FLOOD PLAIN MANAGEMENT STUDY

TOWN OF HOULTON
AROOSTOOK COUNTY, MAINE

Prepared by:
U.S. Department of Agriculture
Soil Conservation Service
Orono, Maine

In cooperation with
Town of Houlton
Southern Aroostook Soil and Water Conservation District
and the
Maine Soil and Water Conservation Commission

June 1987

ACKNOWLEDGEMENTS

Appreciation is expressed for the assistance given by the following agencies and organizations during the study:

Southern Aroostook Soil and Water Conservation District, Houlton, ME

St. John - Aroostook RC&D, Presque Isle, ME

Town of Houlton, ME

U.S. Army, Corps of Engineers, Waltham, MA

U.S. Geological Survey, Augusta, ME

Federal Emergency Management Agency, Boston, MA

National Oceanic and Atmospheric Administration, Asheville, NC

Maine Bureau of Civil Emergency Preparedness, Augusta, ME

Maine Soil and Water Conservation Commission, Augusta, ME

Maine Department of Inland Fisheries and Wildlife, Augusta, ME

Maine Department of Transportation, Augusta, ME

The aerial photography and stereoplotting were completed under contract by Eastern Topographics, Wolfeboro, NH, and Columbus Aerial Mapping Company, Columbus, OH, respectively.

A special expression of thanks is extended to the members and staff of the Aroostook County Action Program (ACAP), Houlton, ME, for the outstanding work that was done in assisting with the field surveys that were so fundamental to this study.

Appreciation also is extended to the many property owners who granted access to their property for obtaining field surveys and gathering other necessary basic data.

TABLE OF CONTENTS

FLOOD PLAIN MANAGEMENT STUDY

HOULTON, MAINE

Introduction

This report presents flood plain information along the Meduxnekeag River, B Stream, Pearce Brook, and Brown Brook within the town of Houlton. Data generated as a result of this study consists of a flood hazard evaluation, including flood plain maps and profiles, recommendations for flood protection, and an inventory of natural resource values served by the flood plains.

The town of Houlton will use the technical information provided in this study to identify flood plain areas, as a guide for developing a flood plain management program for the areas studied, and to update the town's codes and zoning ordinances. This will help the town minimize loss of life and property damage from future floods, prevent environmental degradation of the area's resources and ensure orderly community growth. The data generated from this study also will be used for developing conservation plans, the design of hydraulic structures, roads, bridges, and other types of community planning by federal, state, and local agencies, planning groups, engineers, and conservation district cooperators.

This study was performed in response to a request by the town of Houlton to the Maine Soil and Water Conservation Commission (MSWCC). A cooperative Plan of Work was approved by the town and the MSWCC in March 1982, and authorized by the Soil Conservation Service (SCS) in March 1982. That plan provides the basis for funding and also outlines the areas to be included and scope of the study.

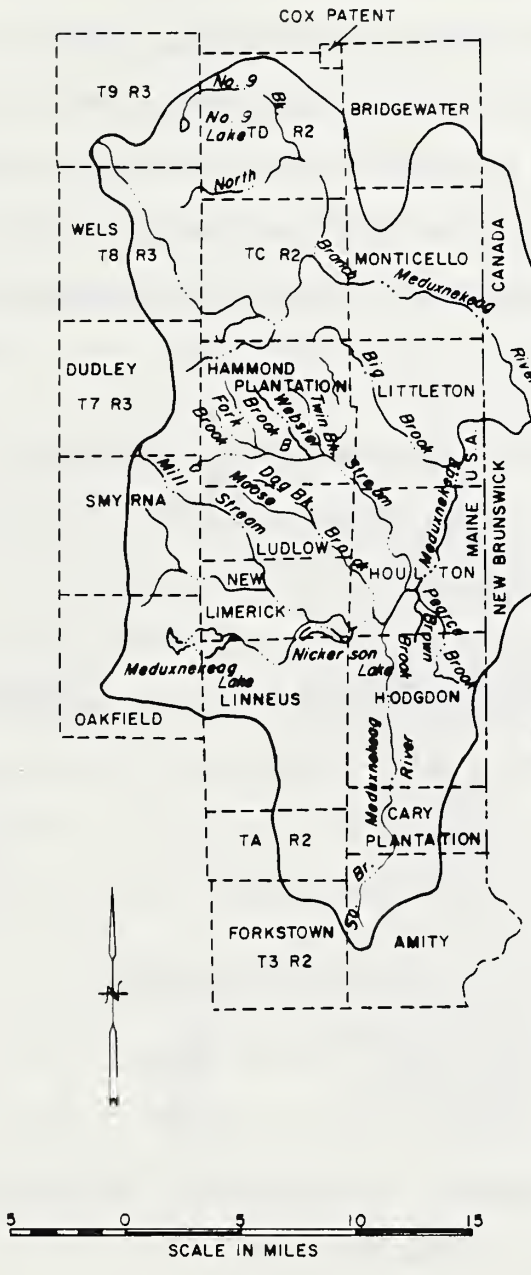
The SCS carries out Flood Plain Management Studies under the provisions of Section 6 of Public Law 83-566, the Watershed Protection and Flood Prevention Act (1954). Priorities of studies in Maine are established by the MSWCC through a Joint Coordination Agreement between the Commission and SCS to carry out these studies.

The Watershed

The streams studied in this report are entirely contained within the Meduxnekeag River watershed. The Meduxnekeag watershed, a sub basin of the St. John River, has a drainage area of 516 square miles at its mouth in Woodstock, New Brunswick, Canada. (See Watershed Location Map.)

The bedrock of the watershed is largely of sedimentary origin and consists chiefly of beds of shale, limestone, and sandstone, mostly of the Paleozoic age. Associated with these rocks are scattered areas of igneous intrusions consisting of rhyolite and diabase masses with some areas of granite. These igneous masses, being more resistant to erosion than the sediments, generally project above the landscape to form monadnocks which furnish the greatest relief of the watershed. Surficial material is mainly glacial drift composed of silty, gravelly sand with cobbles and boulders deposited in varying thickness over the bedrock. The till cover is generally thin over the rock hills, deeper in the valleys and in general is derived from the underlying bedrock at or northwest of its present location. (1)

(1) Reference Number - Bibliography



SOIL CONSERVATION SERVICE
U.S. DEPARTMENT OF AGRICULTURE

WATERSHED LOCATION MAP
MEDUXNEKEAG BASIN

AREA: 516 mi.^{2}

POPULATION: U.S. 12,650.

PRIMARY LAND USES: Forestry, Dairy and Potato Farming.

PRINCIPAL STREAMS: B Stream, North Branch, South Branch and Main Stem of Meduxnekeag River.

SPECIAL FEATURES: Meduxnekeag River is identified as possessing unique resource values of statewide significance.

The relief of the watershed is generally moderate with hills and ridges rising 200 to 500 feet above the valley floors. Scattered monadnocks rise to elevations of 1,000 feet or more above sea level. Saddleback Mountain, the highest point in the watershed, rises to an elevation of 1,695 feet, NGVD.

The Meduxnekeag watershed is located in the Northern Climatic Zone and has average daily temperatures that range from 14°F in January to 67°F in July. The average annual precipitation is approximately 36 inches which includes the water equivalent of some 95 inches of snow. (2) The precipitation is rather evenly distributed throughout the year; however, snowmelt accounts for a large part of the runoff.

There are a number of small lakes and ponds scattered throughout the Meduxnekeag River watershed. The following table displays the larger lakes in the watershed by surface and drainage areas.

Name	Surface Area (3) (Acres)	Drainage Area (Square Miles)
Drews (Meduxnekeag) Lake	1,067	19.2
Nickerson Lake	234	3.1
Number Nine Lake	120	1.8

Land Use in the Meduxnekeag watershed is broken down as follows:

Forest Land	65%
Open Land	29%
Water Areas	3%
Urban	3%

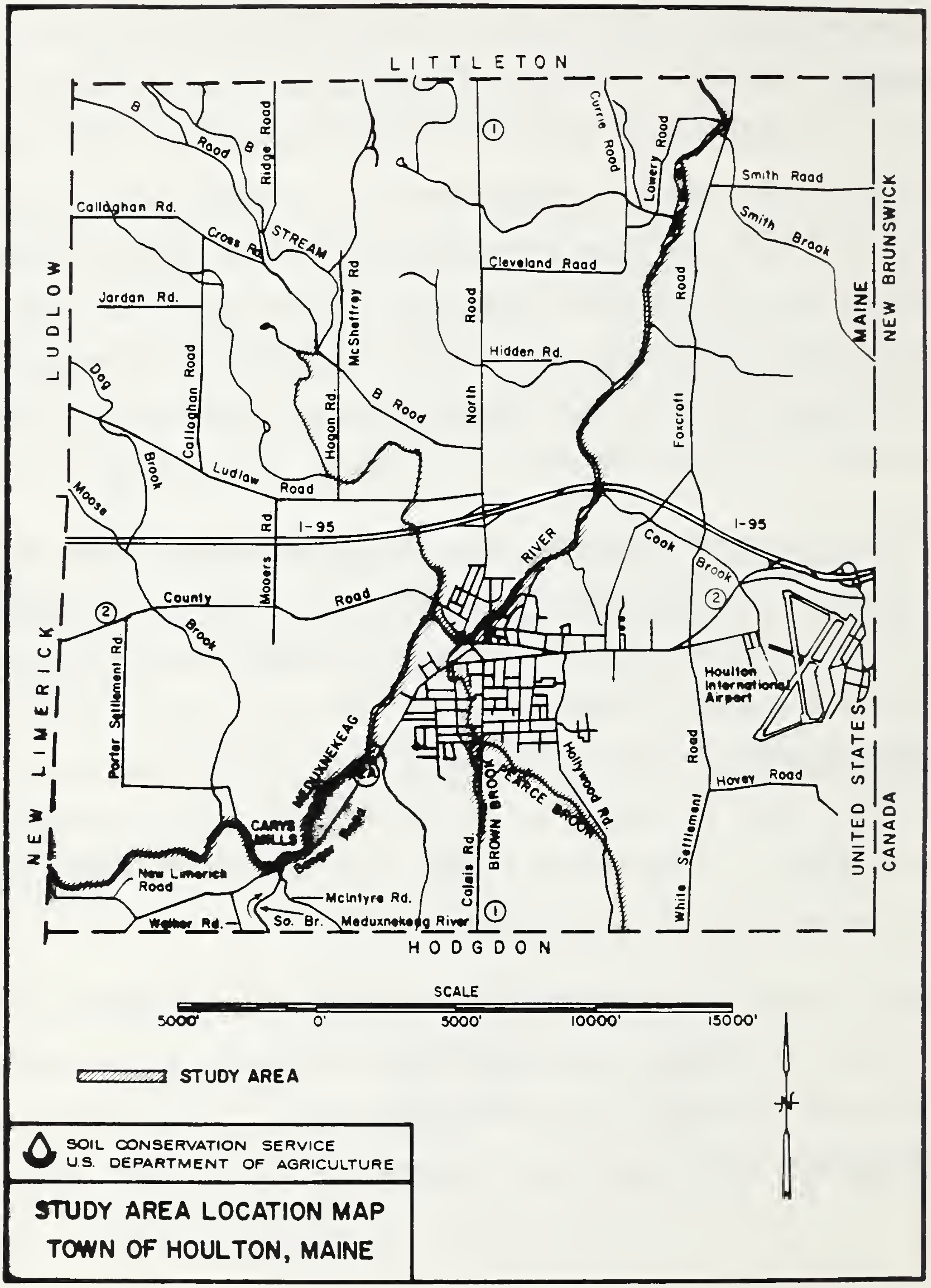
The hydrologic unit code for the watershed is 01010005000. The study area is located in sub basins 01010005030 to 01010005060. (4)

The Study Area

The town of Houlton, in which the study area is located, is the county seat of Aroostook County and is the major commercial and transportation center of southern Aroostook County. Houlton is situated approximately 120 miles north-northeast of Bangor (Maine's third largest city) adjacent the Canadian border. The Bangor and Aroostook Railroad, the Canadian Pacific Railroad, Interstate 95, and U.S. Routes 1 and 2 all intersect in Houlton. The study area (see Study Area Location Map) includes the Meduxnekeag River, B Stream from the Meduxnekeag River to B Road, Pearce Brook, and Brown Brook from Pearce Brook to its upper crossing of U.S. Route 1 (Calais Road).

The Meduxnekeag River enters Houlton at its western corporate limits with the town of New Limerick and flows north-northeasterly for 10.4 miles through Houlton to its northern corporate limits with the town of Littleton. As the Meduxnekeag passes through Houlton it flows through fertile farmland (much of which is classified as prime), woodland, downtown Houlton, and a small urban center at Carys Mills. The drainage area of the Meduxnekeag River in Houlton, ranges from 79.8 square miles at the New Limerick town line to 257.9 square miles at the Littleton town line.

B Stream, a major tributary of the Meduxnekeag River, is studied for 3.8 miles in Houlton. The segment studied flows south-southeasterly from B Road, where the stream has a drainage area of 40.9 square miles, to its confluence with the Meduxnekeag River where it has a drainage area of 45.5 square miles.



STUDY AREA LOCATION MAP
TOWN OF HOULTON, MAINE

The primary land use along B Stream is farm and woodland with residential and commercial use near road crossings of the stream. The water of B Stream is used by the Houlton Water District, which maintains a dam and pumping station near its mouth, to supplement the town's water supply.

Pearce Brook, a small tributary of the Meduxnekeag River, is studied for 3.1 miles from the Hodgdon-Houlton town line, through Houlton, to its confluence with the Meduxnekeag. The upper portion of Pearce Brook in Houlton flows through woodland with scattered residential development, and the lower portion through residential and commerical areas. Drainage areas of Pearce Brook in Houlton range from 5.0 square miles at the Hodgdon town line to 7.8 square miles at its mouth.

Brown Brook, a tributary of Pearce Brook, is studied from its southern crossing by the Calais Road (U.S. Route 1) for 0.7 miles northerly to its confluence with Pearce Brook. Land use along this segment of Brown Brook is primarily residential. Brown Brook has drainage areas of 0.4 square miles at its upper crossing by the Calais Road and 0.8 square miles at its mouth.

There are 30 bridges spanning the streams studied in Houlton. These include nine over the Meduxnekeag River, six over B Stream, eight over Pearce Brook, and seven over Brown Brook (see Bridge Data in the Appendix for further information on these bridges).

Historically there have been a number of dams located on the streams studied in Houlton. The largest of these, the Houlton Dam and the Carys Mills Dam, were located on the Meduxnekeag River and are now breached. The only remaining dam in the study area is a low head timber crib structure, the lower B Stream Dam, located near the mouth of B Stream.

The soils in Houlton are mainly developed in glacial till that was derived chiefly from limestone. They are the Caribou, Mapleton, and Conant soils. Caribou soils are very deep and well drained. Mapleton soils are shallow to bedrock and well drained and somewhat excessively drained. Conant soils are very deep and moderately well drained to somewhat poorly drained.

The remainder of the soils consist mainly of nearly level to strongly sloping soils on terraces, eskers, and glacial outwash. They are the Masardis and Machias soils. Masardis soils are very deep and somewhat excessively drained. Machias soils are very deep and moderately well drained.

Scattered throughout the town in depressions are areas of nearly level to gently sloping soils developed in glacial till and nearly level soils developed in organic deposits. The glacial till soils are the very deep and poorly drained Monarda soils and the very deep and very poorly drained Burnham soils. The soils developed in organic deposits are very deep and very poorly drained Peat and Muck.

Southern Aroostook County has been completely soil mapped and a soil survey report published. (5) Based on the soil survey, much of the land in and adjacent to the flood plains studied is considered to be prime farmland or farmland of statewide importance. (6) Additional soils information may be obtained from the SCS field office which is located one-half mile north of Interstate 95 on U.S. Route 2 in Houlton (Tel. 207-532-2087).

Natural Values

The presence of the Meduxnekeag River within the confines of the village of Houlton demonstrates its importance to the Town. For many years the river provided a source of energy around which the village grew. Originally harnesed to grind flour, this energy was later used to power sawmills and other manufacturing and eventually to produce electricity.

Farming has been an important activity associated with the river. For years farming in this area was of a general nature including dairy, grain, and potatoes. Today's farming is largely focussed on potatoes, with a gradual resurgence of general farming taking place.

The Meduxnekeag at one time was a major resource of the Maliseet Indians. Evidence of their activities still exists along the river and the reader is invited to contact the Houlton Band of Maliseet Indians, located on Market Square in Houlton, for further information (Tel. 207-532-7339).

Prior to 1974 the river also served the drainage needs of the town. With the construction of a water pollution control plant in 1974 the river has reached a level of cleanliness that supports a wide range of wildlife, birds, and fish. A partial list of species found in or near the river includes: whitetail deer, moose, bear, coyote, rabbits, hares, red fox, beaver, otter, mink, martin, muskrats, many species of ducks, herons, brown trout, brook trout, salmon, black bass plus a wide range of other wildlife and fish. Recreational use of the river for hunting, fishing, and nature study has increased greatly as a result of its improved water quality.

Today's use of the river not only includes the activities mentioned above but canoeing, boating, photography, nature walks, and flood storage. Offering examples of rare plant life (see below), bird and animal life, and pleasant views and vistas, the river is gaining much local importance as a resource to be protected and enjoyed.

Various species of rare plant life that have been found along the Meduxnekeag River in Houlton are as follows (7 and 8):

1. Trisetum melicoides - a grass, no common name.
   Found on ledgy shores of the Meduxnekeag River, 26 August, 1897 by M.L. Fernald.

2. Pyrola asarifolia - Purple Pyrola.

   Found 28 June, 1899; "wooded bank, Houlton" by E.B. Chamberlain.
   Note: this species probably was found on a bank along the river under cedar trees, there is no way of being certain.

3. Primula laurentiana - Bird's-eye Primrose.
   1880; 1881 by Kate Furbish.
   Note: this species and the following are beautiful, tiny, pinkish-blue 3-inch plants which probably still occur on the ledges nearest the bridge in Houlton.

4. Primula mistassinica - Bird's-eye Primrose; Mistassini Primrose.
   1881 by Kate Furbish.

   Note: see preceding species

5. *Aster junciformis* - Rush Aster.
   1881 by Kate Furbush, "valley of the Meduxnekeag River".

