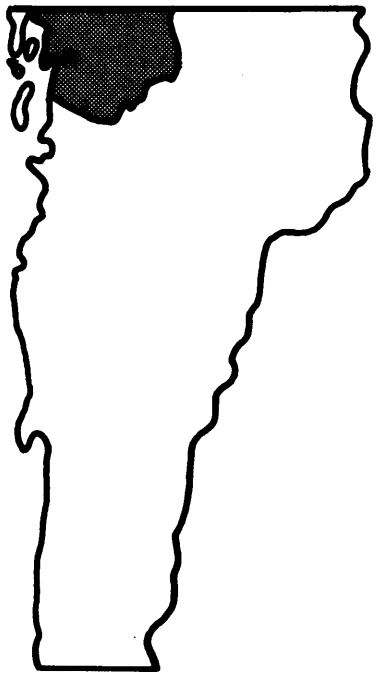
FLOOD INSURANCE STUDY

TOWN OF ST. ALBANS, VERMONT
FRANKLIN COUNTY



JUNE 15, 1988

Federal Emergency Management Agency

COMMUNITY NUMBER - 500219

NOTICE TO
FLOOD INSURANCE STUDY USERS

Communities participating in the National Flood Insurance Program (NFIP) have established repositories of flood hazard data for floodplain management and flood insurance study purposes. This Flood Insurance Study (FIS) may not contain all data available within the repository. It is advisable to contact the community repository for any additional data.

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FLOOD INSURANCE STUDY
TOWN OF ST. ALBANS, FRANKLIN COUNTY, VERMONT

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study investigates the existence and severity of flood hazards in the Town of St. Albans, Franklin County, Vermont, and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This study has developed flood risk data for various areas of the community that will be used to establish actuarial flood insurance rates and assist the community in its efforts to promote sound floodplain management. Minimum floodplain management requirements for participation in the National Flood Insurance Program (NFIP) are set forth in the Code of Federal Regulations at 44 CFR, 60.3.

In some states or communities, floodplain management criteria or regulations may exist that are more restrictive or comprehensive than the minimum Federal requirements. In such cases, the more restrictive criteria take precedence and the state (or other jurisdictional agency) will be able to explain them.

1.2 Authority and Acknowledgments

The sources of authority for this Flood Insurance Study are the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

The hydrologic and hydraulic analyses for this study were prepared by the U. S. Geological Survey (USGS) for the Federal Emergency Management Agency (FEMA), under Inter-Agency Agreement No. EMW-85-E-1823, Project Order No. 20. This work was completed in October 1986.

1.3 Coordination

On February 13, 1985, an initial Consultation and Coordination Officer's (CCO) meeting was held with representatives from FEMA, the town, and the USGS (the study contractor) to determine the streams to be studied by detailed methods. During the course of the work by the USGS, flood elevations and flood boundaries were review with community officials. An intermediate CCO meeting was held on October 28, 1986, to review the study in progress.

On March 19, 1987, a final CCO meeting was held with representatives from FEMA, the town, and the study contractor to review the results of the study.

2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the incorporated area of the Town of St. Albans, Franklin County, Vermont. The area of study is shown on the Vicinity Map (Figure 1).

Flooding caused by Lake Champlain was studied by detailed methods. The areas studied by detailed methods were selected with priority given to all known flood hazard areas and areas of projected development and proposed construction through October 1991.

The following streams were studied by approximate methods: Stevens Brook, Jewett Brook, Rugg Brook, and various unnamed tributaries. Approximate analyses were used to study those areas having a low development potential or minimal flood hazards. The scope and methods of study were proposed to, and agreed upon by, FEMA and the Town of St. Albans.

2.2 Community Description

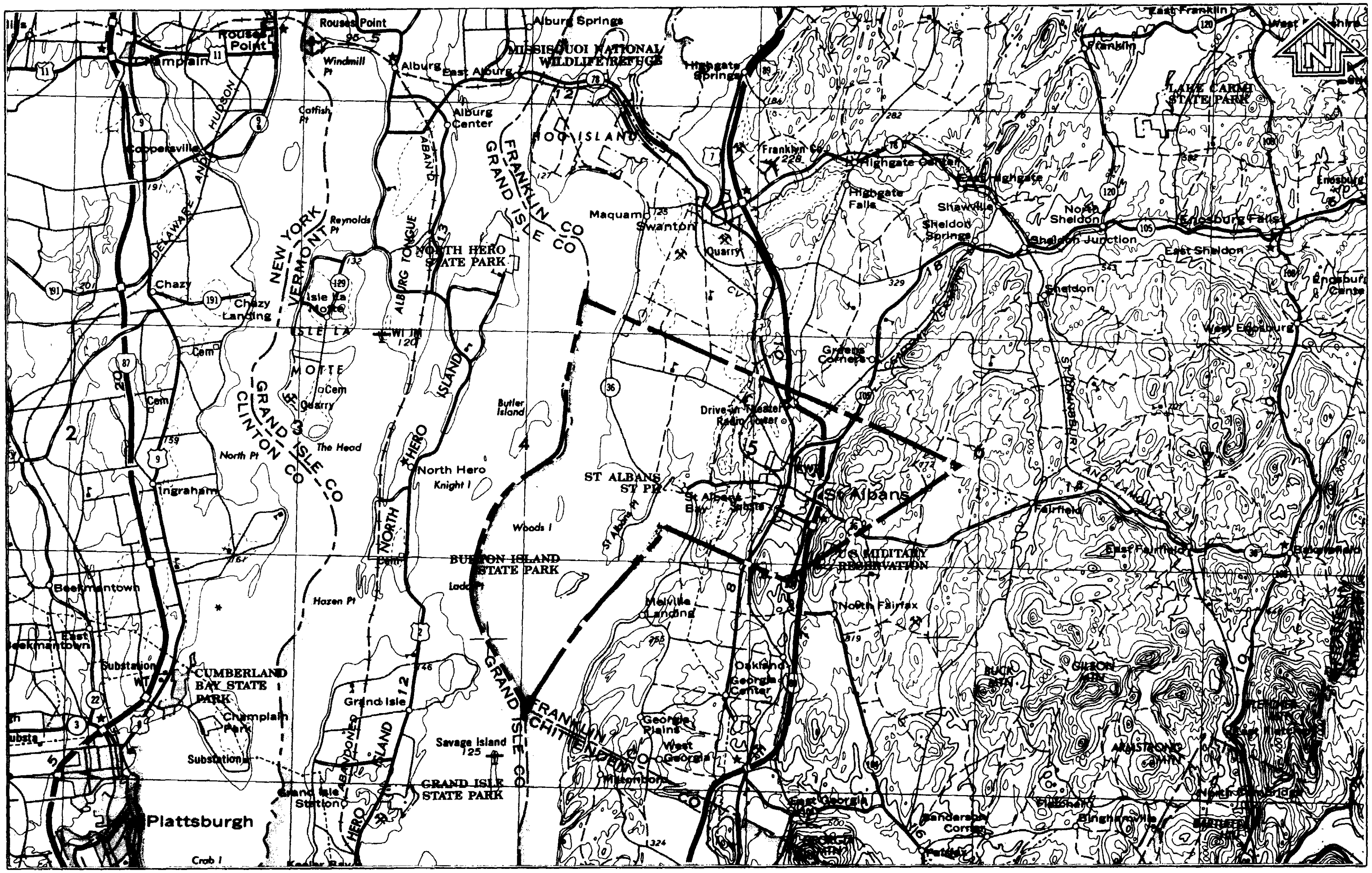
The Town of St. Albans is located on the western side of Franklin County in Vermont. It is bordered by the Town of Swanton to the north, the Towns of Georgia and Fairfax to the south, the Town of Fairfield to the east, and Lake Champlain to the west. St. Albans has an area of approximately 51.6 square miles and a population density of 69 persons per square mile. The town had a population of 3,555 in 1984 (Reference 1).

