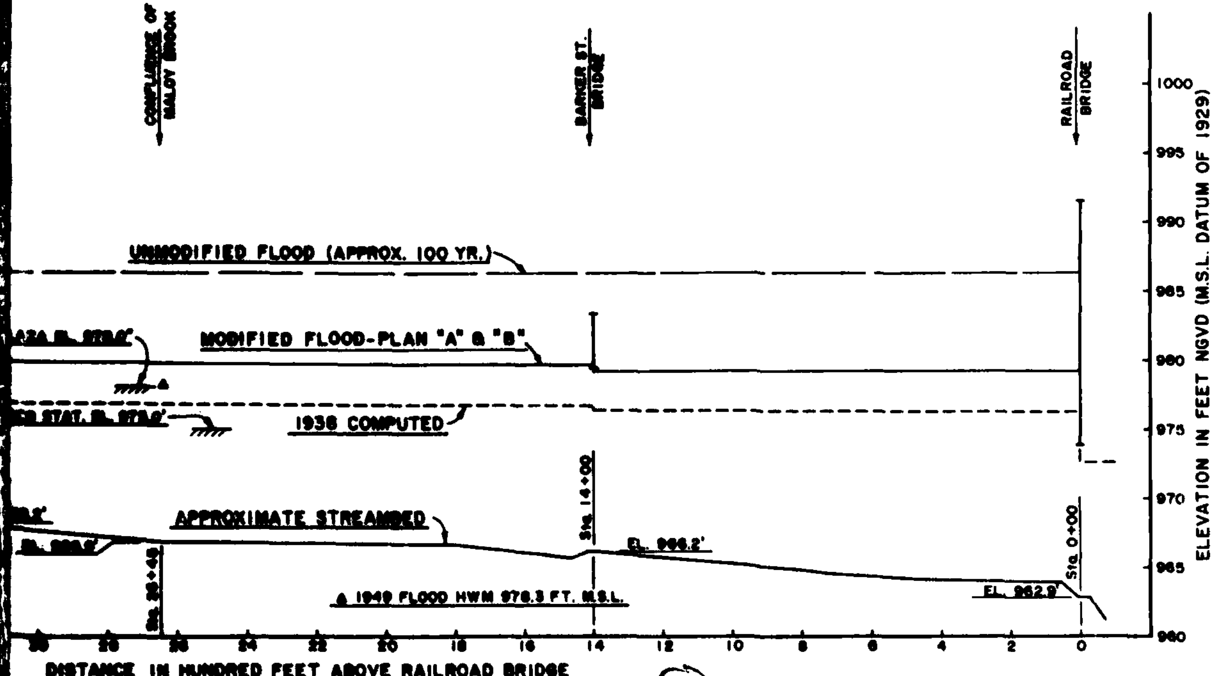

CORPS OF ENGINEERS
A
B
C
D
PITTSFIELD PLAZA
U.S. ROUTE 20
PROPOSED CHANNEL CLEARING
FOOTBRIDGE
UNMODIFIED FLOOD LIMITS
(APPROX. 100 YR.)
SOUTHWEST
1
2
3
4
5
6
7
8
ELEVATION IN FEET NGVD (M.S.L. DATUM OF 1929)
CADWELL RD. BRIDGE
FOOTBRIDGE
CONFLUENCE OF MALOY BROOK
BARKER ST. BRIDGE
UNMODIFIED FLOOD (APPROX. 100 YR.)
PITTSFIELD PLAZA EL. 979.0'
MODIFIED FLOOD-PLAN "A" & "B"
SUNOCO STAT. EL. 975.0'
1938 COMPUTED
APPROXIMATE STREAMBED
EL. 969.2'
EL. 968.2'
EL. 966.9'
Sta. 43+15
Sta. 32+45
Sta. 26+45
Sta. 14+00
△ 1949 FLOOD HWM 978.3 FT. M.S.L.
DISTANCE IN HUNDRED FEET ABOVE RAILROAD BRIDGE
SOUTHWEST BRANCH PROFILE

PLATE 3

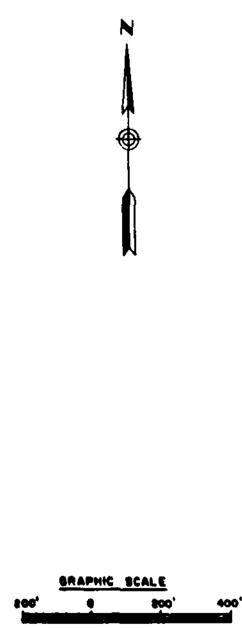


PLAN
SCALE: 1" = 200'

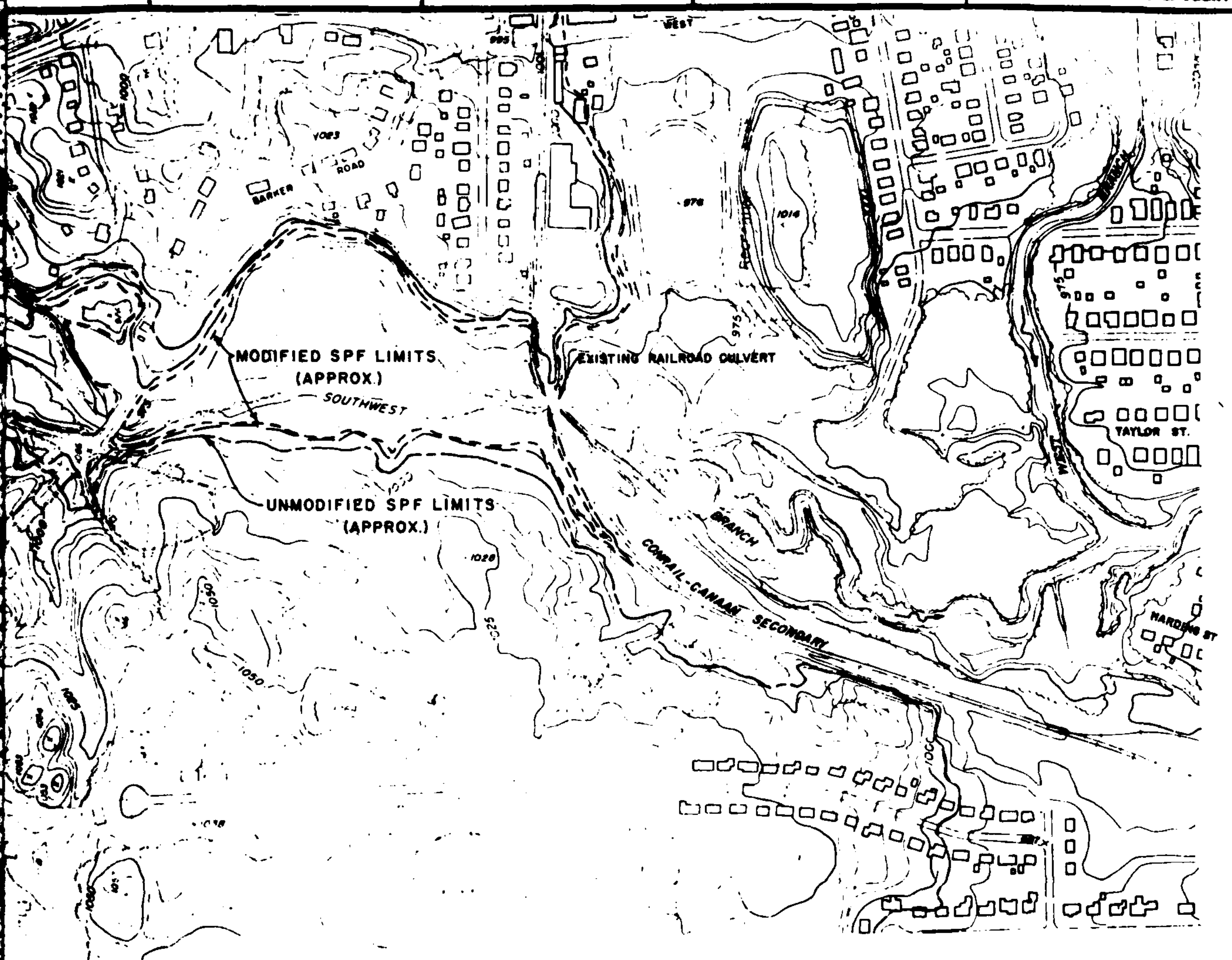


SOUTHWEST BRANCH PROFILE

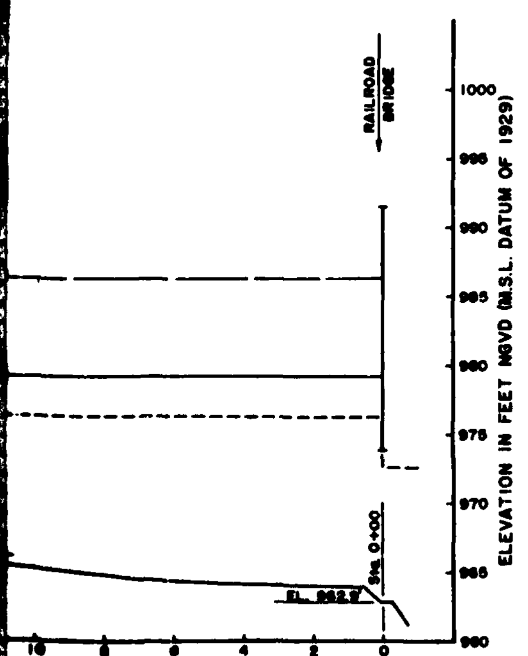
(2)



(3)



PLAN
1" = 200'



GRAPHIC SCALE
200' 0 200' 400'

NOTE:
ELEVATIONS REFER TO MEAN SEA LEVEL.

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

WATER RESOURCES DEVELOPMENT PROJECT
PITTSFIELD, MASSACHUSETTS

LOCAL PROTECTION PROJECT
GENERAL PLAN AND PROFILE

SOUTH-WEST BRANCH, HOUSATONIC RIVER MASS.

APPROVED DATE

CHIEF, ENGINEERING DIVISION

SCALE AS SHOWN SPEC. NO.

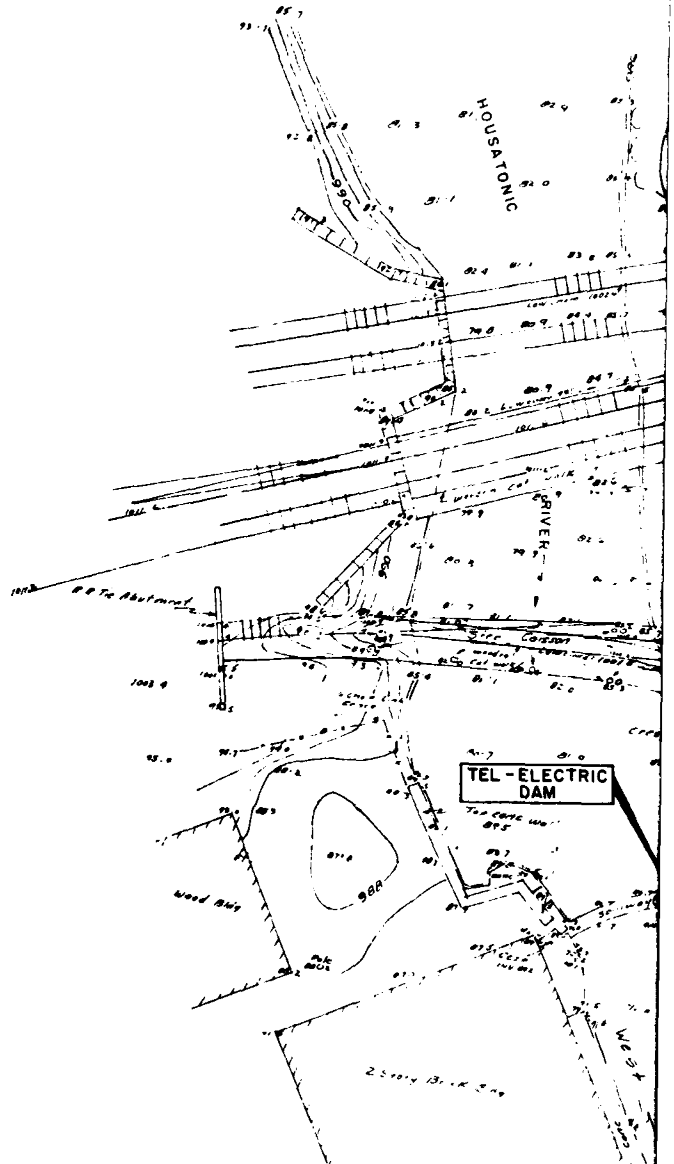
DRAWING NUMBER

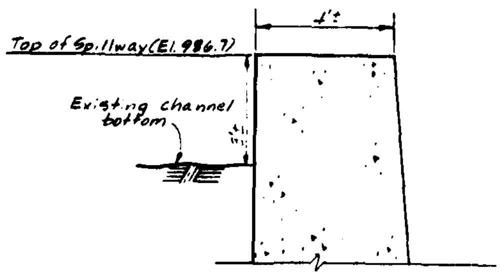
SHEET 3

(3)

PLATE 3

CORPS OF ENGINEERS





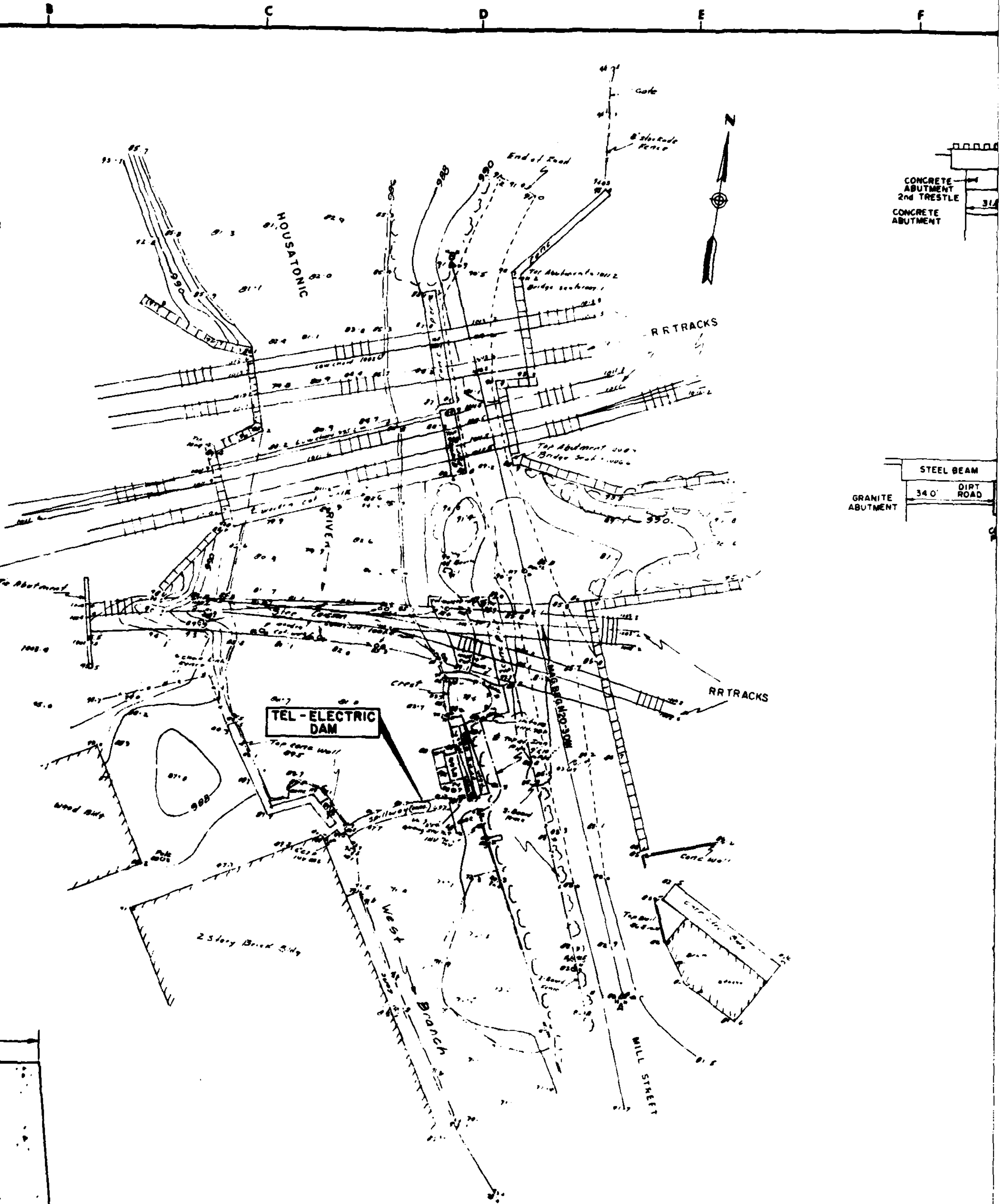
TYPICAL SPILLWAY SECTION

(EXISTING)

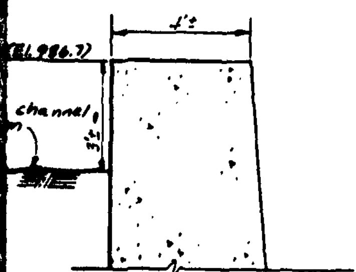
SCALE: 1" = 2'

1

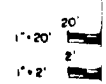
PLATE 4



PLAN
SCALE: 1"=20'



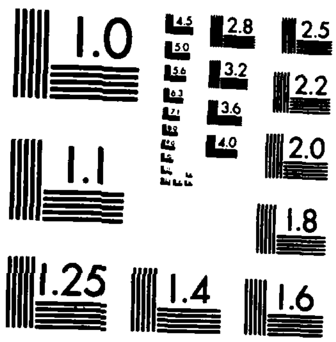
PICAL SPILLWAY SECTION
(EXISTING)
SCALE: 1"=2'



2

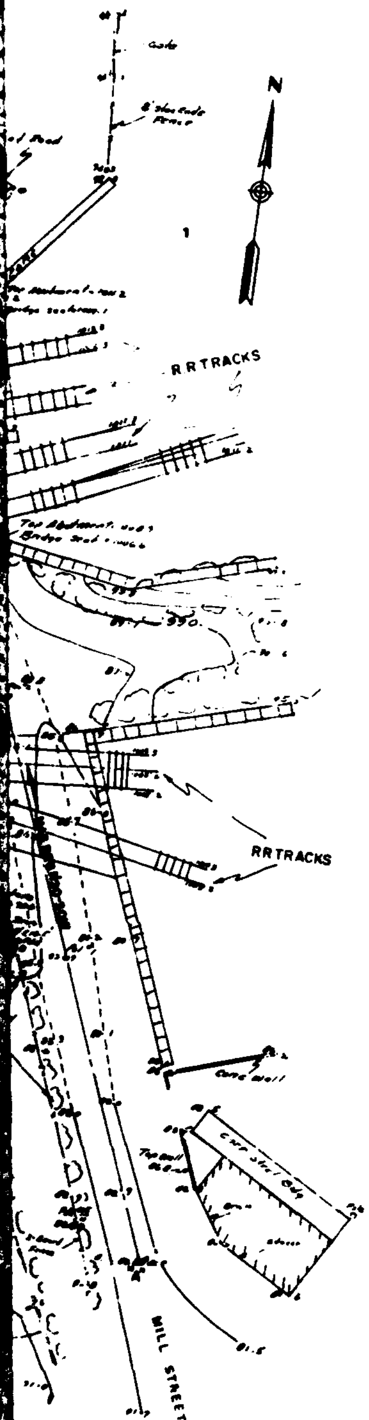
AD-A143 397 PITTSFIELD LOCAL FLOOD PROTECTION WEST BRANCH AND SOUTHWEST BRANCH HOUSAT..(U) CORPS OF ENGINEERS WALTHAM MA NEW ENGLAND DIV OCT 80 2/3

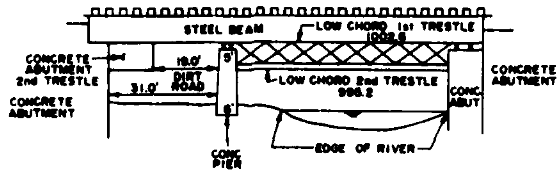
UNCLASSIFIED F/G 13/2 NL



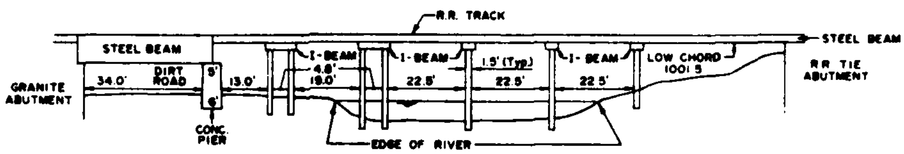
MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

U. S. ARMY

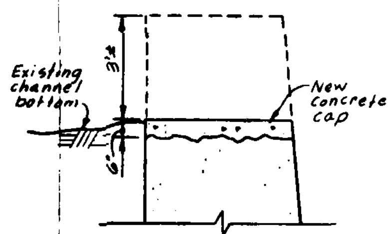




BRIDGE SECTION
(LOOKING DOWNSTREAM)
SCALE: 1" = 20'



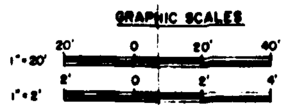
BRIDGE SECTION
(LOOKING DOWNSTREAM)
SCALE: 1" = 20'



TYPICAL SPILLWAY SECTION
(PROPOSED)
SCALE: 1" = 2'

NOTE:
Elevations refer to mean sea level.

GRAPHIC SCALES



REVISION	DATE	DESCRIPTION	BY

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

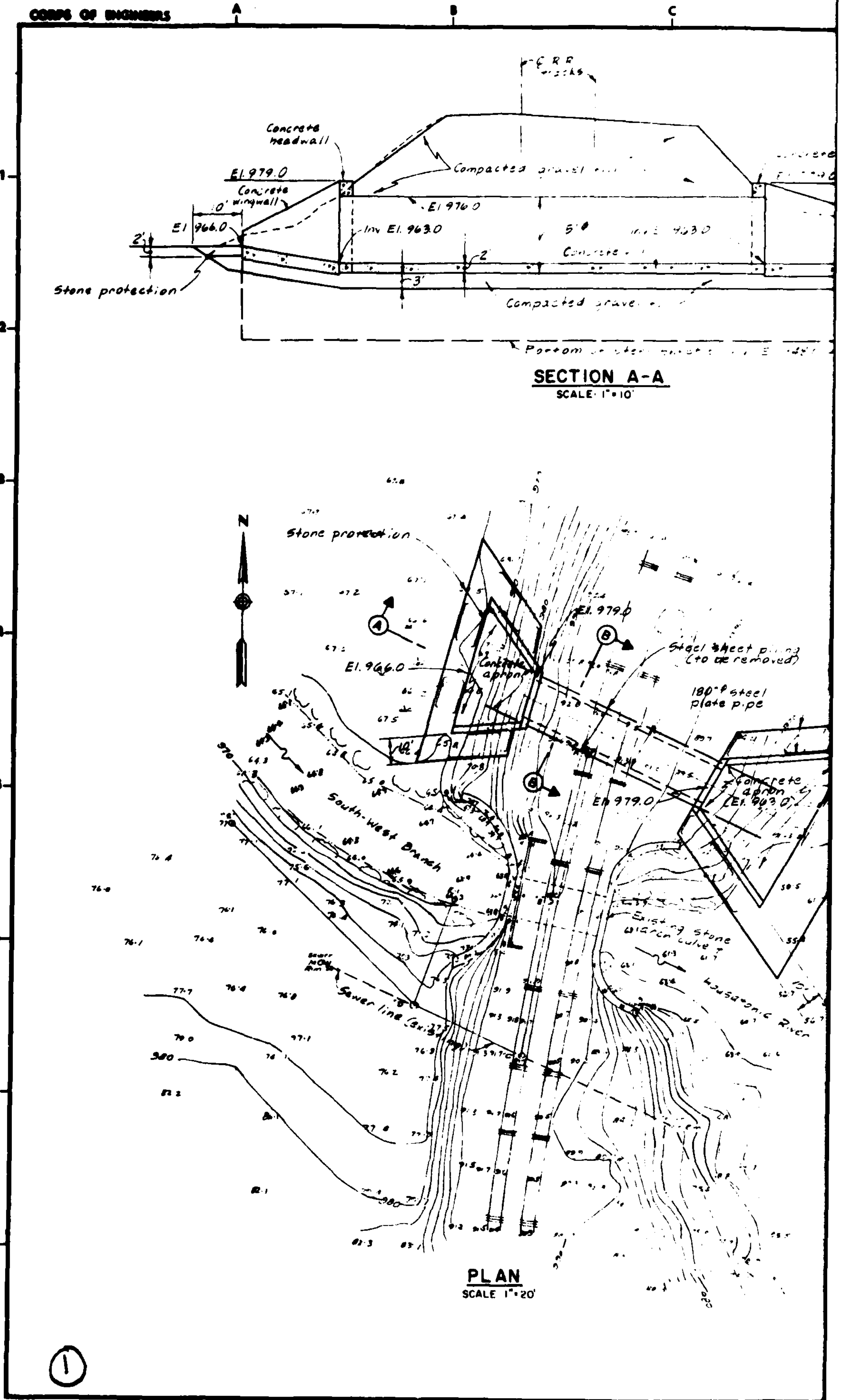
WATER RESOURCES DEVELOPMENT PROJECT
PITTSFIELD, MASSACHUSETTS
LOCAL PROTECTION PROJECT
PROJECT PLAN AND SECTIONS
WEST BRANCH HOUSATONIC RIVER MASS

APPROVED DATE

SCALE AS SHOWN SPEC. NO.
DRAWING NUMBER
SHEET 4

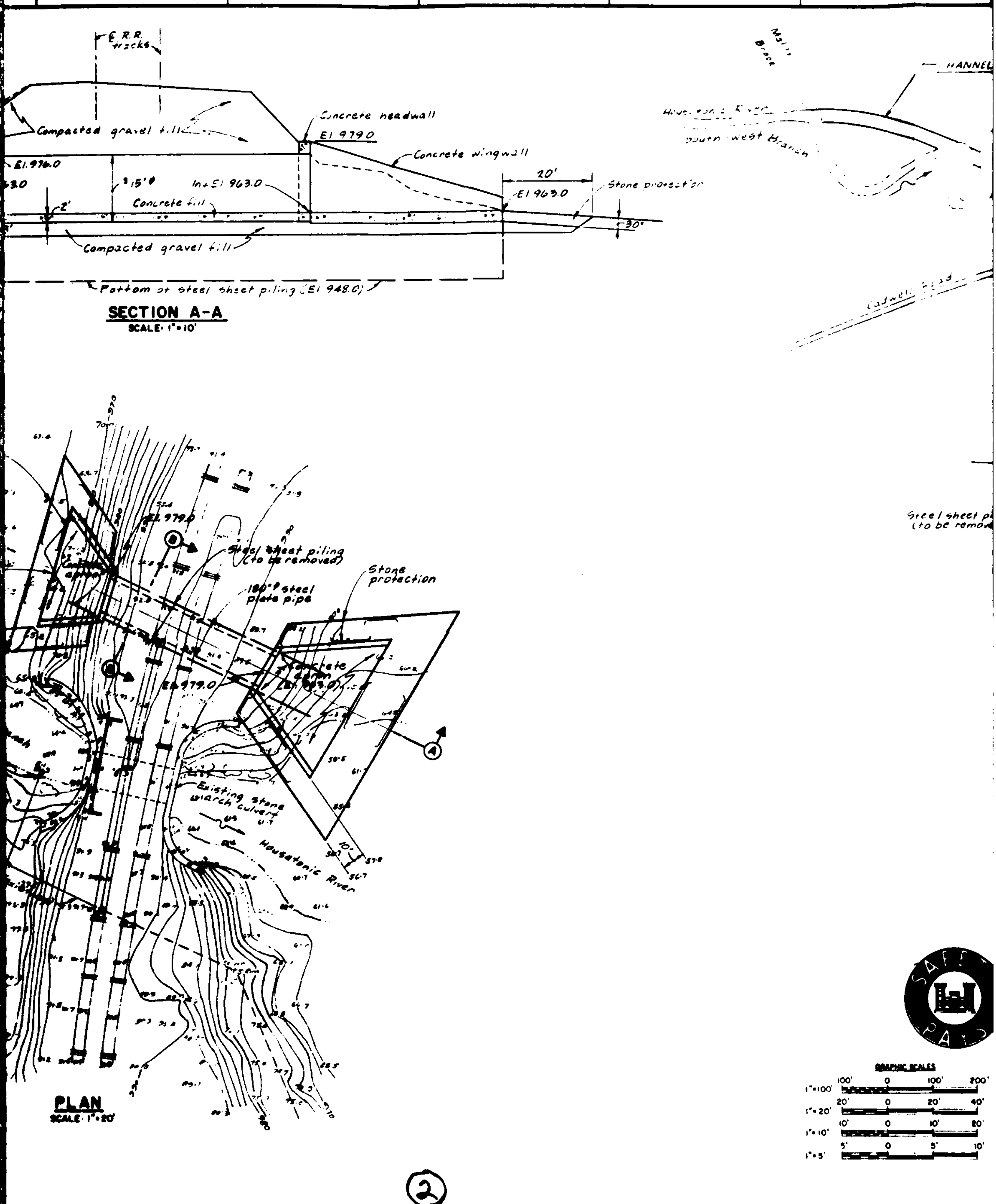
(3)

PLATE 4



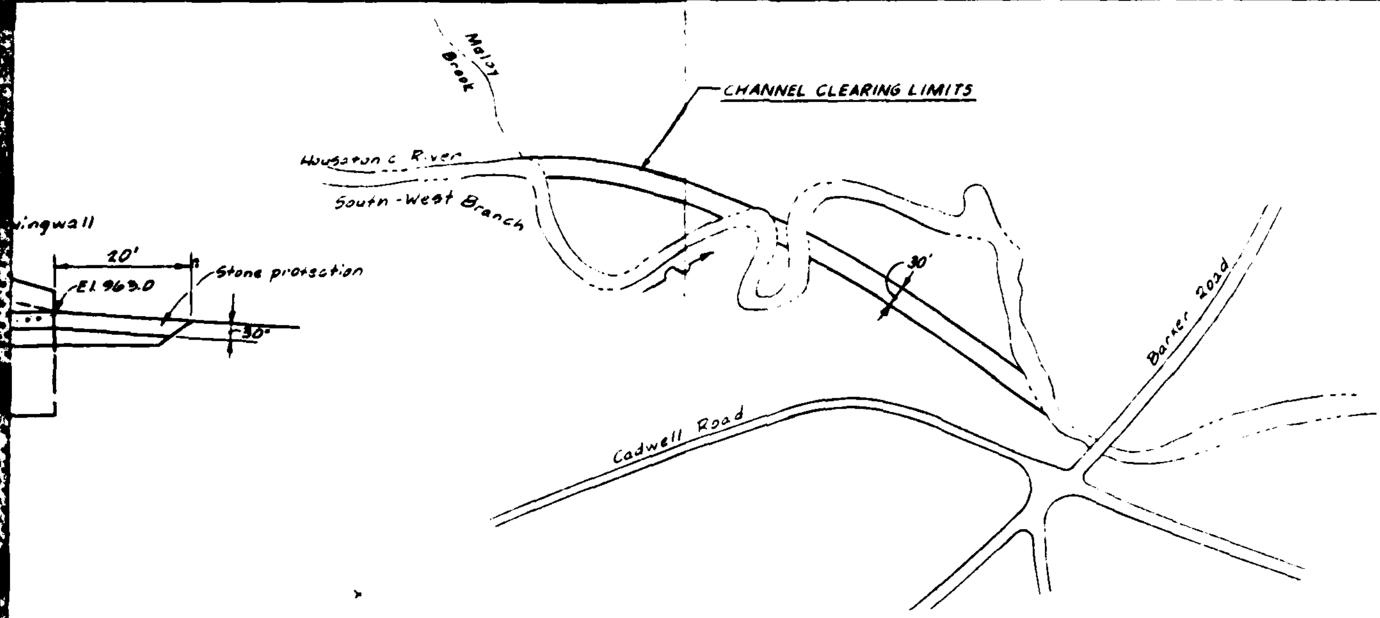
CORPS OF ENGINEERS
Concrete headwall
Compacted gravel
El. 979.0
Concrete wingwall
El. 976.0
El. 966.0
Inv El. 963.0
Stone protection
Compacted gravel
SECTION A-A
SCALE: 1" = 10'
Stone protection
El. 979.0
El. 966.0
Concrete apron
Steel sheet piling (to be removed)
180" steel plate pipe
South-West Branch
El. 979.0
Concrete apron
El. 963.0
Existing stone arch culvert
Housatonic River
Sewer line
PLAN
SCALE 1" = 20'

PLATE 5

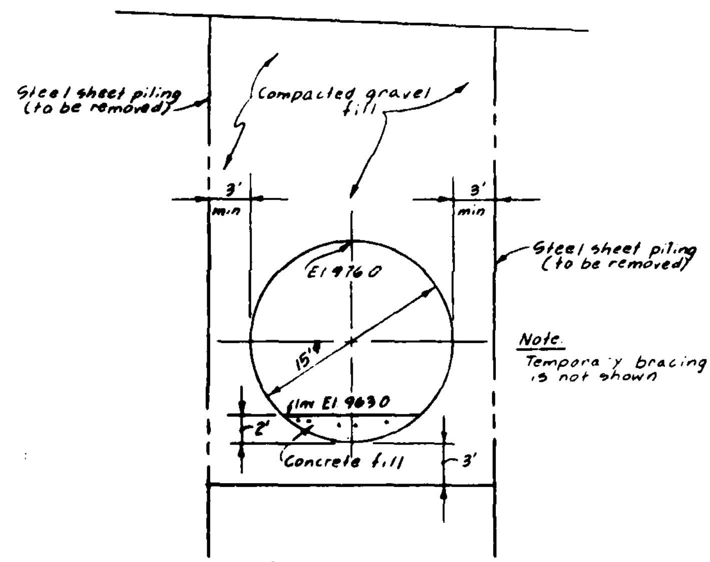


B
C
D
E
F
℄ R.R. tracks
Compacted gravel fill
Concrete headwall
El 979.0
Concrete wingwall
El. 976.0
15'ϕ
Inv El 963.0
Concrete fill
20'
El 963.0
Stone protection
2'
30"
Compacted gravel fill
Bottom of steel sheet piling (El 948.0)
SECTION A-A
SCALE: 1"=10'
Main Brook
CHANNEL
Housatonic River
South west Branch
Cadwell Road
Steel sheet piling (to be removed)
Stone protection
180"ϕ steel plate pipe
El 979.0
Concrete apron
Existing stone arch culvert
Housatonic River
PLAN
SCALE: 1"=20'
GRAPHIC SCALES
1"=100'
1"=20'
1"=10'
1"=5'

(2)



PLAN
SCALE: 1" = 100'



SECTION B-B
SCALE: 1" = 5'

NOTE:
Elevations refer to mean sea level.

GRAPHIC SCALES
1" = 100': 100' 0 100' 200'
1" = 20': 20' 0 20' 40'
1" = 10': 10' 0 10' 20'
1" = 5': 5' 0 5' 10'

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

WATER RESOURCES DEVELOPMENT PROJECT
PITTSFIELD, MASSACHUSETTS
LOCAL PROTECTION PROJECT
PROJECT PLAN AND SECTIONS
SOUTH-WEST BRANCH, HOUSATONIC RIVER MASS.

SCALE AS SHOWN SPEC. NO.
SHEET 5

TABLE 5
SUMMARY COMPARISON
ANNUAL COSTS VS. ANNUAL BENEFITS
WEST BRANCH, SOUTHWEST BRANCH
PITTSFIELD, MASSACHUSETTS

	Annual Cost	Annual Benefit	B/C Ratio
WEST BRANCH	$3,200	$12,000	3.75
SOUTHWEST BRANCH	$37,200	$100,200	2.69

DIVISION OF PLAN RESPONSIBILITIES

This section presents pertinent information regarding cost apportionment between Federal and non-Federal interests for the recommended plans. The apportionment is based on Federal legislation and administrative policies governing local flood control projects. Although non-structural measures such as flood proofing of individual structures, zoning and building codes are not requirements of the recommended plan, local interests should consider and adopt such non-structural measures as necessary. The responsibility for implementing non-structural measures is non-Federal, although technical advice can be furnished. The basis for apportioning the costs for the project is described in the following paragraphs.

Cost Apportionment

Sharing of costs between Federal and non-Federal interests for the protection projects is based on the requirements established as Federal policy for "local protection" improvement.

Under this policy, the Federal Government would be responsible for all flood control design and construction costs. Non-Federal interests would be required to provide funding for local drainage improvements, furnish all lands and rights-of-way and costs of damages, including relocations, required by the plan. Non-Federal interests would also bear the cost of operating and maintaining project features after construction in accordance with Federal requirements. Total project first costs for the recommended channel improvements are estimated at $29,600 for the West Branch protection and $491,200 for the Southwest Branch protection.

Federal Responsibilities

Under the current guidelines for cost apportionment the scope of improvements recommended for the West Branch precludes Federal participation because Plan A is a local drainage measures providing limited flood protection. The currently estimated Federal share of the total first costs for Plan A on the Southwest Branch is $433,200.

The Federal Government would design and prepare detailed plans and construct the project following approval and funding by the Office of the Chief of Engineers and after receipt of the non-Federal share of the cost.

Non-Federal Responsibilities

The currently estimated non-Federal share of the total first costs of the West Branch protection is $29,600 while the Southwest Branch protection is $58,000. However, because the West and Southwest Branches are hydrologically independent, and improvements on either branch will not impact the other, it has been determined that the non-Federal construction of West Branch improvements may be completed at a later date. In addition, the non-Federal interest would maintain the two projects at an estimated average annual cost of $1,000 for each project.

Letters of assurance have been received from the Commonwealth of Massachusetts and the city of Pittsfield indicating their willingness and ability to participate in the project and to fulfill the conditions of local cooperation.

The requirements of local cooperation follow:

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

b. Hold and save the United States free from damages due to construction works except damages due to the fault or negligence of the United States or its contractors.

c. Maintain and operate all works after completion in accordance with regulations prescribed by the Secretary of the Army.

d. Provide without cost to the United States all alterations and replacements of existing utilities.

e. Prescribe and enforce regulations to prevent encroachment on both the improved and unimproved channels, and manage all project-related channels to preserve capacities for local drainage as well as for project functions.

f. Comply with the provisions under Sections 210 and 305 of Public Law 91-646, 91st Congress, approved 2 January 1971, entitled: "Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970."

Because the recommended plans of local flood protection do not provide complete protection against the 100-year flood event, the city of Pittsfield would be required to enforce current regulations on flood plain zoning to restrict future construction within the flood plain limits. In addition, the city of Pittsfield should take aggressive action to provide its residents with information about the flood insurance program and to provide financial assistance whenever possible, through for example, tax abatements and low interest loans.

Finding of No Significant Impact

Pittsfield Local Protection Project

The Environmental Assessment for this project is attached and it describes the need for the proposal, the alternative solutions, the planned actions and the anticipated environmental impact.

Implementation of the proposed project will not require a significant commitment of physical, human or economic resources. Coordination among all parties during the planning process has resulted in the recommended plans of improvement. There does not appear to be any remaining major environmental problems, conflicts or disagreements in the selection of the improvement. I have determined that implementation of the proposed action will not have a significant adverse impact on the human environment.

23 September 1980
DATE

MAX B. SCHEIDER
Colonel, Corps of Engineers
Division Engineer

ENVIRONMENTAL ASSESSMENT

Summary

Project Objective

The objective was to determine what assistance the Corps of Engineers could provide to reduce flooding and flood damages along two tributaries of the Housatonic River in Pittsfield, Massachusetts.

Studies were done to assess flooding problems along the Southwest and West Branches of the Housatonic River and, as a result, several alternative projects were formulated and considered to help relieve the flooding conditions.

Project Need

Serious flooding along the two streams has caused damage to commercial, industrial, public and residential properties. Recent flooding has caused damages that totalled nearly $315,000 and under present conditions the worst flood on record would now cause damages worth more than half a million dollars.

Alternatives

Several solutions to the flooding problems were considered. The proposed solutions are structural and provide for lowering the Tel-Electric Dam on the West Branch and the addition of a culvert and floodpath on the Southwest Branch. Some other alternatives have been reviewed and include constructing new channels, inserting additional culverts, and promoting non-structural type solutions.

Environmental Impacts

The proposed improvements would have minimal impacts on the local natural environment. Effects of construction would be temporary and would not impact on the area's terrestrial ecology, nor on the stream, it's wetlands or trout fishery. Impacts vary among the other alternatives. The greatest environmental effects and economic costs are associated with the channeling improvements, but they also provide for the greatest flood relief. The proposed project will not eliminate all flooding but would reduce flood damages and inconveniences, and promote a sense of security.

Coordination and Public Participation

Coordination with several Federal, State, and local agencies has been maintained during the development of this report/assessment. Written correspondence was used to obtain comments on the problems and the proposed plans of improvements. Several meetings were held to obtain information and to provide a forum for comments and discussion. Part of this process included a public meeting in Pittsfield, Massachusetts, on August 29, 1979.

Purpose and Need for Action

There are two separate flood problem areas in Pittsfield that were evaluated. The purpose and need for providing flood relief to areas along the West and Southwest Branches has already been presented in detail in the Project Report (Problem Identification).

In general, there have been several substantial floods in these areas during 1936, 1938, 1949, 1969 and most recently in March 1977. In one flood zone, water backs up in the West Branch upstream of the Tel-Electric Dam (see Report, page 14) because the stream gradient is flat. As a result the stream cannot carry floodwaters quickly enough through the area before it begins accumulating and flooding.

Along the Southwest Branch two conditions combine to create flooding. The existing stone arch culvert under the Conrail railroad track is too small to pass the heavy streamflow during severe rainfall and major storms. This causes the water to backup and flood the surrounding low lying area. In addition, the stream meander upstream of Barker Road (in the vicinity of McDonald's Restaurant) restricts streamflow so much that even rainfall from less severe storms begins backing up to cause moderate flooding. As a result, any structural changes to the railroad culvert alone would not eliminate flooding in the Maloy Brook-Barker Road area since it is significantly separate from the Conrail bridge area. Water cannot pass through the Maloy Brook-Barker Road area quickly enough to get to the improved culverts at the railroad bridge before water levels begin to rise.

Major flooding causes damage to commercial, industrial, public and residential properties along both of these branches of the Housatonic River. Approximately \$314,000 of damage would occur in a recurrence of the March 1977 flood today. The most severe flood on record was the 1938 flood, and if it were to occur today it would cause over \$700,000 in damages.

Proposed Action and Alternatives

Proposed Improvement

The proposed plan is to provide structural remedies to help relieve flooding conditions on both streams. On the West Branch (Plan A) the Tel-Electric Dam would be lowered 3 feet to improve the hydraulic gradient of the channel upstream of the dam. This would improve the flow characteristics of the stream to carry off waters more quickly and efficiently during flooding conditions.

On the Southwest Branch under Plan A, the existing stone arch culver through the Conrail railroad embankment would be supplemented with additional conduit. This would help reduce flooding by doubling the s m's carrying capacity through the embankment. In addition, a 1,000-foot path would be cleared upstream of the Barker Road bridge to improve conditions for the more frequent flood events.

The proposed plans of improvements are described in detail in the project report.

Alternatives

Several possible projects have been considered in an effort to determine which reasonable alternatives would reduce flooding conditions. In this effort several schemes were presented in a public meeting at the Pittsfield City Hall on August 29, 1979. The structural alternatives are described briefly below (also see "Description, Assessment and Evaluation of Detailed Plans" in main report).

West Branch

Plan A provides for lowering the Tel-Electric Dam 3 feet (described above) and Plan B is essentially the same, but it also includes replacement of the West Street bridge. The Plan B improvement has an added advantage of conveying floodwaters backing upstream of the bridge. A new bridge structure with larger openings would increase the discharge capacity through it and reduce the flood elevation upstream.

Plan C proposed a major stream renovation to eliminate nearly all flooding. Of all the plans, it provides for the greatest reduction in flooding and maximizes the protection from economic damages. It includes replacing the dam with floodgate type structures, replacing the West Street bridge with one of greater discharge capacity, and constructing a major 40-foot wide and 7,000-foot long channel along the stream beginning at Linden Street, below Wahconah Park.

Southwest Branch

Plan A has been described above as the "proposed plan" of improvements. Plan B has the same supplemental culvert provision but also includes the excavation and construction of a 40-foot wide, 1,000-foot long channel in Type 1 wetland to increase flood protection. The channel would provide greater flow efficiency to pass floodwaters past the meander in the Maloy Brook-Barker Road section of the stream. It would essentially eliminate this area of natural stream in favor of a hydraulically efficient channel.

Under Plan C two supplemental culverts would be placed through the Conrail railroad embankment. This alternative would not require the floodpath clearing or channel construction of the first two plans, nor would there be any construction in the Maloy Brook-Barker Road section of the stream. The two culverts would be placed alongside the existing stone archway, similar to the single culvert designs of Plan A and B. This would greatly increase the flow rates downstream of the railroad crossing by passing the floodwaters normally delayed upstream.

Also reviewed was a nonstructural alternative which would not have reduced the flooding that occurs, but could reduce the economic damages caused by flooding. Actions that could be taken under this alternative included flood-proofing existing affected properties, relocating businesses and family residences, and purchasing flood insurance to insure against economic and hardship losses.

Affected Environment

For a general discussion of the Pittsfield area including a basin and site description, flooding history, demography, and other human and economic resources please refer to the "Problem Identification" section of the main report and Appendix 1.

This Assessment will contain itself principally to the impacts to the physical environment in the area of the proposed and alternative projects. The economic effects and considerations for the proposed project, and the alternatives, are presented elsewhere in the report. Since the recommended project to reduce flooding is a structural solution the adverse impacts are essentially related to the construction phase of the project and any permanent displacement of natural areas by new structures. This section reviews the project area that would be affected and generally discusses the areas that could be affected with the other alternatives. The economic and social benefits of alleviating flooding are addressed in the main report and in Appendix 2.

The potentially affected environment is limited to the narrow area of the stream along the West and Southwest Branches of the Housatonic River within the project area.

Vegetation Characteristics[1]

Upland

The Berkshire area is predominantly forest covered. The region is approximately 70 percent forested, but the Pittsfield area is more urbanized with about 35 pecent of the land cover being forested.

Around Pittsfield the cover is an integrated mix of agricultural, urban, forested and open lands. The predominant upland forest types are spruce and fir in higher elevations while beech, oak, maple and birch represent the majority of forest cover elsewhere. In the past 25 years, wetland and forest areas have increased slightly and urban type cover has increased over 100 percent. The increase in urban, forested and wetland areas resulted from the loss of agricultural land.

The areas that could be affected by any of the structural alternatives are characteristic of the vegetation found along the streambanks and adjacent uplands throughout the region. However, along the West and Southwest Branches there is a more urban-residential environment than along the majority of streams in the forested areas. Below the wetland area in Wahconah Park, the West Branch runs almost entirely through residential areas up to the Tel-Electric dam. It often passes through sections of manmade vertical walled channels or it flows through neighborhood back yards as a narrow stream with low banks. The Southwest Branch also flows through residential areas, but unlike the West Branch project area, the stream also passes through more open and wooded land as well. In the areas that could be affected, there is only minimal amount of upland vegetation. There does not appear to be any unique or high value upland habitat at any of the alternative project sites.

[1]Water and Related Land Resources of the Berkshire Region, Massachusetts U.S.D.A. Soil Conservation Service, 1977.

Wetlands

The Berkshire region contains about 21,800 acres of inland wetlands that help provide flood storage, fisheries and wildlife habitat, aesthetic open land and water quality. Wetlands have been valued as unique areas and their protection is prescribed by local, State and Federal laws and regulations. Of the 21,000 acres, some 8,000 acres are considered to have regional importance. In the Pittsfield area there are approximately 1,200 acres of open wetlands and an additional 750 acres of wooded swamp type wetland. Regionally important wetlands have been identified in the "Southeastern New England Water and Related Land Resources Study" and also presented in the study of "Water and Related Land Resources of the Berkshire Region, Massachusetts." The only regionally important site identified near the Southwest Branch project area was the wetland around Richmond Pond. There were no wetlands identified along the West Branch, even though the Wahconah Park wetland is recognized for its value.

The vegetation associated with swamp and wooded wetlands include such plants as red maple, black ash, green ash, American elm, arrowwood, pond weeds, cattail, sedges, pickerel weed, duckweed, purple loosestrife, and jewel weed. A more complete listing is presented in Table 6. The principal wetland to be affected by the proposed project is a five to six acre parcel upstream of the Barker Road bridge on the Southwest Branch. Along its streambank the vegetation is typical of normal wetland species for slow flow conditions and provides cover and surface food for the stream fishery. The vegetative cover shelters the stream and shades it from the sun helping to keep the water temperature down. Otherwise the vegetation is characteristic of saturated soils or occasionally flooded areas.

On the West Branch, there is a large wetland around Wahconah Park, but this area is upstream and outside the impact area for all the alternative improvements. Even the 40-foot wide channel reviewed in Plan C would begin downstream of the park at Linden Street and there would not be any construction in the wetland.

Additional information on wetlands in the area was published in a "Report of the Housatoanic River Flood Plain and the Inland Wetlands in the Town of Lenox" and another for the town of Lee, Massachusetts (Robert G. Brown and Assoc. Inc., Lee, Massachusetts).

TABLE 6

WETLAND VEGETATION AND ASSOCIATED WILDLIFE [1]

LAND COVER TYPE	ACRES	PERCENT OF LAND IN REGION	VEGETATION ASSOCIATED WITH COVER TYPE: TREES	VEGETATION ASSOCIATED WITH COVER TYPE: UNDERSTORY PLANTS	WILDLIFE ASSOCIATED WITH COVER TYPE: MAMMALS	WILDLIFE ASSOCIATED WITH COVER TYPE: BIRDS	WILDLIFE ASSOCIATED WITH COVER TYPE: REPTILES, AMPHIBIANS
Wetland (Type 1)	11,600 1/ 2/	2.6	red maple American elm	highbush blueberry buttonbush silky dogwood red osier dogwood jewelweed speckled alder winterberry wild raisin arrowwood pond weeds coontail cattail various sedges arrowhead pickerel weed burreed white waterlily yellow waterlily duckweed reed canary grass purple loosestrife	mink beaver raccoon muskrat otter little brown Myotis	American bittern mallard duck black duck coot green-winged teal blue winged teal wood duck red-tailed hawk tree swallow catbird yellow warbler yellowthroat red winged blackbird Canada goose spotted sandpiper swamp sparrow bobolink common grackle little green heron great blue heron cedar waxwing short billed marsh wren	spotted turtle painted turtle Northern water snake common garter snake ribbon snake spring peeper blue frog green frog Pickerel frog leopard frog wood frog American toad common newt spotted salamander

Table 6
WETLAND VEGETATION AND ASSOCIATED WILDLIFE (Cont'd)

LAND COVER TYPE	ACRES	PERCENT OF LAND IN REGION	VEGETATION ASSOCIATED WITH COVER TYPE: TREES	VEGETATION ASSOCIATED WITH COVER TYPE: UNDERSTORY PLANTS	WILDLIFE ASSOCIATED WITH COVER TYPE: MAMMALS	WILDLIFE ASSOCIATED WITH COVER TYPE: BIRDS	WILDLIFE ASSOCIATED WITH COVER TYPE: REPTILES, AMPHIBIANS
Bottomland Hardwood (Type 7 Wetland)	10,300	2.3	red maple black ash green ash American elm	high-bush blueberry arrowwood wild raisin elderberry highbush - cranberry speckled alder white helle- bore winterberry honeysuckle skunk cabbage Jack-in-the pulpit	snowshoe hare raccoon boreal red- back vole whitetail deer Northern flying squirrel little brown Myotis	woodcock tufted titmouse wood thrush cedar waxwing yellow warbler catbird American red- start tree swallow	common garter snake Eastern ribbon snake spring peeper wood frog spotted salamander common newt gray tree frog wood turtle box turtle Eastern ringneck snake

1/ Inventory area is the Berkshire Region as defined in "Water and Related Land Resources of the Berkshire Region", prepared by the Soil Conservation Services, et al, 1977.

2/ Data obtained from Massachusetts Map Down Project at University of Massachusetts, directed by Prof. William P. MacConnell.

Fish and Other Wildlife

The Berkshire Region is well known for its natural environs that provide plentiful wildlife habitat in its forests, streams and lakes. At the project sites, however, the area that would be affected is so small that effects to terrestrial habitat are only minimal. Along the West Branch project area there is little significant habitat or threat to wildlife. The only wildlife that could be impacted by the proposed or alternative projects would be associated with the stream and wetlands on the Southwest Branch.

The Southwest Branch is characteristic of other valley bottom streams in the region. It has a low gradient that slows its flow and causes it to meander in flat areas and wetlands. The stream supports native brown and brook trout populations along most of its length and the Massachusetts Division of Fish and Wildlife stocks it annually with brown trout for game fishing. In the project area upstream of the Barker Road bridge, alternative Plan B would affect 1,300 feet of fishery habitat.

In cooperation with Mr. Leo Daly of the Western District Office of Massachusetts Division of Fisheries and Wildlife, the Maloy Brook to Barker Road section of the stream was surveyed in August 1979. This section was found to be highly productive by providing "excellent brown trout habitat for both spawning and growth." It was estimated that this section of stream supported about 40 pounds of natural brown trout per acre of stream surface and that this amount "is well above the state average." The brown trout ranged in length from 2.7 inches to 15.2 inches. The most abundant fish was the white sucker, while other species that were found included brook trout, fall fish, pumpkin seed, large mouth bass, yellow perch, creek chub, long nose dace, black nose dace, common shiner, bridled shiner, and rock bass.

In addition to the fishery on the Southwest Branch, the only other wildlife of substantive importance comes from an unconfirmed reporting that a single muskrat borrow was found along the streambank. The area, however, does not support a significant muskrat habitat (Mr. Leo Daly, personal communication: 1980).

The West Branch also supports a brown trout fishery as well as the other fish species mentioned above. No survey of this stream was made, however, since Plan C, which proposed a 40-foot channel, did not appear to be economically feasible to warrant a detailed survey.

Water Quality

Water quality classifications for both the West and Southwest Branches show that the stream's present "C" classification condition meets its proposed "C" standard. Generally, these waters are described as being "suitable for recreational boating and secondary water contact recreation; habitat for wildlife and common food and game fishes indigenous to the region; certain agricultural and industrial uses; under some conditions, acceptable for public water supply with treatment and disinfection; and have good aesthetic value."

Environmental Consequences

Physical Ecological Impacts

Building the proposed project will not cause any major adverse problems in the natural environment. Nor will the operation of the constructed projects cause any substantial new impacts. Impacts normally associated with construction will cause some temporary, but minor increases in noise and dust immediately around the worksite. On the West Branch there will be little impact to the stream area from Plan A (removing the top several feet of the Tel-Electric dam and recapping it three feet lower than the existing elevation). To accomplish this the stream will continue to be bypassed through the existing discharge pipe around the dam.

The construction area will be isolated from the flow of the stream so that all work will be done in a dry zone. Consequently, no significant impacts are expected from siltation or any construction related stream disturbance. After the top of the dam is lowered and capped, the diversion which kept the work zone dry will be removed. The normal stream course would be directed over the top of the dam and the existing bypass pipe will serve to provide additional discharge capacity when waters begin to rise during flood periods. Since the new dam height will remain above the streambed there will be no scouring of the existing channel. The size of the small pool behind the dam will decrease slightly as a result of lowering the dam top, but, this will not adversely affect any stream fishery or upstream wetlands.

On the Southwest Branch, the proposed project (Plan A) will have no impact on the stream's natural course or fishery capacity. Under Plan A a single relief culvert would be placed through the Conrail railroad embankment beside the existing stone railroad bridge. The stone archway would not be altered to increase its capacity. The new culvert would be placed off to the side and higher than the present stream to pass only rising floodwaters. Only the outlet apron and some stone protection would be constructed within a wet area. Two to three hundred square feet of stream would be affected along the embankment. However, there will be virtually no effect to the stream's existing natural environment or fishery.

Plan A also proposed clearing brush and entangled vegetation from an area between Maloy Brook and the Barker Road bridge. In effect, this would create a path above the existing streambank to direct floodwaters through the area and under the Barker Road bridge. It would increase the stream's hydraulic efficiency for conveying floodwaters to reduce flooding. Under this plan there would be no construction to alter the stream's existing environment.

The floodpath alignment is shown in Figure 5 attached to the main report. Clearing and maintaining a floodpath would remove the tall ferns, brush and few trees along its alignment but should not cause any significant disturbance or alteration to the area. Approximately a half acre of Type 1 wetland vegetation would be removed, but the streambank vegetation will remain except where the floodpath cuts across the stream. With proper maintenance only short ground cover such as grasses would grow in the floodpath. Maintaining it would prevent erosion without the need to channel or pave a pathway.

An alternative to Plan A, Plan B also provides for a single culvert through the Conrail enbankment, but it also includes the construction of a new channel, 40 feet wide and 1,000 feet long, between Maloy Brook and Barker Road. The channel would be constructed along the same alignment as the floodpath of Plan A. Even though the construction of Plan B would be through dry upland areas, it would potentially remove approximately 4 acres of Type 1 wetland by excavating and dewatering them. The new channel would eliminate nearly 1,300 feet of existing natural stream, streambank vegetation and fishery habitat. The water depth in the improved channel would be considerably more shallow with a slightly increased velocity during normal flows. These conditions combined with lack of streambank vegetation, deep pools and appropriate spawning conditions would eliminate this section of stream as a prime habitat for the existing fishery which now supports 40 pounds/acre of natural brown trout. It would represent approximately a 10 percent loss of the stream's brown trout fishery and an additional loss of habitat for the other species as well. It is uncertain whether conditions in the new channel would affect spawning in other areas of the stream. This would depend principally on the level of water in the channel at the time of spawning and larval migration through this section of stream. In addition, where channel construction passes near or through the stream it would cause siltation. If this plan were to be implemented, silting could significantly affect trout spawning. It would require detention basins and filters, and construction scheduled would have to coincide with the season when the fisheries downstream would be least affected.

The combined impact of the proposed plans for the West & Southwest Branches on locations downstream would be minimal. There would be small increases in the 100-year flood level just below the confluence of the West and Southwest Branches, but further downstream the Housatonic River enters an extensive wetland and relatively undeveloped flood plain. This wetland would be capable of absorbing any increases in stream levels that may result from the proposed plans, and therefore would eliminate any potential adverse impacts to the proposed wild and scenic river section of the Housatonic below the Massachusetts-Connecticut state line.

To further evaluate the environmental effects Tables 7 and 8 present an Effects Assessment of the different alternatives. In this manner the relative impacts of the alternatives can be compared.

TABLE 7

ENVIRONMENTAL AFFECTS ASSESSMENT OF PLAN
PITTSFIELD, MASSACHUSETTS, LOCAL FLOOD PROTECTIO
WEST BRANCH, HOUSATONIC RIVER

Effects	PLAN A Lower dam 3 feet	PLAN B Lower dam 3 feet and replace West Street bridge.
Channel Excavation	None	None
Temporary Construction Impacts	Disturbance to immediate work area around Tel-Electric Dam. Work to be done in dry area, minor stream siltation. Construction noise, dust and inconvenience would be minor.	Same as Plan A Traffic detour around West Street bridge would be necessary for approx. 2 to 2-1/2 months during reconstruction of bridge.
Permanent Streambed Alteration	None	Same as Plan A
Effect on Wetlands	No effect	No effect
Loss of Productive Fish/Trout Habitat	None	None
Effect on Terrestrial Vegetation	No effect	No effect
Effect on Flooding (100 year event) Local Economic/Social Well-Being	Reduces flooding 1-1.5 feet. Substantial flooding still to occur. Some damages and inconveniences from residual flooding will remain, road closings and wetted basements. Annual Benefit = $12,000 Residual Losses = $63,800 B/C = 3.75	Reduces flooding. Moderate losses still to occur. Annual Benefit = $33,300 Residual Losses = $42,500 B/C = 1.14
Effect on Flooding (25 year event) Local Economic/Social Well-Being	Reduces losses from 25 year flood by 25 to 30%.	Reduce losses from 25 year flood by 50 to 75%.
Downstream Effects	Project will slightly increase downstream flow. No significantly greater adverse effect. Least disruptive alternative.	Increases downstream discharges. Will not cause impacts significantly greater than present flooding.
Archeological-Historical Impacts	None anticipated	None anticipated, but survey would be made.
Impact Mitigation	No impacts are expected. However, siltation reduction measures and seasonal construction schedules would be implemented if unexpected impacts warrant their use.	Same as Plan A

(1)

* B/C Ratio : Project Benefits ($)/Project Costs ($)

TABLE 7

ENVIRONMENTAL AFFECTS ASSESSMENT OF PLANS
PITTSFIELD, MASSACHUSETTS, LOCAL FLOOD PROTECTION PROJECT
WEST BRANCH, HOUSATONIC RIVER

	PLAN B	PLAN C	PLAN D
nt	Lower dam 3 feet and replace West Street bridge.	Replace dam and West Street bridge, and construct 40 foot wide channel.	Non-structural solution (flood proofing, insurances, etc.)
	None	Excavate 7,000 feet of stream from Wahconah Park to Tel-Electric Dam. Construct new 40 foot wide trapazoidal channel.	None
work area Work to be stream noise, dust be minor.	Same as Plan A Traffic detour around West Street bridge would be necessary for approx. 2 to 2-1/2 months during reconstruction of bridge.	Disruption of aquatic environment and streambed from Linden Street area to Tel-Electric dam. Full reduction of fish habitat from siltation and other construction disturbances in work areas ranging from 1000 to 4000 feet at a time.	Noise and dust during the demolition, removal and relocation of structures out of the flood areas.
	Same as Plan A	7,000 feet of stone lined channel and cleared bottom.	None
	No effect	Could affect wetland immediately upstream and adjacent to new channel. Potential to alter 2-4 acres of wetland at downstream end of Wahconah Park by draining down water level.	No effect
	None	Approx. 5000 feet of natural stream lost. Only deeper, narrow reaches could retain fishery potential. Present fishery is moderately productive. The wider, shallow sections of new channel would nearly eliminate trout fishery.	None
	No effect	Small loss of vegetation along widening where stream passes through residential properties. Possible loss along length of new channel could amount to 1.5 to 2.5 acres.	No effect
eet. ill to incon- flooding ge and ,000 ,800	Reduces flooding. Moderate losses still to occur. Annual Benefit = $33,300 Residual Losses = $42,500 B/C = 1.14	Eliminates nearly all flooding. Annual Benefit = $70,800 Residual Losses = $5,000 B/C = 0.38	Continued flooding, but $ damages would be reduced by an insurance program. Some residences may be demolished or relocated and occupants would be relocated out of flood areas. B/C = 0.35
ear flood by	Reduce losses from 25 year flood by 50 to 75%.	Eliminates all floods.	Continued flooding, but $ damages would be reduced by an insurance program.
crease nificantly Least	Increases downstream discharges. Will not cause impacts significantly greater than present flooding.	Not quantified. Flood problems would be transferred downstream.	No change
ted	None anticipated, but survey would be made.	A literature and on-site survey would be made to evaluate potential impacts if Plan C is accepted.	No effect
. However, ures and chedules unexpected se.	Same as Plan A	Same as Plan A In addition, in-stream structures may be necessary to enhance new channel for habitat. Enhancing stream areas not to be affected by project could replace habitat eliminated by construction.	None anticipated

* B/C Ratio : Project Benefits ($)/Project Costs ($)

TABLE 8

ENVIRONMENTAL AFFECTS ASSESSME
PITTSFIELD, MASSACHUSETTS, LOCAL FLOOD
SOUTHWEST BRANCH, HOUSATONI

Effects	PLAN A	PLAN B	
	1 Supplemental culvert and floodpath.	1 Supplemental culvert and construct 40-foot wide channel.	2 Supple
Channel Excavation	None	Excavate 1000 feet for new channel. To remove areas of stream, wetland and upland between Maloy Brook and Barker Road.	
Temporary Construction Impacts	Disturbance to immediate work area at Conrail bridge crossing. Minor stream siltation. Construction noise, dust and inconveniences would be minor.	Same as Plan A Siltation would adversely affect trout and other fish habitat downstream of Barker Road. Effects would be severe in summer and spawning seasons.	
Permanent Streambed Alteration	Minor, 200-300 square feet of streambed/streambank at the Conrail stone arched bridge would be covered for a culvert apron to reduce scour around the new culvert.	New channel would effectively eliminate 1300 feet of existing stream which is prime trout habitat. Normal stream waters would flow through new channel, with no flow in present stream.	
Effect on Wetlands	One-half acre of wetland vegetation would be cut and kept low to ground for floodpath. Early successional plants would replace the mature species in the cut area.	Potential elimination of 4-5 acres of Type 1 wetland. Effects are due to direct construction effects, a new wider channel, and possible dewatering. Dewatering would not allow wetland regeneration.	
Loss of Productive Fish/Trout Habitat	None	Loss of 1,300 feet of stream-prime trout habitat. Minor loss of muskrat habitat. New wide channel would decrease normal flow depth, slightly increase flow velocity, eliminate deep habitat pools and eliminate productive vegetation and cover from the stream banks.	
Effect on Terrestrial Vegetation	None	Eliminate or adversely affect approx. 2 acres of upland wooded area. No effect to upland wildlife habitat.	Minor dis road brid
Effect on Flooding (100 year event) Local Economic/Social Well-being	Substantially reduces major flooding. Moderate losses still to occur. Annual Benefit = $100,200 Residual Losses = $77,500 B/C = 2.69	Substantially reduces major flooding. Moderate losses still to occur. Annual Benefit = $101,000 Residual Losses = $76,700 B/C = 1.54	Substanti in existi Moderate lowest of Annua Resid
Effect on Flooding (25 year event) Local Economic/Social Well-Being	Reduces the smaller flood event; i.e. less than the 10 year flood frequency.	Will eliminate smaller flood events due to channelization.	Plan C wo reduction
Downstream Effects	Increased downstream flow, but this would be offset by relocation of the utility conduit under South Street bridge.	Same as Plan A	Increased because m conveyed Mitigatio
Archeological-Historical Impacts	None anticipated	None anticipated, but survey would be made.	
Impact Mitigation	All construction and clearing would be "in the dry," essentially upland area. No siltation or habitat losses need to be mitigated.	Where new channel cuts across existing stream siltation reduction methods or fishery off-season times could be used for construction periods. Ultimately, channel excavation should result in minor siltation problems. Channel structures would be included for fish maneuverability.	No major to be mit

* B/C Ratio : Project Benefits ($)/Pr

TABLE 8

ENVIRONMENTAL AFFECTS ASSESSMENT OF PLANS
PITTSFIELD, MASSACHUSETTS, LOCAL FLOOD PROTECTION PROJECT
SOUTHWEST BRANCH, HOUSATONIC RIVER

PLAN B	PLAN C	PLAN D	PLAN E
...mental culvert and construct wide channel.	2 Supplemental culverts.	Non-structural solution (flood proofing, insurances, etc.)	Construct upstream dam and reservoir.
...e 1000 feet for new ... To remove areas of stream, ... and upland between Maloy ...d Barker Road.	None	None	No major stream channel.
Same as Plan A ...n would adversely affect ...d other fish habitat down- ...of Barker Road. Effects ...e severe in summer and ... seasons.	Same as Plan A	Noise and dust during the demolition, removal and relocation of structures out of the flood areas.	Disturbance to immediate work areas. Stream would be diverted at work zones for construction bypass. Effects of stream siltation more severe during summer and spawning season. Minor effects from construction noise and dust. Specific construction sites and impact areas not determined.
...nel would effectively ...e 1300 feet of existing ...hich is prime trout habitat. ...tream waters would flow ... new channel, with no flow ...nt stream.	Same as Plan A	None	Upstream of dam, aquatic life would shift from stream to lake type habitat.
...al elimination of 4-5 acres ...l wetland. Effects are due ...t construction effects, a ...r channel, and possible ...ing. Dewatering would not ...tland regeneration.	No effect	No effect	Not quantified
... 1,300 feet of stream-prime ...abitat. Minor loss of ... habitat. New wide channel ...crease normal flow depth, ...y increase flow velocity, ...e deep habitat pools and ...e productive vegetation and ...m the stream banks.	None	None	Stream inundation would eliminate brook trout habitat; warm water fishery would replace stream fishery - ecosystem exchange upstream of dam. Downstream habitat would remain unchanged.
...te or adversely affect ... 2 acres of upland wooded ...No effect to upland wildlife ...	Minor disturbance around the railroad bridge embankment.	No effect	Not quantified
...tially reduces major ...s. Moderate losses still to ... ...al Benefit = $101,000 ...dual Losses = $76,700 B/C = 1.54	Substantially reduces major flooding in existing flood prone areas. Moderate losses still to occur, but lowest of Plans A-C. Annual Benefit = $120,300 Residual Losses = $57,400 B/C = 2.38	Continued major flooding, but $ damages would be reduced by an insurance program. Some residences may be demolished or relocated and occupants would be relocated out of flood areas. B/C = 0.46	Reduced flooding; would enhance local economic well-being in improved area. Creating reservoir would require extensive land taking of private property and possibly requiring relocation of some residents. Specific impact areas not determined.
...iminate smaller flood events ...channelization.	Plan C would provide only minor reduction of smaller flood events.	Continued flooding, but $ damages would be reduced by an insurance program.	Less than 50% of contributing drainage area would be controlled; still allowing for smaller flood events in areas nearer Pittsfield center.
Same as Plan A	Increased flood elevation downstream because major flood waters are conveyed too rapidly downstream. Mitigation by same as Plan A.	No change	Waters contributing to major flood events would be controlled rather than passed downstream. Stream could be regulated to maintain normal downstream conditions during non-flood conditions.
...ticipated, but survey would	None anticipated	No effect	Would be determined. A literature and on-site survey would be made to evaluate potential impacts if Plan E receives further consideration.
...w channel cuts across ... stream siltation reduction ... or fishery off-season times ... used for construction ... Ultimately, channel ...ion should result in minor ...on problems. Channel ...ces would be included for ...aneuverability.	No major siltation or habitat losses to be mitigated.	No physical mitigation, temporary construction impacts from building demolition or relocation.	Change of habitat may require enhancement of stream habitat elsewhere. Mitigation of construction impacts and residential relocation would be employed if Plan E receives further consideration.

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* B/C Ratio : Project Benefits ($)/Project Costs ($)

Section 404(b) Guidelines Evaluation

for

Pittsfield Local Protection Project

Pittsfield, Massachusetts

1. References

a. Section 404(b) of Public Law 92-500, as amended, Clean Water Act.

b. 40 CFR 230.4-230.5, dated 5 September 1975.

c. EC 1105-2-97 Appendix C, dated 8 May 1979.

2. The Proposed Project

A description of the proposed project is presented as the recommended plan in the Detailed Project Report, which also includes the project's Environmental Assessment. For a Section 404 review this evaluation will address the entire recommended plan for improvements to the Southwest and West Branches of the Housatonic River. The recommended plan includes separate Federal and local construction elements. The project on both streams is very small in scope. On the Southwest Branch it is limited to the installation of a single supplemental culvert beside an existing railroad bridge opening and the provision of a floodpath created by clearing heavy vegetative cover in a flood prone area. Installation of the supplemental culvert would be the only Federal responsibility recommended in the proposed project. The remainder of the project on both branches, and on the stream below the confluence of the two branches, would be a local responsibility. This work is limited to lowering the crest of an existing small concrete dam by three feet to improve the stream's flow characteristics. Below the confluence, the recommended project would remove an obstructing utility hanging along the bottom of the South Street Bridge and lower it to cross beneath the stream.

Disposal of fill material for the project is minor and is associated with (1) the placement of the supplemental culvert, (2) a temporary structure to dewater the work site around the dam, and (3) the placement of backfill into the trench after lowering the utility line crossing.

3. Project Authority and Present Status

Under the continuing authorities of the Corps of Engineers based on Section 205 of the 1948 Flood Control Act, as amended, studies were made to determine the need and feasibility of providing local flood protection along the Southwest and West Branches of the Housatonic River in Pittsfield, Massachusetts. Upon completion of the report, which includes the project Environmental Assessment and the Section 404(b) Evaluation, it is forwarded to the Office of the Chief of Engineers for approval and funds. Once funds are allocated it would initiate development of detailed plans for construction.

4. Environmental Concerns

The proposed project will reduce economic losses to residences and several business properties, hardships and inconveniences caused by flooding. The initial design of the project has undergone several modifications to arrive at the presently recommended project which eliminates or mitigates the impacts of earlier concepts and other alternatives. The proposed project is considered to have minimal short term effects and no unacceptable long-term impacts.

5. Technical Evaluation

A technical evaluation with respect to disposal of fill material and potential environmental impacts resulting from such disposal has been completed. The results are presented on page 4. Concomitant reading of or adequate familiarity with Section 404(b) Guidelines will insure understanding of results presented in the technical evaluation.

6. Conclusions

Determinations

a. An ecological evaluation has been made following the evaluation guidance in 40 CFR 230.4, in conjunction with the evaluation considerations in 40 CFR 230.5

b. Appropriate measures have been identified and incorporated in the proposed plan to minimize adverse impacts on the aquatic environment as a result of the discharge.

c. Consideration has been given to the need for the proposed activity, the availability of alternate sites and methods of disposal that might be less damaging to the environment, and such water quality standards as are appropriate and applicable by law.

d. Providing local flood protection along the West and Southwest Branches will require the placement of fill for the culvert or temporary dewatering of a construction site. Except for minor work in the streams the majority of work will be on dry land or adjacent to the stream's present channel. No permanent structure will interfere with the stream's flow or aquatic environments.

Placement of fill material is expected to improve the human and economic environment by reducing flooding and improving the local residential and urban business climate.

Findings

The discharge sites for the placement of fill for flood relief measures along the West and Southwest Branches, in Pittsfield, Massachusetts, have been specified through the application of Section 404(b) Guidelines.

The project files and Federal regulations were reviewed to properly evaluate the objectives of Section 404(b) of Public Law 92-500, as amended. A public notice with respect to the 404 Evaluation will be prepared. A thorough review of the project's planning process, the alternatives that have been considered and the environmental impacts have been presented in the project's Detailed Project Report, which includes an Environmental Assessment. The reader should refer to the report to supplement this Section 404(b) review. Based on the information contained in the Technical Evaluation and referenced Detailed Project Report, I find the project will not result in unacceptable impacts to the environment.

17 July 1980
DATE

MAX B. SCHEIDER
Colonel, Corps of Engineers
Division Engineer

230.4-1 Physical and Chemical-Biological Interaction Effects

(a) Physical Effects (1 through 3)

(1) Effects on Wetlands.

The proposed work will not introduce fill upon any wetland. The project includes clearing, by cutting, the heavy vegetative overgrowth where the floodpath crosses the Southwest Branch. This will reduce approximately ½ acre of existing wetland species to those other wetland species tolerant as lower ground cover.

(2) Effects on the Water Column.

Construction activities are expected to cause minor and temporary increases in stream turbidity around installation of the culvert, the placement and removal of the temporary dewatering structure upstream of the dam's work site, and at South Street where the utility line will cross beneath the stream. The work is minor in scope and is not expected to cause any appreciable siltation in either the West or Southwest Branch. No long-term adverse effects are expected.

(3) Effect on Benthos.

No adverse effect is expected.

(b) Chemical-Biological Interactive Effects (1 through 3)

(1) Fill material meets one of the conditions specified in paragraphs (b)(1)(i), (ii) and (iii) of this section. As such, it has been excluded from procedures specified in paragraphs (b)(2) and (3) of this section.

(i) Fill material will be composed of concrete, wood, gravel or sand, and have grain size larger than silt.

(ii) There is no beach restoration associated with this project.

(iii)(a) Fill material (concrete, sand, gravel or wood) is not substantially the same as the sediments found at the construction site (dirt and silt).

(b) All fill material will be obtained from a clean commercial source and will be free of undesirable contaminants.

(c) Construction of the flood control elements will be designed to insure all fill material remains at the disposal site.

(c) Procedure for Comparison of Sites (1 and 2)

(1) Not applicable. The project does not involve dredging sediments.

(2) Analysis of the biological community at the project site is considered unnecessary. Placement of clean fill material along the West/Southwest Branch will not result in degradation of water quality or release undesirable contaminants in the surrounding environment.

230.4-1 Water Quality Considerations

Placement of clean fill material along the streams will not violate such water quality standards as are appropriate and applicable by law.

230.5 Selection of Disposal Sites and Conditioning of Discharges of Dredged or Fill Material

(a) General Considerations and Objectives (1 through 8)

(1) Discharge of clean fill will not significantly disrupt the chemical physical or biological integrity of the aquatic ecosystem.

(2) Discharge activities should not significantly disrupt the food chain in such a manner as to alter or decrease diversity of plant or animal species.

(3) Discharge activities are not expected to significantly interfere with movement into and out of feeding, spawning, breeding or nursery areas. Any potential turbidity problems will be mitigated by off-season construction or other designed mitigation measures.

(4) There will be no discharge activities into wetlands.

(5) Discharge of fill for flood control will not isolate areas that serve the function of retaining natural high waters or flood waters.

(6) Adverse turbidity levels from discharge activities will be minimized to the extent practicable.

(7) Discharge of clean fill material will not degrade water quality as determined through application of Sections 230.4, 230.5 (c) and (d).

(b) Considerations Relating to Degradation of Water Uses at Proposed Disposal Sites (1 through 10)

(1) Municipal Water Supply Intakes.

Not applicable. There are no public water supply intakes in or near the project area.