6. *Carex flava* - a sedge, no common name.
   1909, M.L. Fernald - along shores of Meduxnekeag in Houlton.

7. *Viola novae-angliae* - New England Violet.
   1909, M.L. Fernald. He was not certain, as at the time he visited the plant was not in flower or in fruit.

8. *Tofieldia glutinosa* - False Asphodel; Stickey Tofieldia.
   1909, M. L. Fernald.

The Meduxnekeag River has been listed in the Maine Rivers Study (9) as having resource values of statewide significance. It appears on the study's final list of "C" rivers (rivers that possess a composite natural and recreational resource value with statewide significance). The Meduxnekeag was identified as having unique/significant resource values in the following areas: critical/ecological (rare vascular plants), anadromous fishery, and inland fishery.

The most recent classification of the Meduxnekeag River, Pearce Brook, and Brown Brook, according to Maine Department of Environmental Protection (ME DEP) standards, is Class B-2. Waters of this class shall be acceptable for recreational purposes including water contact recreation, for industrial and potable water supplies after adequate treatment and for fish and wildlife habitat. B Stream is classified as being B-1. Waters of this class are considered the higher quality of the Class B group and shall be suitable for all uses described under B-2. (10)

Several buildings and a historic district in Houlton are listed on the National Register of Historic Sites. Included are the First National Bank of Houlton, the Smith-Putman Building (Blackhawk Tavern), the White Memorial Building, and the Market Square Historic District. The Market Square Historic District, in which the First National Bank of Houlton and the White Memorial Building are located, is situated on the southeast side of the Meduxnekeag River in downtown Houlton but is not adversely affected by floodwater from the river.

Additional information pertaining to the natural values and present and possible uses of flood plain and other land in Houlton can be found in the "Houlton Comprehensive Plan" (11) and "A Plan for Downtown Houlton" (12). The comprehensive plan has an extensive section dealing with natural values and land use in Houlton, and the downtown plan has sections on land use and a proposal for a river front park along the Meduxnekeag River in downtown Houlton.

The Southern Aroostook Soil and Water Conservation District has prepared a "Study of Non-Point Agricultural Pollution (SNAP)". (13) This report identifies the location, extent, and kinds of agricultural activities causing excessive soil erosion and water pollution from sediment, animal manure, and agricultural chemicals in the Houlton area and the resources needed to solve these problems.

Major items that should be considered to enhance the natural and recreational values of the rivers in Houlton include the adoption of measures that would regulate development within the 100-year flood plain as well as the preparation of an overall use plan for the rivers that would set integrated objectives for such items as public access, historic sites, recreational facilities and the preservation of significant wildlife habitat areas. Other general recommendations include:

1. Maintain wetland and flood plain vegetation buffers to reduce sedimentation and delivery of chemical pollutants to the water body.

2. Support agricultural practices that minimize nutrient flows into water bodies.

3. Support proper use of pesticides and fertilizer.

4. Minimize soil erosion on land within, or adjacent to, flood plains and on forest road systems and timber harvesting operations.

5. Dispose of spoils and waste materials so as not to contaminate ground and surface water or significantly change land contours.

Additional technical information on the above items may be obtained from the SCS field office in Houlton.

Flood Problems

Flooding occurs most frequently in early spring when heavy rains on snow-covered or frozen ground produce greater than normal runoff. It is at this time of year that ice breaks loose from streambanks resulting in potential obstructions at bridge openings and other channel constrictions which can artificially raise flood levels. Flash floods occur on occasion from thunderstorms, but these events generally produce less runoff than that associated with spring flooding.

The flood of record on the Meduxnekeag River, in Houlton, was recorded in April 1976 at former USGS gage No. 01018000 near Carys Mills (14). That flood had a discharge of 6,640 cubic feet per second (cfs) and has an estimated recurrence interval of 20 years. Other notable floods were recorded during 1954, 1958, 1961, 1973, and 1979.

The major flood damage in Houlton is to single and multi-family residences, businesses, farms, roads, and bridges. Properties along the lower portions of Pearce and Brown Brooks, and along the Meduxnekeag River at Carys Mills experience the most frequent flood problems.

Photographs on pages 18 through 21 show estimated flood elevations at various locations in Houlton.

The following tables summarize the approximate extent of flooding caused by the 10-, 100-, and 500-year events to: flood plains, properties, and important farmlands.

Approximate Flood Plain Areas [1]
(Acres)

	10-Year	100-Year	500-Year
Meduxnekeag River			
Woodland	181	213	225
Agricultural Land	38	59	72
Urban [2]	11	18	20
Subtotal	230	290	317
B Stream			
Woodland	82	116	132
Agricultural Land	14	23	29
Urban [2]	1	3	4
Subtotal	97	142	165
Pearce Brook			
Woodland	56	68	68
Urban [2]	12	20	21
Subtotal	68	88	89
Brown Brook			
Woodland	3	4	4
Urban [2]	4	6	6
Subtotal	7	10	10
Grand Total	402	530	581

1/ Primary land use based on photo interpretation.
Does not include normal river area.

2/ Includes commercial, municipal, residential and recreational properties, roads, and bridges.

Approximate Number of Properties in Flood Plain

	10-Year	100-Year	500-Year
Meduxnekeag River			
Commercial	3	4	5
Houses	8	12	14
Seasonal	1	1	1
Other	3	6	6
Subtotal	15	23	26
B Stream			
Houses	-	1	1
Municipal	-	1	1
Other	1	1	1
Subtotal	1	3	3
Pearce Brook			
Commercial	-	2	2
Houses	5	12	13
Other	1	5	5
Subtotal	6	19	20
Brown Brook			
Houses	1	3	4
Other	2	2	2
Subtotal	3	5	6
GRAND TOTAL	25	50	55

Approximate Areas of Important Farmlands 1/
in the Flood Plain
(Areas)

	10-Year	100-Year	500-Year
Meduxnekeag River			
Prime Farmland	72	96	104
Farmland of Statewide Importance	5	8	9
Subtotal	77	104	113
B Stream			
Prime Farmland	5	8	9
Farmland of Local Importance	5	7	8
Subtotal	10	15	17
Pearce Brook			
Prime Farmland	1	1	1
Subtotal	1	1	1
Brown Brook			
Prime Farmland	1	1	1
Subtotal	1	1	1
Total Important Farmland	89	121	132

1/ See Glossary for Definition.

Meduxnekeag River, Carys Mills Road, cross section 25B - The 100-year flood is estimated to be at elevation 353.6 feet NGVD or 1.4 feet above the ground at this point. (SCS photo)

B Stream, Hogan Road, cross section 113B - The 100-year flood is estimated to be at elevation 367.2 feet NGVD or 3.2 feet above the bridge deck. (SCS photo)

Pearce Brook, Bangor Street (U.S. Route 2A) at its intersection with Military Street, cross section 202B. A 100-year flood would reach an estimated elevation of 347.4 feet NGVD or 1.3 feet above the road at this busy intersection. (SCS photo)

Pearce Brook, Franklin Street, cross section 207B. The 100-year flood is estimated to be at elevation 353.8 feet or 1.3 feet above the road. (SCS photo)

Pearce Brook, Green Street, cross section 210B. The 100-year flood is estimated to be at elevation 354.1 feet NGVD or 5.3 feet above the road. (SCS photo)

Pearce Brook, Columbia Street, cross section 213B. It is estimated that the 100-year flood would be at elevation 358.0 or 1.8 feet above the road. (SCS photo)

Pearce Brook, Brook Street, cross section 215B. The 100-year flood is estimated to be at elevation 358.4 feet NGVD or 2.0 feet above the road. (SCS photo)

Pearce Brook, Court Street (U.S. Route 1), cross section 218B. The 100-year flood is estimated to be at elevation 366.6 feet NGVD or 1.6 feet above the road. (SCS photo)

Flood Plain Management

This report is intended to provide a technical basis for arriving at solutions to minimize both present and projected flood damages. The management options presented herein are aimed at providing information on various means of flood protection, and/or alleviation of monetary loss caused by flooding. These options fall into two major categories (nonstructural and structural) and are briefly described in this section. With further study, the town or individuals may find one, or a combination of several, of these alternatives to be a viable means of reducing flood losses in a given area. Considerations in this evaluation include: if the area being studied is in a high or low hazard zone (see glossary for definitions), engineering feasibility, economics, effect on flooding elsewhere, and social acceptability.

Nonstructural Measures

1. Floodproofing

   Floodproofing is any measure, or combination thereof, that property owners might take to minimize flood damages to their property. The following are some of the more common means used to floodproof buildings.

   a. Elevating the building above expected flood levels.
   b. Relocating the structure to an area where there is no threat of flooding.
   c. Construction of earthen levees or masonry floodwalls to prevent water from reaching the building.
   d. Water tight closures that can be quickly and easily installed over openings.

e. Application of waterproof sealants to foundations and permanent closing and sealing of lower openings.

f. Protection of utilities and appliances such as furnaces, washers, dryers, electrical and plumbing systems from floodwater.

A number of homes and businesses in Houlton could derive benefit from floodproofing. The selection of which measure(s) might be most appropriate in any particular case should be based on the depth, velocity, and duration of flood flows; the cost versus benefit of the measure; engineering feasibility; soils types; and local building codes and zoning restrictions.

Further information on floodproofing is contained in the Federal Emergency Management Agency's publication, Design Manual for Retrofitting Flood-prone Structures, FEMA 114. (15) The publication is available at no cost and can be ordered by writing to the following address:

Federal Emergency Management Agency
P.O. Box 70274
Washington, D.C. 20024
Attn: Publications

2. Purchase and Relocation

In areas where the danger of flooding is so great as to render all other means of flood protection ineffective or impractical, federal/state funds may be available to purchase properties and relocate buildings and/or their occupants. Once the properties have been evaluated the land may be used for parks or some other purpose not significantly affected by floodwaters.

It is not expected that this approach would have much support or practical application in Houlton.

3. Land Use Regulation and Flood Insurance

Conservation, scenic, or flood control restrictions, and/or easements may be acquired for floodway or flood hazard areas where little or no development is desirable. Land use restrictions can be used to prevent development that is incompatible with public objectives, while allowing continued private ownership of the land. Certain future land use rights, such as construction of buildings that are not consistent with good flood plain management, could be purchased from present land-owners. Permitted uses could be farming, wildlife, low intensity recreation, and woodland. Land use restrictions may also result in a lowering of the landowner's tax assessment.

In 1971 the State of Maine enacted the "Mandatory Zoning and Subdivision Control Law" (Chapter 424, Sec. 4811 thru 4814 of the Maine Statutes) which requires all municipal units of government to adopt zoning and subdivision control ordinances for shoreland areas. Shoreland areas are defined as land within 250 feet of the normal high water mark of any pond, river, or salt water body and include a major portion of the flood plain. Under Houlton's present zoning laws, building permits are required for all new construction.

In 1983 Maine enacted the "Maine Rivers Act" (S.P. 598 - L.D. 1721). This law provides a number of Maine rivers with special protection. Among these rivers is the Meduxnekeag with special land use restrictions covering certain types of stream alteration and subdivisions.

Since 1974 Houlton has participated in the "emergency" phase of the National Flood Insurance Program. This permits existing dwellers within the approximate 100-year flood plain to purchase up to $45,000 worth of flood insurance coverage at subsidized rates on their homes and contents ($100,000 for multi-family and small businesses). The community must require building permits for all proposed construction and review the permit to assure the sites are reasonably free from flooding. For the flood-prone areas it is also required that structures be properly anchored and that construction materials and methods be used that will minimize flood damage.

Flood plain regulations and flood insurance cannot prevent flood damages, but they can help alleviate future problems and monetary loss. As of June 1986, there were six flood insurance policies, with a total amount of coverage of $97,000 in Houlton.

4. Warning Signs

A method which has been used successfully in some communities to discourage flood plain development is the erection of flood warning signs in flood-prone areas or the prominent posting of previous or predicted highwater levels. This could be done on various bridge crossings in Houlton. These signs carry no enforcement, but simply serve to inform the public that a flood hazard exists.

5. Flood Warning

In some communities flood warning systems are of major importance in the reduction of flood loss. These systems utilize rainfall and/or water level information in upstream areas to predict flood stages downstream.

Because of the relatively small drainage areas of B Stream, Pearce Brook, and Brown Brook a flood warning system would provide little advance notice of flood danger and its expense could not be justified. For the Meduxnekeag River, the high expense alone would be prohibitive for the number of properties involved.

Structural Measures

Structural measures generally include such items as dams, channel work, removal of channel restrictions, and dikes. The following discussion touches on each of these as they might apply to the town of Houlton. Any structural measure would require additional in depth engineering, environmental, and economic studies in order to determine its feasibility. Some factors to be considered in the selection of any structural measure are the effect of increased flood stages (if any) elsewhere on the stream, the cost-benefit ratio, and the environmental impact.

1. Dams

Dams control flood flows by temporarily storing storm runoff in the reservoir and releasing it slowly after the storm has passed. An impoundment site, located on Pearce Brook approximately 1,000 feet upstream from Court Street (U.S. Route 1), was studied in 1973 as a proposed measure of the St. John-Aroostook Resource Conservation and Development Project. (16)

The proposed dam would have limited the maximum discharge from its principal spillway to 400 CFS which was the capacity of the downstream channel.

The study found that no "recreational water" could be stored in the reservoir because the total capacity of reservoir would be needed to store storm runoff. Therefore, the dam would be a single purpose, dry, flood control structure. The dam would control a drainage area of 6.9 square miles, have a height of 36 feet and would temporarily store 649 acre-feet of water with a surface area of 75 acres.

A flood damage survey also was made as part of the study. The total average annual benefits with the dam in place were estimated to be $5,000 at that time. This resulted in a benefit-cost ratio calculated to be 0.3 to 1 which was less than the 1 to 1 ratio required to justify the project.

An interdisciplinary team of SCS specialists toured the damage area of Pearce Brook in June 1985 and subsequently reviewed the findings of the 1973 study and the data gathered for the Houlton Flood Plain Management Study. Although there were some differences between the two studies, it was concluded that a flood control dam for Pearce Brook still could not be economically justified.

2. <u>Channel Work</u>

Channel work is generally undertaken to improve the flood carrying capacity of a given stream section and/or to reduce flood damage along the segment. This work can involve widening or deepening portions of the channel, lining the channel, or changing the channel alignment.

Channel work was explored in conjunction with the replacement of 7 bridges and culverts in the 1973 Pearce Brook study. The benefit-cost ratio was calculated to be 0.4 to 1 which was considerably less than the 1 to 1 ratio required to justify the work.

Channel work in general has significant environmental impacts. Major channel work such as widening, deepening, and straightening the alignment would be difficult on Brown or Pearce Brooks due to the proximity of urban development to the flood plains along their lower reaches.

Lining a channel with a smooth material, such as concrete, increases channel velocities and reduces flood stages. Structural channels of this type are very expensive and could not be economically justified for the streams studied in Houlton.

3. Removal of Channel Restrictions

The primary channel restrictions on the rivers and streams in Houlton, that could be dealt with practically, are the bridges and culverts. As replacement or improvement of these occurs, consideration should be given to enlargement of their discharge capacity to minimize head loss through them.

4. Dikes

Floodwater retaining dikes would have very little practical application in the town of Houlton due to the close proximity of urban development to the channel in the areas of major flood damage.

Floodways

Any encroachment in the flood plain which increases the elevation of the land and/or present obstructions to flood flows will reduce the flood carrying capacity, resulting in increased flood heights and flow velocities. Flood hazards, both upstream and downstream of the encroachment itself, generally will be increased in these situations.

One aspect of flood plain management involves balancing the economic gain from flood plain development against the resulting increase in flood hazard. Under this concept, the 100-year flood plain is divided into a floodway and a floodway fringe.

The floodway is the main channel of watercourse plus any adjacent flood plain areas that must be kept free of encroachment so that the 100-year flood can be conveyed without substantial increase in flood heights. Minimum standards of the Federal Emergency Management Agency (FEMA) limit such increases in flood heights to 1.0 foot, provided that hazardous velocities do not result.

The floodway fringe includes that portion of the flood plain that can be completely obstructed without increasing the water surface elevation of the 100-year flood by more than 1.0 foot at any point. Theoretical floodways were computed by SCS for all streams studied within Houlton on the basis of equal conveyance reduction from each side of the flood plain.

Floodway data are not included in this report but may be obtained upon request from the U.S. Soil Conservation Service, USDA Office Building, University of Maine, Orono, Maine 04473, telephone (207) 581-3446.

Use of Technical Data

This report contains flood profiles, photo base flood plain maps, selected valley cross sections and other information which indicate the extent of potential flooding along the streams studied in the town of Houlton.

Four floods were analyzed, the 10-year (10 percent chance) flood, 50-year (2 percent chance) flood, 100-year (1 percent chance) flood and the 500-year (0.2 percent chance) flood.

The results of this study are summarized in the Flood Profiles which depict the elevations of the above four floods throughout the study area. The analyses do not account for the unpredictable obstructing effects of ice or other debris which could reduce the capacity of the channel and/or bridges during flooding conditions. Thus, the elevations presented in this report should be considered minimum for flood plain management purposes.

The Flood Plain Maps include a delineation of the 10-year, 100-year and 500-year flood boundaries and the 100-year flood elevations. Where these lines merge there is no appreciable difference in the flood boundaries.

Due to variations in relief and scale, the areas outlined on the maps are approximate. To check a specific property the user should locate the property in question on the appropriate Flood Plain Map and read the elevation for the desired frequency flood at the corresponding location on the Flood Profiles.

Cross section locations, as shown on the maps and profiles, can be used as references for this purpose. By comparing the elevation from the profiles to the surveyed elevation of the property in question, the extent of flooding for that property can be estimated. Elevation bench marks, whose approximate locations are shown on the Flood Plain Map Index and Flood Plain Maps, are described in the Appendix and can be used as starting points to transfer elevations (NGVD) to the desired properties.