Lake Champlain is St. Alban's principal water body. Continued economic development in the Lake Champlain lowlands is expected and pressures leading to floodplain use will accompany such development.

The climate of St. Albans is moderate and is characterized by the even distribution of an average of approximately 36 inches of precipitation during the year. The town experiences large ranges of temperature both on a daily and an annual basis and a considerable variety of weather in short periods of time (Reference 2).

The topography of the town ranges from gently rolling terrain in the valleys and lowlands to steep hilly terrain in several upland areas. The land area of the town consists mainly of well drained, glacial, stratified drift in the valleys and glacial till and bedrock in the uplands.

The maximum elevation observed at USGS gaging station No. 04295000 on the Richelieu River (Lake Champlain) at Rouses Point, New York, for the period of record from March 1871 to October 1986, was 101.80 feet on March 30, 1803. The maximum elevation known since at least 1827 was 102.1 feet on May 4, 1869, from marks at the railroad bridge near the present gaging station.



FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWN OF ST. ALBANS, VT

(FRANKLIN CO.)

APPROXIMATE SCALE

4 0 4 8 12 MILES

VICINITY MAP

FIGURE 1

2.3 Principal Flood Problems

Floods in St. Albans have occurred in every season of the year. Flooding in the spring is common and is caused by rainfall combined with snowmelt. Floods in late summer and fall are usually the result of above normal precipitation. Winter floods result from occasional thaws, particularly in years of heavy snow cover.

2.4 Flood Protection Measures

There are no flood protection measures existing at the time of this study that effect flooding along Lake Champlain in St. Albans.

3.0 ENGINEERING METHODS

For the flooding source studied in detail in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. A flood event of a magnitude which is expected to be equaled or exceeded once on the average during any 100-year period (recurrence interval) has been selected as having special significance for floodplain management and for flood insurance rates. This event, commonly termed the 100-year flood, has a 1 percent chance of being equaled or exceeded during any year. Although the recurrence interval represents the long term average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than 1 year are considered. For example, the risk of having a flood which equals or exceeds the 100-year flood (1 percent chance of annual exceedence) in any 50-year period is approximately 40 percent (4 in 10), and, for any 90-year period, the risk increases to approximately 60 percent (6 in 10). The analyses reported herein reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Analyses were carried out to establish the peak elevation-frequency relationships for the flooding source studied in detail affecting the community.

Elevations of the selected recurrence interval were obtained from a recent report on Lake Champlain (Reference 3). The flood elevations determined for Lake Champlain were based on a log-Pearson Type III distribution of annual peak elevation data (Reference 4). The principal source of data were records of water levels as recorded at USGS gaging station No. 04295000 on Lake Champlain at Rouses Point, New York, for the period from 1871 to 1986 (Reference 5).

The 100-year flood elevations determined for this study are shown on the Flood Insurance Rate Map (Exhibit 1).

The stillwater elevations for the 100-year flood have been determined for Lake Champlain and are summarized in Table 1, "Summary of Stillwater Elevations."

TABLE 1 - SUMMARY OF STILLWATER ELEVATIONS

FLOODING SOURCE AND LOCATION	ELEVATION (feet) 100-YEAR
LAKE CHAMPLAIN	
For its entire shoreline within community	102.0

All elevations are referenced to the National Geodetic Vertical Datum of 1929 (NGVD). Elevation reference marks used in this study are shown on the maps; the descriptions of the marks are presented in Elevation Reference Marks (Exhibit 2).

4.0 FLOODPLAIN MANAGEMENT APPLICATIONS

The NFIP encourages State and local governments to adopt sound floodplain management programs. Therefore, each Flood Insurance Study provides 100-year flood elevations and delineations of the 100-year floodplain boundaries to assist communities in developing floodplain management measures.