(2) Shellfish (i through iv)

(i) Not applicable. The area of proposed construction does not support concentrated shellfish production.

(ii) Not applicable. Discharge of clean fill will not release pollutants that could be moved by currents or wave action into productive shellfish beds.

(iii) Discharge of fill will not cause undesirable changes in current patterns, salinity patterns and flushing rates which could affect shellfish.

(iv) Construction activities are not expected to interfere with reproductive processes or cause undue stress to juvenile forms of shellfish.

(3) Fisheries (i through iii)

(i) Discharge of fill should not significantly disrupt fish spawning or nursery areas.

(ii) Discharge of fill material will be scheduled to avoid interference with fish spawning cycles or migration patterns and routes, or mitigated features would be specially designed to ensure no impact or migration obstruction.

(iii) Not applicable. There is no significant submersed or emergent vegetation at the project site.

(4) Wildlife

Discharge of fill should have little, if any, impact on habitat, the food chain or community structures of wildlife and marine or aquatic sanctuaries.

(5) Recreational Activities (i through iv)

(i) Reasonable methods will be employed to minimize any increase in amount or duration of turbidity which would reduce the numbers and diversity of fish or cause a significant aesthetically displeasing change in the color, taste or odor of the water.

(ii) Not applicable. Clean fill will not release nutrients which might result in eutrophication, degrade aesthetic values or impair recreational uses along the West or Southwest Branches.

(iii) Not applicable. Fill material will be obtained from a clean commercial source and will be free of unacceptable levels of pathogens.

(iv) Not applicable. Fill material will be free of oil and grease in harmful quantities as defined in 40 CFR 110.

(6) Threatened and Endangered Species.

No known threatened or endangered species inhabit the project area nor would the project, as proposed, destroy or modify critical habitat of such species in a way to jeopardize their continued existence.

(7) Benthic Life

Discharge of fill will destroy those benthic organisms inhabiting the immediate areas of construction. The area of impact, however, is so small as to have a negligible effect on the streambed ecosystem. There will be no long-term adverse effect.

(8) Wetlands (i and ii)

(i) Not applicable. Discharge of dredged material will not occur.

(ii)(a) Discharge of fill material for the different project elements necessitates that the work have direct access or proximity to, or be located in the streams and that other alternative sites are not practicable.

(b) Development of this flood control project will not cause permanent unacceptable disruption to the beneficial water quality uses along the West and Southwest Branches.

(9) Submersed Vegetation.

Not applicable. There is no significant submersed vegetation at the project site.

(10) Size of Disposal Site.

Approximately 1000-2000 square feet of fill area may be affected, and approximately 750-1500 square feet of the total would be replaced and not permanently lost. This area would return to its former condition in a very short period.

(c) Other Considerations (1 through 7)

(1) Appropriate scientific literature was incorporated on the project design.

(2) Not applicable. There is no open water disposal.

(3) Discharge of fill is designed to enhance retention of all fill at the project site.

(4) Not applicable. There is no disposal seaward of the territorial sea.

(5) Not applicable. There is no disposal of dredged material. All fill material will be obtained from a clean commercial source.

(6) Not applicable. Discharge activities will not create any confined areas with runoff problems.

(7) Because of the nature of the project, monitoring is deemed unnecessary.

(d) Contaminated Fill Restrictions.

Not applicable. All fill material will be obtained from a clean commercial land source and will be free of undesirable constituents in critical constituents.

(e) Mixing Zone Determinations (1 through 6)

Not applicable. Mixing zone determinations apply to open water disposal of materials.

RECOMMENDATIONS

It is recommended that local flood protection plans for the West and Southwest Branches of the Housatonic River in Pittsfield, described as the selected plans in this report and shown on Plates 1 through 5, be authorized for construction, with such modifications as the Chief of Engineers may find advisable. Total Federal first costs are estimated at $433,200 while non-Federal first costs are estimated at $87,600. Of this total non-Federal cost, $29,600 would be required for improvements along the West Branch. Because this work is not a prerequisite to the Southwest Branch improvements, the city of Pittsfield would have the option of either constructing the dam modification concurrent with the recommended plan of Federal participation, or at a later date. The city of Pittsfield would be the non-Federal sponsor and would be responsible for the following items of local cooperation:

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

b. Hold and save the United States free from damages due to construction works except damages due to fault or negligence of the United States or its contractors.

c. Maintain and operate all project works as well as the existing channel after completion in accordance with regulations prescribed by the Secretary of the Army.

d. Provide, without cost to the United States, all alterations and replacement of existing utilities.

e. In accordance with plans approved by the Division Engineers, prescribe and enforce regulations to prevent encroachment on both the improved and unimproved channels, and manage all project related channels to preserve capacities for local drainage as well as for project functions.

f. Comply with the provisions under Section 210 and 305 in Public Law 91-646, 91st Congress, approved 2 January 1971, entitled, "Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970."

In addition, it is recommended that the city of Pittsfield consider plans to replace the West Street bridge over the West Branch, Housatonic River. Replacement of this flow restriction is a non-Federal responsibility under the Section 205 authority. Although this feature is not included as part of this Detailed Project Report, replacement of the West Street bridge with a 50-foot span would reduce annual flood losses along the West Branch by approximately $21,300.

It is recommended that funding in the amount of $65,000 be provided to prepare plans and specifications for the formulated flood protection project. An additional $368,200 in construction funds would be required during early FY 81 to initiate a contract for implementation of the proposal.

MAX B. SCHEIDER
Colonel, Corps of Engineers
Division Engineer

ACKNOWLEDGEMENTS

This report was completed by the New England Division, Army Corps of Engineers, under the general direction of Colonel Max B. Scheider, Division Engineer. It was prepared by Ms. Karen Dennison, Project Manager, under the overall direction of Mr. William Swaine, Senior Project Manager, and Mr. Joseph Ignazio, Chief, Planning Division.

Members of the study team included Mr. James O'Leary, Mr. Joseph Colucci, Mr. Farrell McMillan, Mr. Robert Adler, Mr. Warren Weiner, Ms. Diana Platt, Mr. John Wilson, and Mr. Glenn Brock, all of the New England Division.

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Acknowledgement is also made of the engineering consulting firm of Hayden, Harding and Buchanan of Boston, Massachusetts for their formulation of a non-structural plan of flood protection. The results of this study were useful in developing final alternative plans for both branches of the study area.

REPORT APPENDICES

APPENDIX 1

PROBLEM IDENTIFICATION

APPENDIX 1

PROBLEM IDENTIFICATION

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TABLES

APPENDIX 1

PROBLEM IDENTIFICATION

Background information concerning the authorization of this study and a description of the problems and needs of the city of Pittsfield is presented here to augment the findings of the main report.

Study Authority

This study was accomplished under the authority of Section 205 of the Flood Control Act of June 1948, as amended, which states:

> "The Secretary of the Army is authorized to allot from any appropriations heretofore or hereafter made for flood control, not to exceed $30,000,000 for any one fiscal year, for the construction of small projects for flood control and related purposes not specifically authorized by Congress, which come within the provisions of Section 1 of the Flood Control Act of June 22, 1936, when in the opinion of the Chief of Engineers such work is advisable. The amount allotted for a project shall be sufficient to complete Federal participation in the project. Not more than $2,000,000 shall be allotted under this section for a project at any single locality, except that not more than $3,000,000 shall be allotted under this section for a project at a single locality if such project protects an area which has been declared to be a major disaster area pursuant to the Disaster Relief Act of 1966 or the Disaster Relief Act of 1970 in the five-year period immediately preceding the date the Chief of Engineers deems such work advisable. The provisions of local cooperation specified in Section 3 of the Flood Control Act of June 22, 1936, as amended, shall apply. The work shall be complete in itself and not commit the United States to any additional improvement to insure its successful operation, except as may result from the normal procedure applying to projects authorized after submissions of preliminary examination and survey reports."

Prior Studies and Reports

The flood hazards of Pittsfield have been included in several reports written by the USDA Soil Conservation Service regarding the Housatonic River Basin and Berkshire County. Some of these have recommended improvements for water resources development directly related to the flood problems, and others are more broad in scope, including the water supply problems of the area. These report findings are described below.

Flood Hazard Analysis: Upper Housatonic River, Massachusetts

Prepared in 1974 by the Soil Conservation Service in cooperation with the Massachusetts Water Resources Commission and the Berkshire Conservation District, this report identifies major flood prone areas of the river, flood plain regulations and recommendations for alternative methods of flood plain management. It was prepared under authority of Section 6 of Public Law 83-566, in compliance with Executive Order 11296, dated 10 August 1966. It includes a description of the West and Southwest Branch drainage areas, outlining the soil type, vegetation and extent of development within the 100-year flood plain. It concludes that immediate action should be taken to assure proper flood plain management and suggests methods by which damages from high flood stages could be reduced.

Watershed Investigation Report for the Upper Housatonic River Watershed

This report was also written by the Soil Conservation Service as a contribution to the Massachusetts Water Resources Study. It was completed in September 1976 and is primarily directed at outlining the alternatives available to reduce flood damages in the upper Housatonic River watershed. The report describes the extent of Federal assistance available for development of management measures under the authority of Public Law 83-566, "The Watershed Protection and Flood Prevention Act," and it suggests that local authorities apply for this aid through the proper channels.

Water & Related Land Resources of the Berkshire Region, Massachusetts

This report is the most comprehensive of those published by the Soil Conservation Service to date. It was published in 1977, and again its subject is directly concerned with the conditions of the watershed and the extent of Federal assistance available to the region under authority of PL-83-566. It describes in detail the existing and expected future conditions of the following resources in the river basin: land use, economic development, flood hazard, erosion and sediment, recreation, fish and wildlife, wetlands, water supply and water quality. This represents the final report on the Berkshire Region presented to the Massachusetts Water Resources Commission by the USDA Field Advisory Committee.

Flood Insurance Study: City of Pittsfield, Berkshire County, Mass.
U.S. Department of Housing and Urban Development, FIA

Under authority of the National Flood Insurance Act of 1968, as amended, this study was made to convert Pittsfield to a regular program of flood insurance by the Federal Insurance Administration. The report is dated May 1977. It details the hydrology of the West and Southwest Branches and outlines those area of the city that are threatened by the 100-year and 500-year floods. A Flood Insurance Rate Map relating different flood threats to potential damages and establishing varying insurance rates for the city of Pittsfield was the principal result of this study.

Profile of Existing Conditions

This section of the appendix presents an assessment of the basin characteristics such as terrain, land use, population, housing and economic activity which are important factors when choosing a remedy for the flood problems of Pittsfield.

Terrain and Soil Cover

The drainage basins of the West and Southwest Branches of the Housatonic River are characterized by hilly uplands with steep, V-shaped stream valleys, and by lower hills that merge into the lowlands of the city. In the upper reaches of the watershed the bedrock is generally a soft schist and cavernous limestone, while in the intermediate uplands and the low lying lands the bedrock is dolomite and limestone. The bedrock in the uplands is generally close to the surface and the soil is stony and gravelly, providing very good drainage. The bedrock in the low lands has a highly irregular surface and in places there are depressions up to 50 feet in depth, which are filled with sedimented, glacial outwash. These gravel pits are one of the more important natural resources of the area. Silt and sand is abundant in swamp lands and in low flat areas, and is responsible for the poor drainage in these parts.

Vegetation

On the West Branch below Pontoosuc Lake, the vegetative cover of the flood plain is generally limited to Wahconah Park and to the two cemetaries located north of this park.

Elsewhere in the reach between Pontoosuc Lake and Tel-Electric Dam, the vegetation is confined to a narrow strip along the West Branch and is comprised of deciduous trees, alders and shrubs. Upstream of and around Pontoosuc Lake the vegetation of the flood plain is mostly pasture, hayland, shrub thicket and woodland. Some open areas have developed from abandoned agricultural lands and these are covered with tall grasses and weeds.

On the Southwest Branch the flood plain is less developed and, furthest away from Pittsfield, it remains primarily a wetland. Around Richmond Pond, the vegetation is mostly cattails and other grasses in the wetland storage areas, but the perimeter is heavily wooded. Closer towards the center of Pittsfield grasses and wooded thickets dominate the flood plain with some wooded areas in thin stands.

Wildlife

Wildlife in both branches exists only where substantial development has not taken place. Species such as waterfowl, amphibious reptiles, song birds and game birds inhabit the upper reaches of both rivers. Also, both the West Branch and the Southwest Branch support native trout. While most of the West Branch supports native brown trout, Onota Brook also supports brook trout. On the Southwest Branch brook trout are found in all of the upper tributaries and both brook and brown trout are found in Smith Brook and in the main channel below Richmond Pond.[1] To help support the demands of sport fisheries, these species are stocked every year.

Population

From 1930 to 1960, Pittsfield showed growth similar to that of Berkshire County and the Commonwealth of Massachusetts. From 1960 to 1970, Pittsfield showed a slight decrease of 1.5 percent to a population of 57,020 while Berkshire County and the State continued to grow. Between 1970 and 1975, Pittsfield's population continued to drop, with a decrease of 3.7 percent, leaving Pittsfield with a population of 54,893. Berkshire County reported a slight decrease of 0.3 percent, while the State showed a small increase of 2.3 percent. Population data for Pittsfield, the county and State is displayed in Table 1.

[1] Water and Related Land Resources of the Berkshire Region, U.S.D.A. Soil Conservation Service, 1977.

TABLE 1
POPULATION

	Pittsfield	% Change	Berkshire County	% Change	Mass.	% Change
1920	41,763		113,033		3,852,356	
		18.9		6.8		10.3
1930	49,677		120,700		4,249,614	
		0.0		1.3		1.6
1940	49,684		122,273		4,316,721	
		7.3		8.7		8.7
1950	53,348		132,966		4,690,514	
		8.5		6.9		9.8
1960	57,879		142,135		5,148,578	
		-1.5		5.1		10.5
1970	57,020		149,402		5,689,170	
		-3.7		-0.3		2.3
1975	54,893		148,969		5,812,489	

Source: U.S. Census

The population of Pittsfield is overwhelmingly white, with 2.3 percent of the population being nonwhite. Close to 30 percent of the population is foreign stock (first and second generation Americans), with the largest proportions coming from Italy (28.7 percent), Canada (15.7 percent), and Poland (10.7 percent).

Housing

The 1970 Census indicated that just over fifty percent of housing units in Pittsfield were single family structures. Twenty-two percent were two family dwellings with 14.7 percent of the structures housing three and four families. This data is presented in the following table.

TABLE 2
HOUSING; UNITS PER STRUCTURE
PITTSFIELD, 1970

UNITS	NUMBER	% OF TOTAL
1	9,922	52.7
2	4,181	22.2
3 and 4	2,779	14.7
5 or more	1,919	10.2
mobile	55	0.3
Total	18,856	100.1

Source: U.S. Census, 1970

Close to 60 percent of the housing units were owner-occupied. The median value of housing in Pittsfield is $18,000. The median value countywide is $17,100.

Economy

Industry

Pittsfield evolved from a small agricultural community to an important manufacturing center by early in the 19th century. It was the demand for clothing and military supplies during the War of 1812 that encouraged industrial activity in Pittsfield. The paper and shoe industries were the most important activities that prospered during this century. The Tilleston Textile foundries, producing machinery for textile and paper factories, were among the firms that contributed towards Pittsfield's place as the largest industrial center in western Massachusetts.

Manufacturing remains the largest source of employment, although its contribution has declined. In 1967, the manufacturing sector accounted for 57.5 percent of employment opportunities, which dropped to 44 percent by 1977. During both these years, wholesale and retail trade followed, employing close to 22 percent of the labor force. The services sector followed third in both 1967 and 1977, although it showed a tremendous growth of 173.5 percent over the period. Employment declined slightly (0.4 percent) during this period. Detail on these changes is presented in Table 3.

TABLE 3
Employment in Establishments Subject to Massachusetts Employment Security Law by Major Industry Divisions Pittsfield, Mass.

	1967		1977		Change	
	#	%	#	%	#	%
Agric. Forestry and Fisheries	28	0.1	34	0.1	6	21.4
Construction and Mining	1,002	4.2	661	2.8	-341	34.0
Manufacturing	13,813	57.2	10,536	44.0	-3,277	-23.7
Trans., Comm., and Utilities	1,156	4.8	1,225	.1	69	6.0
Wholesale/Retail Trade	5,084	21.2	5,335	22.3	251	4.9
Finance, Insurance and Real Estate	1,309	5.5	1,692	7.1	383	29.3
Services	1,602	6.7	4,431	18.5	2,811	173.5
TOTAL	24,012	100.0	23,914	99.9	-98	-0.4

Source: Mass. Division of Employment Security, 1978.

Labor Force

Data on employed civilian workers by occupational groups were made available in the 1970 Census of Population. With a labor force of 22,400 and employment of 23,933, Pittsfield accommodates most of its residents with employment opportunities within the city. The largest group of workers were clerical and kindred making up 21.0 percent of the employed, followed by the professional, technical, and kindred with 18.9 percent and operatives with 17.8 percent. These three groups make up over 56 percent of the total elmployed. Table 4 provides the complete breakdown of occupational categories.

TABLE 4
OCCUPATIONS, PITTSFIELD
(Employed Persons 16 years old and over)

Groups	1970 #	%
Prof., Tech., and kindred	4,233	18.9
Managers and administrators	1,685	7.5
Sales workers	1,517	6.8
Clerical and kindred	4,703	21.0
Craftsmen, foremen, and kindred	2,706	12.1
Operatives	3,976	17.7
Laborers	653	2.9
Farmers and farm laborers	39	0.2
Service workers	2,888	12.9
Total	22,400	100

Source: U.S. Census, 1970

Employment statistics provided by the Massachusetts Division of Employment Security indicated a labor force of 26,802 for Pittsfield in November 1979. Of this, 25,431 were employed, yielding an unemployment rate of 5.1 percent, falling below that of the Labor Market Area* (LMA) but exceeding the State's rate of 4.8 percent. Employment data for these three areas for November 1979 are as follows:

	Pittsfield	Pittsfield LMA	Massachusetts
Labor Force	26,802	64,060	2,818,000
Employed	25,431	60,630	2,684,800
Unemployed	1,371	3,430	134,000
Unemployment Rate	5.1	5.4	4.8

Income

The median family income for Pittsfield in 1969 was reported in the 1970 Census to be $10,678. Earning under $4,000 was 9.7 percent of the population while 22.2 percent earned over $15,000. The median income in Pittsfield fell slightly below that for the State and the Standard Metropolitan Statistical Area (SMSA), but above that reported for the county. These data are presented in the following table.

*The Labor Market Area, in addition to Pittsfield, includes 23 of the 32 communities in Berkshire County.

TABLE 5
INCOME, 1969

	Median Family	Percent Earning Under $4,000	Percent Earning Over $15,000
Pittsfield	$10,678	9.7	22.2
Pittsfield SMSA	10,794	9.2	22.7
Berkshire County	10,268	10.2	20.2
Massachusetts	10,835	9.9	25.2

Land Use

With an area of approximately 42 square miles, Pittsfield has a population density close to 1300 persons per square mile. Of acreage developed in urban uses the overwhelming proportion is devoted to residential usage. Data gathered by William P. MacConnell of the University of Massachusetts provides a look of land use development and change between 1952 and 1972. MacConnell's findings are presented in Table 6.

TABLE 6
LAND USE
PITTSFIELD, MASS.
1952 AND 1972

	1952		1972		change	
Uses	acres	%	acres	%	acres	%
Residential	4,073	15.0	5,337	19.6	1,264	31.0
Commercial	336	1.2	674	2.5	338	100.6
Industrial	449	1.7	387	1.4	-62	-16.0
Transportation	33	0.1	153	0.6	120	363.6
Open & Public	702	2.6	716	2.6	14	2.0
Forest	10,323	38.0	9,591	35.3	-732	-7.1
Agriculture	8,772	32.3	6,895	25.4	-1877	-21.4
Wetland	2,480	9.1	2,364	8.7	-116	-4.7
Mining, Waste Disposal	-	-	248	0.9	-	-
Outdoor recreation	-	-	803	3.0	-	-
Total	27,168	100.0	27,168	100.0	0	0.0

Source: MacConnell, William P., Remote Sensing: 20 Years of Change in Berkshire County, Massachusetts, 1952 - 1972. Massachusetts Agricultural Experiment Station Research Bulletin Number 629, Amherst, Mass, November, 1975.

Forest land has remained the largest category and showed a small proportional decrease over the 20-year period. Agriculture remained the second largest use but lost one fifth of its acreage devoted to such uses. Most of this acreage was converted for residential use; residential acreage increased by almost one-third. Significant growth was noted in the commercial and transportation categories, although proportionately, acreage devoted to these uses remained small. Industrial acreage declined by 16 percent from 449 to 387 acres.

Flood Prone Areas

The flood prone areas within the 100-year flood plain cover a total of approximately 200 acres; 150 of which are subjected to flooding from the West Branch, the remaining 50 from the Southwest Branch. Much of this land area is undeveloped. Approximately 264 structures lie within the flood plains of both the West and Southwest Branches. Approximately 65 percent of these structures are single family residences, 20 percent are apartments, and 15 percent are commercial establishments.

About 80 percent of the flood prone structures lie within the reaches of the West Branch. Development is flooded along most all of the fringe of the flood plain with the densest areas being John Street, Dewey Avenue, King Street areas north of Danforth Avenue and Wahconah Street. Much of the West Branch's flood plain, however, is developed and occupied by Wahconah Park. A large tract of land lying west of the Park, east of King Street, is unutilized.

Only 62 of the 264 flood prone structures in Pittsfield lie within the flood plain of the Southwest Branch. Most of the development in this area is along and near West Housatonic Street and Cadwell Road. Structures along West Housatonic Street include a shopping mall complex, gas stations, motel, restaurant, and other commercial users. The rest of the development in the Southwest Branch flood plain is single family residential.

The Without Project Condition

Population Projections

The "most likely future" of Pittsfield, as presented in their Local Growth Policy Statement for the Office of State Planning, suggests a population stabilization or decrease. Projections prepared by the Office of State Planning, now the Office of Community Development, in conjunction with the Berkshire County Regional Planning Commission suggested the following populations for Pittsfield.

1985	53,480
1990	53,500
1995	53,280
2000	53,200

A population of 53,000 in 2000 would be a 3.4 percent decrease from the 1975 population. While Pittsfield's population decreases, populations of the surrounding towns are expected to increase, with a larger proportion of people working in Pittsfield and living outside of the city. It is expected that Pittsfield will continue to depend heavily in manufacturing employment; however, the proportion of total employment in this industry will continue to decline. With expansion of the Berkshire Medical Center, an upward trend for services and jobs in the medical profession is expected.

Future Growth and Development

A look at Pittsfield's Master Plan and its Local Growth Policy Statement reveals past development problems along with goals and policies to guide future growth and development of the city. A primary goal supported by both the Master Plan and the growth policy statement is to preserve the best possible living environment, while keeping the community in economic balance. In accomplishing this, reinforcement of Pittsfield as a regional center is desired. Residentially, Pittsfield should provide a wide range of housing types, preserve existing neighborhoods and provide residents with maximum access to facilities. Commercially, Pittsfield's goals are to promote the Central Business District's (CBD) viability by making it the center of a variety of activities, by providing better access (roads and parking), by promoting pedestrian convenience, and by discouraging large shopping centers competitive with the CBD and by discouraging strip commercial development. To promote Pittsfield's appeal for industrial development the city needs to offer a wide range of housing opportunities, employee skills, high level of community facilities, and suitable industrial land served by utilities and a means of transportation.

The greatest potential for residential growth in Pittsfield, is in the southeast quadrant, closely followed by the northwest and northeast sections. Although there are large open areas in the southwest quadrant, the airport district, restrictive topography, and low density zoning make its residential growth potential low. High density housing construction would be encouraged in areas close to the CBD. These units would reinforce the built-up character of existing neighborhoods and offer the opportunity of living within walking distance of central area activities.

Commercial development outside of the CBD is being encouraged in the form of "community shopping centers", containing supermarkets, discount stores, small shops, and perhaps a junior department store, which do not threaten the viability of the CBD. Two community shopping centers have been constructed, with another one being proposed at the junction of West Housatonic Street and the western end of Lebanon Avenue. The availability of vacant land in the

West Pittsfield and Onota Lake south neighborhoods make them the probable locale of much of Pittsfield's future growth, particularly with the relocation of the Community College and the extension of improved water pressure and sewer interceptors. Of the two community shopping centers in existence one lies within the flood plain of the Southwest Branch on West Housatonic Street at Gale Avenue. Much of the center is vacant at the present time. Despite the convenient location of this site relative to the proposed Route 7 bypass interchange, it is too close to the CBD and too severely restricted by its propensity to flood to develop into a fully utilized center.

Two major areas in Pittsfield are proposed for industrial expansion. Heavy industry should be located in the extension of the present complex northeast of the city center. The Industrial Park is an attractive forerunner of this expansion. Light industry will have the choice of scattered sites, but it is expected that new development would occur in the southwest section of the city and in the airport district.

The extension of service at Pittsfield's Municipal Airport would allow the city to better compete for continued establishment of industrial and commercial activities. In the National Airport Plan, Pittsfield's airport is designated for development as a "larger than General Utility" facility with a runway of 6,000 feet, regular scheduled flights to New York and the capability to handle jet aircraft. Because of this, an airport district controlling development is proposed for two sides of the facility. Strictly controlled commercial and light industrial uses would be permitted within the district. This basically would preclude any residential development in the immediate vicinity of the airport.

Two important features to be considered in the utilization and expansion of open space lands are flood prone areas and stream and ridge protection areas.

Pittsfield's newly adopted zoning ordinance provides for Flood Districts to ensure the safe use of flood prone lands. The land use plan encourages open use of the flood prone areas. This does include parking areas for commercial and industrial complexes and some forms of open space with the most desirable being the reservation of these flood prone areas for recreation or open space.

Stream and ridge protection tracts were proposed in the Master Plan to protect vulnerable natural features. Currently, the Housatonic River and its tributaries are subjected to industrial effluent, polluting the river to a level unsuitable for water supply. The tracts proposed for protection include a 25 foot strip along both sides of all major river courses in the city. However, tracts such as these have not been acquired by the city along the West and Southwest Branches.

Because Pittsfield expects to continue its growth in the future, more urban development will result. New regulations within the flood plain will moderate the effect of this growth on the river discharges and flood stages. The following figures relating urban development to stream hydrology were developed by the SCS in their flood hazard analysis report for the Upper Housatonic River Basin.

TABLE 7

Results of 10% Increase of Urbanization in Upper Housatonic River

	% Increase Direct Runoff		% Increase Peak Discharge		Increased Stage, Feet	
	10-yr	100-yr	10-yr	100-yr	10-yr	100-yr
Elm St., Pittsfield	7.0	5.0	8.0	5.5	1.3	2.5
Pontoosuc Lake	5.5	3.5	7.0	4.0	0.1	0.1
West St., Pittsfield	5.5	3.0	5.0	4.0	0.1	0.1
Conrail Culvert (S.W. Branch)	4.0	3.0	3.0	3.5	0.4	0.4
South St., Pittsfield	5.0	3.0	3.0	2.0	0.2	0.2
Holmes Rd., Pittsfield	4.0	3.0	4.5	3.5	0.5	0.2

These figures were compiled assuming there was no change in the current use of the flood plain. Using a similar assumption that recent flood plain regulations will curb future development, the S.C.S. in their report, Water & Related Land Resources of the Berkshire Region, project the following percentage changes in land use in Berkshire County between 1972 and 1990.

TABLE 8

PERCENT CHANGE IN LAND USE, BERKSHIRE COUNTY

Category	1972 Acres	1990 Acres	Per Cent Change
Agricultural Land	60,765	48,612	-20.0
Wetland	11,569	11,160	- 3.5
Water	7,523	7,843	+ 4.2
Forest	301,505	313,424	+ 4.0
Urban	29,965	48,400	+61.5
Other	28,062	9,950	-64.5

In this projection, the increase of 61.5 percent in urban land use is considered by the Soil Conservation Service to be a conservative estimate. It follows that the predictions for the increase in stream runoff and flood stage in the West and Southwest Branches, based on a 10 percent increase in urban lands, are probably very low, and flooding will be an increasing problem in the future.

Planning Constraints

Throughout the plan formulation phase of the study, close coordination has been maintained with local interests regarding their intentions in the solution of Pittsfield's flood problems. Apart from their own flood problems, they are most concerned for the safety of other communities located downstream of Pittsfield, as they do not wish to see the flooding problems transferred to these areas. A letter expressing this opinion was received from the Pittsfield Planning Board prior to the public meeting of 29 August 1979 and at this meeting the topic was again raised by many of the local citizens.

The area immediately below the confluence of the West Branch with the East Branch is primarily undeveloped and downstream in Lenox it has been designated by the SCS as an important wetland. The gradient in this reach continues to be very shallow and the stream meanders considerably over the distance to Lenox, some 7 miles downstream. The Housatonic is crossed by three roads within this distance, and the Pittsfield sewage treatment plant and the Housatonic River Valley Wildlife Management Area are located along this stretch. Heavy flows passing through Pittsfield into this area would most likely be successfully stored by the open wetlands of this reach. Nevertheless, a detailed hydrological analysis has been performed according to the requirements of the 1948 Flood Protection Act to assess the constraints presented by downstream conditions. This analysis is presented in Appendix 4.

Other environmental constraints placed on the local flood protection of Pittsfield include the recreation area of Wahconah Park on the West Branch and the natural brown trout population of the Southwest Branch. Intrinsic in these resources are the properties of water quality and water quantity.

The water quality of both of these rivers is designated by the Massachusetts Division of Water Pollution Control as being a Class C. That is, it is suitable for recreational boating and secondary water contact recreation. It provides a habitat for wildlife and common food and game fishes indigenous to the region. It has certain industrial and agricultural uses and under some conditions it is acceptable for public water supply with treatment and disinfection. This quality of water should at least be preserved, if not enhanced, through the implementation of a local flood protection project.

The quantity of water in the West and Southwest Branches passing through Pittsfield is also important in preserving the recreational values of Wahconah Park and the trout fisheries. Brook and Brown trout require a narrow range of pool depths and temperatures in order to thrive; the Wahconah Park provides opportunties for small boat recreation and some of the scarce riparian vegetation in Pittsfield. A solution to the flood problems of Pittsfield should insure the safety of these resources.

A final constraint placed on a local flood protection project is the extensive development of the flood plain within the city of Pittsfield. Both the West and the Southwest Branches have been severely encroached upon, making storage in the immediate area of flooding impractical, and safe passage of flood flows only possible through the use of high dikes. These would be very costly to install along the complete distances where overflow occurs, and as such a solution to the flood problems of Pittsfield must necessarily investigate the areas upstream and downstream of the city.

Pittsfield is expected to experience a shortage of water supply by 1990. While not constraining the program of flood protection, it would be efficient if both of these problems could be solved with one project. The SCS in their report, "Water and Related Land Resources of the Berkshire Region," estimates the expected deficit of water supply in 1990 to be approximately 3.6 million gallons per day (mgd). The Berkshire County Regional Planning Commission has investigated the potential of surface and ground water supplies for meeting this demand, where traditionally in Massachusetts ground water supplies have proved to be the most economical source of this requirement. However, in addition to the needs of Pittsfield, Lenox is expected to merge its water supply system with Pittsfield's. This would raise the demand to 4.1 mgd. Currently Pittsfield supplies its municipal water needs with surface water. In the future it may tap the ground water aquifer which exists under the East Branch, or it may need to develop another surface reservoir. The cost involved in constructing a reservoir to meet water supply standards and to provide storage during storm periods is too high for implementation within the framework of a Section 205 project.

APPENDIX 2

FORMULATION, ASSESSMENT & EVALUATION OF DETAILED PLANS

APPENDIX 2

FORMULATION, ASSESSMENT & EVALUATION OF DETAILED PLANS

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APPENDIX 2

FORMULATION,ASSESSMENT AND EVALUATION OF DETAILED PLANS

Plan Formulation

The plans selected for detailed assessment and evaluation were developed through an iterative process of first defining the problems and constraints of the flood problem in Pittsfield and then choosing a remedy which would achieve the related objectives. This process began with unconstrained proposals to fulfill all plan objectives (Table 2-1), and through the management measures outlined in the main report, the following plans, which principally address the objective of flood protection, were developed.

West Branch

All of the structural plans for flood protection on the West Branch rely on improving the channel in the vicinity of overflows. The extent to which this is achieved is the distinction between the three plans. Plan A lowers the Tel-Electric Dam by 3 feet, increasing the slope of the channel between Wahconah Park and this point. Plan B augments Plan A by replacing West Street bridge with a wider opening, in addition to lowering the Tel-Electric Dam. Both of these plans would require non-Federal funding of total first costs. Plan B provides flood protection considerably beyond that of Plan A, but it still doesn't protect against the 100-year flood. Plan C does protect against this magnitude flood; it calls for lowering the Tel-Electric Dam 11 feet, installing an 8 foot high bascule gate, and excavating a channel upstream to Wahconah Park. This channel would have a bottom width of 40 feet with sides sloped 2 on 1, and it would be excavated to a depth sufficient to contain the 100-year flood. In addition, this plan would require replacement of the West Street bridge by non-Federal participants, and some modification of the upstream railroad bridges. Other plans studied included non-structural measures and combinations of structural and non-structural.

Southwest Branch

The structural proposals for the Southwest Branch are included in three plans. Plan A calls for installing an additional 150 square feet of discharge capacity through the Conrail Railroad embankment. This would substantially reduce the damages sustained from the 100-year flood. In addition, Plan A would include clearing a 30' wide strip of brush away from the area upstream of Barker Road in a straight alignment between the entrance of Maloy Brook and the Barker Road bridge. This brush clearing would allow for unrestricted overland flow of the floodwaters away from the Pittsfield Plaza and U.S. Route 20. Plan B consists of excavating 1,000 linear feet of grass lined channel upstream of the Barker Street bridge in addition to installing the culvert of Plan A. The channel would be excavated to cut across the meander that currently exists along that reach. This channel would allow direct discharge of higher flows away from the entrance of Maloy Brook and would eliminate the more frequent periods of back-up which inundate U.S. Route 20 and the Pittsfield Plaza. Plan C calls for placing an additional 300 square feet of discharge capacity through the railroad embankment, using two 150 square foot culverts on each side of the river. Non-structural plans (Plan D) and combination plans (Plans E and F) were also investigated for the Southwest Branch.

TABLE 1
MANAGEMENT MEAURES VS. PLAN OBJECTIVES

	MANAGEMENT MEASURES			
PLAN OBJECTIVES	Reservoirs	Dikes, Channel Improvements Diversions	Zoning, Management & Standards Implementation	Flood-proofing & Relocation
Flood Control	x	x	x	x
Water Supply	x			
Water Quality	x			
Recreation	x		x	x
Fish & Wildlife			x	

Non-Structural Investigations

During plan formulation, a complete investigation was made to determine the feasibility of using flood proofing as a non-structural method of flood protection.

The levels of protection designed for in this analysis were the flood of 100-year interval and the Standard Project Flood (SPF). Six categories of flood protection were determined according to the extent of inundation, the condition of the structures involved, and the usage of the basements. These six categories had the following distinctions in application: Types A, B, & C were applied to structures where the level of inundation was below the elevation of the first floor; Type D was applied to structures where the first floor was inundated by three feet or less; and Type E involved the same criterion but was applied to unusual cases where the structures were individually analyzed; Type F applied to structures needing no flood proofing, and Type G was applied to structures where the depth of inundation was greater than three feet above the first floor, or where there was no practical means of flood proofing.

As this investigation was a preliminary effort to determine the feasibility of such a solution, the exact elevations of structures within the 100-year and SPF flood plains was not determined; rather, they were estimated from photogrammetric topography maps having contour intervals of 5 feet. The 100-year and SPF flood stages for the West Branch and the Southwest Branch were developed by the Corps of Engineers. Flood proofing of the structures within these flood plains would be applied, according to the criteria outlined above, in the following manner:

TYPE A

Type A flood proofing would be used for structures that have unfinished basements with no storage. Type A flood proofing techniques would consist of digging a trench in the basement floor and installing a drainage system to remove the water that accumulated. The trench would be located around the periphery of the basement approximately two feet inward from the walls. The trench should have a depth of about two feet. A system of six-inch diameter vitrified clay pipes leading to a sump hole containing a pump would be installed within the bottom of the trench and backfilled with crushed stone. The sump pump would require a separate electric outlet and would be connected to an outside hose which would divert water away from the basement. The top four inches of the trench would be finished concrete in order to restore the basement to its original condition. Twelve structures under the 100-year flood and 6 under the SPF were placed in this category.

TYPE B

Type B flood proofing would be used for structures that have finished basements with storage but no living accommodations. Houses in fair to excellent condition having basements were classified within this category. The procedures to be followed for this type of flood proofing would consist of the Type A drainage system, as well as waterproofing of the outside of the basement walls. Waterproofing basement walls would require that a trench be excavated around the outside periphery of the structure. The exposed basement walls would then be cleaned and waterproofing applied. The trench would be backfilled and compacted and the yard restored to its original condition. One hundred forty-five structures under the 100-year flood and 93 under the SPF were placed in this category.

TYPE C

Type C flood proofing would be applied to structures having finished basements being used for living quarters and storage. This technique would require the same measures as Type B with the additional precaution of blocking up all windows and doors. This would require the removal of existing doors and windows, to be replaced with block masonry. This measure could cause problems with regard to local fire and building codes. Such related problems were not formally addressed within the scope of this report. Twenty-one structures under the 100-year flood and 15 under the SPF were placed in this category.

TYPE D

Type D flood proofing would be used for structures having basements which would receive a depth of inundation above the first floor. This technique would consist of the Type C technique with the additional measure of raising the first floor above the flood elevation. The raising of the foundation would require that the structure be lifted by hydraulic jacks and temporarily supported by cribbing. All utility lines would be disconnected prior to this operation. The foundation would then be extended to the new elevation of the structure and the utilities reconnected. After the new foundation had been completed, the jacks could be removed and the house and yard restored to their original condition. In order to perform this operation, it would be necessary to evacuate the occupants for approximately two to four weeks while construction was being completed. Costs for temporary lodging of occupants are included in the cost estimates. Forty structures under the 100-year flood and 74 structures under the SPF were placed in this category.

TYPE E

Type E flood proofing would apply to residential and commercial cases which would have a depth of inundation above the first floor, but could not be flood proofed by any of the already mentioned procedures. These structures were examined on an individual basis, in all cases, a more detailed engineering investigation would be required prior to construction.

For those cases requiring flood shields, it should be noted that the shields are only installed during a flooding condition. Therefore, suitable warning time would have to be provided prior to a flood. Without this warning time, the structures would have limited protection which could result in substantial damage to the structures and their contents. For the 100-year flood and the SPF, 16 and 34 structures, respectively, were grouped into this category.

TYPE F

Type F would apply to structures which would receive no formal flood proofing under this study. Such structures are those which would not be affected by the flooding conditions under consideration. One hundred three structures under the 100-year flood and 35 structures under the SPF were placed in this category.

TYPE G

Buildings placed into this category were structures which would receive a depth of inundation above or in excess of three feet above the first floor, or because of the structures' construction or intended use, the application of the flood proofing methods discussed would affect the building's structural integrity or severely limit the practical use of the building. Structures categorized under Type G were classified, for the purpose of this study, as requiring demolition. Forty-five under the 100-year flood and 127 under the SPF were placed in this category.

The results of this analysis are presented in Table 2, according to reach and flood proofing method. Table 3 presents the unit costs of these proposals according to the size of the structure, and Tables 4 and 5 summarize the total costs of this proposal by reach and by type of structure.

The costs for Types A, B and C were obtained based on a unit cost per perimeter foot, and these are presented in Table 3. Costs for Types A, B and C flood proofing was estimated assuming Type C costs plus an additional lump sum based on the estimated cost of raising a foundation. Type E flood proofing was estimated on an individual basis. Type F flood proofing required no formal procedure and therefore, no costs were assumed for this method.

For structures listed under Category G demolition costs were based upon $0.10 per cubic foot, which were added to the estimated fair market value for total demolition cost (not involving costs for the relocation and resultant social impact upon apartment tenants).

Since certain variables making up the flood proofing and foundation raising costs were related to the size of the building, different unit prices for different size buildings are presented in Table 3. The raw unit costs used in these calculations are based on typical values from the Robert Snow Means Company, Inc., 1979 Building Cost Data publication as well as estimates provided by local contractors. Final costs were derived from the raw costs with operational adjustments. These adjustments consist of an additional 10 percent for contingencies or unforeseen construction difficulties, an additional 10 percent for general contractors' overhead and profit, and 10-20 percent for engineering and survey fees. For this study it was assumed that the engineering and survey fee would be 20 percent for Types A, B and C flood proofing, and 10 percent for foundation raising (Type D) where the experience of the contractor is most critical to the success of the operation.

TABLE 2

NON-STRUCTURAL ASSESSMENT

							SIZE IN PERIMETER FEET					FLOODPROOFING METHOD													
												A		B		C		D		E		F		G	
	REACH NUMBER	# OF STRUC. STUDIED	# OF RESIDENCES	# OF COMMERCIAL	# OF APARTMENTS	# OF INDUSTRIAL	0 - 76	77 - 120	125 - 170	OVER 171	N/A	100 YR	SPF	100 YR	SPF	100 YR	SPF	100 YR	SPF	100 YR	SPF	100 YR	SPF	100 YR	SPF
S.W. BRANCH	1	1	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0
	2	71	54	13	4	0	1	36	24	10	0	1	0	10	8	8	3	7	4	11	11	9	0	25	45
		72	55	13	4	0	1	36	25	10	0	1	0	10	8	8	3	7	5	11	11	10	0	25	45
WEST BRANCH	1	7	0	1	6	0	0	0	0	0	7	0	0	0	0	0	0	0	0	0	0	7	7	0	0
	2	10	8	1	1	0	0	3	6	1	0	0	0	4	2	2	4	0	2	0	1	3	0	1	1
	3	100	62	11	27	0	0	13	49	31	7	9	2	44	28	1	1	19	34	2	4	23	7	2	24
	4	178	107	33	38	0	0	27	74	55	22	2	4	87	55	10	7	14	33	3	18	60	21	2	40
		295	177	46	72	0	0	43	129	87	36	11	6	135	85	13	12	33	69	5	23	93	35	5	65
TOTALS		367	232	59	76	0	1	79	154	97	36	12	6	145	93	21	15	40	74	16	34	103	35	30	110

Source: Preliminary Engineering Analysis of Non-Structural Flood Damage Prevention; Hayden, Harding & Buchanan, Inc.; Boston, MA; June 1979.

TABLE 3

FLOOD PROOFING COSTS - GENERAL

SIZE (Perimeter ft.)	FLOOD PROOFING TECHNIQUE (Dollars per Perimeter ft.) A	B	C	(Lump Sum Cost in Thousand Dollars) D	E	F	G
0 - 76	37	64	71	12	1	0	1
77 - 124	35	59	63	14		0	
125 - 170	34	57	61	16		0	
171+	35	56	61	18		0	

1. Individual cost for each case.

Source: Same as Table 2

Impact Assessment

The thorough evaluation of the proposed plans of improvement requires an assessment of the impacts induced in the economic community, the environmental setting, and the social environment. A standard for comparison in such an assessment is the "without condition" described in Appendix 1, which is defined to be the most probable future of Pittsfield in the absence of a protection program. A distinction is made between the "without condition" and the "base condition", the latter being the social, economic and land use characteristics of Pittsfield immediately after completion of project construction. The base year is, by definition, the first year in which the plans are expected to become operational.

The standard procedure for comparison of plans is to evaluate the differences between the most probable future of Pittsfield following project implementation, the "with project condition", and the "base condition" and then evaluate the "base condition" relative to the "without condition." The net change between the "with project condition" and the "without project condition" is considered to be the impact of the project.

TABLE 4

FLOODPROOFING COST BY REACH

	REACH NUMBER	NUMBER OF CASES (A, B, C, D, E*, G)		COST IN THOUSANDS OF DOLLARS	
		100 YEAR	SPF	100 YEAR	SPF
S.W. BRANCH	1	0	1	0.0	15.6
	2	62	71	5118.1	5816.7
WEST BRANCH	1	0	0	0.0	0.0
	2	7	10	60.1	109.7
	3	77	93	1017.4	1599.3
	4	117	156	1290.8	2798.9
	TOTALS	263	331	7486.4	10340.2

* EXCLUDING THE STADIUM OFF WAHCONAH STREET (NO COST INVOLVED)

Source: Same as Table 2

TABLE 5

FLOODPROOFING COSTS BY TYPE OF STRUCTURE

CATEGORY	# OF CASES		COST IN THOUSANDS		AVERAGE COST PER CASE IN THOUSANDS	
	100 YEAR	SPF	100 YEAR	SPF	100 YEAR	SPF
RESIDENTIAL	181	218	2306.7	3932.0	12.74	18.04
COMMERCIAL	29	48	4569.6	5361.0	157.57	111.69
APARTMENT	53	65	610.1	1047.2	11.51	16.11
INDUSTRIAL	0	0	0.0	0.0	0.0	0.0
TOTALS	263	331	7486.4	10340.2	28.47	31.17

Source: Same as Table 2

Source of Impacts

Project impacts of varying magnitude and longevity are expected to occur during the two phases of project implementation: the construction phase and the post-construction phase. Construction phase impacts are generally short-term and site specific and are dependent on the length of the construction period, type and source of construction materials, number of construction workers needed, and location and size of project. Post construction impacts are generally long-term and tend to have regional as well as site specific implications. Such effects include the amount of flood protection offered, permanent changes in land use as a result of land takings for project construction or new land development through the offering of flood protection.

Identification of Impacts

Economic Impacts

The following section discusses the economic impacts of each alternative proposed for the West and Southwest Branches.

West Branch

PLAN A - Lower Tel-Electric Dam

This plan would provide an estimated $12,000 annually in reduced flood damages for the city of Pittsfield. Regional growth would be stimulated by both this reduction in losses and by the revenues generated in the town resulting from the first costs of $29,600 required to implement this project. However, it is not expected that this project would increase the property tax base of the town, because only 28 of 202 structures in the flood plain would be relieved of the 100-year flood threat.

PLAN B - Lower Dam and West Street Bridge Replacement

This plan would have first costs totalling approximately $384,900. These would be strictly a non-Federal responsibility owing to the limited degree of protected provided by lowering the dam, and the Section 205 authority requiring non-Federal funding of bridge replacement. The annual benefits provided by this plan would total $33,300, compared to $29,300 in annual costs. The benefit cost ratio of this plan would be 1.14 to 1.00. As such, the net contributions to the NED account would not be significant. Approximately 69 houses would be relieved of the 100-year flood threat, but because 133 other structures located along the river would continue to be inundated, there is not expected to be an appreciable increase in the city tax base.

PLAN C - Major Channel Modification

This plan would provide complete protection against inundation by the 100-year flood, providing approximately $70,800 annually in benefits. While the first costs of $2.5 million required to implement this project would stimulate the city's economy, the benefit/cost ratio of this project would be 0.38 to 1.00, representing a loss to the account of National Economic Development. The city would most likely experience an increase in the tax base as a result of this complete protection against the 100-year flood, and it would also face a reduction in service and emergency costs of greater than $3,800 annually. (This figure is included in the estimate of annual benefits.) However, the adverse impact of the low benefit/cost ratio of this project would not be compensated for by benefits to the EQ account, as described in the Environmental Assessment of the main report, and as such, Plan C is not considered as a viable alternative for flood protection.

PLAN D - Flood proofing, relocation, etc.

This plan, while eliminating $24,800 annually in physical damages to structures, would require partial evacuation of the flood plain to obtain another $36,400 in annual benefits. Evacuation of the flood plain would impose necessary growth in other areas of the city, and flood proofing might induce home improvements to be made and higher tax rates to be generated. However, there would be considerable disruption to commercial activities remaining in the flood plain. Only the flood proofing costs, compensation costs and demolition costs of structures relocated from the flood plain have been included in the annual costs, and benefits derived from the expected relocation of evacuated activities, such as an increase in regional growth and in the tax base, are not expected to be significant. The resulting benefit/cost ratio in this plan would be 0.35 to 1.00, and would be less if the costs of relocating utilities were included. Because overbank flooding would not be eliminated by this plan, the benefits to the EQ account could not compensate for this deficit. In addition, this plan would require continued emergency services during periods of inundation, a condition which precludes further consideration of this plan according to Section 280.7 of ER 1165-2-122, which states in part that, "flood proofing measures that would leave occupied buildings inaccessible during a flood, thereby extending the public commitment for continuing emergency assistance, will not be recommended."

PLAN E - Combination Plan

This plan, which would combine the structural proposal of Plan A with the non-structural proposal of Plan D, would cost an estimated $147,000 annually, compared with an estimated annually derived benefit of $63,600. The resulting benefit/cost ratio for this plan would be 0.43 to 1.00, unfavorable to the recommendation of this plan. The continued inundation of some areas of the city would suppress growth and require continued emergency expenditures.

PLAN F - Combination Plan

This combined plan would include the provisions of Plan B with those of Plan D, providing an annual benefit of $46,100. When compared with the annual cost of this project, $120,800, a benefit/cost ratio of 0.38 to 1.00 is obtained. Again, because overbank flooding would continue to occur under this plan of protection, the addition of flood proofing to lowering the Tel-Electric Dam and replacing the West Street bridge is not a feasible non-structural measure under Corps regulations.

Southwest Branch

PLAN A - Supplemental Culvert and Clearing

This plan would provide an estimated $100,200 in annual benefits from reduced flood losses. Compared with annual costs of $37,200, the ratio of benefits to costs for this plan is 2.69 to 1.0. Regional growth would be encouraged by this plan, by both the construction phase and the post-construction phase. During the construction phase an estimated first cost of $491,200 would be expended to implement the project. Following project completion of a 7-1/2 foot reduction in the stage of the 100-year flood and other stage reductions during more frequent floods would allow for an increase in activities at the Pittsfield Plaza and at other establishments located along Route 20. In addition, approximately 22 out of 62 structures estimated to lie within the 100-year flood plain would be spared inundation by the 100-year event, and the owners of these properties could invest in home improvements. These would not, however, be expected to influence the tax base of the city, unless they included major structural changes.

PLAN B - Supplemental Culvert and Channel Excavation

This plan would induce approximately $101,000 in annual benefits, compared with an estimated annual cost of $65,600. However, the additional benefit of $800 provided by this plan over that of Plan A would not justify the $28,400 increase in annual costs required to excavate a channel. While the benefit/cost ratio of this entire plan remains favorable, 1.54 to 1.00, the incremental benefit/cost ratio of 0.03 to 1.00 precludes further consideration of this plan, regardless of the plan's anticipated effects on regional growth. The small increment in benefits described by this plan over Plan A is because the channelization measure of this plan would not further reduce the 100-year flood stage. It would only effect the lesser stages of higher frequency floods, providing no significant increase in protection benefits. Finally, the significant adverse environmental impacts of this plan, as discussed in the environmental assessment, would further discourage implementation of this plan.

PLAN C - Double Supplemental Culverts

This plan would raise annual benefits to $120,300 because of an additional reduction of 1 to 1.5 feet in the stage of the 100-year flood. Annual costs of this project would total approximately $50,600, generating a benefit/cost ratio of 2.38 to 1.0. Excess benefits would be maximized under this protection plan. Plan C would have impacts on community growth similar to those of Plan A, but these are again not expected to affect the tax revenues of the city.

PLAN D - Flood Proofing, Relocation, etc.

Flood proofing measures similar to those used for protection on the West Branch would generate $51,900 in reduced flood losses annually, and $122,200 annually in benefits from evacuation of activities from the flood plain. These benefits are detailed in Appendix 5, Economics. Under this protection plan, growth would be severely disrupted because 35 buildings, including 11 commercial establishments, would be relocated from the flood plain. The benefit cost ratio of this proposal would be 0.46 to 1.00, owing to the high costs of acquisition of the relocated structures. In addition, because inundation would continue to occur under this protection plan, leaving some occupied buildings inaccessible, this protection plan cannot be recommended under current Corps regulations, owing to the continued need for emergency expenditures.

PLAN E - Combination Plan

This plan would provide approximately $132,100 in annual benefits, compared with an estimated annual cost of $120,100. Under this protection plan, which has a benefit/cost ratio of 1.10 to 1.00, 6 structures would be relocated from the flood plain. These structures would consist mostly of the commercial establishments located along Route 20, causing regional growth to be hindered by this plan. Furthermore, the addition of the non-structural provisions of flood proofing to the supplementary culvert (Plan A) is not justified according to Corps regulations, because overbank flooding would continue to occur, leaving occupied buildings inaccessible without emergency assistance.

PLAN F - Combination Plan

The economic impacts of Plan F are similar to those of Plan E because the additional reduction of 1-foot in the stage of the 100-year flood is not sufficient to eliminate the need for evacuation of the flood plain. Six structures would require relocation, causing a disruption to regional growth.

Community development is not expected to occur following the implementation of any protection project because other areas of the city of Pittsfield currently present a better prospect for this growth. Again with regard to a non-structural proposal, flood proofing would not be a viable addition to the structural measures (Plan C) because the need for emergency services would persist. Average annual benefits for this plan would total $147,800, while annual costs are estimated to be $130,400, giving a benefit-to-cost ratio of 1.13 to 1.00.

Environmental Impacts

A discussion of the anticipated environmental impacts of the alternative plans for the West Branch and the Southwest Branch is contained in the Environmental Assessment included in the main report.

The most significant of these impacts concerns the downstream flood stages resulting from increasing the Conrail culvert capacity on the Southwest Branch. During the 100-year event flood stages in the vicinity of South Street, below the West Branch-Southwest Branch confluence, would be increased by approximately 5 inches, causing an estimated $10,000 in additional damages. As a means of mitigating these transferred damages, each of the plans providing the auxiliary culvert contains the provision that non-Federal interests relocate the sewer line that traverses the river beneath the South Street bridge. Lowering this sewer line to a position beneath the riverbed would eliminate debris blockage and reduce the stage of the 100-year flood by 7 inches, more than offsetting the stage increases caused by the upstream projects.

Social Impacts

The following section describes the social impacts specific to each project alternative for both the West and Southwest Branches.

West Branch

PLAN A

Construction impacts of lowering the Tel-Electric Dam would involve increased noise and dust at the construction site. The transport of materials and equipment would increase the use of residential and commercial roads by heavy truck traffic. Temporary land easements would be taken for storage of materials and equipment for the length of the construction phase. It is estimated that the construction phase would be short and last for no longer than two months.

The major post-construction impact of the project is the reduction of flooding. Damages currently received by 28 structures, mostly homes but some commercial establishments, during a 100-year event would be eliminated.

PLAN B

Impacts for Plan B would include the impacts of Plan A plus those resulting from the replacement of the West Street bridge. The total construction activity for Plan B would take one season. During this period the West Street bridge would be shutdown. Located in the area of this intersection are several residences, one apartment complex, and the Northeast Service Center which would be most inconvenienced by construction activity. Rerouting of traffic around this intersection not only would inconvenience those using the indirect route but also those who would be living along the detour.

Protection offered by inclusion of the West Street bridge replacement with Plan A would increase the number of structures that would be protected from flooding. Under Plan B, 69 houses would no longer be inundated by the 100-year flood, with 133 facing a reduced threat.

PLAN C

Plan C is an extensive protection plan which includes elements of both Plan A and Plan B. Modification, differing from that in Plan A, of the Tel-Electric Dam would be accomplished with the West Street bridge replacement as described in Plan B. Impacts related to these elements would yield similar impacts in Plan C. In addition, Plan C requires modifications to the railroad bridges located upstream of the Tel-Electric Dam, and the widening and deepening of the river channel between the dam and the lower end of Wahconah Park. The accomplishment of all of these construction activities would take approximately two seasons.

Plan C would have similar construction impacts involving increased noise and dust levels, increased use of local roads, hindrance of local traffic with bridge replacement, etc. The more extensive activities required under this alternative would prove particularly disruptive to those property owners residing near the channelization activity. The stretch of river proposed for channelization lies within a densely developed residential area with some commercial users interspersed.

Over the long-term, Plan C offers full 100-year flood protection. Under this alternative then, 202 structures would be relieved of their flood threat. The constant flooding, resulting in under utilization of the park, and interruption of scheduled activities in Wahconah Park would be overcome by adoption of this alternative.

PLAN D

Plan D involves the flood proofing of structures within the 100-year flood plain. Any number of flood proofing measures could be utilized to protect individual structures. Flood proofing is carried out on a structure-by-structure basis. Implicit with being a non-structural measure, flood proofing only controls the flow of floodwaters in that it prohibits the water from entering individual structures. The major "benefit" of flood proofing is the elimination and reduction of structural damage. However, roads would still be flooded, isolating the floodprone areas from the receipt of services and utilities. Businesses in the area would have to shut down resulting in loss of wages and business.

Several of the flood proofing options although called non-structural require structural activities; placing a drainage trench around the perimeter of the basement, raising the foundation above the 100-year event. Under Plan D, 192 structures would be protected by either of these methods. These activities would have similar impacts to the structural alternatives, including increased noise and dust levels, increased truck traffic and congestion, and inconvenience to local residents.

Under the non-structural proposal ten structures were proposed for demolition. These ten structures include three residences, one gas and service station, one bakery, and five other commercial establishments. Most of these structures are not suited to being elevated above the design flood because they are constructed on a slab.

PLAN E

This plan combines Plan A with flood proofing and therefore would have impacts similar to those described for Plan A and D heretofore.

Under Plan E, 174 structures located along the West Branch would require flood proofing. These are all the structures within the 100-year flood which would not receive protection from Plan A alone. Most structures would be flood proofed by waterproofing the outside of the basement walls, creating drainage trenches, and placing a sump pump in the basement. As in Plan D, some type of protection would be offered to all structures lying within the 100-year flood plain. Under this plan, however, nine structures would be demolished.

PLAN F

Plan F is a composite of two other plans already identified; B and D. Basically Plan F suggests lowering the Tel-Electric Dam, replacing the West Street bridge, and flood proofing these structures not protected by the Plan B element would be flood proofed under this plan. That would involve flood proofing of 134 structures. Under Plan F, no structures would require demolition.

Southwest Branch

PLAN A

The construction period to double the capacity of the Conrail culvert is expected to last six months. The neighboring areas would experience "typical" construction related impacts including increased dust and noise levels, increased heavy truck traffic on local streets, increased temporary employment. Most effected by the construction activities would be the residents living along McKinley Terrace. This area is sparsely settled so interference of construction with normal activities would be minimal.

The placement of the additional culvert as described in Plan A would provide protection to 22 of the 62 homes subject to flooding. Flood protection is not expected to encourage development as there is little pressure to develop this area with more appealing sites located in other parts of the city.

PLAN B

This plan would combine Plan A and its impacts with channelization work upstream of Barker Road bridge. Construction of both activities would take approximately 6 months to complete. As in Plan A, since this area has limited development, construction activities would have no significant effects.

The reduction of the stage of the 100-year event would be no different than in Plan A, offering protection to 22 homes.

PLAN C

Plan C triples the capacity of the Conrail culvert. Its impacts are similar to those that would be experienced under Plan A, however, it requires the installation of two additional culverts, rather than just one. Implementation of this project would be done during times that would minimize construction effects to the railroad to the extent possible.

Under this plan, protection would be offered to 34 of the 62 structures that are subject to flooding. Other structures remaining within the flood plain would face a reduced threat as a result of reduced stages.

PLAN D

Flood proofing measures were considered for the 62 structures lying within the 100-year flood plain by a private consultant under contract to the Corps as mentioned heretofore. Under the proposed flood proofing program, 19 structures would have foundation improvements to prevent inundation, seven structures would be raised three feet to be above the 100-year flood, and 35 structures would be evacuated for demolition. One additional structure, the WBEC Radio Station building located behind the Pittsfield Plaza alongside Maloy Brook, would require an earth dike and interior drainage facilities.

Among the structures to be demolished are: 10 structures along Cadwell Road consisting of eight single family homes and two commercial eastablishments, four homes on Gale Avenue, one along Greendale, and a two-family home on Zoar Street, ten homes on West Housatonic Street and much of existing commercial development between the junction of West Housatonic Street at Cadwell Street and Woodleigh Road. This includes the Big N Shopping Mall Complex, MacDonald's restaurant, Fitch's motel and diner, three gasoline/service stations, a tire shop, and a body shop.

Under this alternative, 25 families would be displaced, along with 10 to 15 commercial establishments. Although 26 structures would no longer receive structural damages under this alternative, roads and yards would still be inundated during a flood situation, requiring effective evacuation plans to ensure the safe removal of these occupants.

As with the flood proofing proposal for the West Branch, many flood proofing activities require structural activity with its resultant impacts. Again, isolation of protected structures during a flood situation is of concern with implementation of a flood proofing program.

PLAN E

This plan combines Plan A with flood proofing of structures to provide protection against the 100-year flood. The flood proofing program within this plan involves 40 structures: 32 would have their foundations waterproofed, two would be raised above the modified 100-year flood and six would be relocated.

The impacts, therefore, of this plan are similar to those under Plan A and Plan D. The six structures recommended for demolition are commercial establishments along West Housatonic Street that are built on slabs, including: the Big N Shopping Mall Complex, MacDonald's restaurant, service stations, and Fitch's motel.

PLAN F

This plan combines Plan C with a flood proofing program to prevent structural damage within the 100-year flood plain. Under this program 34 structures would require flood proofing, six of which were recommended for relocation.

This plan would have impacts similar to those for Plan E. It is more efficient in lowering the flood stages than Plan E and therefore requires that fewer structures be flood proofed.

Evaluation of Alternative Plans

Period of Analysis

The time period used in the economic evaluation of the alternative plans studied is 50 years. Project first costs are amortized over this period of time at an interest rate of 7-1/8 percent. The resulting average annual cost is compared with the estimated average annual benefit to obtain a benefit/cost ratio. Projects can only be recommended by the Corps if the benefit/cost ratio exceeds unity or if some other viable environmental consideration justifies the project.

Fulfillment of Planning Objectives

The plans of the West Branch have the following effect on the objectives of the local flood protection project.

Plan A, which would lower the Tel-Electric Dam by three feet, does not substantially reduce the flooding hazards of the West Branch. The 100-year floodstage would be reduced by only 1.0 to 1.5 feet throughout the reach from Tel-Electric Dam to Wahconah Park. It would provide a savings, or benefit, of approximately $12,000 annually.

Plan B lowers the elevation of the flood stage by 2.5 to 5.0 feet, the latter experienced in the immediate vicinity of the West Street bridge. This plan goes much further to fulfill the objective of this project, but because it requires non-Federal funding, its implementation might be difficult.

Plan C fulfills the plan objective of reducing flood losses, however, its costs preclude recommendation for Federal participation. The benefits associated with complete protection against the 100-year flood are not sufficient to justify this cost.

On the Southwest Branch the fulfillment of the plan objective of reducing flood damages is again a matter of incremental protection between the three plans. The flood stage of the 100-year event would be identical in Plans A and B; it would be 7 to 8 feet lower than the natural level. This would provide protection equivalent to $100,200 per year. Against the more frequent floods Plan B would provide an additional $800 per year of protection through installation of the new channel. Plan C, by adding an extra 300 square feet of discharge capacity to the culvert under the railroad embankment, would lower the 100-year flood stage by an extra foot beyond the effect of Plans A & B. Although none of these plans eliminates the 100-year flood they substantially reduce the damages associated with this flood and hence are considered to fulfill the plan objective.

Plan fulfillment of the remaining planning objectives is outlined in the summary comparison tables 1 and 2 the main report.

Response to Specified Performance Criteria

The following tables (Tables 6 and 7) present an evaluation of the study plans, including: acceptability, completeness, effectiveness, efficiency, certainty, geographic scope, cost/benefit ratio, reversability and stability.

Acceptability of a plan is determined by analyzing public opinion; if the public support for the plan is substantial, then, the plan is considered acceptable.

The completeness of a plan is a determination of the extent to which the technical performance of a plan fulfills the planning objectives and the National Objectives.

The efficiency of the plan is a determination of the ability of a plan to achieve the objectives in the least cost manner.

The certainty of a plan is a measurement of the confidence in a plan to achieve the objective.

The geographic scope determines the relevance of a plan; the plan should be broad enough to completely understand the problem, and it must be narrow enough to be effective in its objective.

The benefit/cost ratio relates to the economic justification of a plan.

The reversibility of a plan is determined by analyzing the capability as public needs and values change or should unusual future circumstances so warrant, of restoring the partially or fully implemented plan to approximate the "without" condition.

Finally, the stability of a plan is determined by analyzing the range of alternative futures, data and/or assumptions which can be meaningfully accommodated within the recommended plan.

TABLE 6

EVALUATION OF PLAN PERFORMANCE

WEST BRANCH

Evaluation Criteria	Plan A Lower Dam	Plan B Lower Dam Replace Bridge	Plan C Channel Improvements	Plan D Flood proofing
Acceptability	yes	yes	no	no
Completeness	yes	yes	yes	no
Effectiveness	no	no	yes	no
Efficiency	yes	yes	no	no
Certainty	yes	yes	yes	yes
Geographic Scope	yes	yes	yes	yes
NED B/C	3.75	1.14	0.38	0.35
Reversibility	yes	no	no	no
Stability	yes	yes	no	yes

TABLE 7

EVALUATION OF PLAN PERFORMANCE

SOUTHWEST BRANCH

Evaluation Criteria	Plan A 150 sq ft Culvert Brush clearing	Plan B 150 sq ft culvert Channelization	Plan C 300 sq ft Culvert	Plan D Flood Proofing
Acceptability	yes	no	yes	no
Completeness	yes	yes	yes	no
Effectiveness	no	no	no	no
Efficiency	yes	no	yes	no
Certainty	yes	yes	yes	yes
Geographic Scope	yes	yes	yes	yes
NED B/C	2.69	1.54	2.38	0.46
Reversibility	yes	no	no	no
Stability	yes	no	yes	yes

Display of Alternative Plan Impacts

The U.S. Water Resources Council's Principles and Standards procedures require that all alternative plans carried through the final planning stage be evaluated for their fulfillment of the planning objectives and for their contributions to four national accounts: National Economic Development, Environmental Quality, Social Well-Being, and Regional Development. A table presenting a comparison of alternative plans and their fulfillment of the planning objectives is contained in the main report. This appendix contains the System of Accounts, in which all the significant beneficial and adverse impacts of alternative improvement plans are displayed for each national account. Section 122 of the River and Harbor and Flood Control Act of 1970 requires that, at a minimum, the following impacts must be identified and assessed:

ECONOMIC IMPACTS

- Tax Revenues
- Property Values
- Public Facilities
- Public Services
- Regional Growth
- Employment/Labor Force
- Business and Industrial Activity
- Displacement of Farms

ENVIRONMENTAL IMPACTS

- Manmade Resources
- Natural Resources
- Air Quality
- Water Quality

SOCIAL IMPACTS

- Noise
- Displacement of People
- Aesthetic Values
- Community Cohesion
- Community Growth

Only those impacts which were considered to be *significant* were included in this table. The impacts not included in this table are discussed in the Economic Report contained in Appendix 5.

In this appendix, two System of Account tables are presented, one for each branch of the Housatonic River in Pittsfield. The alternatives displayed for the West Branch are as follows:

A. Dam Modification
B. Dam Modification and Bridge Replacement
C. Major Channel Modification, Replacement of Dam with Bascule Gate, and Bridge Replacement
D. Non-structural Flood Proofing

For the Southwest Branch, the following alternatives are displayed:

A. Additional Culvert (150 sq. ft.) under Conrail Embankment plus Wetland Clearing
B. Additional Culvert (150 sq. ft.) under Conrail Embankment plus Channel Excavation
C. Two Additional Culverts (300 sq. ft.) under Conrail Embankment
D. Non-structural Flood Proofing

Finally, the impacts presented in these tables are qualified according to the location of the impact and by a system of codes defining the timing, uncertainty, exclusivity, and actuality of an impact.

Principles and Standards require that all regions in which a significant impact occurs will be displayed. Of the regions suggested for inclusion, only the planning area, i.e., the area encompassing communities directly affected by West and Southwest Branch discharges, and impacts affecting the remainder of the nation are specified. It is also required that the following system of codes be used to further quality the impacts on the National Accounts:

a. Timing

<u>Code</u>

1 Impact is expected to occur prior to or during plan implementation.

2 Impact is expected to occur within 15 years following plan implementation.

3 Impact is expected to occur later than 15 years following plan implementation.

\+ Impact occurs after indicated period and continues for an indefinite future period.

b. Uncertainty

<u>Code</u>

4 Level of uncertainty associated with the impact is greater than 50 percent.

5 Level of uncertainty is between 10 and 50 percent.

6 Level of uncertainty is between 0 and 10 percent.

c. Exclusivity

<u>Code</u>

7 Overlapping entry; fully monetized in NED account.

8 Overlapping entry; not fully monetized in NED account.

d. Actuality

Code

9 Impact will occur with implementation.

10 Impact will occur only when specific additional sections are carried out during implementation.

11 Impact will not occur because necessary additional actions are lacking.

e. Section 122

* Items specifically required in Section 122 and Appendix B in ER 1105-2-240.

The System of Account tables present the impacts of the alternative plans for the West and Southwest Branches. They also show the designated NED plans for both branches, these being Plan A on the West Branch and Plan C on the Southwest Branch. The EQ plan for both branches has been determined to be the "No Action" alternative, not shown on these tables, because no alternative was found to contribute a net positive benefit to the EQ account.

TABLE 8
SYSTEM OF ACCOUNTS

WEST BRANCH

Accounts	Impact Codes	PLAN A Dam Modification (NED)	PLAN B Dam Modification Bridge Replacement (EQ)	PLAN C Major Channel Modification Bascule Gate	PLAN D Non-structural Flood Proofing
(1) NATIONAL ECONOMIC DEVELOPMENT (NED)					
a) Beneficial Impacts					
1) Annual Flood Damage Reduction (Local)	2	$12,000	$ 33,300	$ 70,800	$ 24,800
2) Annual Reduction in Federal Flood Insurance Subsidies (National)	2	0	0	0	36,400
3) Total NED Benefits	2	$12,000	$ 33,300	$ 70,800	$ 61,200
b) Adverse Impacts					
1) Federal First Costs		$ 0	$ 0	$2,065,500	$1,898,000
2) Non-Federal First Costs	1	29,600	384,900	431,400	472,000
3) Total First Costs	1	$29,600	$384,900	$2,496,900	$2,370,000
4) Average Annual Cost		$ 3,200	$ 29,300	$ 186,300	$ 174,400

	Impact Codes	PLAN A	PLAN B	PLAN C	PLAN D
c) Net NED Benefits		$ 8,800	$ 4,000	$ 0	$ 0
d) Benefit/Cost/Ratio		3.75	1.14	0.38	0.35
(2) ENVIRONMENTAL QUALITY (EQ)					
a) EQ Improved					
1) Water Quality & Natural Resources (National)	2,6*	Less overbank scouring along 1400 ft. of bank.	Reduced overbank scouring of 2400 ft. of bank.	Elimination of overbank scouring over 4300 ft of channel. Reduction of siltation in channel will improve water quality.	No significant change, some increase in open space.
b) EQ Degraded					
1) Water Quality (National)	1,6*	Temporary increase in turbidity during construction.	Same as Plan A.	More pronounced turbidity increase than A, but temporary.	Temp. reduction during plan implementation.
2) Natural Resources (National)	2,5*	No significant reduction of stream level at Wahconah Park.	Some reduction of stream level at Wahconah Park.	Stream level at Wahconah Park reduced by about 3 ft.	No Impact.
3) Fishery Resources (National)	2,6	No Impact.	No Impact.	Reduction in quality of 4300 ft of potential trout habitat.	No Impact.

	Impact Codes	PLAN A	PLAN B	PLAN C	PLAN D
(3) SOCIAL WELL-BEING					
a) Beneficial Impacts					
1) Enhancement of Health, Safety, and Community Well-being. (Local)	2,5,7,9	Reduction of 1-1.5 feet in stage or 100-yr flood would increase health and safety.	Reduction of 2.5 to 5 feet in the stage of the 100-yr flood would increase health and safety.	Elimination of over-bank flooding during 100-yr event would eliminate safety hazard.	Health & safety improved by elimination of inundation by 100-yr flood to 91 houses in the flood plain.
2) Enhancement of Community Cohesion (Local)	2,6*	Additional protection of 28 structures formerly inundated by 100-yr flood improves community cohesion.	Additional protection to 69 structures formerly threatened by 100-yr flood improves community cohesion.	Protection of 202 structures formerly threatened by 100-yr flood.	Elimination of damages from 100-yr flood to 92 structures given flood proofing promotes community cohesion.
3) Cultural and Recreational Opportunities (Local)	2,6	No disturbance to 2 cultural sites near channel. No impact on recreation.	Same as Plan A.	Same as Plan A.	Same as Plan A. Evacuation of 10 lots would provide small field recreation.
4) Aesthetics (Local)	2,5*	Some renovation of older buildings.	Same as Plan A.	Cleaner channel.	Some improved appearance of structures.
b) Adverse Impacts					
1) Injurious Displacement of People & Community Disruption (Local)	1,2,6,8*	No displacement.	No displacement.	No displacement.	Relocation of 10 structures from flood plain. Temporary displacement for residents of 33 structures raised above flood elevation.

	Impact Codes	PLAN A	PLAN B	PLAN C	PLAN D
2) Transportation (Local)	1*	Minimal temporary impacts.	Same as Plan A. Detour required during bridge construction.	Same as Plan B.	Some temporary disruption of traffic patterns.
3) Noise (Local)	1*	Temporary increase during construction.	Same as Plan A.	Same as Plan A.	Largest noise increase working closer to and adjacent to all developed properties.
(4) REGIONAL DEVELOPMENT (RD)					
a) Beneficial Impacts					
1) Taxes (Local)	2,6,7*	Reduction in *emergency expenditures*	More reduction than *Plan A.*	Elimination of *emergency costs.*	$3,850 reduction in emergency costs.
b) Adverse Impacts					
1) Disruption of Growth (Local)		No impact.	No impact.	No impact.	Evacuation of 6 commercial *establishments and* 4 residences along the West Branch.

TABLE 9
SYSTEM OF ACCOUNTS
SOUTHWEST BRANCH

Accounts	Impact Codes	PLAN A Install Auxiliary Culvert, Wetland Clearing (EQ)	PLAN B Install Auxiliary Culvert, Excavate Channel	PLAN C Install Two Auxiliary Culverts (NED)	PLAN D Non-structural Flood Proofing
(1) NATIONAL ECONOMIC DEVELOPMENT (NED)					
a) Beneficial Impacts					
1) Annual Flood Damage Reduction (Local)	2	$ 100,200	$ 101,000	$ 120,300	$ 51,900
2) Annual Reduction in Federal Flood Insurance Subsidy (National)	2	0	0	0	122,200
3) Total NED Benefits	2	$ 100,200	$ 101,000	$ 120,300	$ 174,100
b) Adverse Impacts					
1) Federal First Costs	1	$ 434,200	$ 820,700	$ 625,900	$4,080,000
2) Non-Federal First Costs	1	$ 57,000	$ 57,000	$ 56,600	$1,040,000
3) Total First Costs	1	$491,200	$ 877,700	$ 682,500	$5,120,000
4) Average Annual Cost		$ 37,200	$ 65,600	$ 50,600	$ 376,800

Revised 5/81

	Impact Codes	PLAN A	PLAN B	PLAN C	PLAN D
c) Net NED Benefits		$ 63,000	$ 35,400	$ 69,700	$ 0
d) Benefit/Cost Ratio		2.69	1.54	2.38	0.46
(2) ENVIRONMENTAL QUALITY (EQ)					
a) EQ Improved					
1) Water Quality (National)	2,6*	Less overbank scouring during flood periods.	Less deposition of silts in channel owing to improved gradients.	More reduction than Plan A.	No impact.
2) Natural Resources (National)	2,6*	Spring flows would continue to cleanse existing channel.	No impact.	Same as Plan A.	Conversion of commercial lands back to wetland habitat.
b) EQ Degraded					
1) Water Quality (National)	1,6*	Temporary increase in turbidity during project construction.	Same as Plan A.	Same as Plan A.	Same as Plan A.
2) Natural Resources (National)	2,5*	Clearing of approximately 1/2 acre of wetland with no uprooting of plants. Minimal reduction in normal stream level.	Excavation of 1/2 acre of wetlands. Potential reduction in normal river stage of up to 2 feet.	Minimal reduction in normal stream level.	No significant impact.
3) Fishery Resources (National)	2,6,8	No significant impact.	Complete disruption of natural brown trout habitat.	Same as Plan A.	Same as Plan A.

	Impact Codes	PLAN A	PLAN B	PLAN C	PLAN D
(3) SOCIAL WELL-BEING (SWB)					
a) Beneficial Impacts					
1) Enhancement of Health and Safety (Local)	2,5	Reduction of 7 ft in the stage of the 100 year flood would increase public health and safety.	Same as Plan A.	Reduction of 8 ft in the stage of the 100-yr flood would increase public health and safety.	Health and safety improved by elimination of inundation of 27 structures during the during the 100 yr. flood.
2) Enhancement of Community Cohesion.	2,5*	Additional protection of 22 structures formerly inundated by 100 yr. flood would improve community cohesion.	Same as Plan A.	Additional protection of 28 structures formerly inundated by 100 yr. flood would improve community cohesion.	Elimination of damages from 100 yr. flood to 27 structures given formal flood proofing.
b) Adverse Impacts					
1) Injurious Displacement of People & Community Disruption (Local)	1,6,8*	No significant impact.	Same as Plan A.	Same as Plan A.	Evacuation of 35 buildings from the flood plain would highly disrupt the community.
2) Transportation (Local)	1*	Potential disruption of rail traffic during installation of auxiliary culvert.	Same as Plan A	Same as Plan A	Minimal disruption of traffic during plan implementation.
3) Noise (Local)	1*	Temporary increase of noise during construction.	Longer period of disturbance than Plan A.	Same as Plan A.	Largest noise increase-working closer to and adjacent to all developed properties.