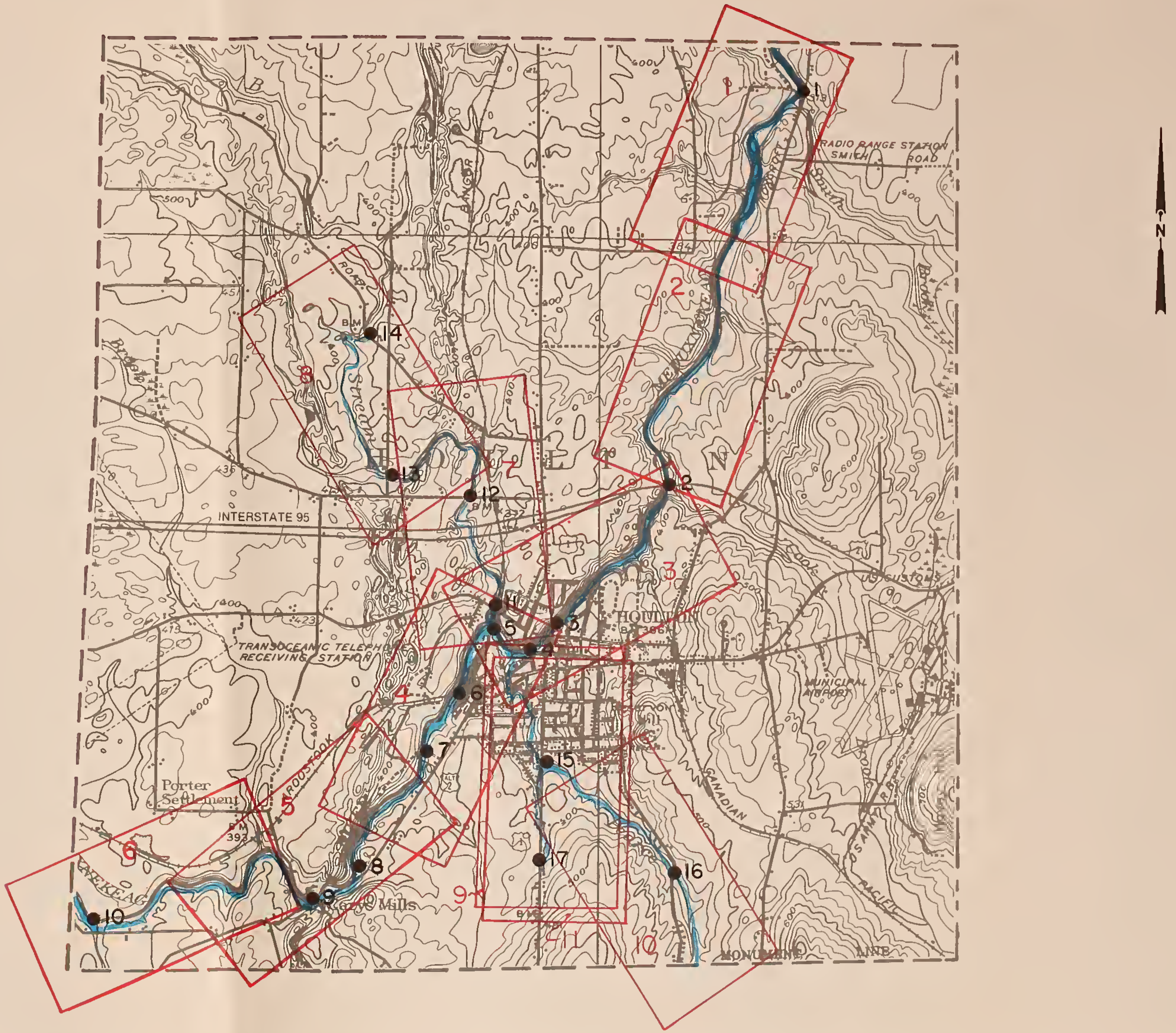
Also included are selected valley cross sections which slow the relationship of various floods to existing topography under unobstructed flow conditions.

The following tables are contained in the Appendix:

Selected Flood Discharges - provides rates of flow in cubic feet per second (cfs) for the 10-year, 50-year, 100-year, and 500-year floods within the study area. This data can be used as a guide for the hydraulic design of new bridges and/or stream channel modifications.

Bridge Data - presents a summary of flood and other elevations for bridges within the study area. This information also can be obtained from the Flood Profiles.

Field surveys were obtained during the summer of 1982. Only those features in the flood plain at the time the surveys were completed were considered in the computations. Changes of bridge openings, dams, and/or flood plain encroachment will affect flood levels and necessitate updating the information given in this report. Additionally, major changes in land use due to unforeseen future development within the watershed could cause a significant increase in flood discharges and require revisions in the data.



SOIL CONSERVATION SERVICE
U.S. DEPARTMENT OF AGRICULTURE

FLOOD PLAIN MAP INDEX
HOULTON, MAINE

LEGEND

STUDY AREA
3● ELEVATION BENCH MARKS (SEE APPENDIX)
2 FLOOD PLAIN MAP
TOWN LINE
U.S. BOUNDARY

0 3000 6000 9000
FEET

JULY 1987 1001773 01

LEGEND

- 500 YEAR FLOOD PLAIN
- 100 YEAR FLOOD PLAIN
- 10 YEAR FLOOD PLAIN
- 6——— VALLEY CROSS SECTION
- ~~310~~ 100 YEAR FLOOD ELEV.

LIMITS OF FLOODING SHOWN MAY VARY FROM ACTUAL LOCATIONS ON THE GROUND AS EXPLAINED IN THE NARRATIVE.

500' 0' 500' 1000'

APPROXIMATE

SOIL CONSERVATION SERVICE
U.S. DEPARTMENT OF AGRICULTURE

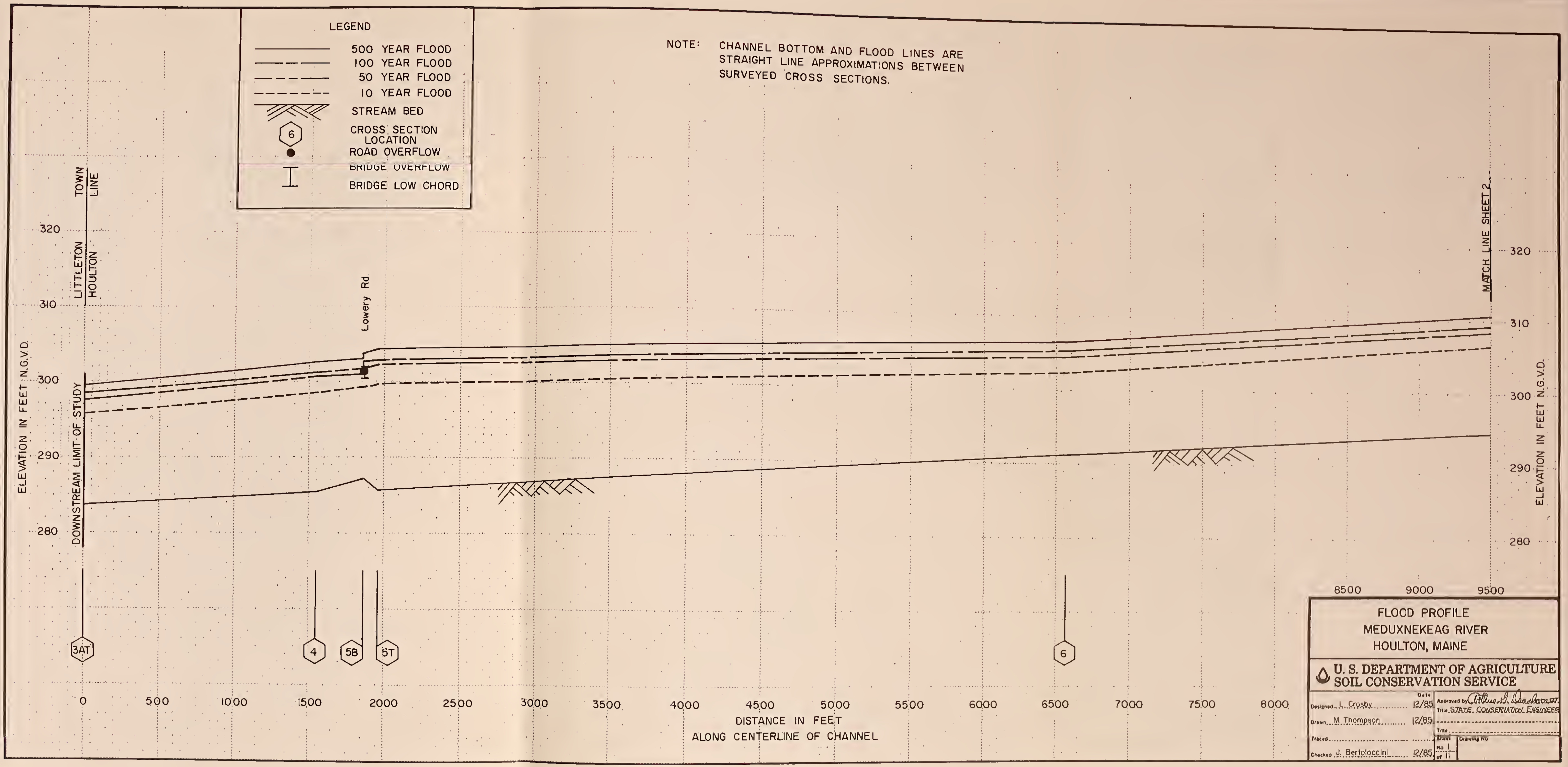
FLOOD PLAIN MAP

FLOOD PLAIN MANAGEMENT STUDY

TOWN OF HOULTON, MAINE

SHEET 1 OF 11

JULY 1987 1001773


LEGEND
500 YEAR FLOOD
100 YEAR FLOOD
50 YEAR FLOOD
10 YEAR FLOOD
STREAM BED
CROSS SECTION LOCATION
ROAD OVERFLOW
BRIDGE OVERFLOW
BRIDGE LOW CHORD
NOTE: CHANNEL BOTTOM AND FLOOD LINES ARE STRAIGHT LINE APPROXIMATIONS BETWEEN SURVEYED CROSS SECTIONS.
TOWN LINE
LITTLETON
HOULTON
DOWNSTREAM LIMIT OF STUDY
Lowery Rd
MATCH LINE SHEET 2
ELEVATION IN FEET N.G.V.D.
280
290
300
310
320
3AT
4
5B
5T
6
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
6500
7000
7500
8000
8500
9000
9500
DISTANCE IN FEET
ALONG CENTERLINE OF CHANNEL
FLOOD PROFILE
MEDUXNEKEAG RIVER
HOULTON, MAINE
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
Designed L. Crosby 12/85
Drawn M. Thompson 12/85
Traced
Checked J. Bertoloccini 12/85
Title STATE CONSERVATION ENGINEER
Sheet No. 1 of 11

LEGEND

(blue)	500 YEAR FLOOD PLAIN
(yellow)	100 YEAR FLOOD PLAIN
(light blue)	10 YEAR FLOOD PLAIN
7———	VALLEY CROSS SECTION
~~318~~	100 YEAR FLOOD ELEV.

LIMITS OF FLOODING SHOWN MAY VARY FROM ACTUAL LOCATIONS ON THE GROUND AS EXPLAINED IN THE NARRATIVE.

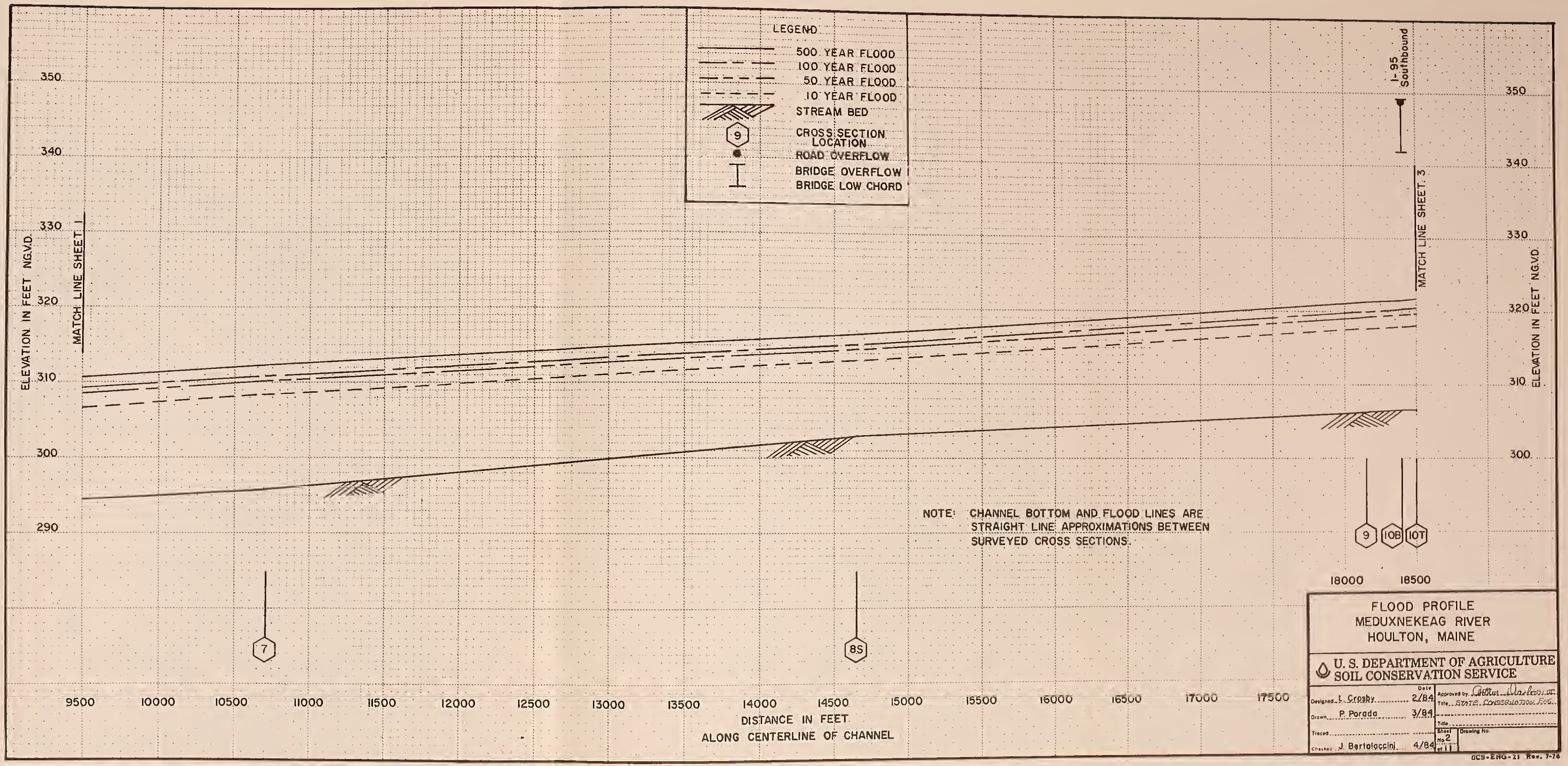
500' 0' 500' 1000'

APPROXIMATE

SOIL CONSERVATION SERVICE
U.S. DEPARTMENT OF AGRICULTURE

FLOOD PLAIN MAP
FLOOD PLAIN MANAGEMENT STUDY
TOWN OF HOULTON, MAINE
SHEET 2 OF 11

JULY 1987 1001773


LEGEND
500 YEAR FLOOD
100 YEAR FLOOD
50 YEAR FLOOD
10 YEAR FLOOD
STREAM BED
CROSS SECTION LOCATION
ROAD OVERFLOW
BRIDGE OVERFLOW
BRIDGE LOW CHORD
ELEVATION IN FEET NGVD
MATCH LINE SHEET 1
MATCH LINE SHEET 3
I-95 Southbound
350
340
330
320
310
300
290
7
8S
9
10B
10T
NOTE: CHANNEL BOTTOM AND FLOOD LINES ARE STRAIGHT LINE APPROXIMATIONS BETWEEN SURVEYED CROSS SECTIONS.
9500
10000
10500
11000
11500
12000
12500
13000
13500
14000
14500
15000
15500
16000
16500
17000
17500
18000
18500
DISTANCE IN FEET ALONG CENTERLINE OF CHANNEL
FLOOD PROFILE
MEDUXNEKEAG RIVER
HOULTON, MAINE
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
Designed L. Crosby 2/84
Drawn P. Porada 3/84
Traced
Checked J. Bertolaccini 4/84
Title STATE CONSERVATION ENG.
Sheet No. 2 of 11
Drawing No.
SCS-ENG-21 Rev. 7-76

LEGEND

- 500 YEAR FLOOD PLAIN
- 100 YEAR FLOOD PLAIN
- 10 YEAR FLOOD PLAIN
- 15 —— VALLEY CROSS SECTION
- ~327~ 100 YEAR FLOOD ELEV.