4.1 Floodplain Boundaries

To provide a national standard without regional discrimination, the 1 percent annual chance (100-year) flood has been adopted by FEMA as the base flood for floodplain management purposes. For Lake Champlain studied in detail, the 100-year floodplain boundaries were delineated using the flood elevations determined at each cross section. Between cross sections, the boundaries were interpolated using topographic maps at a scale of 1:24,000 with a contour interval of 10 feet (Reference 6).

For the streams studied by approximate methods, the 100-year flood boundaries were delineated using the Flood Hazard Boundary Map for the Town of St. Albans (Reference 7).

The 100-year floodplain boundaries are shown on the Flood Insurance Rate Map (Exhibit 1). On this map, the 100-year floodplain boundary corresponds to the boundary of the areas of special flood hazards (Zones A and AE). Small areas within the floodplain boundaries may lie above the flood elevations but cannot be shown due to limitations of the map scale and/or lack of detailed topographic data.

4.2 Floodways

Encroachment on floodplains, such as structures and fill, reduces flood-carrying capacity, increases flood heights and velocities, and increases flood hazards in areas beyond the encroachment itself. One aspect of floodplain management involves balancing the economic gain from floodplain development against the resulting increase in flood hazard. For purposes of the National Flood Insurance Program, a floodway is used as a tool to assist local communities in this aspect of floodplain management. Under this concept, the area of the 100-year floodplain is divided into a floodway and a floodway fringe. The floodway is the channel of a stream, plus any adjacent floodplain areas, that must be kept free of encroachment so that the 100-year flood can be carried without substantial increases in flood heights. Minimum federal standards limit such increases to 1.0 foot, provided that hazardous velocities are not produced.

The area between the floodway and 100-year floodplain boundaries is termed the floodway fringe. The floodway fringe encompasses the portion of the floodplain that could be completely obstructed without increasing the water-surface elevation of the 100-year flood by more than 1.0 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to floodplain development are shown in Figure 2.

No floodways were calculated as part of this study.

5.0 INSURANCE APPLICATION

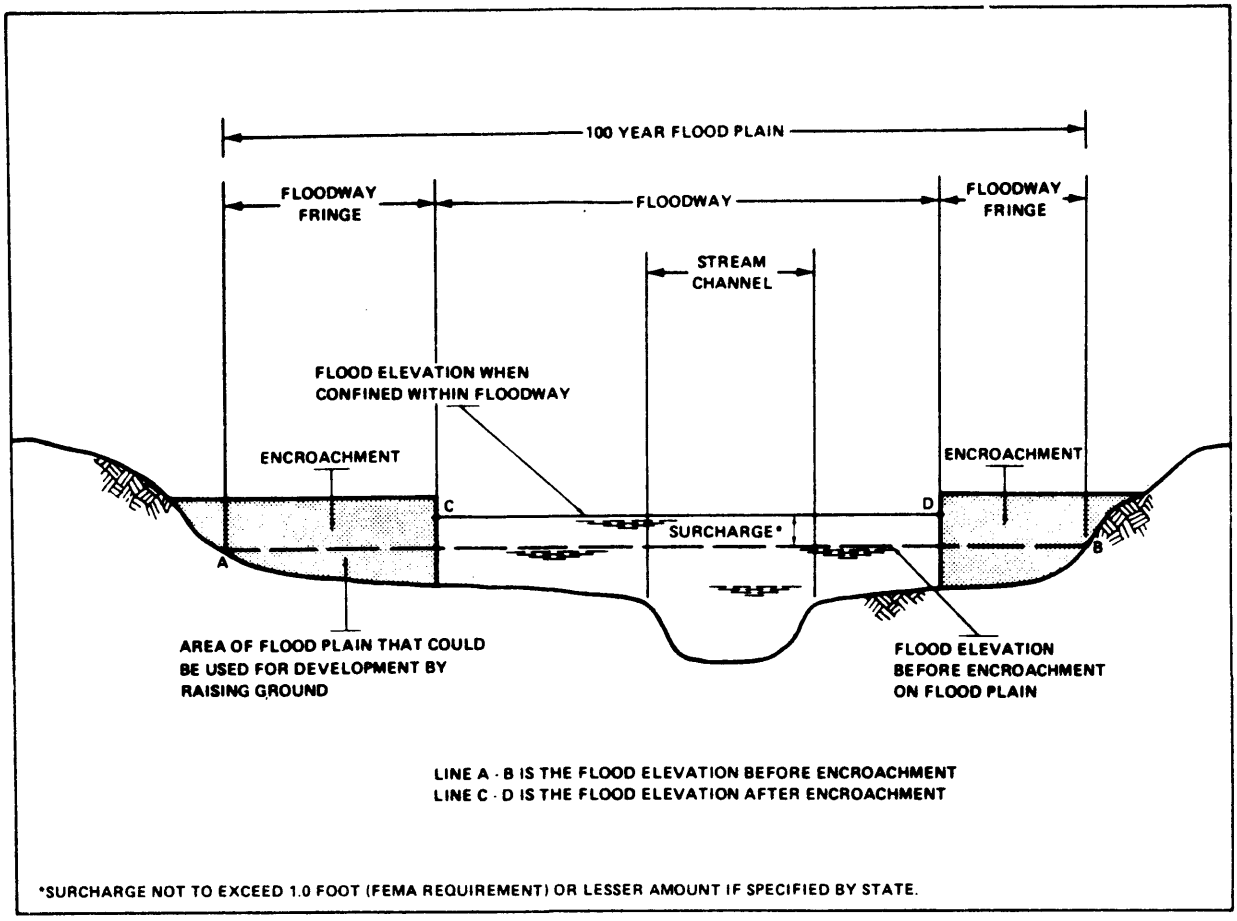
For flood insurance rating purposes, flood insurance zone designations are assigned to a community based on the results of the engineering analyses. These zones are as follows:

Zone A

Zone A is the flood insurance rate zone that corresponds to the 100-year floodplains that are determined in the Flood Insurance Study by approximate methods. Because detailed hydraulic analyses are not performed for such areas, no base flood elevations or depths are shown within this zone.