	Impact Codes	PLAN A	PLAN B	PLAN C	PLAN D
4) Recreation (Local)	2,6,8	No significant impact.	Loss to fishery recreation related to loss of trout habitat.	Same as Plan A.	Same as Plan A.
(4) REGIONAL DEVELOPMENT (RD)					
a) Beneficial Impacts					
1) Taxes (Local)	2,10	Reduction in emergency costs.	Further reduction of emergency costs than Plan A.	Further reduction of emergency costs than Plan B.	Reduction of $16,070 in emergency costs resulting from evacuation of all flood prone public utilities from the flood plain.
b) Adverse Impacts					
1) Disruption of growth (Local)	2,6,7	No significant impact.	Same as Plan A.	Same as Plan A.	Relocation of 11 commercial establishments, 1 apartment building would severely limit growth.

APPENDIX 3

PUBLIC VIEWS AND RESPONSES

Section A - Public Involvement Program

Section B - Pertinent Correspondence

APPENDIX 3

SECTION A

PUBLIC INVOLVEMENT PROGRAM

To best respond to the needs and priorities of the residents of Pittsfield, while striving to achieve the goals of the nation, public partcipation in the planning process is encouraged throughout the study period. Initially this involvement is important in accurately defining the flood problem; later it is essential in determining the priorities of the citizens in formulating and subsequently selecting an improvement plan. Meetings, letters and verbal communication were used throughout the study to achieve this coordination.

As a part of this planning process, a public meeting was held in Pittsfield on 29 August 1979. An announcement of this meeting was sent out to all Federal, State and local agencies and those private citizens who were cons[illegible]d to have an interest in the flooding problem of Pittsfield. This announce[illegible] described four preliminary plans developed for each branch, and at the public meeting the costs for these plans were detailed further. A digest of the proceedings of this meeting is contained in Section B of this appendix.

Following the completion of further detailed hydrologic and economic studies, two plans were selected for recommendation for approval by to the Chief of Engineers. These were Plan A for the West Branch and Plan B for the Southwest Branch. Prior to making this recommendation letters of coordination announcing this decision were sent to various public agencies.

The Federal agencies contacted include:

The Soil Conservation Service
The Bureau of Sport Fisheries and Wildlife
The Environmental Protection Agency
The Federal Highway Administration
The Department of Housing and Urban Development

State agencies requested to review the plans include:

The Department of Environmental Quality Engineering
The Department of Natural Resources
The Office of Environmental Affairs
The Massachusetts Water Resources Commission
The Massachusetts Department of Public Works
The Massachusetts Division of Fisheries and Wildlife
The Massachusetts Historical Commission
The Office of State Planning

Local agencies included in the coordination are:

The Pittsfield Department of Public Works
The Berkshire County Regional Planning Commission

Copies of responses from these agencies are exhibited in Section B of this appendix.

Following the receipt of these responses, several meetings were held with representatives of the U.S. Fish and Wildlife Service, Massachusetts Division of Fisheries and Wildlife, and Berkshire County Regional Planning Commission, primarily to address their objections to the proposed plans. The principal thrusts of these meetings were threefold, namely:

(1) To select a plan of local flood protection for the Southwest Branch that would have little or no impact on the fishery resource,

(2) To avoid transfer of the flooding problem to downstream areas, and

(3) To resolve differences between Corps and SCS developed stage-frequency data, because the SCS rationale was utilized as the base for the Pittsfield flood insurance program.

Item 1, above, was basically resolved when the recommended plan was changed from channel excavation upstream of the Barker Road bridge, Plan B, to a plan of channel clearing (brush removal) Plan A. The brush clearing would be undertaken in a strip about 25 to 30 feet in width in straight alignment, and would pass overbank flows at a faster rate, minimizing backflows into Maloy Brook. This would not change the normal flow regimen, allowing the fish habitat to remain unchanged. Only about 5 percent of the entire wetland area between Barker Road and Maloy Brook would be affected by the clearing. Although periodic cutting would have to be accomplished by the city of Pittsfield to maintain the channel, it is anticipated that leaving the brush roots in the ground would minimize scour during flood periods. This plan not only provides for the preservation of brown trout habitat but also is considerably less expensive than channel excavation and would be nearly as effective in discharging flows from moderate floods.

Item 2 (downstream transfer of flood problem) was also a particular concern voiced at the public meeting by residents living downstream from the confluence of the West and Southwest Branches. Because of the concrete encased sewer line located under the South Street bridge, there has been periodic flooding of an area along Taylor Street and local residents feel that the proposed upstream flood control improvements would worsen flood conditions at that location. Although the area at Taylor Street was not referenced as a flood problem zone by city officials early in the study, it became evident that any recommended plan for upstream improvements would have to be formulated to avert additional hardships on downstream residents. As noted in Appendix 4, detailed hydrologic investigations determined that the construction of Plan B on each Branch would include a maximum increase of 0.4 feet at Taylor Street during the 100-year flood event, and lesser floods would have correspondingly less impact. Due to the severity of the 100-year flood event, this relatively small increase in flood stage is expected to cause additional losses only to structures located at the perimeter of the 100-year flood boundary. It is estimated that these structures would experience losses totaling $10,000 during the 100-year event as a result of the project. However, these losses represent negative benefits requiring mitigation. Therefore, the plans have been reformulated to include the mitigation of these impacts through relocation of the sewer conduit at South Street. Relocation of the sewer line would be a non-Federal cost estimated to total $50,000, averaging $3,700 annually.

Item 3 concerned the differences in stage-frequency data between studies by the Corps and the SCS. At the 21 February meeting of the Berkshire County Regional Planning Commission it was explained by the Corps that given the inexact nature of hydrologic studies, the stage-frequency computations of the Corps and the SCS were considered to be in close agreement. The differences in these two studies exist between the 100-year flood stages computed for the West and Southwest Branches. On the West Branch the Corps' computed 100-year flood stage ranges from 0.5 feet less to 3.2 feet greater than the SCS 100-year flood. On the Southwest Branch the Corps' computations indicate a 100-year stage approximately 3.3 feet higher than that computed by the SCS. The differences between these studies are discussed in Appendix 4 - Section A, "Hydraulics and Hydrology."

Coordination with the U.S. Fish and Wildlife Service, the Massachusetts Division of Fisheries and Wildlife, the Pittsfield Planning Board and the Berkshire County Regional Planning Commission regarding these subjects was continued by letter after these meetings to resolve these issues. Two letters sent to these agencies by the Corps in response to the questions raised during these meetings are included in Section B of this appendix.

Final coordination with public agencies and private citizens occurred in July 1980 when a Public Notice and a Section 404 Evaluation were widely distributed for a 30-day comment period. The draft Environmental Assessment for the project was also distributed at this time. Comments submitted within the 30-day period ending 29 August 1980 are displayed as Exhibits 20 through 24 in Section B of this appendix. The U.S. Environmental Protection Agency informed NED by telephone that it had no objections to the proposed project (Reiner, EPA; 18 August 1980). Responses to the remaining comments are addressed as follows:

U.S.D.A Forest Service:

It is noted that Plan B on the Southwest Branch is recognized as having potentially significant adverse impacts on the wetland and forest land, and it is further noted that Plan A is the recommended plan for this Branch.

U.S.D.I. National Park Service:

The Environmental Assessment has been altered to reflect the consideration for potential adverse impacts to the National Wild and Scenic River proposal downstream on the Housatonic River, running south from the Massachusetts-Connecticut line.

Conrail Corporation:

It is noted that the CE-8 specifications mentioned in the letter have been inserted in the Design Appendix, 4C.

U.S.D.A. Soil Conservation Service:

Comment 1: Table 6 of the Environmental Assessment has been changed to reflect these three points.

Comment 2: No changes have been made to Plate 5.

Comment 3: The Notice and Environmental Assessment have been changed to indicate that brush clearing will be performed in a Type 1 wetland. The remaining information regarding the development of a maintenance free floodway will be considered in drawing up final specifications.

APPENDIX 3
SECTION B
PERTINENT CORRESPONDENCE

TABLE OF CONTENTS

AD-A143 397 PITTSFIELD LOCAL FLOOD PROTECTION WEST BRANCH AND SOUTHWEST BRANCH HOUSAT..(U) CORPS OF ENGINEERS WALTHAM MA NEW ENGLAND DIV OCT 80 3/5

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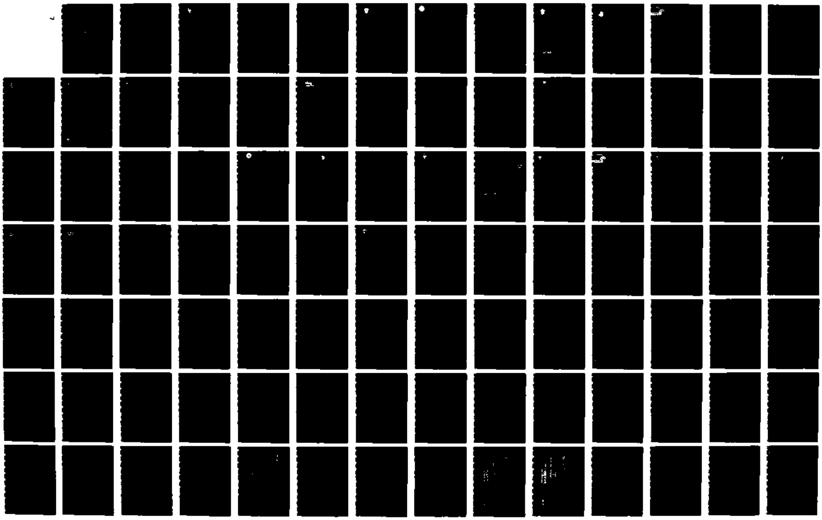

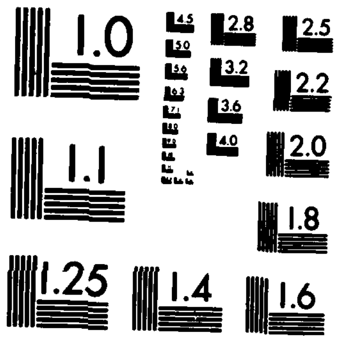
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EXHIBIT NO.	AGENCY	LETTER DATED
14.	Corps of Engineers, NED Response to Mass. Division of Fish & Wildlife	28 February 80
15.	Corps of Engineers, NED Response to Berkshire County Regional Planning Commission	21 March 80
16.	U.S. Department of Transporation Federal Highway Administration	24 March 80
17.	City of Pittsfield Department of Public Works	31 March 80
18.	Berkshire County Regional Planning Commission	22 April 80
19.	U.S. Department of the Interior Fish and Wildlife Service	30 April 80
20.	U.S. Department of Agriculture Forest Service	6 August 80
21.	U.S. Department of the Interior National Park Service	
22.	Conrail Corporation	18 August 80
23.	U.S. Department of Agriculture Soil Conservation Service	25 August 80
24.	U.S. Department of Transporation Federal Highway Administration	28 August 80
25.	Corps of Engineers, NED Cover Letter, Section 404 Public Notice	29 July 80
26.	Mayor of Pittsfield Letter of Intent	October 80
27.	Commonwealth of Massachusetts Water Resources Commission	1 October 80
28.	Public Meeting Digest	

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
ECOLOGICAL SERVICES
P. O. BOX 1518
CONCORD, NEW HAMPSHIRE 03301

August 2, 1978

Division Engineer
New England Division, Corps of Engineers
424 Trapelo Road
Waltham, Massachusetts 02154

Dear Sir:

This planning aid letter has been prepared to assist your planning efforts for local flood protection on the Southwest Branch and West Branch of the Housatonic River in Pittsfield, Massachusetts. This letter is to provide a preliminary fish and wildlife inventory and an assessment of critical factors for the resources which could be impacted by various flood control measures.

The West Branch originates in Pontoosuc Lake in the northern section of Pittsfield and flows southerly, draining 36.1 square miles, to its confluence with the Southwest Branch, thereby forming the Housatonic River. The Southwest Branch is formed by the confluence of Shaker Brook and the outlet from Richmond Pond, in the southwest corner of Pittsfield. This branch drains 23.1 square miles and flows northeasterly and then easterly to its confluence with the West Branch. We will address our comments to the different activities proposed for each branch.

West Branch

We understand that the proposed work on the West Branch involves the lowering of the Tel Electric Dam, removal of shoals or natural ledge dam, and dredging from the Tel Electric Dam to north of Wahconah Park. The spoil material would be used as fill in Wahconah Park. The flood-plain in this reach is quite fully developed. These developments are basically a combination of commercial and residential buildings. However, in the vicinity of Wahconah Park a sizable wetland borders the west shore of the West Branch.

The fishery resources of this reach are presently limited but there is potential for future trout stocking. The vegetation is primarily restricted to the banks and fringes of the channel and is comprised of deciduous trees, shrubs, and associated herbaceous ground cover. This vegetation provides habitat for songbirds and small mammals. The wetland in the vicinity of Wahconah Park contains sedges, canary grass, cattails, and associated shrubs. This provides important habitat for wildlife, particularly songbirds and small mammals and is a considerable asset to a highly urbanized environment.

EXHIBIT 1

We recommend that non-structural alternatives such as flood insurance, flood proofing, and zoning be given careful consideration, especially in light of the redevelopment that is taking place in this area of Pittsfield. Channel modification should not be considered if a practical alternative exists. Before any channel modification work is considered, the hydraulic control of the wetland in the vicinity of Wahconah Park must be determined. We will vigorously discourage any Federal action that would directly or indirectly result in the unmitigated loss or drainage of this wetland.

Southwest Branch

We understand that the proposed work on the Southwest Branch involves adding supplemental culverts under the Conrail railroad bridge in the vicinity of Clapp Park and dredging upstream from this culvert for approximately three thousand feet. Flooding in this reach is the result of backwater from the Conrail railroad crossing and is centered in the vicinity of the Pittsfield Plaza shopping center. This shopping center was constructed about 20 years ago in a wetland. It was noted during a field inspection in July, 1978 that about one-half of this shopping center was closed and boarded up. The rest of the floodplain has scattered commercial and residential buildings.

A significant Brown trout fishery both wild and stocked exists in the Southwest Branch upstream from the Conrail railroad crossing. A trout fishery of this caliber is a significant asset to the region and the state. Its close proximity to a highly populated area increases its value in these days of decreasing energy resources. The vegetation of the floodplain in this reach ranges from tall deciduous trees to overhanging shrubs and associated herbaceous ground cover species. This vegetation provides habitat for numerous songbirds and small mammals. In addition, this riparian vegetation plays an important role in the biology of the stream by providing an effective buffer to temperature extremes and in low order streams such as this by providing the major energy source through input of organic matter from terrestrial vegetation.

The Fish and Wildlife Service, as a rule, discourages stream modification practices because of the following negative impacts: sedimentation, especially downstream; destruction of benthic and aquatic populations; destruction or removal of overhanging trees and other riparian vegetation causing temperature changes in the stream and loss of food for fish and benthic invertebrates; removal of pool and riffle areas necessary for fish; and increases in flow velocity. Recent studies in Vermont on the White River have shown that stream channel alterations have severely impacted trout populations, and that brown trout were affected most by the stream alterations. The Southwest Branch is a brown trout fishery.

We recommend that non-structural solutions to the flooding problems on the Southwest Branch be given careful consideration. These non-structural solutions seem to be more viable in light of recent closings in the Pittsfield Plaza. We will vigorously oppose any channel modifications which would directly or indirectly result in the unmitigated loss of the sizable brown trout fishery in the Southwest Branch. We feel that the benefits of such a viable trout fishery to the people of the area are far greater than the benefits which would be afforded to relatively few people through any channel modifications. The addition of supplemental culverts to the Conrail railroad bridge would probably be acceptable if proper construction techniques to minimize erosion, sedimentation, and damage to riparian vegetation were employed.

<u>Summary</u>

Considering the fish and wildlife resources of the area, we have the following preliminary recommendations:

1. That non-structural solutions such as flood proofing, zoning, and flood insurance be fully explored before other alternatives are developed.

2. That the hydraulic control of the wetland in the vicinity of Wahconah Park (West Branch) be determined, and any action that would directly or indirectly result in the loss or drainage to this wetland be avoided.

3. That channel modifications be done only if no other practical alternative exists and, if it is done, proper mitigation or compensation for the loss of a wetland (West Branch) and a brown trout fishery (Southwest Branch) be provided for as a part of the project.

Thank you for the opportunity to comment on this project. We also request the opportunity to provide additional comments as more detailed plans are developed.

Sincerely yours,

Vernon B. Lang
Acting Supervisor

EXHIBIT 1

The Commonwealth of Massachusetts

Department of Public Works

100 Nashua Street, Boston 02114

January 29, 1980

SUBJECT DESIGN - Pittsfield
Linden Street Bridge
U.S. Army Corps of Engineers (NEDPL-PS)

Colonel Max B. Scheider, Division Engineer
Corps of Engineers, Department of the Army
New England Division
424 Trapelo Road
Waltham, MA 02154

Dear Colonel Scheider

This is to acknowledge receipt of your January 7, 1980 letter addressing the studies for improving flood protection along the West and Southwest Branches of the Housatonic River in Pittsfield, Massachusetts, under authority of Section 205 of the 1948 Flood Control Act.

This Department favors the described project, especially along the Southwest Branch, where recent localized flooding has threatened the safe use of U.S. Route 20, West Housatonic Street, a State highway and the principal arterial route serving traffic to and from the West of Pittsfield.

Also, we are preparing to replace the City-owned bridge at Linden Street over the West Branch and have coordinated our plans with your staff, such that the Hydraulic Study for the new bridge was jointly prepared utilizing your study material. Thus, the design for the waterway opening and abutment foundations is totally compatible with this project.

We, therefore, recommend the project undertaking and look forward to its successful completion.

Very truly yours

Dean P. Amidon
COMMISSIONER

cc DistOne

EXHIBIT 2

OFFICE OF COMMUNITY AND ECONOMIC DEVELOPMENT
CITY HALL
PITTSFIELD, MASSACHUSETTS 01201
(413) 499-1100

PAUL E. BRINDLE, III
MAYOR

CARTER TERENZINI
COMMISSIONER

February 7, 1979

Mr. John P. Chandler
Colonel, Army Corps of Engineers
New England Division
424 Trapelo Road
Waltham, Massachusetts 02154

Dear Colonel Chandler:

The Pittsfield City Council, at a meeting on January 30, 1979, requested that I write you to express their strong support of the Army Corps of Engineer's forthcoming Housatonic River Flood Protection Project.

The City Council is concerned with the flooding that continually takes place along this river. At a Council hearing on February 1, 1978, they supported and voted to expend $75,000 for a flood control project on the West Branch of the Housatonic. They realized that this was a small start on a large undertaking.

Councilman Charles Smith understood the magnitude of the Flood Protection Project and realized that the Army Corps of Engineers would be in a better position to perform this work. Because of the necessity for a large amount of funds and the needs for an EIS, the City Council agreed. It is fortunate that the proposal outlined by the Pittsfield Department of Public Works corresponds to the Corps' suggestions for the West Branch, as outlined in your letter of May 26, 1978.

The Pittsfield City Council hopes that the Flood Protection Project can move forward in a timely fashion. Because of the urgent need for such a program, the Mayor and City Council offer you their full commitment and co-operation on any aspect of the project where we may be of assistance.

EXHIBIT 3

Please contact Ms. Kate Lyons, Environmental Compliance Officer of my staff, should you have any further questions.

Sincerely,

Carter Terenzini

Carter Terenzini
Commissioner

CT/dm

cc: Mayor Brindle
Commissioner Doyle
Council President Stracuzzi

EXHIBIT 3

The Commonwealth of Massachusetts
Executive Office of Environmental Affairs
Department of Environmental Quality Engineering
Division of Land and Water Use
100 Nashua Street, Boston 02114

August 9, 1979

Colonel Max B. Scheider,
Division Engineer
Army Corp of Engineers
424 Trapelo Road
Waltham, MA 02154

RE: NEDPL-PS
Public Meeting - West and Southwest Branches
Housatonic River - Pittsfield

Dear Colonel Scheider:

Reference is made to the "Invitation to a Public Meeting" to be held in Pittsfield relative to the subject projects.

I will be unable to attend the meeting, however, I would like to be recorded in favor of any project that would alleviate the serious flooding conditions.

Please contact me if I may be of assistance in undertaking this worthwhile project.

Very truly yours,

JOHN J. HANNON, P.E.
Chief Engineer

EXHIBIT 4

P L A N N I N G   B O A R D
CITY OF PITTSFIELD, MASSACHUSETTS
CITY HALL, ROOM 222, 01201   PHONE (413)499-1100

August 23, 1979

Division Engineer
U. S. Army Corps of Engineers
New England Division
Attention: WEDPL-P
424 Trapelo Road
Waltham, MA 02154

RE: Proposals for local Flood Protection on the West Branch, Housatonic River and Southwest Branch, Housatonic River, Pittsfield, Massachusetts

Gentlemen:

The Pittsfield Planning Board reviewed the proposal for local flood protection on the West Branch and Southwest Branch of the Housatonic River in Pittsfield, MA at its meeting on August 20, 1979. A major concern was that the proposal did not adequately address what was viewed as the original intent of the study - to resolve the flooding problems in the Wahconah Park, Turner Avenue area. Attached is a list of comments on your proposal.

Representatives of the Planning Board will be present at the public hearing to be held on August 29, 1979 at 7:30 P.M. in the City Hall in Pittsfield and we would welcome receiving any further information concerning this study prior to the hearing.

Yours truly,

Pittsfield Planning Board

David Hathaway

David P. Hathaway,
Director

DPH:ps

EXHIBIT 5

CONRAIL

December 6, 1979

SUBJECT: Pittsfield, Massachusetts - Proposed flood protection improvements to be made to the west and southwest branches of the Housatonic River in the vicinity of the Main Line, L.C.4-1-03, M.P. 148±, and the Canaan Secondary, L.C.4-2-20, M.P. 85.97, Berkshire County, New England Division, Northeastern Region. (File:Location-RWH)

Mr. Joseph L. Ignazio
Chief, Planning Division
Department of the Army-Corps of Engineers
New England Division
424 Trapelo Road
Waltham, Massachusetts 02154

Dear Mr. Ignazio:

Reference is made to your letter of November 6, 1979 in which you submitted concepts for our review concerning the project construction. We have reviewed your submission and generally have no objection.

However, the railroad does recommend using the temporary railroad bridge shown on the attached sheets, with steel sheet piling to hold the roadbed for the open cut or tunnel beneath the track.

As to your request of plans of structures for area affected by your project, please be advised Conrail has no plans on file.

We appreciate your interest in this matter. Please keep this office advised of further developments on this project.

Very truly yours,

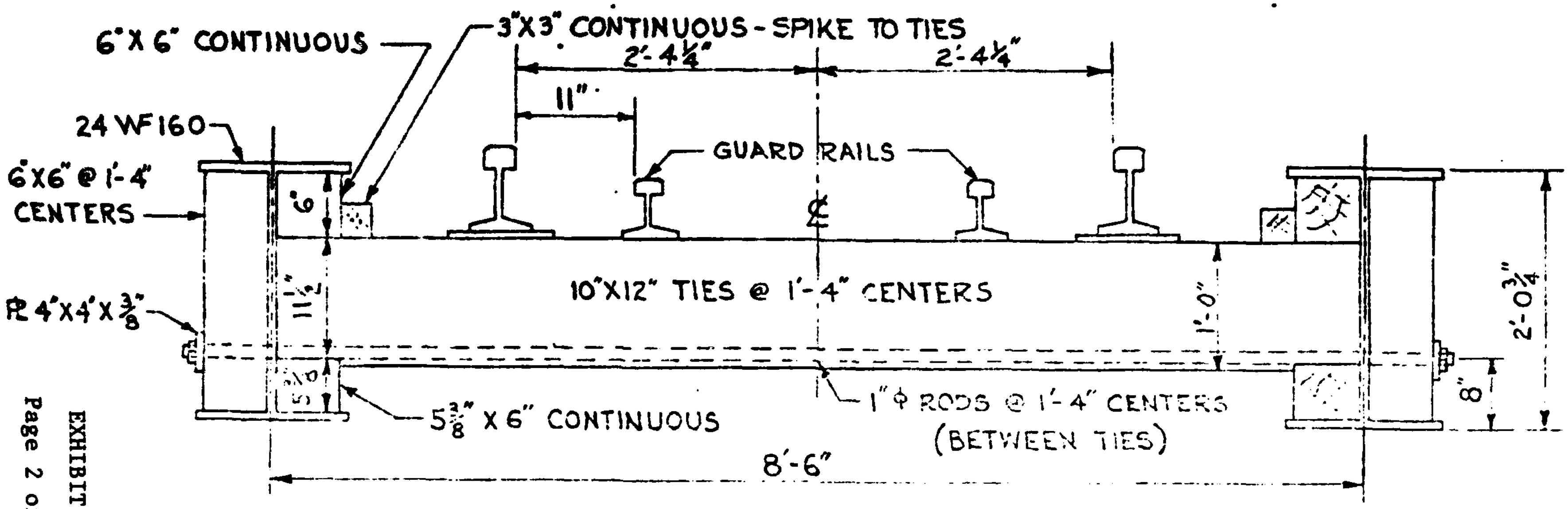
J. T. Sullivan

J. T. Sullivan, P.E.
Chief Engineer -
Design & Construction

19th Floor - (215) 893-6047

EXHIBIT 6

CONSOLIDATED RAIL CORPORATION 1528 WALNUT STREET PHILADELPHIA, PA 19102



NOTE TOP OF RAIL TO BE ABOVE TOP OF BEAM.
ALL TIMBER TO BE CUT TO CONTOUR OF STEEL TO GIVE FULL, UNIFORM BEARING ON ALL CONTACT SURFACES. PREFERABLY TIMBERS SHALL BE CUT SLIGHTLY OVERSIZED AND LIGHTLY DRIVEN TO FIT.
ALL TIMBER TO BE UNTREATED STRUCTURAL GRADE OAK.
USE PILE CAPS ON PILE BENTS.

CROSS SECTION FOR TEMPORARY BRIDGE

OFFICE OF ASST. CHIEF ENGR. - STRUCTURES
. . PA

EXHIBIT 6

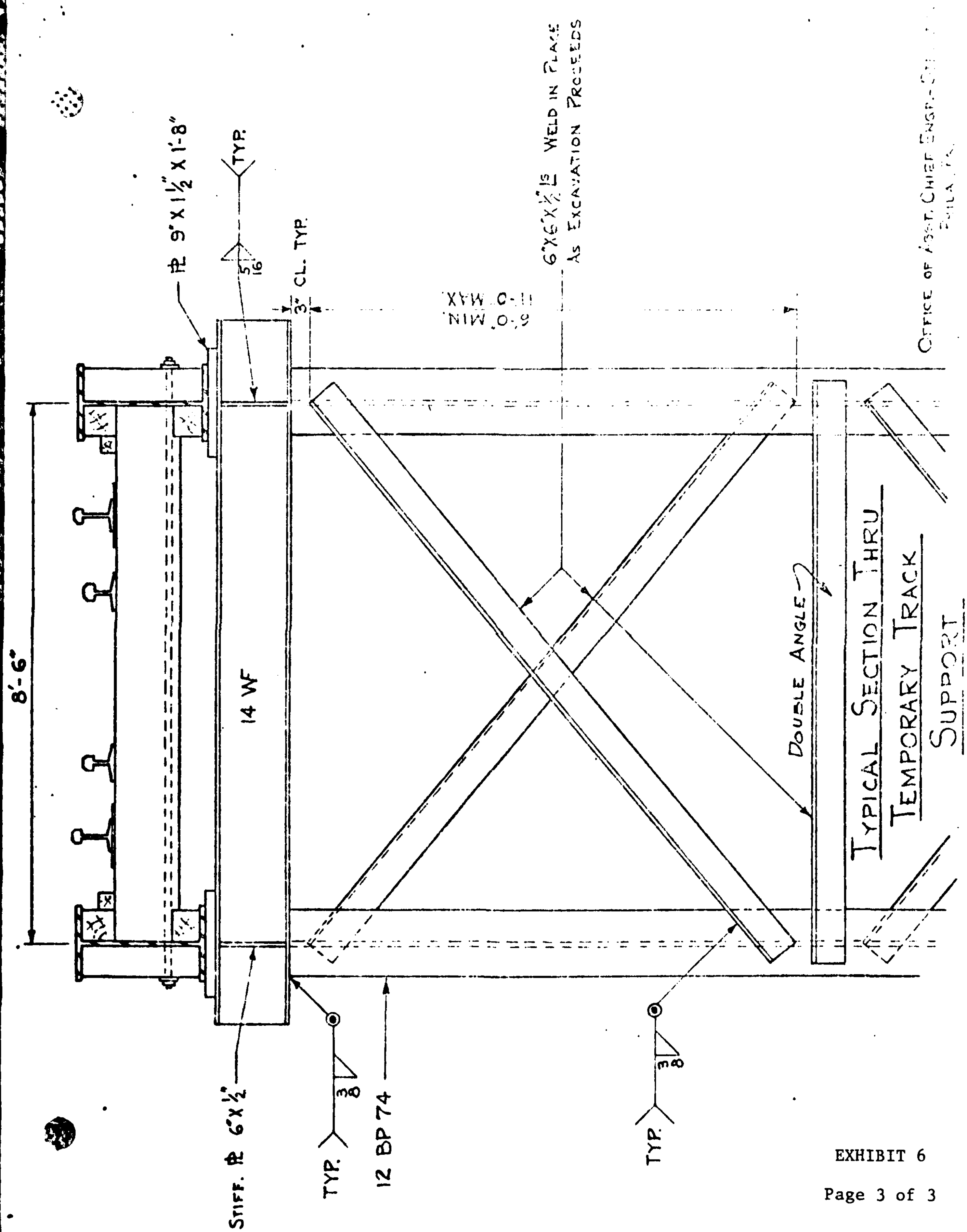

8'-6"
PL 9"X1½"X1'-8"
TYP.
5/16
3" CL. TYP.
6'-0" MIN.
11'-0" MAX.
6"X6"X½" Ls WELD IN PLACE AS EXCAVATION PROCEEDS
14 WF
DOUBLE ANGLE
TYPICAL SECTION THRU TEMPORARY TRACK SUPPORT
STIFF. PL 6"X½"
TYP.
3/8
12 BP 74
TYP.
3/8
OFFICE OF ASST. CHIEF ENGR.

EXHIBIT 6

RICHARD E. KENDALL
COMMISSIONER

The Commonwealth of Massachusetts
Executive Office of Environmental Affairs
Department of Environmental Management
Leverett Saltonstall Building, Government Center
100 Cambridge Street, Boston 02202

January 14, 1980

Max B. Scheider, Colonel
Corps of Engineers
NED Division Engineer
424 Trapelo Road
Waltham, Massachusetts, 02154

Dear Col. Scheider:

Mr. Kennedy has brought to my attention your letter of January 7, 1980, concerning the proposed Pittsfield Local Protection Project on the West and Southwest Branches of the Housatonic River. While we assume that non-federal first costs would be borne by the community, we do have an interest in the design and impact of the project.

The lowering of the dam crest and the increase in the railroad culvert capacity appear to be without potential detrimental in situ effects. We do recommend that you work closely with the Massachusetts Division of Fisheries and Wildlife if they feel that either mitigation or enhancement should be considered in regard to the proposed channel realignment. We realize that this is an urban setting, but we have become increasingly aware that water resources in heavily developed areas can often be enhanced, e.g., the Nashua River in Fitchburg is being improved in terms of channel capacity and esthetics.

Our other concern is the possible downstream effects on flood elevations. We noted that no flood profiles have been provided below the enlarged railroad culvert capacity. Our understanding is that these elevations have not yet been calculated, but that they will be. Any significant increase, we believe, should be reflected in a project modification.

Thus our position is one of general support if there is community support, if Fisheries and Wildlife opportunities are considered and if downstream effects are thoroughly analyzed and dealt with effectively.

Very truly yours,

Richard E. Kendall

Richard E. Kendall, Commissioner

REK/EHC/hrb

EXHIBIT 7

United States Department of Agriculture
Soil Conservation Service
P.O. Box 848
Amherst, Massachusetts
01002

January 29, 1980

Colonel Max B. Scheider
Division Engineer
New England Division,
Corps of Engineers
424 Trapelo Road
Waltham, Massachusetts 02154

Dear Colonel Scheider:

Attn: NEDPL-PS

We have reviewed the proposed local protection project on the Housatonic River in Pittsfield, as requested in your letter of January 7, 1980, and offer the following general comments for your consideration:

Previous available information on this project, and that presented at the public information meeting on August 29, 1979, in Pittsfield, Massachusetts, lists four plan alternatives (three structural and one nonstructural) for the Southwest Branch of the Housatonic River. This information indicates that Plan C, which would triple the Conrail culvert capacity, is a more desirable alternative to your chosen Plan B. The increased average annual benefit of Plan C over Plan B is substantial in relation to the modest increase in average annual cost. Plan C also avoids the environmental impacts of channelization.

Fish and wildlife habitat values of the proposed channelization reach are reported to be significant. Data in our files on this reach show it to provide excellent brown trout habitat and to support a high natural brown trout population (approximately 40 pounds of trout per surface acre). The Massachusetts Division of Fisheries and Wildlife should be contacted regarding the fish and wildlife values in this reach. Also consideration should be given to potential impacts on the wetland acreage within this reach.

We suggest that if the project evaluation is to utilize existing published frequency-stage data, then the more recent (May 1977) Flood Insurance Study data should be used. We have recently provided basic hydrologic and hydraulic data (developed during the Flood Insurance investigations) to your Hydrologic Engineering Section. If we can be of further assistance, please do not hesitate to call upon us.

The alternatives considered are consistent with those identified in prior studies by the Soil Conservation Service. We appreciate the opportunity to provide comments.

Sincerely,

Philip Christensen

DR. BENJAMIN ISGUR
State Conservationist

EXHIBIT 8

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION I

J.F. KENNEDY FEDERAL BUILDING, BOSTON, MASSACHUSETTS 02203

January 30, 1980

Max B. Scheider, Colonel
Division Engineer
New England Division
Corps of Engineers
424 Trapelo Road
Waltham, MA 02154

Dear Colonel Scheider:

We have reviewed the information prepared by the Corps of Engineers on local flood protection projects along the West and Southwest Branches of the Housatonic River in Pittsfield, Massachusetts. These projects will increase the hydraulic gradient by lowering the Tel-Electric Dam and improve flow characteristics through conduit and channel modifications.

Our review of water quality data on the affected segments indicate that criteria for intended uses are generally met. Recent surveys have shown that while water quality is generally good, there is evidence of some pollution in the lower reaches of the West Branch. The sources have not been identified and may be of nonpoint or urban runoff origin. For this reason, any modifications should include a channel configuration that provides for adequate velocity even at the lowest flows to minimize deposition and to maintain sufficient reaeration in the stream. Otherwise, we believe these projects will have no adverse affects on water quality.

Thank you for the opportunity to comment on these projects. If you have any questions, please feel free to contact me at 223-2226 or Eric Hall of my staff at 223-5131.

Sincerely,

Charles W. Murray, Jr.
Director, Water Division

EXHIBIT 9

The Commonwealth of Massachusetts

Division of Fisheries and Wildlife

Field Headquarters, Westboro 01581

January 30, 1980

Col. Max B. Scheider
Corps. of Engineers
424 Trapelo Rd.
Waltham, MA 02154

Dear Col. Scheider:

In response to your January 7, request for comments relating to the proposed flood control project along the West and Southwest Branches of the Housatonic River in Pittsfield. We have reviewed the information provided in your letter, the information provided for the 8/29/80 public meeting and the summary of costs and benefits for the proposed project.

As outlined by the plan we have no comment or opposition to the lowering of the Tel-Electric Dam on the West Branch of the Housatonic, however, we have serious reservations with the selected option for the Southwest Branch. More specifically we oppose the part of the plans which proposes to channelize 1,300 ft. of stream from Malloy Brook to Barker Road Bridge.

Recent investigations by staff biologist indicate that this reach of the river affords excellent brown trout habitat for both spawning and growth. It is estimated that this section of the river supports about 40 pounds of wild brown trout per acre. This is well above the state average. Obviously we are greatly concerned with any project that threatens to completely destroy this existing stream potential as the channel would.

Upon reviewing the options presented from a cost benefit perspective the staff and I agree that plan C which calls for the installation of two 15' diameter culverts at the Conrail crossing would accomplish your objective with no significant difference in the cost/benefit ratio but a savings of 1,300' of irreplacable trout habitat.

Additionally, we note that the residual annual losses provided by your estimates favors plan C by $17,000. Might not this savings easily underwrite the slight initial cost differential between alternative B and C?

It is our recommendation that the Corp select plan C to remedy problems along the Southwest Branch of the Housatonic.

EXHIBIT 10

Should the Corp proceed with plan B as indicated in your letter, we will strongly oppose the project for the reason as stated above and believe we are justified under President Carter's Executive Order 11,990 Protection of Wetlands 3/which states that each agency "shall avoid undertaking or providing assistance for new construction located in wetlands unless the head of the agency finds that there is no practicle alternative to such construction".

Thank you very much for sending me the information relative to this proposal and if I or my staff can be of any assistance in your efforts, please do not hesitate to contact us.

Sincerely

Richard Cronin

Richard Cronin,
Director

RC:dk

cc: Leo Daly, Fisheries Manager
David Halliwell, Asst. Aquatic Biologist

Letter drafted by Peter H. Oatis,
Chief Aquatic Biologist

MASSACHUSETTS HISTORICAL COMMISSION

COMMONWEALTH OF MASSACHUSETT
Office of the Secretary of State
294 Washington Street
Boston, Massachusetts
02108
617-727-8470

MICHAEL JOSEPH CONNOLLY
Secretary of State

February 6, 1980

Mr. Max B. Scheider
Colonel, Corps of Engineers
Division Engineer
Department of the Army
New England Division, Corps of Engineers
424 Trapelo Road
Waltham, Massachusetts 02154

RE: Local Flood Protection, West and Southwest Branches of the Housatonic River, Pittsfield

Dear Mr. Scheider:

Thank you for your letter of January 7, 1980 describing the proposed flood protection project along the west and southwest Branches of the of the Housatonic River in Pittsfield.

The Massachusetts Historical Commission's Inventory includes three prehistoric sites along the West Branch of the river. The status of the prehistoric survey is incomplete, and presently unknown sites undoubtedly exist in the City.

If the Army Corps project will disturb previously undisturbed land, an assessment of potential archaeological impacts should be conducted. An archaeological survey designed to identify archaeological sites and potential impacts should be conducted in order to provide information for compliance with Section 106 of the National Historic Preservation Act of 1966.

If you should have further questions, please contact Valerie Talmage, State Archaeologist.

Sincerely,

Patricia L. Weslowski

Patricia L. Weslowski
State Historic Preservation Officer
Executive Director
Massachusetts Historical Commission

PLW/ej

EXHIBIT 11

BERKSHIRE COUNTY REGIONAL PLANNING COMMISSION

10 FENN STREET, PITTSFIELD, MASSACHUSETTS 01201

TELEPHONE (413) 442-1521

February 25, 1980

Max B. Scheider, Colonel
Division Engineer
New England Division
Army Corps of Engineers
424 Trapelo Road
Waltham, Massachusetts 02154

RE: Review of 205 Flood Protection Project on the West and Southwest Branches of the Housatonic River, Pittsfield, Mass.

Dear Colonel Scheider:

This letter is to update the status of our A-95 review of the 205 flood control project in Pittsfield, Massachusetts. On January 10, 1980 we received your letter requesting our review of the project under A-95 requirements and coordination regulations of the Corps of Engineers. This letter contained plans and profiles of the recommended alternatives for the West and Southwest Branches.

BCRPC, following its normal clearinghouse review procedures, copied the letter and attachments and sent them to affected agencies and towns. The responses that we received are attached.

BCRPC attended a meeting with the Corps, Massachusetts Fisheries and Wildlife officials and federal Fish and Wildlife officials in Westborough, Massachusetts on February 8, 1980. It was at this meeting that a modification to the plans on the Southwest Branch was discussed.

At our Commission meeting on February 21, 1980, Bill Swain, Farrell MacMillian and Karen Dennison presented the project with the modifications and answered questions from the Commissioners. An official motion on the project, in favor or opposed, was not made at this meeting due to the introduction of new material.

BCRPC has requested that Bill Swain reply in a letter to BCRPC concerning the downstream flooding effects and the inconsistency with 100 year flood elevations as prepared by the Soil Conservation Service for the 1977 Flood Insurance Study.

EXHIBIT 12

In the interim, BCRPC will review the new alternatives presented at our Commission meeting and solicit comments from affected agencies on the new project design. The submission of the Detailed Project Report to the Chief of Engineers should be delayed until the questions raised at our meeting can be answered.

If you have any questions, please call.

Sincerely,

Karl Hekler

Karl Hekler
Director

KH/SPR/bv

cc: Leo Daley, Division of Fisheries & Wildlife
Pittsfield Planning Board
William Swain
Win Robinson, U. S. Fish & Wildlife

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
ECOLOGICAL SERVICES
P.O. Box 1518
Concord, New Hampshire 03301

Ref: NEDPL-PS

FEB 2 . 1980

Colonel William E. Hodgson
Deputy Division Engineer
New England Division, Corps of Engineers
424 Trapelo Road
Waltham, Massachusetts 02154

Dear Colonel Hodgson:

This is another fish and wildlife planning aid letter concerning your study of local flood protection on the Southwest and West Branches of the Housatonic River in Pittsfield, Massachusetts. Your letter of January 7, 1980, provided plans that have been revised from those considered in our planning aid letter dated August 2, 1978. This report is prepared under authority of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.) and supplements our planning aid letter dated August 2, 1978. Resource data provided in the letter will not be repeated here.

We have no objection to the proposed lowering of the spillway crest at the Tel-Electric Dam based upon your assurance that this measure will not impact the hydrology of the wetland upstream in the vicinity of Wahconah Park. We would, however, maintain our objections to any proposal that adversely impacts this wetland. We also have no objection to construction of the additional culvert through the railroad embankment.

The proposed channelization of 1,350 feet of the Southwest Branch will destroy the aquatic habitat. The Massachusetts Division of Fisheries and Wildlife surveyed this reach on August 16, 1979, and found that it is supporting a standing crop of 131 pounds of fish per acre. Thirteen species were collected that included brown trout, brook trout, white sucker, fallfish, pumpkinseed, largemouth bass, yellow perch, common shiner, longnose dace, blacknose dace, bridled shiner, rock bass and creek chubsuckers. Only brook trout are stocked. Nineteen brown trout ranged from 2.7 inches to 15.2 inches and the three brook trout ranged from 8.7 to 10.8 inches. The total weight of trout equaled 40 pounds per acre, or about 30% of the total weight of fish.[1] The length-weight ratio of the trout in comparison to other fish species is relatively high. A 1978 study of the Westfield River drainage revealed an average standing crop of 52.0 pounds per acre (range 5 to 180 pounds/acre) of all species and 18.7 pounds of trout per acre.[2]

[1]Daly, Leo. 1980. Personal communication.

[2]Halliwell, David B. 1978. Stream survey of the Westfield River System Job Performance Report, F-36-R-10.

EXHIBIT 13

The Southwest Branch is supporting both warm- and cold-water fish and its trout producing potential could be very sensitive to any action which would increase stream temperatures by reducing instream or riparian cover. The high standing crop of fish is also an indication of good natural habitat conditions that should be protected. Streams of this quality are seldom found within walking distance of urban centers. The immediate area around the stream is undeveloped and densely covered with scrub and tree growth.

Replacement of the lost stream habitat is not possible. Mitigation of even a small part of the habitat loss would be costly, assuming that a similar sized stream with improvement potential could be found. We, therefore, believe that channelization should be avoided. We also believe that channelization would not be in compliance with Executive Order 11990, dated May 24, 1977, because the area is considered a wetland and there are alternates to the channelization.

Possible alternatives were reviewed at a meeting on February 8, 1980, between representatives of this office, the Massachusetts Division of Fisheries and Wildlife, the Berkshire County Regional Planning Commission, and your office. Alternatives included: (1) a larger culvert through the railroad embankment, (2) several possible revised flood channels through the oxbow area between Malloy Brook and the Barker Road Bridge with invert elevations well above normal water levels and which would cause less alteration of the stream banks and streamside vegetation, and (3) preservation of the area as a flood retardation site. It was agreed that your staff would evaluate these options. It was also agreed that a diversion around the entire reach between Malloy Brook and the Barker Road Bridge or clearing of brush to create a floodway without ditching, would be the two most promising options.

While the work will reduce flooding up to 50-year intervals, it would not significantly reduce flooding from major (50-100 year) events. Nevertheless, flood control work could tempt developers to build in the floodplain with appropriate flood proofing measures such as raised foundations. We believe that your planning for this area should discourage further development, so that it will continue to serve as a natural area with temporary storage capacity. Land acquisition for this purpose by the Federal Government is not included in the authority for this study, Section 205 of the 1948 Flood Control Act as amended. However, you should encourage local people to preserve this area as a condition of the project.

Current plans for construction of a Highway No. 7 bypass could include a crossing of this stream in the project area. You should take the necessary action to assure that if such a crossing is constructed, it will neither increase the flood hazard or adversely impact the stream or riparian area.

We will comment further after the results of your evaluation of the alternates are available. We appreciate your efforts to find a satisfactory plan to avoid damage to the stream habitat.

We recommend that (1) an alternative be found for the channelization, and (2) your final plan encourage local action to preserve the area as a condition of the project.

Sincerely yours,

Gordon E. Beckett

Gordon E. Beckett
Supervisor

EXHIBIT 13

NEDPL-PS 28 February 1980

Mr. Richard Cronin, Director
Mass. Division of Fisheries and Wildlife
Field Headquarters
Westboro, Mass. 01581

Dear Mr. Cronin:

In response to your letter of 30 January 1980, stating opposition of any plan of channelization of the Southwest Branch in Pittsfield, Mass. for flood control purposes, engineers of my staff met with Mass. Division of Fish and Wildlife personnel, as well as representatives from the U.S. F & W Service and Berkshire County Regional Planning Commission on 8 February 1980 in an attempt to resolve several issues. We believe that the following modifications to the original plan of improvements will be acceptable to all concerned parties.

In lieu of the proposed channel excavation in the 1300 foot reach upstream from the Barker Road bridge, brush and tree clearing would be accomplished on approximately the same alignment. This clearing would be limited to a 30' width and would impact on less than 5% of the total wetland area between Barker Road and U.S. Route 20 (West Housatonic Street). Although this plan would not be as effective in discharging flood flows as the channel excavation proposal, because the existing embankment is 3 to 4 feet above the streambed, it would allow for an overflow path when flood stages exceeded the 3 to 4 foot depth. The brush and the tree cutting would not include root removal (grubbing) and therefore scour of the "relief channel" would be minimized. Also, the clearing for the most part would take place far enough away from the existing channel so that the overhanging shrubs along the streambank would not be disturbed. Low ground cover along the straightened cleared bypass area would remain intact. Maintenance of the brush free area would have to be accomplished periodically by the City of Pittsfield as part of the local cooperation agreements, required under the Section 205 authority.

EXHIBIT 14

Mr. Daly of your staff requested further evaluation of two alternative proposals, namely (1) excavate sediment materials under and downstream from the Barker Road bridge and (2) excavate a bypass channel downstream from Maloy Brook along the outside perimeter of the wetland area. Excavation of the river bottom under the Barker Road bridge would not appreciably lower flood profiles in this area as it is not the primary hydraulic control. This plan would also have short range environmental consequences associated with channel excavation and would not provide any appreciable benefits to the economic development account. Similarly, costs for excavation of the bypass channel would exceed derived benefits and is therefore not considered to be a viable solution.

Your letter of 30 January 1980 recommends that we select Plan C (two supplemental culverts at the Conrail embankment) to provide flood protection along the Southwest Branch. Although this plan has economic justification, it does not maximize net benefits and would have additional adverse impacts on downstream properties in the vicinity of South Street. By the use of flood routing computations we have determined that one supplemental culvert at the railroad embankment on the Southwest Branch and the recommended improvements on the West Branch would increase flood stages about 5 inches at the South Street bridge during the 100 year event. Lesser floods would have similarly lower flood stage increases. At the request of Pittsfield officials we will attempt to make further economic studies of residential properties upstream from South Street to determine the monetary impacts of the increased flood levels. For these reasons we do not concur in the use of Plan C as the recommended plan of flood control improvements.

I trust the foregoing resolves the channelization problem which would have adversely impacted upon the fishery resource of the Southwest Branch and provides sufficient information to allow for concurrance of the modified plan by the Mass. Div. of Fisheries and Wildlife. Your earliest response in this matter would be appreciated.

MAX B. SCHEIDER
Colonel, Corps of Engineers
Division Engineer

EXHIBIT 14

NEDPL-PS 20 March 1980

Mr. Karl Hekler, Director
Berkshire County Regional Planning Commission
10 Fenn Street
Pittsfield, MA 02161

Dear Mr. Hekler:

Reference is made to your letters of 7 February 1980 and 25 February 1980, expressing concerns for certain issues relative to our proposals for providing local flood control measures along the West and Southwest Branches of the Housatonic River in Pittsfield, Massachusetts. Engineers of my staff attended the BCRPC meeting on 21 February 1980 to explain the rationale for the development of structural measures that would reduce economic hardships to the community and its citizens during flood periods. Because members of the BCRPC and the Pittsfield Planning Board felt that two major issues were not completely resolved, the acceptance of the proposed projects was tabled until the March meeting of the BCRPC. Hopefully, the following information will clarify the unresolved issues and allow for final action on the recommended plans by the BCRPC.

The two remaining principal concerns are: (1) that the computed 100-year flood stages of the Soil Conservation Service and Corps of Engineers are different, and (2) that the proposed local protection projects would increase 100-year flood stages in the vicinity of South Street by about 5 inches if an existing sewer crossing is not modified. With reference to (1) above Mr. McMillan of my staff explained, at the 21 February meeting, that the methodology for estimating flood stage-frequencies was not an exact science and that the adopted 100-year discharge was derived by a combination of (a) statistical analysis of past peak flows, and (b) hydrological analysis of the watershed, applying a 100-year storm rainfall and computing the peak flows. The resulting flows and flood profiles were considered in reasonable agreement with the SCS, considering the independent nature of the two studies. Further detailed information pertaining to our hydrologic and hydraulic analysis is contained in a report which is inclosed for your information.

EXHIBIT 15

We regret that city officials feel that these differences will cause confusion to local merchants and citizens who would like to purchase sufficient flood insurance to cover their needs. However, the Corps of Engineers, as part of its studies, considered it necessary to perform an independent cursory hydrologic analysis and review. It is noted that our study is not considered, in any way, to be more accurate or refined than earlier studies; nor is it intended to supersede or void any related studies or actions by other Federal agencies or local commissions in regards to any adopted flood plain zoning elevations or ordinances.

Although our flood control study has not been approved by the Chief of Engineers, the flood profile sheets received widespread distribution at the August 1979 public meeting and again during our January/February 1980 coordination review period. We have modified the nomenclature on the flood profiles to indicate that the computed 100-year flood levels are approximate. Hopefully, this problem area will not remain as a major source of concern and local citizens will continue to use the HUD Flood Insurance statistics for purchase of Federally subsidized insurance, understanding the elusive nature of determining the 100-year flood level.

The second major issue of concern was that of increased flood stages in the vicinity of South Street, if the two recommended upstream projects were implemented. Because the existing Massachusetts Department of Public Works topography sheets used for our flood plain delineation have a five foot contour interval, a determination of the impact of five additional inches of flood height for the 100-year flood would not be completely accurate. In addition, it is noted that the HUD floodway boundaries are delineated by interpolation between cross sections using a 10-foot contour interval map. Their cross sections and profiles indicate an approximate 100-year flood elevation of about 974 to 975 feet above mean sea level (msl) which compares favorably with the stage of 974.8 feet computed by the Corps for the natural 100-year flow and 975.2 feet for the modified 100-year flow.

As we have stated in the past, the areas of Taylor Street and Fairfield Street were not delineated by city of Pittsfield officials as being flood problem areas during our early investigations. Consequently, detailed flood damage surveys were not performed in this area. However, a rationale has been developed to determine, quantitatively, what impacts would result from an additional five inches of water during a 100-year flood event.

Utilizing the Massachusetts Department of Public Works five foot contour interval map, it was estimated that 25 houses in the sub-divisions upstream from South Street would be inundated by the 100-year flood at elevation 975. These structures, already experiencing flooding above the first floor level, would not be additionally impacted by an increase of 5 inches in the stage of the 100-year flood. Wallpaper, paneling, flooring and furniture would already need repair or replacement following the 100-year flood, and an additional 5 inches of water would not increase these costs.

Ten houses located at the outer limits of the 100-year flood zone may experience water in the basement via ground seepage during the normal 100-year flood event. However, they would not experience flooding from surface water. A depth of five inches of water above the ground surface may only inundate those houses which have poorly sealed basement windows or bulkheads leading to the basement. Assuming that some houses would already experience seepage from the natural flood, and others would only minimally be impacted from the modified flood, the increment in damages resulting from the modified flood is expected to average $1,000 per house.

The total increase in damages from the 100-year flood resulting from construction of the upstream projects is estimated to be in the range of $8,000 to $10,000. This estimate of damages is considered to be on the high side because it is anticipated that those property owners that are on the fringe of the estimated 100-year event would take precautions such as placing sandbags or barricades around basement windows during these rare flood periods. Whereas losses for the 100-year flood prevented on the West Branch alone by the proposed flood control improvements would be $441,000, the percentage increase in losses at South Street would be in the order of two percent. When compared with Southwest Branch 100-year loss of $850,000, the percentage increase would be about one percent.

As you know, the major factor influencing flooding in this area is the concrete encased sewer line which restricts the waterway under the South Street bridge. This stream crossing is a natural debris collector and depending on the amount of blockage during a flood, it is conceivable that relatively high flood levels could result even with low river flows. As we have stated before, relocation of the utility would be a non-Federal expense under the Section 205 authority and we have recommended that the city of Pittsfield provide funds for relocation as soon as possible.

Other items discussed in your 7 February 1980 letter included: (1) possible further upstream channel erosion due to lowering the Tel-Electric Dam and (2) the effect of channelization on the fishery resource of the Southwest Branch. Regarding channel erosion, topographic surveys of the pond bottom behind the dam indicate an average elevation of about six feet below the dam crest, or about 3 feet below the proposed lowered dam crest. Studies indicate that flood flow velocities in the area would not increase more than approximately one foot per second, from about 3.5 feet per second to 4.5 feet per second, which is not considered sufficiently high to cause excessive scour.

With respect to the opposition of the U.S. Fish and Wildlife Service and the Massachusetts Division of Fisheries and Wildlife to channelization for flood control purposes on the Southwest Branch, we have modified the plan to exclude diversion channel excavation and include, in its place, a plan of land clearing. Although the clearing would not be as efficient in discharging minor flood flows as the channel excavation plan, it would provide an overflow path to lessen the degree and duration of flooding at West Housatonic Street. This plan appears to be acceptable to fishery interests. Further information concerning the modified proposal was contained in a letter, dated 28 February 1980, to the Massachusetts Division of Fish and Wildlife, a copy of which was forwarded to you.

I trust the foregoing information will clarify issues that remained after the 21 February 1980 meeting and will allow the BCRPC to act on the proposed plans for local flood protection in the city of Pittsfield.

Sincerely,

Incl
As stated

MAX B. SCHEIDER
Colonel, Corps of Engineers
Division Engineer

CF: Mr. David Hathaway
Pittsfield Planning Board
City Hall, Room 222
Pittsfield, MA 02161

U. S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
REGION ONE
100 Summer Street, Suite 1517
Boston, Massachusetts 02110

IN REPLY REFER TO:
HEV-MA

March 24, 1980

Colonel Max B. Scheider, Division Engineer
Department of the Army
New England Division
Corps of Engineers
424 Trapelo Road
Waltham, Massachusetts 02154

Dear Sir:

In response to your request of January 7, 1980 for comments in regard to the proposed flood control project along the West and Southwest Branches of the Housatonic River in Pittsfield, Massachusetts, we feel that it will have no effect upon the existing highway network.

As you are aware, the Massachusetts Department of Public Works is preparing a draft environmental impact statement for the reconstruction of U.S. Route 7 in Pittsfield. Two of the alternatives pass near parts of the flood control project. However, it appears that construction of the flood control project will not have any significant effect on the proposed highway project, regardless of the alternative selected. We have complied with the requirements of the Council on Environmental Quality concerning early coordination on construction projects. This coordination will continue throughout the design phase of the proposed highway project.

We appreciate the opportunity to review the plans, profiles, and preliminary details of this project.

Sincerely yours,

N. J. Van Ness
Division Administrator

Edwin P. Holahan

By: Edwin P. Holahan
Assistant Division Administrator

EXHIBIT 16

DEPARTMENT OF PUBLIC WORKS
CITY OF PITTSFIELD
MASSACHUSETTS
01201

GERALD S. DOYLE
COMMISSIONER

March 31, 1980

Colonel Max B. Scheider
Division Engineer
U.S. Army Corps of Engineers
424 Trapelo Road
Waltham, MA 02154

Dear Colonel Scheider:

Please excuse the delay in our return of comments on your proposals to provide flood protection on the West and Southwest Branches of the Housatonic River.

In general, we approve with your proposals for both branches; and as you are aware, have in the past made the same suggestions concerning the Tel-Electric Dam and excavation upstream of the Barker Road Bridge.

Realizing these plans do not eliminate all losses from a 100-year flood, we believe they would lessen the problems that occur during the spring run-off where we encounter any abnormal amounts of rain and certainly lessen the appreciation of the abutters along both branches who, each spring, find their homes inundated with water.

I would welcome any assistance you could give us and thank you for your past help.

Sincerely,

Gerald S. Doyle
Commissioner of Public Works

GSD/ah

cc - Mayor Charles L. Smith
Angelo Stracuzzi, President City Council
Daniel Dillon, Chairman Public Works Committee
Francis A. Chichetto, Councilman
Engineer Division

EXHIBIT 17

BERKSHIRE COUNTY REGIONAL PLANNING COMMISSION

10 FENN STREET, PITTSFIELD, MASSACHUSETTS 01201

TELEPHONE (413) 442-1521

April 22, 1980

Colonel Max B. Scheider
Army Corps of Engineers
Division Engineer
424 Trapelo Road
Waltham, Massachusetts 02154

Dear Colonel Scheider:

The Berkshire County Regional Planning Commission conducted its final review of the Army Corps sponsored flood control project on the Housatonic River in Pittsfield, Massachusetts. At the Commission meeting on 4/18/80 the project was unanimously endorsed.

BCRPC appreciates the cooperation that the Corps has displayed in altering plans and answering questions that have been raised during the review process. It is important to note that as a result of the change in design on the Southwest Branch, the Total First Cost has decreased by $386,500, and the benefit/cost ratio has increased from 1.70 to 3.10. This represents a substantial savings for the taxpayers of the U. S. The change in design on the Southwest Branch has also lessened the impact of the project on the fisheries in the river.

BCRPC believes that the A-95 review process for this project has been most beneficial to all concerned with the project.

If you have any questions, please call.

Sincerely,

Karl Hekler

Karl Hekler
Director

KH/SPR/bv

cc: Bill Swain
Pittsfield Planning Board
Mayor Charles Smith, Pittsfield
Peter Oatis, Mass. Div. of Fisheries & Wildlife
Leo Daly, Mass. Div. of Fisheries & Wildlife
Win Robinson, U. S. Fish & Wildlife Service

EXHIBIT 18

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
ECOLOGICAL SERVICES
P.O. Box 1518
Concord, New Hampshire 03301

APR 30 1980

Colonel William E. Hodgson
Deputy Division Engineer
New England Division, Corps of Engineers
424 Trapelo Road
Waltham, Massachusetts 02154

Dear Colonel Hodgson:

This letter supplements our letter of February 22, 1980, concerning your study of flood protection on the Housatonic River at Pittsfield, Massachusetts. It responds to Colonel Scheider's letter to Mr. Richard Cronin, Director, Massachusetts Division of Fisheries and Wildlife at the request of Mr. Robert Adler of your staff.

We concur in your plan to clear a 30-foot wide strip of trees and brush for 1,300 feet along the Southwest Branch between Barber Road and Malloy Brook. Avoidance of root removal will assure early recovery of vegetation and help to reduce erosion. Maintenance of the open strip by the city will allow a habitat type to develop which will have some value for wildlife because it will be different from the surrounding habitat thereby adding interspersion of habitat types. Vegetation overhanging the stream and the streambanks should not be adversely affected by the work. We request that specifications and supervision of the work be designed to minimize damage to the stream habitat.

We appreciate the efforts of your staff in cooperating with the Massachusetts Division of Fisheries and Wildlife and this Service to develop this alternate to the stream channelization originally planned. It will result in far less short- and long-term damage to aquatic habitat in the Southwest Branch. This is a good example of accomplishments that are possible with appropriate coordination between our agencies.

Sincerely yours,

Gordon E. Beckett

Gordon E. Beckett
Supervisor

EXHIBIT 19

UNITED STATES DEPARTMENT OF AGRICULTURE
FOREST SERVICE
NORTHEASTERN AREA STATE AND PRIVATE FORESTRY
370 REED ROAD — BROOMALL, PA. 19008
Telephone (215) 461-3170

1950
August 6, 1980

Mr. Robert Adler
Impact Analysis Branch
U. S. Army Corps of Engineers
424 Trapelo Road
Waltham, MA 02154

Refer to: NEDPA - IA, Environmental Assessment, Pittsfield Local Protection Project

Dear Mr. Adler:

In general, we agree that this project would have little effect on the environment. Implementation of Plan B on the Southwest Branch of the Housatonic, however, might be considered to cause significant effects on wetland and forestland. Our preference would be one of the other Plans.

Thank you for the opportunity to review this assessment.

Sincerely:

Robert D Wolfe

ROBERT D. WOLFE
Acting Staff Director
Forest Insect and Disease Management

EXHIBIT 20

United States Department of the Interior
NATIONAL PARK SERVICE
North Atlantic Region
15 State Street
Boston, Massachusetts 02109

IN REPLY REFER TO:
L7619
NEDPL-IA
NAR(PEC)

Mr. Robert Adler
Impact Analysis Branch
U.S. Army Corps of Engineers
424 Trapelo Road
Waltham, Massachusetts 02154

Dear Mr. Adler:

This is in response to your July 29 request for comment on the Corps Draft Environmental Assessment and Tentative Finding of No Significant Impact for the proposed Local Flood Protection Project on the West and Southwest Branches of the Housatonic River, Pittsfield, Massachusetts.

The assessment indicates minimal fluctuation in stream flow, hence, the proposed National Wild and Scenic River section downstream on the Housatonic may not be affected. However, in a showing of environmental concern the final assessment document should consider the potential for adverse effects on the Wild and Scenic River Proposal (running south from Connecticut-Massachusetts line), and reflect on this potential for adverse effect.

We appreciate this opportunity to review the proposal and have no further comments. You should understand this is the outlook of only the National Park Service and it does not predispose any position the Department of the Interior or any of its bureaus may take.

Sincerely yours,

Richard L. Stanton

Richard L. Stanton
Regional Director

EXHIBIT 21

CONRAIL

August 18, 1980

Subject: Pittsfield, Massachusetts - Flood Protection Project on the West and Southwest Branches of the Housatonic River, Berkshire County, New England Division, Northeastern Region. (File: Location - RWH)

Mr. Joseph L. Ignazio
Chief, Planning Division
Department of the Army
New England Division
Corps of Engineers
424 Trapelo Road
Waltham, MA 02154

Attention: Mr. Robert Adler
Impact Analysis Branch

Dear Mr. Ignazio:

Reference is made to your letter of July 29, 1980 in which you submitted an Evaluation concerning the subject project in Pittsfield, Massachusetts.

Please be advised that although we have no objection to this project, the 15' Metal Plate Pipe shown on Plate 5 should be installed beneath our Canaan Secondary in conformance with the attached CE-8 specifications.

Kindly submit preliminary plans when they have been prepared.

Very truly yours,

J. T. Sullivan

J. T. Sullivan, P.E.
Chief Engineer
Design and Construction

12th Floor

(215) 596-2888

EXHIBIT 22

CONSOLIDATED RAIL CORPORATION 15 N. 32ND ST., PHILADELPHIA, PA 19104

United States Department of Agriculture

Soil Conservation Service

451 West Street
Amherst, MA 01002
Tel. (413) 256-0441

August 25, 1980

Mr. Robert Adler
Impact Analysis Branch
U.S. Army Corps of Engineers
424 Trapelo Road
Waltham, Massachusetts 02154

Dear Mr. Adler:

We have reviewed the Public Notice of Section 404(b) Evaluation and Draft Environmental Assessment for the Local Flood Protection Project West and Southwest Branches of the Housatonic River, Pittsfield, Massachusetts, requested in your letter of July 29, 1980. The following comments are offered for your consideration:

1. Environmental Assessment, Table 6

   a. A more appropriate title would be: "Wetland Vegetation and Associated Wildlife" since all land cover types are not presented.

   b. The inventory area to which the acreages of wetlands pertains should be given. In this case the inventory area is the Berkshire Region as defined in "Water and Related Land Resources of the Berkshire Region," 1977, prepared by the Soil Conservation Service et al.

   c. The footnote (1/) as shown in the source document should be given, since types 5 and 7 are not included in the 11,600 acres.

2. The Section and Plan drawings on Plate 5 in the Public Notice should be more clearly identified.

3. Page 3 of the Public Notice of Section 404(b) Evaluation (and elsewhere in the Notice and Environmental Assessment) states that on the Southwest Branch a "1/2-acre strip of brush from the flood plain upstream of Barker Road bridge" will be cut. "By cutting this heavy vegetation rather than uprooting it, it will give way eventually to other wetland species tolerant as lower ground cover."

   It should be mentioned throughout the Notice and Environmental Assessment that this cutting will occur in a Type 1 wetland.

   Merely cutting the shrub (primarily silky dogwood) and tree cover will not provide the desired result for more than a few years since sprouting from the existing rootstocks will rapidly occur. For a long term, relatively maintenance free floodway, it is suggested that the shrubs and trees be cut and removed, a woody herbicide be applied to the cut stems, the cleared area bog harrowed, and a long term, dense grass planted. Reed canarygrass would be ideally suited to this purpose and site since it is dense, retards woody invasion, and is highly tolerant of flooding.

EXHIBIT 23

We appreciate the opportunity to review and comment on this project.

Sincerely,

SHERMAN L. LEWIS
State Conservationist

U. S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
REGION ONE
100 Summer Street, Suite 1517
Boston, Massachusetts 02110

Subj: Local Flood Protection
Project of the West and Southwest Branches of
the Housatonic River - Pittsfield, MA

IN REPLY REFER TO:
HEV-MA

August 28, 1980

Mr. Robert Adler
Impact Analysis Branch
U.S. Army Corps of Engineers
424 Trapelo Road
Waltham, Massachusetts 02154

Dear Mr. Adler:

The Section 404(b) evaluation and the Environmental Assessment for the subject project have been reviewed by members of our staff. The proposed project should have no effect on the local street network.

As you may know, the Massachusetts Department of Public Works is presently preparing a Draft Environmental Impact Statement for the reconstruction of U.S. Route 7 in Lenox, Pittsfield, and Lanesborough. Your work on the Tel-Electric Dam and the cutting of brush on the Southwest Branch are very near locations where parts of one or more of the build alternatives would be constructed. The two projects might have an effect upon each other if construction were to occur simultaneously. Since construction on the Route 7 project is not scheduled to begin until 1985 at the earliest, there should be no conflicts between these two projects.

Thank you for the opportunity to comment on this project.

Sincerely yours,

N. J. Van Ness
Division Administrator

cc: J. Hurley - DPW - Boston

EXHIBIT 24

Page 1 of 1

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM, MASSACHUSETTS 02154

REPLY TO
ATTENTION OF:

NEDPL-IA 29 July 1980

To Interested Parties:

Inclosed for your review is a Public Notice and Section 404(b) evaluation for the proposed Local Flood Protection Project on the West and Southwest Branches of the Housatonic River in Pittsfield, Massachusetts. Also inclosed at this time is a copy of the project's Draft Environmental Assessment with a tentative Finding of No Significant Impact attached.

This coordination is a requirement of the National Environmental Policy Act of 1969 and the Federal Water Pollution Control Act, as amended. It is our procedure to send the "404 Evaluation" to those agencies, groups, and members of the public who are known to us to have interests or responsibilities associated with the project. Whereas the Environmental Assessment is normally an integral part of the Detailed Project Report, it has been sent as an independent document to expedite the review process. Should you desire a complete copy of the Detailed Project Report, a request should be forwarded to the New England Division.

Any comments you may have pertaining to the 404 Evaluation and the Environmental Assessment should be sent within 30 days of the date of this letter to:

Mr. Robert Adler
Impact Analysis Branch
U.S. Army Corps of Engineers
424 Trapelo Road
Waltham, MA 02154

Sincerely,

Joseph L. Ignazio

JOSEPH L. IGNAZIO
Chief, Planning Division

Incl: as stated

EXHIBIT 25

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM, MASSACHUSETTS 02154

REPLY TO
ATTENTION OF:
NEDPL-P

PUBLIC NOTICE
OF
SECTION 404 EVALUATION
FOR

PITTSFIELD LOCAL PROTECTION PROJECT
WEST BRANCH, SOUTHWEST BRANCH
HOUSATONIC RIVER
PITTSFIELD, MASSACHUSETTS

The New England Division of the Corps of Engineers announces that the proposed local flood protection project has been evaluated in accordance with the provisions of Section 404(b) of the Federal Water Pollution Control Act, as amended (Public Law 92-500, enacted 28 December 1977 and commonly referred to as the Clean Water Act). This act regulates the discharge of dredged or fill material into waters of the United States.

Project Authorization

The proposed local protection project along the West and Southwest Branches of the Housatonic River in Pittsfield, Massachusetts, is being recommended under authority contained in Section 205 of the 1948 Flood Control Act, as amended. The purpose of this notice is to provide all interested parties with the opportunity to submit their views and opinions concerning the 404 evaluation and to insure that the needs and desires of the public are incorporated in the project wherever possible.

Location

Pittsfield is located in western Massachusetts, approximately 40 miles north of Springfield, Massachusetts and about 6 miles east of the Massachusetts-New York border. It is the site of the confluence of the East, West and Southwest Branches of the Housatonic River. The proposed project involves two locations on the Southwest Branch, one location on the West Branch, and one location below the confluence of these two branches (see Plates 1, 2, and 3 for the locations of proposed project).

Problem Description

The principal problem in Pittsfield involves flooding along the West and Southwest Branches of the Housatonic River. The most recent flooding occurred in March 1977, when both branches overtopped their banks. This flood caused property damage to residential and commercial structures, blocked traffic on a major artery for 2 days, and resulted in losses to the economy from disruption of work schedules. Under present conditions, losses from the recurrence of this event would total $314,000. This flood represented a 10 to 15-year event. The flood of record for each branch occurred on two separate occasions, but were of similar magnitude. On the West Branch the flood of record occurred on 18 March 1936 and on the Southwest Branch it occurred on 31 December 1949. Both of these events represented approximately the 30 to 40-year flood. Losses resulting from a 100-year flood, under present conditions, would total approximately $2,344,000 on the West Branch and $15,714,000 on the Southwest Branch.

Resolution of this flooding problem is the primary objective of the local protection project.

Description of Proposed Work

Several alternatives for flood protection were formulated during detailed studies. The recommended plan would include measures at 4 separate locations on the West and Southwest Branches, as follows:

On the West Branch, approximately 1 mile above the confluence with the Southwest Branch, the river is impounded by the run-of-river Tel-Electric Dam. The proposed project would lower the spillway elevation of this dam by 3 feet to elevation 983.7 National Geodetic Vertical Datum (NGVD), thereby providing a better channel gradient for more rapid discharge of flood flows. To accomplish this measure, a temporary cofferdam would be placed in the river during construction to route stream flows through an old penstock access conduit. This cofferdam would be removed following project completion (see Plate 4 for the plans for this work).

On the Southwest Branch, the principal measure of the proposed project would be the installation of an auxiliary culvert through Conrail railroad embankment to the side of the existing conduit. Its installation would double the discharge capacity of the Southwest Branch and reduce upstream flood conditions. This auxiliary culvert would be constructed above the normal stream elevation and is designed to pass flood flows only. It would have an inside diameter of 15 feet, with gravel-lined inlet and outlet channels. Construction of this auxiliary conduit would be one of twc [illegible]ements within the project requiring the permanent placement of fill material (see Plate 5 for plans and cross-sections).

The second item on the Southwest Branch involves clearing, by cutting, approximately a ½-acre strip of brush from the flood plain upstream of Barker Road bridge. Cut in a straight alignment between the entrance of Maloy Brook and Barker Road, this path would discharge overland flood flows at a faster rate than the existing flood plain. By cutting this heavy vegetation rather than uprooting it, it will give way eventually to other wetland species tolerant as lower ground cover (see Plate 5 for detailed plans).

The last element of the proposed plan would involve the relocation of a sewer line which traverses the Housatonic River beneath the South Street bridge. This conduit presently runs across the river on piers set above the streambed, and traps debris carried by high flows. A significant accumulation of debris could act like a dam, withholding flows and causing upstream flood conditions.

This proposal would involve lowering this conduit to a position below the streambed, where it would operate by syphon. During construction, temporary fill in cofferdams would be used to dewater the construction site and permanent backfill would be required to restore the streambed to its original condition.

Environmental Assessment

The scope of this local flood protection project and its expected environmental impacts have been summarized in the Environmental Assessment, which is included in the main document of the Detailed Project Report. A copy of this main report is available from the New England Division, upon written request to the Division Engineer.

Section 404 Evaluation

The evaluation of the proposed project includes application of Environmental Protection Agency guidelines under the authority of Section 404(b) of the Federal Water Pollution Control Act (40 CFR, Part 230) and covers the following conditions for any discharge of dredged or fill materials in waters of the United States:

1. That the discharge will not destroy a threatened or endangered species, as identified under the Endangered Species Act, or endanger the critical habitat of such species;

2. That the discharge will consist of suitable materials free from toxic pollutants in other than trace quantities; and

3. That fill placed will be properly maintained to prevent erosion and other non-point sources of pollution.

The Corps of Engineers will comply with any permit requirements set forth in the 1977 Water Pollution Control Act prior to initiating construction. It is essential that all potential problems, needs, and desires of the community surface now to insure early consideration.

Public Response

Any person may request, in writing, within 30 days, that a public hearing be held to consider the water quality aspects of the proposed local flood protection project in Pittsfield, Massachusetts. The request for a public hearing should state specifically the reasons for this request. If you know of others with an interest in this project, please make this notice known to them. Written communications in response to this notice should be mailed to:

Division Engineer
New England Division
424 Trapelo Road
Waltham, MA 02154

17 July 1980
Date

Max B. Scheider
MAX B. SCHEIDER
Colonel, Corps of Engineers
Division Engineer

Incl: as

EXHIBIT 25

Page 5 of 5

OFFICE OF THE MAYOR
CITY OF PITTSFIELD
MASSACHUSETTS

CHARLES L. SMITH
MAYOR

October 6, 1980

Max B.Scheider
Colonel, , Army Corp of Engineers
New England Division
424 Trapelo Rd.
Waltham, Ma. 02154

Dear Colonel Scheider:

As Mayor of the City of Pittsfield, Ma. I wish to assure your agency of our cooperation and support for the flood protection project along the west and southwest branches of the Housatonic River as proposed in your letter of July 24, 1980.

The city would agree to provide any of the easements, rights-of way and other alteration as they pertain to the project; hold and serve the United States free from damages due to construction, operation and maintenance of the project except damages which are the fault of the U. S. or its contractors; maintain and operate the project in a manner presecribed by the Corps of Army Engineers; assume the non-Federal first cost estimated to total no more than the $80,600 as set forth in the letter of July 24, 1980; work to prevent future encroachment which might interfere with the proper functioning of the flood control aspects of the project; provide any cash contribution for project cost assigned to project features other than flood control; and comply with all applicable requirements of non-Federal cooperation specified in Sections 210 and 305 of Public Law 91-646, entitled Uniform Retoactive Assistance and Real Property Acquistion Policies Act of 1970.

We look forward to working with the Corp of Army to reduce the dangers of flooding along those sections of the Housatonic River.

Very truly yours,

Charles L. Smith
Charles L. Smith
Mayor, City of Pittsfield

EXHIBIT 26

Page 1 of 1

The Commonwealth of Massachusetts

Water Resources Commission

Division of Water Pollution Control

110 Tremont Street, Boston 02108

OFFICE OF THE DIRECTOR

October 1, 1980

Joseph L. Ignazio, Chief
Planning Division
U.S. Army - Corps of Engineers
424 Trapelo Road
Waltham, Massachusetts 02154

Re: Water Quality Certification
Local Protection Project
Pittsfield, MA.

Dear Mr. Ignazio:

This is in response to your letter of September 5, 1980 in which you request our comments on a proposed local protection project at Pittsfield, Massachusetts together with a request for a water quality certification for the work. The project consists basically of three elements:

1. Lowering the elevation of the Tel-Electric Dam on the West Branch of the Housatonic River by three feet;

2. Installing an auxiliary culvert through the Conrail railroad embankment and clearing a half-acre flood-way upstream of the Barker Road bridge on the Southwest Branch of the Housatonic River; and

3. Removing a sewer line beneath the South Street bridge over the Housatonic River.

Construction work associated with the project could cause some temporary adverse effects on the quality of the rivers involved through siltation. The constructor should therefore be required to exercise due care to minimize such impacts.