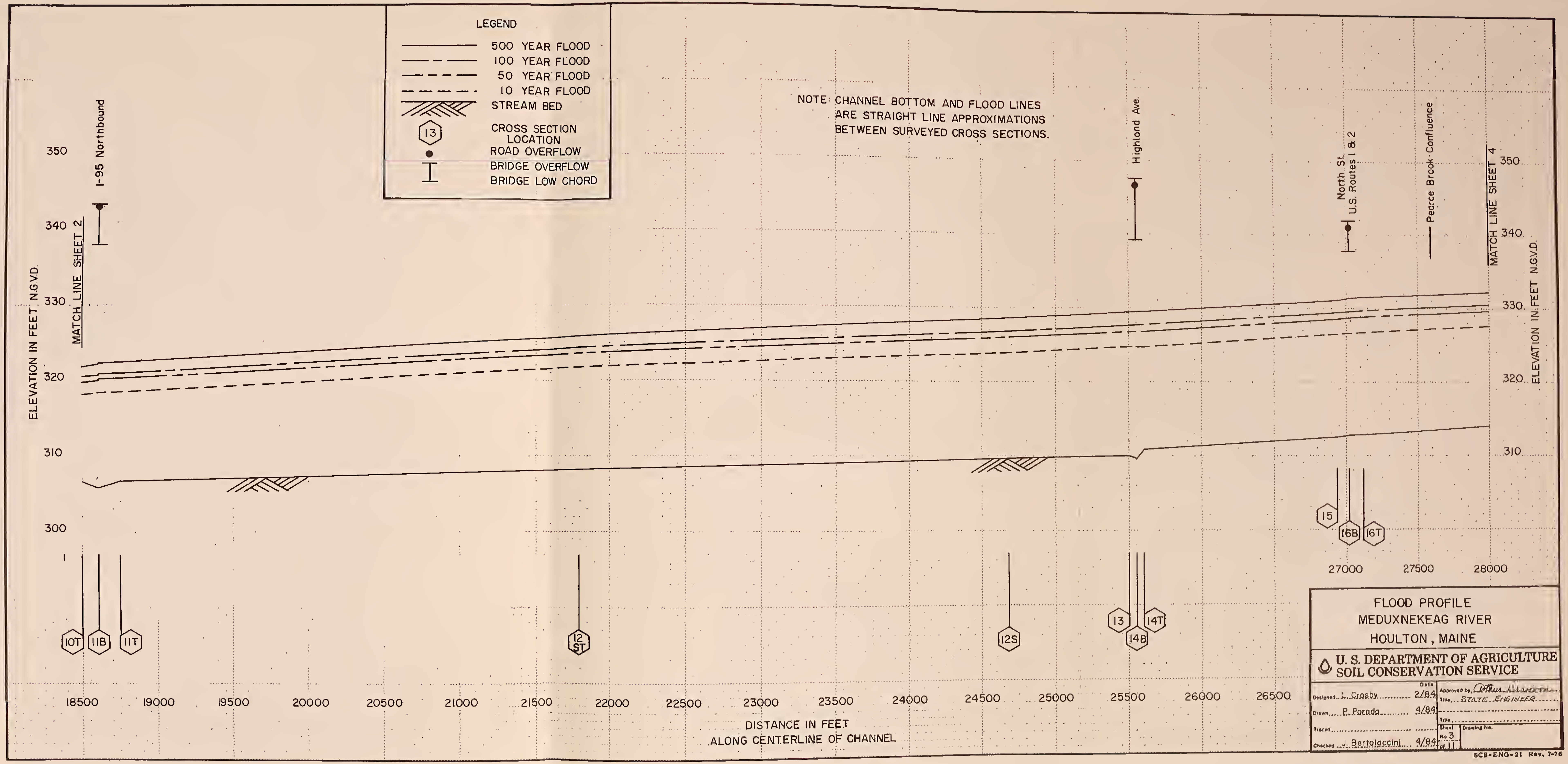
LIMITS OF FLOODING SHOWN MAY VARY FROM ACTUAL LOCATIONS ON THE GROUND AS EXPLAINED IN THE NARRATIVE.

500' 0' 500' 1000'

APPROXIMATE

SOIL CONSERVATION SERVICE
U.S. DEPARTMENT OF AGRICULTURE

FLOOD PLAIN MAP
FLOOD PLAIN MANAGEMENT STUDY
TOWN OF HOULTON, MAINE
SHEET 3 OF 11



LEGEND
500 YEAR FLOOD
100 YEAR FLOOD
50 YEAR FLOOD
10 YEAR FLOOD
STREAM BED
13
CROSS SECTION LOCATION
ROAD OVERFLOW
BRIDGE OVERFLOW
BRIDGE LOW CHORD
NOTE: CHANNEL BOTTOM AND FLOOD LINES ARE STRAIGHT LINE APPROXIMATIONS BETWEEN SURVEYED CROSS SECTIONS.
I-95 Northbound
MATCH LINE SHEET 2
Highland Ave.
North St.
U.S. Routes 1 & 2
Pearce Brook Confluence
MATCH LINE SHEET 4
ELEVATION IN FEET N.G.V.D.
350
340
330
320
310
300
10T
11B
11T
12 ST
12S
13
14B
14T
15
16B
16T
18500
19000
19500
20000
20500
21000
21500
22000
22500
23000
23500
24000
24500
25000
25500
26000
26500
27000
27500
28000
DISTANCE IN FEET
ALONG CENTERLINE OF CHANNEL
FLOOD PROFILE
MEDUXNEKEAG RIVER
HOULTON, MAINE
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
Designed L. Crosby 2/84
Drawn P. Porada 4/84
Traced
Checked J. Bertolaccini 4/84
Approved by
Title STATE ENGINEER
Sheet No. 3 of 11
Drawing No.
SCS-ENG-21 Rev. 7-76

LEGEND

500 YEAR FLOOD PLAIN
100 YEAR FLOOD PLAIN
10 YEAR FLOOD PLAIN
20 —— VALLEY CROSS SECTION
~337~ 100 YEAR FLOOD ELEV.

LIMITS OF FLOODING SHOWN MAY VARY FROM ACTUAL LOCATIONS ON THE GROUND AS EXPLAINED IN THE NARRATIVE.

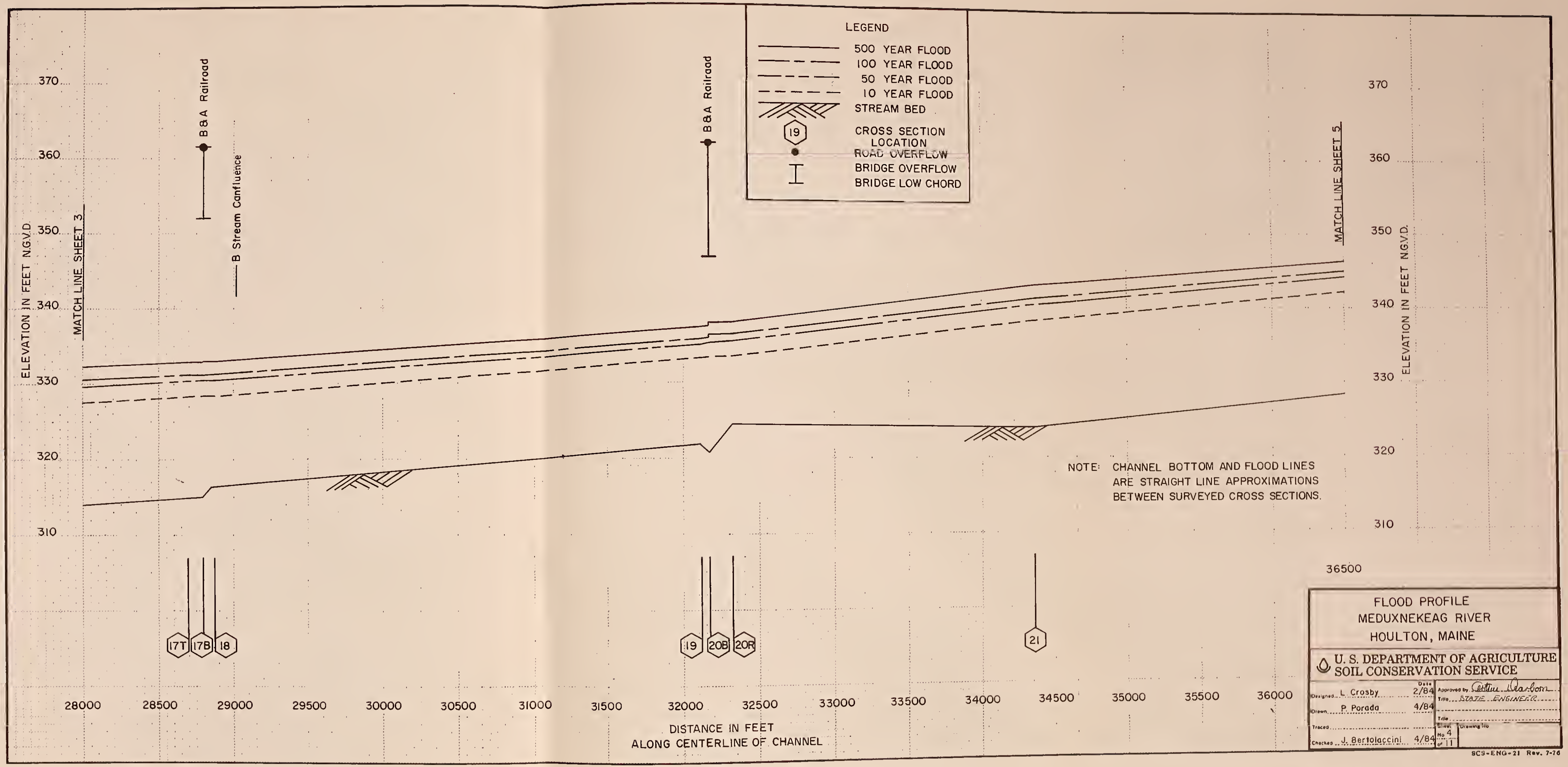
500' 0' 500' 1000'

APPROXIMATE

SOIL CONSERVATION SERVICE
U.S. DEPARTMENT OF AGRICULTURE

FLOOD PLAIN MAP
FLOOD PLAIN MANAGEMENT STUDY
TOWN OF HOULTON, MAINE
SHEET 4 OF 11

JULY 1987 1001773


LEGEND
500 YEAR FLOOD
100 YEAR FLOOD
50 YEAR FLOOD
10 YEAR FLOOD
STREAM BED
CROSS SECTION LOCATION
ROAD OVERFLOW
BRIDGE OVERFLOW
BRIDGE LOW CHORD
ELEVATION IN FEET N.G.V.D.
370
360
350
340
330
320
310
MATCH LINE SHEET 3
B&A Railroad
B Stream Confluence
B&A Railroad
MATCH LINE SHEET 5
NOTE: CHANNEL BOTTOM AND FLOOD LINES ARE STRAIGHT LINE APPROXIMATIONS BETWEEN SURVEYED CROSS SECTIONS.
17T
17B
18
19
20B
20R
21
28000
28500
29000
29500
30000
30500
31000
31500
32000
32500
33000
33500
34000
34500
35000
35500
36000
36500
DISTANCE IN FEET
ALONG CENTERLINE OF CHANNEL
FLOOD PROFILE
MEDUXNEKEAG RIVER
HOULTON, MAINE
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
Designed L. Crosby 2/84
Drawn P. Porada 4/84
Traced
Checked J. Bertolaccini 4/84
Approved by
Title STATE ENGINEER
Sheet No 4 of 11
SCS-ENG-21 Rev. 7-76