Zone AE

Zone AE is the flood insurance rate zone that corresponds to the 100-year floodplains that are determined in the Flood Insurance Study by detailed methods. In most instances, whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.



FLOODWAY SCHEMATIC Figure 2

Zone AH

Zone AH is the flood insurance rate zone that corresponds to the areas of 100-year shallow flooding (usually areas of ponding) where average depths are between 1 and 3 feet. Whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone AO

Zone AO is the flood insurance rate zone that corresponds to the areas of 100-year shallow flooding (usually sheet flow on sloping terrain) where average depths are between 1 and 3 feet. Average whole-foot depths derived from the detailed hydraulic analyses are shown within this zone.

Zone A99

Zone A99 is the flood insurance rate zone that corresponds to areas of the 100-year floodplain that will be protected by a Federal flood protection system where construction has reached specified statutory milestones. No base flood elevations or depths are shown within this zone.

Zone V

Zone V is the flood insurance rate zone that corresponds to the 100-year coastal floodplains that have additional hazards associated with storm waves. Because approximate hydraulic analyses are performed for such areas, no base flood elevations are shown within this zone.

Zone VE

Zone VE is the flood insurance rate zone that corresponds to the 100-year coastal floodplains that have additional hazards associated with storm waves. Whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone X

Zone X is the flood insurance rate zone that corresponds to areas outside the 500-year floodplain, areas within the 500-year floodplain, and to areas of 100-year flooding where average depths are less than 1 foot, areas of 100-year flooding where the contributing drainage area is less than 1 square mile, and areas protected from the 100-year flood by levees. No base flood elevations or depths are shown within this zone.

Zone D

Zone D is the flood insurance rate zone that corresponds to unstudied areas where flood hazards are undetermined, but possible.

6.0 FLOOD INSURANCE RATE MAP

The Flood Insurance Rate Map is designed for flood insurance and floodplain management applications.

For flood insurance applications, the map designates flood insurance rate zones as described in Section 5.0 and, in the 100-year floodplains that were studied by detailed methods, shows selected whole-foot base flood elevations or average depths. Insurance agents use the zones and base flood elevations in conjunction with information on structures and their contents to assign premium rates for flood insurance policies.

For floodplain management applications, the map shows by tints, screens, and symbols, the 100-year floodplain. The locations of selected cross sections used in the hydraulic analyses are shown where applicable.

7.0 OTHER STUDIES

Flood Insurance Studies for the Towns of Georgia and Swanton have been published (References 8 and 9). The results of this study are in agreement with the results of those studies. Both studies share approximate flooding.

Due to its more detailed analyses, this study supersedes the Flood Hazard Boundary Map for the Town of St. Albans (Reference 7).

8.0 LOCATION OF DATA

Information concerning the pertinent data used in preparation of this study can be obtained by contacting FEMA, the Natural and Technological Hazards Division, J. W. McCormack Post Office and Courthouse Building, Room 462, Boston, Massachusetts 02109.

9.0 BIBLIOGRAPHY AND REFERENCES

1. National Survey, 1984 Vermont Yearbook, Chester, Vermont, 1985.

2. U. S. Department of Commerce, National Oceanic and Atmospheric Administration, Climatological Data, New York, Asheville, North Carolina, National Climatic Center, 1976-1980.

3. The International Champlain-Richelieu Board, Report to the International Joint Commission, Regulation of Lake Champlain and the Richland River, Vermont, 1977.

4. Water Resources Council, "Guidelines for Determining Flood Flow Frequency," Bulletin 17A, Washington, D. C., June 1977.

5. U. S. Department of the Interior, Geological Survey, National Water Data Storage and Retrieval System, Peak Flow File, Reston, Virginia, August 1979.

6. U. S. Department of the Interior, Geological Survey, 7.5-Minute Series Topographic Maps, Scale 1:24,000, Contour Interval 10 Feet: East Albery, Vermont, 1972; St. Albans Bay, Vermont, 1964.

7. U. S. Department of Housing and Urban Development, Federal Insurance Administration, Flood Hazard Boundary Map, Town of St. Albans, Franklin County, Vermont, January 10, 1975.

8. Federal Emergency Management Agency, Federal Insurance Administration, Flood Insurance Study, Town of Georgia, Franklin County, Vermont, Washington, D. C., September 16, 1981.

9. Federal Emergency Management Agency, Flood Insurance Study, Town of Swanton, Franklin County, Vermont, Washington, D. C., April 18, 1985.

EXHIBIT 2 - ELEVATION REFERENCE MARKS

Reference Mark	FIRM Panel	Elevation (Feet NGVD)	Description of Location
RM 1	05	109.83	6.2 miles northwesterly along Maguam Road from St. Albans Bay, 23 feet west of road, 2 feet south of telephone pole, in concrete post, Standard USGS Tablet "20 LLB 1962".
RM 2	05	11.01	4.1 miles northwesterly along Maguam Road from St. Albans Bay, 30 feet east of road, at fence, 78 feet southwest of southwest corner of barn, in concrete post, Standard USGS Tablet "19 LLB 1962 111".
RM 3	05	128.13	2.1 miles northwesterly along Maguam Road from St. Albans Bay, 22 feet east of road, at fence-Y, in concrete post, Standard USGS Tablet "18 LLB 1962 128".
RM 4	05	108.71	At St. Albans Bay, at store, in north end of stone steps, Standard USGS Tablet "108".