With this proviso and in accordance with the provisions of Section 401 of the Federal Water Pollution Control Act as amended (Public Law 95-217), this Division hereby certifies that, based on information and investigations, there is reasonable assurance that the proposed activity will be conducted in a manner which will not violate applicable water quality standards adopted by this Division under authority of Section 27 (5) of Chapter 21 of the Massachusetts General Laws, said water quality standards having been filed with the Secretary of State of the Commonwealth on September 15, 1978.

EXHIBIT 27

Should any violation of the water quality standards or the terms of this certification occur as a result of the proposed activity, the Division will direct that the condition be corrected. Non-compliance on the part of the permittee will be cause for this Division to recommend the revocation of the permit(s) issued therefor or to take such other action as is authorized by the General Laws of the Commonwealth.

Very truly yours,

Thomas C. McMahon erf

Thomas C. McMahon
Director

TCM/WAS/rew

cc: Anthony D. Cortese, Sc.D., Commissioner, Department of Environmental Quality Engineering, 100 Cambridge Street, Boston 02202
Morgan Rees, Chief, Permits Branch, Corps of Engineers, 424 Trapelo Road, Waltham 02154
John J. Hannon, Director, Division of Land & Water Use, Department of Environmental Quality Engineering, 100 Nashua Street, Boston 02114
Richard Cronin, Director, Division of Fisheries & Wildlife, 100 Cambridge Street, Boston 02202

EXHIBIT 27

EXHIBIT 28

PUBLIC MEETING DIGEST

The following summary presents the concerns of local interests which were expressed at the public meeting on 29 August 1979.

Mr. Peter Arlos, Chairman of the Berkshire County Commission and member of the City Council, initiated the discussion of downstream impacts associated with improved channeling in the reaches of Pittsfield. He also indicated a desire to use the existing lakes on the West Branch as a means of temporary storage of flood flows. In this context he suggested the formation of a Housatonic Regional Flood Control Commission responsible for the coordination of this activity.

Mr. William Paulaski, a concerned citizen, presented flow estimates for the West and Southwest Branches near his property at 85 Taylor Street, located adjacent to the West Branch immediately above its confluence with the Southwest Branch. He attributed the inconsistency of these flow rates to an obstruction which crosses the Housatonic River downstream of his property, underneath the South Street bridge. Apparently this conduit is so located that it traps debris during high flows and acts as a dam, backing water up to his property. Mr. Paulaski also mentioned that the recent loss of natural and man-made storage along the Southwest Branch had increased flood stages at his property, and he expressed his hope that the Corps of Engineers' project would not further reduce this storage by breaching the Tel-Electric Dam, nor pass the flood problems to other communities located downstream. Finally, he expressed an interest in having the city play a major role in cleaning storm drains and regulating activities which would decrease the existing flow and storage areas.

Mr. Charles Smith, a member of City Council at the time of the meeting, currently Mayor of Pittsfield, expressed support for any kind of solution which would eliminate flooding rather than transfer costs, the latter being the only result of flood insurance. He reiterated the concern about transferring the flood problems to a downstream community, and pledged $75,000 in city funds to fulfill the requirements of local assurance, providing these could be amortized over a 50 year period.

Mr. David Hathaway, member of the Pittsfield Planning Board, raised the following points: he was concerned that the proposed solutions did not adequately address the original intent of the study which was the flooding problems of Wahconah Park - Turner Avenue area; he raised a question regarding the siltation behind the Tel-Electric Dam; he requested that the environmental assessment include a discussion of the downstream impacts of the construction phase and the post-construction phase of the project; he asked that the requirements for "Local Cooperation" be more explicit; and finally, that discrepancies between the 100-year floods computed by HUD and the Corps of Engineers be explained.

Mrs. Alfred Menard, a local resident, decribed the extent of flood damages incurred at her property following the 1977 flood and expressed support for any solution to this recurring problem.

Mr. Donald Butler, a former city official, discussed a 6' diameter sewer pipe which runs along the channel of the Southwest Branch below the railroad culvert. He said that the drainage pipes placed beneath this sewer conduit to recover lost flow area channeled the water into the low area of Clapp Park and flooded the houses of that area. He suggested filling in this low spot. He also discussed the rock ledge in the channel of the West Branch, suggesting that blasting it clear might relieve some of the flooding problems of that reach. Finally, he offered the trout fishery of both branches as evidence that although dumping continues to occur, the river is not too dirty to support these populations.

Representative Joseph Scelsi of the 5th Berkshire District indicated that he was satisfied with Plan A of the Southwest Branch but that Plan A for the West Branch did not adequately reduce the flooding potential for the residents upstream of Linden Street Bridge.

Lon Nordeen, an interested citizen, proposed the draw-down of upstream dams to provide storage during storms and also suggested silt removal as a means of increasing storage along the channel. He later referred to a 3' settlement of a bus depot on Center Street as an example of the problems that might be generated by lowering the ground water table as a result of lowering the Tel-Electric Dam spillway by three feet.

Mr. Vincent Herbert, Superintendent of the Department of Parks and Recreation, requested any available aid to support the Wahconah Park, citing it is a major recreational resource for the residents of that neighborhood.

Ms. Betty Phinney, resident of Lenox, raised a question about the number of public meetings that were going to be held and asked whether another would be held following the completion of the environmental assessment to explain the anticipated impacts.

Mr. Gerald McCluskey, a local citizen, described the extent of siltation that has taken place in the river over the last 40 years and related this to the increasing incidence of flooding on his property. He stated that the 1977 flood stage was the worst that he had seen since 1947, and that his property had experienced flooding problems once a year in the three years prior to 1977.

Mr. David Halliwell of the State Division of Fish and Wildlife described the natural brown trout population of the Southwest Branch and said that channelization of this reach would significantly harm this population. He requested that serious consideration be given to other means of reducing flood damage along this reach.

Mr. Winston Saville, a local citizen, supported the position held by Mr. Halliwell, requesting that this trout population be evaluated as an important natural resource.

APPENDIX 4

ENGINEERING INVESTIGATIONS

Section A - Hydraulics and Hydrology
Section B - Design and Cost Estimates
Section C - Specifications for Pipeline
Occupancy of Conrail Property

APPENDIX 4

Section A - Hydraulics and Hydrology

APPENDIX 4

SECTION A
HYDRAULICS AND HYDROLOGY

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SECTION A

HYDRAULICS AND HYDROLOGY

Introduction

Purpose and Scope

This report presents hydrologic information and analysis relative to flood problems on the West and Southwest Branches of the Housatonic River in Pittsfield, Massachusetts. The study was performed under authority contained in Section 205 of the 1948 Flood Control Act and analysis was directed specifically to flood conditions on the West Branch in the reach extending approximately 7,000 feet upstream of the Tel-Electric Dam and on the Southwest Branch in the 3,000 foot reach upstream of the Conrail railroad crossing. Included are sections on watershed description, flood history and frequencies, standard project flood, flood profiles, and alternate plans of improvement.

Studies by Others

A report entitled: "Flood Hazard Analysis Upper Housatonic River," dated March 1974, prepared by the Soil Conservation Service, USDA, was a valuable aide during this analysis. The same agency also prepared a Flood Insurance report for the city of Pittsfield in 1977.

Watershed Description

General

Pittsfield is located in western Massachusetts in the headwaters of the Housatonic River, nestled in the "Berkshires" between two mountain ranges, the Hoosac mountain range to the east and the Taconic mountain range to the west. The city, in Berkshire County, is approximately 38 miles east of Albany, New

York and 40 miles northwest of Springfield, Massachusetts. Elevations in the Upper Housatonic Basin range from 2600 feet msl in the mountain ranges to a low of 1000 feet msl at Pittsfield. Three tributary rivers: the West, Southwest, and East Branches join in Pittsfield to form the beginning of the main stem of the Housatonic River. A watershed map of the West and Southwest Branches is shown on Plate 1.

Southwest Branch

The Southwest Branch originates at the confluence of Shaker Brook and the discharge from Richmond Pond in the southwest corner of Pittsfield. The Southwest Branch flows northeasterly and then easterly for a distance of about 5 miles to its confluence with the West Branch in the city of Pittsfield. The Southwest Branch has a total drainage area of 23.0 square miles and a maximum flow path of about 9 miles dropping in elevation from about 2000 feet msl to 970 feet msl. This stream is hydrologically more sluggish than the other two branches, a characteristic of streams in New England that drain in a northerly direction. The principal stream flows to the northeast draining the sluggish lower part of the watershed, but it also receives water from short tributaries draining almost due south from the northerly portion of the watershed. This dissimilar drainage characteristic serves to further desynchronize high intensity runoff from the total watershed.

West Branch

The West Branch originates at the outlet of Pontoosuc Lake in the northern section of Pittsfield and flows southerly to its confluence with the Southwest Branch. The main tributaries of the West Branch are Town and Onota Brooks. Town Brook drains the northerly section of the watershed and discharges into Pontoosuc Lake. Onota Brook originates at the outlet of Onota Lake, and flows southeasterly to its confluence with the West Branch. The West Branch drains almost due south from Pontoosuc Lake and has a total drainage area of 36.1 square miles. Elevations in this branch vary from about 2600 feet msl, in the headwater mountain ranges, to 970 feet msl at its confluence with the Southwest Branch. The longest flow path distance is approximately 13 miles. The Pontoosuc and Onota Lake watersheds are hydrologically flashy, but their runoff is modified by surcharge storage in the two relatively large lakes. Pertinent data on these two lakes is listed in Table 1.

TABLE 1

WEST BRANCH RESERVOIRS

PERTINENT DATA

	Pontoosuc Lake	Onota Lake
Drainage Area (sq. mi.)	21.6	10.3
Dam Elevation (msl)	1101.1	1081.4
Spillway Elevation (msl)	1097.1	1078.9
Approx. Dam Height (ft.)	19.0	15.0
Spillway Length (ft.)	80.0	38.0
Lake Area (acres)	482.0	619.0

East Branch

This third branch drains westerly into Pittsfield from the Hoosac mountain range and has a total drainage area of 70.2 square miles. This branch has produced flood problems in the past in Pittsfield, but improvements by others have apparently prevented major flood damage in recent years. Therefore, in this analysis the East Branch was considered only for its streamflow records, and flood problem studies were limited to the West and Southwest Branches in Pittsfield.

Climatology

General

The Upper Housatonic Basin has a variable climate and frequently experiences periods of heavy precipitation produced by local thunderstorms and large weather systems of tropical and extratropical origin that move northeastward up the eastern seaboard. The basin also lies in the path of the prevailing "westerlies" which generally travel across the country in an easterly direction producing frequent weather changes. The study area has the humid climate and annual temperatures characteristic of the North Temperate Zone.

Temperature

The mean annual temperature in Pittsfield is about 48°F. Extremes in temperature range from occasional highs just over 100°F to lows in the minus twenties. Freezing temperatures may be expected from the latter part of October until late in April. The mean, maximum, and minimum monthly and annual temperatures at Pittsfield are shown in Table 2.

TABLE 2

MONTHLY TEMPERATURES
(Degrees - Fahrenheit)

PITTSFIELD, MASSACHUSETTS

ELEVATION 1153 FEET MSL
(52 Years of Record Through 1970)

MONTH	MEAN	MAXIMUM	MINIMUM
January	21.8	65	-22
February	22.3	63	-26
March	31.6	80	-11
April	43.3	91	5
May	55.0	95	24
June	63.7	100	33
July	66.5	101	39
August	66.2	100	31
September	57.6	95	23
October	47.3	89	14
November	36.8	76	-1
December	25.0	67	-23
ANNUAL	47.7	101	-26

Precipitation

The mean annual precipitation at Pittsfield is about 40.8 inches. The distribution of the precipitation is quite uniform throughout the year. However, extremes in monthly values range from more than 12 inches to less than 0.1 inch on different occasions. The monthly and annual precipitation at Pittsfield is summarized in Table 3. Though precipitation is quite uniform throughout the year, much of it occurs as snow during the winter months.

Snowfall and Snowpack

The average annual snowfall at Pittsfield is nearly 70 inches with greater amounts in the surrounding mountain ranges. The mean monthly and annual snowfall for Pittsfield, Massachusetts are shown in Table 4.

Snow surveys are taken by the Corps of Engineers in the adjacent Westfield River basin and data from this basin would be representative of snow cover in the Upper Housatonic basin. These surveys indicate that water content of the snow reaches a maximum during early March. A flood threat due to a combination of heavy rain and snowmelt runoff is a possibility nearly every year. Monthly water equivalents of the snow cover in the Westfield basin are listed in Table 5.

Streamflow

There are no streamflow gaging stations on either the West or Southwest Branches of the Housatonic River. The nearest gage is a U.S. Geological station on the East Branch at Coltsville, Massachusetts. This gaging station records the runoff from 57.1 square miles of the East Branch watershed and has been in existence since 1936. The average annual runoff at this gage is 114 cfs, equivalent to 27.3 inches of runoff or 57 percent of average annual precipitation. Average annual and monthly runoff for the period of record at Coltsville is listed in Table 6. It is noted that though precipitation is quite uniform throughout the year, approximately 45 percent of the runoff occurs during the three-month period, April through May, as a result of the spring snowmelt.

Peak flows, for each water year of record, on the East Branch are listed in Table 7. Also listed in Table 7 are estimated peak flows experienced on the West and Southwest Branches during the most significant flood events. Flows on the West and Southwest Branches are estimated based on an analysis of miscellaneous high water information and stage-discharge computations.

TABLE 3

MONTHLY PRECIPITATION RECORD
(in inches)

PITTSFIELD, MASSACHUSETTS

ELEVATION 1153 FEET MSL
(72 Years of Record Through 1970)

MONTH	MEAN	MAXIMUM	MINIMUM
January	2.88	6.25	1.13
February	2.62	6.80	0.78
March	3.27	6.63	0.25
April	3.22	6.30	0.63
May	3.25	6.91	0.66
June	3.70	11.38	1.06
July	4.20	12.19	0.48
August	3.82	9.26	0.60
September	3.86	10.50	0.50
October	2.93	8.04	0.06
November	3.42	10.44	0.45
December	3.19	8.88	0.49
ANNUAL	40.4	58.1	28.6

TABLE 4

MEAN MONTHLY SNOWFALL
(Average Depth in Inches)

PITTSFIELD, MASSACHUSETTS

ELEVATION 1153 FEET MSL
(49 Years of Record Through 1970)

MONTH	SNOWFALL
January	17.4
February	17.9
March	11.9
April	3.7
May	0.1
June	0.0
July	0.0
August	0.0
September	0.0
October	0.2
November	5.6
December	12.0
ANNUAL	68.5

TABLE 5

WATER EQUIVALENT IN SNOW COVER
(Westfield Watershed)

	1950-1978		
	MEAN (inches)	MAXIMUM (inches)	MINIMUM (inches)
1 February	2.5	6.0	0.4
15 February	3.5	7.4	0.2
1 March	4.0	8.0	0.0
15 March	4.0	8.5	0.0
1 April	3.0	9.3	0.0
15 April	0.8	5.0	0.0

TABLE 6

MONTHLY RUNOFF

HOUSATONIC RIVER BASIN

EAST BRANCH HOUSATONIC RIVER AT

COLTSVILLE, MASSACHUSETTS

(D.A. = 57.1 sq. mi.)

MONTH	AVERAGE		MAXIMUM		MINIMUM	
	CFS*	INCHES**	CFS*	INCHES**	CFS*	INCHES**
January	93.5	2.17	252	5.08	27.4	0.70
February	92.8	1.89	213	3.25	34.3	0.65
March	169.0	3.75	383	7.96	50.4	1.34
April	269.0	5.31	573	11.19	107.0	2.09
May	142.1	3.15	304	6.14	43.8	1.53
June	85.5	1.81	326	4.25	25.4	0.70
July	56.6	1.29	220	4.44	12.9	0.45
August	48.2	1.00	169	3.05	16.6	0.45
September	59.3	1.32	326	6.37	16.8	0.54
October	63.4	1.43	318	6.63	19.9	0.51
November	95.7	2.04	279	5.65	19.1	0.72
December	101.3	2.12	321	4.16	33.3	0.90
ANNUAL	106.4	27.3	155	36.9	60.3	15.5

* Period of record 1936-1977 observed.

** Period of record 1936-1958 adjusted.

TABLE 7

PEAK DISCHARGES

UPPER HOUSATONIC RIVER BASIN

WATER YEAR	EAST BRANCH AT COLTSVILLE (D.A. = 57.1 sq.mi.)	WEST BRANCH (computed) (D.A. = 36.1 sq.mi.)	SOUTHWEST BRANCH (computed) (D.A. = 23.0 sq. mi.)
1936	6000	2500	
1937	1910		
1938	6400	2250	1800
1939	3410		
1940	1380		
1941	832		
1942	1440		
1943	1740		
1944	1280		
1945	1970		
1946	1190		
1947	1730		
1948	1970		
1949	5700	1050	2500
1950	1070		
1951	3280		
1952	2080		
1953	1630		
1954	1870		
1955	1640		
1956	2010		
1957	1120		
1958	1090		
1959	1730		
1960	1920		
1961	998		
1962	1450		
1963	582		
1964	908		
1965	394		
1966	654		
1967	1040		
1968	1480		
1969	3710		
1970	1060		
1971	1080		
1972	2700		
1973	875		
1974	3490		
1975	2440		
1976	3920		
1977	3220	1400	1900
Mean Log	= 3.2281	2.763	2.764
Standard Deviation	= 0.2701	0.2701	0.2701

Analysis of Floods

General

Floods on the Housatonic River date back to the first settlers, about 300 years ago, and several floods occurred during the 1800's. However, hydrologic data on floods in the river basin prior to the turn of the century are meager.

The Housatonic River basin is susceptible to damaging floods as a result of heavy rainfall, melting snow, or a combination of the two. The three general types of flood-producing storms in the Housatonic River basin are continental, coastal, and those associated with thunderstorms which may be of local origin or the result of a stationary front. Continental storms may be rapidly moving intense cyclones or the stationary type. They are not limited to any season or month, but follow one another at more or less regular intervals with varying intensities throughout the year. Tropical hurricanes are the most important of the coastal storms, and in general, are likely to occur during the months of August and September. Coastal storms of an extra-tropical nature differ from the hurricanes principally as they originate along the eastern seaboard and have less energy associated with them. Within the past 50 years, the most significant floods occurred in 1927, 1936, 1938, 1948-49, and 1977. Of these floods, the flood of September 1938 and the New Year flood of 1948-49 were comparable and were the greatest events in the Upper Housatonic Basin.

March 1936

The 1936 flood was a double peaked flood event produced by two storm events on the 9-13 and 16-22 of March resulting in a large volume long duration flood runoff. The first storm runoff was augmented by snowmelt and the total precipitation in the Upper Housatonic basin for the 9-22 period was about 6 inches. This event produced the estimated record discharge on the West Branch and near record flow on the East Branch.

September 1938

This flood-producing storm was the result of a stationary cold front along the Atlantic coast overrun by a rapidly moving tropical hurricane, producing record breaking rainfall over large areas of Connecticut, Massachusetts, and New Hampshire. The storm which started with light rain, gradually increased in intensity over the 4-day period (17-21 September). The total storm rainfall was

7.32 inches at Pittsfield with somewhat greater amounts falling in the easterly Hoosac mountain range as compared to the westerly Taconic range. Hourly rainfall amounts are listed in Table 8. The discharge recorded on the East Branch at the Coltsville stream gaging station during this flood was the maximum recorded to this date. As part of this study, the 1938 flood was analyzed to determine the rainfall runoff characteristics of the component watersheds and their respective contributions to the total discharges of the West and Southwest Branches. During this event, the 48-hour rainfall was about 5.8 inches and the runoff, as recorded on the East Branch, was 3.8 inches indicating infiltration and other losses of about 2 inches.

A 2-hour unit graph was developed for the East Branch by analysis of the 1938 flood hydrograph and then used to develop 2-hour unit graphs for the West and Southwest Branches with adjustments for varying watershed characteristics and relative peak flood discharges.

Pertinent characteristics of the developed and adopted 2-hour graphs are listed in Table 9. The unit graphs and storage-discharge characteristics of Pontoosuc and Onota Lakes were then used in the development of an HEC-1 hydrologic computer model of the West and Southwest Branches. The model was calibrated by applying the 1938 excess rainfall and determining the degree to which the experienced peak flows could be computed. Once calibrated, the model was used to compute the 100-year storm runoff hydrographs and the standard project flood. Plate 2 graphically illustrates the 1938 flood analysis.

December 1948 - January 1949

The "New Year's" storm of 1949, typical of winter cyclonic events of continental origin, was characterized by a low pressure area which deepened and intensified as it moved northward from the middle Atlantic coast. Rain fell on partially frozen ground and deposited amounts ranging from 5 to 12 inches over the watershed. Total precipitation for 29 December through 2 January at Pittsfield, Massachusetts was 8.1 inches. With this storm, the greatest rainfall amounts tended to be over the western Taconic mountain range and produced the estimated record flood on the Southwest Branch. The resulting flood on the West Branch was significantly modified by available storage capacity in Onota lake.

TABLE 8

SEPTEMBER 1938 STORM RAINFALL

(Recorded in Albany, New York - adopted for Pittsfield, Mass.)

TIME (day)	TIME (hrs.)	RAINFALL	LOSS	EXCESS
19 Sept	10	.13	.10	.03
19 Sept	12	.84	.10	.74
20 Sept	2	.08	.08	0
20 Sept	4	.07	.07	0
20 Sept	6	.10	.10	0
20 Sept	8	.21	.10	.11
20 Sept	10	.01	.01	0
20 Sept	12	.02	.02	0
20 Sept	2	.12	.10	.02
20 Sept	4	.18	.10	.08
20 Sept	6	.06	.06	0
20 Sept	8	.23	.10	.13
20 Sept	10	.15	.10	.05
20 Sept	12	.12	.10	.02
21 Sept	2	.08	.08	0
21 Sept	4	.09	.09	0
21 Sept	6	.22	.10	.12
21 Sept	8	.14	.10	.04
21 Sept	10	.46	.10	.36
21 Sept	12	.65	.10	.55
21 Sept	2	.40	.10	.30
21 Sept	4	.57	.10	.47
21 Sept	6	.90	.10	.80
TOTAL		5.83	2.01	3.82

TABLE 9

TWO-HOUR UNIT HYDROGRAPHS

PERTINENT DATA

SUBBASINS	DRAINAGE AREA (sq.mi.)	L (miles)	L_{CA} (miles)	SLOPE (ft/ft)	C_T	C_{P640}	T_P (hours)	Q_P (cfs)
Pontoosuc Lake	21.7	8.6	3.1	.018	2	420	6	1516
Onota Lake	11.0	3.6	1.4	.058	2	420	4	1158
West Branch Local	4.0	4.5	2.2	.008	2	420	4	414
Southwest Branch	23.0	8.7	3.5	.015	3	320	9	825
East Branch (at Coltsville)	57.1	14.3	5.3	.015	2	420	8	3000

March 1977

The most recent flooding occurred in July and December of 1973, and March of 1977. Although the extent and depth of flooding was not exceptional, it did refresh memories of past floods and emphasize the risks associated with potential floods of greater magnitude. The March 1977 storm did cause flooding along the West Branch and its tributary. Heavy rainfall and snowmelt associated with frozen ground conditions contributed to the unusually high runoff. Total amount of precipitation for the period 13-15 March at Lanesboro, Massachusetts (about 5 miles north of Pittsfield) was 3.64 inches. Estimated peak flows on the Southwest and West Branches were 1900 and 1400 cfs, respectively. The East Branch had a recorded flood of 3220 cfs. Comparative rainfall duration data for the 1938, 1949, 10-year, 100-year, and SPF storms are shown in Table 10.

Flood Frequencies

The adopted peak discharge frequency curves for the West and Southwest Branches of the Housatonic River are shown on Plates 3 and 4. These curves were based on the following analysis.

A statistical analysis was made of the 42 years of flow records for the East Branch, using a Log Pearson Type III analysis. This analysis was used to judge the relative frequency of the 3 or 4 largest flood events and the slope (Standard Deviation) of the curve. The computed frequency curve for the East Branch for a drainage area of 57.1 square miles had a mean log of 3.228, a Standard Deviation of 0.2701 and an adopted skew of 0.5. The curve is shown on both Plates 3 and 4.

Experienced peak flows for the largest flood events on the West and Southwest Branches were estimated based on miscellaneous high water information and computed stage-discharge relationships. These 3 or 4 largest flood events were then assigned plotting positions, based on their relative magnitude, and the comparative plotting positions and period of record analysis of floods on the East Branch. Frequency curves were then developed for the West and Southwest Branches based on the frequency of the experienced flood events and the slope of the computed East Branch frequency curve. The resulting mean annual flood flows were also compared with that of the East Branch and judged for reasonableness based on relative drainage area size and runoff character.

TABLE 10

MAXIMUM RAINFALL - DURATION DATA
(in inches)

Storm	1 hour	2 hour	3 hour	6 hour	12 hour	24 hour	48 hour
10-year	1.8	2.3	2.5	3.1	3.7	4.3	4.9
100-year	2.6	3.3	3.6	4.4	5.3	6.2	7.3
Standard Project	3.1	4.3	5.4	8.1	9.3	10.4	-
Sept. 1938 (at Pittsfield)	.7	.9	1.3	1.9	3.1	4.1	6.1
Dec. 1948 - Jan. 1949 (at Pittsfield)	.4	.9	1.2	1.9	3.1	4.0	7.5

Lastly, as a further comparative analysis, the 100-year storm rainfall excess, as determined from U.S. Weather Bureau Technical Paper No. 40, was applied to the developed HEC-1 computer model and the resulting peak discharges of the West and Southwest Branches were checked for relative agreement with the adopted frequency curves. The computed historical and 100-year storm runoff peaks are plotted along with the adopted frequency curves on Plates 3 and 4.

Standard Project Flood

General

The Standard Project Flood (SPF) represents the flood discharge that may be expected from the most severe combination of meteorologic and hydrologic conditions that are considered reasonably characteristic of the region, excluding extremely rare combinations. The SPF represents a "Standard" against which the flood potential of a river can be judged, as constrasted to an analysis of flood records which may be misleading due to abnormal sequences of events during the period of record. The SPF for the West and Southwest Branches of the Housatonic River was developed by applying standard project rainfall to adopted unit hydrographs for each subbasin and the resulting component hydrographs were then routed and combined at selected index stations.

Rainfall

Standard project storm rainfall was determined in accordance with Civil Engineer Bulletin 52-8 and EM 1110-2-1411. The 24-hour index rainfall for the 60 square mile Upper Housatonic watershed was 10.7 inches. Losses were assumed to be 0.1 inch per hour, resulting in a 24-hour rainfall excess of 8.3 inches. The rainfall values are listed in Table 11.

Unit Hydrographs

Unit hydrographs developed for the various component watersheds in the analysis of the 1938 flood were used for the SPF development. These adopted unit graphs were considered appropriate for a high intensity storm runoff and no added "peaking" was applied.

TABLE 11

STANDARD PROJECT STORM RAINFALL

TIME (hours)	RAINFALL (inches)	LOSS (inches)	EXCESS (inches)
2	.4	.2	.2
4	.3	.2	.1
6	1.7	.2	1.5
8	4.3	.2	4.1
10	2.1	.2	1.9
12	.6	.2	.4
14	.3	.2	.1
16	.2	.2	0
18	.2	.2	0
20	.2	.2	0
22	.2	.2	0
24	.2	.2	0
TOTAL	10.7	2.4	8.3

Standard Project Discharges

Rainfall excess was applied to the unit hydrographs and the SPF hydrographs computed using the HEC-1 computer model. Resulting hydrographs for Onota and Pontoosuc Lakes were routed through surcharge storage assuming the reservoirs initially filled to spillway crest. The development of the SPF for the West and Southwest Branches is graphically illustrated on Plate 5.

Flood Profiles

Flood profiles and stage-discharge relationships for the Southwest and West Branches were computed utilizing the backwater computer program, HEC-2, and conventional hydraulic formuli. Backwater computations were made using both Corps of Engineers and Soil Conservation Service cross sectional surveys. Analysis extended from the Tel-Electric Dam upstream to the confluence of Onota Brook on the West Branch, and from the Conrail railroad culvert upstream to Maloy Brook on the Southwest Branch. Backwater computations were made for both natural and modified conditions using a Manning's "n" of 0.03. Assumed contraction and expansion loss coefficients were, respectively, 0.3 and 0.5 on the West Branch and 0.4 and 0.6 on the Southwest Branch. A starting stage-discharge relationship was developed at the Tel-Electric Dam using the conventional weir formula $Q = CLH^{1.5}$, with a "c" value of 3.6 for the main spillway and 3.3 for concrete non-overflow sections. Starting water surface elevations on the Southwest Branch were controlled by backwater levels of the mainstem Housatonic River. Computed natural and modified profiles plus miscellaneous historic high-water elevations are shown on Plates 6 and 7.

Alternative Plans of Improvements

Hydrologic evaluations were made of various plans of improvements for the West and Southwest Branches to determine modified flood profiles and stage frequency curves for use in further planning and design studies. It is noted that none of the plans of improvements provide complete Standard Project Flood protection and any of the structural plans of improvement would be considered only as one component in a comprehensive flood control plan including flood plain zoning and flood insurance.

SOUTHWEST BRANCH

General

A relatively large flood plain exists along the Southwest Branch in the flat reach of the river upstream of the Conrail railroad culvert. Stages in this flood plain are affected by backwater from the downstream Housatonic River and more notably, during high flood flows, by the 10-foot high by 16-foot wide arch opening under the railroad having a cross-sectional flow area of approximately 150 square feet. Flooding in this reach has been a long time occurrence, however, the damages posed by such flooding have increased in recent years with the construction of a shopping plaza and a fast-food franchise in the flood plain on West Housatonic Street (Route 20). The following three alternate plans of improvement were hydrologically investigated for this reach of the Southwest Branch.

Alternate "A"

The first alternate improvement would consist of providing an additional 150 square feet of opening at the railroad. Such an improvement might involve tunneling a 15-foot diameter multiplate pipe, or the equivalent, through the railroad embankment. It was determined that this improvement would provide considerable stage reduction during major floods. In addition, a half strip of brush would be cleared in a straight alignment from Maloy Brook to Barker Street bridge to allow for overland passage of flood flows. This measure would render the plan more effective during the more frequent events. Natural and modified stage frequencies are shown on Plate 8.

Alternate "B"

This alternate included the improvements of Alternate "A" plus an improved trapezoidal channel with a 40-foot bottom width. This channel would have an invert slope of 0.0011 from elevation 963 feet msl at the railroad bridge to 966 feet msl at the confluence of Maloy Brook, 2600 feet upstream. It was determined that this added improvement would provide added stage reductions for the more frequent flood events but would add nothing during major floods events.

Alternate "C"

This alternate consisted of providing 300 square feet of additional opening under the railroad bridge with no improvements upstream. This plan was basically a modified Alternate "A" and was considered to determine the incremental advantage of providing flow area larger than the 150 square feet provided in Alternate "A".

WEST BRANCH

General

The flood problem area on the West Branch extends upstream from the Tel-Electric Dam about 7500 feet to the Wahconah Park area of Pittsfield. Flooding in this reach is due largely to the extremely flat gradient of the river. It was determined that little could be done to lower flood levels in the reach without making improvements starting at the dam and progressing all the way up to Linden Street, about 4000 feet upstream. The area upstream of Linden Street is a broad natural flood plain with flood levels highly dependent on the downstream channel capacity from Linden Street to the dam. The Wahconah Park area contains a ball field - a wise use of a flood plain - any plan of improvement for flood control should include strict zoning of this area to prevent flood prone development.

The West Branch has a long history of flood problems particularly in the vicinity of Columbus and Linden Streets. Following the major flood of 1936, the city of Pittsfield performed improvements on the river extending from West Street upstream to above Linden Street. These improvements consisted of enlarging and straightening the channel to the maximum practical limit without taking a large number of developed properties, and concrete walls were built adjacent to properties in the more restrictive channel sections. These improvements provided flow capacity in the 1,600 cfs to 1,800 cfs range, or about 70 percent of the flood of record capacity. These improvements have been relatively effective in minimizing major flood damage over the past 40 years, though lesser flooding such as experienced in 1938, 1949, and 1977 still persists. Because this former plan of improvements was carried out in the thirties, no minor improvements remain to be performed that would significantly lessen existing flood problems. And, it was determined that any plan that would greatly increase the capacity of the original improved channel would involve extensive and costly structural modifications. The following three alternative structural plans of improvement were hydrologically examined. The first two are of lesser scope and therefore provide little flood reduction. The third alternate examined was a major structural plan of improvement that would be required to provide substantial flood stage reductions in the reach.

The relative effectiveness of the alternate plans is graphically illustrated on Plates 6 through 8.

Alternate "A"

This alternate would consist of lowering the 40-foot spillway crest at Tel-Electric Dam by 3 feet from elevation 986.7 to 983.7 feet msl. It was determined that the effectiveness of this plan was reduced beyond West Street due to the restrictive opening at West Street. Reductions in the 100-year flood level at Linden Street with this plan was about 1 foot.

Alternate "B"

This plan would consist of Alternate "A" improvements plus the replacement of West Street bridge with twin 25-foot wide openings. This plan resulted in 100-year flood level reductions, at Linden Street, of about 2.5 feet.

Alternate "C"

This major plan of improvement involved the following:

Lowering the Tel-Electric Dam crest to the elevation 975.7 feet msl, and installing an 8-foot high by 49-foot long bascule gate.

Excavating a 40-foot wide channel upstream on a uniform slope of 0.0025 from elevation 973.5 feet msl just upstream of the dam to elevation 983.5 feet msl at Linden Street. This channel would be rectangular in shape with concrete walls below existing grades due to space limitations.

The railroad bridge upstream of the dam would be modified to accommodate the channel.

West Street bridge would be replaced with twin 20-foot wide openings.

This plan would reduce the 100-year flood level in the vicinity of Linden Street by more than 6 feet.

Downstream Effects of Channel Modification

The West and Southwest Branches join to form the Housatonic River about 1300 feet upstream of South Street. Just downstream of South Street, the Housatonic River enters a very extensive flood plain storage reach where flood stages are more a function of total flood runoff "volume" rather than "rate" of runoff.

Just upstream of South Street, there are flood-prone properties that can receive flooding as a result of either high rates of flow of the river before entering downstream storage or by subsequent high backwater from the downstream storage reach. There is presently a concrete encased utility line spanning the bridge opening at South Street which could aggravate the upstream flood problem during high rates of riverflow, particularly if there is a build-up of debris at the bridge. South Street bridge has an approximate total cross-sectional area of 647 square feet, of which 135 square feet is taken by the utility line, leaving a remaining net flow area of about 512 square feet.

Any modifications to the West or Southwest Branches would have no measurable effect on total flood runoff "volume" and therefore would have negligible effect on resulting flood levels in the extensive storage reach downstream of South Street. The modifications could, however, have some small effect on peak "rate" of river flow which could affect that aspect of the flood situation at South Street related to peak flow rates on the Housatonic River. In an effort to make an approximate quantification of this effect, flood storage routings were made on both branches for both natural and channel modified conditions, the modified conditions being the plan "B" improvement for each branch. The resulting outflow hydrographs were combined to determine the peak flow at South Street, and peak stage was then computed for conditions both with and without the sewer spanning the bridge opening, assuming conditions of no debris. Differences in head, with and without sewer, were based on differences in velocity head through the bridge section. It is noted that these computations were greatly facilitated by discharge rating and storage rating information furnished by the Soil Conservation Service of the U.S. Department of Agriculture. Storage routings were made using the HEC-1 computer model of the Corps of Engineers. Table 12 summarizes the findings of this study.

Effect of Upstream Reservoirs

There are two relatively large reservoirs in the headwaters of the West Branch; Onota and Pontoosuc Lakes. Onota has a surface area of 619 acres and Pontoosuc 482 acres. Surcharge storage at these lakes presently serves to substantially modify flood flows on the West Branch through Pittsfield. For example, during the September 1938 flood, it has been estimated that surcharge storage at these lakes reduced peak watershed runoff by about 60% at Pontoosuc and 75% at Onota Lake. Further lowering of the lakes some small amounts, either permanently or seasonally, could provide some added flood reduction during minor to moderate storm runoff but would become less effective during larger flood events. Any such plan of lake regulations that could be developed and agreed upon at the local level would be a worthy pursuit, provided its limited effectiveness was understood and the practice didn't lead to a false sense of security on the part of downstream flood plain dwellers. To provide what the Corps of Engineers considers adequate storage for highly reliable flood regulation capability, would require drafting the lakes 4 to 6 feet. This was considered impractical in view of the recreational value of the lakes and the fact that such regulation would only control that portion of the West Branch watershed draining to the respective lakes-runoff that is presently being significantly modified by natural surcharge storage in the two lakes.

Richmond Lake on the Southwest Branch is a smaller lake with a smaller watershed, therefore its flood reducing potential on the Southwest Branch would be correspondingly much less.

TABLE 12

PITTSFIELD LOCAL PROTECTION

DOWNSTREAM EFFECTS OF CHANNEL MODIFICATIONS

	Computed 1938 Flood	Computed 100-year Synthetic Flood
WEST BRANCH (D.A. = 36.1 sq. mi.)		
Natural Q (cfs) (Project Site Outflow)	2050	2830
Modified Q by Plan "B" Improv.	2130	2990
Delta Storage (Acre-Feet)	60	175
SOUTHWEST BRANCH (D.A. = 23.0 sq. mi.)		
Natural Q (cfs) (Project Site Outflow)	1850	2750
Modified Q by Plan "B" Improv.	1880	3060
Delta Storage (Acre-Feet)	50	200
HOUSATONIC R. AT SOUTH STREET (D.A. = 59.1 sq. mi.)		
Natural Q (cfs)	3880	5520
Stage with sewer (ft. msl)	972.8	974.8
Stage without sewer (ft. msl)	972.4	974.2
Modified Q (cfs)	3990	5950
Stage with sewer (ft. msl)	973.0	975.2
Stage without sewer (ft. msl)	972.6	974.6

Study Comparisons

In 1974, the Soil Conservation Service (SCS) of the U.S. Department of Agriculture prepared a report entitled: "Flood Hazard Analysis Upper Housatonic River." Subsequently, in 1977, that agency prepared a Pittsfield, Massachusetts flood report for the Flood Insurance Administration of the Department of Housing and Urban Development (HUD). Much of the basic data and information compiled by the SCS was utilized, along with other available flood information, in the current independent study by the Corps of Engineers. Though there are some differences in the results of all three studies, the findings are in general agreement considering the inexact nature of such studies. Comparative data for the 100-year synthetic flood, referred to in all three reports, is summarized in Table 13. It is noted that this study is not considered, in anyway, to be more accurate or refined than earlier studies, nor is it intended to supersede or void any related studies or actions by other Federal agencies or local commissions in regards to any adopted flood plain zoning elevations or ordinances.

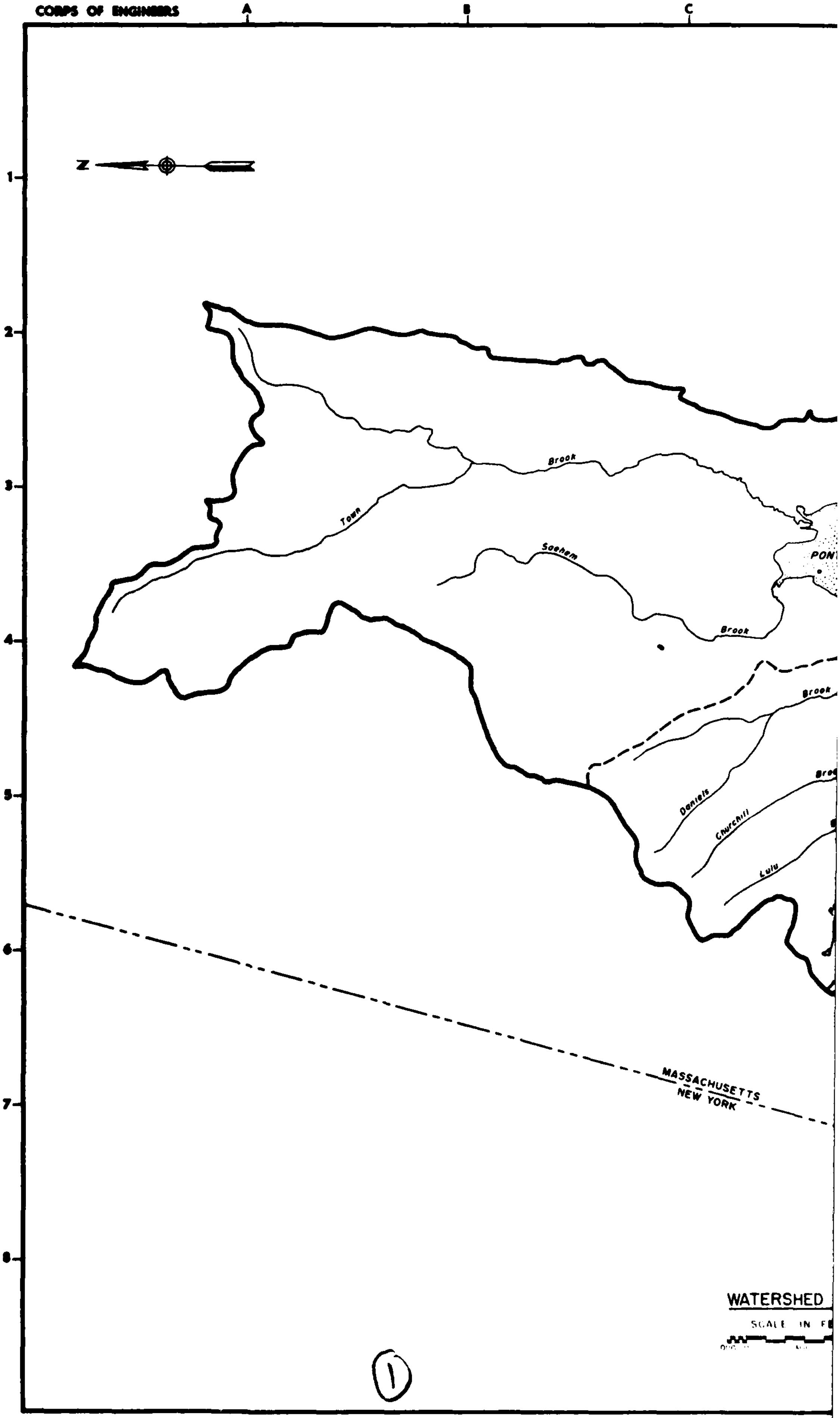
TABLE 13

SYNTHETIC 100-YEAR FLOOD

COMPARATIVE DATA

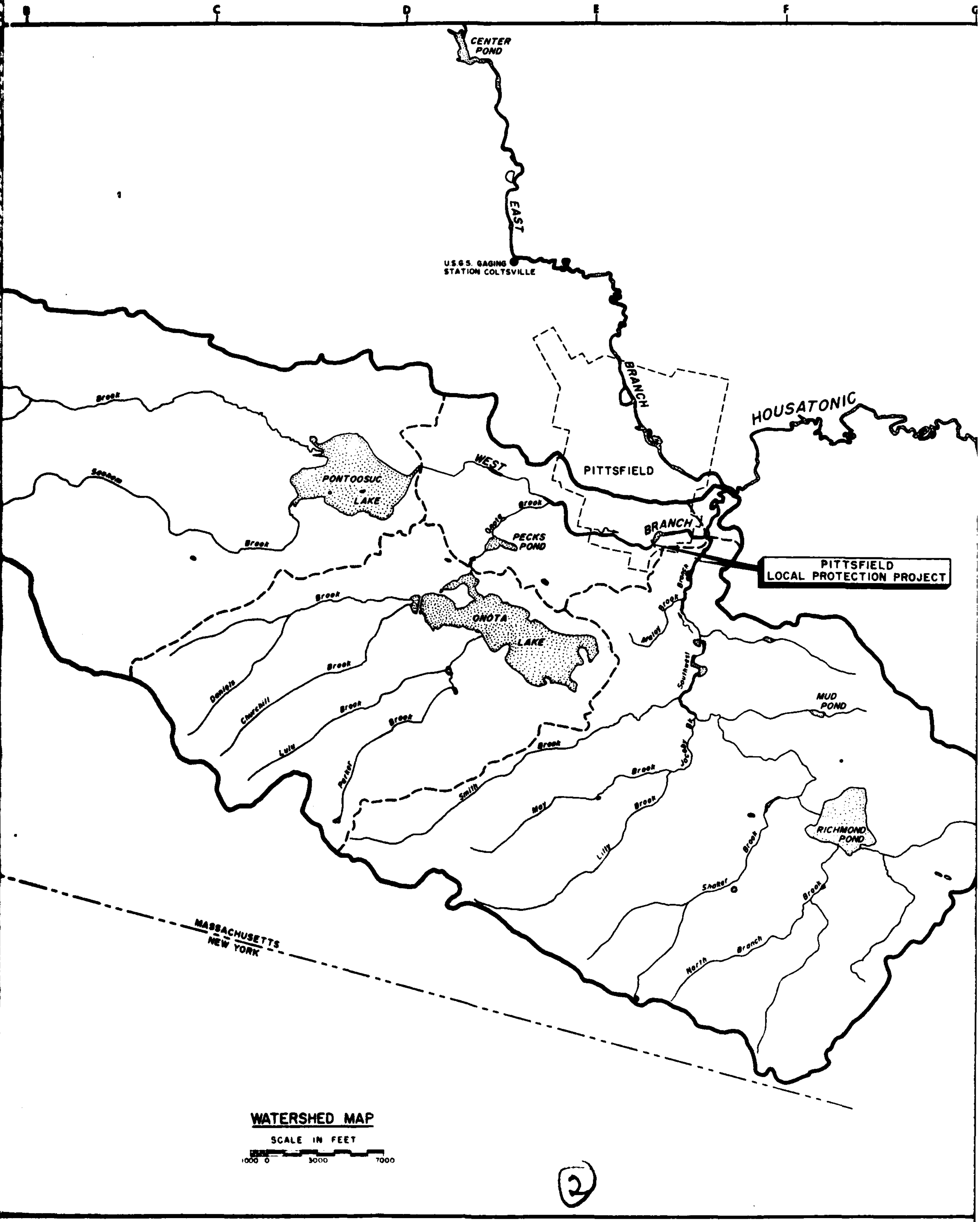
Study	Southwest Branch at Railroad (cfs)	Southwest Branch at Railroad (El.)	West Branch at Linden Street (cfs.)	West Branch at Linden Street (El.)
1974 SCS Flood Hazard Report	3100	986.7	2570	997.7
1977 Flood Insurance Report	2300	984	2700	997.8
1979 Corps of Engineers Study	3100	986.2	3100	999.2

CORPS OF ENGINEERS



(1)

PLATE 1


B
C
D
E
F
G
CENTER POND
EAST BRANCH
U.S.G.S. GAGING STATION COLTSVILLE
HOUSATONIC
PITTSFIELD
WEST BRANCH
PONTOOSUC LAKE
PECKS POND
PITTSFIELD LOCAL PROTECTION PROJECT
ONOTA LAKE
MUD POND
RICHMOND POND
Daniels
Churchill
Lulu Brook
Parker
Smith
Brook
Lilly
Brook
Shaker
Brook
North Branch
Southwest
MASSACHUSETTS
NEW YORK
WATERSHED MAP
SCALE IN FEET
1000 0 3000 7000

2

U. S. ARMY

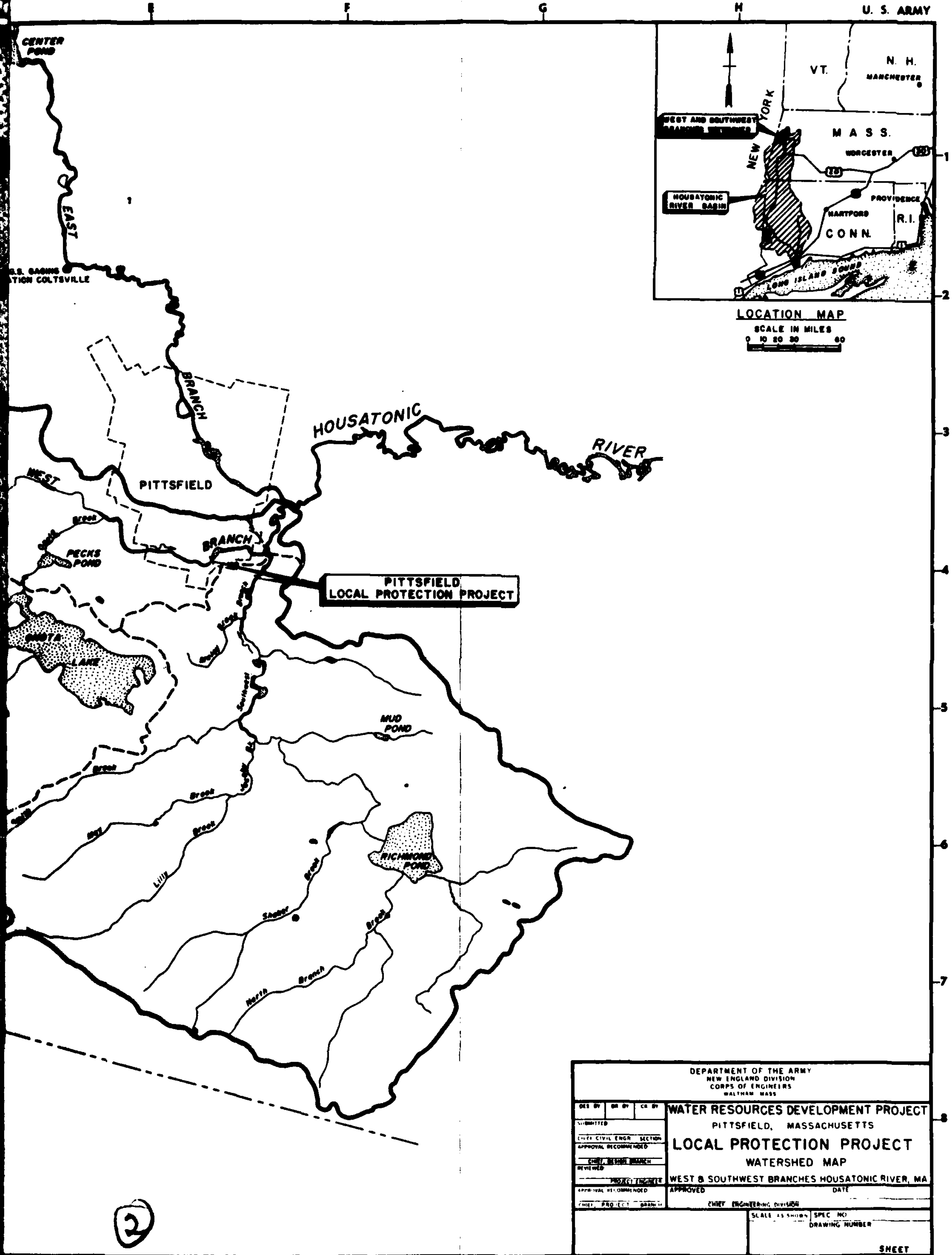
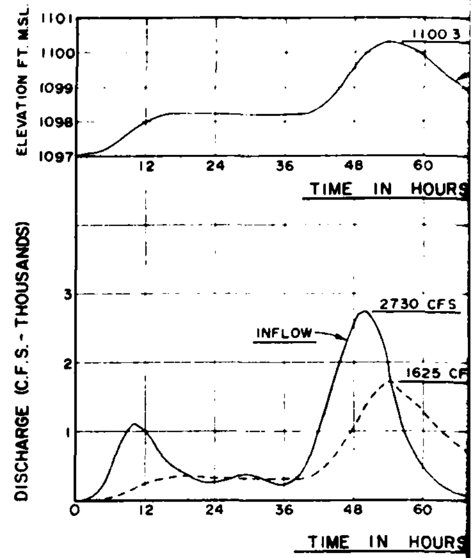
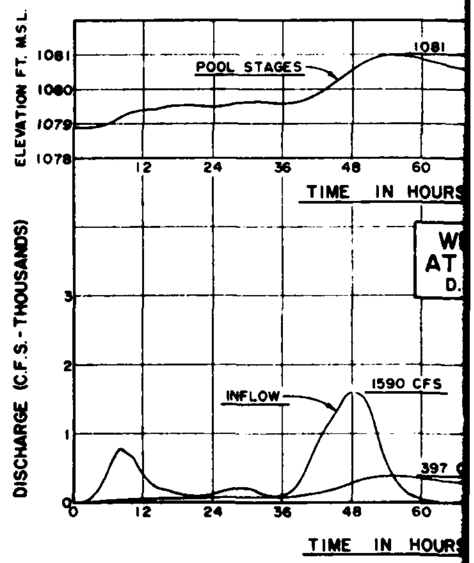


PLATE I

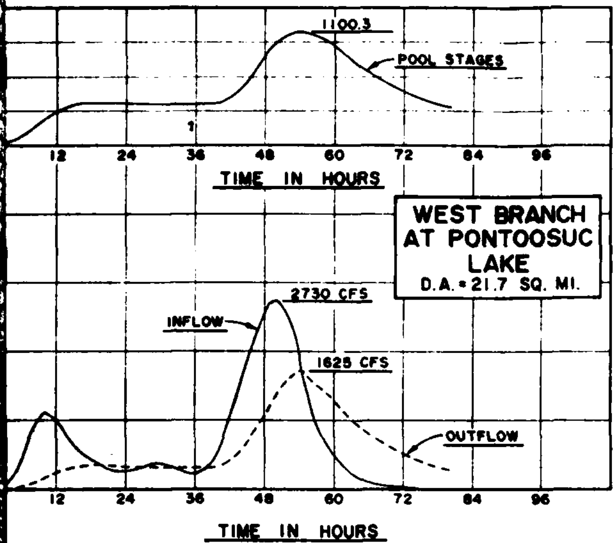


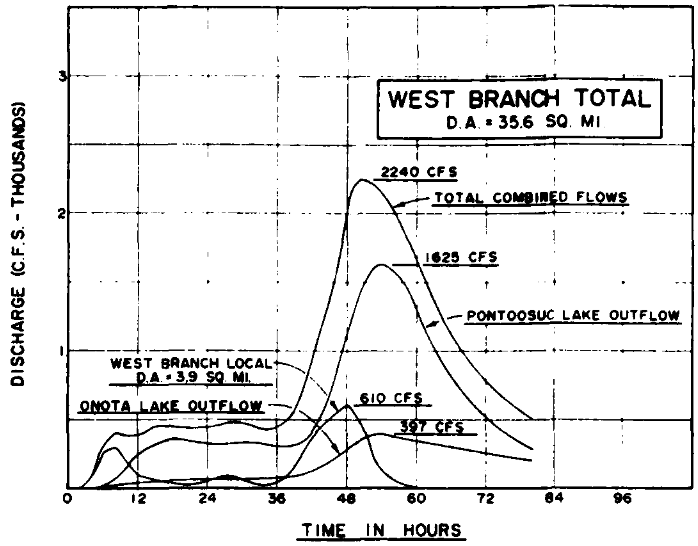


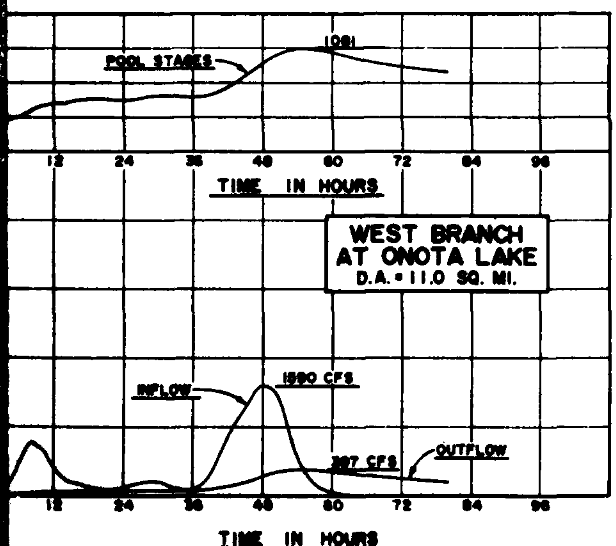
TRIBUTARY AREA	DRAINAGE AREA NET	DRAINAGE AREA TOTAL	PEAK "Q"	CONTRIBUTION TO CONFLUENCE	% CONTRIB	CONTRIBUTION TO SOUTHWEST BRANCH	% CONTRIB
PONTOOSUC LAKE RESERVOIR INFLOW	21.7		2730				
PONTOOSUC LAKE RESERVOIR OUTFLOW	–		1625	1395	62.3		
ONOTA LAKE RESERVOIR INFLOW	11.0		1590				
ONOTA LAKE RESERVOIR OUTFLOW	–		397	350	15.6		
WEST BRANCH LOCAL	3.9		610	496	21.1		
WEST BRANCH AT CONFLUENCE WITH SOUTHWEST BRANCH		35.6	2240	2240	100		
SOUTHWEST BRANCH LOCAL	23.1		1910			1910	100

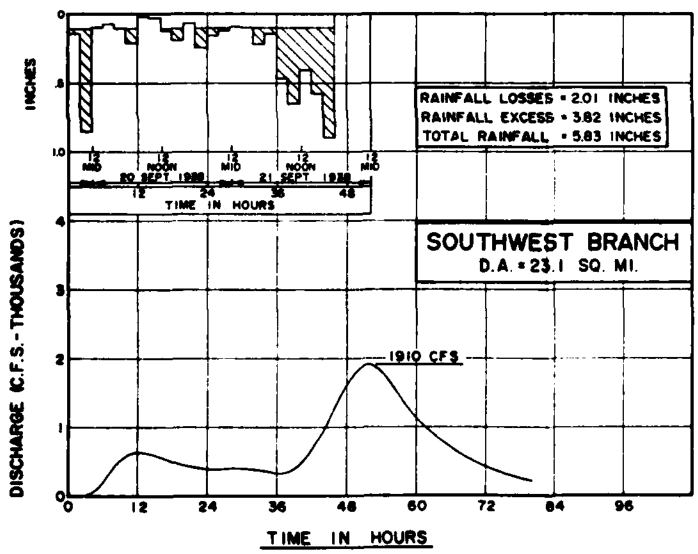
PLATE 2

C D E F G









% CONTRIB.	CONTRIBUTION TO SOUTHWEST BRANCH	% CONTRIB.
3.3		
8.6		
1.1		
100		
	1910	100

2

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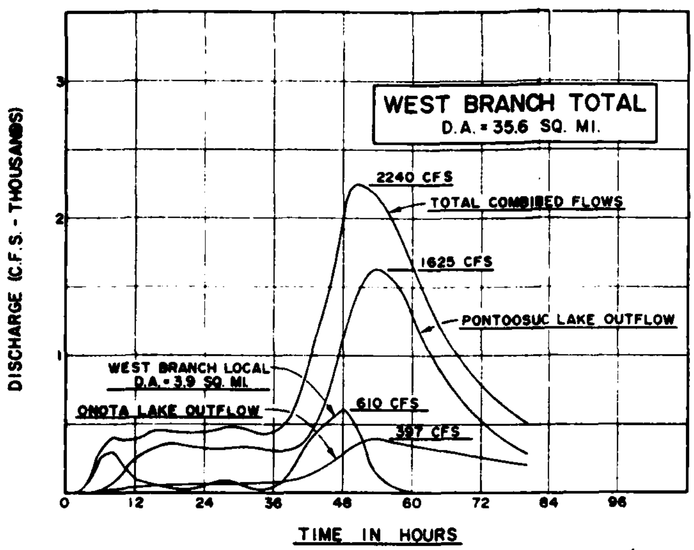
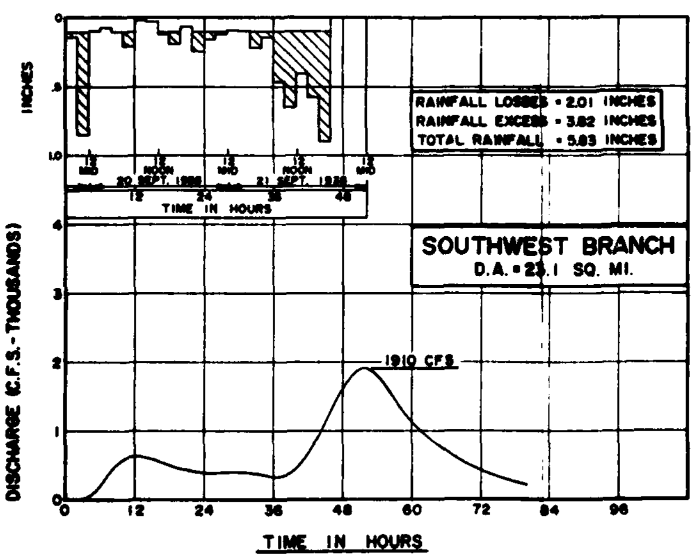




DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.

HOUSATONIC RIVER FLOOD CONTROL

WEST AND SOUTHWEST BRANCHES

SEPTEMBER 1938 TYPE FLOOD ANALYSIS

HOUSATONIC RIVER PITTSFIELD, MASS

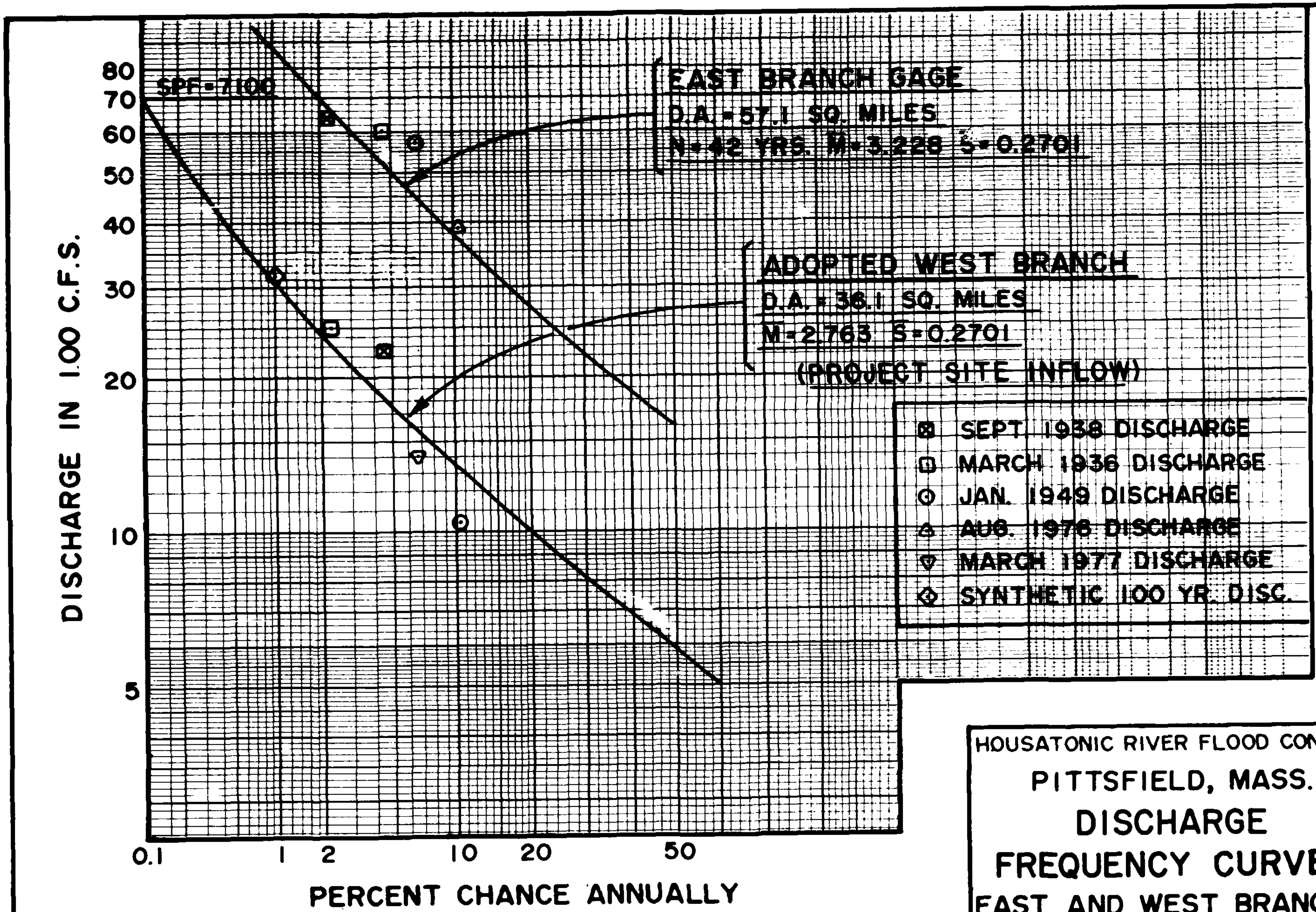
APPROVED DATE

CHIEF, ENGINEERING DIVISION

SCALE SPEC. NO. DRAWING NUMBER

SHEET

PLATE 2



HOUSATONIC RIVER FLOOD CONTROL

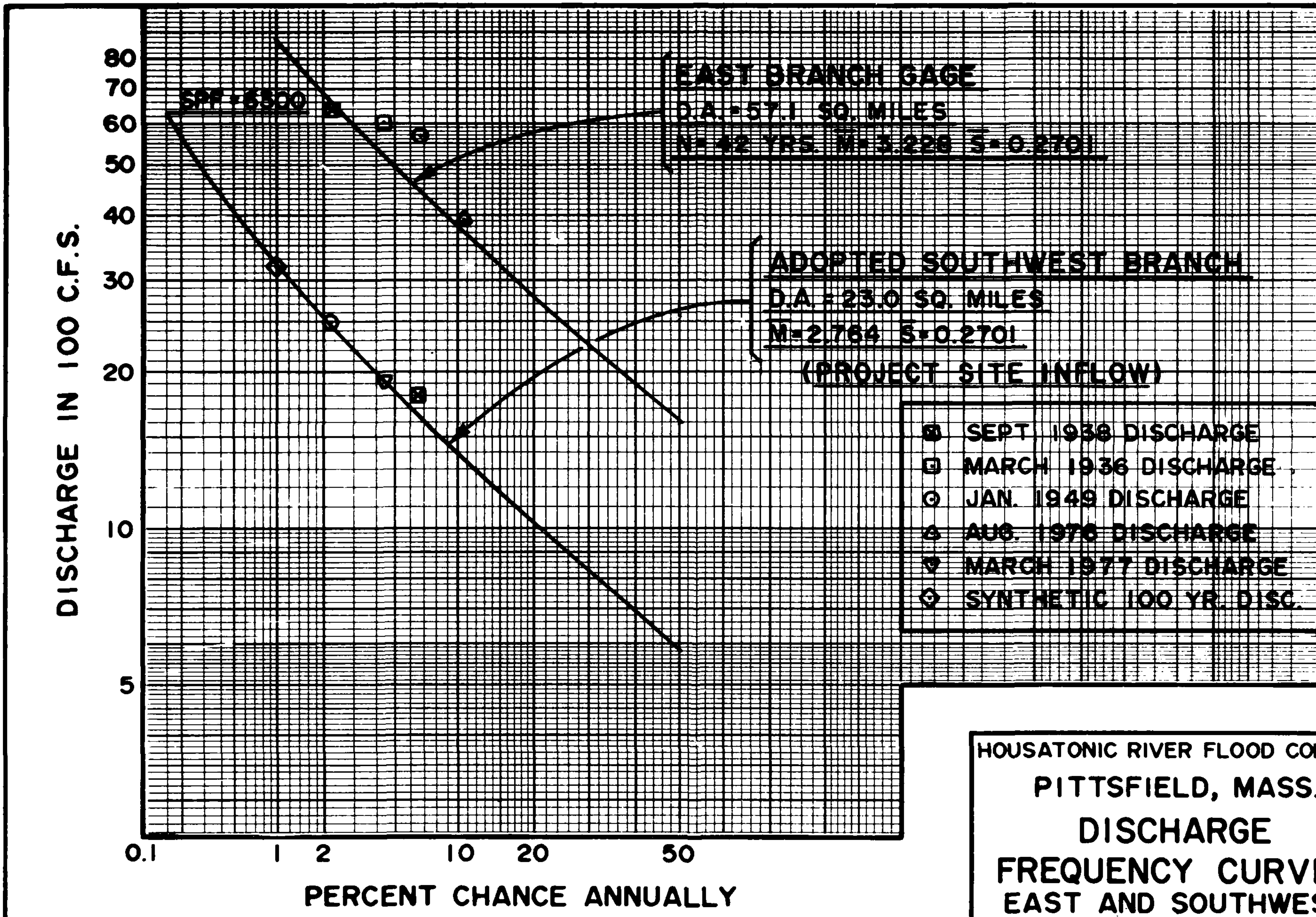
PITTSFIELD, MASS.

DISCHARGE

FREQUENCY CURVES

EAST AND WEST BRANCHES

WATER CONTROL BR. JAN. 1980



HOUSATONIC RIVER FLOOD CONTROL

PITTSFIELD, MASS.

DISCHARGE

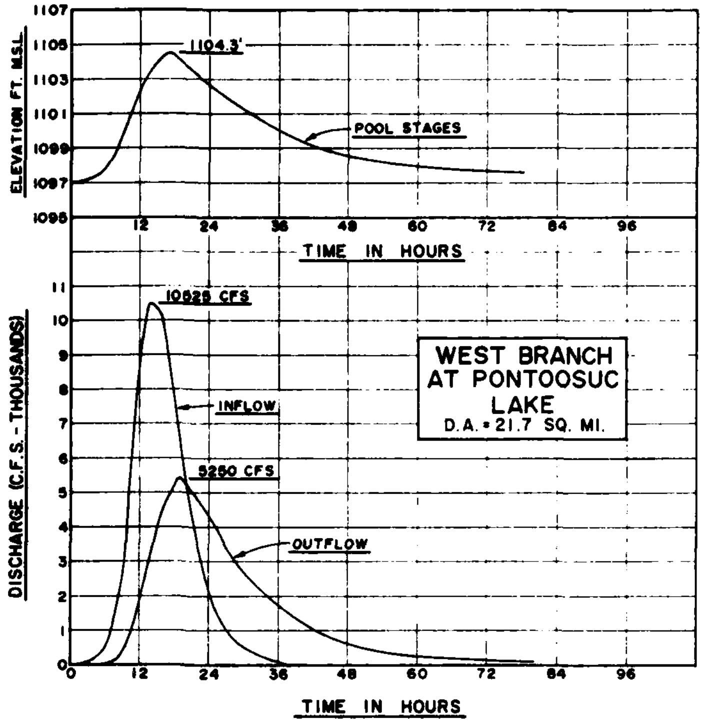
FREQUENCY CURVES

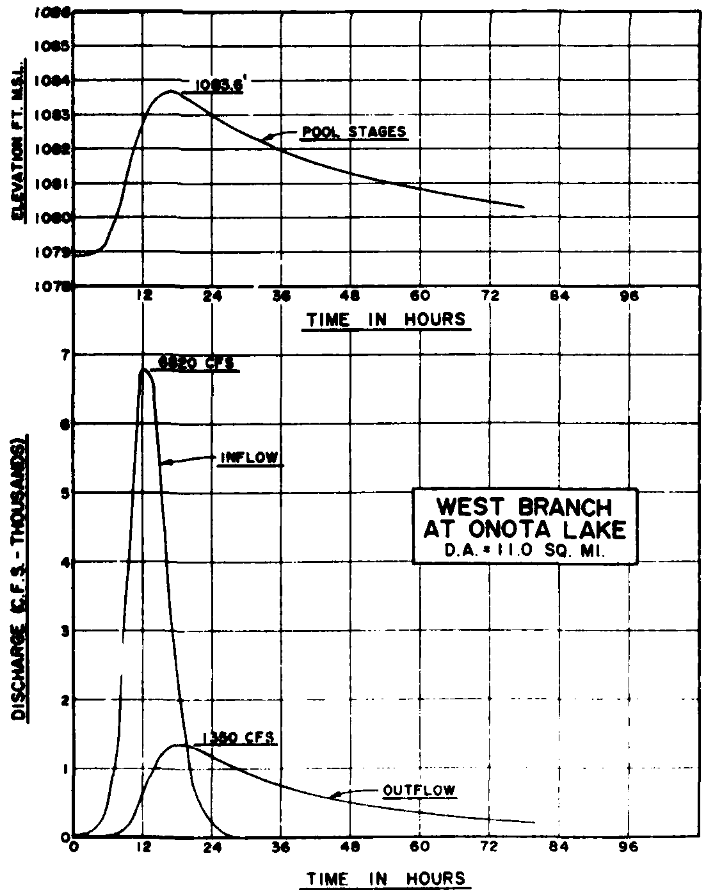
EAST AND SOUTHWEST BRANCHES

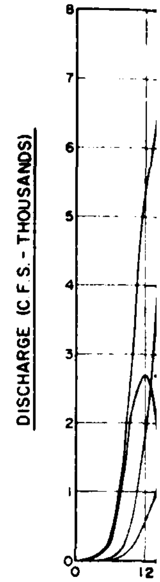
WATER CONTROL BR. JAN. 1980

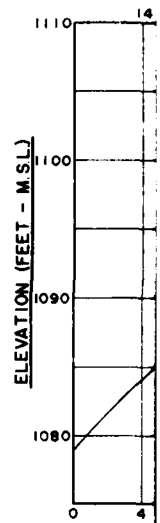
PLATE 4

A B C


WEST BRANCH
AT PONTOOSUC
LAKE
D.A. = 21.7 SQ. MI.
1104.3'
POOL STAGES
ELEVATION FT. M.S.L.
TIME IN HOURS
10525 CFS
INFLOW
5250 CFS
OUTFLOW
DISCHARGE (C.F.S. - THOUSANDS)
TIME IN HOURS


WEST BRANCH
AT ONOTA LAKE
D.A. = 11.0 SQ. MI.
1083.6'
POOL STAGES
ELEVATION FT. M.S.L.
TIME IN HOURS
6820 CFS
INFLOW
1350 CFS
OUTFLOW
DISCHARGE (C.F.S. - THOUSANDS)
TIME IN HOURS


DISCHARGE (C.F.S. - THOUSANDS)


ELEVATION (FEET - M.S.L.)

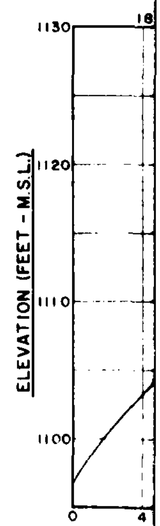
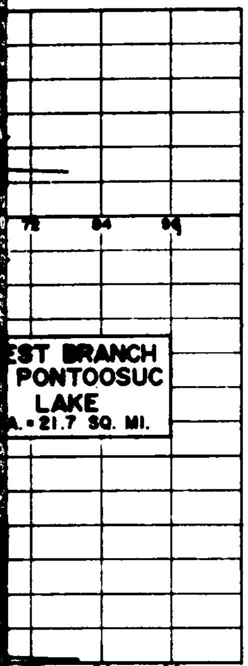
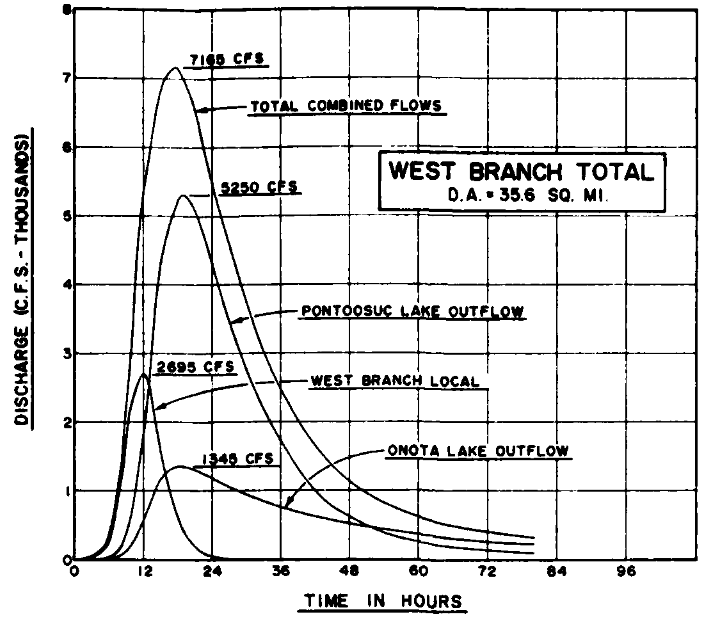
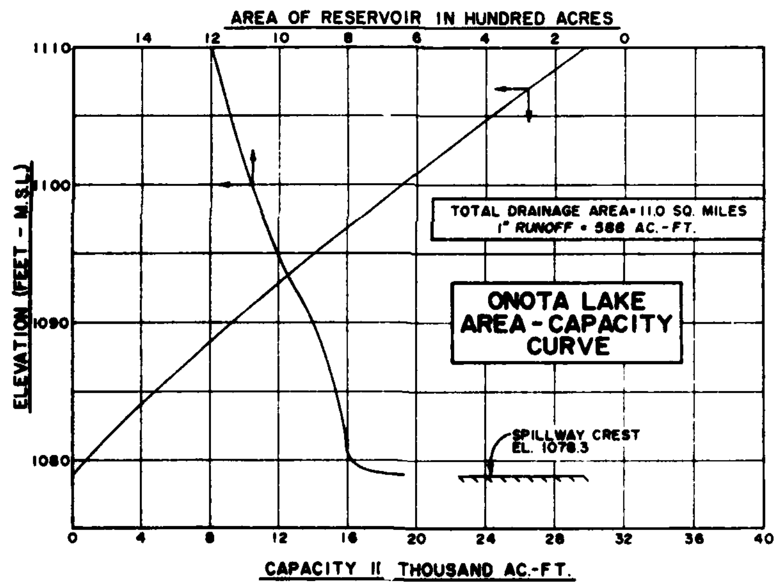
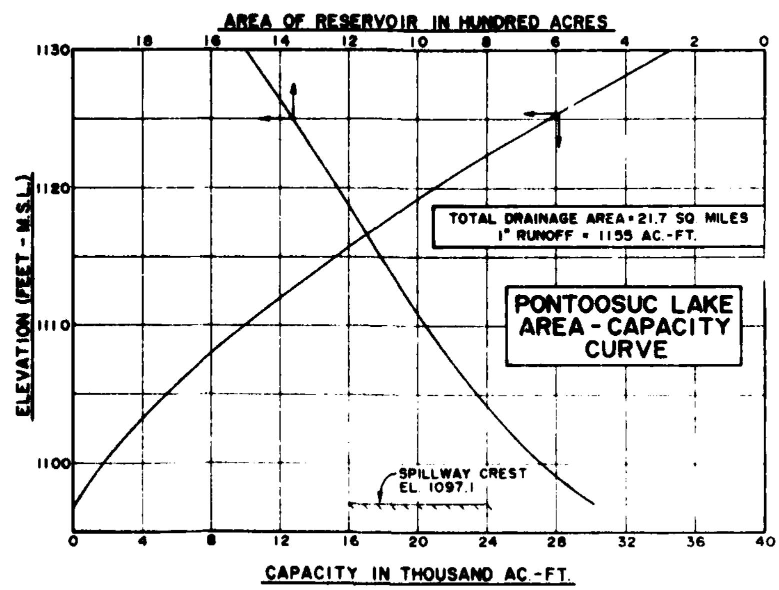

ELEVATION (FEET - M.S.L.)