LEGEND

- 500 YEAR FLOOD PLAIN
- 100 YEAR FLOOD PLAIN
- 10 YEAR FLOOD PLAIN
- 22 ——— VALLEY CROSS SECTION
- ~~~356~~~ 100 YEAR FLOOD ELEV.

LIMITS OF FLOODING SHOWN MAY VARY FROM ACTUAL LOCATIONS ON THE GROUND AS EXPLAINED IN THE NARRATIVE.

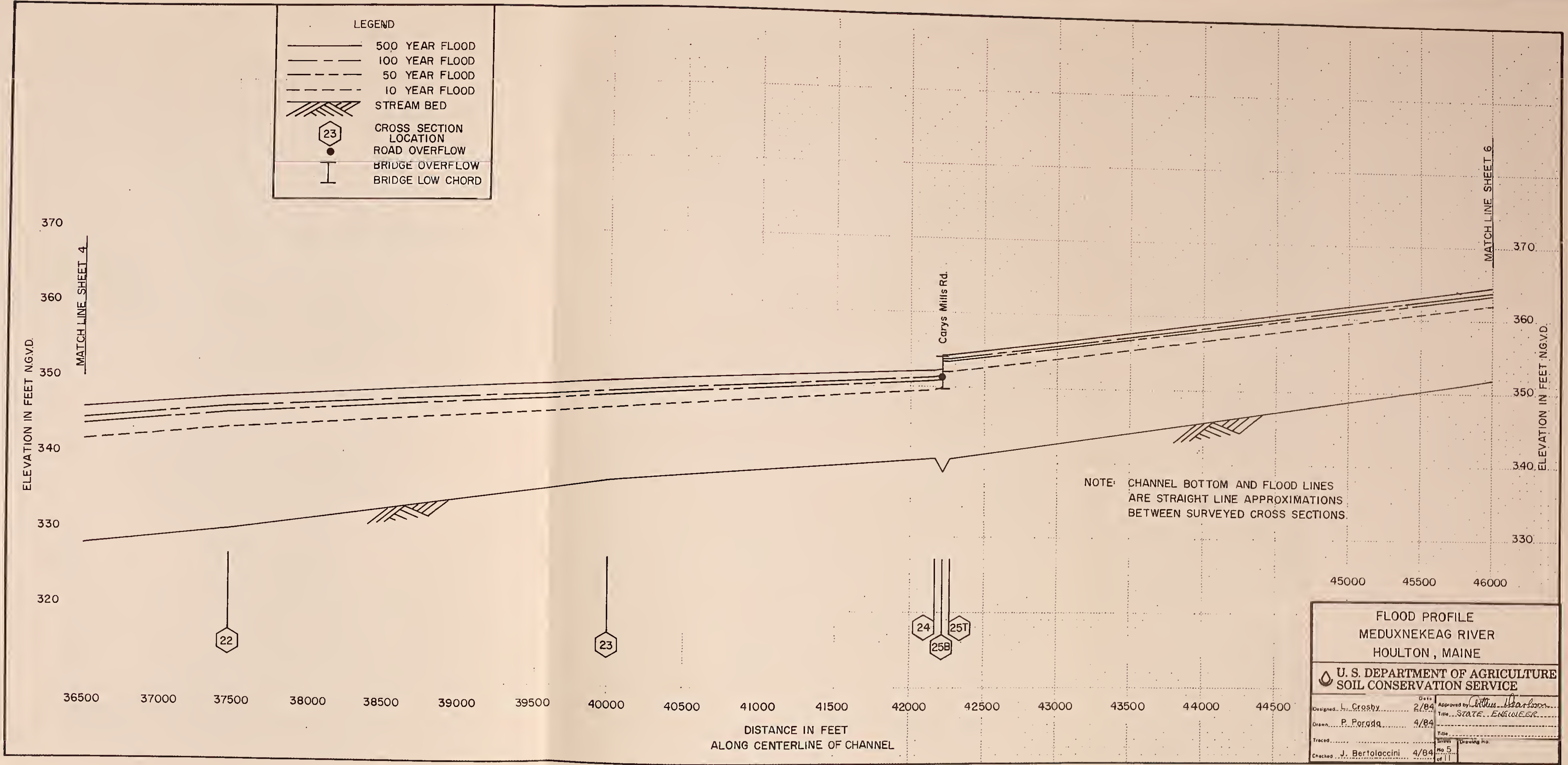
500' 0' 500' 1000'

APPROXIMATE

SOIL CONSERVATION SERVICE
U.S. DEPARTMENT OF AGRICULTURE

FLOOD PLAIN MAP
FLOOD PLAIN MANAGEMENT STUDY
TOWN OF HOULTON, MAINE
SHEET 5 OF 11

JULY 1987 1001773



FLOOD PROFILE
MEDUXNEKEAG RIVER
HOULTON, MAINE

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed L. Crosby	2/84	Approved by Arthur Barlow	
Drawn P. Porada	4/84	Title STATE ENGINEER	
Traced		Title	
Checked J. Bertolaccini	4/84	Sheet No. 5 of 11	Drawing No.

SCS-ENG-21 Rev. 7-76

LEGEND

- 500 YEAR FLOOD PLAIN
- 100 YEAR FLOOD PLAIN
- 10 YEAR FLOOD PLAIN
- 27 —— VALLEY CROSS SECTION
- ~367~ 100 YEAR FLOOD ELEV.

LIMITS OF FLOODING SHOWN MAY VARY FROM ACTUAL LOCATIONS ON THE GROUND AS EXPLAINED IN THE NARRATIVE.

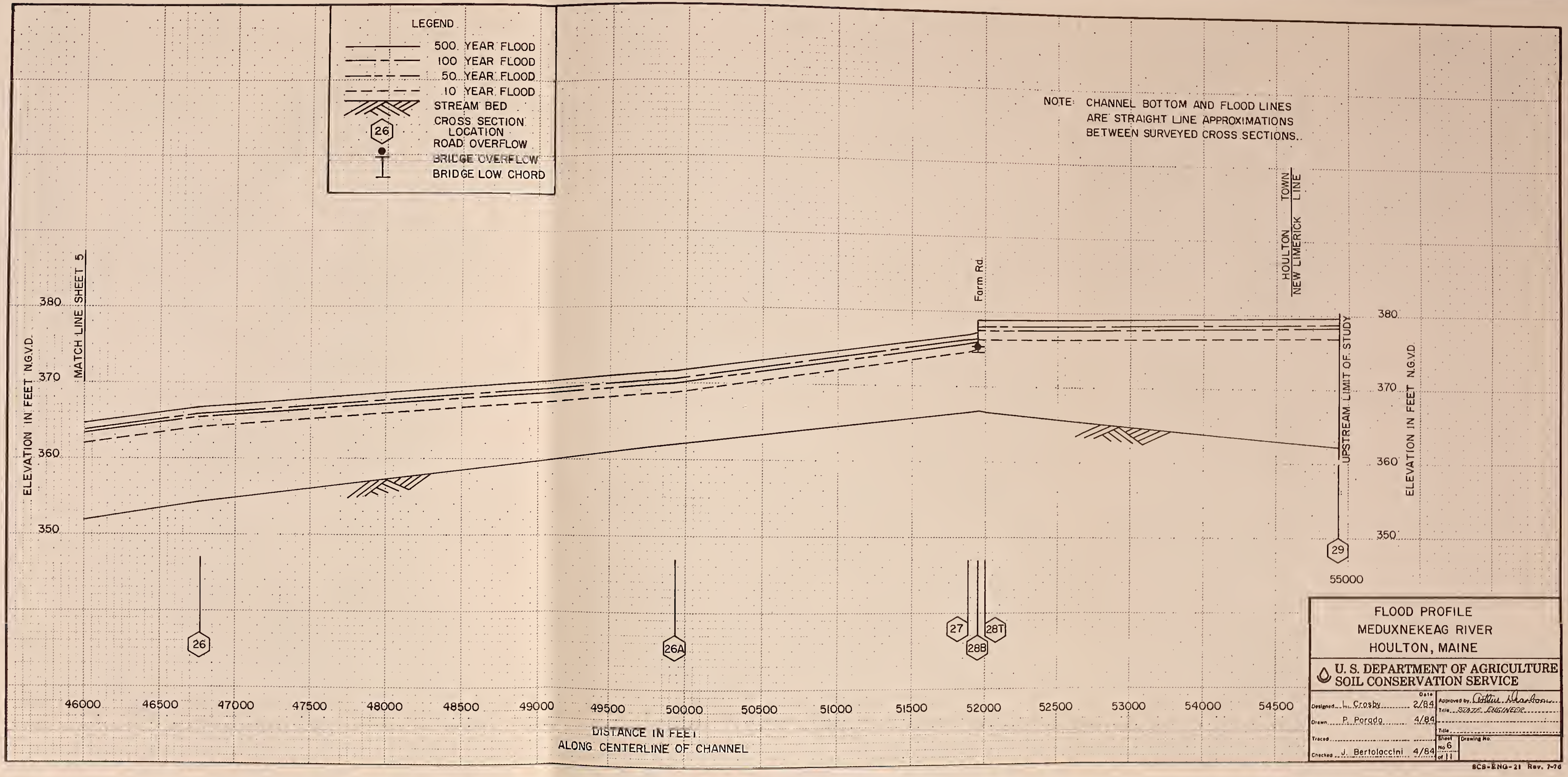
500' 0' 500' 1000'

APPROXIMATE

SOIL CONSERVATION SERVICE
U.S. DEPARTMENT OF AGRICULTURE

FLOOD PLAIN MAP
FLOOD PLAIN MANAGEMENT STUDY
TOWN OF HOULTON, MAINE
SHEET 6 OF 11

JULY 1987 1001773


LEGEND
500 YEAR FLOOD
100 YEAR FLOOD
50 YEAR FLOOD
10 YEAR FLOOD
STREAM BED
CROSS SECTION LOCATION
26
ROAD OVERFLOW
BRIDGE OVERFLOW
BRIDGE LOW CHORD
NOTE: CHANNEL BOTTOM AND FLOOD LINES ARE STRAIGHT LINE APPROXIMATIONS BETWEEN SURVEYED CROSS SECTIONS.
HOULTON TOWN
NEW LIMERICK LINE
Farm Rd.
MATCH LINE SHEET 5
UPSTREAM LIMIT OF STUDY
ELEVATION IN FEET N.G.V.D.
380
370
360
350
26
26A
27
28B
28T
29
55000
46000
46500
47000
47500
48000
48500
49000
49500
50000
50500
51000
51500
52000
52500
53000
54000
54500
DISTANCE IN FEET
ALONG CENTERLINE OF CHANNEL
FLOOD PROFILE
MEDUXNEKEAG RIVER
HOULTON, MAINE
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
Designed L. Crosby 2/84
Drawn P. Porada 4/84
Traced
Checked J. Bertoloccini 4/84
Approved by
Title STATE ENGINEER
Sheet No. 6 of 11
SCS-ENG-21 Rev. 7-76

LEGEND

(blue)	500 YEAR FLOOD PLAIN
(yellow)	100 YEAR FLOOD PLAIN
(light blue)	10 YEAR FLOOD PLAIN
101 ———	VALLEY CROSS SECTION
〰333〰	100 YEAR FLOOD ELEV.

LIMITS OF FLOODING SHOWN MAY VARY FROM ACTUAL LOCATIONS ON THE GROUND AS EXPLAINED IN THE NARRATIVE.

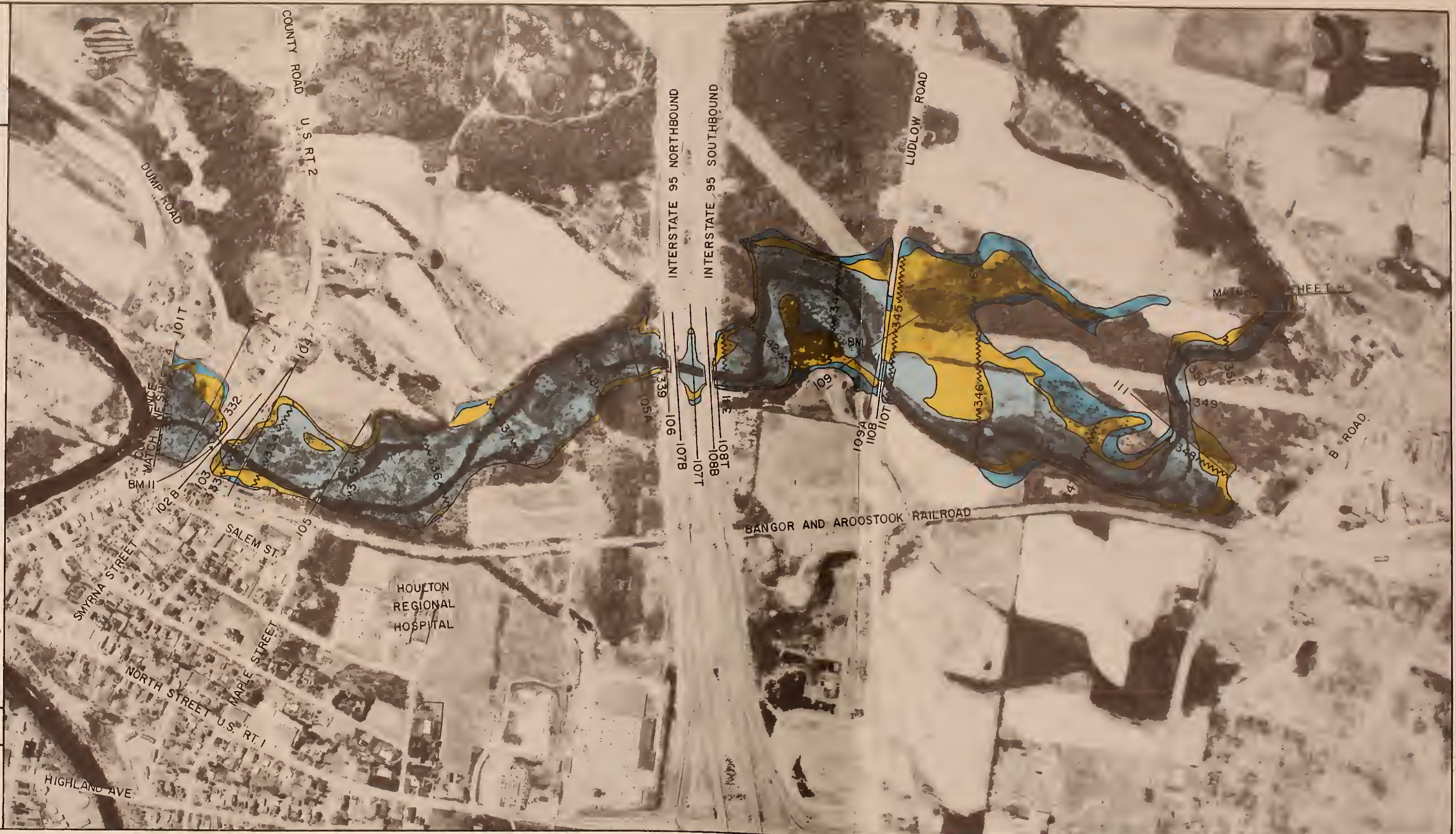
500' 0' 500' 1000'

APPROXIMATE

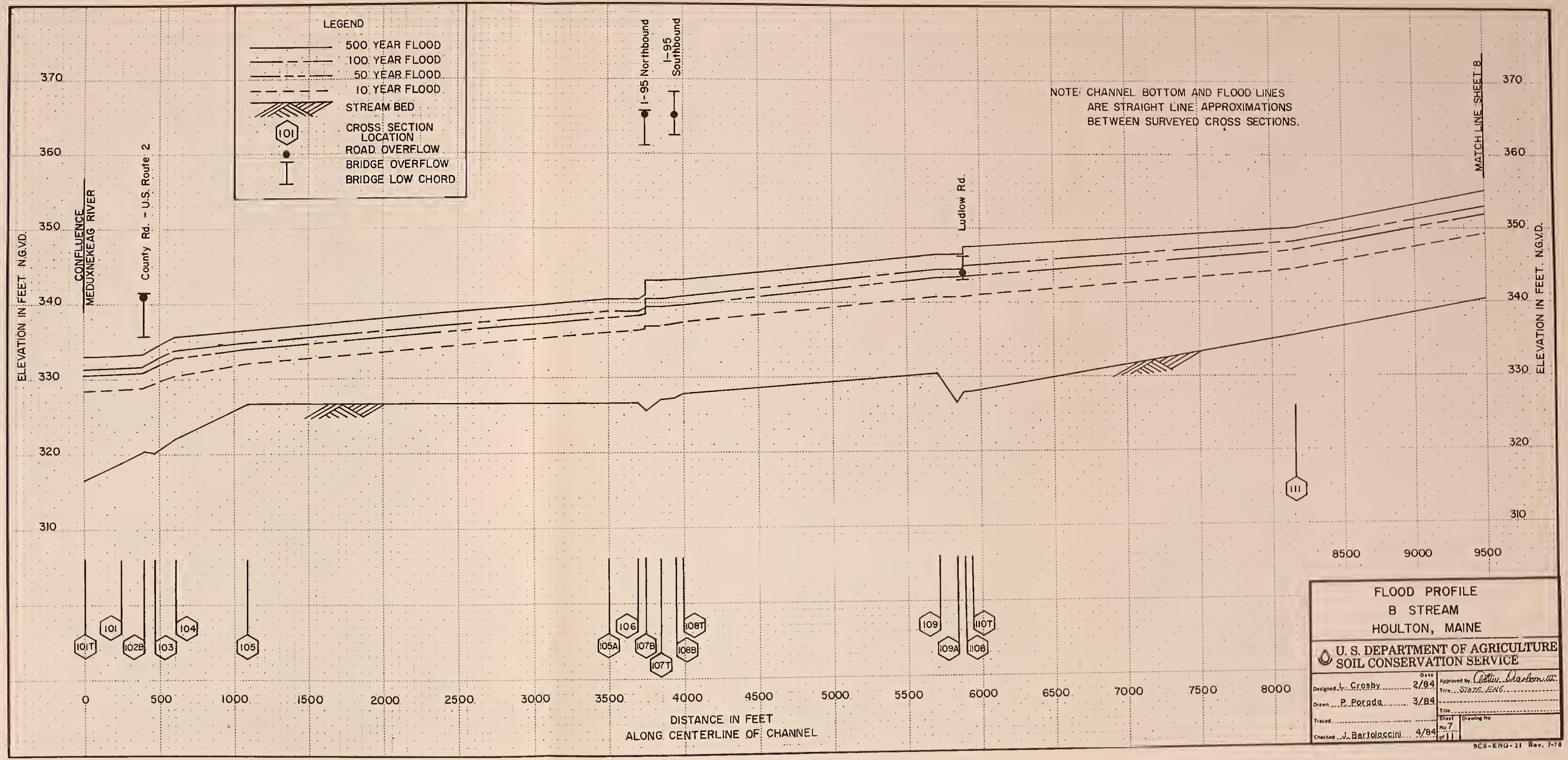
SOIL CONSERVATION SERVICE
U.S. DEPARTMENT OF AGRICULTURE

FLOOD PLAIN MAP
FLOOD PLAIN MANAGEMENT STUDY
TOWN OF HOULTON, MAINE

SHEET 7 OF 11



JULY 1987 1001773


LEGEND
500 YEAR FLOOD
100 YEAR FLOOD
50 YEAR FLOOD
10 YEAR FLOOD
STREAM BED
CROSS SECTION LOCATION
101
ROAD OVERFLOW
BRIDGE OVERFLOW
BRIDGE LOW CHORD
NOTE: CHANNEL BOTTOM AND FLOOD LINES ARE STRAIGHT LINE APPROXIMATIONS BETWEEN SURVEYED CROSS SECTIONS.
CONFLUENCE MEDUXNEKEAG RIVER
County Rd. - U.S. Route 2
I-95 Northbound
I-95 Southbound
Ludlow Rd.
MATCH LINE SHEET 8
ELEVATION IN FEET N.G.V.D.
310
320
330
340
350
360
370
101T
101
102B
103
104
105
105A
106
107B
107T
108T
108B
109
109A
110T
110B
111
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
6500
7000
7500
8000
8500
9000
9500
DISTANCE IN FEET ALONG CENTERLINE OF CHANNEL
FLOOD PROFILE
B STREAM
HOULTON, MAINE
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
Designed L. Crosby 2/84
Drawn P. Porada 3/84
Traced
Checked J. Bartoloccini 4/84
Approved by
Title STATE ENG.
Sheet No 7 of 11
SCS-ENG-21 Rev. 7-76

LEGEND

- 500 YEAR FLOOD PLAIN
- 100 YEAR FLOOD PLAIN
- 10 YEAR FLOOD PLAIN
- 112 —— VALLEY CROSS SECTION
- ~357~ 100 YEAR FLOOD ELEV.

LIMITS OF FLOODING SHOWN MAY VARY FROM ACTUAL LOCATIONS ON THE GROUND AS EXPLAINED IN THE NARRATIVE.

N

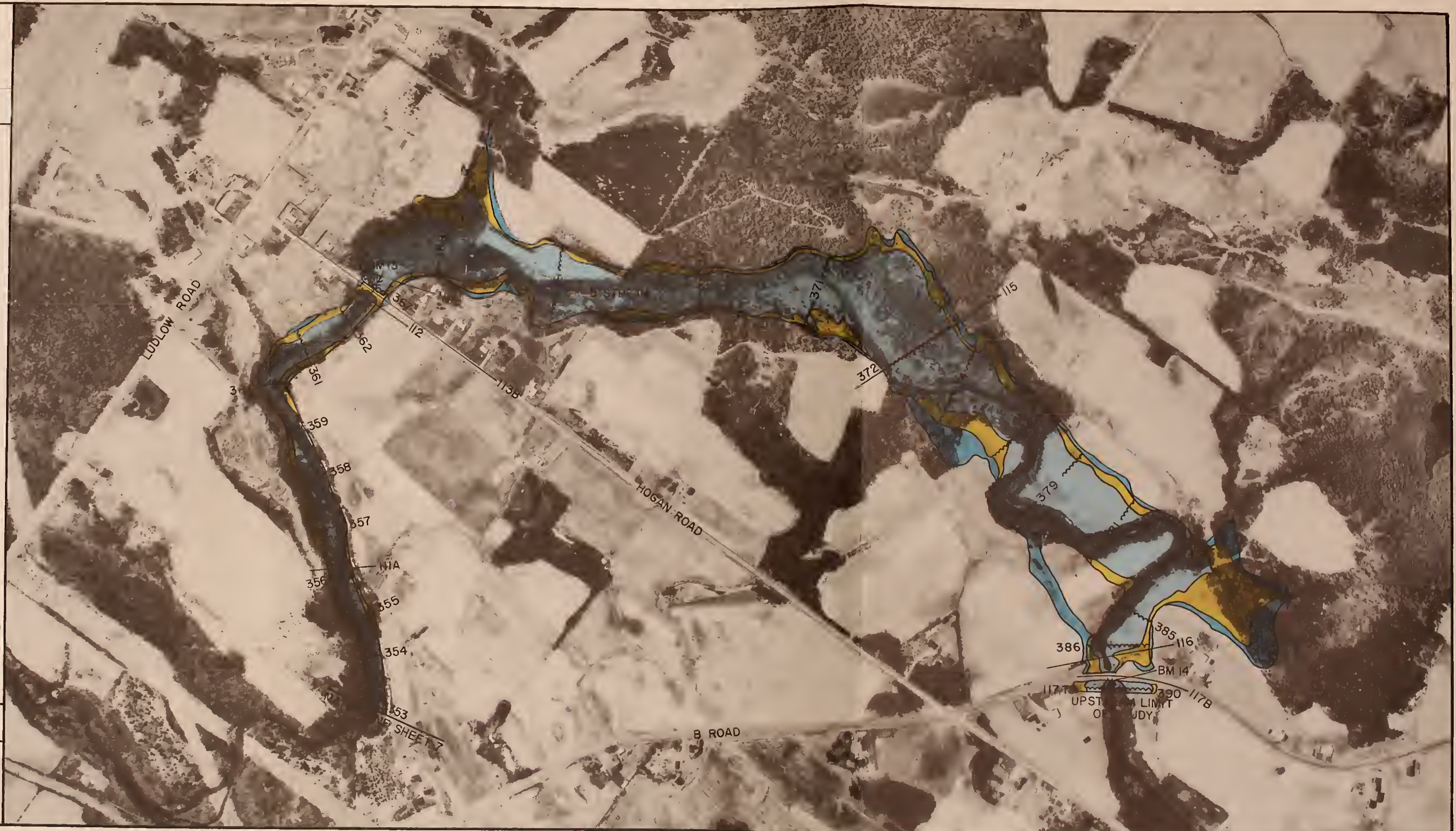
500' 0' 500' 1000'

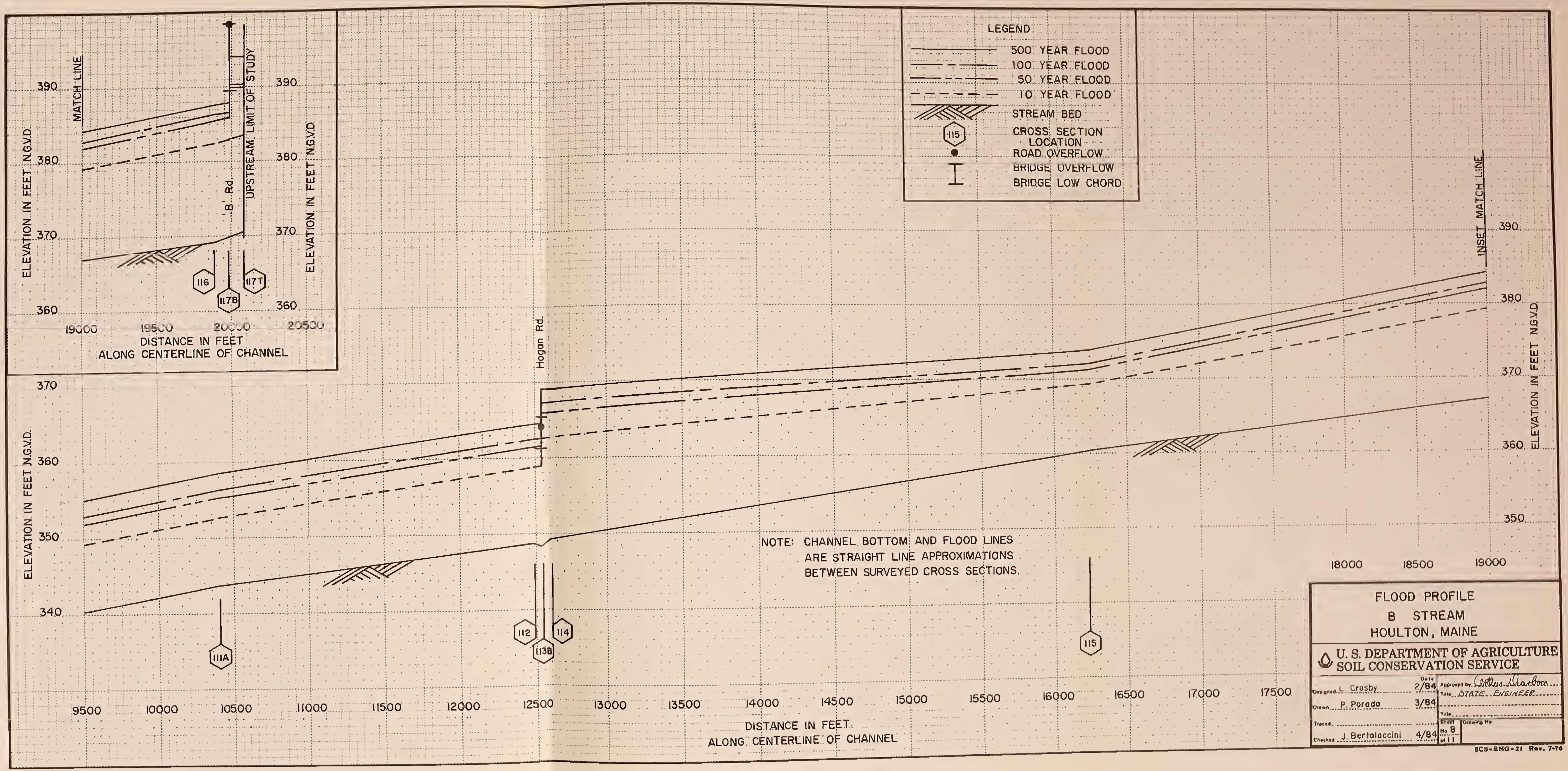
APPROXIMATE

SOIL CONSERVATION SERVICE
U.S. DEPARTMENT OF AGRICULTURE

FLOOD PLAIN MAP

FLOOD PLAIN MANAGEMENT STUDY
TOWN OF HOULTON, MAINE
SHEET 8 OF 11




LEGEND
500 YEAR FLOOD
100 YEAR FLOOD
50 YEAR FLOOD
10 YEAR FLOOD
STREAM BED
CROSS SECTION LOCATION
ROAD OVERFLOW
BRIDGE OVERFLOW
BRIDGE LOW CHORD
MATCH LINE
UPSTREAM LIMIT OF STUDY
'B' Rd.
ELEVATION IN FEET N.G.V.D.
DISTANCE IN FEET ALONG CENTERLINE OF CHANNEL
INSET MATCH LINE
Hogan Rd.
NOTE: CHANNEL BOTTOM AND FLOOD LINES ARE STRAIGHT LINE APPROXIMATIONS BETWEEN SURVEYED CROSS SECTIONS.
111A
112
113B
114
115
116
117B
117T
FLOOD PROFILE
B STREAM
HOULTON, MAINE
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
Designed L. Crosby 2/84
Drawn P. Porada 3/84
Checked J. Bertalaccini 4/84
Title STATE ENGINEER
Sheet No. 8 of 11
SCS-ENG-21 Rev. 7-76

LEGEND

(blue)	500 YEAR FLOOD PLAIN
(yellow)	100 YEAR FLOOD PLAIN
(grey-blue)	10 YEAR FLOOD PLAIN
210 ———	VALLEY CROSS SECTION
~~380~~	100 YEAR FLOOD ELEV.

LIMITS OF FLOODING SHOWN MAY VARY FROM ACTUAL LOCATIONS ON THE GROUND AS EXPLAINED IN THE NARRATIVE.

500' 0' 500' 1000'

APPROXIMATE

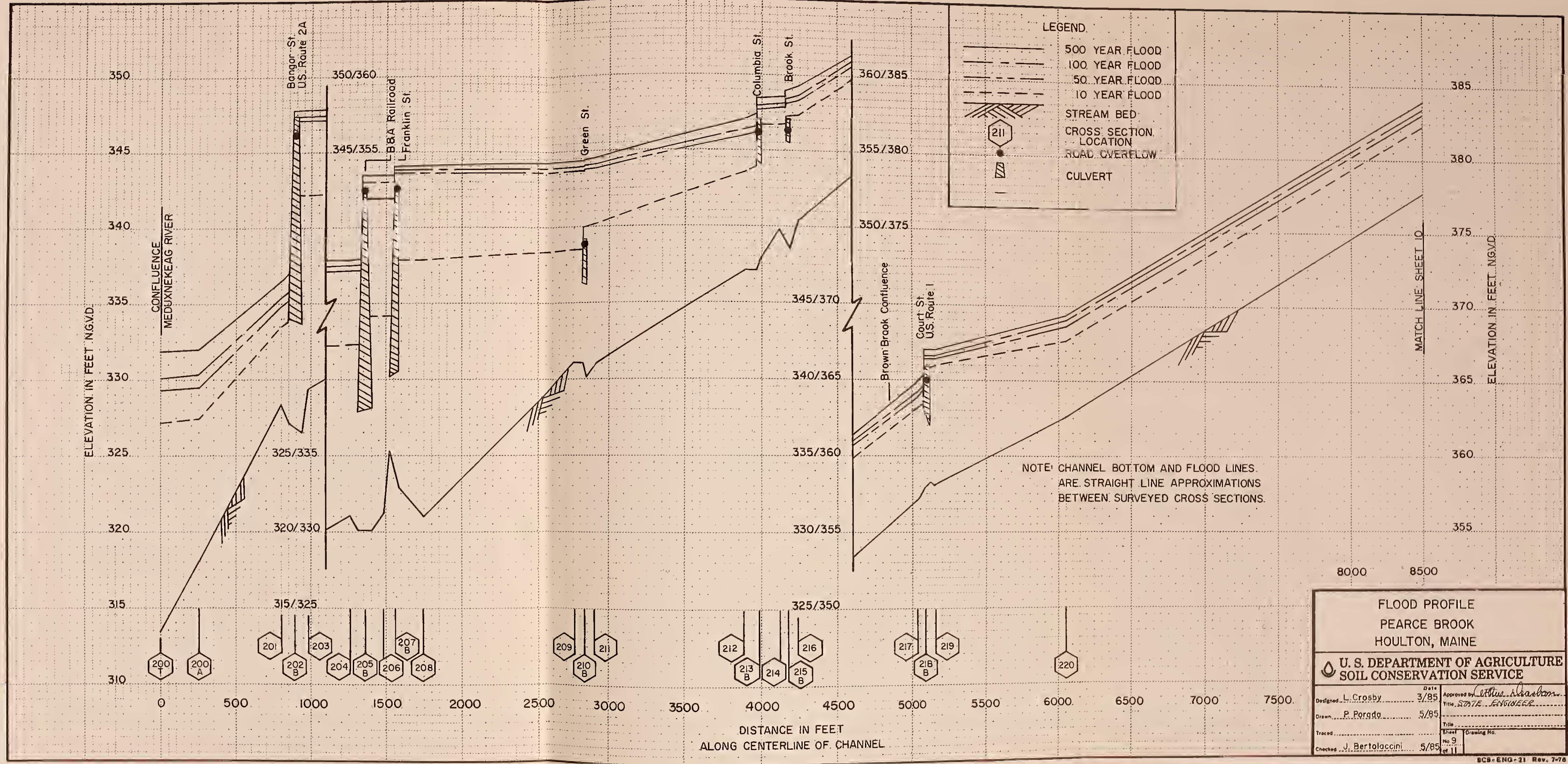
SOIL CONSERVATION SERVICE
U.S. DEPARTMENT OF AGRICULTURE

FLOOD PLAIN MAP

FLOOD PLAIN MANAGEMENT STUDY
TOWN OF HOULTON, MAINE

SHEET 9 OF 11

JULY 1987 1001773



FLOOD PROFILE
PEARCE BROOK
HOULTON, MAINE

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed L. Crosby	3/85	Approved by [signature]
Drawn P. Porada	5/85	Title STATE ENGINEER
Traced		Sheet No. 9 of 11
Checked J. Bertolaccini	5/85	Drawing No.

SCS-ENG-21 Rev. 7-78

LEGEND

500 YEAR FLOOD PLAIN
100 YEAR FLOOD PLAIN
10 YEAR FLOOD PLAIN
373 —— VALLEY CROSS SECTION
~374~ 100 YEAR FLOOD ELEV.

LIMITS OF FLOODING SHOWN MAY VARY FROM ACTUAL LOCATIONS ON THE GROUND AS EXPLAINED IN THE NARRATIVE

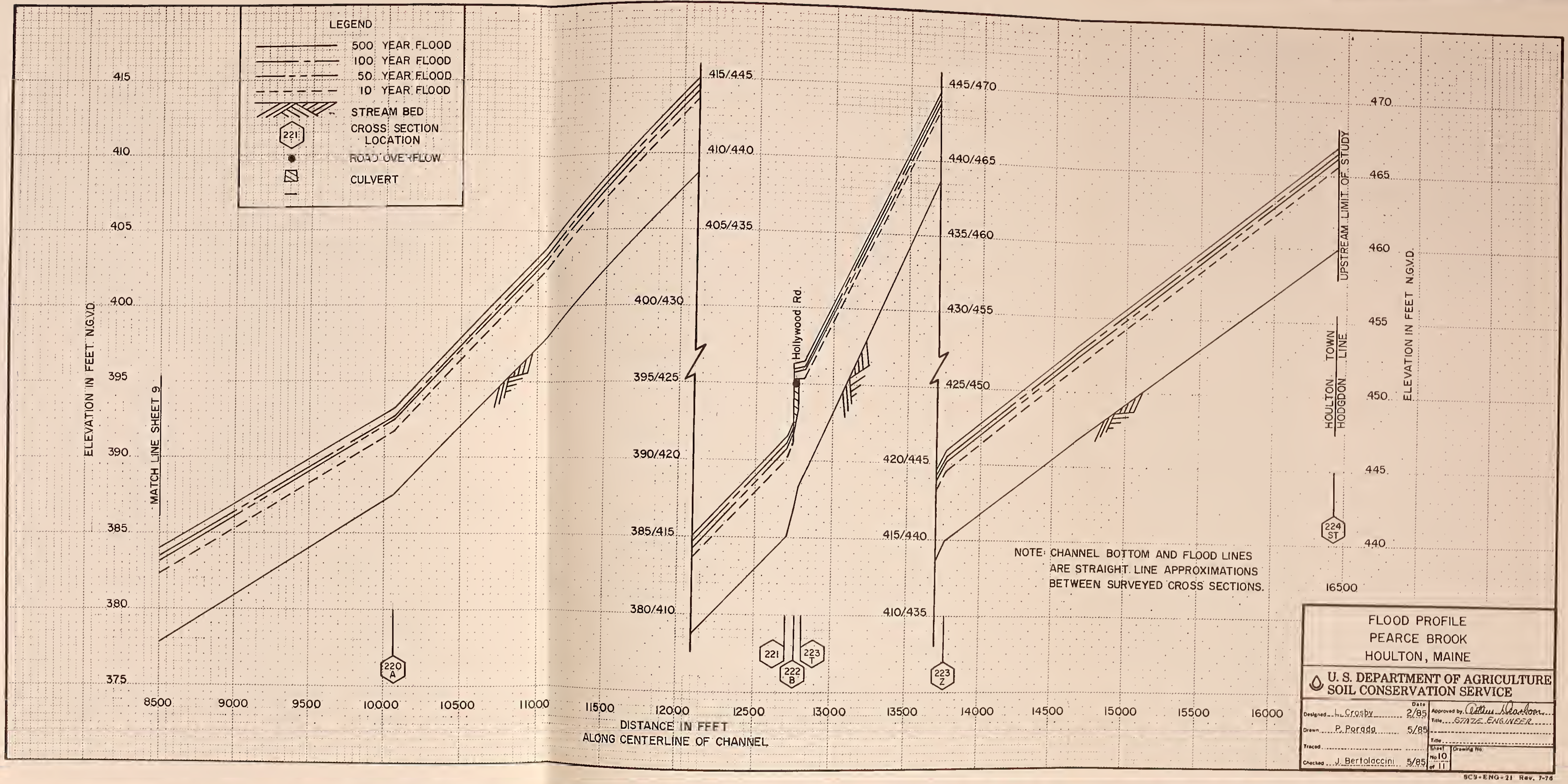
500' 0 500' 1000'

APPROXIMATE

SOIL CONSERVATION SERVICE
U.S. DEPARTMENT OF AGRICULTURE

FLOOD PLAIN MAP
FLOOD PLAIN MANAGEMENT STUDY
TOWN OF HOULTON, MAINE
SHEET 10 OF 11

JULY 1987 1001773



LEGEND
500 YEAR FLOOD
100 YEAR FLOOD
50 YEAR FLOOD
10 YEAR FLOOD
STREAM BED
CROSS SECTION LOCATION
ROAD OVERFLOW
CULVERT
ELEVATION IN FEET N.G.V.D.
415
410
405
400
395
390
385
380
375
MATCH LINE SHEET 9
415/445
410/440
405/435
400/430
395/425
390/420
385/415
380/410
Hollywood Rd.
445/470
440/465
435/460
430/455
425/450
420/445
415/440
410/435
UPSTREAM LIMIT OF STUDY
HOULTON TOWN
HODGDON LINE
470
465
460
455
450
445
440
ELEVATION IN FEET N.G.V.D.
220 A
221
222 B
223 T
223 Z
224 ST
NOTE: CHANNEL BOTTOM AND FLOOD LINES ARE STRAIGHT LINE APPROXIMATIONS BETWEEN SURVEYED CROSS SECTIONS.
16500
8500
9000
9500
10000
10500
11000
11500
12000
12500
13000
13500
14000
14500
15000
15500
16000
DISTANCE IN FEET
ALONG CENTERLINE OF CHANNEL
FLOOD PROFILE
PEARCE BROOK
HOULTON, MAINE
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
Designed L. Crosby 2/85
Drawn P. Porada 5/85
Traced
Checked J. Bertolaccini 5/85
Approved by
STATE ENGINEER
Sheet No 10 of 11
SCS-ENG-21 Rev. 7-78

LEGEND

500 YEAR FLOOD PLAIN
100 YEAR FLOOD PLAIN
10 YEAR FLOOD PLAIN
302 —— VALLEY CROSS SECTION
~380~ 100 YEAR FLOOD ELEV.

LIMITS OF FLOODING SHOWN MAY VARY FROM ACTUAL LOCATIONS ON THE GROUND AS EXPLAINED IN THE NARRATIVE.

N

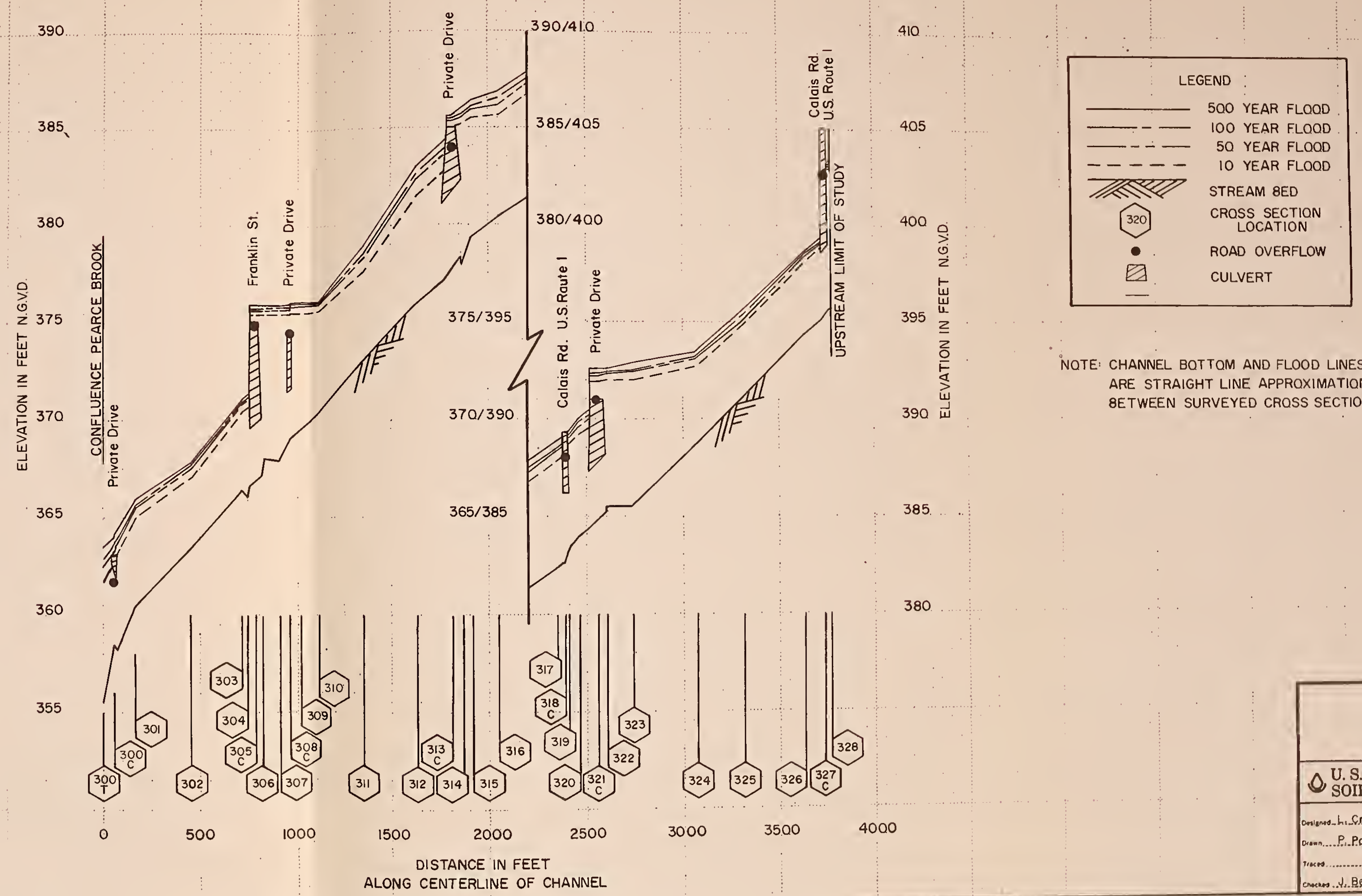
500' 0' 500' 1000'

APPROXIMATE

SOIL CONSERVATION SERVICE
U.S. DEPARTMENT OF AGRICULTURE

FLOOD PLAIN MAP
FLOOD PLAIN MANAGEMENT STUDY
TOWN OF HOULTON, MAINE
SHEET 11 OF 11

JULY 1987 1001773



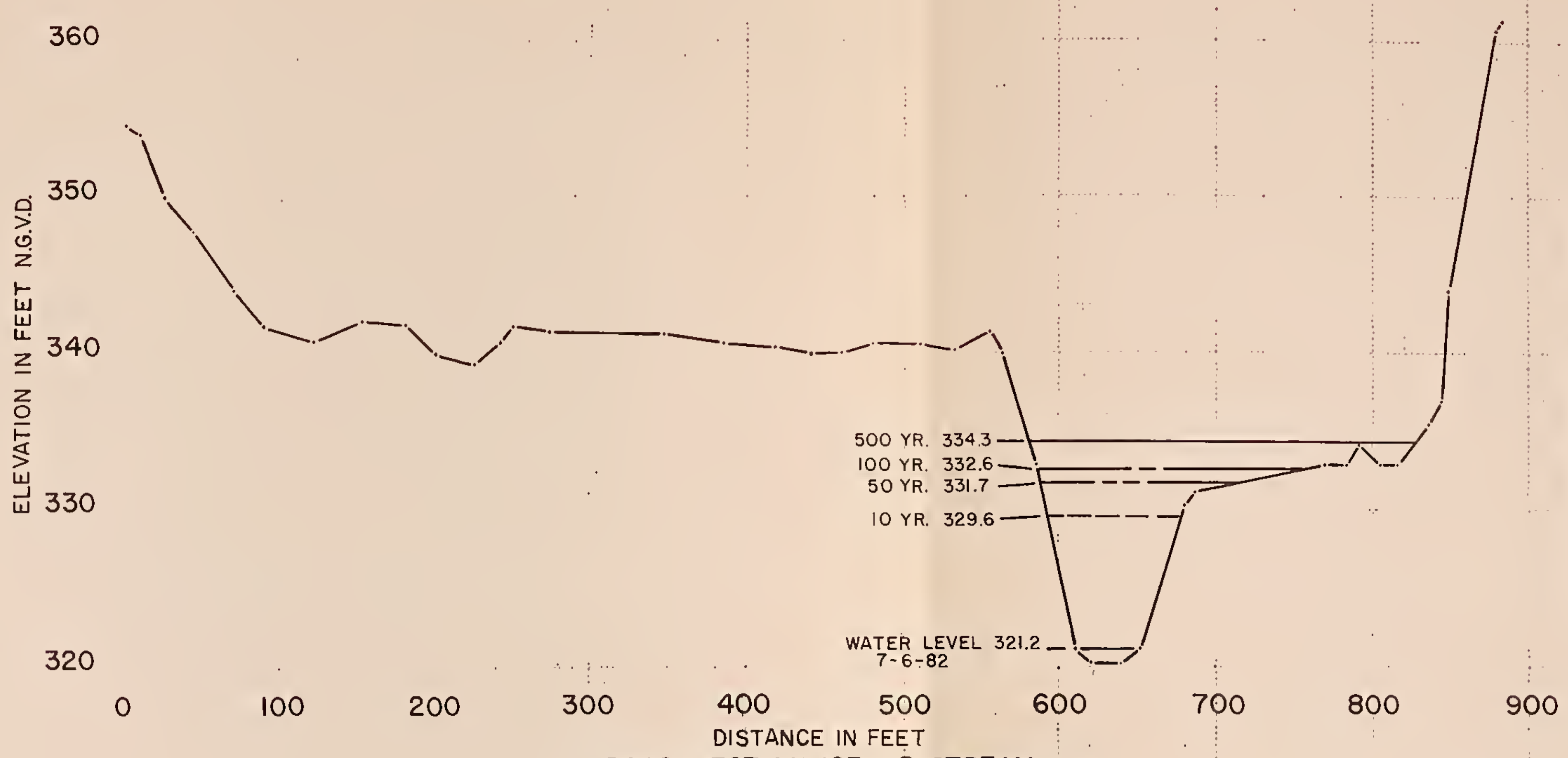