NOTICE TO
FLOOD INSURANCE STUDY USERS

Communities participating in the National Flood Insurance Program have established repositories of flood hazard data for floodplain management and flood insurance purposes. This Flood Insurance Study (FIS) may not contain all data available within the repository. It is advisable to contact the community repository for any additional data.

Part or all of this FIS may be revised and republished at any time. In addition, part of this FIS may be revised by the Letter of Map Revision process, which does not involve republication or redistribution of the FIS. It is, therefore, the responsibility of the user to consult with community officials and to check the community repository to obtain the most current FIS components.

FIS Effective Date: June 3, 1991

Revised FIS Date: June 22, 1998

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FLOOD INSURANCE STUDY
VILLAGE OF BRADFORD, ORANGE COUNTY, VERMONT

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study (FIS) revises and updates a previous FIS/Flood Insurance Rate Map (FIRM) for the Village of Bradford, Orange County, Vermont. This information will be used by the Village of Bradford to update existing floodplain regulations as part of the Regular Phase of the National Flood Insurance Program (NFIP). The information will also be used by local and regional planners to further promote sound land use and floodplain development.

In some States or communities, floodplain management criteria or regulations may exist that are more restrictive or comprehensive than the minimum Federal requirements. In such cases, the more restrictive criteria take precedence and the State (or other jurisdictional agency) will be able to explain them.

1.2 Authority and Acknowledgments

The sources of authority for this FIS are the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

For the original, June 3, 1991, FIS, the hydrologic and hydraulic analyses for the Connecticut River were prepared by the U.S. Geological Survey (USGS) for the Federal Emergency Management Agency (FEMA), under Inter-Agency Agreement No. EMW-85-E-1823, Project Order No. 4. That work was completed in December 1988. The hydrologic and hydraulic analyses for the Waits River were taken from a U.S. Army Corps of Engineers (USACE) Flood Profile and Floodway Study (Reference 1).

For this revision, the hydraulic analyses for an unnamed flooding source near Depot Road were prepared by Green International Affiliates, Inc. for FEMA, under Contract No. EMW-93-C-4144, Task No. 20. This work was completed in January 1997.

The planimetric base files were provided in digital format by the Vermont Center for Geographic Information, 206 Morrill Hall, University of Vermont, Burlington, VT 05405-0106. Certain features in these files were compiled at a scale of 1:24,000 from USGS 7.5-Minute Series Topographic Maps; other features were compiled at a scale of 1:5,000 from orthophotos.

The digital FIRMs were produced using Universal Transverse Mercator coordinates referenced to the North American Datum of 1927 and the Clarke 1866 spheroid.

1.3 Coordination

The purpose of an initial Consultation Coordination Officer's (CCO) meeting is to discuss the scope of the FIS. A final CCO meeting is held to review the results of the study.

For the June 3, 1991, FIS, an initial CCO meeting was held on November 19, 1986, and a final CCO meeting was held on April 24, 1990. Both of these meetings were attended by representatives of the USGS, the village, and FEMA.

For this revision, representatives from Green International met with the Village of Bradford on September 13, 1995, to coordinate the work being performed under the Limited Map Maintenance Program. A final CCO meeting was held on October 27, 1997, and was attended by representatives of FEMA, the State of Vermont, and the City of Bradford.

2.0 AREA STUDIED

2.1 Scope of Study

This FIS covers the incorporated area of the Village of Bradford, Orange County, Vermont. The area of study is shown on the Vicinity Map (Figure 1).

For the June 3, 1991, FIS, the Connecticut River and the Waits River were studied by detailed methods.

For this revision, an unnamed tributary to the Waits River near Depot Road was studied by approximate methods.

Limits of detailed study are indicated on the Flood Profiles (Exhibit 1) and on the FIRM (Exhibit 2). The areas studied by detailed methods were selected with priority given to all known flood hazard areas and areas of projected development and proposed construction.

Portions of the Waits River were studied by approximate methods. Approximate analyses were used to study those areas having a low development potential or minimal flood hazards. The scope and methods of study were proposed to, and agreed upon by, FEMA and the village.

2.2 Community Description

The Village of Bradford is located in the eastern portion of Orange County, in eastern Vermont. It is bordered by the Town of Bradford in all directions. Its 1990 population was 672.

The climate of the village is moderate and is characterized by the even distribution of 40 inches of precipitation during the year. The village experiences large ranges of temperature both on a daily and an annual basis, and a considerable variety of weather in short periods of time (Reference 2). The topography of the village ranges from gently rolling terrain in the valleys to steep, hilly terrain in several upland areas. The land area of the village and surrounding area consists mainly of well-drained, glacial, stratified drift in the valleys and glacial till and bedrock in the uplands.

The Waits River forms part of the corporate limits between the Village and Town of Bradford. Continued economic development in these areas is expected and pressures