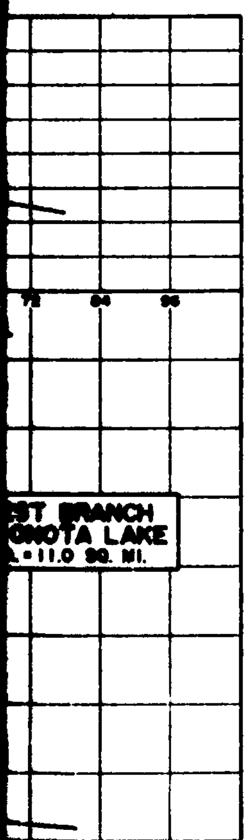
PLATE 5

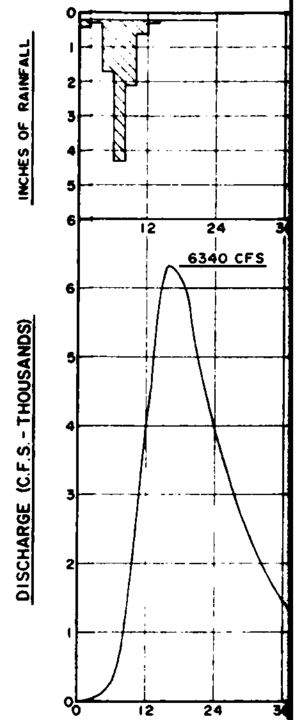












TRIBUTARY AREA	DRAINAGE AREA NET	TOTAL
PONTOOSUC LAKE RESERVOIR INFLOW	21.7	
PONTOOSUC LAKE RESERVOIR OUTFLOW	–	
ONOTA LAKE RESERVOIR INFLOW	11.0	
ONOTA LAKE RESERVOIR OUTFLOW	–	
WEST BRANCH LOCAL	3.9	
WEST BRANCH AT CONFLUENCE WITH SOUTHWEST BRANCH		35.6
SOUTHWEST BRANCH LOCAL	23.1	

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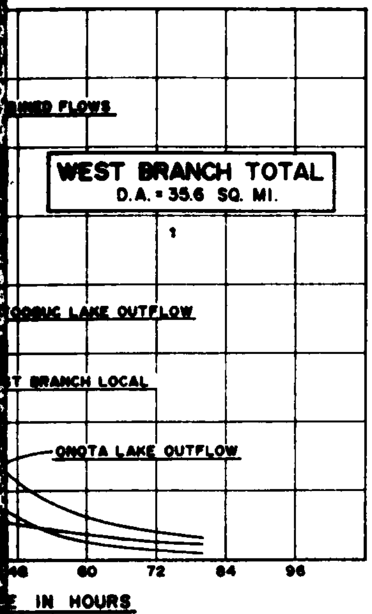
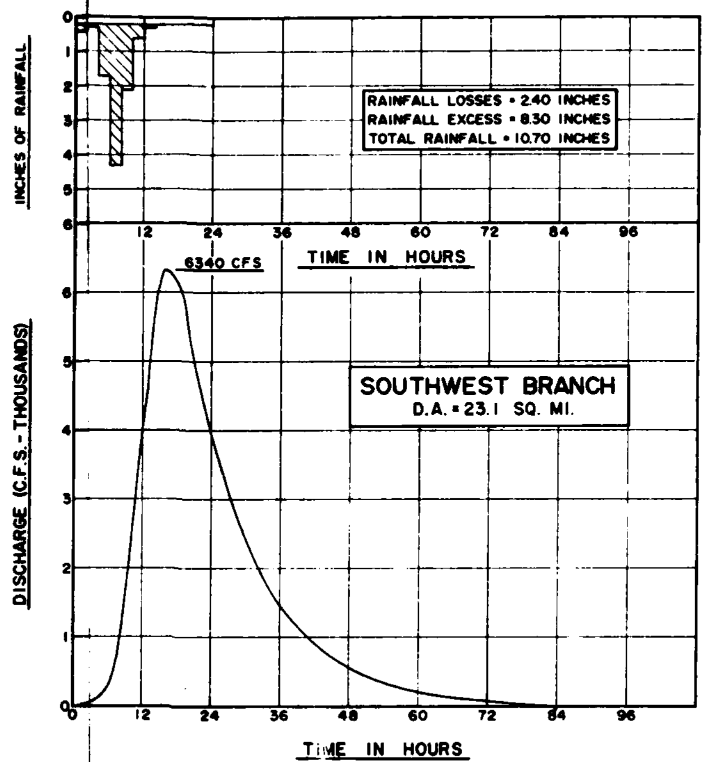
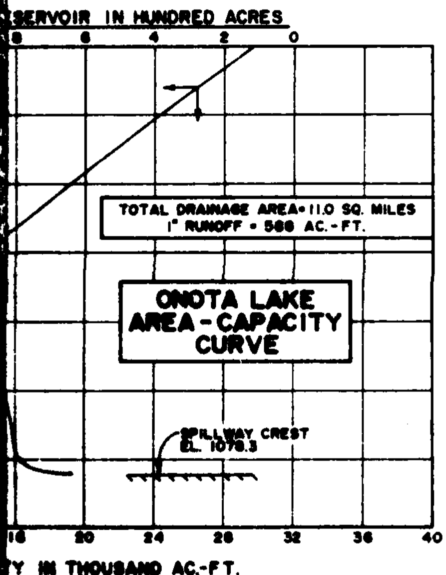
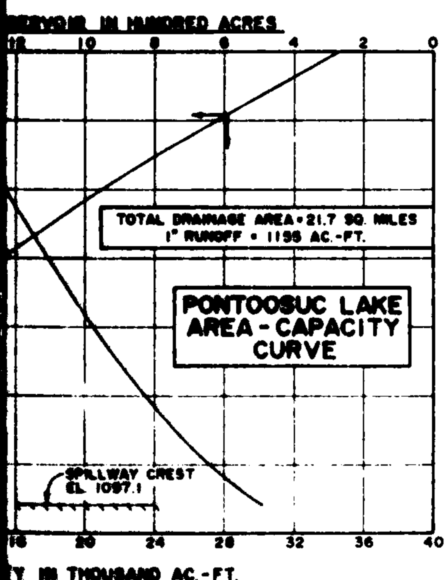






TRIBUTARY AREA	DRAINAGE AREA NET	DRAINAGE AREA TOTAL	PEAK "Q"	CONTRIBUTION TO CONFLUENCE	% CONTRIB.	CONTRIBUTION TO SOUTHWEST BRANCH	% CONTRIB.
PONTOOSUC LAKE RESERVOIR INFLOW	21.7		10525				
PONTOOSUC LAKE RESERVOIR OUTFLOW	–		5250	5240	73.2		
ONOTA LAKE RESERVOIR INFLOW	11.0		6820				
ONOTA LAKE RESERVOIR OUTFLOW	–		1350	1350	18.8		
WEST BRANCH LOCAL	3.9		2695	575	8.0		
WEST BRANCH AT CONFLUENCE WITH SOUTHWEST BRANCH		35.6	7165	7165	100		
SOUTHWEST BRANCH LOCAL	23.1		6340			6340	100



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

HOUSATONIC RIVER FLOOD CONTROL
WEST AND SOUTHWEST BRANCHES
STANDARD PROJECT FLOOD ANALYSIS
HOUSATONIC RIVER PITTSFIELD, MASS

APPROVED DATE
CHIEF, ENGINEERING DIVISION
SCALE SPEC. NO.
DRAWING NUMBER
SHEET

PLATE 5

2 3

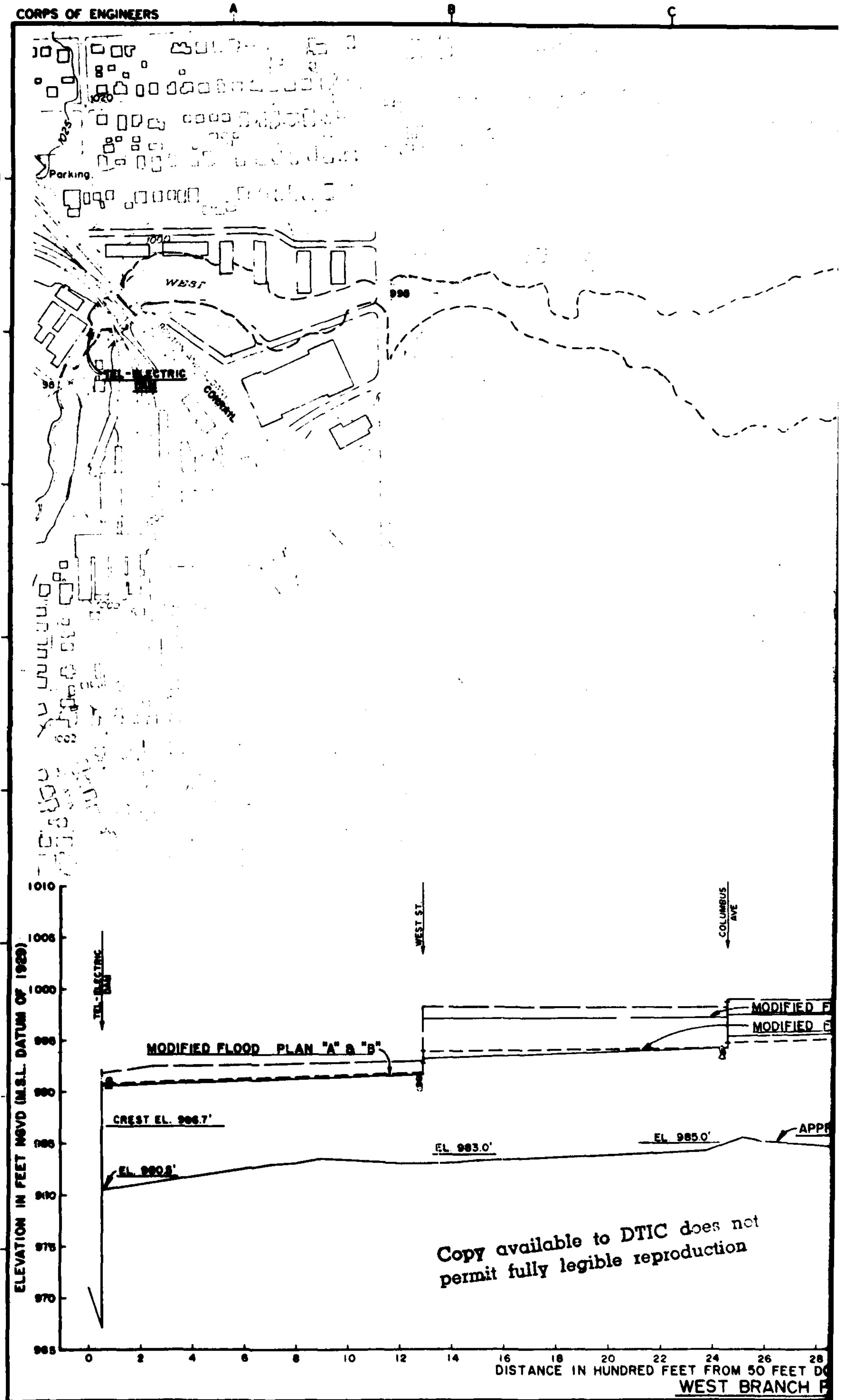
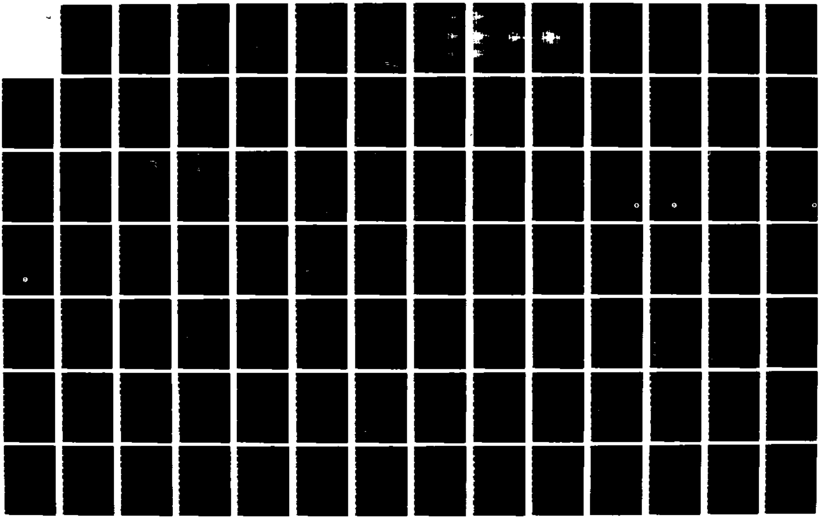
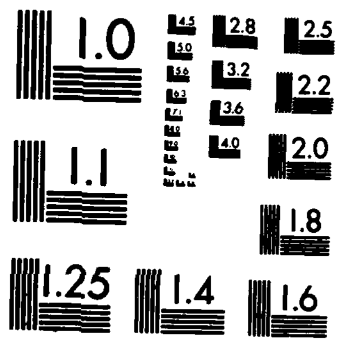

CORPS OF ENGINEERS
A
B
C
1020
1025
Parking
1000
WEST
998
TEL-ELECTRIC
CONRAIL
1002
1010
1005
1000
995
990
985
980
975
970
965
ELEVATION IN FEET NGVD (M.S.L. DATUM OF 1929)
TEL-ELECTRIC DAM
WEST ST.
COLUMBUS AVE
MODIFIED FLOOD PLAN "A" & "B"
MODIFIED F
MODIFIED F
CREST EL. 986.7'
EL. 983.0'
EL. 985.0'
EL. 980.8'
APP
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
DISTANCE IN HUNDRED FEET FROM 50 FEET DO
WEST BRANCH F

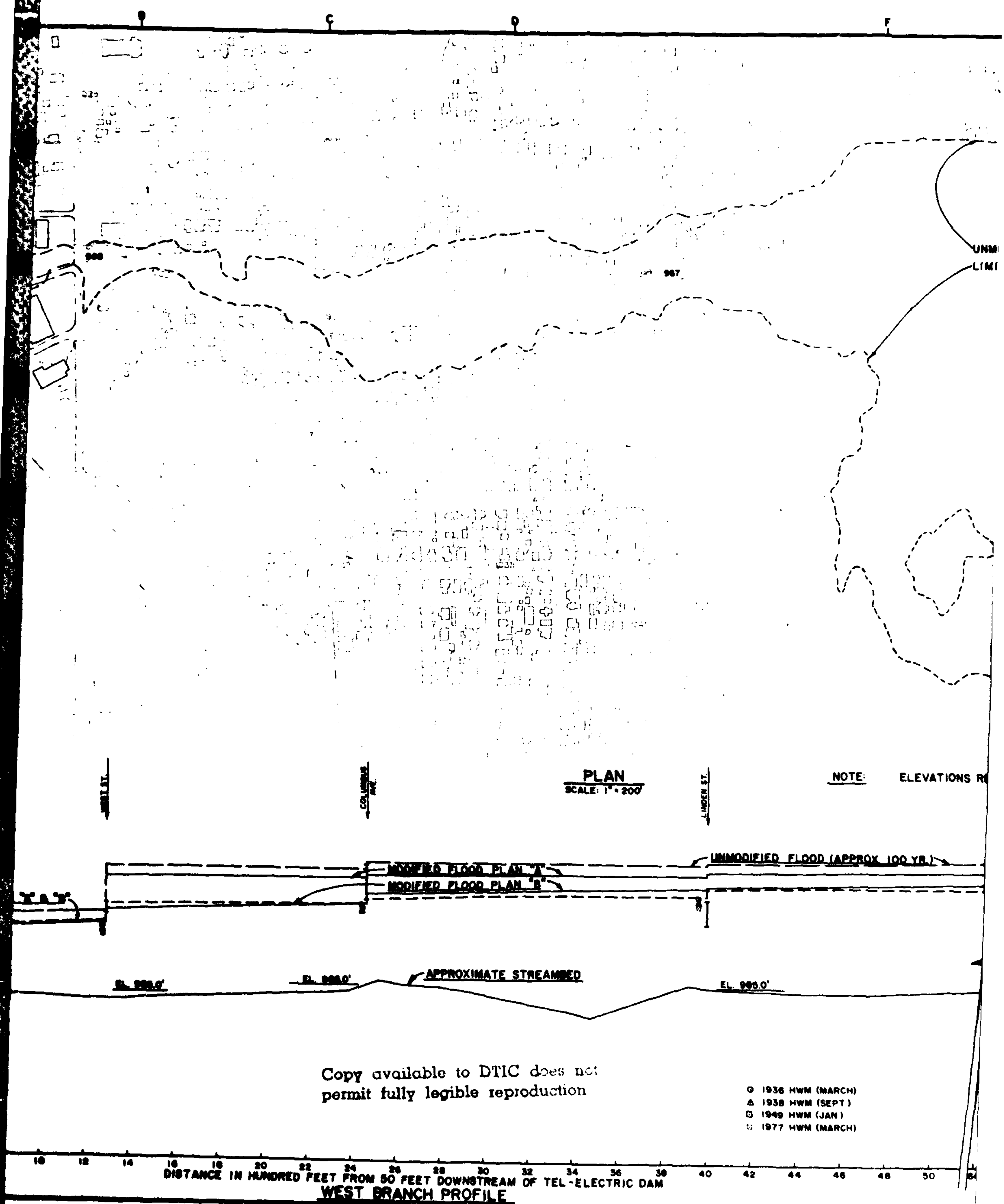
PLATE 6

AD-A143 397 PITTSFIELD LOCAL FLOOD PROTECTION WEST BRANCH AND SOUTHWEST BRANCH HOUSAT..(U) CORPS OF ENGINEERS WALTHAM MA NEW ENGLAND DIV OCT 80 4/5

UNCLASSIFIED F/G 13/2 NL




1.0
2.8
2.5
3.2
2.2
3.6
4.0
2.0
1.1
1.8
1.25
1.4
1.6


B
C
D
F
987
UNM
LIMI
PLAN
SCALE: 1" = 200'
NOTE: ELEVATIONS R
WEST ST.
COLUMBUS AVE.
LINDEN ST.
UNMODIFIED FLOOD (APPROX. 100 YR.)
MODIFIED FLOOD PLAN "A"
MODIFIED FLOOD PLAN "B"
"A" & "B"
APPROXIMATE STREAMBED
EL. 985.0'
1936 HWM (MARCH)
1938 HWM (SEPT)
1949 HWM (JAN)
1977 HWM (MARCH)
10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50
DISTANCE IN HUNDRED FEET FROM 50 FEET DOWNSTREAM OF TEL-ELECTRIC DAM
WEST BRANCH PROFILE

1

2

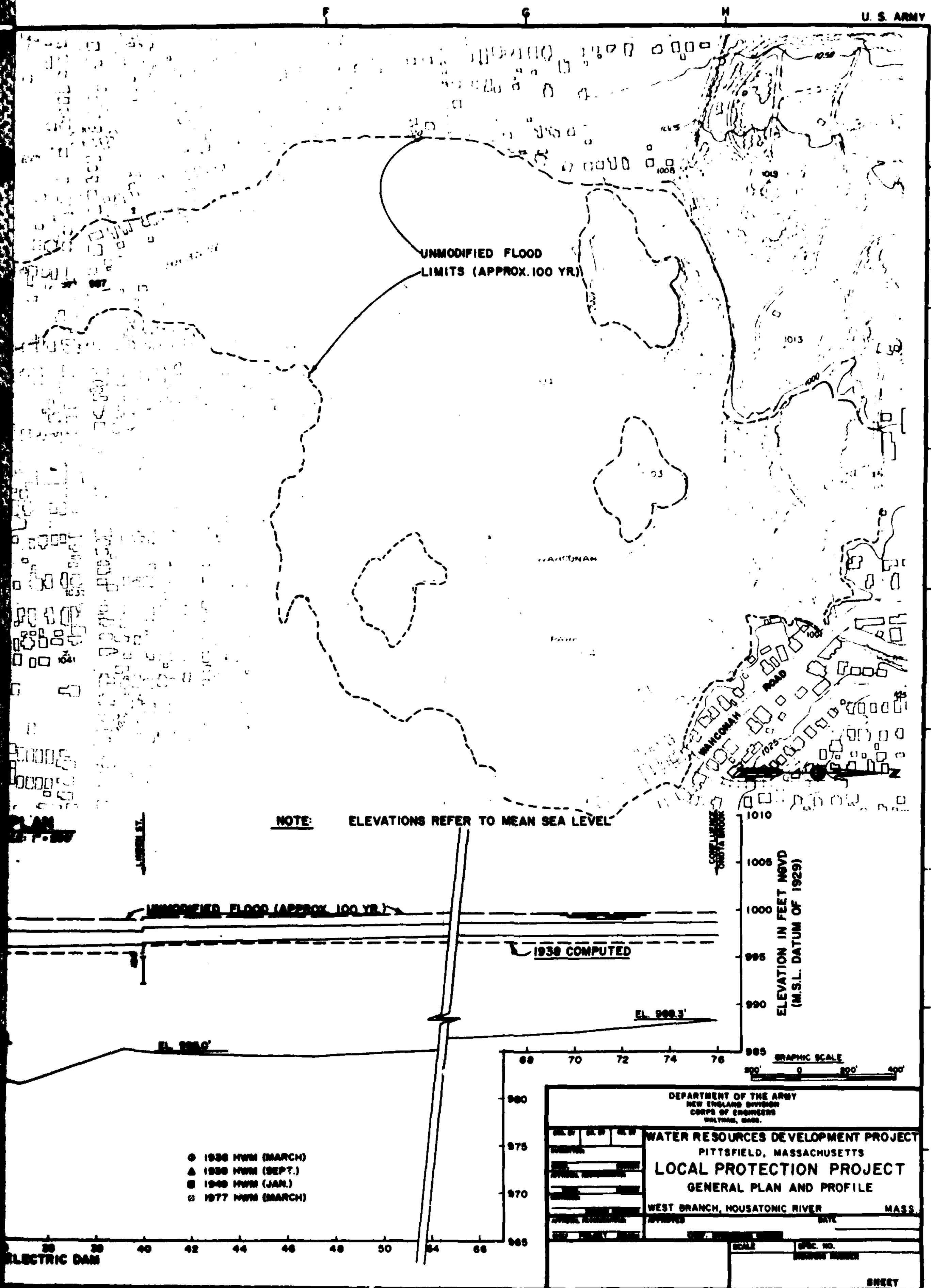


PLATE 6

2

Copy available to DTIC does not permit fully legible reproduction

3

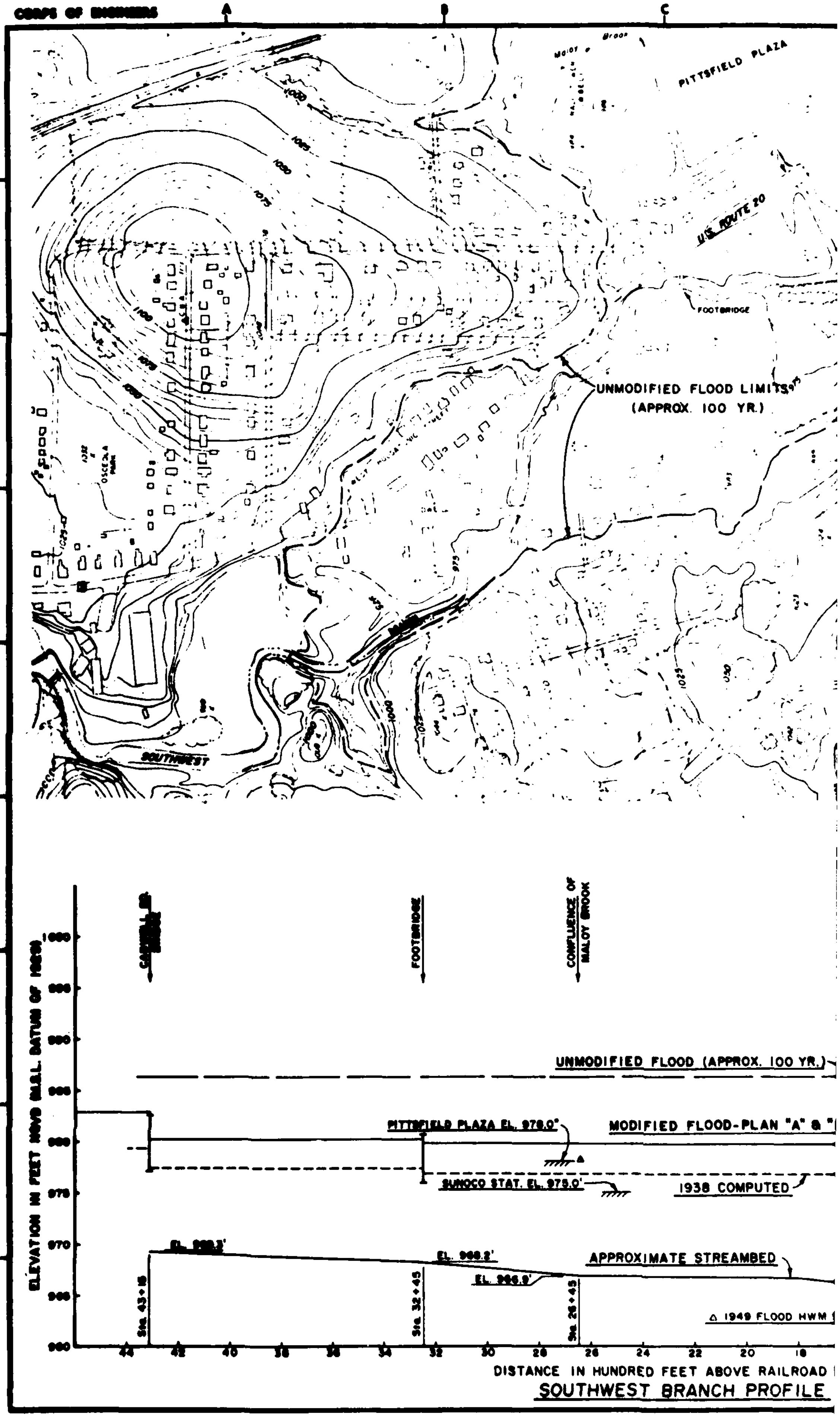
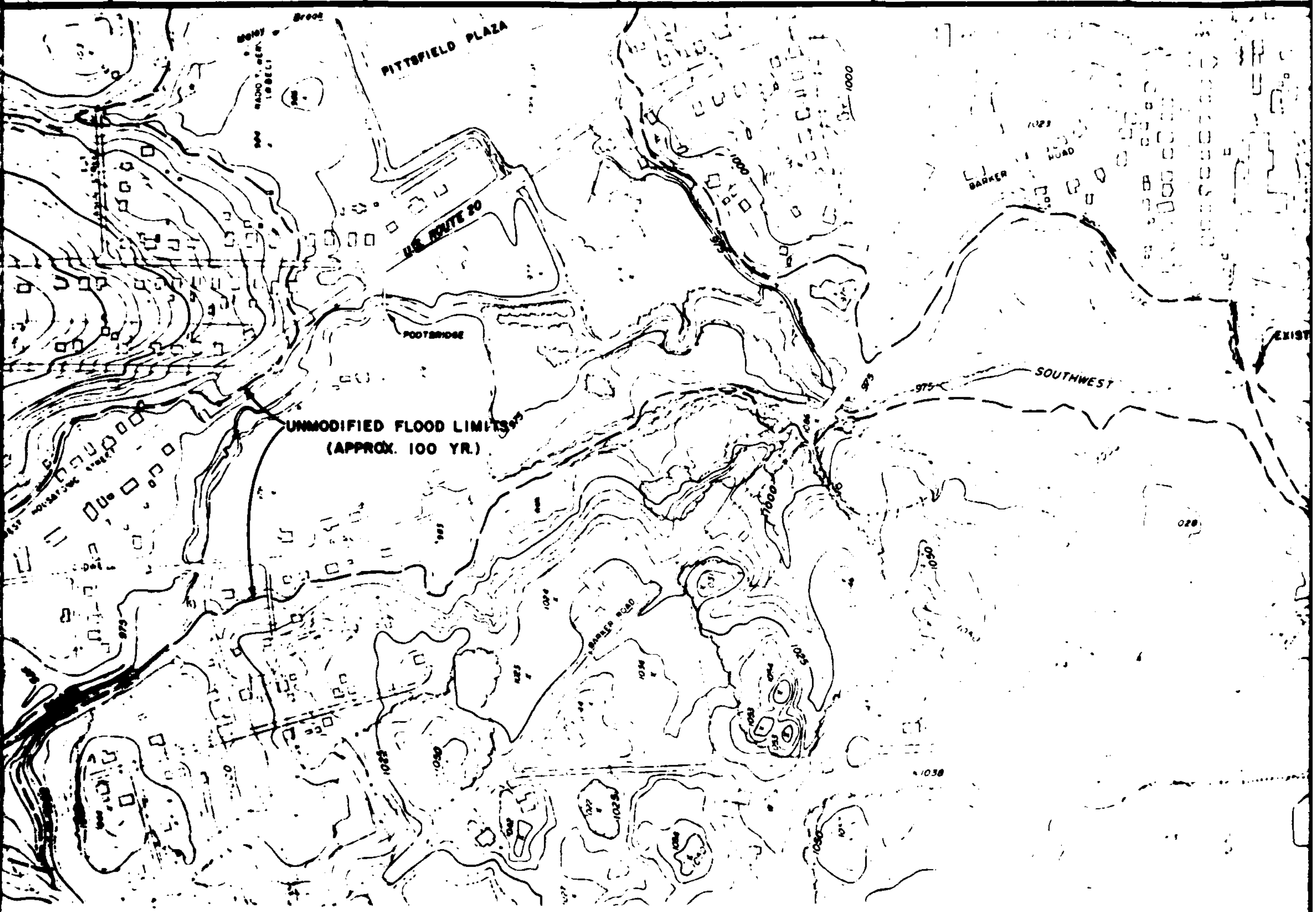
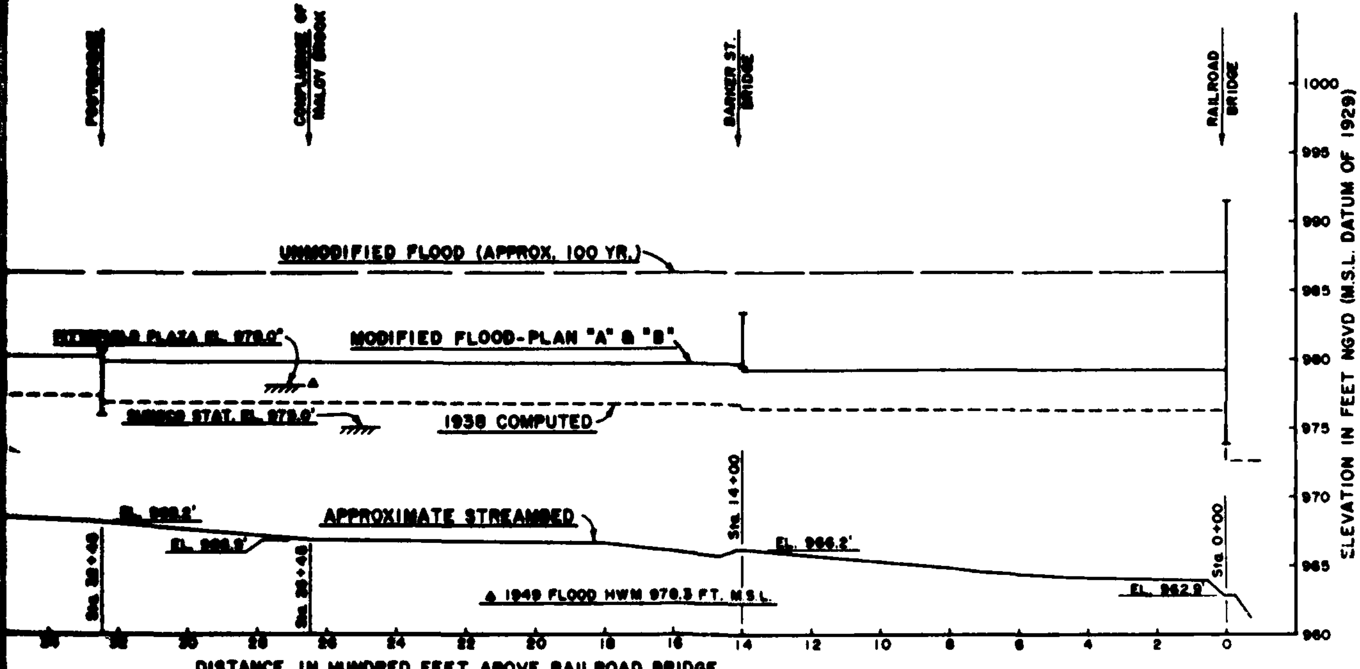

CORPS OF ENGINEERS
PITTSFIELD PLAZA
U.S. ROUTE 20
FOOTBRIDGE
UNMODIFIED FLOOD LIMITS
(APPROX. 100 YR.)
OSCEOLA PARK
SOUTHWEST
FOOTBRIDGE
CONFLUENCE OF MALOY BROOK
UNMODIFIED FLOOD (APPROX. 100 YR.)
PITTSFIELD PLAZA EL. 979.0'
MODIFIED FLOOD-PLAN "A" & "
SUNOCO STAT. EL. 975.0'
1938 COMPUTED
APPROXIMATE STREAMBED
EL. 968.2'
EL. 966.9'
Sta. 43+15
Sta. 32+45
Sta. 26+45
△ 1949 FLOOD HWM
DISTANCE IN HUNDRED FEET ABOVE RAILROAD
SOUTHWEST BRANCH PROFILE

Plate 1

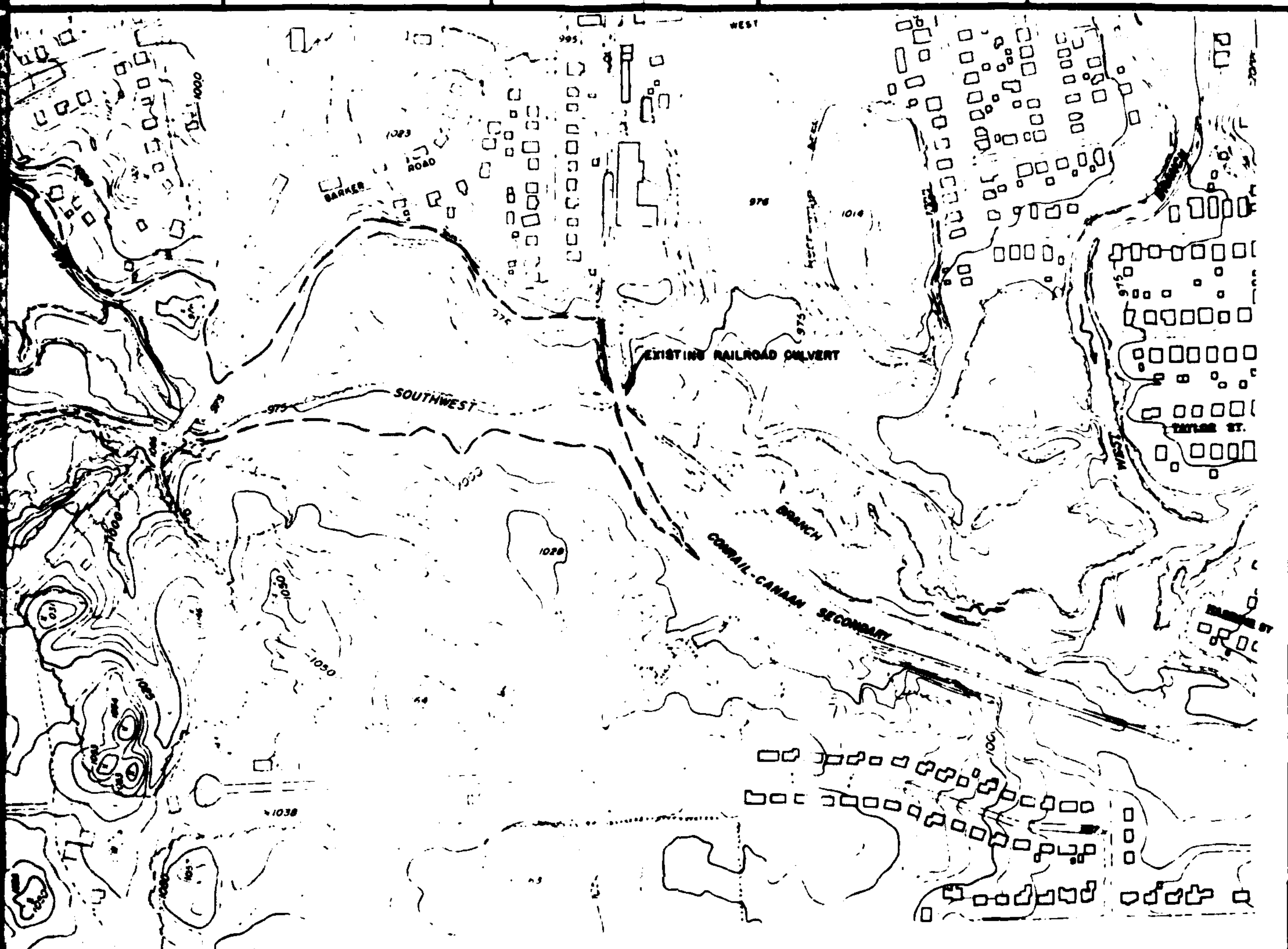


PLAN
SCALE: 1" = 200'

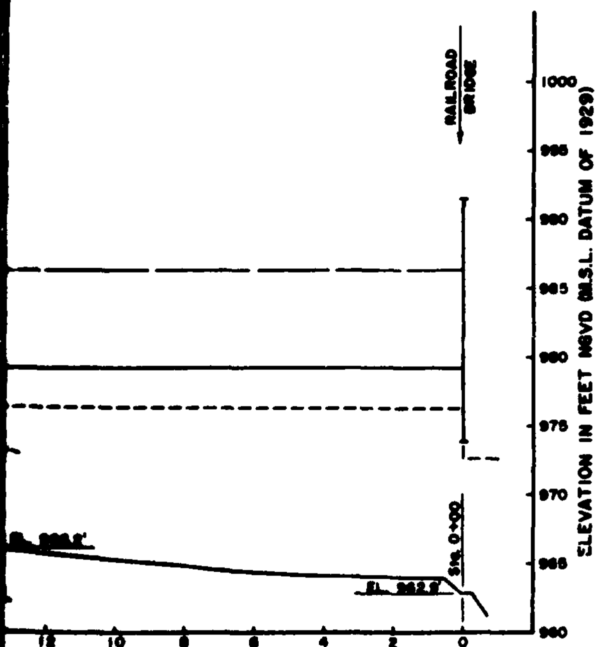


SOUTHWEST BRANCH PROFILE

U. S. ARMY



PLAN
SCALE: 1" = 200'



GRAPHIC SCALE

NOTE: ELEVATIONS REFER TO MEAN SEA LEVEL.

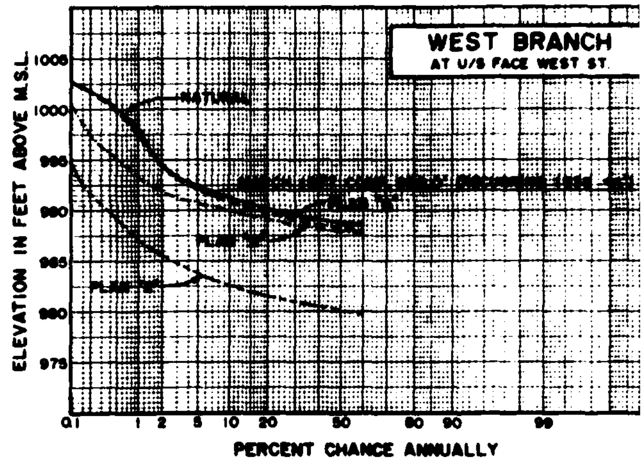
DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.

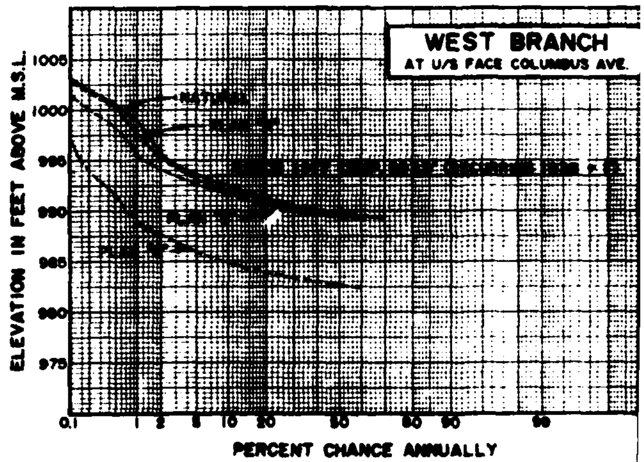
WATER RESOURCES DEVELOPMENT PROJECT
PITTSFIELD, MASSACHUSETTS
LOCAL PROTECTION PROJECT
GENERAL PLAN AND PROFILE
SOUTH-WEST BRANCH HOUSATONIC RIVER MA33.

PLATE 7

3

CORPS OF ENGINEERS





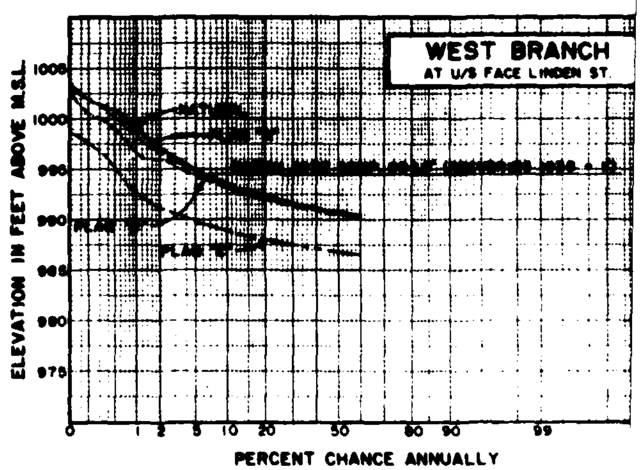
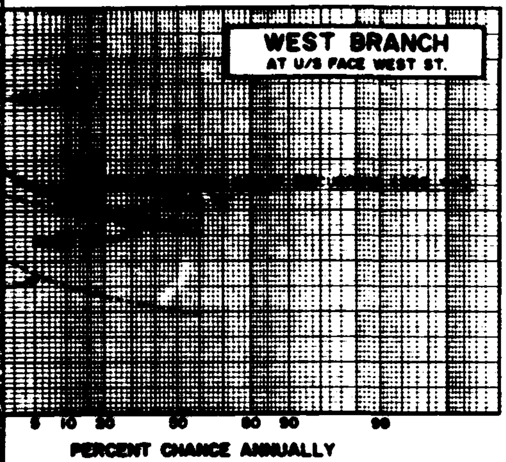
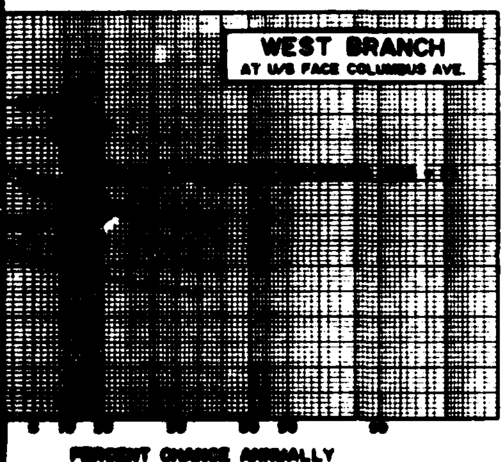
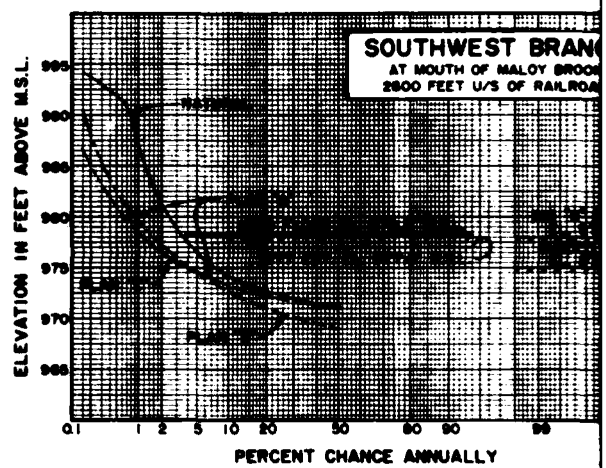


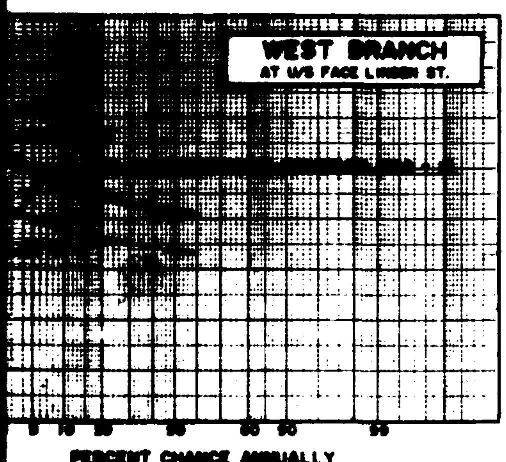
Plate 7

C D E F G









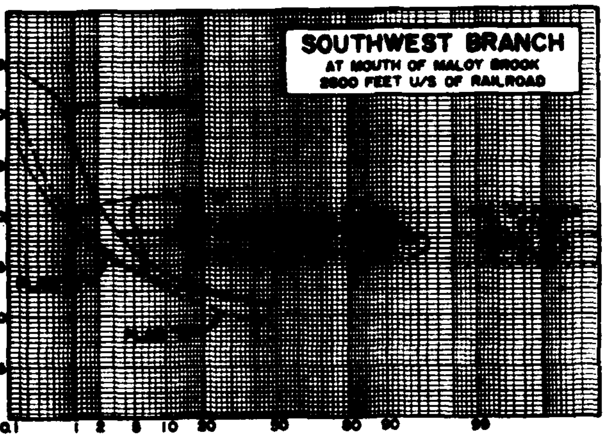
WEST BRANCH:

"A" = LOWER TEL-ELECTRIC DAM 3.0 FEET
"B" = "A" PLUS REPLACE WEST ST. BRIDGE
"C" = LOWER TEL-ELECTRIC DAM, REPLACE WEST ST. BRIDGE AND CHANNEL IMPROVEMENTS

SOUTHWEST BRANCH:

"A" = 150 FT.^{2} AUXILLARY CONDUIT
"B" = "A" PLUS CHANNEL IMPROVEMENT
"C" = 300 FT.^{2} AUXILLARY CONDUIT

U. S. ARMY



EST BRANCH:
"A" = LOWER TEL-ELECTRIC DAM 3.0 FEET
"B" = "A" PLUS REPLACE WEST ST. BRIDGE
"C" = LOWER TEL-ELECTRIC DAM, REPLACE WEST ST. BRIDGE AND CHANNEL IMPROVEMENTS

UTHWEST BRANCH:
"A" = 150 FT.^{2} AUXILLARY CONDUIT
"B" = "A" PLUS CHANNEL IMPROVEMENT
"C" = 300 FT.^{2} AUXILLARY CONDUIT

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

HOUSATONIC RIVER FLOOD CONTROL
WEST AND SOUTHWEST BRANCHES
STAGE FREQUENCY CURVES
NATURAL AND MODIFIED
HOUSATONIC RIVER PITTSFIELD MASS

APPROVED DATE
CHIEF ENGINEERING DIVISION
SCALE SPEC NO
DRAWING NUMBER
SHEET

PLATE 8

APPENDIX 4

Section B - Design and Cost Estimates

APPENDIX 4

SECTION B

DESIGN AND COST ESTIMATES

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ESTIMATES OF FIRST COST AND ANNUAL CHARGES

APPENDIX 4

SECTION B

DESIGN AND COST ESTIMATES

This section of the report appendices presents engineering data to support selection of a recommended plan of improvement through the plan selection process. For clarity, the analysis is divided into the two separate flood damage areas on the West and the Southwest Branches of the Housatonic River.

Design Rationale

West Branch

Subsequent to the flood of September 1936, the city of Pittsfield construc - major channel improvements (widening and deepening) on the West Branch upstream from the Tel-Electric Dam to prevent a recurrence of these flood losses. At the time this plan was considered to be the ultimate extent of flood control improvements that could be accomplished for this area, based on economic and planned constraints. The current design analysis determined that this was true. Recurring flood stages during 1949 and 1977 were considerably reduced from what they would have been if the channel project had not been constructed. This factor is further emphasized by the wide disparity of costs for alternate plans to alleviate flooding upstream of the Tel-Electric Dam. Whereas lowering the Tel-Electric overflow weir to improve the channel gradient would have an estimated first cost of only $30,000, the major widening and deepening project to provide "100 year" flood protection would have an estimated first cost of about $2,500,000. Although lowering the dam crest (Plan A) only provides limited increased flood protection above that of the old channel project, it does provide a justified increment in reducing flood stages.

The existing Tel-Electric Dam is essentially a concrete overflow weir, about 19 feet high and 40 feet wide, located just downstream from two railroad bridges (see Plate 4). The major considerations in determining the extent of dam lowering, that would be economically justified, were the potential impact on upstream bridge piers and abutments and the possible increase of downstream flood stages. Several requests were made to Conrail Corporation to provide foundation information for the bridge piers and abutments. However, their reply stated that they had no plans on file for the bridges. Consequently, high contingency factors were utilized, in lieu of expensive foundation borings, to offset any possible pier reinforcement costs that would be required by lowering the dam more than 3 feet. Also, because the restriction of the West Street stone arch bridge, located 1,200 feet upstream from the Tel-Electric Dam, is the primary hydraulic control influence on upstream flooding, lowering of the dam more than 3 feet would not appreciably reduce the flood profile upstream from West Street. A steeper channel gradient between West Street and the dam would tend to increase flood velocities in this reach, thereby increasing channel scour and erosion. Therefore, costs for placement of stone slope protection along the riverbanks would be required.

A large wetland area exists on the right bank of the West Branch opposite the landfill area known as Wahconah Park. During the March 1977 flood the wetland area and the landfill site were inundated. Local officials would like to place additional landfill at the Wahconah Park site in order to raise it above flood levels and develop additional recreational facilities. At the present time, the entire Wahconah Park, except for the baseball stadium, is undeveloped. Because local citizens expressed an interest in utilizing a flood control project as a catalyst for recreational development, a study for providing an earth dike around the park was investigated. This study determined that the costs for providing a 2,500-foot long earth dike and pumping facilities would not be justified for the proposed development. It would be far more reasonable for the city of Pittsfield to utilize dumped fill on the existing park area as it becomes available. This plan would preclude the need for costly pumping facilities and would also tend to deflect flood flows into the wetland on the opposite riverbank and away from the downstream residential areas. Additional earth dikes in the approximate 3/4 mile long reach between West Street and Wahconah Park, in lieu of major channel widening and deepening would, of necessity, have to be constructed to an elevation of a Standard Project Flood plus freeboard. In addition to the restriction of existing buildings near the river that would have to be removed for the dike construction, extensive local drainage improvements would be required for the interior runoff discharge facilities. Primarily because of this disparity in project costs, it was determined that lowering of the Tel-Electric Dam would be the only economically justified plan of local flood control improvements for the West Branch.

Southwest Branch

During flood periods, the existing 30 foot high Conrail Railroad embankment, located downstream from Barker Road, acts as a non-overflow dam, due to the inadequate waterway opening. The resulting backwater condition inundates low lying areas (wetlands) upstream to Cadwell Road. The March 1977 flood stage inundated U.S. Route 20 (West Housatonic Street) and adjacent commercial and residential properties to depths between 1 and 4 feet. Early hydrologic studies indicated that substantial flood profile reductions could be obtained by supplementing the existing stone arch culvert through the railroad embankment (see Plate 3).

Preliminary plans for the placement of one supplemental 15-foot diameter pipe through the embankment were coordinated with Conrail Corporation. A plan for temporary support of the tracks during constrution, to allow for uninterrupted rail traffic, was provided to Conrail. No objections to the plan were voiced, and Conrail provided typical sections of the structural members that could be utilized. These sections are attached to Exhibit 6, Appendix 3B. As a result of late-stage correspondence with the Conrail Corporation in August 1980, specifications for pipeline occupancy of Conrail property have been provided and are included in Section C of this appendix.

The following eight items represent an alternate method for installing the proposed culvert under the railroad embankment.

1. Drive double row of steel sheet piling (20' ± apart) up one side of the railroad embankment.

2. Break both tracks and drive the sheeting beneath the tracks. Excavate for and install timber abutments (outside the sheeting) for the temporary bridge. Backfill and replace the two tracks. It is anticipated that this can be accomplished during one weekend when no trains are scheduled.

3. Drive the two rows of sheeting down the other side of the embankment.

4. Remove the rails and ties, as required, between the temporary timber abutments. Excavate for and install the temporary girders and bracing. Replace the two tracks using bridge ties. Accomplish this work when no trains are scheduled.

5. Excavate and brace between the rows of sheeting.

6. Install the new culvert, removing bracing, and backfill to the temporary bridge.

7. Remove the temporary bridge. Pull the steel sheet piling across the top of the embankment. Backfill to final grade, and reinstall the two tracks. Accomplish this work when no trains are scheduled.

8. Remove the remainder of the steel sheet piling, and complete final grading and clean-up.

The design rationale for upstream improvements, to supplement the proposed culvert installation, was also clearly delineated during initial stages of the investigation. In the 1,000 foot river reach between Barker Road and Maloy Brook confluence the river alignment includes several sharp bends and a severe oxbow. The river banks are about 3 to 4 feet in height, and the overflow area (wetland) is overgrown with low brush and small trees. Hydrologic studies indicated that for the rare flood events (those exceeding 25 years), either channel clearing or channel excavation would be ineffective in reducing flood stages. But for the more frequent flood events, a straightened channel, 30 to 40 feet in width, would be beneficial in allowing for a more efficient discharge of flows from Maloy Brook. In order to protect the existing fishery resource of the Southwest Branch, the channel clearing plan was selected over the channel excavation plan.

Plan Descriptions

Detailed descriptions for the recommended plans of local flood protection for both branches of the Housatonic River in Pittsfield, are as follows:

West Branch - Plan A

Only one work item is included in this plan of protection, namely, lowering of the Tel-Electric Dam. The crest of the 40 foot long concrete overflow section would be removed by line drilling procedures. An earthfill cofferdam would be placed upstream of the dam and the river flow would be diverted through the existing abandoned penstock on the left bank. Approximately 27 cubic yards of concrete would be removed and hauled to a disposal site. The rough-cut new top elevation would be raised to a finished elevation of 983.7 msl with a concrete cap to provide a smooth overflow surface. The cofferdam would be removed and any silt deposition above elevation 983 would also be excavated.

Southwest Branch - Plan A

Three principal work items would be included in this plan of protection, namely: (1) placement of a 15-foot diameter multiplate, corrugated metal pipe through the railroad embankment; (2) 1,300 feet of channel clearing to eliminate a river oxbow upstream from Barker Road; and (3) relocation of the sewer line underneath the South Street bridge.

The method for temporary shoring of the railroad tracks was described in the previous section. The new pipe would be about 80 feet long and would be provided with both entrance and outlet concrete aprons, wingwalls, and headwalls. The invert of the pipe would be filled with 2 feet of concrete to an elevation of 963 msl, which is the approximate invert of the existing culvert. The new construction would be about 35 feet north of the existing stone arch culvert so that cofferdam construction would not be required, and the existing headwater would not be disturbed. Compacted gravel fill would be placed around and over the new pipe. Three feet of compacted gravel fill would be placed under the pipe. The upstream concrete apron would slope from elevation 966 msl to 963 msl to allow for a 3-foot increase in river stages, prior to flow through this supplemental culvert. This would insure that normal river flows would continue in the existing channel and that the existing stream regimine would not be altered. Details of this improvement are shown on Plate 5.

The channel clearing would be accomplished with a 30-foot width in the reach between Barker Road and Maloy Brook. No grubbing or excavation would be included. The area is principally composed of low brush growth with only a few larger trees to be cut down. The alignment of the overflow channel would be generally straight and allow for a more rapid excavation of flood flows from the area. The total area of channel clearing is estimated at 0.5 acres.

Relocation of the sewer line underneath the South Street Bridge to a position beneath the streambed would mitigate the adverse impacts of the increase discharge capacity of the Conrail Culvert. The relocated sewer would function by syphon and would cost approximately $50,000 to implement.

Cost Estimates

The following tables not only present detailed cost estimates for the recommended plans of protection along the West and Southwest Branches of the Housatonic River, but also provide detailed cost information for the alternate plans studied in the second iteration. The designations of Plans A, B and C correspond with those shown in the System of Accounts table of Appendix 2 - Formulation, Assessment and Evaluation of Detailed Plans. Implementation of Plan A for both branches is recommended.

Construction

Assuming the authorization and availability of construction funds, it is estimated that the recommended projects could be constructed during a single construction season of 6 months.

During the construction phase, earthfill would be required for the temporary worksite (cofferdam) at the Tel-Electric Dam. Excavation materials from the Tel-Electric Dam and the Conrail embankment would be disposed of by the contractor at Government-approved disposal sites. About 2,400 cubic yards of gravel fill material would be required for placement around the corrigated metal pipe. Concrete required for the aprons, wingwalls and headwalls at the pipe culvert is estimated at 150 cubic yards.

TABLE 1
ESTIMATES OF FIRST COSTS AND ANNUAL CHARGES
LOCAL PROTECTION, WEST BRANCH
PITTSFIELD, MASSACHUSETTS

PLAN A
(January 1980 Price Level)

FIRST COSTS
Non-Federal

Item	Quantity	Unit	Unit Price	Amount
Site Preparation	1	Job	L.S.	$1,000
Mobilization/Demobilization	1	Job	L.S.	1,000
Control of Water	1	Job	L.S.	8,500
Concrete Removal	720	C.F.	4.00	2,880
Concrete Disposal	720	C.F.	1.00	720
Concrete Cap	6	C.Y.	250.00	1,500
Clean-up	1	Job	L.S.	500
Sub-Total				$16,100
Contingencies				3,240
TOTAL CONSTRUCTION COST				$19,340
Engineering and Design				4,250
Supervision and Administration				2,510
SUBTOTAL				$26,100
Lands and Damages				$3,500
TOTAL ESTIMATED NON-FEDERAL FIRST COST				$29,600
TOTAL ESTIMATED PROJECT FIRST COST				$29,600

ANNUAL CHARGES

Non-Federal Cost

Interest and Amortization (.07360 x $29,600)	$2,200
Operation and Maintenance	1,000
TOTAL ANNUAL COST	$3,200

TABLE 2
ESTIMATES OF FIRST COSTS AND ANNUAL CHARGES
LOCAL PROTECTION, WEST BRANCH
PITTSFIELD, MASSACHUSETTS

PLAN B
(January 1980 Price Level)

FIRST COSTS
Non-Federal

Lower Dam

Item	Quantity	Unit	Unit Price	Amount
Site Preparation	1	Job	L.S.	$1,000
Mobilization/Demobilization	1	Job	L.S.	1,000
Control of Water	1	Job	L.S.	8,500
Concrete Removal	720	C.F.	4.00	2,880
Concrete Disposal	720	C.F.	1.00	720
Concrete Cap	6	C.Y.	250.00	1,500
Clean-up	1	Job	L.S.	500
Sub-Total				$16,100
Contingencies				3,240
TOTAL CONSTRUCTION COST - LOWER DAM 3'				$19,340
Engineering and Design				4,250
Supervision and Administration				2,510
SUBTOTAL - LOWER DAM				$26,100

TABLE 2 (Cont'd)
PLAN B

Replace Bridge

Item	Quantity	Unit	Unit Price	Amount
Site Preparation	1	Job	L.S.	$2,000
Mobilization/Demobilization	1	Job	L.S.	2,000
Traffic Control	1	Job	L.S.	5,000
Bridge Demoliton	1	Job	L.S.	50,000
Steel Sheet Piling	7,200	S.F.	7.00	50,400
Concrete @ Abutment Section & Face	60	C.Y.	300.00	18,000
Neoprene Bearing Pads	80	S.F.	60.00	4,800
Foundation Excavation	650	C.Y.	6.00	3,900
Gravel Bedding	200	C.Y.	10.00	2,000
Stone Protection	450	C.Y.	30.00	13,500
Prestressed Conc. Deck Beams (4' wide - 40' span)	700	L.F.	80.00	56,000
Grouted Connections	1	Job	L.S.	2,500
Tensioned Laterial Ties	1	Job	L.S.	2,500
Bridge Rail	140	L.F.	40.00	5,600
Bit. Concrete Pavement	400	S.Y.	12.00	4,800
Sub-Total				$223,000
Contingencies				44,600
TOTAL CONSTRUCTION COST - REPLACE BRIDGE				$267,600
Engineering & Design				47,400
Supervision & Administration				30,500
SUBTOTAL - REPLACE BRIDGE				$345,500
Lands and Damages				$13,300
TOTAL ESTIMATED NON-FEDERAL FIRST COST				$384,900
TOTAL ESTIMATED PROJECT FIRST COST				$384,900

ANNUAL CHARGES

Non-Federal Cost	
Interest and Amortization (.07360 x $384,900)	$28,300
Operations and Maintenance	1,000
TOTAL ANNUAL COST	$29,300

TABLE 3
ESTIMATES OF FIRST COSTS AND ANNUAL CHARGES
LOCAL PROTECTION, WEST BRANCH
PITTSFIELD, MASSACHUSETTS

PLAN C
(January 1980 Price Level)

FIRST COSTS
Federal

Item	Quantity	Unit	Unit Price	Amount
Site Preparation	1	Job	L.S.	$2,000
Mobilization/Demobilization	1	Job	L.S.	2,000
Control of Water	1	Job	L.S.	15,000
Concrete Removal	1,260	C.F.	4.00	5,040
Concrete Disposal	1,260	C.F.	1.00	1,260
Dredge (50' U/S of Spillway)	250	C.Y.	8.00	2,000
Concrete (Walls, Abut, Base)	1	Job	C.S.	65,000
Gate (Including Lifting Mech.)	1	Job	L.S.	72,000
Modify Bridges (R.R.)	1	Job	L.S.	30,000
Excavation	45,000	C.Y.	10.00	450,000
Gravel Bedding	11,000	C.Y.	10.00	110,000
Stone Protection	20,000	C.Y.	30.00	600,000
Clean-up	1	Job	L.S.	1,000
Sub-Total				$1,355,300
Contingencies				271,080
TOTAL CONSTRUCTION COST				$1,626,380
Engineering & Design				276,480
Supervison & Administration				162,640
TOTAL ESTIMATED FEDERAL FIRST COST				$2,065,500

TABLE 3 (Cont'd)
PLAN C

Item	Quantity	Unit	Unit Price	Amount
Non-Federal Costs				
Replace Bridge				
Site Preparation	1	Job	L.S.	$2,000
Mobilization/Demobilization	1	Job	L.S.	2,000
Traffic Control	1	Job	L.S.	5,000
Bridge Demolition	1	Job	L.S.	50,000
Steel Sheet Piling	7,200	S.F.	7.00	50,400
Concrete @ Abutment Section & Face	60	C.Y.	300.00	18,000
Neoprene Bearing Pads	80	S.F.	60.00	4,800
Foundation Excavation	650	C.Y.	6.00	3,900
Gravel Bedding	200	C.Y.	10.00	2,000
Stone Protection	450	C.Y.	30.00	13,500
Prestressed Conc. Deck Beams (4' wide - 40' span)	700	L.F.	80.00	56,000
Grouted Connections	1	Job	L.S.	2,500
Tensioned Laterial Ties	1	Job	L.S.	2,500
Bridge Rail	140	L.F.	40.00	5,600
Bit. Concrete Pavement	400	S.Y.	12.00	4,800
Sub-Total				$223,000
Contingencies				44,600
TOTAL CONSTRUCTION COST				$267,600
Engineering & Design				47,400
Supervision & Administration				30,500
TOTAL ESTIMATED NON-FEDERAL COST - REPLACE BRIDGE				$345,500
Lands and Damages				$85,900
TOTAL ESTIMATED NON-FEDERAL COST				431,400
TOTAL ESTIMATED PROJECT FIRST COST				$2,496,900
ANNUAL CHARGES				
Federal Cost				
Interest and Amortization (.07360 x $2,065,500)				$152,000
Non-Federal Cost				
Interest and Amortization (.07360 x $431,400)				$31,800
Operations and Maintenance				2,500
TOTAL ANNUAL COST				$186,300

TABLE 4
ESTIMATES OF FIRST COSTS AND ANNUAL CHARGES
LOCAL PROTECTION, SOUTHWEST BRANCH
PITTSFIELD, MASSACHUSETTS

PLAN A
(January 1980 Price Level)

FIRST COSTS
Federal Cost

Item	Quantity	Unit	Unit Price	Amount
Site Preparation	1	Job	L.S.	$2,000
Mobilization/Demobilization	1	Job	L.S.	2,000
Steel Sheet Piling	10,000	S.F.	8.50	85,000
Steel Wales and Bracing	82,000	Lbs.	0.50	41,000
Temporary Bridge	1	Job	L.S.	30,000
Excavation	2,900	C.Y.	6.00	17,400
15' dia. Corr. Metal Pipe (plate, #8 Gauge)	40,000	Lbs.	0.70	28,000
Compacted Gravel Fill	2,400	C.Y.	10.00	24,000
Concrete Fill	20	C.Y.	200.00	4,000
Concrete (Headwall, Wingwall, Apron)	150	C.Y.	250.00	37,500
Stone Protection	250	C.Y.	30.00	7,500
Sub-Total				$278,400
Contingencies				55,900
TOTAL CONSTRUCTION COST				$334,300
Engineering and Design				60,300
Supervision and Administration				38,600
TOTAL ESTIMATED FEDERAL FIRST COST				$433,200

Non-Federal Cost

Item	Quantity	Unit	Unit Price	Amount
Mitigation	1	Job	L.S.	$50,000
Brush Clearing	0.5	Acre	2000.00	1,000
Lands and Damages				7,000
TOTAL ESTIMATED NON-FEDERAL FIRST COST				$58,000
TOTAL ESTIMATED PROJECT FIRST COST				$491,200

TABLE 4 (Cont'd)
PLAN A

ANNUAL CHARGES

Federal Cost	
Interest and Amortization (.07360 x $433,200)	$31,900
Non-Federal Cost	
Interest and Amortization (.07360 x $58,000)	$4,300
Operations and Maintenance	1,000
TOTAL ANNUAL COST	$37,200

TABLE 5
ESTIMATES OF FIRST COSTS AND ANNUAL CHARGES
LOCAL PROTECTION, SOUTHWEST BRANCH
PITTSFIELD, MASSACHUSETTS

PLAN B
(January 1980 Price Level)

FIRST COSTS
Federal

Item	Quantity	Unit	Unit Price	Amount
Culvert				
Site Preparation	1	Job	L.S.	$2,000
Mobilization/Demobilization	1	Job	L.S.	2,000
Steel Sheet Piling	10,000	S.F.	8.50	85,000
Steel Wales and Bracing	82,000	Lbs.	0.50	41,000
Temporary Bridge	1	Job	L.S.	30,000
Excavation	2,900	C.Y.	6.00	17,400
15' dia. Corr. Metal Pipe (plate #8 gauge)	40,000	Lbs.	0.70	28,000
Compacted Gravel Fill	2,400	C.Y.	10.00	24,000
Concrete Fill	20	C.Y.	200.00	4,000
Concrete (Headwall, Wingwall, Apron)	150	C.Y.	250.00	37,500
Stone Protection	250	C.Y.	30.00	7,500
Sub-Total				$278,400
Contingencies				55,680
TOTAL CONSTRUCTION COST - 150 S.F. CULVERT				$334,080
Channel Excavation				
Excavation	23,600	C.Y.	6.00	$141,600
Gravel Bedding	2,800	C.Y.	10.00	28,000
Stone Protection	2,550	C.Y.	30.00	76,500
Topsoil	400	C.Y.	9.00	3,600
Seeding	6,200	S.Y.	1.00	6,200
Sub-Total				$255,900
Contingencies				51,180
TOTAL CONSTRUCTION COST-CHANNEL				$307,080
Total Construction Cost				$641,160
Engineering and Design				109,000
Supervision and Administration				70,540
TOTAL ESTIMATED FEDERAL FIRST COST				$820,700

TABLE 5 (Cont'd)
PLAN B

Non-Federal Cost	
Mitigation	$50,000
Lands and Damages	7,000
TOTAL ESTIMATED NON-FEDERAL FIRST COST	$57,000
TOTAL ESTIMATED PROJECT FIRST COST	$877,700
ANNUAL CHARGES	
Federal Cost	
Interest and Amortization (.07360 x $820,700)	$60,400
Non-Federal Cost	
Interest and Amortization (.07360 x $57,000)	$4,200
Operations and Maintenance	1,000
TOTAL ANNUAL COST	$65,600

TABLE 6
ESTIMATES OF FIRST COSTS AND ANNUAL CHARGES
LOCAL PROTECTION, SOUTHWEST BRANCH
PITTSFIELD, MASSACHUSETTS

PLAN C
(January 1980 Price Level)

FIRST COSTS
Federal

Item	Quantity	Unit	Unit Price	Amount
Site Preparation	1	Job	L.S.	$2,000
Mobilization/Demobilization	1	Job	L.S.	2,000
Steel Sheet Piling (PZ-32)	10,000	S.F.	8.50	85,000
Steel Wales and Bracing	125,000	Lbs.	0.50	62,500
Temporary Bridge	1	Job	L.S.	55,000
Excavation	5,300	C.Y.	6.00	31,800
15' dia. Corr. Metal Pipe (Plate #8 gauge)	80,000	Lbs.	0.70	56,000
Compacted Gravel Fill	4,300	C.Y.	10.00	43,000
Concrete Fill	40	C.Y.	200.00	8,000
Concrete (Headwall, Wingwall, Apron)	200	C.Y.	250.00	50,000
Stone Protection	300	C.Y.	30.00	9,000
Sub-Total				$404,300
Contingencies				80,860
TOTAL CONSTRUCTION COST				$485,160
Engineering and Design				87,350
Supervision and Administration				53,370
TOTAL ESTIMATED FEDERAL FIRST COST				$625,900

Non-Federal

Mitigation	$50,000
Lands and Damages	6,600
TOTAL ESTIMATED NON-FEDERAL FIRST COST	56,600
TOTAL ESTIMATED PROJECT FIRST COST	$682,500

ANNUAL CHARGES

Federal Cost

Interest and Amortization (.07360 x $625,900)	$46,100

Non-Federal Cost

Interest and Amortization (.07360 x $56,600)	$4,200
Operations and Maintenance	300
TOTAL ANNUAL COST	$50,600

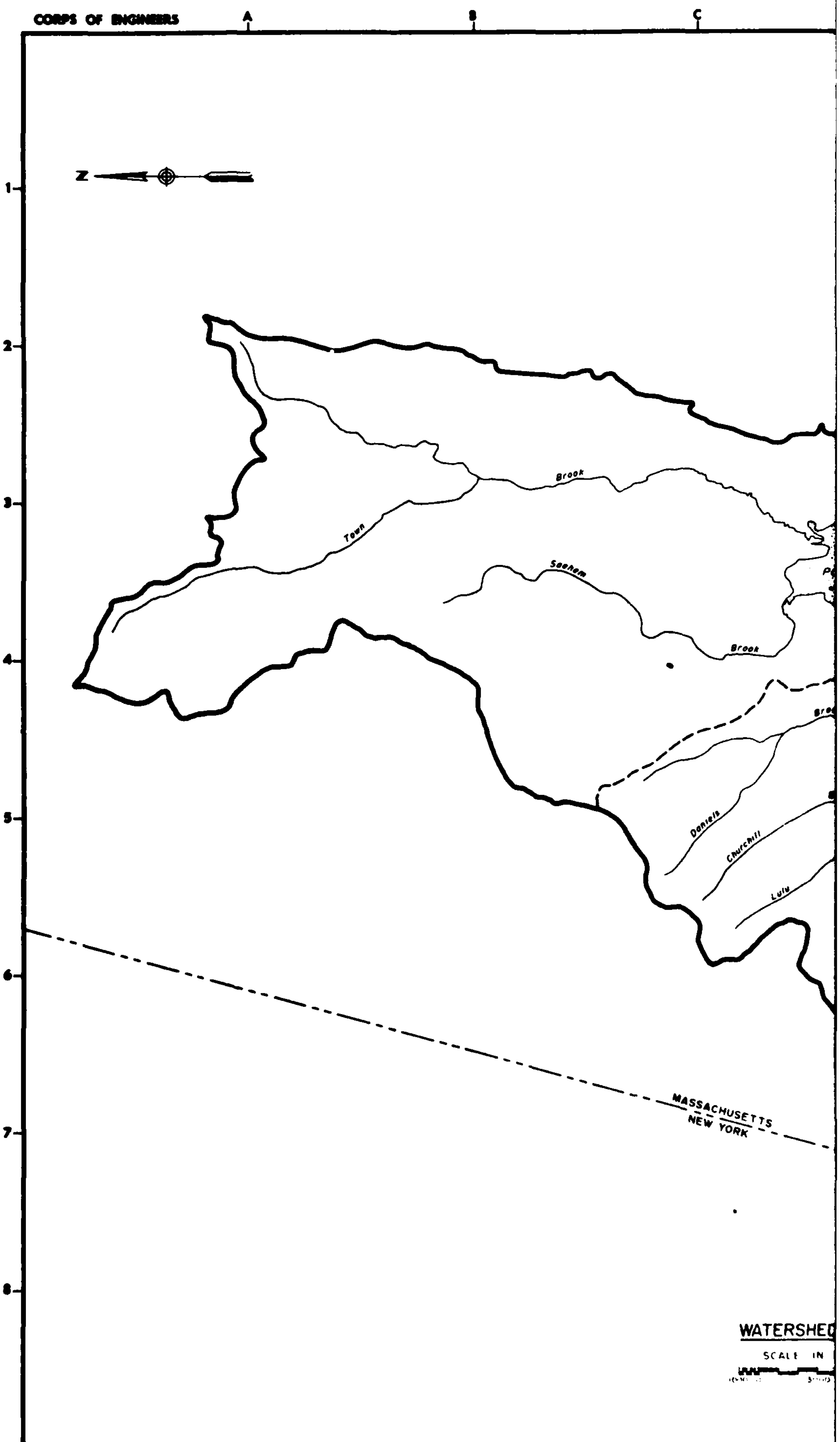
Operation and Maintenance

Although existing Massachusetts legal statutes do not permit local communities to directly enter into agreements with the Federal government, the Commonwealth will require that the city of Pittsfield assume all responsibility for future maintenance of the projects. No operational features are included with the proposed works.

A principal maintenance item for the Pittsfield Department of Public Works will be to insure that brush growth in the overflow channel does not exceed a foot in height at any time. Other maintenance requirements will be to periodically remove debris from the Tel-Electric Dam and from both culverts under the Conrail Track.

An Operation and Maintenance Manual will be provided to the city of Pittsfield to insure that future maintenance meets Federal standards.