NOTE: CHANNEL BOTTOM AND FLOOD LINES ARE STRAIGHT LINE APPROXIMATIONS BETWEEN SURVEYED CROSS SECTIONS.

FLOOD PROFILE
BROWN BROOK
HOULTON, MAINE

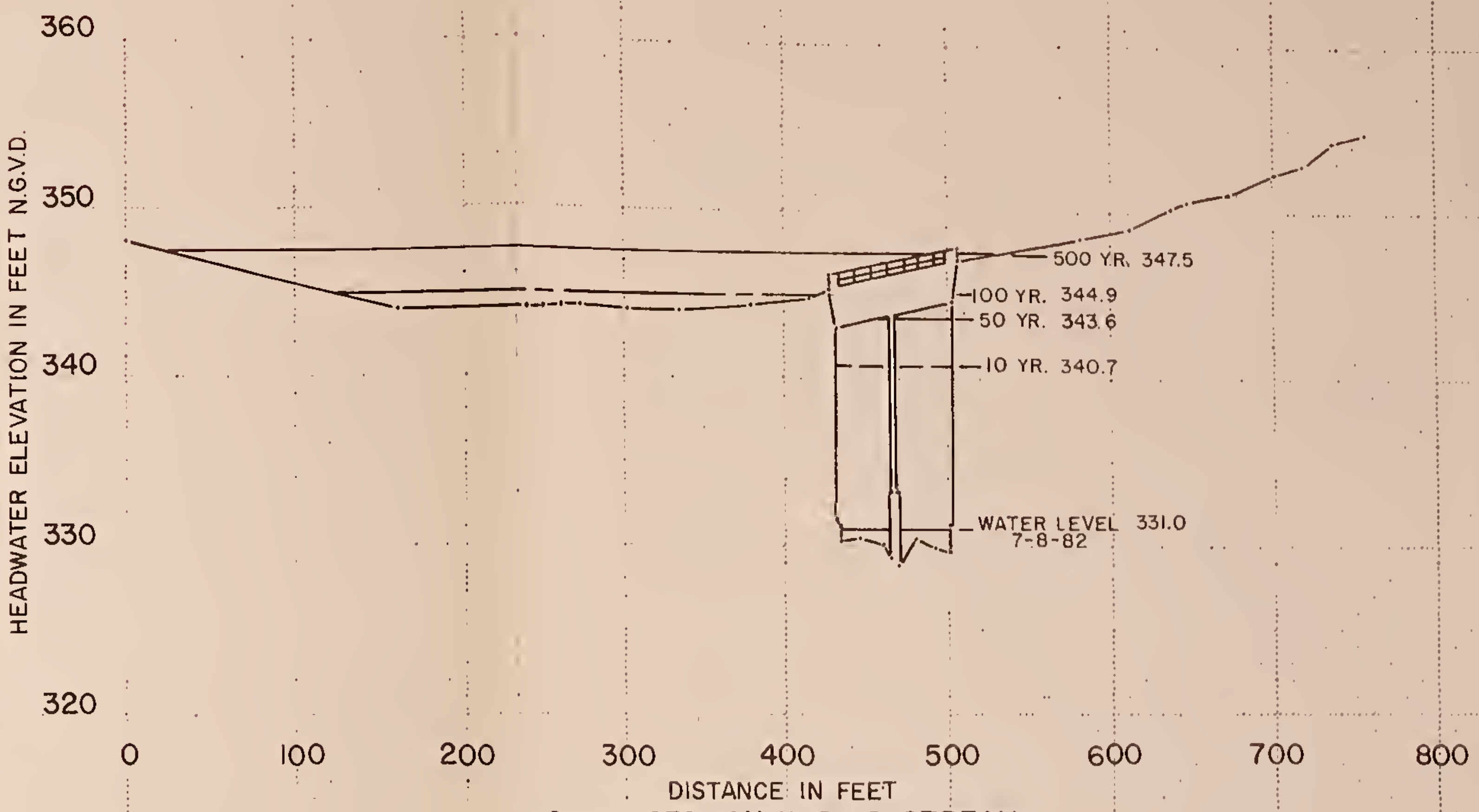
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed L. Crosby	Date 2/85	Approved by Arthur Dearborn
Drawn P. Porada	5/85	Title STATE ENGINEER
Traced		Title
Checked J. Bertolaccini	5/85	Sheet No. 11 of 11 Drawing No.

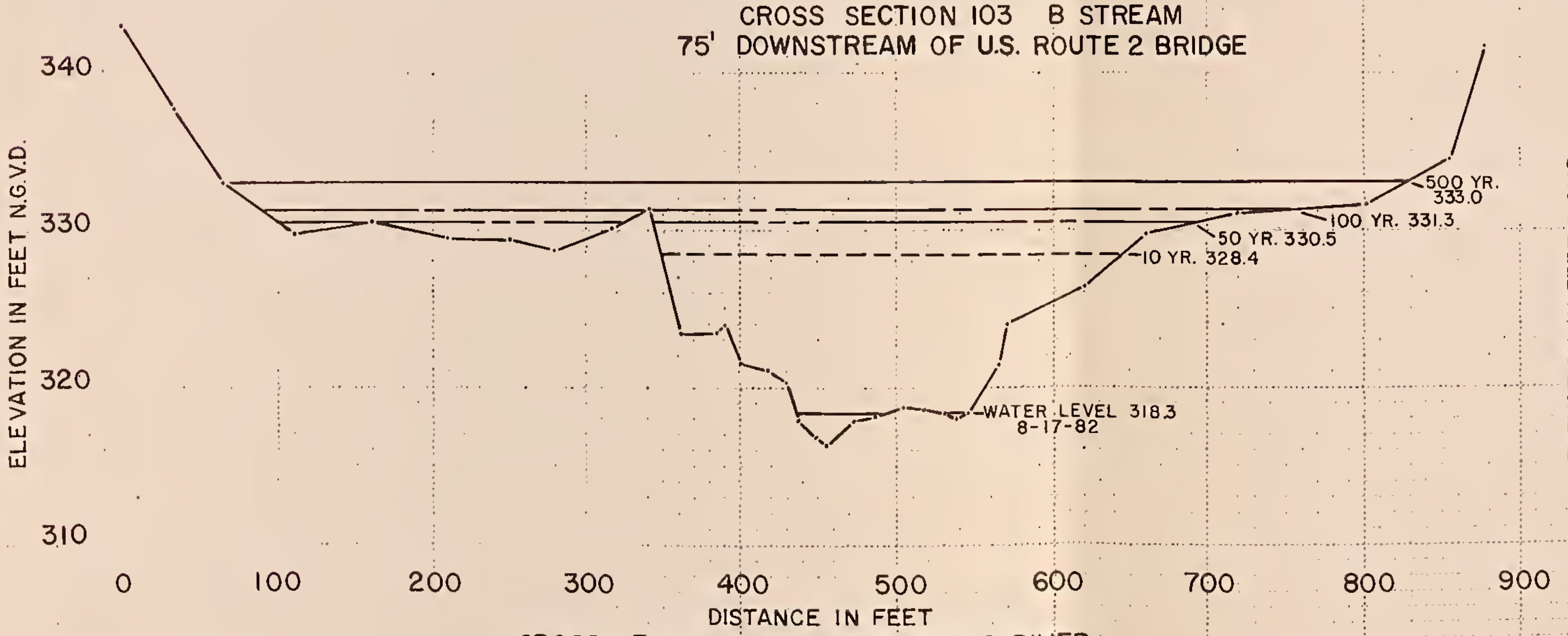
SCS-ENG-21 Rev. 7-76



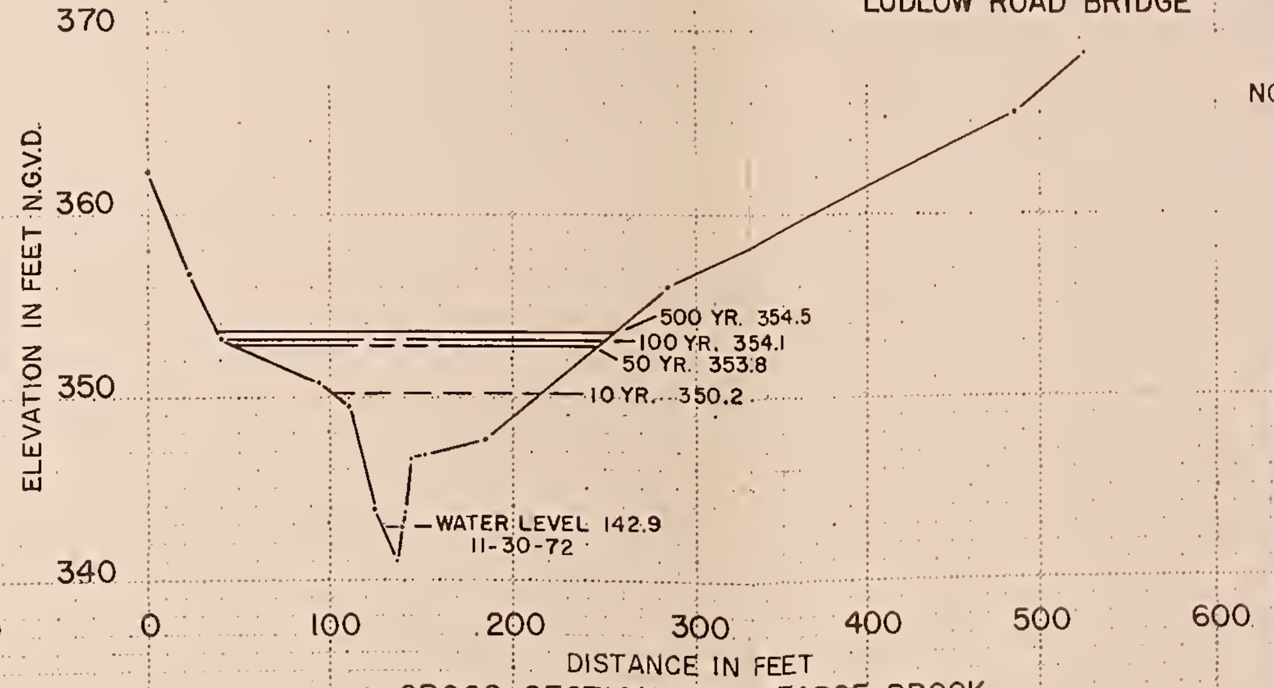
CROSS SECTION 103 B STREAM
75' DOWNSTREAM OF U.S. ROUTE 2 BRIDGE



CROSS SECTION 110B B STREAM
LUDLOW ROAD BRIDGE



CROSS SECTION 18 MEDUXNEKEAG RIVER
80' UPSTREAM OF B&A RAILROAD BRIDGE



CROSS SECTION 211 PEARCE BROOK
80' UPSTREAM OF GREEN ST. BRIDGE

NOTE: CROSS SECTIONS SHOWN LEFT
TO RIGHT LOOKING UPSTREAM.

SELECTED CROSS SECTIONS
HOULTON, MAINE

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

	Date	
Designed L. Crosby	2/84	Approved by ARTHUR DEARBORN
Drawn P. Parada	4/84	Title STATE CONSERVATION ENG.
Traced		Sheet No. 1 of 1
Checked J. Bartolaccini	4/84	Drawing No.

SCS-ENG-21 Rev. 7-76

APPENDIX

Investigations and Analyses

Topographic data were obtained from surveyed and/or stereoplotted valley and bridge cross sections and 1" = 500' stereoplotted topographic maps with a 2-foot contour interval. Elevations are based upon National Geodetic Vertical Datum, 1929 (NGVD). Elevation bench marks that were used for this study are described in the Appendix and located on the Flood Plain Map Index and Flood Plain Maps.

Flood discharges on the Meduxnekeag River in Houlton were computed from a log-Pearson Type III analysis (17) of former USGS gage No. 01018000 near Houlton (14), period of record 1940 to 1982.

Discharges at sites in Houlton were computed using the following equation.

$$Q_s = Q_g \left(A_s / A_g \right)^a$$

Where Q_s is the discharge at the site, Q_g is the discharge at the gage, A_s is the drainage area of the site, A_g is the drainage area of the gage, and the exponent a equals 0.80.

Discharges on B Stream, Pearce Brook and Brown Brook were generated from the SCS TR-20 hydrologic evaluation model and checked against the USGS regression equation for Maine (18 and 19).

A table of selected discharges is located on page A-3.

Water surface elevations of floods of the selected recurrence intervals were computed through use of the SCS WSP2 computer program. (20) Water surface profiles for the Meduxnekeag River were started from a given slope approximately

9,000 feet downstream of Houlton in the town of Littleton. Water surface profiles for B Stream, Pearce Brook, and Brown Brook were started from flood elevations at their respective mouths.

Flood profiles were drawn showing computed water-surface elevations for floods of the selected recurrence intervals. These profiles were checked against historic flood data provided by USGS, the Maine Department of Transportation, and others.

The hydraulic analyses of this study were based on unobstructed flow. The flood elevations shown on the profiles are thus considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail.

The boundaries of the 10-year, 100-year, and 500-year floods as shown on the maps were delineated from flood elevations determined at each cross section; between cross sections, the boundaries were interpolated from stereoplotted topographic maps with a 2-foot contour interval. (21)

Field survey information, engineering computations, and other data pertinent to the study are on file with the Soil Conservation Service, USDA Office Building, University of Maine, Orono, Maine 04473, telephone (207) 581-3446.

SELECTED FLOOD DISCHARGES

Cross Section No.	Location	Drainage Area (Mi^2)	Flood Discharges (CFS)			
			10-Year	50-Year	100-Year	500-Year
Meduxnekeag River						
5B	Lowery Road	256.26	7,770	10,570	11,760	14,540
16B	North Street, U.S. Routes 1 & 2	231.00	7,160	9,730	10,830	13,390
25B	Carys Mills Road	106.42	3,850	5,230	5,820	7,200
B Stream						
	County Road U.S. Route 2	45.49	3,460	5,780	6,930	9,350
110B	Ludlow Road	44.75	3,410	5,700	6,830	9,220
117B	B Road	40.92	3,180	5,300	6,340	8,540
Pearce Brook						
202B	Bangor Street	8.00	740	1,180	1,410	1,830
218B	Court Street	6.99	690	1,110	1,320	1,700
222B	Hollywood Road	5.91	660	1,010	1,220	1,570
Brown Brook						
305C	Franklin Street	0.73	260	380	440	550
327C	Calais Road U.S. Route 1	0.44	170	250	290	370

BRIDGE DATA

Cross Section No.	Location	Channel Bottom Elevations	Low Chord Elevations	Road Overflow Elevations	Flood Elevations 10-Year	50-Year	100-Year	500-Year
Meduxnekeag River								
5B	Lowery Road	287.1	300.3	301.8	299.1	301.6	302.5	303.8
10B	Interstate 95	306.6	342.0	348.9	318.0	319.7	320.4	321.8
11B	Interstate 95	305.8	338.0	343.1	318.4	320.2	320.9	322.3
14B	Highland Avenue, U.S. Route 1&2	309.7	339.2	346.7	324.7	326.8	327.6	329.5
16B	North Street	312.7	337.7	341.0	326.5	328.7	329.6	331.4
17B	B&A Railroad	315.0	352.0	361.6	328.4	330.5	331.2	333.0
20B	B&A Railroad	320.8	346.6	361.7	333.3	335.2	336.3	337.9
25B	Carys Mills Road	338.7	349.7	351.3	352.0	353.3	353.6	354.2
28B	Farm Road	366.8	374.5	375.2	376.2	377.5	377.9	378.8
B Stream								
102B	County Road, U.S. Route 2	320.4	335.7	341.1	328.9	330.9	331.7	333.3
107B	Interstate 95	325.5	361.1	365.2	336.8	339.5	340.5	343.0
108B	Interstate 95	327.2	362.5	365.3	337.2	339.7	340.8	343.1
110B	Ludlow Road	327.9	343.0	344.2	340.7	343.6	344.9	347.5
113B	Hogan Road	348.3	361.3	364.0	362.6	366.0	367.2	369.0
117B	B Road	369.9	389.4	398.5	383.0	389.9	390.3	394.1
Pearce Brook								
202B	Bangor Street, U.S. Route 2A	326.5	333.6	346.1	342.2	347.1	347.4	347.8
205B	B&A Railroad	330.1	338.1	352.5	344.2	351.9	353.0	353.5
207B	Franklin Street	332.9	340.5	352.6	347.8	353.6	353.8	354.1
210B	Green Street	340.1	346.2	348.8	350.0	353.8	354.1	354.4
213B	Columbia Street	347.8	354.1	356.2	356.7	357.7	358.0	358.5
215B	Brook Street	348.5	355.5	356.3	357.3	358.1	358.4	359.0
218B	Court Street, U.S. Route 1	358.3	361.9	365.0	365.8	366.4	366.6	367.0
222B	Hollywood Road	418.3	423.3	425.0	425.3	425.8	426.0	426.3

Elevations refer to feet NGVD, at upstream end of bridge opening.

BRIDGE DATA

Cross Section No.	Location	Channel Bottom Elevations	Low Chord Elevations	Road Overflow Elevations	Flood Elevations			
					10-Year	50-Year	100-Year	500-Year
Brown Brook								
300C	Private Drive	358.1	361.6	361.6	362.9	363.5	363.7	364.2
305C	Franklin Street	367.1	370.1	374.8	375.4	375.6	375.7	375.9
308C	Private Drive	369.1	371.6	374.5	375.5	375.8	376.0	376.1
313C	Private Drive	378.3	382.3	384.0	385.0	385.3	385.4	385.6
318C	Calais Road, U.S. Route 1	382.7	386.2	388.0	388.7	389.0	389.1	389.3
321C	Private Drive	385.2	388.2	391.0	391.9	392.2	392.3	392.6
327C	Calais Road, U.S. Route 1	395.6	399.1	402.6	402.9	403.1	403.2	403.3

Elevations refer to feet NGVD, at upstream end of bridge opening.

Bench Mark Descriptions

1. SCS BM, Elev. 290.90

   Houlton; Near Lowery Road bridge over the Meduxnekeag River, on steep ledge along easterly downstream bank, 100 feet northeasterly of bridge; chiseled square, painted red.

2. MDOT BM, Elev. 355.487

   Houlton; On Interstate 95 southbound, near bridge over the Meduxnekeag River, on "Meduxnekeag River" sign, easterly downstream bank; Northeast base bolt, painted red.

3. SCS BM, Elev. 347.56