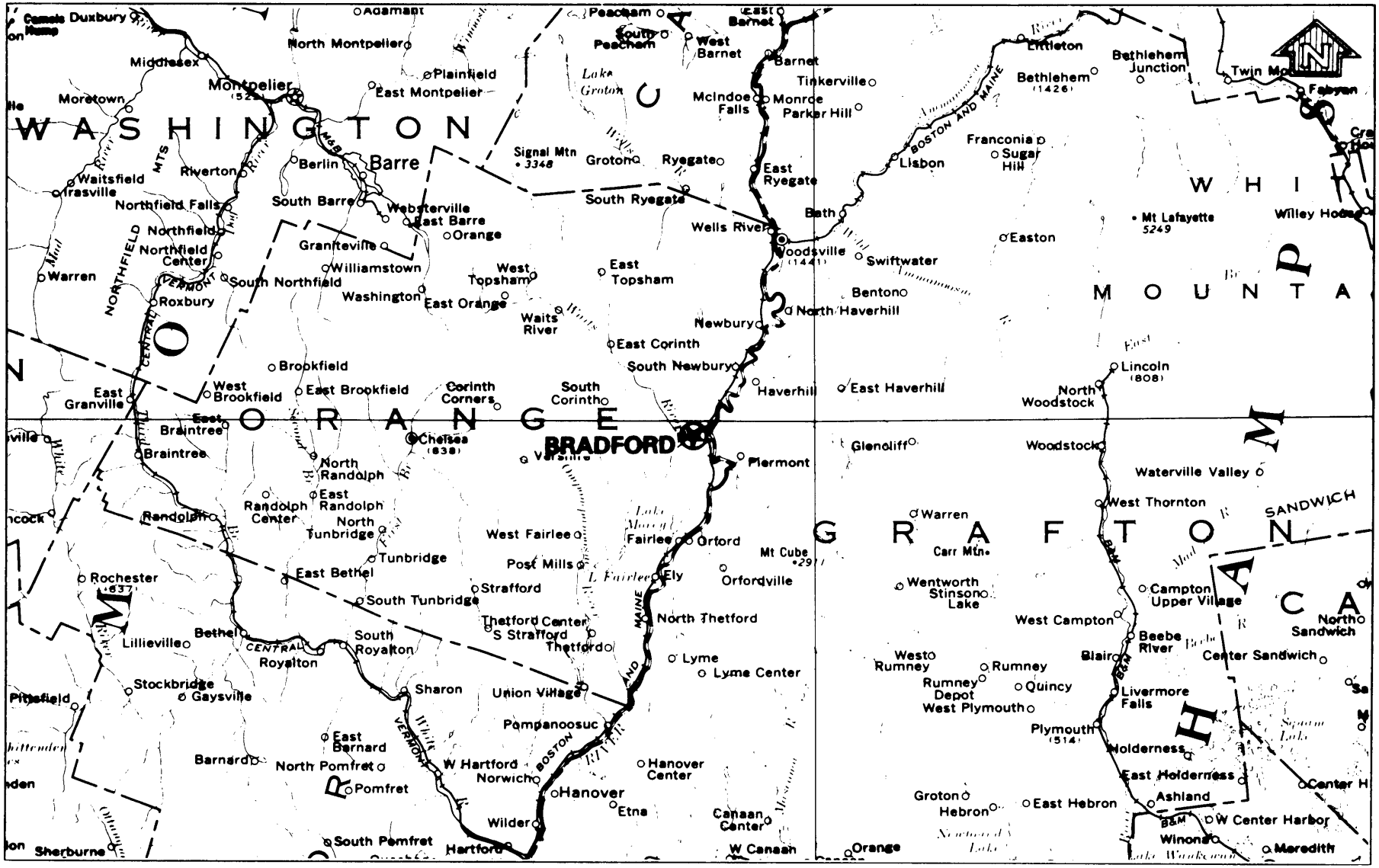


FIGURE 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

VILLAGE OF BRADFORD, VT

(ORANGE CO.)

APPROXIMATE SCALE

8 0 8 16 24 MILES

VICINITY MAP

leading to floodplain use will accompany such development.

2.3 Principal Flood Problems

Floods in the village have occurred in every season of the year. Spring floods are common and are caused by rainfall in combination with snowmelt. Floods in late summer and fall are usually the result of normal precipitation. Winter floods result from the occasional thaws, particularly in years of heavy snow cover.

Major floods of this century within the Village of Bradford have occurred in March 1913, November 1927, March 1936, September 1938, and July 1973. Of these, the flood of July 1973 was the most severe. Long-term streamflow records (1949 to present) at USGS gaging station No. 01138500 on the Connecticut River at Wells River indicate that the July 1973 flood had a recurrence interval of less than 100 years.

2.4 Flood Protection Measures

Several upstream reservoirs affect flooding along the Connecticut River in the Town of Bradford. First and Second Connecticut Lakes, Lake Francis, Moore and Comerford Reservoirs and smaller reservoirs, with a combined usable capacity of approximately 14,800,000 cubic feet, exert a significant retarding effect on flood peaks.

3.0 ENGINEERING METHODS

For the flooding sources studied in detail in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. Flood events of a magnitude which are expected to be equaled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for floodplain management and for flood insurance rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10-, 2-, 1-, and 0.2-percent chance, respectively, of being equaled or exceeded during any year. Although the recurrence interval represents the long term average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than 1 year are considered. For example, the risk of having a flood which equals or exceeds the 100-year flood (1-percent chance of annual exceedence) in any 50-year period is approximately 40 percent (4 in 10), and, for any 90-year period, the risk increases to approximately 60 percent (6 in 10). The analyses reported herein reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency relationships for each flooding source studied in detail affecting the community.

A summary of the drainage area-peak discharge relationships for the streams studied by detailed methods is shown in Table 1, "Summary of Discharges."

TABLE 1 - SUMMARY OF DISCHARGES

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
CONNECTICUT RIVER					
At USGS gage No. 01138500	2,644.0	*	*	72,200	*
WAITS RIVER					
At mouth	146.0	4,000	6,300	7,500	10,700
Upstream of confluence of South Branch Waits River	95.0	3,100	4,800	5,800	8,200
At corporate limits of of Topsham/Corinth	43.6	1,730	2,700	3,200	4,600

*Data not computed

The stillwater elevations have been determined for the 100-year floods for the Connecticut River and are summarized in Table 2, "Summary of Stillwater Elevations."

TABLE 2 - SUMMARY OF STILLWATER ELEVATIONS

FLOODING SOURCE AND LOCATION	ELEVATION (feet NGVD*) 100-YEAR
CONNECTICUT RIVER	
Along the western corporate limits	414.0
Backwater on the Waits River, from the downstream corporate limits to U.S. Route 5	414.0

*National Geodetic Vertical Datum of 1929

The approximate analysis of the unnamed tributary to the Waits River was studied by methods for ungaged sites from the USGS Water Resources Investigations Report 94-4002 (Reference 3).