CORPS OF ENGINEERS



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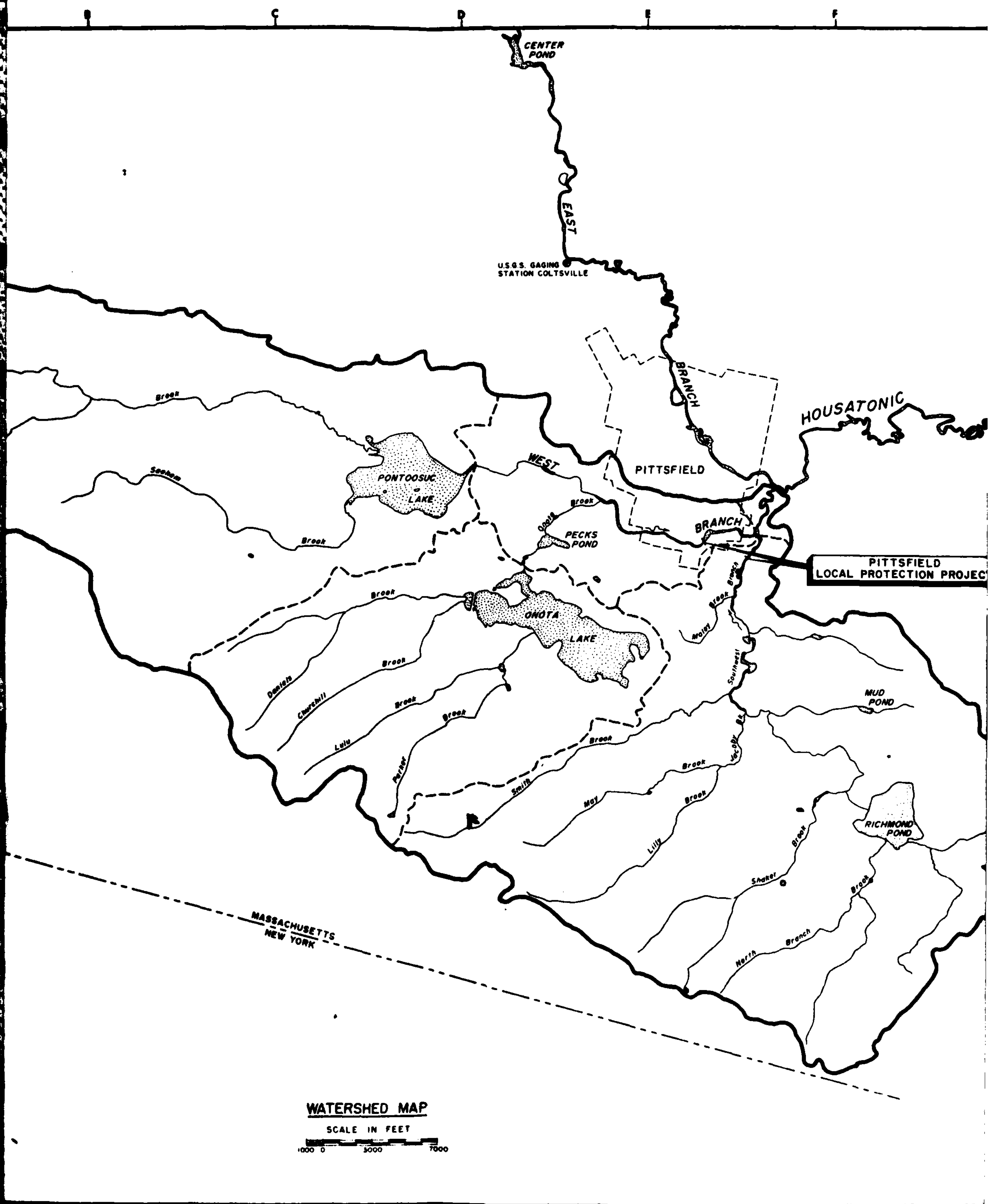
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Daniels
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Lulu Brook
Parker Brook
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Lilly Brook
Shaker Brook
North Branch
Brook
MASSACHUSETTS
NEW YORK
WATERSHED MAP
SCALE IN FEET
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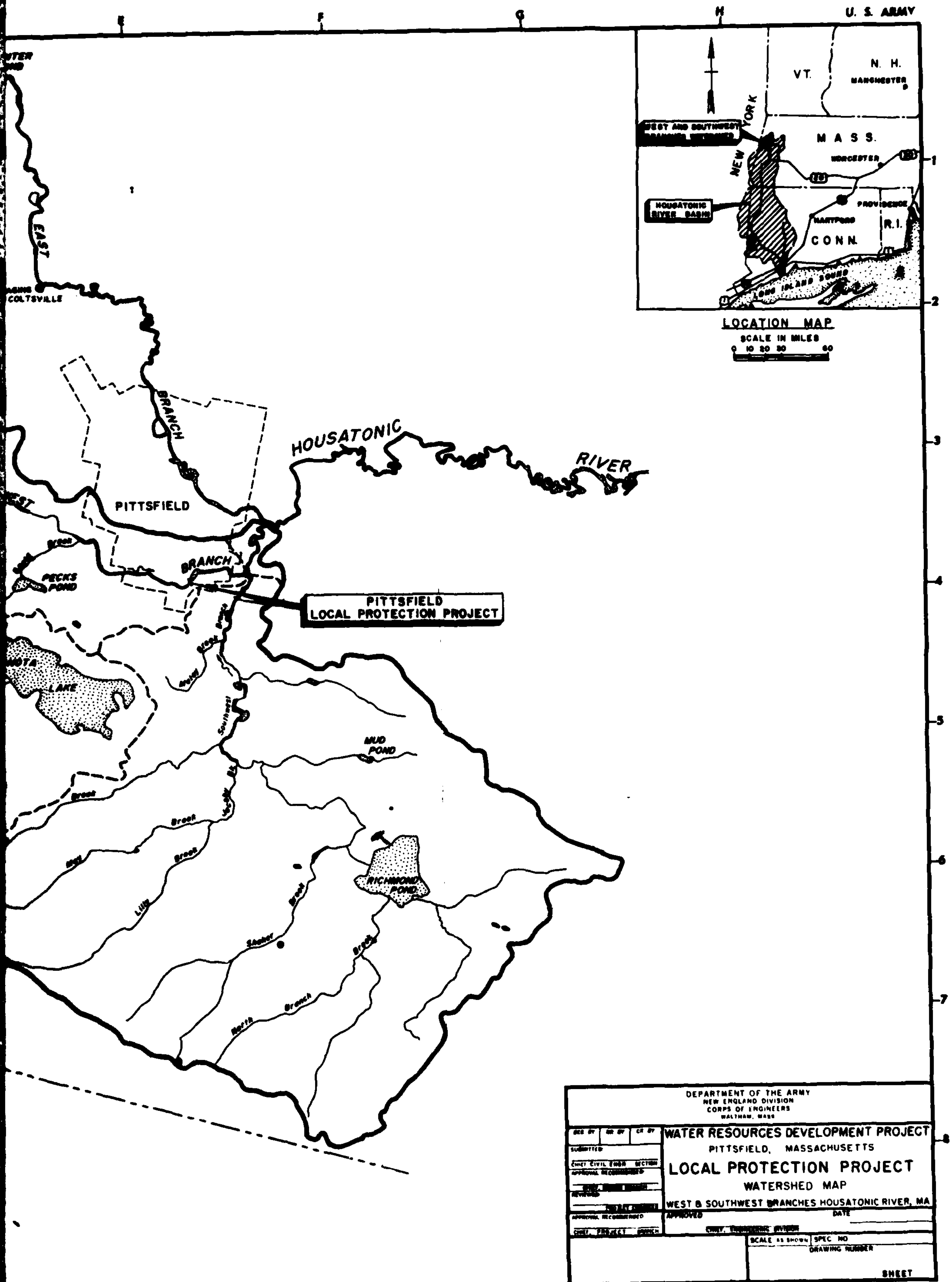
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VT.
N. H.
MANCHESTER
NEW YORK
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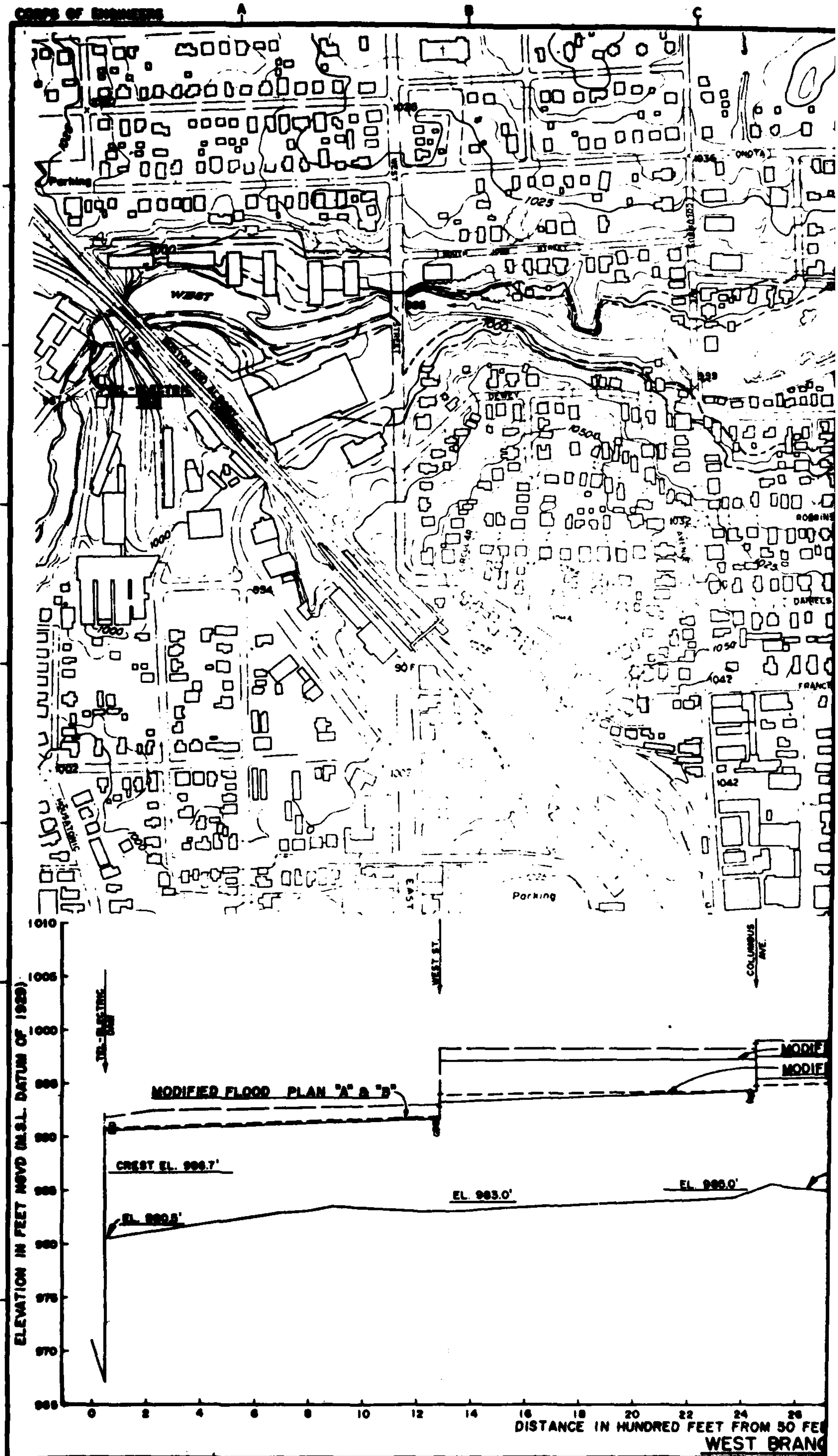
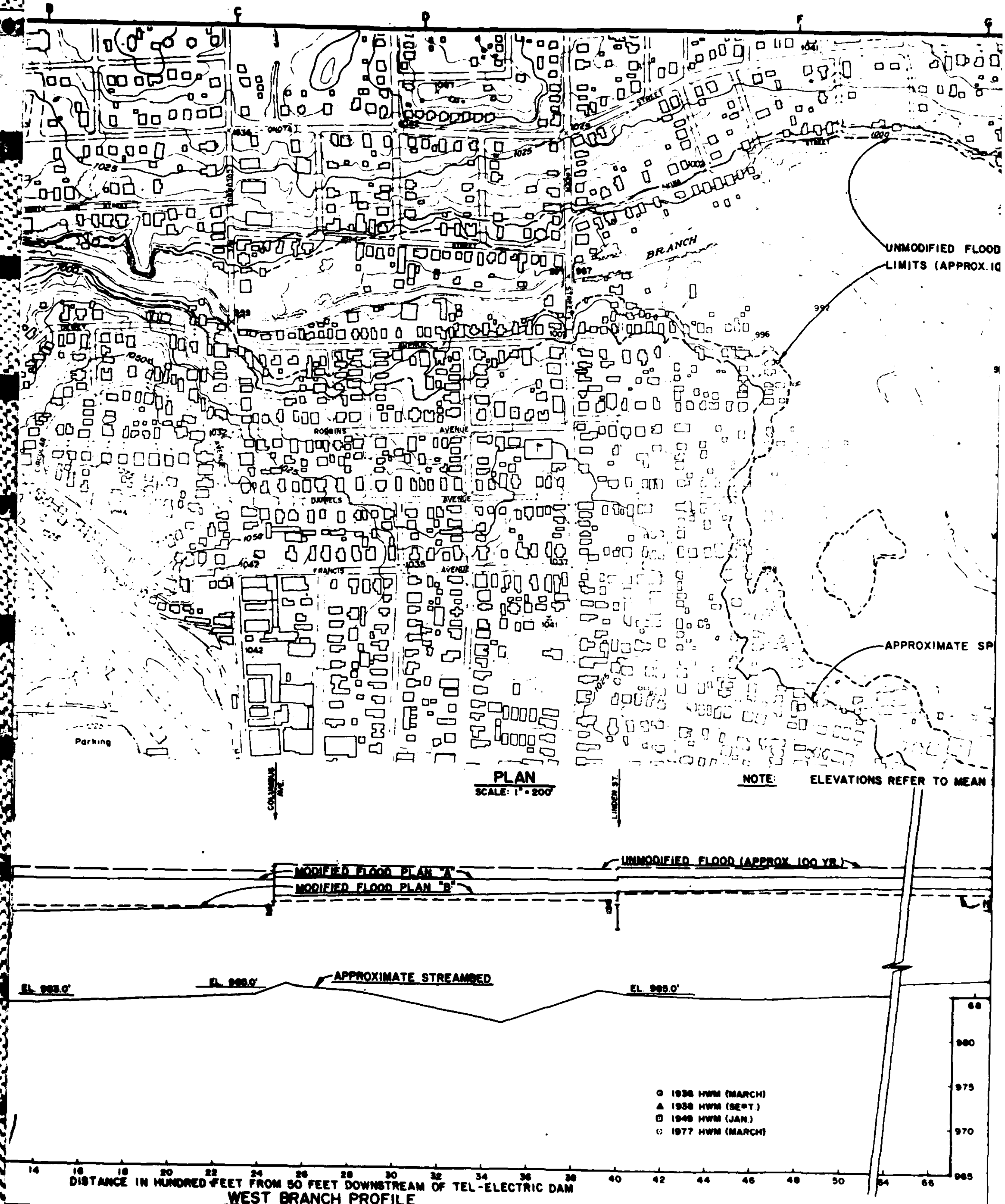
HARTFORD
R.I.
CONN.
LONG ISLAND SOUND
WEST AND SOUTHWEST BRANCHES WATERSHED
HOUSATONIC RIVER BASIN
LOCATION MAP
SCALE IN MILES
0 10 20 30 60
EAST
BRANCH
COLTSVILLE
HOUSATONIC
RIVER
PITTSFIELD
WEST
BRANCH
PECKS POND
PITTSFIELD LOCAL PROTECTION PROJECT
LAKE
Southwest
MUD POND
Brook
RICHMOND POND
Shaker
North Branch
Brook
DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS
WATER RESOURCES DEVELOPMENT PROJECT
PITTSFIELD, MASSACHUSETTS
LOCAL PROTECTION PROJECT
WATERSHED MAP
WEST & SOUTHWEST BRANCHES HOUSATONIC RIVER, MA
SUBMITTED
CHIEF CIVIL ENGR SECTION
APPROVAL RECOMMENDED
REVIEWED
APPROVED
DATE
CHIEF, ENGINEERING DIVISION
CHIEF, PROJECT BRANCH
SCALE AS SHOWN
SPEC NO
DRAWING NUMBER
SHEET

PLATE I



CORPS OF ENGINEERS
Parking
WEST ST.
COLUMBUS AVE.
MODIFIED FLOOD PLAN "A" & "B"
ELEVATION IN FEET NGVD (M.S.L. DATUM OF 1929)
DISTANCE IN HUNDRED FEET FROM 50 FE
WEST BRANC



UNMODIFIED FLOOD
LIMITS (APPROX.10
APPROXIMATE SP
BRANCH
ROBBINS AVENUE
DANIELS AVENUE
FRANCIS AVENUE
Parking
COLUMBUS AVE.
LINDEN ST.
PLAN
SCALE: 1" = 200'
NOTE: ELEVATIONS REFER TO MEAN
UNMODIFIED FLOOD (APPROX. 100 YR.)
MODIFIED FLOOD PLAN "A"
MODIFIED FLOOD PLAN "B"
APPROXIMATE STREAMBED
EL. 965.0'
1936 HWM (MARCH)
1938 HWM (SEPT.)
1949 HWM (JAN.)
1977 HWM (MARCH)
DISTANCE IN HUNDRED FEET FROM 50 FEET DOWNSTREAM OF TEL-ELECTRIC DAM
WEST BRANCH PROFILE

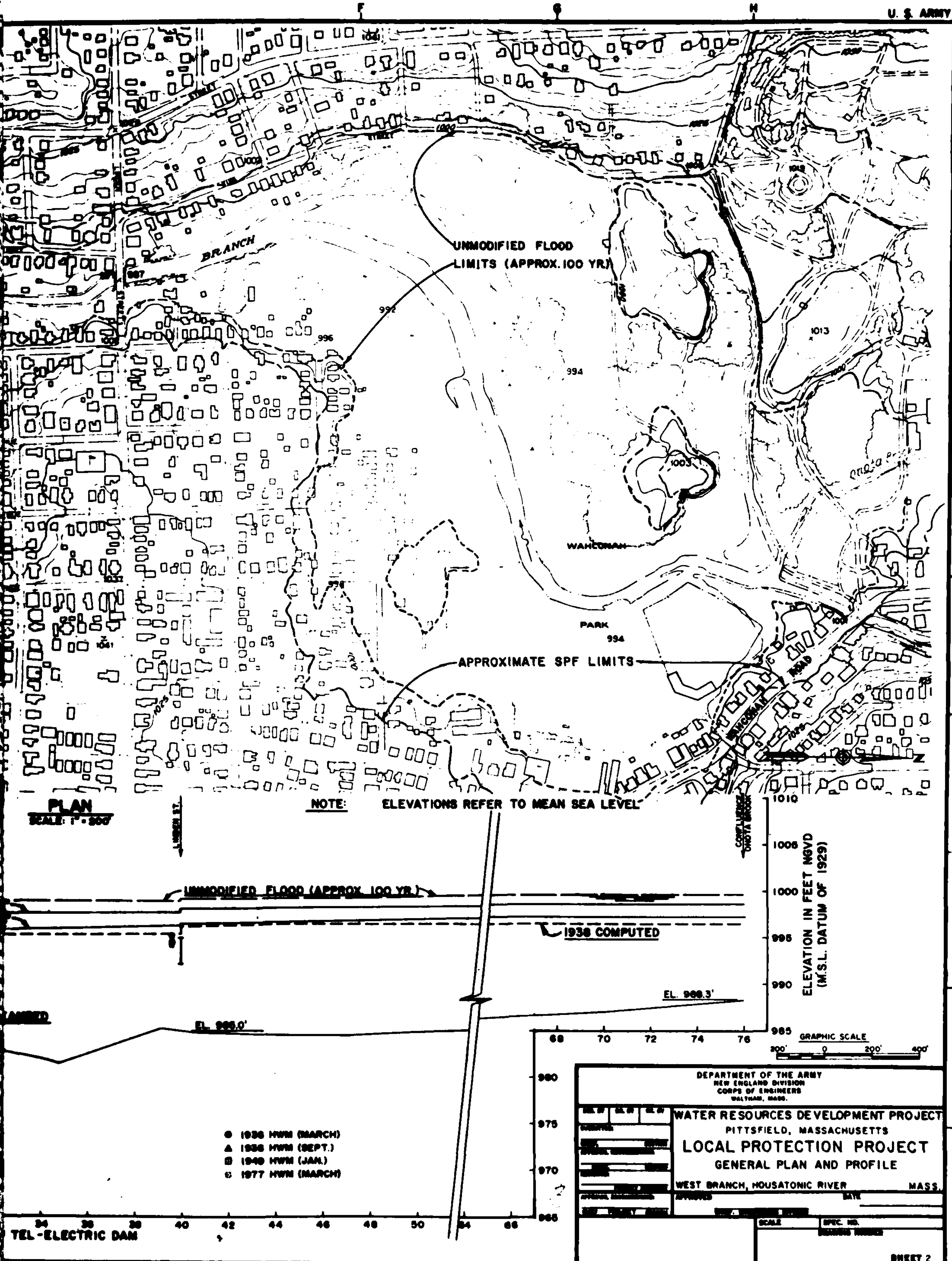
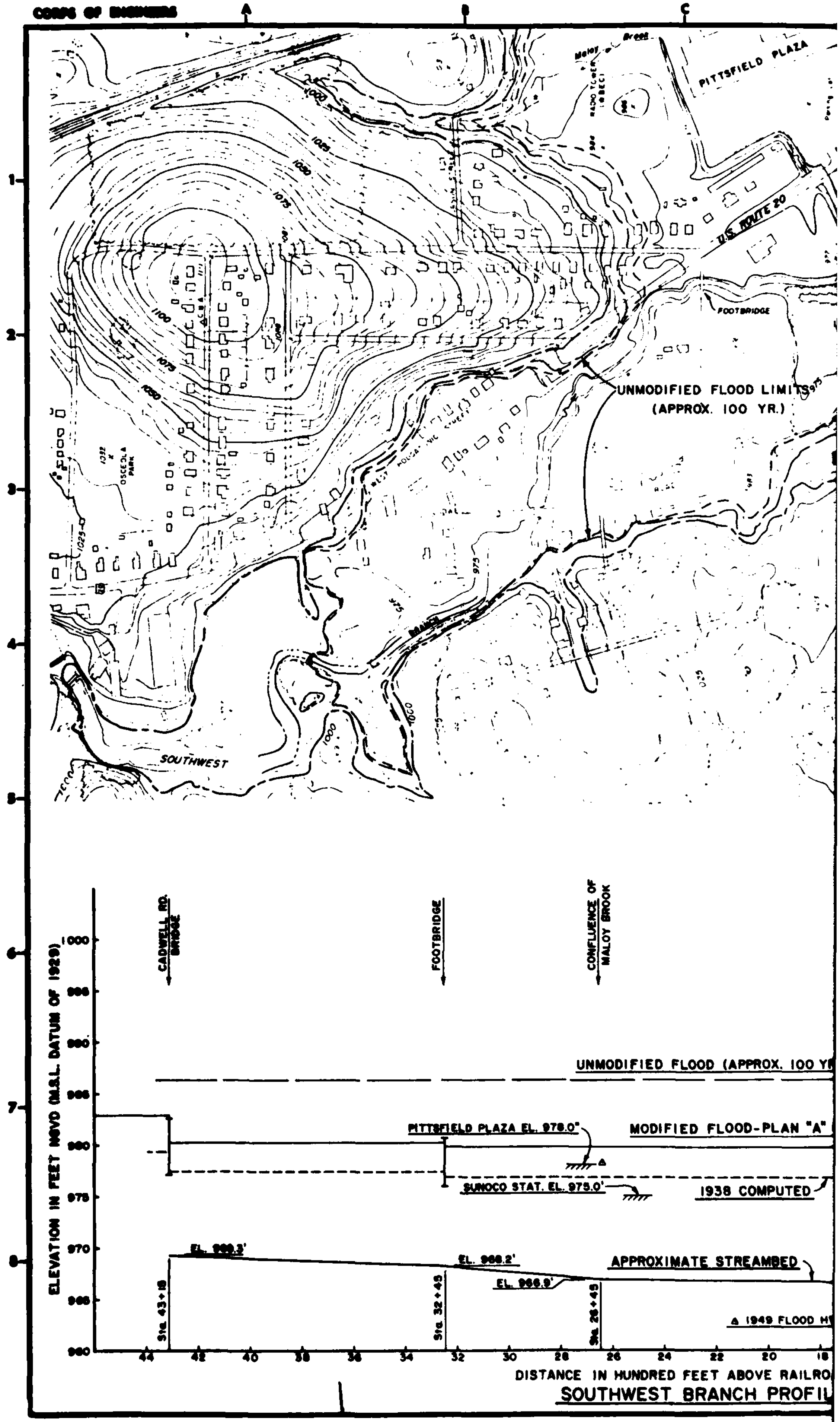
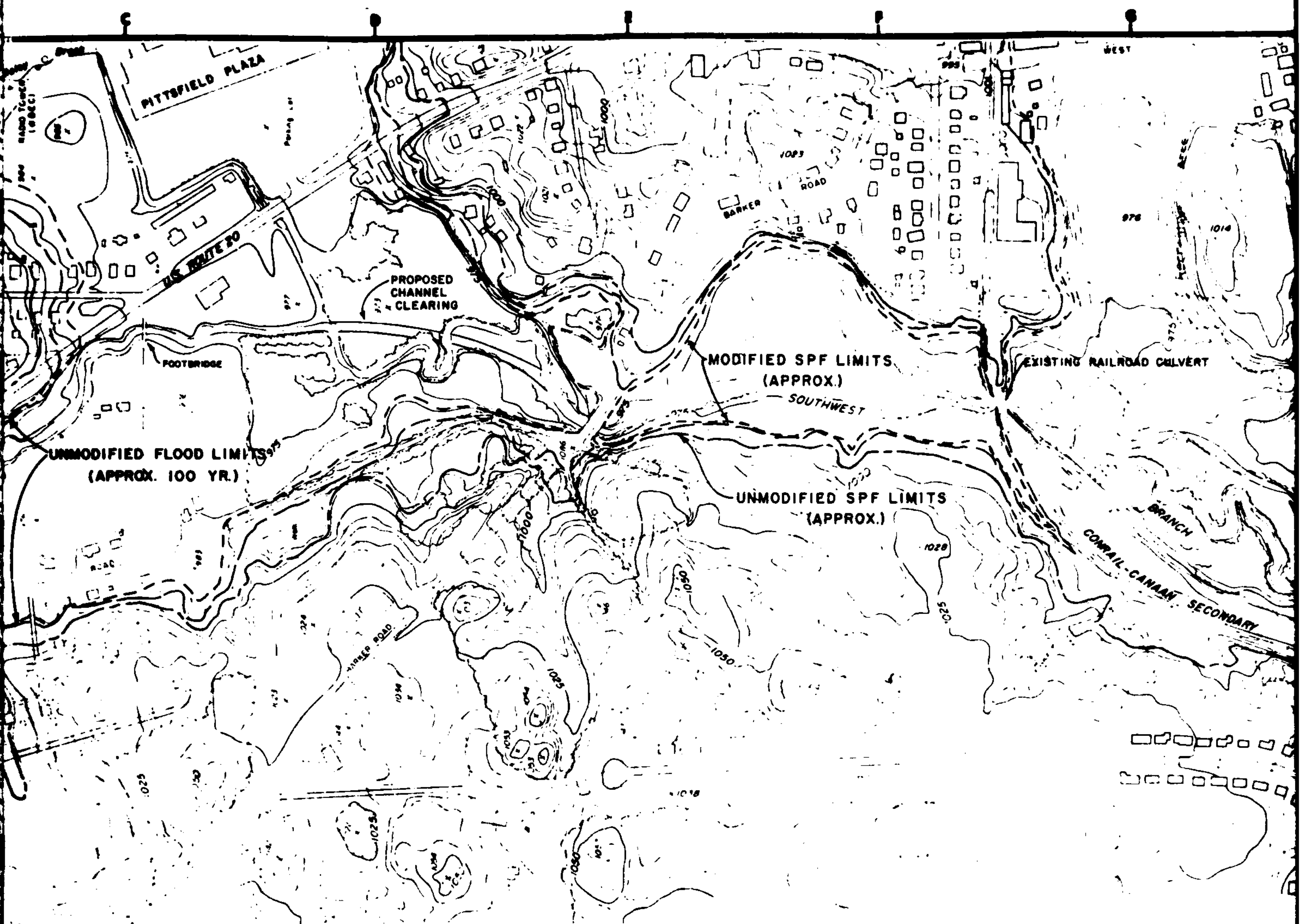

U. S. ARMY
UNMODIFIED FLOOD
LIMITS (APPROX. 100 YR.)
BRANCH
992
996
994
1013
1003
WAHCONAH
PARK
994
APPROXIMATE SPF LIMITS
PLAN
SCALE: 1" = 200'
NOTE: ELEVATIONS REFER TO MEAN SEA LEVEL
UNMODIFIED FLOOD (APPROX. 100 YR.)
1936 COMPUTED
EL. 988.3'
EL. 986.0'
ELEVATION IN FEET NGVD
(M.S.L. DATUM OF 1929)
GRAPHIC SCALE
● 1936 HWM (MARCH)
▲ 1936 HWM (SEPT.)
1949 HWM (JAN.)
1977 HWM (MARCH)
TEL-ELECTRIC DAM
DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.
WATER RESOURCES DEVELOPMENT PROJECT
PITTSFIELD, MASSACHUSETTS
LOCAL PROTECTION PROJECT
GENERAL PLAN AND PROFILE
WEST BRANCH, HOUSATONIC RIVER MASS.
SHEET 2

PLATE 2

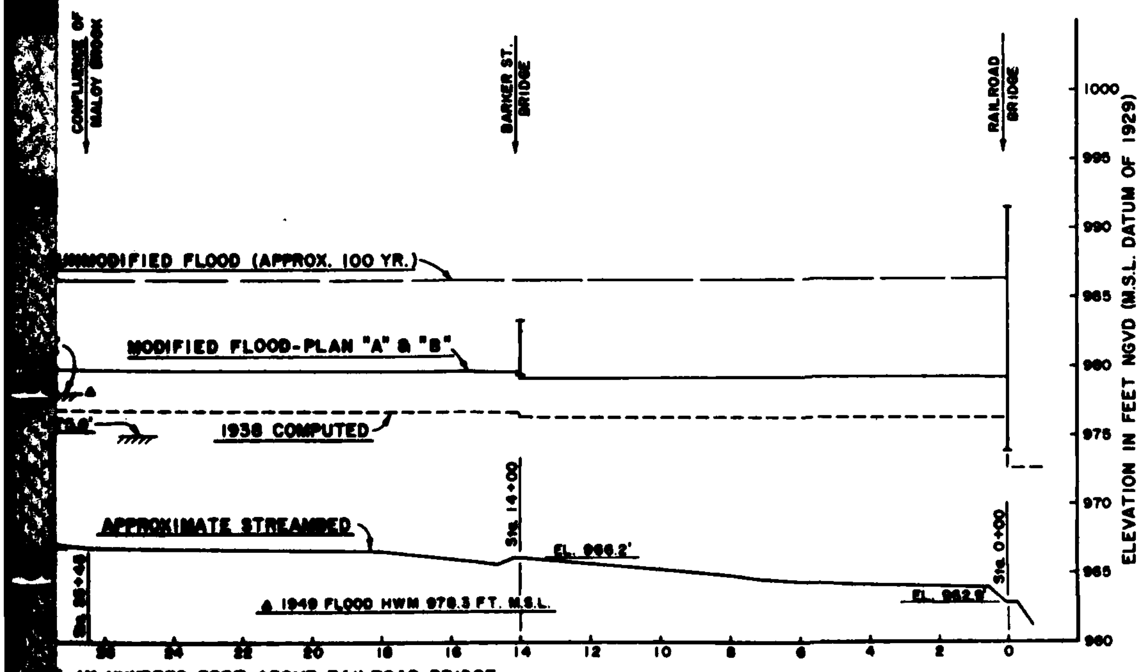


CORPS OF ENGINEERS
PITTSFIELD PLAZA
U.S. ROUTE 20
FOOTBRIDGE
UNMODIFIED FLOOD LIMITS
(APPROX. 100 YR.)
OSCEOLA PARK
SOUTHWEST
CADWELL RD. BRIDGE
FOOTBRIDGE
CONFLUENCE OF MALOY BROOK
ELEVATION IN FEET NGVD (M.S.L. DATUM OF 1929)
UNMODIFIED FLOOD (APPROX. 100 YR
PITTSFIELD PLAZA EL. 979.0'
MODIFIED FLOOD-PLAN "A"
SUNOCO STAT. EL. 975.0'
1938 COMPUTED
EL. 969.3'
EL. 968.2'
EL. 966.9'
APPROXIMATE STREAMBED
1949 FLOOD H
Sta. 43+18
Sta. 32+45
Sta. 26+45
DISTANCE IN HUNDRED FEET ABOVE RAILRO
SOUTHWEST BRANCH PROFIL



PLAN

SCALE: 1" = 200'



UTHWEST BRANCH PROFILE

2

N

GRAPHIC SCALE

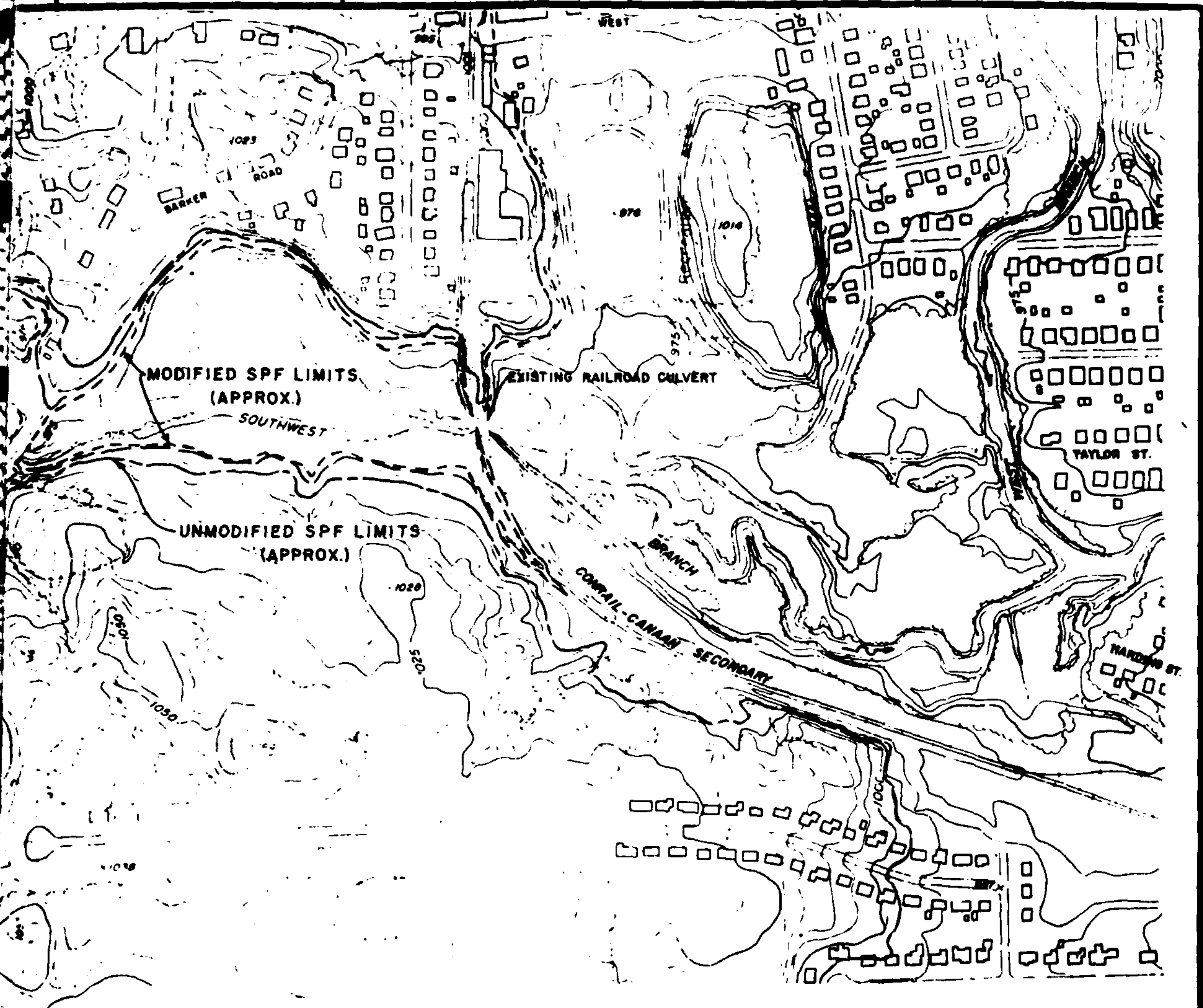
200' 0 200' 400'

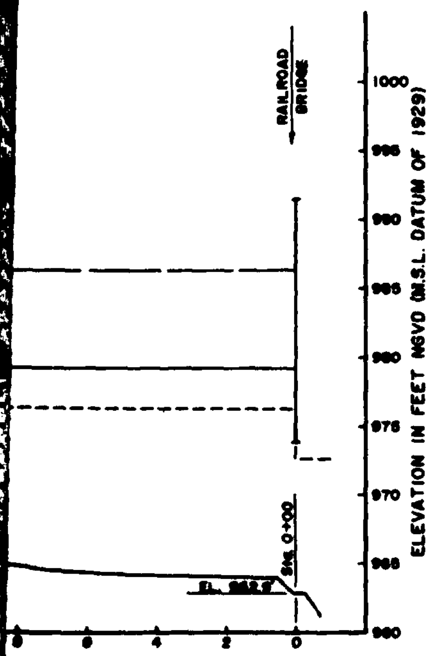
NOTE:

ELEV

DES. BY	DR. BY	CK. BY
SUBMITTED:		
CHIEF, CIVIL ENGR. SECTION		
APPROVAL RECOMMENDED:		
CHIEF, DESIGN BRANCH		
REVIEWED:		
PROJECT ENGINEER		
APPROVAL RECOMMENDED:		
CHIEF, PROJECT BRANCH		

3





GRAPHIC SCALE

NOTE:
ELEVATIONS REFER TO MEAN SEA LEVEL.

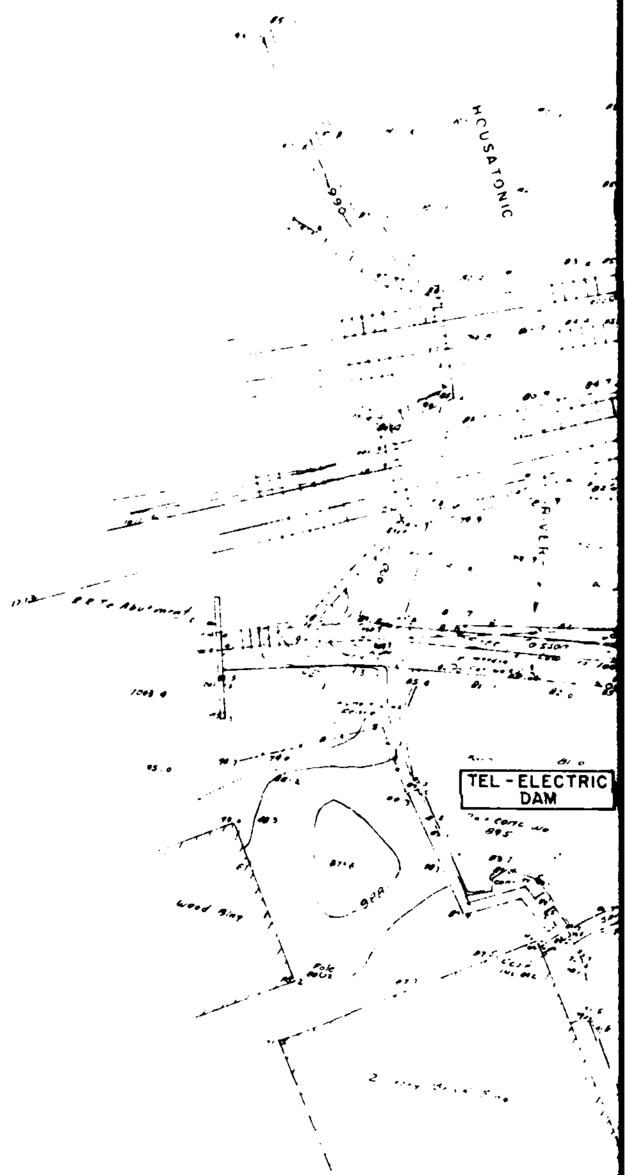
DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.

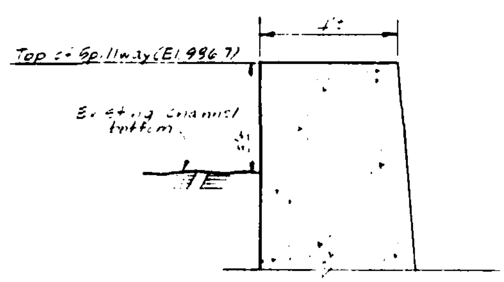
WATER RESOURCES DEVELOPMENT PROJECT
PITTSFIELD, MASSACHUSETTS
LOCAL PROTECTION PROJECT
GENERAL PLAN AND PROFILE
SOUTH-WEST BRANCH, HOUSATONIC RIVER MASS.

SCALE: AS SHOWN

3

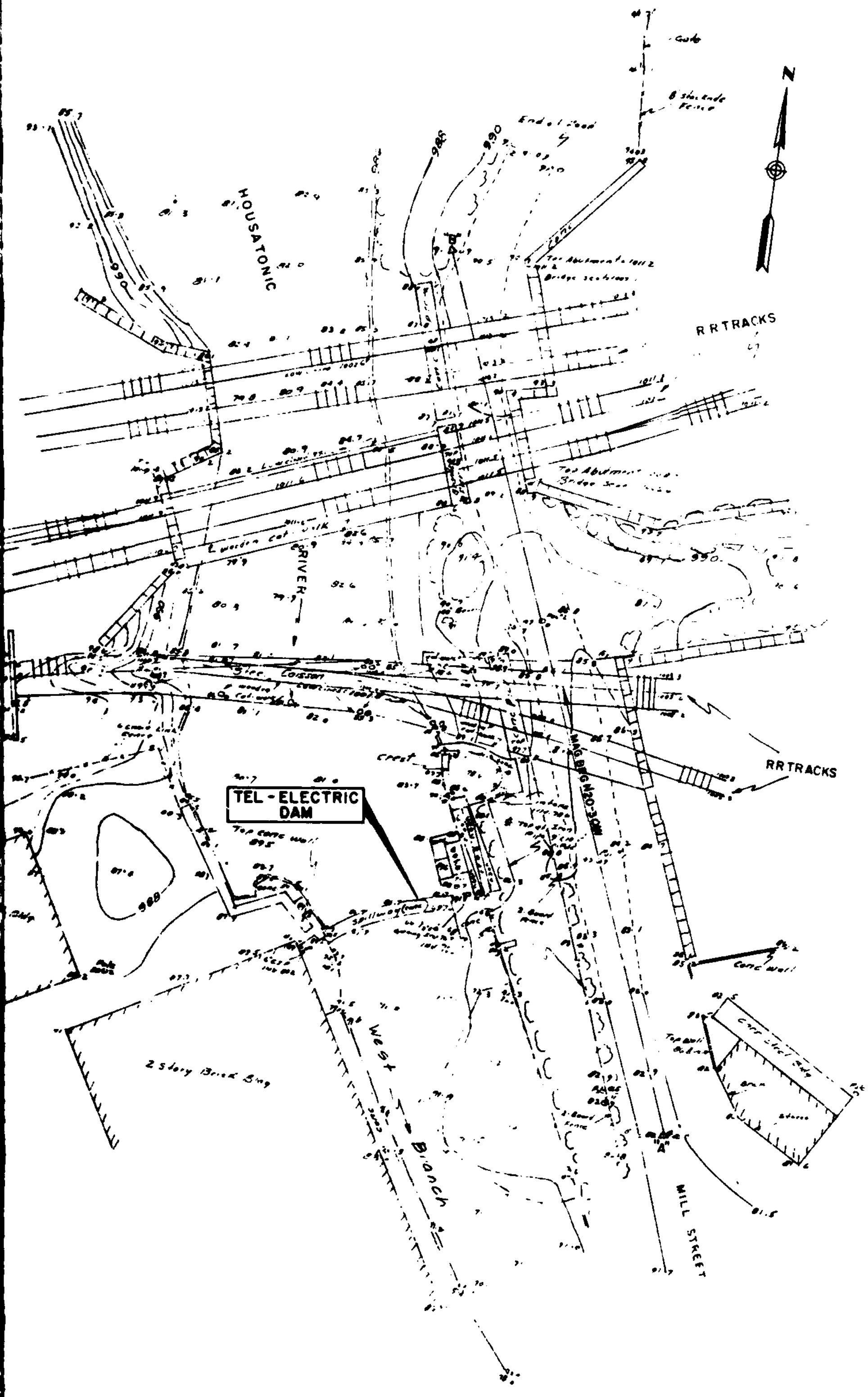
PLATE 3



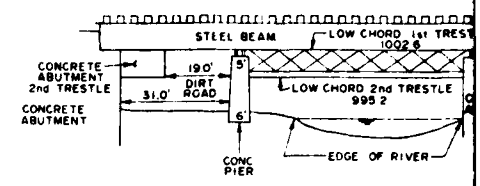


TYPICAL SPILLWAY SECTION
(EXISTING)
SCALE 1"=2'

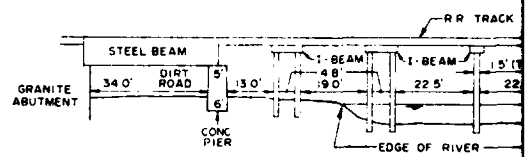
Plate 4



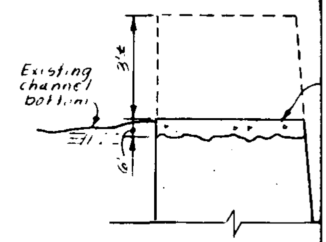
PLAN
SCALE: 1" = 20'



BRIDGE SECTION
(LOOKING DOWNSTREAM)
SCALE: 1" = 20'



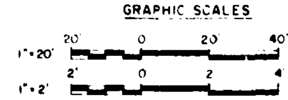
BRIDGE SECTION
(LOOKING DOWNSTREAM)
SCALE 1" = 20'



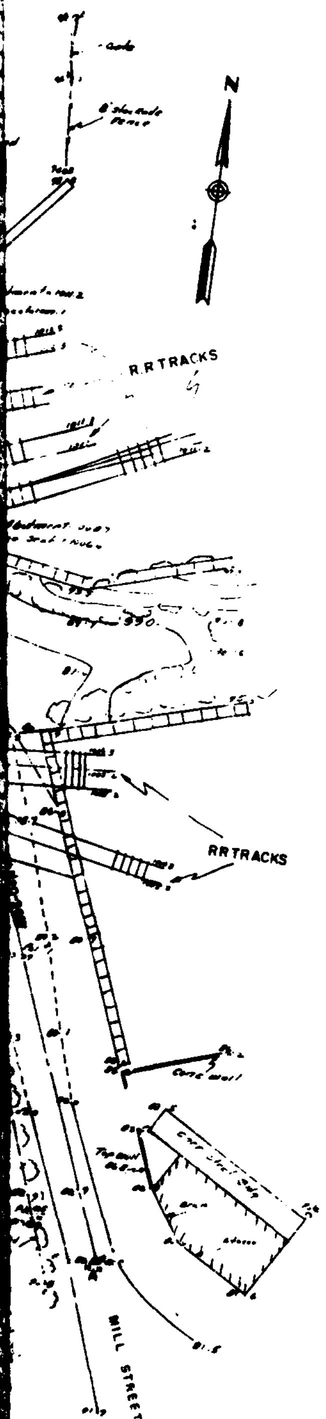
TYPICAL SPILLWAY SECT
(PROPOSED)
SCALE: 1" = 2'

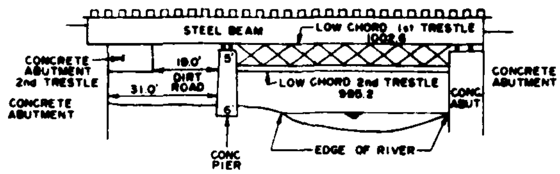
NOTE
Eleva

GRAPHIC SCALES



E F G H U. S. ARMY

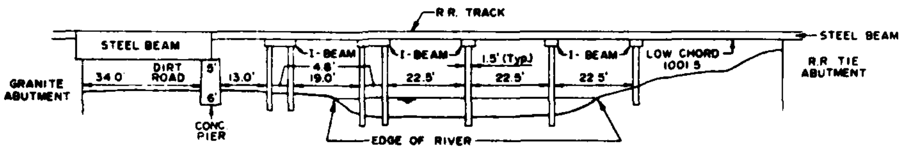




BRIDGE SECTION

(LOOKING DOWNSTREAM)

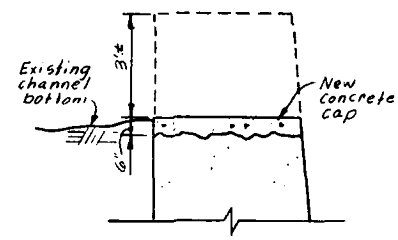
SCALE: 1" = 20'



BRIDGE SECTION

(LOOKING DOWNSTREAM)

SCALE: 1" = 20'



TYPICAL SPILLWAY SECTION

(PROPOSED)

SCALE: 1" = 2'

NOTE:
Elevations refer to mean sea level.

GRAPHIC SCALES

REVISION	DATE	DESCRIPTION	BY

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

WATER RESOURCES DEVELOPMENT PROJECT
PITTSFIELD, MASSACHUSETTS

LOCAL PROTECTION PROJECT

PROJECT PLAN AND SECTIONS

WEST BRANCH, HOUSATONIC RIVER MASS.

APPROVED DATE

SCALE AS SHOWN SPEC. NO.

DRAWING NUMBER

3

SHEET 4

PLATE 4

CORPS OF ENGINEERS

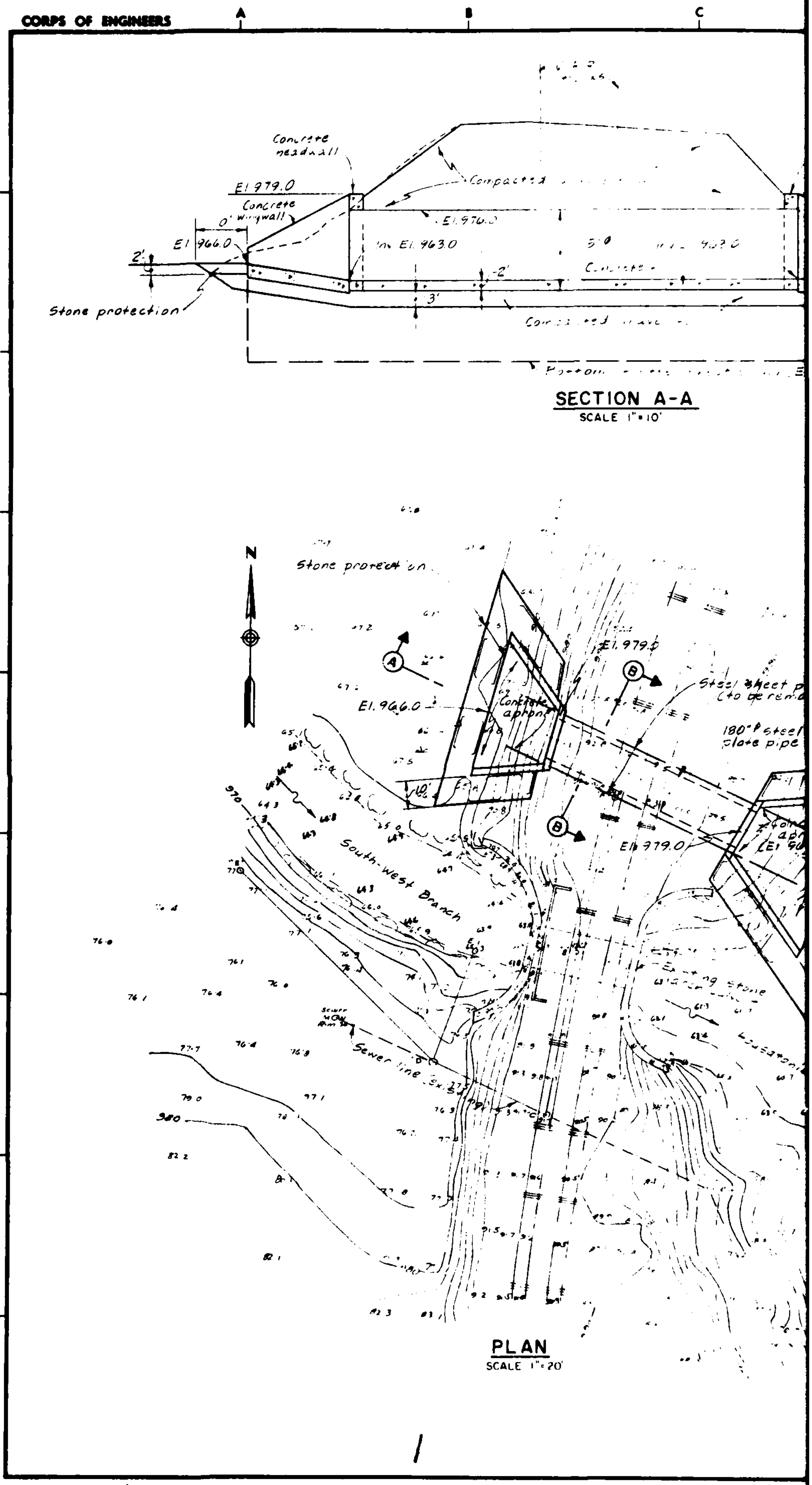
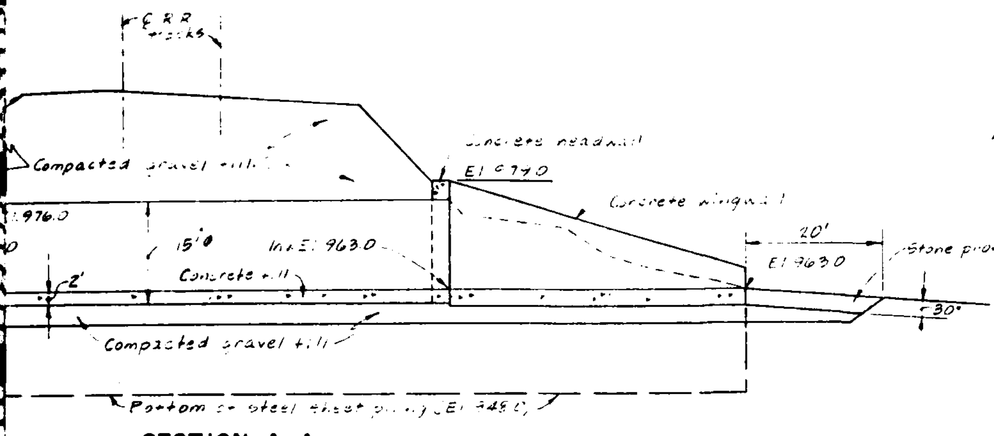
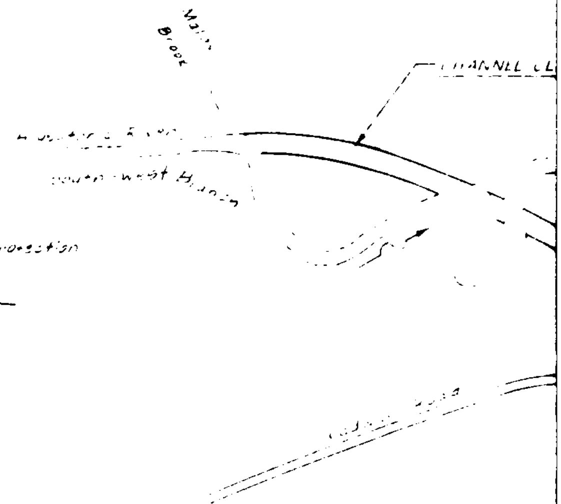
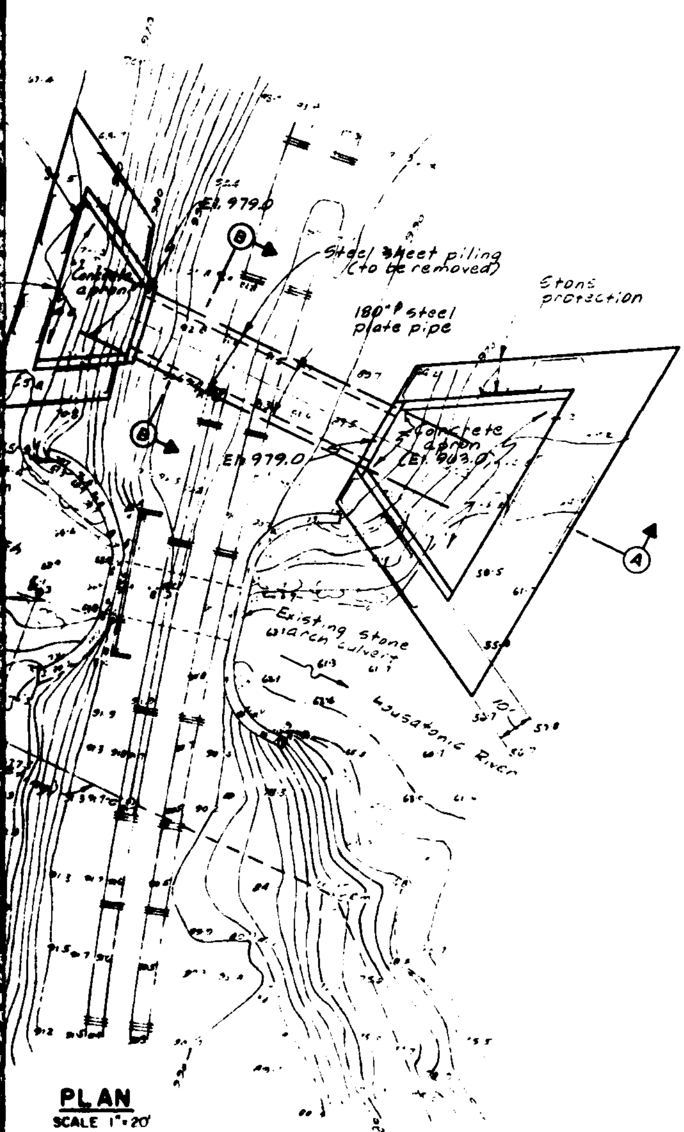


Plate 5

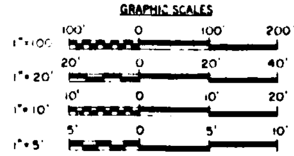


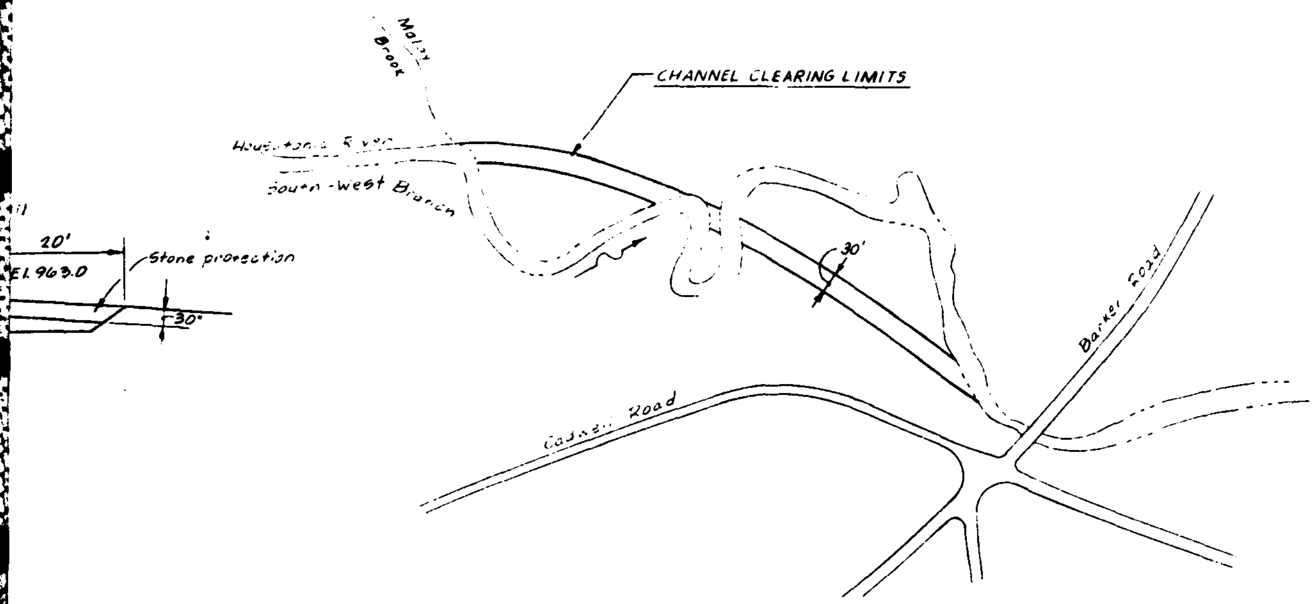
SECTION A-A
SCALE: 1"=10'



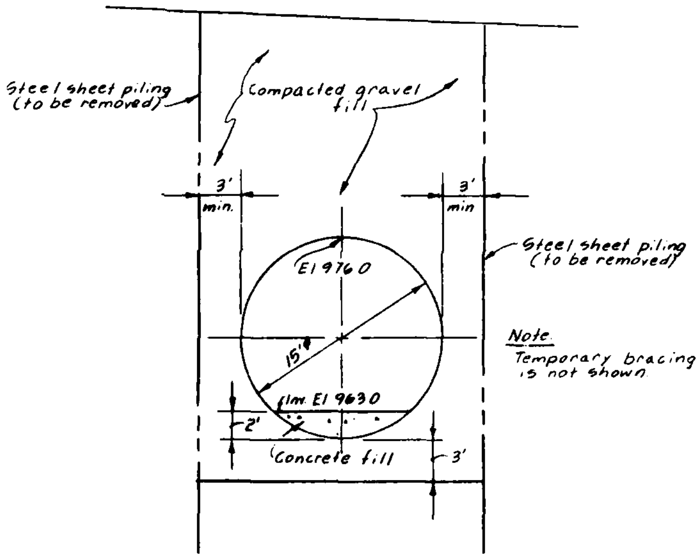


PLAN
SCALE 1"=20'





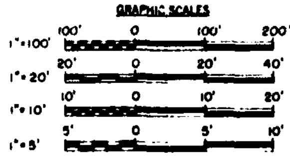
PLAN
SCALE: 1" = 100'



SECTION B-B
SCALE: 1" = 5'

NOTE:
Elevations refer to mean sea level.

GRAPHIC SCALES



REVISION	DATE	DESCRIPTION	BY

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

WATER RESOURCES DEVELOPMENT PROJECT
PITTSFIELD, MASSACHUSETTS

LOCAL PROTECTION PROJECT
PROJECT PLAN AND SECTIONS
SOUTH-WEST BRANCH, HOUSATONIC RIVER MASS.

APPROVED DATE

SCALE: AS SHOWN SPEC. NO.
DRAWING NUMBER

3

SHEET 5

APPENDIX 4

Section C - Specifications for Pipeline
Occupancy of Consolidated Rail Corporation Property

INDEX

CE-8
4/1/76

SPECIFICATIONS

FOR

PIPELINE OCCUPANCY

OF

CONSOLIDATED RAIL CORPORATION

PROPERTY

Recommended:

Asst. Chief Engineer-Structures

Approved:

Chief Engineer

1. SCOPE

A. These specifications apply to the design and construction of pipelines carrying flammable and non-flammable substances and casings over 4-inches containing wires and cables, under, across and along Railroad property and facilities and tracks owned by others over which the Railroad operates its equipment.

2. APPLICATION FOR OCCUPANCY

A. Individuals, Corporations and Municipalities (known as the Owner) desiring occupancy of railroad property by such pipe line occupations must agree, upon approval of the construction details by the Office of the Chief Engineer of Railroad, to execute an appropriate occupational agreement and pay any required fees and/or rentals outlined therein.

B. Application for an occupancy shall be by letter addressed to Assistant Vice President - Contracts, Consolidated Rail Corporation, Room 801, 1528 Walnut Street, Philadelphia, PA 19102, giving the following:

(1) Name of Individual, Corporation or Municipality desiring the occupancy

(2) Complete mailing address of applicant

(3) Name and title of person who will sign the agreement

(4) The State in which the applicant is incorporated.

C. All applications shall be accompanied with eight (8) copies of all construction plans and three (3) copies of specifications and computations concerning the proposed occupancy.

3. APPROVAL OF PLANS

A. No entry upon railroad property for the purpose of conducting surveys, field inspections, obtaining soil information, or any other purpose associated with the design and engineering of the proposed occupancy, will be permitted without a proper entry permit (Form CE-17) prepared by the Chief Engineer of the Railroad or his designated representative and executed by the applicant. It is to be clearly understood that the issuance of such a permit does not constitute authority to proceed with the actual construction which cannot begin until a formal agreement is finally executed by the Railroad Company and permission is received by the Owner from the designated inspection agency of the Railroad to proceed.

B. Plans for proposed pipeline occupations shall be submitted to and meet the approval of the Chief Engineer of Railroad prior to start of construction. These plans are to be prepared in sizes as small as possible and are to be folded to an 8½ inch by 11-inch size (folded dimensions) with a 1½ inch margin on the left hand side and a 1-inch margin on the top so that they can be secured in a file at the upper left hand corner and still be unfolded to full size without being removed from the file.

Also, after folding, the title block and other identification of the plans shall be visible at the lower right hand corner, without the necessity of unfolding. Each plan shall bear an individually identifying number and an original date, together with subsequent revision dates, clearly identified on the plan so as to be readily apparent as to just what revisions were made and when.

All plans are to be individually folded and where more than one plan is involved, they shall be assembled into complete sets before submission to the Railroad.

C. Plans shall be drawn to scale and show the following (see Plates I, II, III, & IV)

(1) Plan view of proposed pipeline in relation to all Railroad facilities (see Plate I).

(2) Location of pipe (in feet) from nearest Railroad milepost, centerline of a Railroad bridge (giving bridge number), or centerline of an existing or former passenger station. In all cases, the name of the County in which the proposed facilities are located must be shown. In States where Townships, Ranges, and Sections are used, give distance in feet to the nearest Section line and identify the Section number, Township and Range

(3) Profile of ground on centerline of pipe from field survey showing relationship of pipe and casing to ground level, tracks and other facilities (see Plate II). For longitudinal occupations, the profile of adjacent track or tracks must be shown (see Plate III).

(4) All Railroad property lines. If pipeline is in a public highway, the limits of the right-of-way for the highway shall be clearly indicated with dimensions from centerline.

(5) The angle of crossings in relation to centerline of tracks.

(6) Location of valves or control stations of the pipeline.

(7) "Pipe Crossing Data Sheet" completed and put on plan (see Plate IV).

D. The plan must be specific (on Railroad property and under tracks that are not on Railroad property) as to:

(1) Method of installation (see Paragraph 15-C).

(2) Size and material of casing pipe.

(3) Size and material of carrier pipe.

These three (3) items cannot have an alternative and any application received indicating such options will not be processed. Once an application is approved by the Chief Engineer, no variance from the plans, specifications, method of construction, etc., as approved in the occupancy document will be considered or permitted without the imposition by the Railroad of additional handling charges.

E. Location and dimensions of jacking, boring, or tunneling pits shall be shown with details of their sheeting and shoring. If the bottom of the pit excavation nearest the adjacent track intersects a line from a point 4.5 feet horizontally from center line of adjacent track at the plane of the base of rail drawn on a slope of 1½ horizontal to 1 vertical, the design and details of the pit construction with computations prepared by a Registered Professional Engineer shall be submitted for Railroad approval. In any event, the face of the pit shall be no less than 25 feet from adjacent track, unless otherwise approved by the Chief Engineer of the Railroad. Pits shall be fenced, lighted, and otherwise protected as directed by the Chief Engineer of the Railroad or his designated representative.

F. All plans and computations shall bear the seal of a Registered Professional Engineer. If not so imprinted, they will be given no further consideration. This includes plans submitted by contractors.

G. Computations for all structures involving the support or protection of Railroad track, embankment and facilities shall be prepared by and bear the seal of a Registered Professional Engineer and submitted with the construction plans.

H. When computer calculations are included with design calculations the following documentation shall be furnished as a minimum:

(1) A synopsis of the computer program(s) stating briefly required input, method of solution, approximations used, second order analysis incorporated, specifications or codes used, cases considered, output generated, extent of previous usage or certification of program(s) and program(s) author.

(2) Identification by number, indexing and cross referencing of all calculation sheets, including supplemental "long-hand" calculation sheets.

(3) Fully identified, dimensioned, and annotated diagram of each member or structure being considered.

(4) Clear identification and printing of all input and output values, including intermediate values if such values are necessary for orderly reviewal.

(5) Identification of the processing unit, input/output devices, storage requirements, etc., if such supplemental information is significant and necessary for evaluation of the submittal.

4. GENERAL REQUIREMENTS

A. Pipelines under Railroad tracks and across Railroad operating right-of-way shall be encased in a larger pipe or conduit called the casing pipe as indicated in Plate II.

B. Casing pipe will be required for all pipelines carrying oil, gas, petroleum products, or other flammable or highly volatile substances under pressure, and all non-flammable substances which, from their nature or pressure, as determined by the Chief Engineer, might cause damage if escaping on or near Railroad property.

C. For non-pressure sewer or drainage crossings where the installation can be made without interference to Railroad operations, as determined by the Chief Engineer, the casing pipe may be omitted when the pipe strength is capable of withstanding Railroad loading hereinafter specified.

D. The casing pipe shall be laid across the entire width of the right-of-way unless the right-of-way line on either side of the tracks is less than the minimum length of casing specified in Para. 6J even though such extension is beyond the right-of-way.

E. Pipelines laid longitudinally on railroad rights-of-way shall be located as far as practicable from any tracks or other important structures and as close to the Railroad property line as possible. If located within 25 feet of the centerline of any track or closer than 45 feet to nearest point of any bridge, building or other important structure, the carrier pipe shall be encased (see also Para. 11C and Plate III)

F. Pipelines shall be located, where practicable, to cross tracks at approximate right angles thereto, but preferably at not less than 45 degrees.

G. Pipelines shall not be placed within a culvert, under Railroad bridges, nor closer than 45 feet to any portion of any Railroad bridge, building, or other important structure, except in special cases, and then by special design, as approved by the Chief Engineer.

H. Pipelines carrying liquified petroleum gas shall, where practicable, cross the Railroad where tracks are carried on embankment.

I. Any replacement or modification of an existing carrier pipe and/or casing shall be considered a new installation, subject to the requirements of these specifications.

J. Where laws or orders of public authority prescribe a higher degree of protection than specified herein, then the higher degree so prescribed shall be deemed a part of these specifications.

K. Pipelines and casings shall be suitably insulated from underground conduits carrying electric wires on Railroad property.

CE 4/

5. CARRIER PIPE

A. Pipelines carrying oil, liquefied petroleum gas, natural or manufactured gas and other flammable products shall conform to the requirements of the current ANSI B 31.4, with Addenda, Liquefied Petroleum Transportation Piping Systems," ANSI B 31.8, "Gas Transmission and Distribution Piping Systems," and other applicable ANSI Codes, except that the maximum allowable stresses for design of steel pipe shall not exceed the following percentages of the specified minimum yield strength (multiplied by the longitudinal joint factor) of the pipe as defined in the ANSI Codes:

(1) Steel pipe within a casing, under Railroad tracks, across Railroad rights-of-way, and longitudinally on Railroad rights-of-way. (The following percentages apply to hoop stress):

(a) Seventy-two percent for installation on oil pipelines.

(b) Fifty percent for pipelines carrying liquefied petroleum gas and other flammable liquids with low flash point

(c) Sixty percent for installations on gas pipelines.

(2) Steel pipe without a casing laid longitudinally on Railroad rights-of-way or on Railroad property. (The following percentages apply to hoop stress):

(a) Sixty percent for installations on oil pipelines.

(b) Forty percent for pipelines carrying liquefied petroleum gas and other flammable liquids with low flash point.

(c) Forty percent for installations on gas pipelines.

Design computations showing compliance with the requirements of Paragraphs 5A(1) & 5A(2) prepared by a Registered Professional Engineer, shall accompany the application for occupancy.

If the maximum allowable stress in the carrier pipe on either side of the occupancy of Railroad property is less than specified above, the carrier pipe on Railroad property shall be designed at the same stress as the adjacent carrier pipe.

Requisites for carrier pipe under Railroad tracks shall apply for a minimum distance of 50 feet (measured at right angles) from centerline of outside tracks, or 2 feet beyond toe of slope, or 25 feet beyond the ends of casing, whichever is greater.

Carrier pipes within a casing shall be designed for Railroad live loads as if they were not encased.

All pipes shall be designed for the external and internal loads to which they will be subjected. The dead load of earth shall be considered 120 pounds per cubic foot. Railroad live loading shall be Cooper's E-80 with 50% added for impact. In any event on Railroad property or where Railroad loading will be experienced, the following shall be the minimum requirements for carrier pipes:

A. Reinforced concrete pipe—ASTM Spec. C-76, Class V, Wall C

B. Ductile Iron Pipe - ANSI Spec A21.51, Class 6

C. Cast Iron Pipe - For Culverts and Gravity Sewers - ASTM Spec. A-142 Extra Heavy

Cast Iron Pipe for water and other materials under pressure shall conform to the current ANSI specifications A-21 Series 21/45 Iron strength with plain end, compression type or mechanical joints. The strength to sustain external Railroad and other loadings shall be computed in accordance with the current ANSI A-21.1 "Thickness Design of Cast Iron Pipe".

D. Vitrified Clay Pipe - ASTM Spec. C-700, Extra Strength

E. Corrugated Metal Pipe - AREA Spec. Chapter 1, Part 4.

F. Asbestos Cement Pipe - Non pressure: ASTM Spec. C-428, Cl. 5000 Min.
Pressure: AWWA Spec. C-400, Cl. 150 Min.

G. Others - as approved by Chief Engineer.

All pipes, ditches and other structures carrying surface drainage on Railroad property and/or crossing under Railroad tracks shall be designed to carry the run-off from a one hundred (100) year storm. Computations indicating this design and suitable topographic plans, prepared by a Registered Professional Engineer, shall be submitted for Railroad approval. If the drainage is to discharge into an existing drainage channel on Railroad right-of-way and/or under Railroad tracks, the computations should include the hydraulic analysis of any existing structures. Submitted with the computations should be formal approval of the proposed design by the appropriate governmental agency.

Carrying pipes shall be laid with sufficient slack so that they are not in tension.

6. CASING PIPE

A. Casing pipe and joints shall be of metal and of leakproof construction, designed for the earth and/or other pressures present, plus a Cooper's E-80 Railroad live loading with 50% added for impact.

LIVE LOADS, INCLUDING IMPACT, FOR VARIOUS HEIGHTS OF COVER FOR COOPER E 80

HGT/COVER (FT)	LOAD	HGT/COVER (FT)	LOAD	HGT/COVER (FT)	LOAD LB/FT^2
2	3800	10	1100	20	300
5	2400	12	800	30	100
8	1600	15	600		

TABLE OF MINIMUM WALL THICKNESS FOR STEEL CASING PIPE
(For Information Only)

Nominal Thickness - Inches

Coated or Cathodically Protected	Uncoated and Unprotected	Nominal Diameter Inches	Coated or Cathodically Protected	Uncoated and Unprotected	Nominal Diameter Inches
0.188	0.251	Under 14	0.406	0.469	28 & 30
0.219	0.282	14 & 16	0.438	0.501	32
0.250	0.313	18	0.469	0.532	34 & 36
0.281	0.344	20	0.500	0.563	38, 40 & 42
0.312	0.375	22	0.563	0.626	48
0.344	0.407	24	0.625	0.688	54
0.375	0.438	26			

Smooth wall steel pipes with a nominal diameter of over 54 inches will not be permit

B. Steel pipe shall have a minimum yield strength of 35,000 psi.

C. Cast iron pipe may be used for a casing, provided the method of installation is by open trench only. Cast iron pipe shall conform to the current ASTM Specifications A-142, Extra Heavy. The pipe shall be of the mechanical joint type or plain end type with compression type couplings.

D. Corrugated metal pipe and corrugated structural plate pipe may be used for casing only when emplaced by the open-cut method. Jacking or boring through Railroad embankment is not permitted. Pipe shall be asbestos-bonded, bituminous coated and shall conform to the current American Railway Engineering Association Specifications Chapter 1, Part 4.

E. Tunnel liner plates shall be galvanized and bituminous coated and shall conform to the current American Railway Engineering Association Specifications Chapter 1, Part 4. In no event shall the liner plate thickness be less than 0.1046 inches.

If the tunnel liner plates are used only to maintain a tunneled opening until the carrier pipe is installed, and the carrier pipe is installed and the annular space between the carrier pipe and the tunnel liner is completely filled with cement grout within a reasonably short time after completion of the tunnel, then the tunnel liner plates need not be galvanized and coated.

F. Reinforced concrete pipe may be used for a casing. It shall conform to the current ASTM Specifications C-76, Class V, Wall C. It shall be used only in the open cut and jacking methods of installation.

If concrete pipe is to be jacked into place, grout holes tapped for no smaller than 1½ inch pipe spaced at approximately 3 feet around the circumference and approximately 4 feet longitudinally shall be cast into the pipe at manufacture. Immediately upon completion of jacking operations, the installation shall be pressure grouted as specified in Paragraph 15C(3)a herein.