   Houlton; On Highland Avenue bridge over the Meduxnekeag River, southerly downstream abutment; chiseled square, painted red.

4. MDOT BM, Elev. 343.68

   Houlton; On North Street bridge over the Meduxnekeag River, northwesterly downstream abutment, top of concrete guardrail support; standard tablet.

5. SCS BM, Elev. 361.72

   Houlton; On Bangor and Aroostook railroad bridge over the Meduxnekeag River, 250 feet downstream of B Stream confluence, southerly downstream abutment; chiseled square, painted red.

6. SCS BM, Elev. 362.51

   Houlton; Near Bangor and Aroostook railroad bridge over the Meduxnekeag River, at southwest end of railroad yard, northwest corner of concrete slab (former railroad handcar building), 100 feet east of bridge, easterly upstream bank; chiseled square, painted red.

7. SCS BM, Elev. 330.07

Houlton; Near USGS tramway over the Meduxnekeag River, easterly bank, 25 feet downstream of tramway, on concrete block; chiseled square, painted red.

8. USGS BM, Elev. 343.63

Houlton; Near USGS gaging station on the Meduxnekeag River, in ledge, easterly bank, 150 feet downstream of gage; standard tablet.

9. SCS BM, Elev. 353.53

Houlton; On Carys Mills Road bridge over the Meduxnekeag River, southerly upstream abutment; chiseled square, painted red.

10. SCS BM, Elev. 374.67

Houlton; On a farm road bridge over the Meduxnekeag River, off of New Limerick Road, 1,500 feet from the U.S. Route 2 intersection; southerly upstream abutment; red paint spot.

11. SCS BM, Elev. 341.36

Houlton; On U.S. Route 2 bridge over B Stream, easterly upstream abutment; chiseled square, painted red.

12. MDOT BM, Elev. 334.78

Houlton; Near Ludlow Road bridge over B Stream, in ledge, easterly bank, 50 feet downstream of bridge; chiseled square.

13. SCS BM, Elev. 360.97

Houlton; On Hogan Road bridge over B Stream, northerly upstream abutment; bolt, painted red.

14. SCS BM, Elev. 391.99

Houlton; On B Road bridge over B Stream, southeasterly upstream abutment; chiseled square, painted red.

15. SCS BM, Elev. 365.91

Houlton; On U.S. Route 1 bridge over Pearce Brook, southerly upstream abutment; chiseled square, painted red.

16. SCS BM, Elev. 424.36

Houlton; On Hollywood Road culvert at Pearce Brook, rock on upstream side over most northerly culvert; chiseled square, painted red.

17. SCS BM, Elev. 399.20

Houlton; On southernmost U.S. Route 1 culvert at Brown Brook, upstream center of culvert; chiseled "X", painted red.

GLOSSARY

Aquisition - Purchasing flood prone properties for the specific purpose of reducing flood damage by changing land use.

Bench Mark - A point of known elevation based on National Geodetic Vertical Datum (NGVD) that can be used to determine elevations at other desired locations in the area of concern.

CFS or cfs - Cubic feet per second. Used to describe the amount of flow passing a given point in a stream channel. One cubic foot per second is equivalent to approximately 7.5 gallons per second.

Channel - A natural or artificial watercourse with definite bed and banks to conduct and confine flowing water.

Critical Area Treatment - The application of vegetative and mechanical practices used to reduce runoff and erosion. Practices normally consist of seeding, tree planting, grass waterways, diversions, gully stabilization, etc.

Cross Section - A graph or plot of ground elevation across a stream valley or a portion of it, usually along a line perpendicular to the stream or direction of flow.

Environmental Corridor - A strip of land, usually along one or both sides of a stream, which is set aside, regulated, or otherwise protected to preserve its environmental values.

Erosion - The group of processes whereby soil or rock material is loosened or dissolved and removed from any part of the earth's surface.

Flood - An overflow or inundation onto land areas not normally covered by water that are used or usable by people. Floods are usually characterized as temporarily inundating land areas which are adjacent to a body of water such as an ocean, lake, stream or river.

Flood Crest - The maximum stage or elevation reached by the waters of a flood at any location.

Flood Peak - The maximum instantaneous discharge of a flood at a given location usually occurring at the flood crest.

Flood Plain - The relatively flat area of lowlands adjoining the channel of a river, stream, or watercourse or ocean, lake, or other body of standing water which has been or may be covered by floodwater.

Flood Plain Management - The operation of a program intended to lessen the damaging effects of floods, maintain and enhance natural values, and make effective use of relative water and land resources within the flood plain. It is an attempt to balance values obtainable from use of flood plains with potential losses arising from such use. Flood plain management stresses consideration of the full range of measures potentially useful in achieving its objectives.

Flood Plain Map - A map showing the lateral extent of projected floods.

Flood Profile - A graph which shows the relationship of water surface elevation to distance along the centerline of channel. It is used in this report to show the crest elevations of specific floods.

Floodproofing - A combination of structural changes and adjustments to new or existing structures and facilities, their contents and/or their sites for the purpose of reducing or eliminating flood damages by protecting against structural failure, keeping water out, or reducing the effect of water entry.

Flood Warning - The issuance and dissemination of information about an imminent or current flood.

Floodway - That portion of the main stream channel plus any adjacent flood plain areas that must be kept free of encroachment in order that the 100-year flood can be carried without substantial increases in flood heights.

Frequency - A statistical measure of how often an event of a given size or magnitude should, on the average, be equalled or exceeded.

(a) A 500-year frequency flood is one that is equalled or exceeded, on the average, once in 500 years. It has a 0.2 percent chance of being equalled or exceeded in any given year.

(b) A 100-year frequency flood is one that is equalled or exceeded on the average, once in 100 years. It has a 1 percent chance of being equalled or exceeded in any given year.

(c) A 50-year frequency flood is one that is equalled or exceeded on the average once in 50 years and has a 2 percent chance of being equalled or exceeded in any year.

(d) A 10-year frequency flood is one that is equalled or exceeded, on the average, once in 10 years and has a 10 percent chance of being equalled or exceeded in any year.

Head - The height of water above any plane of reference.

Head Loss - The effect of obstructions, such as narrow bridge openings or buildings, that limit the area through which water must flow, raising the surface of the water upstream from the obstruction.

High Hazard Zone - An area, normally nearest the stream, where flooding may pose a significant risk to life and property. Areas having any one of the following conditions are generally considered high hazard.

a. Areas where flood velocities exceed 12 feet per second (fps).

b. Areas where flood depths are greater than 3 feet.

c. Areas where the product of the velocity (in fps) and the depth (in feet) of the flood water exceeds 7.