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of flooding from the sources studied were carried out to provide estimates of the elevations of floods of the selected recurrence intervals.

Cross section information for the Waits River were obtained from field surveys. Bridge plans, a drawing of the Smith Hydroelectric Station Dam and field measurements were used to obtain elevation data and structural geometry.

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1). For stream segments for which a floodway was computed (Section 4.2), selected cross-section locations are also shown on the FIRM (Exhibit 2).

Water-surface elevations of floods of the selected recurrence interval for the Connecticut River were based upon high-water marks of notable past floods located along the Connecticut River in the Town of Bradford. These high-water marks have been published as flood-crest data in USGS Water-Supply Paper 798 (Reference 4). Water-surface elevations for the Waits River were computed using the USACE HEC-2 step-backwater computer program (Reference 5). Starting water-surface elevation for the Waits River was determined assuming critical depth at the Smith Hydroelectric Station Dam. For all return period flows, both taintor gates at the dam were assumed to be open, the flashboards were removed, and no flow was assumed through the penstock. A sediment elevation 4 feet below dam crest was assumed upstream of the dam. Flood profiles were drawn showing computed water-surface elevations for floods of the selected recurrence intervals.

Channel roughness factors (Manning's "n") used in the hydraulic computations were chosen by field inspection at each cross section of Waits River. Channel roughness factors for the Waits River ranged from 0.040 to 0.050, and overbank "n" values ranged from 0.040 to 0.100.

The hydraulic analyses for 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.

All elevations are referenced to the National Geodetic Vertical Datum of 1929 (NGVD). Elevation reference marks used in this study are shown on the FIRM.

4.0 FLOODPLAIN MANAGEMENT APPLICATIONS

The NFIP encourages State and local governments to adopt sound floodplain management programs. Therefore, each FIS generally provides 100-year flood elevations and delineations of the 100- and 500-year floodplain boundaries and 100-year floodway to assist in developing floodplain management measures.

4.1 Floodplain Boundaries

To provide a national standard without regional discrimination, the 1-percent annual chance (100-year) flood has been adopted by FEMA as the base flood for floodplain management purposes. The 0.2-percent annual chance (500-year) flood is employed to indicate additional areas of flood risk in the community. For the streams studied in detail, the 100- and 500-year floodplains have been delineated using the flood elevations determined at each cross section. Between cross sections, the boundaries were interpolated using topographic maps at a scale of 1:24,000 with a contour interval of 20 feet (Reference 6).

For the Waits River and other streams studied by approximate methods, the 100-year floodplain boundaries were taken from topographic maps and the previously printed FIS/FIRM for the Village of Bradford (References 6 and 7).

The 100- and 500-year floodplain boundaries are shown on the FIRM (Exhibit 2). On this map, the 100-year floodplain boundary corresponds to the boundary of the areas of special flood hazards (Zones A and AE), and the 500-year floodplain boundary corresponds to the boundary of areas of moderate flood hazards. In cases where the 100- and 500-year floodplain boundaries are close together, only the 100-year floodplain boundary has been shown. Small areas within the floodplain boundaries may lie above the flood elevations but cannot be shown due to limitations of the map scale and/or lack of detailed topographic data.

For the streams studied by approximate methods, only the 100-year floodplain boundary is shown on the FIRM (Exhibit 2).

4.2 Floodways

Encroachment on floodplains, such as structures and fill, reduces flood-carrying capacity, increases flood heights and velocities, and increases flood hazards in areas beyond the encroachment itself. One aspect of floodplain management involves balancing the economic gain from floodplain development against the resulting increase in flood hazard. For purposes of the NFIP, a floodway is used as a tool to assist local communities in this aspect of floodplain management. Under this concept, the area of the 100-year floodplain is divided into a floodway and a floodway fringe. The floodway is the channel of a stream, plus any adjacent floodplain areas, that must be kept free of encroachment so that the 100-year flood can be carried without substantial increases in flood heights. Minimum Federal standards limit such increases to 1.0 foot, provided that hazardous velocities are not produced. The floodway in this study is presented to local agencies as a minimum standard that can be adopted directly or that can be used as a basis for additional floodway studies.

The floodway presented in this study was computed for certain stream segments on the basis of equal conveyance reduction from each side of the floodplain. Floodway widths were computed at cross sections. Between cross sections, the floodway boundaries were interpolated. The results of the floodway computations are tabulated for selected cross sections (Table 3). The computed floodway is shown on the FIRM (Exhibit 2). In cases where the floodway and 100-year floodplain boundaries are either close together or collinear, only the floodway boundary is shown. Waits River's floodway extends beyond the city limits for the entire reach.

Encroachment into areas subject to inundation by floodwaters having hazardous velocities aggravates the risk of flood damage, and heightens potential flood hazards by further increasing velocities. A listing of stream velocities at selected cross sections is provided in Table 3, "Floodway Data." To reduce the risk of property damage in areas where the stream velocities are high, the community may wish to restrict development in areas outside the floodway.