G. The inside diameter of the casing pipe shall be such as to allow the carrier pipe to be removed subsequently without disturbing the casing or the roadbed. For steel pipe casings, the inside diameter of the casing pipe shall be at least two (2) inches greater than the largest outside diameter of the carrier pipe joints or couplings, for carrier pipe less than six (6) inches in diameter; and at least four (4) inches greater for carrier pipe six (6) inches and over in diameter.

For flexible casing pipe, a minimum vertical deflection of the casing pipe of 3 percent of its diameter, plus 1/2 inch, shall be provided so that no loads from the roadbed, track, traffic or casing pipe itself are transmitted to the carrier pipe. When insulators are used on the carrier pipe, the inside diameter of the flexible casing pipe shall be at least two (2) inches greater than the outside diameter of the carrier pipe for pipe less than eight (8) inches in diameter; at least 3-1/4 inches greater for pipe 8 inches to 16 inches, inclusive, in diameter; and at least 4-1/2 inches greater for pipe 18 inches and over in diameter. In no event shall the casing pipe diameter be greater than is necessary to permit the insertion of the carrier pipe.

I. When steel casing pipe is used, the joints shall be fully welded completely around the circumference of the pipe.

J. Casing pipe under Railroad tracks and across Railroad rights-of-way shall extend the <u>Greater</u> of the following distances, measured at right angles to centerline of track:

1. Across the entire width of Railroad right-of-way (See paragraph 4D).
2. Three (3) feet beyond ditch line.
3. Two (2) feet beyond toe of slope.
4. A minimum distance of 25 feet each side from centerline of outside track when casing is sealed at both ends.
5. A minimum distance of 45 feet from centerline of outside track when casing is open at both ends.
6. The distance 1.5 (C + D) + 4.5 feet as indicated on Plate II.

K. If additional tracks are constructed in the future, the casing shall be extended correspondingly at the expense of the owner.

7. PROTECTION AT ENDS OF CASING

A. Casings for carriers of flammable substances shall be suitable sealed to the outside of the carrier pipe. Details of seals shall be shown on the plans.

B. Casings for carriers of non-flammable substances shall have both ends of the casing blocked up in such a way as to prevent the entrance of foreign material, but allowing leakage to pass in the event of a carrier break.

C. Where ends of casings are at or above ground surface and above high water level, they may be left open, provided drainage is afforded in such a manner that leakage will be conducted away from railroad tracks and structures.

8. VENTS

A. Sealed casings for flammable substances shall be properly vented. Vent pipes shall be of sufficient diameter, but in no case less than two (2) inches in diameter, and shall be attached near each end of the casing and project through the ground surface at right-of-way lines or not less than 45 feet (measured at right angles) from centerline of nearest track.

B. Vent pipes shall extend not less than four (4) feet above the ground surface. Top of vent pipe shall have a down-turned elbow, properly screened, or a relief valve. Vents in locations subject to high water shall be extended above the maximum elevation of high water and shall be supported and protected in a manner approved by the Chief Engineer.

C. Vent pipes shall be at least four (4) feet (vertically) from aerial electric wires.

D. When the pipeline is in a public highway, street-type vents shall be installed.

9. SIGNS

A. All pipelines (except those in streets where it would not be practical to do so) shall be prominently marked at rights-of-way (on both sides of track for undercrossings) by durable, weatherproof signs located over the centerline of the pipe. Signs shall show the following:

1. Name and address of Owner
2. Contents of Pipe
3. Pressure in Pipe
4. Depth below grade at point of sign
5. Emergency telephone in event of pipe rupture

For pipe lines running longitudinally on Railroad property, signs shall be placed over the pipe (or offset and appropriately marked) at all changes in direction of the pipe line. Such signs should also be located so that when standing at one sign the next adjacent marker in either direction is visible. In no event shall they be placed less than 500 feet apart unless otherwise specified by the Chief Engineer of the Railroad.

10. SHUT-OFF VALVES

A. Accessible emergency shut-off valves shall be installed within distances each side of the Railroad at locations selected by the Chief Engineer of the Railroad where hazard to life and property should be guarded against. Where pipelines are provided with automatic control stations and within distances approved by the Chief Engineer, no additional valves will be required.

11. DEPTH OF INSTALLATION

A. Casing pipe under Railroad tracks and across Railroad rights-of-way shall be not less than 5-1/2 feet from base of rail to top of casing at its closest point, except that under secondary or industry tracks this distance may be 4-1/2 feet as approved by the Chief Engineer. On other portions of rights-of-way where casing is not directly beneath any track, the depth from ground surface or from bottom of ditches to top of casing shall be not less than three (3) feet, unless otherwise specified herein.

B. Pipelines laid longitudinally on Railroad rights-of-way, 50 feet or less from centerline of track, shall be buried not less than five (5) feet from ground surface to top of pipe for pipelines carrying oil, gas, petroleum products, or other flammable or highly volatile substances under pressure and all non-flammable substances which by their nature or pressure in the judgment of the Chief Engineer may be hazardous to life or property. For pipelines carrying water, sewage and non-flammable substances, the distance from surface of ground to top of pipe may be four (4) feet.

C. The pipeline is subjected to Railroad loading and it shall require a casing or be of special design approved by the Chief Engineer when it is within the line of track live load influence as shown on Plate III.

D. Where pipeline is laid more than 50 feet from centerline of track, the minimum cover shall be at least three (3) feet.

12. INSPECTION AND TESTING

A. For pipelines carrying flammable or hazardous materials, ANSI Codes B 31.8 and B 31.4, current at time of constructing the pipeline, shall govern the inspection and testing of the facility on Railroad property, except that proof-testing of strength of carrier pipe shall be in accordance with the requirements of ANSI Code B 31.8 for location Classes 2, 3, or 4 or ANSI Code B 31.4, as applicable, for all pipelines carrying oil, liquified petroleum gas, natural or manufactured gas, and other flammable substances.

13. CATHODIC PROTECTION

A. Cathodic protection shall be applied to all pipelines and casings carrying flammable substances.

B. Where casing and/or carrier pipe is cathodically protected by other than anodes, the Chief Engineer shall be notified and suitable test shall be made, witnessed by the Railroad to insure that other Railroad structures and facilities are adequately protected from the cathodic current in accordance with the recommendations of Reports of Correlating Committee on Cathodic Protection, current issue by The National Association of Corrosion Engineers.

14. SOIL INVESTIGATIONS

A. For all pipe crossings 60 inches in diameter and larger under tracks, and at other locations the Chief Engineer may direct, soil borings or other soil investigations approved by the Railroad shall be made to determine the nature of the underlying material. (See Paragraph 3A relative to Procedures)

B. For pipe crossings less than 60 inches in diameter under tracks, and at other locations as the Chief Engineer may direct, soil borings or other approved investigations may be required when, in the judgment of the Chief Engineer, they are necessary to determine the adequacy of the design and construction of the facilities.

C. Borings shall be made on each side of the tracks, on the centerline of the pipe crossing, and as close to the tracks as practicable. (See Paragraph 3A relative to Procedures)

D. Soil borings shall be in accordance with the current issue of the American Railway Engineering Association Specifications, Chapter 1, Part 1, "Specifications for Test Borings." Soils shall be investigated by the split-spoon and/or thin-walled tube method and rock by the Coring method specified therein, as appropriate.

E. Soil boring logs shall clearly indicate All of the following: (Plate VI

(1) Boring number as shown on boring location plan
(2) Elevation of ground at boring, using same datum as the pipeline construction plans
(3) Description or soil classification of soils and rock encountered
(4) Elevations or depth from surface for each change in strata
(5) Identification of where samples were taken and percentage of recovery
(6) Location of ground water at time of sampling and, if available, subsequent readings
(7) Natural dry density in Lbs./Sq.ft. for all strata
(8) Unconfined compressive strength in Tons/Sq.ft. for all strata
(9) Water content (Percent). Liquid limit (Percent) and Plastic limit (Percent)
(10) Standard penetration in Blows/ft.

The location of the carrying pipe and casing shall be superimposed on the Boring logs before submission to the Chief Engineer.

Soil investigations by Auger, Wash, or Rotary drilling are not acceptabl

F. Soil Boring logs shall be accompanied with a plan drawn to scale showing location of borings in relation to the tracks and the proposed pipe location, the elevation of ground surface at each boring, and the elevation of the base of rail of the tracks.

15. CONSTRUCTION

A. Casing pipe shall be so constructed as to prevent leakage of any substance from the casing throughout its length, except at ends of casing where ends are left open, or through vent pipes when ends of casing are sealed. Casing shall be installed so as to prevent the formation of a waterway under the Railroad, and with an even bearing throughout its length, and shall slope to one end (except for longitudinal occupancy).

B. Installations by open-trench methods will be permitted only with the approval of the Division Superintendent of the territory involved and shall comply with the current American Railway Engineering Association Specifications, Chapter 1, Part 4, "Installation of Pipe Culverts."

C. Casing pipes shall be installed by the following methods:

(1) Jacking - This method shall be in accordance with the current American Railway Engineering Association Specifications, Chapter 1, Part 4, "Jacking Culvert Pipe Through Fills." This operation shall be conducted without hand-mining ahead of the pipe and without the use of any type of boring, auguring, or drilling equipment.

Bracing and backstops shall be so designed and jacks of sufficient rating used so that the jacking can be progressed without stoppage (except for adding lengths of pipe) until the leading edge of the pipe is at least the distance 1.5 (C + D) + 4.5 feet (see Plate II) beyond the last track.

(2) Drilling - This method employs the use of an oil field type rock roller bit or a plate bit made up of individual roller cutter units which is solidly welded to the pipe casing being installed and which is turned as it is advanced. The pipe is turned for its entire length from the drilling machine to the head to give the bit the necessary cutting action against the ground being drilled. A high density slurry (oil field drilling mud) is injected through a small supply line to the head which acts as a cutter lubricant. This slurry is injected at the rear of the cutter units to prevent any jetting action ahead of the pipe. The drilling machine runs on a set of steel rails and is advanced (thus advancing the pipe) by a set of hydraulic jacks. The method is the same whether earth or rock is being drilled. Methods of a similar nature shall be submitted to the Chief Engineer for approval.

(3)a <u>Tunneling</u> - Tunneling operations shall be conducted as approved by the Chief Engineer. Care shall be exercised in trimming the surface of the excavated section in order that the steel liner plates fit snugly against undisturbed material. Excavation shall not be advanced ahead of the previously installed liner plates any more than is necessary for the installation of the succeeding liner plate. The vertical face of the excavation shall be supported as necessary to prevent sloughing. At any interruption of the tunneling operation, the heading shall be completely bulkheaded. Unless otherwise approved by the Chief Engineer, the tunneling shall be conducted continuously, on a 24-hour basis, until the tunnel liners extend at least the distance 1.5 (C + D) + 4.5 feet (see Plate II) beyond the centerline of the last track.

A uniform mixture of 1:6 cement grout shall be placed under pressure behind the liner plates to fill any voids existing between the liner plates and the undisturbed material. Grout holes tapped for no smaller than 1½-inch pipe, spaced at approximately 3 feet around the circumference of the tunnel liners, shall be provided in every third ring. Grouting shall start at the lowest hole in each grout panel and proceed upwards simultaneously on both sides of the tunnel. A threaded plug shall be installed in each grout hole as the grouting is completed at that hole.

Grouting shall be kept as close to the heading as possible, using grout stops behind the liner plates if necessary. Grouting shall proceed as directed by the Chief Engineer, but in no event shall more than six lineal feet of tunnel be progressed beyond the grouting.

b <u>Tunneling Shields</u> - All pipes 60 inches and larger in diameter shall be emplaced with the use of a tunneling shield, unless otherwise approved by the Chief Engineer. Pipes of smaller diameter may also require a shield when, at the sole discretion of the Chief Engineer, soil or other conditions indicate its need.

The shield shall be of steel construction, designed to support railroad track loading as specified in Paragraph 6A herein, in addition to other loadings it must sustain. The advancing face shall be provided with a hood, extending no less than 20 inches beyond the face and extending around no less than the upper 240° of the total circumference. It shall be of sufficient length to permit the installation of at least one complete ring of liner plates within the shield before it is advanced for the installation of the next ring of liner plates. It shall conform to and not exceed the outside dimensions of the pipe being emplaced by more than one inch at any point on the periphery unless otherwise approved by the Chief Engineer.

It shall be adequately braced and provided with necessary appurtenances for completely bulkheading the face with horizontal breastboards, and arranged so that the excavation can be benched as may be necessary. Excavation shall not be advanced beyond the edge of the hood, except in rock.

Manufacturer's Shop Detail plans and manufacturer's computations showing the ability of the tunnel liner plates to resist the jacking stresses shall be submitted to the Chief Engineer for approval.

For jacking reinforced concrete pipe, the shield shall be fabricated as a special section of reinforced concrete pipe with the steel cutting edge, hood, breasting attachments, etc., cast into the pipe. The wall thickness and reinforcing shall be designed for the jacking stresses.

Grout holes tapped for no less than 1½-inch pipe, spaced at approximately 3 feet centers around the circumference of the shield (or the aforementioned special reinforced concrete section) and no more than 4 feet centers longitudinally shall be provided.

Detail plans sufficient to determine the adequacy of the shield, accompanied with design calculations prepared by a Registered Professional Engineer, shall be submitted to the Chief Engineer for approval and no work shall proceed until such approval is obtained.

(4) Boring - This method consists of pushing the pipe into the fill with a boring auger rotating within the pipe to remove the spoil. When augers, or similar devices, are used for pipe emplacement, the front of the pipe shall be provided with mechanical arrangements or devices that will positively prevent the auger and cutting head from leading the pipe so that there will be no unsupported excavation ahead of the pipe. The auger and cutting head arrangement shall be removable from within the pipe in the event an obstruction is encountered. The over-cut by the cutting head shall not exceed the outside diameter of the pipe by more than one-half inch. The face of the cutting head shall be arranged to provide reasonable obstruction to the free flow of soft or poor material.

The use of water or other liquids to facilitate casing emplacement and spoil removal is prohibited.

Plans and descriptions of the arrangement to be used shall be submitted to the Chief Engineer for approval and no work shall proceed until such approval is obtained.

Any method which employs simultaneous boring and jacking or drilling and jacking for pipes over 8 inches in diameter which does not have the above approved arrangement WILL NOT BE PERMITTED. For pipes 8 inches and less in diameter, augering or boring without this arrangement may be considered for use only as approved by the Chief Engineer.

D. If an obstruction is encountered during installation to stop the forward action of the pipe, and it becomes evident that it is impossible to advance the pipe, operations will cease and the pipe shall be abandoned in place and filled completely with grout.

E. Bored or jacked installations shall have a bored hole essentially the same as the outside diameter of the pipe plus the thickness of the protective coating. If voids should develop or if the bored hole diameter is greater than the outside diameter of the pipe (plus coating) by more than approximately 1 inch, grouting or other methods approved by the Chief Engineer shall be employed to fill such voids.

F. Pressure grouting of the soils or freezing of the soils before jacking, boring, or tunneling may be required at the direction of the Chief Engineer to stabilize the soils, control water, prevent loss of material and prevent settlement or displacement of embankment. Grout shall be cement, chemical or other special injection material selected to accomplish the necessary stabilization.

G. The materials to be used and the method of injection shall be prepared by a Registered Professional Soils Engineer, or by an experienced and qualified company specializing in this work and submitted for approval to the Chief Engineer before the start of work. Proof of experience and competency shall accompany the submission.

H. When water is known or expected to be encountered, pumps of sufficient capacity to handle the flow shall be maintained at the site and, upon approval of the Railroad to operate them, they shall be in constantly attended operation on a 24-hour basis until, in the sole judgment of the Railroad, their operation can be safely halted. When dewatering, close observation shall be maintained to detect any settlement or displacement of railroad embankment, tracks, and facilities.

I. All operations shall be conducted so as not to interfere with, interrupt, or endanger the operation of trains nor damage, destroy, or endanger the integrity of railroad facilities. All work on and near railroad property shall be conducted in accordance with railroad safety rules and regulations. The contractor shall secure and comply with the railroad safety rules and shall give written acknowledgment to the Railroad that they have been received, read, and understood by the contractor and his employees. Operations will be subject to Railroad inspection at any and all times.

J. All cranes, lifts, or other equipment that will be operated in the vicinity of the Railroad's electrification and power transmission facilities shall be electrically grounded as directed by the Railroad's Chief Engineer.

K. At all times when the work is being progressed, a field supervisor for the work with no less than 12 months experience in the operation of the equipment being used shall be present. If boring, drilling, or similar machines are being used, the machine operator also shall have no less than 12 months experience in the operation of the equipment being used.

L. Blasting will not be permitted under or near railroad tracks and facilities.

M. Whenever equipment or personnel are working closer than 15 feet to the centerline of an adjacent track, that track shall be considered as being obstructed. Insofar as possible, all operations shall be conducted no less than this distance. Operations closer than 15 feet to the centerline of a track shall be conducted only with the permission of, and as directed by, a duly qualified railroad employee present at the site of the work.

N. Crossing of tracks at grade by equipment and personnel is prohibited except by prior arrangement with, and as directed by, the Railroad's Chief Engineer.

16. SUPPORT OF TRACKS

A. When the jacking or the tunneling method of installation is used, and depending upon the size and location of the crossings, temporary track supporting structures shall be installed at the direction of the Chief Engineer.

B. The type of temporary track supporting structures to be installed shall be approved by the Chief Engineer.

C. Unless otherwise agreed, all work involving rail, ties and other track material will be performed by the Railroad's employees.

17. PIPELINES ON BRIDGES

A. Pipelines carrying flammable substances or non-flammable substances, which by their nature might cause damage if escaping on or near railroad facilities or personnel, shall not be installed on bridges over railroad tracks or bridges carrying railroad tracks.

B. In special cases when it can be demonstrated to the Chief Engineer's satisfaction that such an installation is necessary and that no practicable alternative is available, the Chief Engineer may permit the installation and only by special design approved by him.

C. Pipelines on bridges shall be so located as to minimize the possibility of damage from vehicles, railroad equipment, vandalism and other external causes. They shall be encased in a casing pipe as the Chief Engineer may direct.

18. BONDING AND GROUNDING OF PIPELINES IN ELECTRIFIED TERRITORY

A. Carrier pipe shall be enclosed in a metal casing that is isolated from carrier pipe by approved insulators having a dielectric value of not less than 25 k.v. that provide an air gap between carrier pipe and casing of not less than 2 inches.

B. Carrier pipe supporting hangers, mountings or cradles shall provide an insulation value of not less than 25 k.v. and an air gap of not less than 2 inches between casing and any portion of mounting assembly.

C. Casing shall be bonded to Railroad's return at each end through bridge steel or direct when girders are of non-conductive material, conforming to E.T. 1120C-12 (Details for Power Bonding of Structures), and Plate V.

19. ABANDONED PIPELINES

A. For all abandoned pipe crossings under track and for such other occupancies as the Railroad may direct, the owner of the pipeline shall notify, in writing, the Chief Engineer of the Railroad of the intention to abandon and shall remove the facilities or shall completely fill by cement grout, compacted sand, or other methods approved by the Chief Engineer, all pipes and voids resulting from the presence of the abandoned pipeline.

20. DRAINAGE

A. Occupancies shall be designed, and their construction shall be accomplished, so that adequate and uninterrupted drainage of Railroad right-of-way is maintained. If, in the course of construction, it may be necessary to block a ditch, pipe or other drainage facility, temporary pipes, ditches or other drainage facilities shall be installed to maintain adequate drainage, as approved by the Railroad. Upon completion of the work, the temporary facilities shall be removed and the permanent facilities restored.

CE-8
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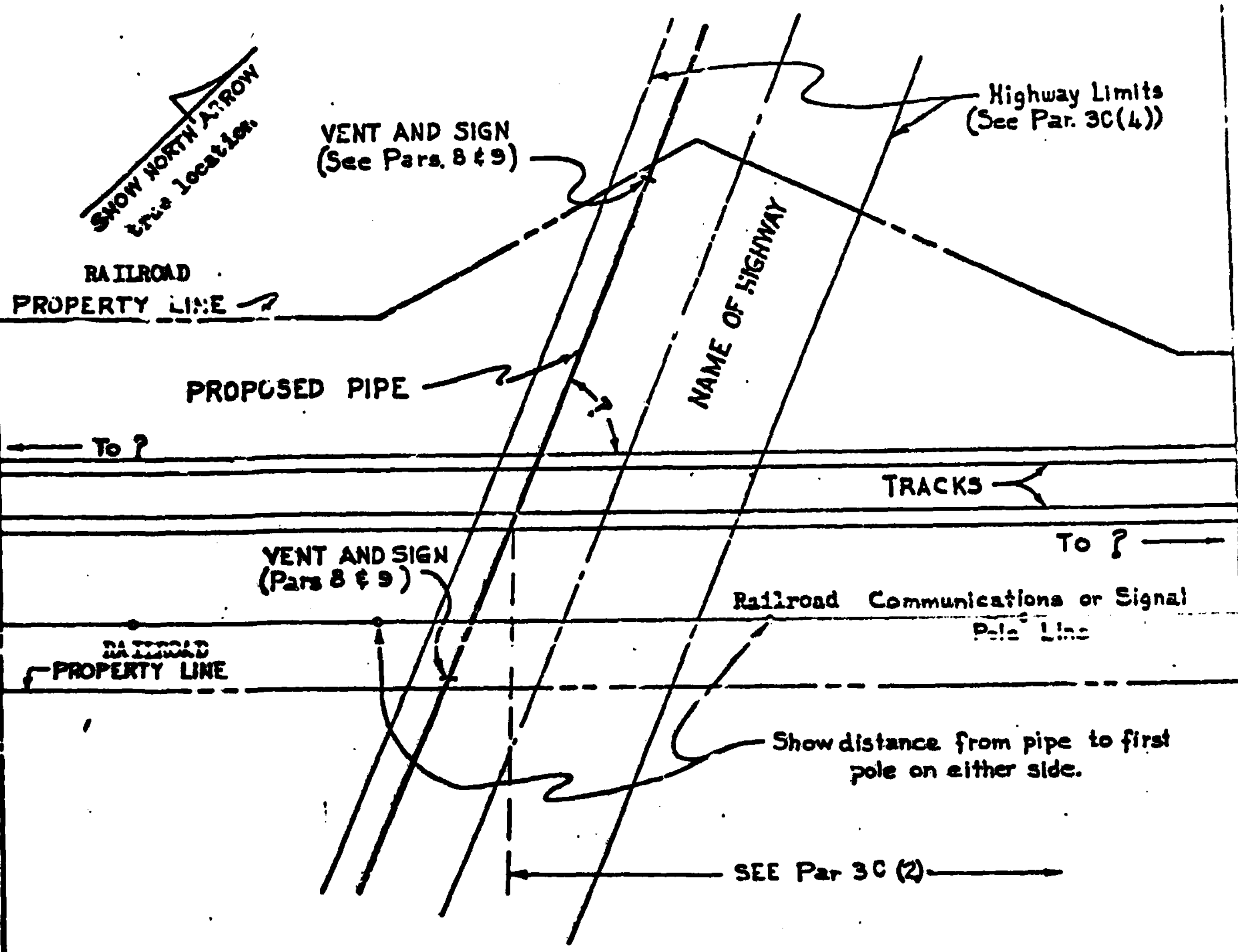
PLATE I

INFORMATION TO BE SHOWN ON PLAN SECTION OF DRAWINGS



SCALE OF DRAWING TO BE SHOWN

NOTE:

If man holes are placed on railroad property, details of same, with clearances to near rails are to be shown on the drawings.

If the proposed pipe is to serve a new development, a map showing the area in relation to established areas and roads is to be sent with the request.

If the proposed pipe is not wholly within highway limits, the same information is required as shown on this Plate.

PLATE II

INFORMATION TO BE SHOWN ON PROFILE
SECTION OF DRAWING

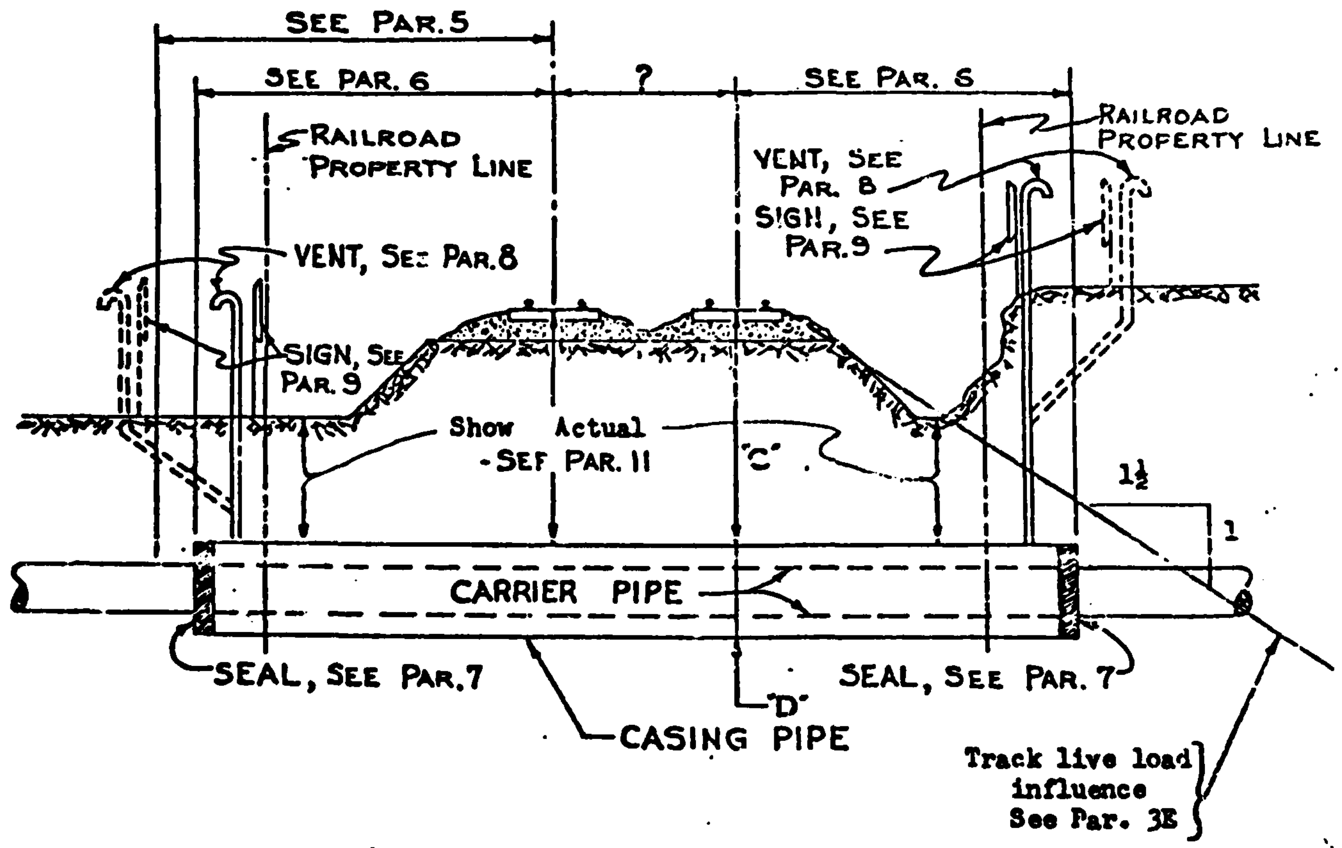
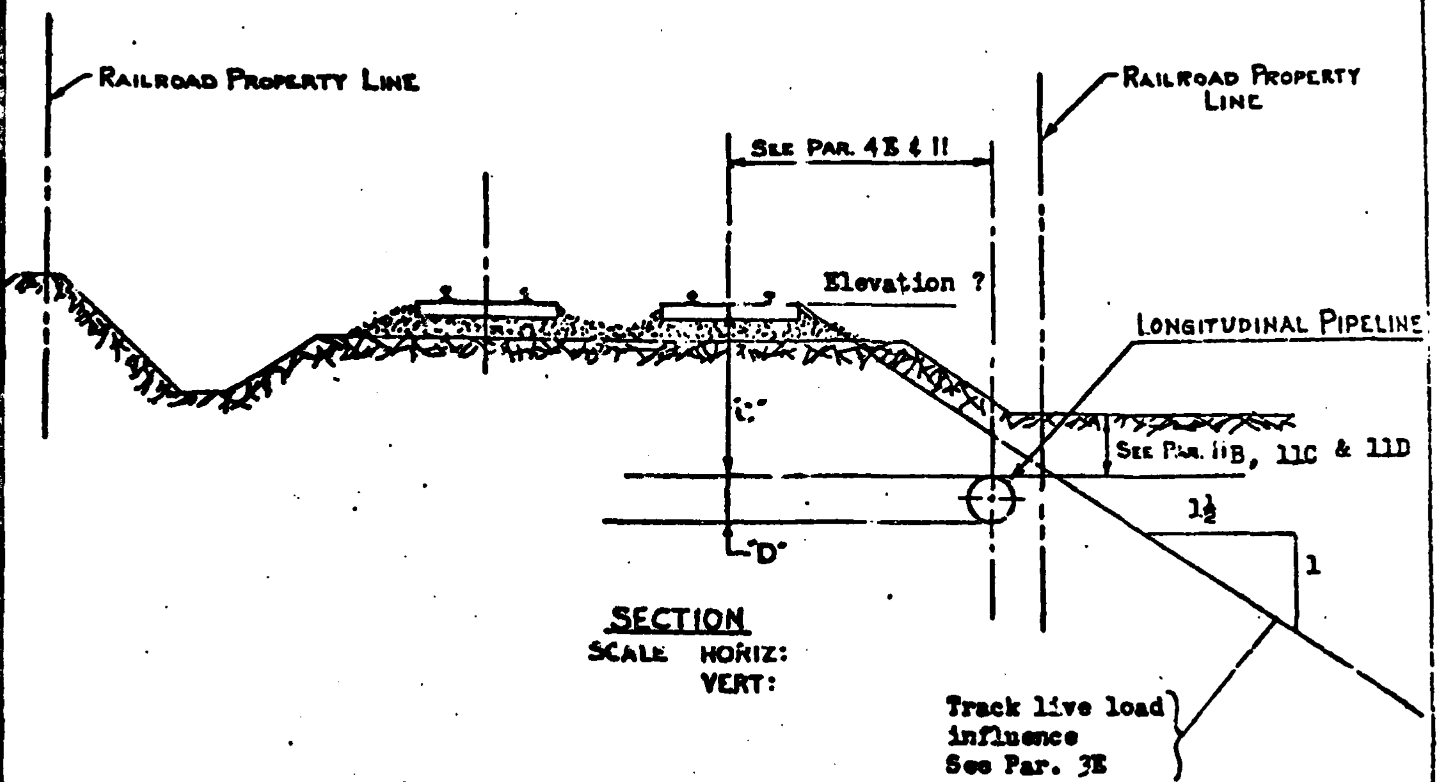
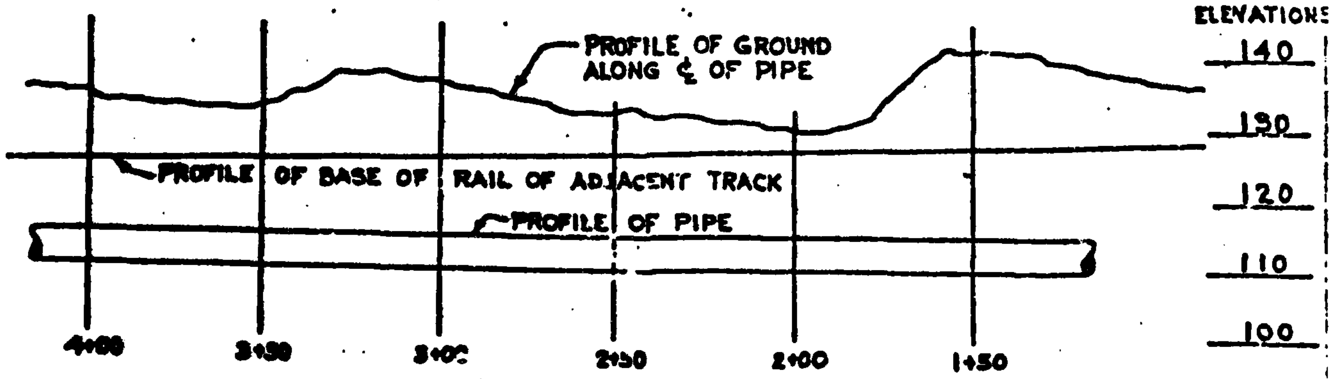


PLATE III

LONGITUDINAL OCCUPANCY



SECTION
SCALE HORIZ:
VERT:



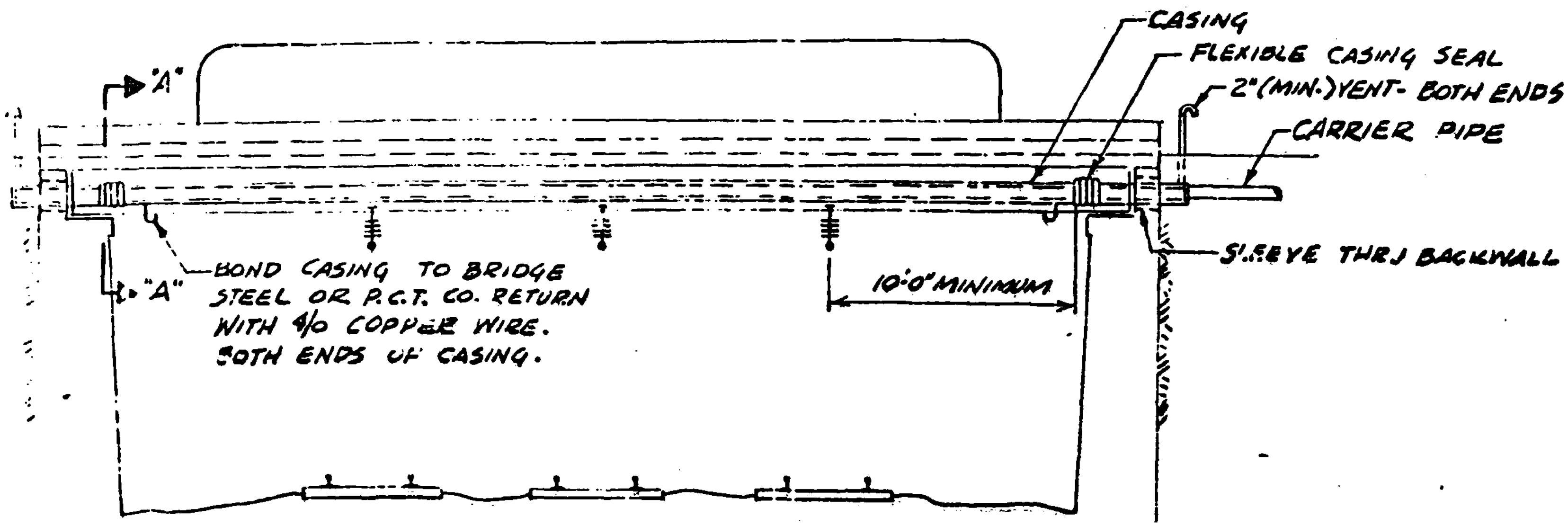
PROFILE - See Par 3 C(3)
SCALE HORIZ:
VERT:

PIPE CROSSING - DATA SHEET

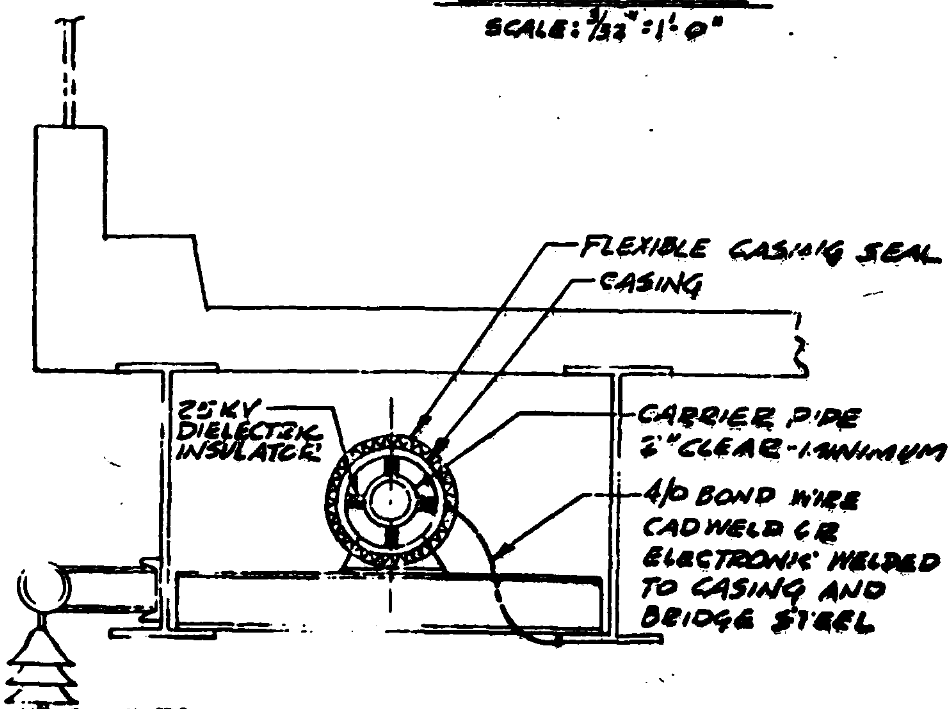
In addition to plan and profile of crossing, drawings submitted for Railroad's approval shall contain the following information:

	Pipe Data	
	Carrier Pipe	Casing Pipe
Contents To Be Handled		
Normal Operating Pressure		
Nominal Size of Pipe		
O. S. Diameter		
I. S. Diameter		
Wall Thickness		
Weight Per Foot		
Material		
Process of Manufacture		
Specification		
Grade or Class		
Test Pressure		
Type of Joint		
Type of Coating		
Details of Cathodic Protection		
Details of Seal or Protection at Ends of Casing		
Method of Installation		
Character of Subsurface Material at the Crossing Location		
Approximate Ground Water Level . . .		
Source of Information on Subsurface Conditions (Borings, Test Pits or Other)		

NOTE: Any soil investigation made on railroad property or adjacent to tracks shall be carried on under the supervision of Railroad Company's Chief Engineer. (See Par. 3A)



ELEVATION
SCALE: 3/32" = 1'-0"



SECTION "A-A"
SCALE: 1/2" = 1'-0"

PLATE V

SPECIFICATIONS FOR BONDING AND GROUNDING OF PIPELINES IN ELECTRIFIED TERRITORY

PROJECT No. 112304 BOREHOLE No. PLATE VI DRAWING No.

PROJECT Tunnel for 42" Dia. Trunk Watermain Under Michigan Central Railroad

LOCATION

HOLE LOCATION AND DATUM SEE DRAWING No. 1

Auger Sample

2" O.D. SPLIT TUBE

2" I.D. SHELBY TUBE

2" DIA CONE

PUSHED P

VANE TEST AND SENSITIVITY (S) + S

NATURAL MOISTURE x

PLASTIC AND LIQUID LIMIT

UNDRAINED TRIAXIAL AT OVERBURDEN PRESSURE

% STRAIN AT FAILURE

SOIL DESCRIPTION	ELEV. FEET	DEPTH FT.	NATURAL UNIT WEIGHT P.C.F.
	599.7	0	
FILL - Mixture of organics, gravel, silt and clay, becoming more clayey with depth, black to grey, moist, (firm to stiff)		5	
	589.0	10	
SILTY CLAY - Silt and sand seams, some gravel, laminated, reddish brown with grey seams, moist, becomes softer with depth, (hard to very stiff)		15	126
Liner Invert - ~ El.576.0'		20	133
	578.0		127
SILTY CLAY - some wet silt seams, grey and brown, layered, (very stiff)		25	120
			121 - Vane
	571.0	30	
SILT - thin clay seams, reddish brown, wet, (compact)			
TERMINATED	568.2		

PENETRATION RESISTANCE 350 FT LB BLOWS FT 20 40 60 80; SHEAR STRENGTH K.S.F.; S=3.7

NATURAL MOISTURE CONTENT AND ATTERBERG LIMITS % DRY WEIGHT 10 20 30

NOTES:

1. Borehole drilled by S.O.I.L. on Jan. 20/76 with continuous flight auger equipment.
2. Borehole terminated at 31½ ft. depth and hole open to 30 ft. depth.
3. Piezometer installed at 29 ft. depth and sealed at 27 to 28 ft. depth.
4. WATER LEVEL OBSERVATIONS

DATE	DEPTH (ft.)
On completion	Dry
Jan. 21/76	27.3
Jan. 23/76	Dry at 27.5'
Jan. 26/76	" " "

PUBLICATION STANDARDS SOURCES

ANSI	American National Standards Institute, Inc. 1430 Broadway New York, N. Y. 10018
ASTM	American Society for Testing and Materials 1916 Race Philadelphia, Pa. 19103
AREA	American Railroad Engineering Association 59 East Van Buren St. Chicago, Ill. 60605
	The National Association of Corrosion Engineer Houston, Texas 77026
AWWA	American Water Works Association, Inc. Two Park Ave. New York, New York 10016

NOTE:

If other than American Railway Engineering Association (AREA), American Society for Testing and Materials (ASTM), and American National Standards (ANSI) specifications are referred to for design, materials or workmanship on the plans and specifications for the work, then copies of the applicable sections of such other specifications referred to shall accompany the plans and specifications for the work.

APPENDIX 5

ECONOMICS

APPENDIX 5

ECONOMICS

TABLE OF CONTENTS

TABLES

APPENDIX 5
ECONOMICS

Methodology

The economic justification of the proposed improvements was determined by comparing the average annual benefits accruing to the project over its economic lifespan to the equivalent annual costs. In general, the benefits should equal or exceed the costs for the Federal Government to participate in the project. Exceptions may be made in cases where substantial, non-quantifiable environmental quality benefits exist.

Benefits and costs are made comparable by conversion to an equivalent time basis using an interest rate of 7-1/8 percent, currently applicable to Federal projects. The project lifetime is considered to be 50 years.

The analysis of costs and benefits follows standard U.S. Army Corps of Engineers procedures. The value of all goods and services used in the project is estimated on the cost side. Benefits considered include flood damages prevented (existing and future), location, intensification, affluence, and employment categories. The evaluation of damages prevented is based on a damage survey which provides damage information related to various stages or elevations of flooding. This information is combined with frequency data to determine expected annual losses. Annual benefits are computed by subtracting annual losses expected to occur with the project from those expected without a project.

Economic justification is associated with the goal of maximization of net quantifiable benefits. This is an economic concept aimed at sizing a project or investment to the point where the greatest excess of benefits over costs occurs. Maximization of net quantifiable benefits does not reflect qualitative factors which may also influence the recommendation of a plan.

First Costs

First costs were determined for both structural and nonstructural alternatives. For the structural plans, quantities of principal construction items were estimated on the basis of a preliminary design which would provide safe structures for given conditions. First costs are based on a 1980 price level and include a 25 percent contingency allowance. Engineering and design along with supervision and administration are estimated on the basis of similar projects and amount to 15 percent and 12 percent of total construction cost, respectively.

First costs for the nonstructural alternatives include expenses for flood proofing and evacuation. The costs take into account the fair market value of apartments falling into the demolition and evacuation category, but no attempt was made to estimate the subsequent costs of relocating the tenants of these apartments to new living quarters.

The first costs of the alternative plans are as follows:

TABLE 1

FIRST COSTS OF ALTERNATIVE PLANS

WEST BRANCH	
Plan A - Lower dam	$ 29,600
Plan B - Replace bridge, lower dam	384,900
Plan C - Channel improvements, etc.	2,496,900
Plan D - Flood proofing to 100 yr.	2,370,000
Plan E - Plan A and flood proofing to 100 year	1,982,600
Plan F - Plan B and flood proofing to 100 year	1,641,900
SOUTHWEST BRANCH	
Plan A - 150 sq. ft. culvert	$ 491,200
Plan B - 150 sq. ft. culvert and channel	877,700
Plan C - 300 sq. ft. culvert	682,500
Plan D - flood proofing to 100 yr.	5,120,000
Plan E - Plan A and flood proofing to 100 yr.	1,618,200
Plan F - Plan C and flood proofing to 100 yr.	1,767,700

Annual Costs

Annual costs are determined by applying a capital recovery factor for a 50-year project life with an interest rate of 7-1/8 percent. The respective annual costs are as follows:

TABLE 2

ANNUAL COSTS OF ALTERNATIVE PLANS

WEST BRANCH	
Plan A	$ 3,200
Plan B	29,300
Plan C	186,300
Plan D	174,400
Plan E	147,000
Plan F	122,000
SOUTHWEST BRANCH	
Plan A	$ 37,200
Plan B	65,600
Plan C	50,600
Plan D	376,800
Plan E	120,100
Plan F	130,400

Flood Losses

A detailed damage survey, conducted in 1977 by the U. S. Army Corps of Engineers, gathered loss data for three zones in the West Branch and one in the Southwest Branch of the Housatonic River in Pittsfield, Massachusetts. The areas involved are: West Branch: Zone 1 - Linden Street to Wahconah Park, Zone 2 - Columbus Street to Linden Street, Zone 3 - West Street to Columbus Street; Southwest Branch: Zone 4 - shopping plaza and surrounding area. The survey evaluated potential physical damages, as well as potential non-physical losses.

The physical damage category includes any damages to or loss of buildings and/or contents including furnishing, equipment, decorations, stocks of raw materials, materials in process, and completed products. Loss of roads, sewers, bridges, and power lines are typical physical damages. Damages to grounds, fences, plumbing, utilities, appliances, food, clothing, furniture, and rugs are also in the physical classification. Non-physical damages include business and financial losses resulting from the disruption of normal profit and return to capital, labor, and management. Emergency costs, including the cost of temporary shelters and subsistence, were also estimated for various flood elevations.

TABLE 3

TYPICAL DAMAGE SHEET - RESIDENTIAL
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
FLOOD LOSSES - COMMERCIAL, RESIDENTIAL, PUBLIC

River or Stream/Tidal West Branch- Housatonic

No. of stories: 1 ____, 2 ✓

State MA Side of River (R. or L. looking downstream)

Basement: Yes ✓, No ____, Area of first floor ____

Town Pittsfield Village ____

Garage: Yes ____, No ✓

Company or Owner ____

ELEVATION OF FIRST FLOOR 999

Address ____

Height of first floor above ground 2'

Source of Information ____

Elevation where flooding to STRUCTURE begins 997

Type of heating: ____

Type of residence: Seasonal ___, Year round ✓, Convertible ___

Heating unit location: Basement ____, 1st Floor ____

Type of construction: Wood Frame ✓, Block ____, Brick ____

ASSESSMENT: LAND ____ BUILDING ____ LAND AREA ____ RECENT SALE ____

Flood Date 1977 — Recurring Loss in $1000 Units

	Exp. Loss	Stage		-8		-6		-4		-2		0	+1	+2	+3	REMARKS
Structures								0	0.8	1.0	4.2	4.6	5.1	5.5		
Grounds, Site								0.1	0.1	0.2	0.2	0.2	0.3	0.3		
Equip., Machinery								0	0.2	0.2	0.4	0.6	0.7	0.7		
Stock, Contents								0	0.2	0.2	0.4	0.6	0.8	0.8		
Cleanup & Other								0	0.2	0.2	0.4	0.5	0.5	0.6		
Furnishings								0	0.1	0.1	3.1	3.6	3.8	4.0		
Total Physical Loss								0.1	1.6	1.9	8.7	10.1	11.2	11.9		
Non-Physical Loss																
Temporary Quarters, Cost Emer. Service																
Total Non-Physical Loss							0	0	0.4	0.5	3.5	4.0	4.5	4.8		
TOTAL LOSS							0	0.1	2.0	2.4	12.2	14.1	15.7	16.7		

REMARKS:

ESTIMATED MRKT VALUE $24,000

Block ____ Ref. No. ____

River ____ Type ____

Date ____ Surveyed By: ____ Mileage ____ Sh. No. 5

TABLE 4

TYPICAL DAMAGE SHEET - COMMERCIAL

NEW ENGLAND DIVISION, CORPS OF ENGINEERS

FLOOD LOSSES - INDUSTRIAL, COMMERCIAL, RESIDENTIAL, PUBLIC

River or Stream/Tidal Southwest Branch - Housatonic   Date ______

State MA   Side of River (R. or L. looking downstream)

Town Pittsfield   Village ______   Nature of Business Gasoline Station

Company or Owner ——   Number of Employees 3

Address ——   Weekly Payroll 275-350

Source of Information ——   Depth of Flooding: Buildings 0 Grounds 1½'

1. DESCRIPTION (Size, Type, Material, Use, Stories, Cellar, Stud Ht.) 50x30, Gas Station, Brick, 1 STORY ON SLAB

ASSESSMENT: LAND ——   BUILDING ——   LAND AREA ——   RECENT SALE ——

Flood Date 1977   Recurring Loss in $1000 Units

Stage	Exp. Loss	-8	-6	-4	-2		0	+1	+2	+3	REMARKS
Structures							0	1.0	2.5	5.0	
Grounds, Site					0	0.7	0.5	0.7	0.8	1.0	
Equip., Machinery							0	1.0	2.0	3.0	
Stock, Contents							0	0.5	1.0	2.0	
Cleanup & Other							0	0.1	0.2	0.3	
Furnishings (OFFICE, RECORDS)							0	0.5	1.0	1.5	
Total Physical Loss					0	0.2	0.5	3.8	7.5	12.8	
Days Shut Down					0	3	3	14	21	28	
Wages					0	0.2	0.2	0.7	1.1	1.4	
Fixed Costs Plus Profit					0	0.1	0.1	0.4	0.6	0.8	
Temporary Quarters											
Cost Emer. Service											
Total Non-Physical Loss					0	0.3	0.3	1.1	1.7	2.2	
TOTAL LOSS					0	0.5	0.8	4.9	9.2	15.0	

REMARKS: ESTIMATED MARKET VALUE: $33,000

Block   Ref. No.

River   Type

NED FORM 1179   Surveyed By: Mileage   Sh. No. 7

TABLE 5

TYPICAL DAMAGE SHEET - APARTMENT

NEW ENGLAND DIVISION, CORPS OF ENGINEERS

FLOOD LOSSES - INDUSTRIAL, COMMERCIAL, RESIDENTIAL, PUBLIC

River or Stream/Tidal Southwest Branch - Housatonic Date ______

State MA Side of River (R. or L. looking downstream)

Town Pittsfield Village ______ Nature of Business Apartment

Company or Owner ______ Number of Employees ______

Address ______ Weekly Payroll ______

Source of Information ______ Depth of Flooding: Buildings ______ Grounds ______

1. DESCRIPTION (Size, Type, Material, Use, Stories, Cellar, Stud Ht.) ______

ASSESSMENT: LAND ______ BUILDING ______ LAND AREA ______ RECENT SALE ______

	Exp. Loss	Flood Date 1927 Stage		-8		-6		-4		-2		0	+1	+2	+3	REMARKS
							Recurring Loss in $1000 Units									
Structures										0	2.3	5.0	7.0	9.0	10.0	
Grounds, Site								0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	
Equip., Machinery } $800	Small equipment									0	1.6	3.2	4.0	4.1	4.0	
Stock, Contents										0	0.5	1.0	2.0	2.0	2.0	
Cleanup & Other										0	0.3	0.6	0.7	0.8	0.8	
Furnishings										0	0.2	0.5	0.8	1.2	1.6	
										0	0.3	1.2	6.0	6.0	6.0	
Total Physical Loss								0	0.1	0.2	5.7	12.1	21.0	23.6	23.1	
Days Shut Down										0	3	7	7	14	N	
~~Wages~~ (3 families live out)										0	0.9	2.1	2.1	4.2	4.2	
Fixed Costs Plus Profit																
Temporary Quarters																
Cost Emer. Service																
Total Non-Physical Loss																
TOTAL LOSS								0	0.1	0.2	6.6	14.2	23.1	27.8	29.3	

REMARKS: ESTIMATED MARKET VALUE $30,000.

Block ______ Ref. No. ______

River ______ Type ______

NED FORM 1170

A sample of properties in the flood plain revealed the following estimated average market values:

Type	Material	Number of Floors	Market Value
Residential	Wood	1	$35,000
Residential	Wood	2	$30,000
Residential	Brick	1-2	$31,000

Commercial properties have market values ranging from the low thousands to a high of $2.5 million. Many are in the $30,000 range. A cursory analysis reveals that the total market value of the property potentially subject to flooding during a record event is approximately $11 million. The damage survey sheets on Tables 2 to 5 give an indication of typical properties and depths of inundation.

Damages were summarized by category and zone as shown in the stage-loss data of Table 6.

The damage survey shows that under present conditions, if floodwaters were to reach the level of the 1977 flood crest, total losses would amount to $314,000. A flood of this magnitude would affect many of the approximately 200 residences, 40 commercial establishments, 4 public buildings, and several utilities located in the West Branch and would cause $169,000 in losses there. In the Southwest Branch, 10 residences, 10 commercial establishments, 1 public building, and several bridges, roads, and highways would suffer $145,00 in losses.

Rarer events would cause substantially higher damages. A breakdown of recurring losses at the 1977 flood crest elevation, the 100-year flood elevation, and the 500-year event elevation is shown in Table 7. The SPF, which is defined as the flood that might be expected from the most severe combination of meteorological and hydrological conditions reasonably characteristic of the area, would result in a dollar damages similar to those of the 500-year event.

TABLE 6
STAGE - LOSS DATA

NEW ENGLAND DIVISION - CORPS OF ENGINEERS
BOSTON, MASS.
STAGE - LOSS DATA ($1000)

PITTSFIELD, MA - HOUSATONIC RIVER

DAMAGE CATEGORY	STAGE IN FEET				ZERO STAGE = 19				FLOOD CREST												
	-7	-6	-5	-4	-3	-2	-1	0	+1	+2	+3	+4	+5	+6	+7	+8	+9	+10	+11	+12	+18
RESIDENTIAL	0	0	0	0	0	0	4.6	11.4	40.7	93.3	190.8	314.5	426.4	538.3	650.2	762.1	874.0	985.9	1097.8	1209.7	
COMMERCIAL	0	0	0	.1	.1	2.9	5.1	20.1	37.4	70.6	112.4	130.5	206.2	281.9	357.6	433.3	509.0	584.7	660.4	736.1	
PUBLIC	0	0	0	0	4.9	11.0	60.8	158.8	275.7	408.8	581.6	754.3	927.1	1099.9	1272.7	1445.5	1618.3	1791.1	1963.9	2136.7	
UTILITIES	0	0	0	0	0	0	0	0	0	0	32.5	64.9	97.4	129.9	162.4	194.9	227.4	259.9	292.4	324.9	
TOTAL ZONE 1	0	0	0	0.1	5.0	13.9	70.5	150.3	353.8	572.7	917.3	1264.2	1657.1	2050.0	2442.9	2835.8	3228.7	3621.6	4014.5	4407.4	
RESIDENTIAL	0	0	0	0	0	0	5.5	15.6	41.1	84.3	126.6	248.2	416.0	621.6	860.3	1105.2	1303.3	1501.4	1699.5	2578.7	
COMMERCIAL	0	0	0	0.1	0.1	1.5	1.7	3.1	9.4	22.2	35.7	54.8	66.8	93.4	117.4	143.1	164.9	186.7	208.5	230.3	
PUBLIC	0	0	0	0	0	0	0	0.1	0.1	2.0	3.8	6.0	13.0	18.3	21.5	30.0	31.2	32.4	33.6	34.8	
UTILITIES	0	0	0	0	0	0	0	0	0	0	32.5	64.9	97.4	129.9	162.4	194.9	227.4	259.9	292.4	324.9	
TOTAL ZONE 2	0	0	0	0.1	0.1	1.5	7.2	18.8	50.6	108.5	198.6	423.9	643.2	953.2	1161.6	1473.2	1726.8	1980.4	2234.0	3168.7	
COMMERCIAL	0	0	0	0	0	0	0	0	0	0	2.3	3.2	4.5	4.7	5.2	5.8	9.9	12.0	15.1	18.2	
UTILITIES	0	0	0	0	0	0	0	0	0	0	32.5	64.9	97.4	129.9	162.4	194.9	227.4	259.9	292.4	324.9	
TOTAL ZONE 3	0	0	0	0	0	0	0	0	0	0	34.8	68.1	161.9	134.6	167.6	200.7	236.3	271.9	307.5	343.1	
RESIDENTIAL	0	0	0	0	0.1	1.8	11.6	23.3	33.1	48.7	54.6	60.5	66.4	72.3	78.2	84.1	90.0	95.9	101.8	107.7	143.
COMMERCIAL	0	0	.5	2.7	5.6	27.5	47.7	110.8	1965.9	3515.8	5015.8	5165.8	6140.8	6190.8	6240.8	6290.8	6340.8	6340.8	6440.8	6490.8	6790
PUBLIC	0	1.1	2.3	3.1	3.8	4.5	6.2	7.6	13.2	14.6	15.7	16.8	17.9	19.0	20.1	21.2	22.3	23.4	24.5	25.6	32.
BRIDGES	0	0	0	0	0.2	0.7	1.1	1.5	1.8	2.3	2.6	2.9	3.2	3.5	3.8	4.1	4.4	4.7	5.0	5.3	7.
HIGHWAY	0	0	0	0	0	0.6	1.2	1.8	3.7	6.1	9.8	13.5	17.2	38.1	41.8	45.5	49.2	52.9	56.6	60.3	82.
TOTAL ZONE 4	0	1.1	2.8	5.8	8.7	35.1	67.8	145.0	2022.7	3587.5	5098.5	5859.5	6245.5	6323.7	6384.7	6445.7	6506.7	6567.7	6628.7	6689.7	705[illegible]

REMARKS: JAN 1980 PL
1977 SURVEY
PRICE FACTORS: 1977-79 1.12
1979-80 1.09
DAMAGES OVER +5 EXTRAPOLATED

NED FORM 208
APRIL 1953

TABLE 7

RECURRING LOSSES

(Thousands of Dollars, January 1980 Price Level)

	1977 Flood		100-Year Event		500-Year Event	
Category	$ Losses	%	$ Losses	%	$ Losses	%
WEST BRANCH						
ZONE 1						
Residential	11.3	7.5	370.5	25.1	706.2	26.8
Commercial	20.2	13.5	182.8	12.4	395.5	15.0
Public	118.8	79.0	840.7	57.0	1,359.1	51.5
Utilities	0.0	0.0	81.2	5.5	178.7	6.8
TOTAL	150.3	100.0	1,475.2	100.0	2,639.5	100.1
ZONE 2						
Residential	15.6	83.1	543.7	72.7	1,204.2	75.3
Commercial	3.1	16.3	75.1	10.0	154.0	9.6
Public	.1	0.6	15.6	2.0	30.6	1.9
Utilities	0	0.0	113.6	15.0	211.2	13.2
TOTAL	18.8	100.0	748.0	100.0	1,600.0	100.0
ZONE 3						
Residential	0.0	0.0	0.0	0.0	12.0	4.4
Utilities	0.0	0.0	121.0	100.0	259.9	95.6
TOTAL	0.0	0.0	121.0	100.0	271.9	100.0
SOUTHWEST BRANCH						
ZONE 4						
Residential	23.3	16.1	95.9	1.5	135.7	1.9
Commercial	110.9	76.5	6,390.8	97.3	6,725.8	96.4
Public	7.5	5.2	23.4	30.8	30.8	0.4
Bridges	1.4	1.0	4.7	0.07	6.7	0.1
Highway	1.9	1.2	52.9	0.8	779	1.1
TOTAL	145.0	100.0	6,567.7	100.0	6,976.9	99.9

Benefits

Flood Damages Prevented

The main benefit to be derived from the structural plans is flood inundation reduction. This includes the prevention of both nonphysical losses and physical flood damages to activities located within the flood plain. The benefit was calculated utilizing "Expected Annual Flood Damage Computation," a computer program developed by the U.S. Army Corps of Engineers' Hydrologic Engineering Center. The program combines stage-damage input with stage-frequency input to obtain damage-frequency information and expected annual damages. The average annual benefits are computed by subtracting expected annual damages with the project from expected annual damages without the project.

The entire computer program output follows. The output includes a listing of the stage-frequency-damage relationship for each reach and plan, including the without project condition. This is followed by an expected annual damage summary by reach and damage category type. A grand summary for all reaches by damage category type is then provided. (Abbreviations - Resid-Residential, Commer-Commercial).

The damage frequency relationship and expected annual damages can be computed by hand calculations also. However, the accurate computation of expected annual damage required a good damage-frequency integration procedure. The integration by the usual hand summation of rectangular areas can result in significant errors because of the nonlinearity of the damage frequency function. The computer program integration procedure yields results which are more accurate than hand calculations. For purposes of comparison the traditional stage-damage and damage-frequency curves have been drawn for Zone 2 and are displayed on Plates 5-4 and 5-5.

Employment Benefits

The employment benefit results from the use of otherwise unemployed or underemployed labor in the construction or implementation of a plan. Benefits are limited to earnings by unemployed or underemployed labor resources in officially designated areas. A "designated area" is one which is officially designated as a TITLE IV redevelopment area under the Public Works and Economic Development Act of 1965, as amended (Public Law 89-136). In order to qualify for employment benefits, an area must be designated on the basis of having substantial and persistent unemployment or being an Indian reservation with the same characteristics. As of May 1978, Pittsfield was determined to have substantial but not persistent unemployment and therefore, does not qualify for employment benefits.

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+++++++++++++++++++++++++++++++++++++++++++
+ EXPECTED ANNUAL FLOOD DAMAGE COMPUTATION +
+ 761-X6-L7580              JANUARY 14, 1977 +
+ VERSION DATE              DECEMBER 7, 1978 +
+++++++++++++++++++++++++++++++++++++++++++

++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
    DEC 1978 - THIS VERSION CORRECTS A FEW ERRORS AND INCLUDES A SUMMARY.
               USERS MANUAL ADDITIONS -
               J1 CARD -
                6   NDOLYR     +  MONTH AND YEAR OF DOLLARS AFTER THE DG CARDS
                                  HAVE BEEN MULTIPLIED BY THE PRICE LEVEL ADJUST
                                  MENT FACTOR PLAF (J2,4).  ENTER ORDER NUMBER O
                                  THE MONTH IN COL 42,43 AND THE YEAR IN COL 45-

               J2 CARD -
                4     PLAF     +  PRICE LEVEL ADJUSTMENT FACTOR.  ALL DAMAGE
                                  DATA ON THE DG CARDS WILL BE MULTIPLIED BY
                                  THIS FACTOR.  NDOLYR (J1,6) MUST BE PROVIDED.

               PP CARD -
                     JDGPR    16  SUPPRESS SUMMARY OF EACH CATEGORY BY REACH
                              32  SUPPRESS GRAND SUMMARY-ALL CATEGORIES BY REACH
                              64  SUPPRESS ALL SUMMARY PRINTOUT

               RV CARD - NOW ACTIVE, BUT NOT FULLY TESTED

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TT   COMPUTER ANALYSIS OF PITTSFIELD MA HOUSATONIC RIVER WEST BRANCH
TT   DAMAGE VALUES IN $1000
TT   JANUARY 1980 PRICE LEVEL,1977 SURVEY

**DAMAGE CATEGORY NAMES**
CN    4     RESID  COMMER  PUBLIC UTILITY

**FLOOD PLAIN MANAGEMENT PLAN NAMES**
PN    1   WITHOUT CONDITION
PN    2   PLAN A LOWER DAM
PN    3   PLAN B REPLACE BRIDGE,LOWER DAM
PN    4   PLAN C CHANNEL IMPROVEMENTS,ETC

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++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++

REACH NAME-RN ZONE 1

++++ INPUT DATA ++++

**FREQUENCIES**
FR              17     80.00     60.00     50.00     40.00     30.00     20.00     10.00     5.
      4.00     3.00     2.00      1.50      1.25      1.00       .50       .25       .10

**FLOOD STAGES**
SF      1      100     -7.00     -4.10     -3.80     -3.30     -2.90     -2.10     -1.00     .
      1.00     1.60     2.70      3.50      3.90      4.50      6.40      7.00      9.00
```

```
SD            13   -5.00   -4.00   -3.00   -2.00   -1.00    0.00    1.00    2.0
   3.00     5.00    7.00    9.00   11.00

**FLOOD DAMAGE DATA**
DG     1       1    0.00    0.00    0.00    0.00    4.60   11.40   40.70   93.3
 190.80   426.40  650.20  874.00 1097.80

**FLOOD DAMAGE DATA**
DG     1       2    0.00     .10     .10    2.90    5.10   20.10   37.40   70.6
 112.40   206.20  357.60  509.00  660.40

**FLOOD DAMAGE DATA**
DG     1       3    0.00    0.00    4.90   11.00   60.80  118.80  275.70  408.8
 581.60   927.10 1272.70 1618.30 1963.90

**FLOOD DAMAGE DATA**
DG     1       4    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.0
  32.50    97.40  162.40  227.40  292.40

**END OF INPUT DATA FOR PLAN  1 **
EP+++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++

**DAMAGE DATA FOR PLAN 1 -- WITHOUT CONDITION
```

	FREQ	FLOW	STAGE	RESID	COMMER	PUBLIC	UTILITY	TOTAL
1	80.00	-1.	-7.00	0.00	0.00	0.00	0.00	0.0
2	60.00	-1.	-4.10	0.00	.09	0.00	0.00	.0
3	50.00	-1.	-3.80	0.00	.10	.98	0.00	1.0
4	40.00	-1.	-3.30	0.00	.10	3.43	0.00	3.5
5	30.00	-1.	-2.90	0.00	.38	5.51	0.00	5.8
6	20.00	-1.	-2.10	0.00	2.62	10.39	0.00	13.[illegible]
7	10.00	-1.	-1.00	4.60	5.10	60.80	0.00	70.5
8	5.00	-1.	.50	26.05	28.75	197.25	0.00	252.0
9	4.00	-1.	1.00	40.70	37.40	275.70	0.00	353.8
10	3.00	-1.	1.60	72.26	57.32	355.56	0.00	485.1
11	2.00	-1.	2.70	161.55	99.86	529.76	22.75	813.9
12	1.50	-1.	3.50	249.70	135.85	667.98	48.73	1102.2
13	1.25	-1.	3.90	296.82	154.61	737.08	61.71	1250.2
14	1.00	-1.	4.50	367.50	182.75	840.73	81.18	1472.1
15	.50	-1.	6.40	583.06	312.18	1169.02	142.90	2207.1
16	.25	-1.	7.00	650.20	357.60	1272.70	162.40	2442.9
17	.10	-1.	9.00	874.00	509.00	1618.30	227.40	3228.7
EXP ANNUAL DAMAGE				11.06	7.38	38.03	2.00	58.46

++

REACH NAME=RN ZONE 1

++++ INPUT DATA ++++

FLOOD STAGES

SF	1	200	-7.00	-4.10	-3.80	-3.30	-2.90	-2.30	-1.10	.
	.70	1.40	2.20	2.90	3.20	3.80	5.70	7.00	8.50	

**END OF INPUT DATA FOR PLAN 2 **

EP++

**DAMAGE DATA FOR PLAN 2 ** PLAN A LOWER DAM

	FREQ	FLOW	STAGE	RESID	COMMER	PUBLIC	UTILITY	TOTA
1	80.00	-1.	-7.00	0.00	0.00	0.00	0.00	0.
2	60.00	-1.	-4.10	0.00	.09	0.00	0.00	.
3	50.00	-1.	-3.80	0.00	.10	.98	0.00	1.
4	40.00	-1.	-3.30	0.00	.10	3.43	0.00	3.
5	30.00	-1.	-2.90	0.00	.38	5.51	0.00	5.
6	20.00	-1.	-2.30	0.00	2.06	9.17	0.00	11.
7	10.00	-1.	-1.10	4.14	4.88	55.82	0.00	64.
8	5.00	-1.	.20	17.26	23.56	150.18	0.00	191.
9	4.00	-1.	.70	31.91	32.21	228.63	0.00	292.
10	3.00	-1.	1.40	61.74	50.68	328.94	0.00	441.
11	2.00	-1.	2.20	112.80	78.96	443.36	6.50	641.
12	1.50	-1.	2.90	181.05	108.22	564.32	29.25	882.
13	1.25	-1.	3.20	214.36	121.78	616.15	38.99	991.
[illegible]	1.00	-1.	3.80	285.04	149.92	719.80	58.46	1213.
15	.50	-1.	5.70	504.73	259.19	1048.06	120.15	1932.
16	.25	-1.	7.00	650.20	357.60	1272.70	162.40	2442.
17	.10	-1.	8.50	818.05	471.15	1531.90	211.15	3032.
EXP ANNUAL DAMAGE				9.17	6.32	33.32	1.57	50.

REACH NAME=RN ZONE 1

**** INPUT DATA ****

FLOOD STAGES

SF	1	300	-7.00	-4.10	-3.90	-3.50	-3.10	-2.50	-1.30	-.
	.30	.90	1.50	1.50	1.60	2.00	4.50	5.70	8.10	

**END OF INPUT DATA FOR PLAN 3 **

EP

**DAMAGE DATA FOR PLAN 3 ** PLAN B REPLACE BRIDGE,LOWER DAM

	FREQ	FLOW	STAGE	RESID	COMMER	PUBLIC	UTILITY	TOTA
1	80.00	-1.	-7.00	0.00	0.00	0.00	0.00	0.
2	60.00	-1.	-4.10	0.00	.09	0.00	0.00	.
3	50.00	-1.	-3.90	0.00	.10	.49	0.00	.
4	40.00	-1.	-3.50	0.00	.10	2.45	0.00	2.
5	30.00	-1.	-3.10	0.00	.10	4.41	0.00	4.
6	20.00	-1.	-2.50	0.00	1.50	7.95	0.00	9.
7	10.00	-1.	-1.30	3.22	4.44	45.86	0.00	53.
8	5.00	-1.	-.10	10.72	18.60	113.00	0.00	142.
9	4.00	-1.	.30	20.19	25.29	165.87	0.00	211.
10	3.00	-1.	.90	37.77	35.67	260.01	0.00	333.
11	2.00	-1.	1.50	67.00	54.00	342.25	0.00	463.
12	1.50	-1.	1.50	67.00	54.00	342.25	0.00	463.
13	1.25	-1.	1.60	72.26	57.32	355.56	0.00	485.
14	1.00	-1.	2.00	93.30	70.60	408.80	0.00	57[illegible]
15	.50	-1.	4.50	367.50	182.75	840.73	81.18	1472.
16	.25	-1.	5.70	504.73	259.19	1048.06	120.15	1932.
17	.10	-1.	8.10	773.29	440.87	1462.78	198.15	2875.
EXP ANNUAL DAMAGE				5.95	4.48	25.45	.88	36.

++

REACH NAME=RN ZONE 1

++++ INPUT DATA ++++

FLOOD STAGES

```
SF      1      400    -7.50    -7.50    -7.30    -7.00    -6.50    -6.00    -5.60    -4
     -4.40    -4.00    -3.30    -2.80    -2.50    -2.00      .60     2.70     4.00
```

**END OF INPUT DATA FOR PLAN 4 **

EP++

**DAMAGE DATA FOR PLAN 4 -- PLAN C CHANNEL IMPROVEMENTS,ETC

	FREQ	FLOW	STAGE	RESID	COMMER	PUBLIC	UTILITY	TOT
1	80.00	-1.	-7.50	0.00	0.00	0.00	0.00	0
2	60.00	-1.	-7.50	0.00	0.00	0.00	0.00	0
3	50.00	-1.	-7.30	0.00	0.00	0.00	0.00	0
4	40.00	-1.	-7.00	0.00	0.00	0.00	0.00	0
5	30.00	-1.	-6.50	0.00	0.00	0.00	0.00	0
6	20.00	-1.	-6.00	0.00	0.00	0.00	0.00	0
7	10.00	-1.	-5.60	0.00	0.00	0.00	0.00	0
8	5.00	-1.	-4.70	0.00	.03	0.00	0.00	
9	4.00	-1.	-4.40	0.00	.06	0.00	0.00	
10	3.00	-1.	-4.00	0.00	.10	0.00	0.00	
11	2.00	-1.	-3.30	0.00	.10	3.43	0.00	3
12	1.50	-1.	-2.80	0.00	.66	6.12	0.00	6
13	1.25	-1.	-2.50	0.00	1.50	7.95	0.00	9
14	1.00	-1.	-2.00	0.00	2.90	11.00	0.00	13
15	.50	-1.	.60	28.98	30.48	212.94	0.00	272
16	.25	-1.	2.70	161.55	99.86	529.76	22.75	813
17	.10	-1.	4.00	308.60	159.30	754.35	64.95	1287
EXP ANNUAL DAMAGE				.89	.56	3.07	.14	4

REACH NAME=RN ZONE 2

**** INPUT DATA ****

```
**FLOOD STAGES**
SF       2     100   -5.00   -4.00   -3.70   -3.50   -3.00   -2.40   -1.00      .
       .50    1.00    2.20    3.80    4.60    5.40    7.00    8.10    9.60

**STAGES FOR DAMAGE DATA**
SD              13   -5.00   -4.00   -3.00   -2.00   -1.00    0.00    1.00     2.
      3.00    5.00    7.00    9.00   11.00

**FLOOD DAMAGE DATA**
DG       2       1    0.00    0.00    0.00    0.00    5.50   15.60   41.10    84.
    126.60  466.00  860.30 1303.30 1699.50

**FLOOD DAMAGE DATA**
DG       2       2    0.00     .10     .10    1.50    1.70    3.10    9.40    22.
     35.70   66.80  117.40  164.90  208.50

**FLOOD DAMAGE DATA**
DG       2       3    0.00    0.00    0.00    0.00    0.00     .10     .10     2.
      3.80   13.00   21.50   31.20   33.60

**FLOOD DAMAGE DATA**
DG       2       4    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.
     32.50   97.40 . 162.40  227.40  292.40