Important Farmland -

Prime: Land that has the best combination of physical and chemical characteristics for producing food, feed, fiber, and oilseed crops, and also is available for these uses. This includes: cropland, pastureland, rangeland, and forestlands. It does not include urbanized land or water. Land in this category has the soil quality, growing season, and moisture supply needed to produce sustained high yields of crops economically when treated and managed (including water management), according to modern agricultural methods.

Additional Farmland of Statewide Importance: Land, in addition to prime farmland, that is of statewide importance for the production of food, fiber, feed, forage, and oilseed crops. Criteria for defining and delineating these lands are to be determined by the appropriate state agency or agencies. Generally these lands include those that are nearly prime farmland and that can economically produce high yields of crops when treated and managed according to acceptable farming methods. Some may produce as high a yield as prime farmlands if conditions are favorable, and in some states these lands may include tracts of land that have been designated for agriculture by state laws.

Low Chord - The elevation at which the bridge girder first begins to reduce the flow area of the channel.

Low Hazard Zone - The area between the high hazard zone and the maximum extent of the 100-year frequency flood where the potential for loss of life and property damage is low.

Natural Values of Flood Plains - The desirable qualities of, or functions served by, flood plains including, but not limited to: water resource values (e.g., moderation of floods, water quality maintenance and groundwater recharge), living resource values (e.g., fish, wildlife, and plant resources and habitat), cultural resource values (e.g., open space, natural beauty, scientific study, outdoor education, and recreation), and cultivated resource values (e.g., agriculture, aquaculture, and forestry).

NGVD - National Geodetic Vertical Datum, formerly Mean Sea Level (MSL) 1929.

Nonstructural Measures - All flood plain management measures except structural flood control works. Examples of nonstructural measures are flood warning/preparedness systems, relocation, floodproofing, regulation, land acquisition and public investment policy.

Relocation - Moving a building from a flood prone area by physically placing it on a vehicle and transporting it from the flood plain.

Road Overflow - The elevation of the point at which water first starts to flow over the road.

Station - Distance in feet along the centerline of the existing channel, increasing in an upstream direction.

Structural Measure - Flood control works such as dams and reservoirs, dikes and floodwalls, channel alterations, and diversion channels which are designed to keep water away from specific dvelopments and/or populated areas or to reduce flooding in such areas.

Wetland - An area where saturation with water is the dominant factor determining the nature of soil development and the types of plant and animal communities present; generally includes swamps, marshes, bogs, shallow lakes, and similar areas.

BIBLIOGRAPHY

1. New England River Basins Commission, St. John River Basin Overview, Boston, Massachusetts, September 1981.

2. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, Climate of Maine, Washington, D.C., May 1972.

3. State of Maine, State Planning Office, Water Resources Division, 916-Z Cross-Town Lake Inventory, Augusta, Maine, July 1976.

4. U.S. Department of Agriculture, Soil Conservation Service, Maine Hydrologic Units and Their Drainage Areas, Orono, Maine September 1982.

5. U.S. Department of Agriculture, Soil Conservation Service, Soil Survey, Aroostook County, Maine, Southern Part, Orono, Maine, August 1964.

6. U.S. Department of Agriculture, Soil Conservation Service, Important Farmlands Maps, Aroostook County, Maine, Orono, Maine, 1981.

7. State of Maine, State Planning Office, Critical Areas Program, S. Gawler, Rare Vascular Plants of Maine, Augusta, Maine, 1981.

8. Fernald, Merritt Lynden, Rhodora, 1910.

9. U.S. Department of the Interior, National Park Service, and State of Maine, Department of Conservation, Maine Rivers Study, Philadelphia, Pennsylvania, May 1982.

10. State of Maine, Department of Environmental Protection, Classification of Surface Waters, Augusta, Maine, September 1979.

11. Town of Houlton, Houlton, Maine Comprehensive Plan, Houlton, Maine, November 1980.

12. State University of New York, College of Environmental Science and Forestry, A Plan For Downtown Houlton, Syracuse, New York, December 1979.

13. Southern Aroostook Soil and Water Conservation District, Study of Non-Point Agricultural Pollution, Houlton, Maine, 1979.

14. U.S. Department of the Interior, Geological Survey, Water Resources Data for Maine, Water Years 1940 to 1982, Washington, D.C.

15. Federal Emergency Management Agency, Design Manual for Retrofitting Flood-prone Residential Structures, FEMA 114, Washington, D.C., September 1986.

16. U.S. Department of Agriculture, Soil Conservation Service, Preliminary Investigation Report, Pearce Brook Flood Prevention Measure, Orono, Maine, June 1973.

17. U.S. Department of the Interior, Geological Survey, Office of Water Data Coordination, Guidelines for Determining Flood Flow Frequency, Bulletin #17B, Reston, Virginia, March 1982.

18. U.S. Department of Agriculture, Soil Conservation Service, Computer Program for Project Formulation - Hydrology, Technical Release Number 20, Washington, D.C., Draft of 2nd Edition, May 1983.

19. U.S. Department of the Interior, Geological Survey, Open-File Report 75-292, a Technique for Estimating the Magnitude and Frequency of Floods in Maine, Washington, D.C., 1975.

20. U.S. Department of Agriculture, Soil Conservation Service, Technical Release No. 61, WSP2 Computer Program, Washington, D.C., May 1976.

21. U.S. Department of Agriculture, Soil Conservation Service, Topographic Maps, Scale 1:6,000, Contour Interval 2 feet; Houlton, Maine, 1983.

United States
Department of
Agriculture

Soil
Conservation
Service

USDA Office Building
University of Maine
Orono, Maine 04473

March 17, 1988

Director
National Agricultural Library
U.S. Department of Agriculture
Beltsville, Maryland 20705

Dear Sir:

Enclosed for your information and use is a copy of our recently completed Flood Plain Management Study, Town of Houlton, Maine. This study was made at the request of the town through the Southern Aroostook Soil and Water Conservation District and the Maine Soil and Water Conservation Commission in accordance with a Joint Coordination Agreement with the Soil Conservation Service. The Town of Houlton provided in-kind services that defrayed about one-third of the study cost.

The Soil Conservation Service's objective in developing this technical report is to help reduce the impact of floods on human safety, health, and welfare, and to restore or preserve the natural and beneficial values served by flood plains.

Flood Plain Management Studies are a part of the Soil Conservation Service's activities in accordance with Section 6 of Public Law 83-566, the Watershed Protection and Flood Prevention Act (1954).

Sincerely,

Charles Whitmore
State Conservationist

Enclosure