**END OF INPUT DATA FOR PLAN  1 **
EP****************************************************************************
```

**DAMAGE DATA FOR PLAN 1 -- WITHOUT CONDITION

	FREQ	FLOW	STAGE	RESID	COMMER	PUBLIC	UTILITY	TOTA
1	80.00	-1.	-5.00	0.00	0.00	0.00	0.00	0.
2	60.00	-1.	-4.00	0.00	.10	0.00	0.00	.
3	50.00	-1.	-3.70	0.00	.10	0.00	0.00	.
4	40.00	-1.	-3.50	0.00	.10	0.00	0.00	.
5	30.00	-1.	-3.00	0.00	.10	0.00	0.00	.
6	20.00	-1.	-2.40	0.00	.94	0.00	0.00	.
7	10.00	-1.	-1.00	5.50	1.70	0.00	0.00	7.
8	5.00	-1.	.20	20.70	4.36	.10	0.00	25.
9	4.00	-1.	.50	28.35	6.25	.10	0.00	34.
10	3.00	-1.	1.00	41.10	9.40	.10	0.00	50.
11	2.00	-1.	2.20	92.76	24.90	2.36	6.50	126.
12	1.50	-1.	3.80	262.36	48.14	7.48	58.46	376.
13	1.25	-1.	4.60	398.12	60.58	11.16	84.42	554
14	1.00	-1.	5.40	544.86	76.92	14.70	110.40	74
15	.50	-1.	7.00	860.30	117.40	21.50	162.40	1161.
16	.25	-1.	8.10	1103.95	143.53	26.84	198.15	1472.
17	.10	-1.	9.60	1422.16	177.98	31.92	246.90	1878.
EXP ANNUAL DAMAGE				13.88	2.35	.32	2.29	18.

****

REACH NAME-RN ZONE 2

**** INPUT DATA ****

FLOOD STAGES

SF 2 200 -5.00 -4.40 -4.00 -3.70 -3.30 -2.50 -1.50 -.
.10 .80 1.90 2.70 3.40 4.00 6.60 7.80 9.40

**END OF INPUT DATA FOR PLAN 2 **

EP***

**DAMAGE DATA FOR PLAN 2 ** PLAN A LOWER DAM

	FREQ	FLOW	STAGE	RESID	COMMER	PUBLIC	UTILITY	TOTA
1	80.00	-1.	-5.00	0.00	0.00	0.00	0.00	0.
2	60.00	-1.	-4.40	0.00	.06	0.00	0.00	.
3	50.00	-1.	-4.00	0.00	.10	0.00	0.00	.
4	40.00	-1.	-3.70	0.00	.10	0.00	0.00	.
5	30.00	-1.	-3.30	0.00	.10	0.00	0.00	.
6	20.00	-1.	-2.50	0.00	.80	0.00	0.00	.
7	10.00	-1.	-1.50	2.75	1.60	0.00	0.00	4.
8	5.00	-1.	-.40	11.56	2.54	.06	0.00	14.
9	4.00	-1.	.10	18.15	3.73	.10	0.00	21.
10	3.00	-1.	.80	36.00	8.14	.10	0.00	44.
11	2.00	-1.	1.90	79.98	20.92	1.81	0.00	102.
12	1.50	-1.	2.70	113.91	31.65	3.26	22.75	171.
13	1.25	-1.	3.40	194.48	41.92	5.64	45.48	287.
14	1.00	-1.	4.00	296.30	51.25	8.40	64.95	420.
15	.50	-1.	6.60	781.44	107.28	19.80	149.40	1057.
16	.25	-1.	7.80	1037.50	136.40	25.38	188.40	1387.
17	.10	-1.	9.40	1382.54	173.62	31.68	240.40	1828.
EXP ANNUAL DAMAGE				10.79	1.93	.25	1.77	14.

++

REACH NAME=RN ZONE 2

++++ INPUT DATA ++++

FLOOD STAGES

SF	2	300	-5.00	-4.40	-4.00	-3.70	-3.50	-2.90	-1.90	-.
	-.50	0.00	.60	1.20	1.50	2.00	4.60	6.30	8.00	

**END OF INPUT DATA FOR PLAN 3 **

EP++

**DAMAGE DATA FOR PLAN 3 -- PLAN B REPLACE BRIDGE,LOWER DAM

	FREQ	FLOW	STAGE	RESID	COMMER	PUBLIC	UTILITY	TOTA
1	80.00	-1.	-5.00	0.00	0.00	0.00	0.00	0.
2	60.00	-1.	-4.40	0.00	.06	0.00	0.00	.
3	50.00	-1.	-4.00	0.00	.10	0.00	0.00	.
4	40.00	-1.	-3.70	0.00	.10	0.00	0.00	.
5	30.00	-1.	-3.50	0.00	.10	0.00	0.00	.
6	20.00	-1.	-2.90	0.00	.24	0.00	0.00	.
7	10.00	-1.	-1.90	.55	1.52	0.00	0.00	2.
8	5.00	-1.	-.90	6.51	1.84	.01	0.00	8.
9	4.00	-1.	-.50	10.55	2.40	.05	0.00	13.
10	3.00	-1.	0.00	15.60	3.10	.10	0.00	18.
11	2.00	-1.	.60	30.90	6.88	.10	0.00	37.
12	1.50	-1.	1.20	49.74	11.96	.48	0.00	62.
13	1.25	-1.	1.50	62.70	15.80	1.05	0.00	79.
14	1.00	-1.	2.00	84.30	22.20	2.00	0.00	10[illegible]
15	.50	-1.	4.60	398.12	60.58	11.16	84.42	554.
16	.25	-1.	6.30	722.30	99.69	18.53	139.65	980.
17	.10	-1.	8.00	1081.80	141.15	26.35	194.90	1444.
EXP ANNUAL DAMAGE				5.82	1.14	.13	.91	8.

REACH NAME-RN ZONE 2

**** INPUT DATA ****

FLOOD STAGES

SF	2	400	-12.00	-11.50	-11.00	-10.50	-10.00	-9.50	-8.60	-7.
	-7.00	-6.50	-5.80	-5.30	-5.00	-4.50	-2.00	0.00	3.50	

**END OF INPUT DATA FOR PLAN 4 **

EP

**DAMAGE DATA FOR PLAN 4 ** PLAN C CHANNEL IMPROVEMENTS,ETC

	FREQ	FLOW	STAGE	RESID	COMMER	PUBLIC	UTILITY	TOTA
1	80.00	-1.	-12.00	0.00	0.00	0.00	0.00	0.
2	60.00	-1.	-11.50	0.00	0.00	0.00	0.00	0.
3	50.00	-1.	-11.00	0.00	0.00	0.00	0.00	0.
4	40.00	-1.	-10.50	0.00	0.00	0.00	0.00	0.
5	30.00	-1.	-10.00	0.00	0.00	0.00	0.00	0.
6	20.00	-1.	-9.50	0.00	0.00	0.00	0.00	0.
7	10.00	-1.	-8.60	0.00	0.00	0.00	0.00	0.
8	5.00	-1.	-7.50	0.00	0.00	0.00	0.00	0.
9	4.00	-1.	-7.00	0.00	0.00	0.00	0.00	0.
10	3.00	-1.	-6.50	0.00	0.00	0.00	0.00	0.
11	2.00	-1.	-5.80	0.00	0.00	0.00	0.00	0.
12	1.50	-1.	-5.30	0.00	0.00	0.00	0.00	0.
13	1.25	-1.	-5.00	0.00	0.00	0.00	0.00	0.
14	1.00	-1.	-4.50	0.00	.05	0.00	0.00	.
15	.50	-1.	-2.00	0.00	1.50	0.00	0.00	1.
16	.25	-1.	0.00	15.60	3.10	.10	0.00	18.
17	.10	-1.	3.50	211.45	43.48	6.10	48.73	309.

EXP ANNUAL DAMAGE	.33	.08	.01	.06	.

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++

REACH NAME=RN ZONE 3

++++ INPUT DATA ++++

FLOOD STAGES

```
SF      3     100   -4.00   -3.50   -3.20   -3.00   -2.50    -.90    -.70
      .70    1.40    2.50    3.70    5.00    6.10    8.00    9.50   10.60
```

STAGES FOR DAMAGE DATA

```
SD            13   -5.00   -4.00   -3.00   -2.00   -1.00    0.00    1.00   2.
     3.00    5.00    7.00    9.00   11.00
```

FLOOD DAMAGE DATA

```
DG      3       2    0.00    0.00    0.00    0.00    0.00    0.00    0.00   0.
     2.30    4.50    5.20    8.90   15.10
```

FLOOD DAMAGE DATA

```
DG      3       4    0.00    0.00    0.00    0.00    0.00    0.00    0.00   0.
    32.50   97.40  162.40  227.40  292.40
```

**END OF INPUT DATA FOR PLAN 1 **

EP++

**DAMAGE DATA FOR PLAN 1 -- WITHOUT CONDITION

	FREQ	FLOW	STAGE	RESID	COMMER	PUBLIC	UTILITY	TO
1	80.00	-1.	-4.00	0.00	0.00	0.00	0.00	0.
2	60.00	-1.	-3.50	0.00	0.00	0.00	0.00	0.
3	50.00	-1.	-3.20	0.00	0.00	0.00	0.00	0.
4	40.00	-1.	-3.00	0.00	0.00	0.00	0.00	0.
5	30.00	-1.	-2.50	0.00	0.00	0.00	0.00	0.
6	20.00	-1.	-.90	0.00	0.00	0.00	0.00	0.
7	10.00	-1.	-.70	0.00	0.00	0.00	0.00	0.
8	5.00	-1.	.50	0.00	0.00	0.00	0.00	0.
9	4.00	-1.	.70	0.00	0.00	0.00	0.00	0.
10	3.00	-1.	1.40	0.00	0.00	0.00	0.00	0.
11	2.00	-1.	2.50	0.00	1.15	0.00	16.25	17.
12	1.50	-1.	3.70	0.00	3.07	0.00	55.22	58.
13	1.25	-1.	5.00	0.00	4.50	0.00	97.40	101.
14	1.00	-1.	6.10	0.00	4.89	0.00	133.15	138.
15	.50	-1.	8.00	0.00	7.05	0.00	194.90	201.
16	.25	-1.	9.50	0.00	10.45	0.00	243.65	254.
17	.10	-1.	10.60	0.00	13.86	0.00	279.40	293.
EXP ANNUAL DAMAGE				0.00	.11	0.00	2.70	2.

REACH NAME=RN ZONE 3

**** INPUT DATA ****

FLOOD STAGES

SF	3	200	-4.50	-4.00	-3.70	-3.50	-3.00	-1.20	-1.00	0.0
	.50	1.10	2.50	3.50	4.50	5.40	7.80	9.40	10.50	

**END OF INPUT DATA FOR PLAN 2 **

EP

**DAMAGE DATA FOR PLAN 2 ** PLAN A LOWER DAM

	FREQ	FLOW	STAGE	RESID	COMMER	PUBLIC	UTILITY	TOTAL
1	80.00	-1.	-4.50	0.00	0.00	0.00	0.00	0.0
2	60.00	-1.	-4.00	0.00	0.00	0.00	0.00	0.0
3	50.00	-1.	-3.70	0.00	0.00	0.00	.00	0.0
4	40.00	-1.	-3.50	0.00	0.00	0.00	0.00	0.0
5	30.00	-1.	-3.00	0.00	0.00	0.00	0.00	0.0
6	20.00	-1.	-1.20	0.00	0.00	0.00	0.00	0.0
7	10.00	-1.	-1.00	0.00	0.00	0.00	0.00	0.0
8	5.00	-1.	0.00	0.00	0.00	0.00	0.00	0.0
9	4.00	-1.	.50	0.00	0.00	0.00	0.00	0.0
10	3.00	-1.	1.10	0.00	0.00	0.00	0.00	0.0
11	2.00	-1.	2.50	0.00	1.15	0.00	16.25	17.4
12	1.50	-1.	3.50	0.00	2.85	0.00	48.73	51.5
13	1.25	-1.	4.50	0.00	3.95	0.00	81.18	85.1
14	1.00	-1.	5.40	0.00	4.64	0.00	110.40	115.0
15	.50	-1.	7.80	0.00	6.68	0.00	188.40	195.0
16	.25	-1.	9.40	0.00	10.14	0.00	240.40	250.5
17	.10	-1.	10.50	0.00	13.55	0.00	276.15	289.7
EXP ANNUAL DAMAGE				0.00	.11	0.00	2.51	2.6

++

REACH NAME=RN ZONE 3

++++ INPUT DATA ++++

FLOOD STAGES

SF	3	300	-4.60	-4.20	-4.20	-3.80	-3.50	-2.80	-2.00	-1.3
	-1.10	-.70	0.00	.50	.70	1.30	3.00	5.00	8.50	

**END OF INPUT DATA FOR PLAN 3 **

EP++

**DAMAGE DATA FOR PLAN 3 ** PLAN B REPLACE BRIDGE,LOWER DAM

	FREQ	FLOW	STAGE	RESID	COMMER	PUBLIC	UTILITY	TOTAL
1	80.00	-1.	-4.60	0.00	0.00	0.00	0.00	0.0
2	60.00	-1.	-4.20	0.00	0.00	0.00	0.00	0.0
3	50.00	-1.	-4.20	0.00	0.00	0.00	0.00	0.0
4	40.00	-1.	-3.80	0.00	0.00	0.00	0.00	0.0
5	30.00	-1.	-3.50	0.00	0.00	0.00	0.00	0.0
6	20.00	-1.	-2.80	0.00	0.00	0.00	0.00	0.0
7	10.00	-1.	-2.00	0.00	0.00	0.00	0.00	0.0
8	5.00	-1.	-1.30	0.00	0.00	0.00	0.00	0.0
9	4.00	-1.	-1.10	0.00	0.00	0.00	0.00	0.0
10	3.00	-1.	-.70	0.00	0.00	0.00	0.00	0.0
11	2.00	-1.	0.00	0.00	0.00	0.00	0.00	0.0
12	1.50	-1.	.50	0.00	0.00	0.00	0.00	0.0
13	1.25	-1.	.70	0.00	0.00	0.00	0.00	[illegible]
14	1.00	-1.	1.30	0.00	0.00	0.00	0.00	[illegible]
15	.50	-1.	3.00	0.00	2.30	0.00	32.50	34.8
16	.25	-1.	5.00	0.00	4.50	0.00	97.40	101.9
17	.10	-1.	8.50	0.00	7.98	0.00	211.15	219.1
EXP ANNUAL DAMAGE				0.00	.03	0.00	.62	.6

++

REACH NAME=RN ZONE 3

++++ INPUT DATA ++++

FLOOD STAGES

SF 3 400 -12.00 -12.00 -12.00 -11.50 -11.00 -10.50 -9.50 -8.4
-7.80 -7.30 -6.50 -6.00 -5.50 -5.00 -2.80 -1.00 2.80

**END OF INPUT DATA FOR PLAN 4 **

EP++

**DAMAGE DATA FOR PLAN 4 ** PLAN C CHANNEL IMPROVEMENTS,ETC

	FREQ	FLOW	STAGE	RESID	COMMER	PUBLIC	UTILITY	TOTAL
1	80.00	-1.	-12.00	0.00	0.00	0.00	0.00	0.0
2	60.00	-1.	-12.00	0.00	0.00	0.00	0.00	0.0
3	50.00	-1.	-12.00	0.00	0.00	0.00	0.00	0.0
4	40.00	-1.	-11.50	0.00	0.00	0.00	0.00	0.0
5	30.00	-1.	-11.00	0.00	0.00	0.00	0.00	0.0
6	20.00	-1.	-10.50	0.00	0.00	0.00	0.00	0.0
7	10.00	-1.	-9.50	0.00	0.00	0.00	0.00	0.0
8	5.00	-1.	-8.40	0.00	0.00	0.00	0.00	0.0
9	4.00	-1.	-7.80	0.00	0.00	0.00	0.00	0.0
10	3.00	-1.	-7.30	0.00	0.00	0.00	0.00	0.0
11	2.00	-1.	-6.50	0.00	0.00	0.00	0.00	0.0
12	1.50	-1.	-6.00	0.00	0.00	0.00	0.00	0.0
13	1.25	-1.	-5.50	0.00	0.00	0.00	0.00	0.0
14	1.00	-1.	-5.00	0.00	0.00	0.00	0.00	0.0
15	.50	-1.	-2.80	0.00	0.00	0.00	0.00	0.0
16	.25	-1.	-1.00	0.00	0.00	0.00	0.00	0.0
17	.10	-1.	2.80	0.00	1.84	0.00	26.00	27.8
EXP ANNUAL DAMAGE				0.00	.00	0.00	.03	.0

** EXPECTED ANNUAL DAMAGE SUMMARY BY REACH **

** FLOOD PLAIN MANAGEMENT PLANS
1 = WITHOUT CONDITION
2 = PLAN A LOWER DAM
3 = PLAN B REPLACE BRIDGE,LOWER DAM
4 = PLAN C CHANNEL IMPROVEMENTS,ETC

SUMMARY FOR DAMAGE CATEGORY 1 = RESID

		EXPECTED ANNUAL DAMAGE						
REACH		WITHOUT	.... PLAN 2		.... PLAN 3		.... PLAN 4	
NO	ID	CONDITION (PLAN 1)	DAMAGE W/PLAN	DAMAGE REDUCED	DAMAGE W/PLAN	DAMAGE REDUCED	DAMAGE W/PLAN	DAMAGE REDUCED
1	1	11.06	9.17	1.89	5.95	5.11	.89	10.16
2	2	13.88	10.79	3.10	5.82	8.07	.33	13.55
3	3	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	RESID	24.94	19.95	4.99	11.76	13.18	1.22	23.72

** EXPECTED ANNUAL DAMAGE SUMMARY BY REACH **

** FLOOD PLAIN MANAGEMENT PLANS
1 = WITHOUT CONDITION
2 = PLAN A LOWER DAM
3 = PLAN B REPLACE BRIDGE,LOWER DAM
4 = PLAN C CHANNEL IMPROVEMENTS,ETC

SUMMARY FOR DAMAGE CATEGORY 2 - COMMER

REACH NO	ID	WITHOUT CONDITION (PLAN 1)	PLAN 2 DAMAGE W/PLAN	PLAN 2 DAMAGE REDUCED	PLAN 3 DAMAGE W/PLAN	PLAN 3 DAMAGE REDUCED	PLAN 4 DAMAGE W/PLAN	PLAN 4 DAMAGE REDUCED
1	1	7.38	6.32	1.06	4.48	2.89	.56	6.81
2	2	2.35	1.93	.42	1.14	1.20	.08	2.27
3	3	.11	.11	.01	.03	.09	.00	.11
COMMER		9.84	8.36	1.48	5.65	4.19	.64	9.20

AD-A143 397 PITTSFIELD LOCAL FLOOD PROTECTION WEST BRANCH AND SOUTHWEST BRANCH HOUSAT..(U) CORPS OF ENGINEERS WALTHAM MA NEW ENGLAND DIV OCT 80 5/5

UNCLASSIFIED F/G 13/2 NL

END

FILMED

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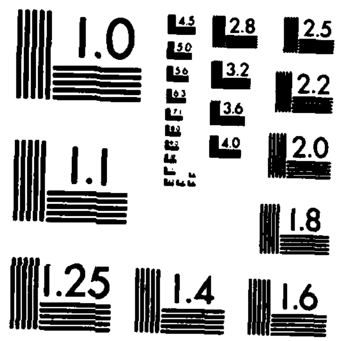

MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

* *

** EXPECTED ANNUAL DAMAGE SUMMARY BY REACH **

** FLOOD PLAIN MANAGEMENT PLANS
1 = WITHOUT CONDITION
2 = PLAN A LOWER DAM
3 = PLAN B REPLACE BRIDGE,LOWER DAM
4 = PLAN C CHANNEL IMPROVEMENTS,ETC

SUMMARY FOR DAMAGE CATEGORY 3 = PUBLIC

REACH NO	ID	WITHOUT CONDITION (PLAN 1)	PLAN 2 DAMAGE W/PLAN	PLAN 2 DAMAGE REDUCED	PLAN 3 DAMAGE W/PLAN	PLAN 3 DAMAGE REDUCED	PLAN 4 DAMAGE W/PLAN	PLAN 4 DAMAGE REDUCED
1	1	38.03	33.32	4.71	25.45	12.58	3.07	34.97
2	2	.32	.25	.07	.13	.19	.01	.31
3	3	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PUBLIC		38.35	33.57	4.78	25.58	12.77	3.08	35.27

** EXPECTED ANNUAL DAMAGE SUMMARY BY REACH **

** FLOOD PLAIN MANAGEMENT PLANS
1 = WITHOUT CONDITION
2 = PLAN A LOWER DAM
3 = PLAN B REPLACE BRIDGE,LOWER DAM
4 = PLAN C CHANNEL IMPROVEMENTS,ETC

SUMMARY FOR DAMAGE CATEGORY 4 = UTILITY

REACH NO	ID	. . . WITHOUT CONDITION (PLAN 1)	.... PLAN 2 .... DAMAGE W/PLAN	DAMAGE REDUCED	EXPECTED ANNUAL DAMAGE .... PLAN 3 .... DAMAGE W/PLAN	DAMAGE REDUCED	.... PLAN 4 .... DAMAGE W/PLAN	DAMAGE REDUCED
1	1	2.00	1.57	.42	.88	1.12	.14	1.86
2	2	2.29	1.77	.52	.91	1.38	.06	2.23
3	3	2.70	2.51	.20	.62	2.08	.03	2.68
UTILITY		6.99	5.85	1.14	2.41	4.58	.23	6.76

** EXPECTED ANNUAL DAMAGE SUMMARY BY REACH **

** FLOOD PLAIN MANAGEMENT PLANS
1 - WITHOUT CONDITION
2 - PLAN A LOWER DAM
3 - PLAN B REPLACE BRIDGE,LOWER DAM
4 - PLAN C CHANNEL IMPROVEMENTS,ETC

GRAND SUMMARY - ALL DAMAGE CATEGORIES

REACH NO	ID	WITHOUT CONDITION (PLAN 1)	PLAN 2 DAMAGE W/PLAN	PLAN 2 DAMAGE REDUCED	PLAN 3 DAMAGE W/PLAN	PLAN 3 DAMAGE REDUCED	PLAN 4 DAMAGE W/PLAN	PLAN 4 DAMAGE REDUCED
1	1	58.46	50.38	8.08	36.76	21.70	4.66	53.80
2	2	18.84	14.74	4.10	8.00	10.84	.48	18.37
3	3	2.82	2.62	.20	.65	2.17	.03	2.79
TOTAL		80.13	67.74	12.39	45.41	34.71	5.17	74.96

** GRAND SUMMARY BY CATEGORY **

** FLOOD PLAIN MANAGEMENT PLANS

1 = WITHOUT CONDITION
2 = PLAN A LOWER DAM
3 = PLAN B REPLACE BRIDGE,LOWER DAM
4 = PLAN C CHANNEL IMPROVEMENTS,ETC

GRAND SUMMARY - ALL DAMAGE CATEGORIES

	EXPECTED ANNUAL DAMAGE						
DAMAGE CATEGORY	WITHOUT CONDITION (PLAN 1)	.... PLAN 2 .... DAMAGE W/PLAN	DAMAGE REDUCED	.... PLAN 3 .... DAMAGE W/PLAN	DAMAGE REDUCED	.... PLAN 4 .... DAMAGE W/PLAN	DAMAGE REDUCED
RESID	24.94	19.95	4.99	11.76	13.18	1.22	23.72
COMMER	9.84	8.36	1.48	5.65	4.19	.64	9.20
PUBLIC	38.35	33.57	4.78	25.58	12.77	3.08	35.27
UTILITY	6.99	5.85	1.14	2.41	4.58	.23	6.76
TOTAL	80.13	67.74	12.39	45.41	34.71	5.17	74.96

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++++++++++++++++++++++++++++++++++++++++
XPECTED ANNUAL FLOOD DAMAGE COMPUTATION +
61-X6-L7580              JANUARY 14, 1977 +
ERSION DATE              DECEMBER 7, 1978 +
++++++++++++++++++++++++++++++++++++++++

++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
  DEC 1978 - THIS VERSION CORRECTS A FEW ERRORS AND INCLUDES A SUMMARY.
             USERS MANUAL ADDITIONS -
             J1 CARD -
              6  NDOLYR      +  MONTH AND YEAR OF DOLLARS AFTER THE DG CARDS
                                HAVE BEEN MULTIPLIED BY THE PRICE LEVEL ADJUST-
                                MENT FACTOR PLAF (J2.4).  ENTER ORDER NUMBER OF
                                THE MONTH IN COL 42,43 AND THE YEAR IN COL 45-48.

             J2 CARD -
              4     PLAF     +  PRICE LEVEL ADJUSTMENT FACTOR.  ALL DAMAGE
                                DATA ON THE DG CARDS WILL BE MULTIPLIED BY
                                THIS FACTOR.  NDOLYR (J1.6) MUST BE PROVIDED.

             PP CARD -
                  JDGPR    16   SUPPRESS SUMMARY OF EACH CATEGORY BY REACH
                           32   SUPPRESS GRAND SUMMARY-ALL CATEGORIES BY REACH
                           64   SUPPRESS ALL SUMMARY PRINTOUT

             RV CARD - NOW ACTIVE, BUT NOT FULLY TESTED

++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++

  COMPUTER ANALYSIS OF PITTSFIELD MA HOUSATONIC RIVER SW BRANCH -ZONE 4'
  DAMAGE VALUES IN $1000
  JANUARY 1980 PRICE LEVEL,1977 SURVEY

AMAGE CATEGORY NAMES**
  5      RESID  COMMER  PUBLIC BRIDGES HIGHWAY

LOOD PLAIN MANAGEMENT PLAN NAMES**
  1    WITHOUT CONDITION
  2    PLAN A 150 SQ FT CULVERT
  3    PLAN B 150 SQ FT CULVERT AND CHANNEL
  4    PLAN C 300 SQ FT CULVERT

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++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++

CH NAME-RN ZONE 4

+ INPUT DATA ++++

REQUENCIES**
           17   80.00    60.00    50.00    40.00    30.00    20.00    10.00     5.00
  4.00   3.00    2.00     1.50     1.25     1.00      .50      .25      .10

.OOD STAGES**
          100   -7.00    -6.50    -6.00    -5.60    -5.00    -4.40    -2.90     -.60
   .80   1.60    4.30     6.20     7.70    10.00    15.00    16.50    18.00

TAGES FOR DAMAGE DATA**
```

```
SD               15   -7.00   -5.00   -4.00   -3.00   -2.00   -1.00    0.00    1.00
     2.0       3.00    5.00    7.00    9.00 1[illegible].00   18.00

**FLOOD DAMAGE DATA**
DG                1    0.00    0.00    0.00     .10    1.80   11.60   23.30   38.10
    48.70     54.60   66.40   78.20   90.00  101.80  143.10

**FLOOD DAMAGE DATA**
DG                2    0.00     .50    2.70    5.60   27.50   47.70  110.80 1965.90
  3515.80   5015.80 6245.50 6384.70 6506.70 6628.70 7055.70

**FLOOD DAMAGE DATA**
DG                3    0.00    2.30    3.10    3.80    4.50    6.20    7.60   13.20
    14.60     15.70   17.90   20.10   22.30   24.50   32.20

**FLOOD DAMAGE DATA**
DG                4    0.00    0.00    0.00     .20     .70    1.10    1.50    1.80
     2.30      2.60    3.20    3.80    4.40    5.00    7.10

**FLOOD DAMAGE DATA**
DG                5    0.00    0.00    0.00    0.00     .60    1.20    1.80    3.70
     6.10      9.80   17.20   41.80   49.20   56.60   82.50

**END OF INPUT DATA FOR PLAN  1 **
EP++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++

++DAMAGE DATA FOR PLAN 1 --  WITHOUT CONDITION
```

	FREQ	FLOW	STAGE	RESID	COMMER	PUBLIC	BRIDGES	HIGHWAY	TOTAL
1	80.00	-1.	-7.00	0.00	0.00	0.00	0.00	0.00	0.00
2	60.00	-1.	-6.50	0.00	.13	.58	0.00	0.00	.70
3	50.00	-1.	-6.00	0.00	.25	1.15	0.00	0.00	1.40
4	40.00	-1.	-5.60	0.00	.35	1.61	0.00	0.00	1.96
5	30.00	-1.	-5.00	0.00	.50	2.30	0.00	0.00	2.80
6	20.00	-1.	-4.40	0.00	1.82	2.78	0.00	0.00	4.60
7	10.00	-1.	-2.90	.27	7.79	3.87	.25	.06	12.24
8	5.00	-1.	-.60	16.28	72.94	6.76	1.26	1.44	98.68
9	4.00	-1.	.40	29.22	852.84	9.84	1.62	2.56	896.08
10	3.00	-1.	1.60	44.46	2895.84	14.04	2.10	5.14	2961.58
11	2.00	-1.	4.30	62.27	5815.11	17.13	2.99	14.61	5912.11
12	1.50	-1.	6.20	73.48	6329.02	19.22	3.56	31.96	6457.24
13	1.25	-1.	7.70	82.33	6427.40	20.87	4.01	44.39	6579.00
14	1.00	-1.	10.00	95.90	6567.70	23.40	4.70	52.90	6744.60
15	.50	-1.	15.00	125.40	6872.70	28.90	6.20	71.40	7104.60
16	.25	-1.	16.50	134.25	6964.20	30.55	6.65	76.95	7212.60
17	.10	-1.	18.00	143.10	7055.70	32.20	7.10	82.50	7320.60

++

REACH NAME=RN ZONE A

++++ INPUT DATA ++++

FLOOD STAGES

```
SF          200   -7.00   -6.50   -6.00   -5.70   -5.40   -4.80   -3.90   -2.50
     -2.00  -1.20    .10    1.10    1.50    2.50    5.50   11.00   16.00
```

**END OF INPUT DATA FOR PLAN 2 **

EP++

++DAMAGE DATA FOR PLAN 2 -- PLAN A 150 SQ FT CULVERT

	FREQ	FLOW	STAGE	RESID	COMMER	PUBLIC	BRIDGES	HIGHWAY	TOTAL
1	80.00	-1.	-7.00	0.00	0.00	0.00	0.00	0.00	0.00
2	60.00	-1.	-6.50	0.00	.13	.58	0.00	0.00	.70
3	50.00	-1.	-6.00	0.00	.25	1.15	0.00	0.00	1.40
4	40.00	-1.	-5.70	0.00	.33	1.50	0.00	0.00	1.82
5	30.00	-1.	-5.40	0.00	.40	1.84	0.00	0.00	2.24
6	20.00	-1.	-4.80	0.00	.94	2.46	0.00	0.00	3.40
7	10.00	-1.	-3.90	.01	2.99	3.17	.02	0.00	6.19
8	5.00	-1.	-2.50	.95	16.55	4.15	.45	.30	22.40
9	4.00	-1.	-2.00	1.80	27.50	4.50	.70	.60	35.10
10	3.00	-1.	-1.20	9.64	43.66	5.86	1.02	1.08	61.26
11	2.00	-1.	.10	24.78	296.31	8.16	1.53	1.99	332.77
12	1.50	-1.	1.10	39.16	2120.89	13.34	1.85	3.94	2179.18
13	1.25	-1.	1.50	43.40	2740.85	13.90	2.05	4.90	2805.10
14	1.00	-1.	2.50	51.65	4265.80	15.15	2.45	7.95	4343.00
15	.50	-1.	5.50	69.35	6280.30	18.45	3.35	23.35	6394.80
16	.25	-1.	11.00	101.80	6628.70	24.50	5.00	56.60	6816.60
17	.10	-1.	16.00	131.30	6933.70	30.00	6.50	75.10	7176.60
EXP ANNUAL DAMAGE				1.43	83.15	1.60	.09	.41	86.68

++

REACH NAME=RN ZONE 4

++++ INPUT DATA ++++

FLOOD STAGES

SF 300 -9.00 -8.50 -8.00 -7.50 -7.00 -6.00 -4.40 -2.50
-2.00 -1.20 .10 1.10 1.50 2.50 5.50 11.00 16.00

**END OF INPUT DATA FOR PLAN 3 **

EP++

++DAMAGE DATA FOR PLAN 3 -- PLAN B 150 SQ FT CULVERT AND CHANNEL

	FREQ	FLOW	STAGE	RESID	COMMER	PUBLIC	BRIDGES	HIGHWAY	TOTAL
1	80.00	-1.	-9.00	0.00	0.00	0.00	0.00	0.00	0.00
2	60.00	-1.	-8.50	0.00	0.00	0.00	0.00	0.00	0.00
3	50.00	-1.	-8.00	0.00	0.00	0.00	0.00	0.00	0.00
4	40.00	-1.	-7.50	0.00	0.00	0.00	0.00	0.00	0.00
5	30.00	-1.	-7.00	0.00	0.00	0.00	0.00	0.00	0.00
6	20.00	-1.	-6.00	0.00	.25	1.15	0.00	0.00	1.40
7	10.00	-1.	-4.40	0.00	1.82	2.78	0.00	0.00	4.60
8	5.00	-1.	-2.50	.95	16.55	4.15	.45	.30	22.40
9	4.00	-1.	-2.00	1.80	27.50	4.50	.70	.60	35.10
10	3.00	-1.	-1.20	9.64	43.66	5.86	1.02	1.08	61.26
11	2.00	-1.	.10	24.78	296.31	8.16	1.53	1.99	332.77
12	1.50	-1.	1.10	39.16	2120.69	13.34	1.85	3.94	2179.18
13	1.25	-1.	1.50	43.40	2740.85	13.90	2.05	4.90	2805.10
14	1.00	-1.	2.50	51.65	4265.80	15.15	2.45	7.95	4343.00
15	.50	-1.	5.50	69.35	6280.30	18.45	3.35	23.35	6394.80
16	.25	-1.	11.00	101.80	6628.70	24.50	5.00	56.60	6816.60
17	.10	-1.	16.00	131.30	6933.70	30.00	6.50	75.10	7176.60
EXP ANNUAL DAMAGE				1.43	82.85	.91	.09	.41	85.69

++

REACH NAME=RN ZONE 4

++++ INPUT DATA ++++

FLOOD STAGES

```
SF          400   -7.00   -6.50   -6.00   -5.70   -5.40   -4.80   -3.90   -2.50
   -2.10  -1.60    -.60     .20     .50    1.40    3.80    7.00   12.00
```

**END OF INPUT DATA FOR PLAN 4 **

EP++

++DAMAGE DATA FOR PLAN 4 -- PLAN C 300 SQ FT CULVERT

	FREQ	FLOW	STAGE	RESID	COMMER	PUBLIC	BRIDGES	HIGHWAY	TOTAL
1	80.00	-1.	-7.00	0.00	0.00	0.00	0.00	0.00	0.00
2	60.00	-1.	-6.50	0.00	.13	.58	0.00	0.00	.70
3	50.00	-1.	-6.00	0.00	.25	1.15	0.00	0.00	1.40
4	40.00	-1.	-5.70	0.00	.33	1.50	0.00	0.00	1.82
5	30.00	-1.	-5.40	0.00	.40	1.84	0.00	0.00	2.24
6	20.00	-1.	-4.80	0.00	.94	2.46	0.00	0.00	3.40
7	10.00	-1.	-3.90	.01	2.99	3.17	.02	0.00	6.19
8	5.00	-1.	-2.50	.95	16.55	4.15	.45	.30	22.40
9	4.00	-1.	-2.10	1.63	25.31	4.43	.65	.54	32.56
10	3.00	-1.	-1.60	5.72	35.58	5.18	.86	.84	48.18
11	2.00	-1.	-.60	16.28	72.94	6.76	1.26	1.44	98.68
12	1.50	-1.	.20	26.26	481.82	8.72	1.56	2.18	520.54
13	1.25	-1.	.50	30.70	1038.35	10.40	1.65	2.75	1083.85
14	1.00	-1.	1.40	42.34	2585.86	13.76	2.00	4.66	2648.62
15	.50	-1.	3.80	59.32	5507.68	16.58	2.84	12.76	5599.18
16	.25	-1.	7.00	78.20	6384.70	20.10	3.80	41.80	6528.60
17	.10	-1.	12.00	107.70	6689.70	25.60	5.30	60.30	6888.60
EXP ANNUAL DAMAGE				1.09	61.36	1.53	.08	.28	64.33

** GRAND SUMMARY BY CATEGORY **

** FLOOD PLAIN MANAGEMENT PLANS
1 = WITHOUT CONDITION
2 = PLAN A 150 SQ FT CULVERT
3 = PLAN B 150 SQ FT CULVERT AND CHANNEL
4 = PLAN C 300 SQ FT CULVERT

GRAND SUMMARY = ALL DAMAGE CATEGORIES

DAMAGE CATEGORY	EXPECTED ANNUAL DAMAGE WITHOUT CONDITION (PLAN 1)	PLAN 2 DAMAGE W/PLAN	PLAN 2 DAMAGE REDUCED	PLAN 3 DAMAGE W/PLAN	PLAN 3 DAMAGE REDUCED	PLAN 4 DAMAGE W/PLAN	PLAN 4 DAMAGE REDUCED
RESID	3.32	1.43	1.89	1.43	1.89	1.09	2.23
COMMER	199.45	83.15	116.30	82.85	116.60	61.36	138.09
PUBLIC	2.12	1.60	.52	.91	1.21	1.53	.59
BRIDGES	.20	.09	.10	.09	.10	.08	.12
HIGHWAY	1.20	.41	.79	.41	.79	.28	.92
TOTAL	206.28	86.68	119.60	85.69	120.59	64.33	141.95

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END OF RUN

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Future Benefits

Future Inundation Reduction Benefit

The future inundation reduction benefit is the value of reducing flood losses to activities which would use the flood plain without a project. Little development is expected in the study area, and it is assumed that development which does occur would replace similar activities. The future inundation reduction benefit is, therefore, assumed to be zero.

Location Benefits

The location benefit is the value provided by making the flood plain available for new uses. If activities not currently feasible can be instituted with the project, due to reduced flood hazard, a location benefit may exist. Because local officials expe development to be mininal, and because no firm commitments to locate in the fl plain have been made, location benefits were not taken.

Intensification Benefits

The intensification benefit arises because a project allows an activity to modify its operation on the flood plain by utilizing its land more intensively. Many activities covered by the flood damage survey did not appear to underutilize space due to the possibility of flooding. Also, residual losses would remain high under several of the proposed plans, and therefore, incentive to utilize land more intensively would be lacking. Because of these factors, intensification benefits are not expected to be significant.

Affluence Benefit

The affluence benefit accrues if it is assumed that the contents value of residential structures will increase in the future, and a project will protect that increased value. Because residential damages are relatively small and comprise a low proportion of total damages, benefits resulting from increasing contents value are expected to be insignificant. Since the minimal amount of affluence benefits would not affect recommendation of a plan, these benefits are not quantified.

Non-Structural Plans

The nonstructural plans consist of flood proofing and evacuation measures. In cases where flood proofing was not feasible, activities were assumed to be permanently evacuated from the flood plain.

Flood Proofing Benefits

Benefits accruing to flood proofing were estimated by comparing average annual damages without protection to average annual damages with structures being flood proofed. Only physical damages were taken into consideration since non-physical losses are not affected by the flood proofing plans. Of the total annual losses, 82 percent were found to be physical. For a simplified method to compute damages prevented (benefits), total annual losses for each zone, up to the 100-year elevation, are multiplied by the percentage of physical losses (82 percent) and the percentage of structures to be flood proofed in each zone. Benefits attributable to flood proofing are shown in Table 8.

TABLE 8

FLOOD PROOFING BENEFITS

	Total Natural Annual Losses	Physical Losses (82%)	% Structures To be Flood-proofed	Total Damages Prevented
WEST BRANCH				
Zone 1	$38,300	$31,406	65%	$20,413
Zone 2	6,800	5,576	75%	4,182
Zone 3	760	623	35%	218
TOTAL, WEST BRANCH	$45,860	$37,605		$24,813
SOUTHWEST BRANCH				
Zone 4	$124,200	$101,844	51%	$51,940

Benefits to Evacuation

Evacuation will result in new activities replacing those originally located in the flood plain. After structures are demolished, the most likely future of the vacated area would be green open space and parks to be used for passive recreation. On West Street, where buildings have been demolished, conversion to a passive recreational area has already taken place.

The computation of a recreation benefit would be appropriate if total recreational activity increases. This seems unlikely, however, because the present amount of passive recreation area appears to be adequate to satisfy present and future demand. Utilization of newly created areas would be at the expense of existing ones and would result in a transfer only, with no net gain. Since it is felt that use of flood plain parks would be small and/or at the expense of use of existing parks, the benefit accruing to recreation is not expected to be significant.

Another benefit which may result from evacuation is the portion of flood damage reduced by a project which would otherwise be borne by occupants outside the flood plain. Such externalized costs borne by taxpayers but eliminated by evacuation are: (1) damages to utility, transportation, and communication systems; (2) subsidized flood insurance costs; and (3) flood emergency costs.

Damages to utility, transportation, and communication systems were determined by combining damage survey information and stage-frequency data. Flood emergency costs were based on previous studies of experienced flood losses. To determine the reduction in subsidized flood insurance costs, damage survey data was used to group similar properties together. Using the Federal Flood Insurance Manual, the premium paid per $100 of coverage was found based on the type of structure and height above or below river elevation. The premium which policy holders pay (e.g., $.25 per $100 coverage) was subtracted from the true rate to obtain the subsidized portion of the premium.

Benefits to evacuation, summarized for each zone and branch, are given in Table 9.

TABLE 9

ANNUAL BENEFITS TO EVACUATION

100-YEAR FLOOD LEVEL PROTECTION
(1979 Price Level)

	Reduction in Flood Insurance Payments	Reduction in Cost to Outsiders	Reduction in Emergency Costs	Total	Total (Jan 1980 P.L.)
WEST BRANCH					
Zone 1	$ 620	$23,180	$ 3,270	$ 27,070	$ 29,510
Zone 2	3,100	1,290	460	4,850	5,290
Zone 3	80	1,290	120	1,490	1,620
TOTAL WEST BRANCH	$ 3,800	$25,760	$ 3,850	$ 33,410	$ 36,420
SOUTHWEST BRANCH					
Zone 4	$93,900	$ 2,130	$16,070	$112,100	$122,190

Total annual nonstructural benefits are as follows:

100-Year Protection	
West Branch - Plan D	$ 61,230
Southwest Branch - Plan D	$174,130

Combination Plans

Plan E combines the structural modifications of Plan A with non-structural measures. Plan F combines Plan B with non-structural in the West Branch and Plan C with non-structural in the Southwest Branch. The inclusion of flood proofing and evacuation measures reduces the physical portion of the residual loss associated with the structural plans. Analysis of damage - frequency relationships produces the following results:

TABLE 10

FLOOD DAMAGE REDUCTION
AVERAGE ANNUAL LOSSES AND BENEFITS, PLANS E AND F

	Alternative ($)	Residual Losses ($)	Benefit
WEST BRANCH			
Zone 1	Plan E	30,706	27,754
	Plan F	22,834	35,626
Zone 2	Plan E	11,238	7,602
	Plan F	6,448	12,392
Zone 3	Plan E	2,328	492
	Plan F	496	2,324
TOTAL WEST BRANCH	Plan E	44,272	35,848
	Plan F	29,778	50,342
SOUTHWEST BRANCH			
Zone 4	Plan E	66,308	139,972
	Plan F	52,196	154,084

The implementation of a structural plan along with flood proofing and evacuation decreases the degree of non-structural measures needed and results in a corresponding decrease in the benefits. The benefits to evacuation alone, for the combined plans are shown below:

TABLE 11

ANNUAL BENEFITS TO EVACUATION, PLANS E AND F
(1979 Price Level)

	Reduction in Flood Insurance Payments	Reduction in Cost to Outsiders	Reduction in Emergency Costs	Total	Total (Jan. 1980 P.L.)
WEST BRANCH					
Plan E					
Zone 1	$ 560	$20,860	$2,940	$24,360	$26,550
Zone 2	2,790	1,160	410	4,360	4,750
Zone 3	70	1,160	110	1,340	1,460
Total	$ 3,420	$23,180	$3,460	$30,060	$32,760
Plan F					
Zone 1					
Zone 2					
Zone 3					
Total	- NO EVACUATIONS				
SOUTHWEST BRANCH					
Plan E					
Zone 4	$15,960	$ 360	$ 2,730	$ 19,050	$20,760
Plan F					
Zone 4	$15,960	$ 360	$ 2,730	$ 19,050	$20,760

Total benefits for Plans E and F are as follows:

West Branch	Plan E - $ 68,608
	Plan F - $ 50,342
Southwest Branch -	Plan E - $160,732
	Plan F - $174,844

Intangible Benefits

In addition to the benefits described above, intangible benefits would accrue to structural and/or non-structural proposals. These benefits include a reduction in health hazards caused by polluted floodwaters and a potential improvement in the social and economic well-being of residents and economic activities in the area. Also, a reduction in the demand for municipal services (police, fire, public works) during flood emergencies would result.

Justification

The annual benefits that have been quantified (rounded to hundreds), annual costs, and the ratio of benefits to costs for each plan are presented in Table 12. In general, annual benefits should equal or exceed annual costs for a project to be economically justified. A plan may also be recommended on the basis of environmental considerations.

TABLE 12

BENEFIT/COST RATIOS

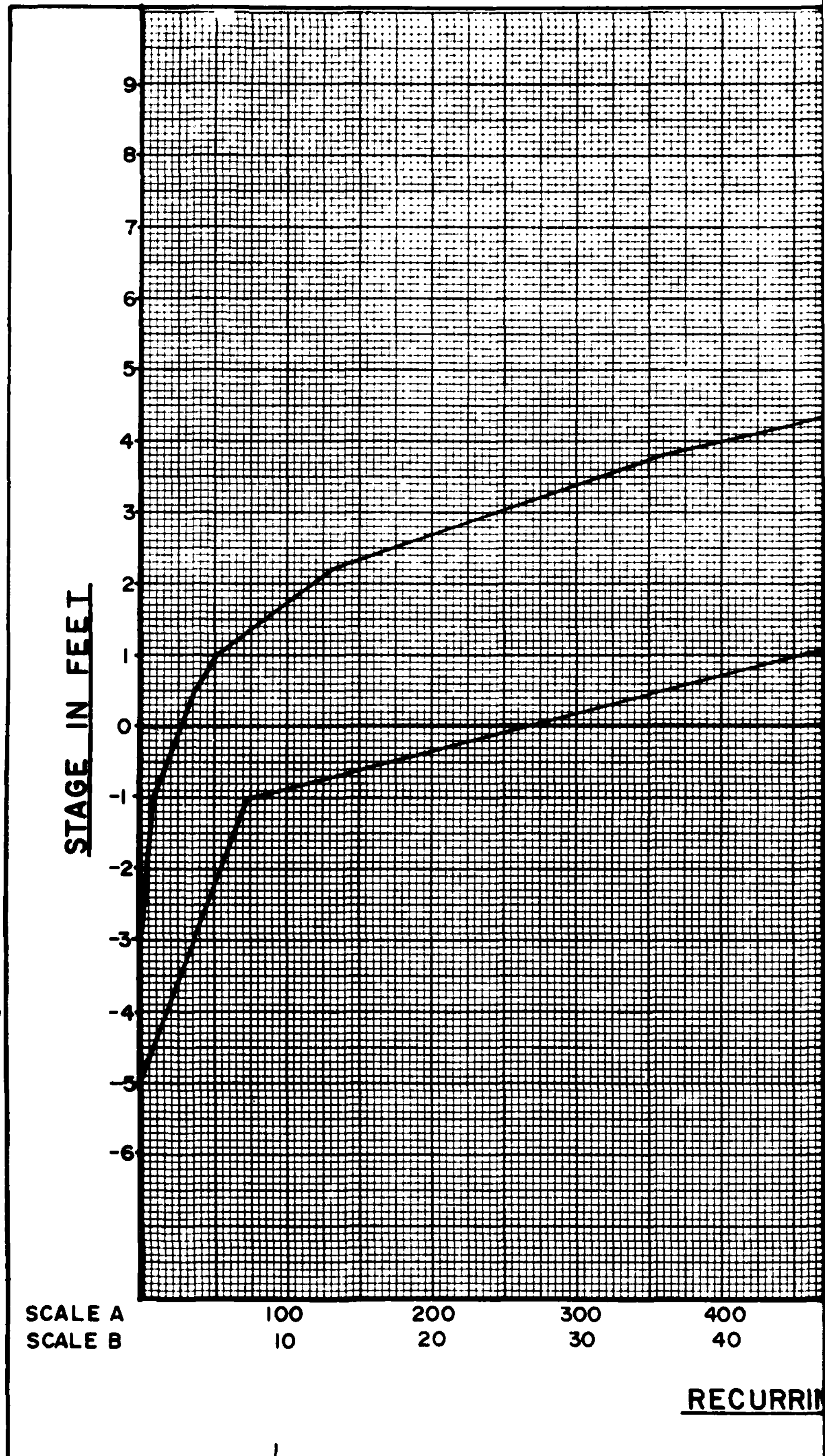
	Annual Benefits	Annual Costs	BCR
WEST BRANCH			
Plan A	$ 12,400	$ 3,200	3.88
B	$ 34,700	$29,300	1.18
C	$ 75,000	$186,300	0.40
D	$ 61,200	$174,400	0.35
E	$ 68,600	$147,000	0.47
F	$ 50,300	$122,000	0.41
SOUTHWEST BRANCH			
Plan A	$119,600	$37,200	3.22
B	$120,600	$65,600	1.84
C	$142,000	$50,600	2.81
D	$174,100	$376,800	0.46
E	$160,700	$120,100	1.34
F	$174,800	$130,400	1.34

The following table presents a comparison of SPF recurring losses without the project and recurring losses of the same elevation if Plan A were implemented:

TABLE 13

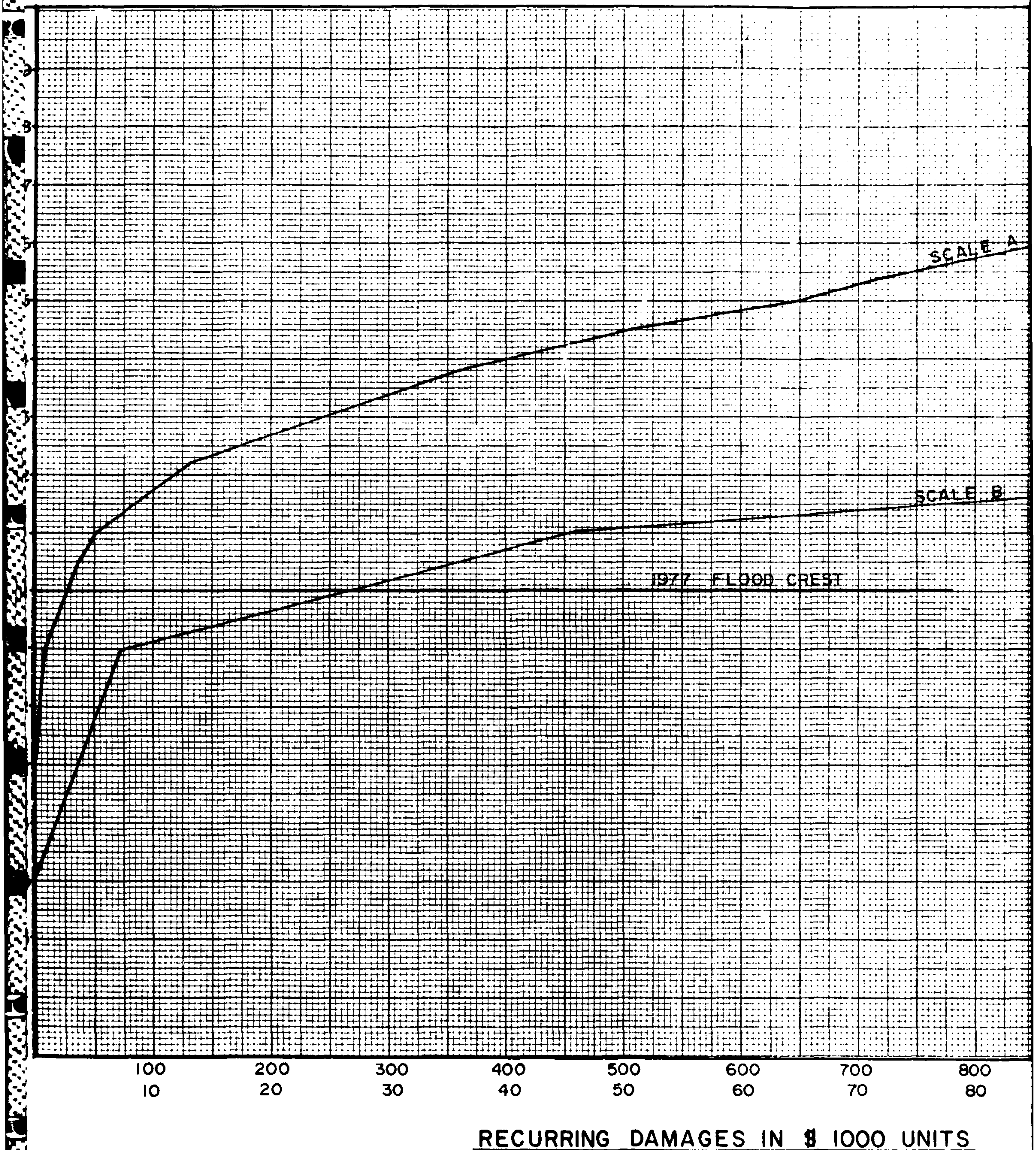
RECURRING LOSSES - SPF ELEVATION
(Thousands of Dollars)

Category	WITHOUT PROJECT Losses	%	WITH PROJECT Losses	%
WEST BRANCH				
ZONE 1				
Residential	706.2	26.8	706.2	26.8
Commercial	395.2	15.0	395.2	15.0
Public	1,359.1	51.5	1,359.1	51.5
Utilities	178.7	6.8	178.7	6.8
TOTAL	2,639.5	100.1	2,639.5	100.1
ZONE 2				
Residential	1,204.2	75.3	1,105.2	75.0
Commercial	154.0	9.6	143.1	9.7
Public	30.6	1.9	30.0	2.0
Utilities	211.2	13.2	194.9	13.2
TOTAL	1,600.0	100.0	1,473.2	99.9
ZONE 3				
Residential	12.0	4.4	11.2	4.3
Utilities	259.9	95.6	251.8	95.7
TOTAL	271.9	100.0	263.0	100.0
SOUTHWEST BRANCH				
ZONE 4				
Residential	135.7	1.9	101.8	1.5
Commercial	6,725.8	96.4	6,440.8	97.2
Public	30.8	0.4	24.5	0.4
Bridges	6.7	0.1	5.0	0.1
Highway	77.9	1.1	56.6	0.8
TOTAL	6,976.9	99.9	6,628.7	100.0

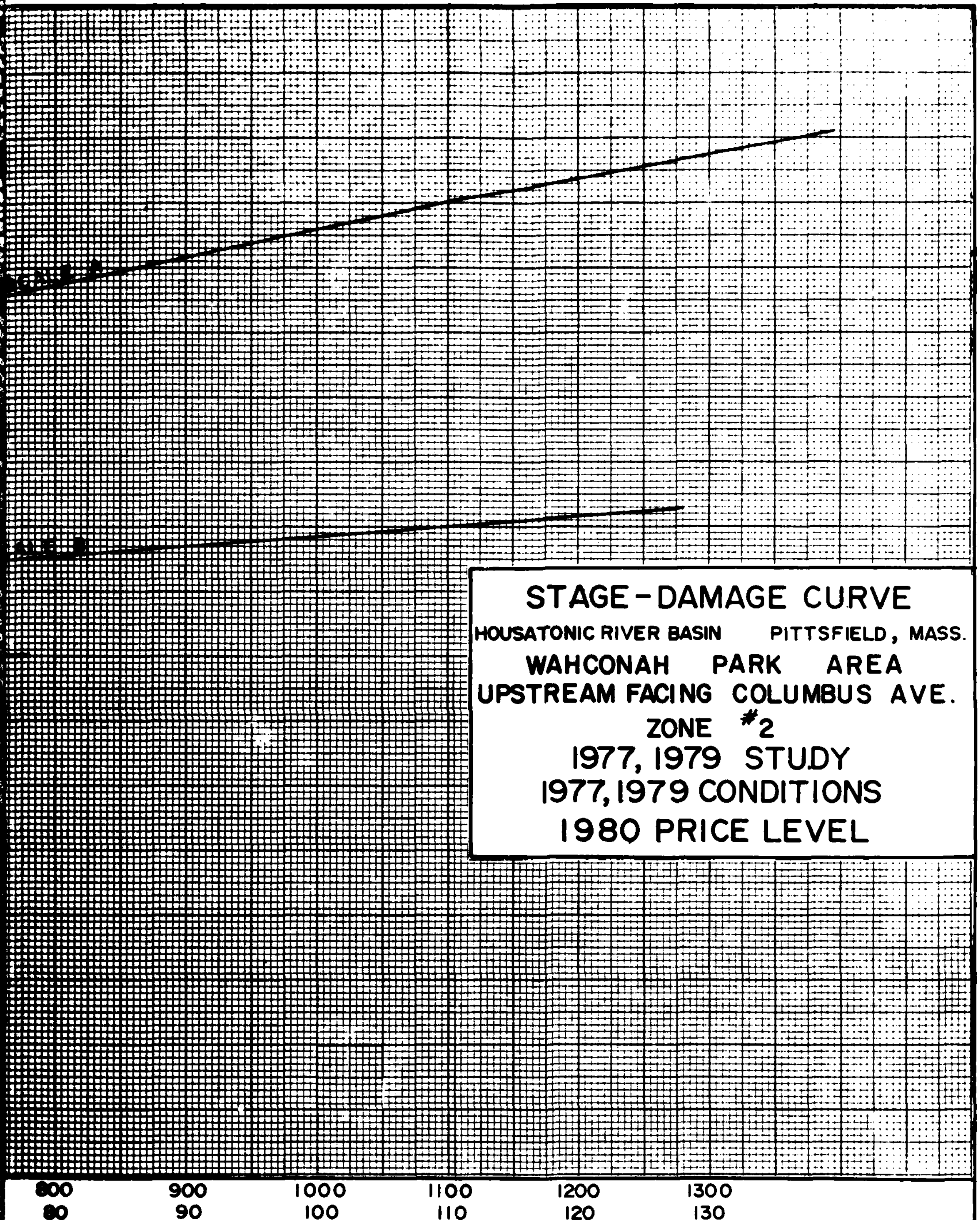


STAGE IN FEET
9
8
7
6
5
4
3
2
1
0
-1
-2
-3
-4
-5
-6
SCALE A
SCALE B
100
10
200
20
300
30
400
40
RECURRIN

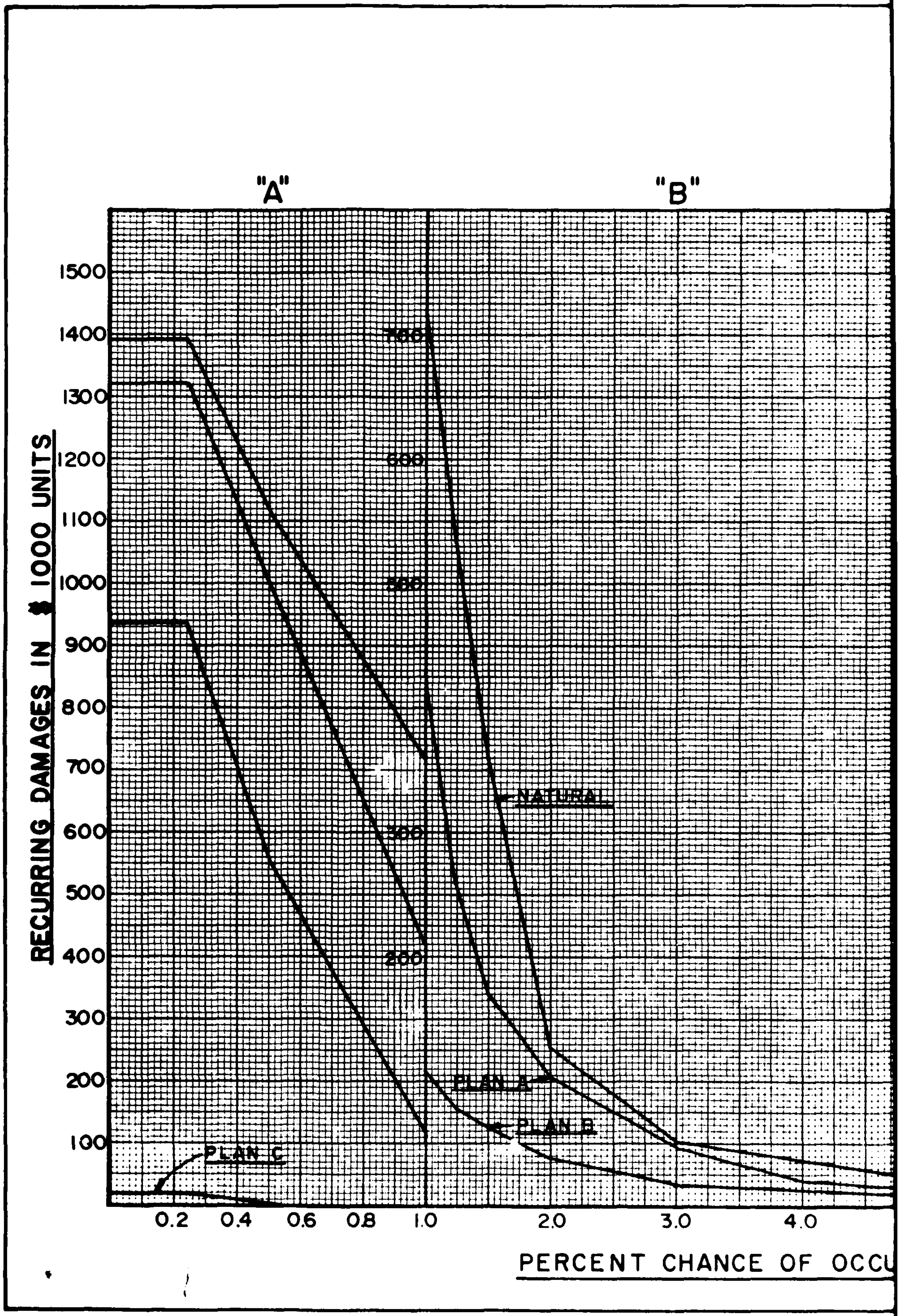
Plate 5-4



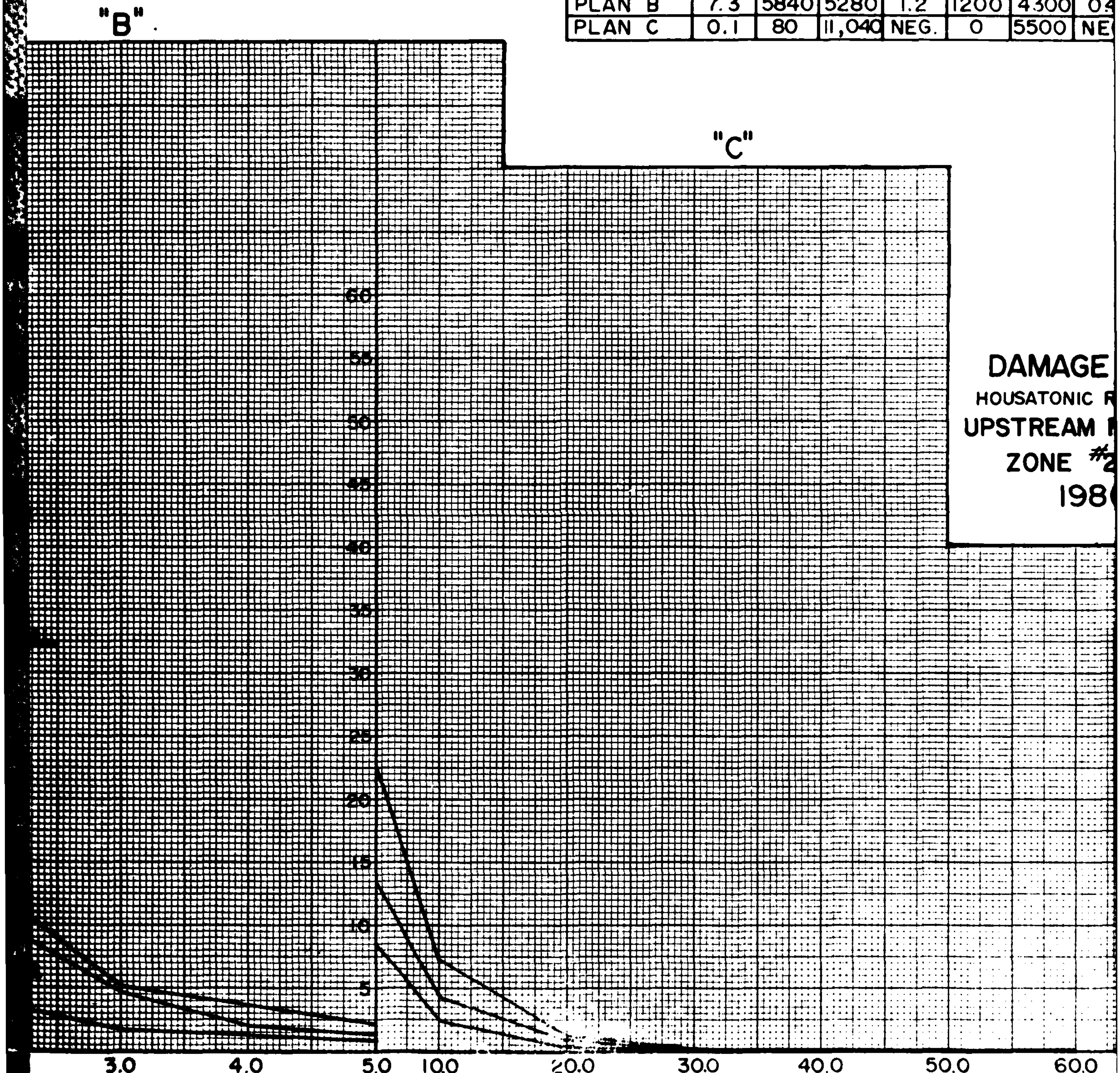
SCALE A
SCALE B
1977 FLOOD CREST
100
200
300
400
500
600
700
800
10
20
30
40
50
60
70
80
RECURRING DAMAGES IN $ 1000 UNITS


STAGE-DAMAGE CURVE
HOUSATONIC RIVER BASIN PITTSFIELD, MASS.
WAHCONAH PARK AREA
UPSTREAM FACING COLUMBUS AVE.
ZONE #2
1977, 1979 STUDY
1977, 1979 CONDITIONS
1980 PRICE LEVEL
800 900 1000 1100 1200 1300
80 90 100 110 120 130

ITS


"A"
"B"
RECURRING DAMAGES IN $ 1000 UNITS
1500
1400
1300
1200
1100
1000
900
800
700
600
500
400
300
200
100
700
600
500
300
200
NATURAL
PLAN A
PLAN B
PLAN C
0.2
0.4
0.6
0.8
1.0
2.0
3.0
4.0
PERCENT CHANCE OF OCCU

	RANGE A 1 SQ. IN.= $ 800			RANGE B 1 SQ. IN.= $ 1000			RA 1 SQ
	AREA	LOSS	BEN.	AREA	LOSS	BEN.	ARE
NATURAL	13.9	11,120	—	5.5	5500	—	1.3
PLAN A	12.1	9680	1440	3.4	3400	2100	0.7
PLAN B	7.3	5840	5280	1.2	1200	4300	0.4
PLAN C	0.1	80	11,040	NEG.	0	5500	NE



DAMAGE

HOUSATONIC R

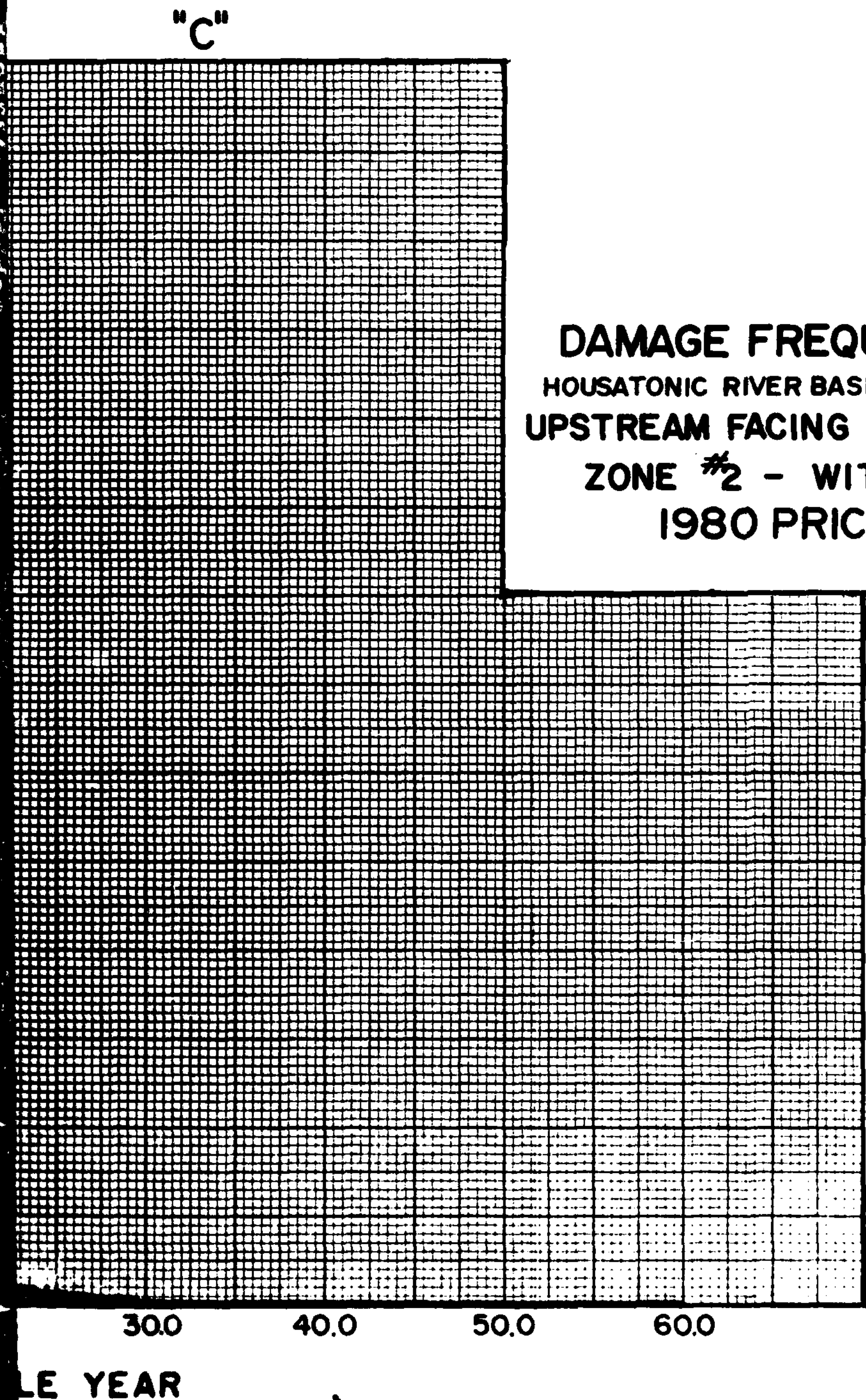
UPSTREAM

ZONE #2

198

ENT CHANCE OF OCCURRENCE PER SINGLE YEAR

	RANGE A 1 SQ. IN. = $ 800			RANGE B 1 SQ. IN. = $ 1000			RANGE C 1 SQ. IN. = $ 1000			AVERAGE ANNUAL	
	AREA	LOSS	BEN.	AREA	LOSS	BEN.	AREA	LOSS	BEN.	LOSS	BEN.
ATURAL	13.9	11,120	—	5.5	5500	—	1.3	1300	—	17,920	
LAN A	12.1	9680	1440	3.4	3400	2100	0.7	700	600	13,780	4140
LAN B	7.3	5840	5280	1.2	1200	4300	0.4	400	900	7440	10,480
LAN C	0.1	80	11,040	NEG.	0	5500	NEG.	0	1300	80	17,840



DAMAGE FREQUENCY CURVE

HOUSATONIC RIVER BASIN PITTSFIELD, MASS.

UPSTREAM FACING COLUMBUS AVE.

ZONE #2 - WITH ADDITIONS

1980 PRICE LEVEL

APPENDIX 6

REAL ESTATE

APPENDIX 6

REAL ESTATE

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APPENDIX 6

REAL ESTATE

Purpose

The purpose of this report is to estimate the fair market value of real estate interests and the allied real estate costs for the proposed modifications on the West and Southwest Branches of the Housatonic River, Pittsfield, Massachusetts for local flood protection.

The effective date of this report is 12 July 1979.

Scope

This report is presented in three alternative plans for the Southwest Branch and two alternative plans for the West Branch of the Housatonic River.

The Southwest Branch alternative Plans A, B, and C include a brief description of the modification measures and a summary of real estate costs.

The West Branch alternative Plans A and B include a brief description of the modification measures and a summary of real estate costs.

Location and Area Data

Pittsfield is located on the Housatonic River in Berkshire County near the western border of Massachusetts. Highways 7 and 20 run through Pittsfield. The area was originally geared to an agricultural economy; however, the transition to urban life and industry began with the building of a fulling mill in 1797. In 1800 the textile industry really got underway when a young Englishman, Arthur Scholfield, set up a woolen mill with machinery smuggled out of England. Branches of the Housatonic River provided the needed water and water power for the many textile mills that were soon built along its courses.

Today, the Pittsfield area is the commercial trading and industrial center of the far western sector of the Commonwealth and has a well-balanced economic base. In addition to the normal commercial and industrial business, this area is surrounded by the popular recreation and vacation area of the Berkshire Hills.

Description of Project

The proposed project involves modification along the West and Southwest Branches and the Housatonic River in four different locations.

Southwest Branch

1. Install supplemental culvert through the Conrail Corporation embankment, which is located about 1,100 feet south of Housatonic Street and east of McKinley Terrace.

2. Clearing of brush in an over land strip westward about 1,000 feet from the bridge on Barker Road.

West Branch

1. Lower Tel-Electric Dam by 3 feet.

Housatonic River

1. Lower the sewer line crossing the river beneath South Street bridge to a position beneath the streambed.

Description of Project Area

Southwest Branch

1. The area around the railroad bridge over the Southwest Branch is an area of trees and brush. On the west side, beyond the railroad right-of-way, the land is privately owned. On the east side, that portion north of the river is owned by the Conrail Corporation. Access could be from the railroad right-of-way or through Clapp Park and the city-owned property on the northeast. Access from the west would be possible across privately-owned property.

2. Most of the land in the project area along the alignment of brush-clearing along the Southwest Branch is privately owned and is in the city flood plain. There is access from Barker Road or Cadwell Road.

West Branch

1. The Tel-Electric Dam is located in an industrial area. There are railroad bridges across the river just above the dam. There is access to the dam site and the east bank from Mill Street. There is also access to the west bank of

the river below the dam from the bank between the river and a brick building which is continguous to the dam.

Rights to be Acquired

Local interests are required to provide all lands, easements, and rights-of-way necessary for project construction.

A. Temporary Easements

Southwest Branch

1. To install a supplemental culvert, it will require an access road and a work area on each side of the present bridge. This will require a total of about one acre of temporary easement for the length of time required to complete the project.

2. To clear the flood plain of brush for a distance of 1,000 feet will require a temporary easement for access to the site and a work area on each side of the channel. This will require about 3 acres for the duration of the cleaning operation.

West Branch

1. The modification of the Tel-Electric Dam will require access to the dam site from both sides of the river plus a work area. This will require about 0.50 acre for the time of modification.

Housatonic River

1. To lower the sewer line under South Street bridge to a position below the stream bed will require access and a work area on each side of the bridge. Collectively, this will require about an acre for the time of modification.

B. Permanent Easement

A permanent easement will be required for the area of the brush clearing which is to be maintained on the Southwest Branch. This will consist of about 2 acres.

Approach to Value

The estimated fair market value of the real estate required for project purposes are based upon a study of comparable sales in the vicinity, discussions with people knowledgeable in the local real estate market, the appraiser's general knowledge of values in the area, and experience of this office in similar projects.

Acquisition Costs

Acquistion costs will include costs for mapping and surveys, legal description, title evidence, appraisals, negotiations, and closing and adminstrative costs for possible condemnations. The acquisition costs are based upon this office's experience in similar civil works projects in this general area and are estimated at $3,000 per ownership.

Relocation Assistance Costs

Public Law 91-646, Uniform Relocations Assistance Act of 1970, provided for equitable treatment of persons displaced from their homes, businesses, or farms by a Federally assisted program. No persons, businesses, or farms would be displaced.

In accordance with this law, a sum of $200 per ownership is estimated to cover possible reimbursable expenses which may be incurred in this acquisition program.

Protection and Enhancement of Cultural Environment

There are no known structures of historic significance which will be affected by the proposed modifications.

Tax Loss

No tax loss is anticipated due to this project.

Severance Damages

No severance damages are anticipated due to this project.

Contingencies

A contingency allowance of 20 percent is considered to be reasonably adequate to provide for possible appreciation of property values, from the time of this estimate to acquistion date, for possible minor property line adjustments or for additional hidden ownerships which may be developed by refinement of taking lines, for adverse condemnation awards and to allow for practical and realistic negotations.

Government-Owned Facilities

Section III of the Act of Congress, approved 3 July 1958 (PL 85-500), authorized the protection, realteration, reconstruction, relocation, or replacement of municipally-owned facilities. A preliminary inspection of the project area indicates no Government-owned facilities are affected.

Temporary Construction Easement

The cost of temporary construction easements is estimated to be about 15 percent of the estimated fair market value per year. This amount is predicated on an amount equal to the estimated fair return an investor would be entitled to on invested capital or fair market value. For purposes of this report, it is estimated that the construction easements will be required for one year.

Zoning

The private lands affected by the project are zoned General Industrial and Residential.

Highest and Best Use

The highest and best use of the affected private lands is considered to be the present use.

Real Estate Costs

The following is a summary of the estimated real estate costs based upon a preliminary plan furnished this office, dated 19 June 1979, entitled "Detailed Project Report (DPR), Local Flood Protection - West and Southwest Branches, Housatonic River, Pittsfield, Massachusetts."

DESCRIPTION OF MODIFICATION MEASURES AND RECAPITULATION OF REAL ESTATE COSTS

SOUTHWEST BRANCH

Plan A - Modification Measure

Install a supplemental culvert, 150 square feet, through Conrail Corporation embankment.

Brush clearing of overland flow path above Barker Road bridge.

Plan A - Estimated Real Estate Costs

Temporary Easements	$ 200
Permanent Easements	200
Severance Damage	0
20% Contingency	80
Subtotal	$ 480
Relocation Assistance Costs (2 private ownerships)	400
Acquisition Costs (2 private ownerships)	6,000
Total Estimated Real Estate Costs - Plan A	$6,880
Called	$7,000

Plan B - Modification Measure

Install supplemental culvert, 150 square feet, through Conrail Corporation embankment; excavate channel to 40' bottom width, grass lined.

Plan B - Estimated Real Estate Costs

Temporary Easements	$ 200
Permanent Easements	200
Severance Damage	0
20% Contingency	80
Subtotal	$ 480
Relocation Assistance Cost (2 private ownerships)	400
Acquistion Costs (2 private ownerships)	6,000
Total Estimated Real Estate Cost - Plan B(1)	$6,880
Called	$7,000

Plan C - Modification Measure

Install a supplemental culvert, 300 square feet, through Conrail Corporation embankment.

Plan C - Estimated Real Estate Costs

Temporary Easements		$ 200
Permanent Easements		0
Severance Damage		0
20% Contingency		40
	Subtotal	$ 240
Relocation Assistance Costs (2 private ownerships)		400
Acquistion Costs (2 private ownerships)		6,000
Total Estimated Real Estate Costs - Plan C		$6,640
	Called	$6,600

WEST BRANCH

Plan A - Modification Measure

Lower Tel-Electric Dam by 3 feet.

Plan A - Estimated Real Estate Costs

Temporary Easements		$ 100
Permanent Easements		0
Severance Damage		0
20% Contingency		20
	Subtotal	$ 120
Relocation Assistance Costs (1 private ownership)		200
Acquistion Costs (1 private ownership)		3,000
Total Estimated Real Estate Costs - Plan A		$3,320
	Called	$3,500

Plan B - Modification Measure

Lower Tel-Electric Dam by 3 feet and replace West Street bridge with twin 25-foot wide openings.

Plan B - Estimated Real Estate Costs

Temporary Easements	$ 400
Permanent Easements	0
Severance Damage	0
20% Contingency	80
Subtotal	$ 480
Relocation Assistance Costs (4 private ownerships)	800
Acquistion Costs (4 private ownerships)	12,000
Total Estimated Real Estate Costs - Plan B	$13,280
Called	$13,300

SUMMARY OF REAL ESTATE COSTS

Southwest Branch

Plan A	$ 7,000
Plan B	7,000
Plan C	6,600

West Branch

Plan A	$ 3,500
Plan B	13,300

APPENDIX 7

STUDY PARTICIPANTS

APPENDIX 7

STUDY PARTICIPANTS

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  - William McCarthy, Chief

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  - William Coke, Chief

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  - George Sarandis, Chief
- Design Branch
  - Fred Ravens, Chief

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