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH[2] (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Waits River								
A	0	233	1,905	3.9	463.9	463.9	463.9	0.0
B	1,157	105	568	13.2	464.6	464.6	464.6	0.0
C	1,330	400	1,674	4.5	467.9	467.9	467.9	0.0
D	2,480	112	1,025	7.3	469.4	469.4	469.9	0.5
E	2,780	88	795	9.4	469.8	469.8	470.5	0.7
F	2,953	88	856	8.8	470.8	470.8	471.6	0.8
G	3,253	812	4,058	1.8	472.5	472.5	473.2	0.7
H	4,153	87	763	9.8	473.0	473.0	473.3	0.3
I	4,279	90	941	8.0	473.9	473.9	474.6	0.7

[1]Feet above downstream face of Smith Hydroelectric Dam
[2]This width extends beyond the corporate limits

TABLE 3

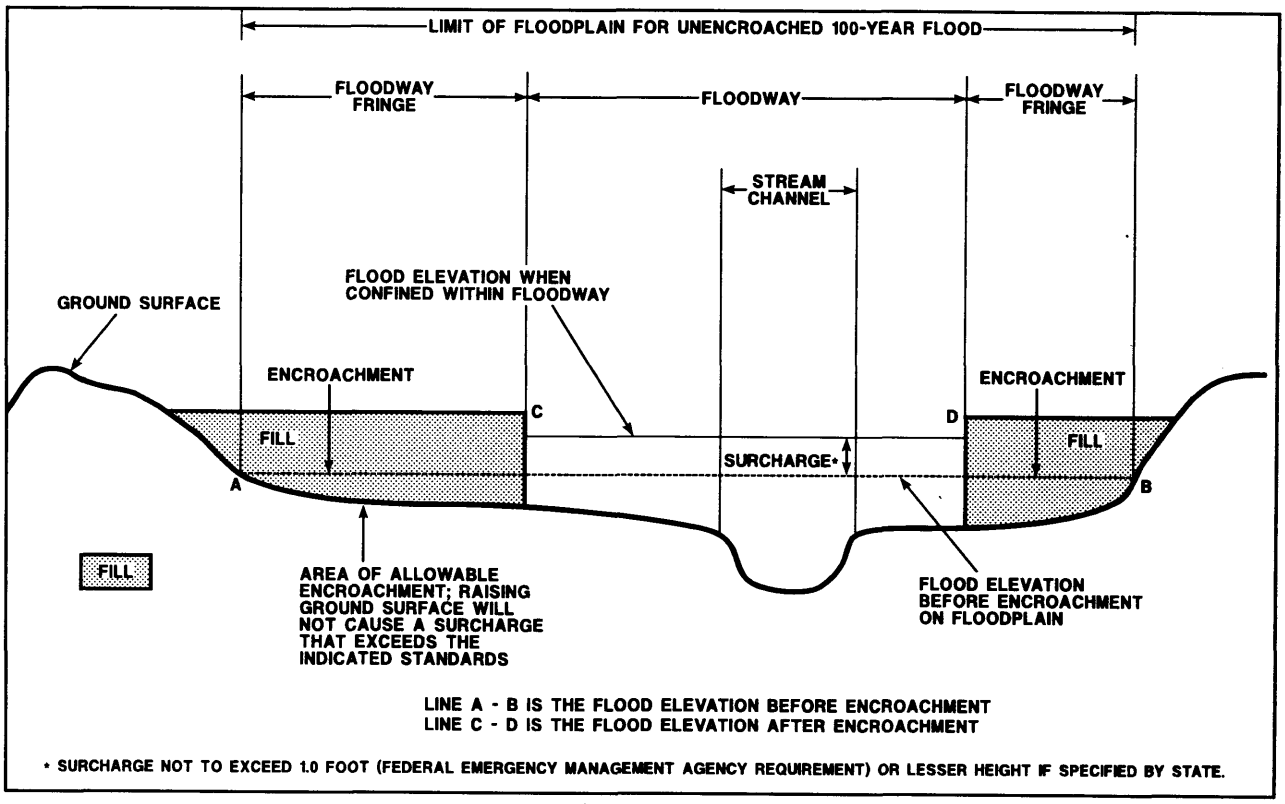
FEDERAL EMERGENCY MANAGEMENT AGENCY

VILLAGE OF BRADFORD, VT
(ORANGE CO.)

FLOODWAY DATA

WAITS RIVER

The area between the floodway and 100-year floodplain boundaries is termed the floodway fringe. The floodway fringe encompasses the portion of the floodplain that could be completely obstructed without increasing the water-surface elevation of the 100-year flood by more than 1.0 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to floodplain development are shown in Figure 2.



FLOODWAY SCHEMATIC Figure 2

5.0 INSURANCE APPLICATIONS

For flood insurance rating purposes, flood insurance zone designations are assigned to a community based on the results of the engineering analyses. The zones are as follows:

Zone A

Zone A is the flood insurance rate zone that corresponds to the 100-year floodplains that are determined in the FIS by approximate methods. Because detailed hydraulic analyses are not performed for such areas, no base flood elevations or depths are shown within this zone.

Zone AE

Zone AE is the flood insurance rate zone that corresponds to the 100-year floodplains that are determined in the FIS by detailed methods. In most instances, whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone AH

Zone AH is the flood insurance rate zone that corresponds to the areas of 100-year shallow flooding (usually areas of ponding) where average depths are between 1 and 3 feet. Whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone AO

Zone AO is the flood insurance rate zone that corresponds to the areas of 100-year shallow flooding (usually sheet flow on sloping terrain) where average depths are between 1 and 3 feet. Average whole-depths derived from the detailed hydraulic analyses are shown within this zone.

Zone A99

Zone A99 is the flood insurance rate zone that corresponds to areas of the 100-year floodplain that will be protected by a Federal flood protection system where construction has reached specified statutory milestones. No base flood elevations or depths are shown within this zone.

Zone V

Zone V is the flood insurance rate zone that corresponds to the 100-year coastal floodplains that have additional hazards associated with storm waves. Because approximate hydraulic analyses are performed for such areas, no base flood elevations are shown within this zone.

Zone VE

Zone VE is the flood insurance rate zone that corresponds to the 100-year coastal floodplains that have additional hazards associated with storm waves. Whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone X

Zone X is the flood insurance rate zone that corresponds to areas outside the 500-year floodplain, areas within the 500-year floodplain, and to areas of 100-year flooding where average depths are less than 1 foot, areas of 100-year flooding where the contributing

drainage area is less than 1 square mile, and areas protected from the 100-year flood by levees. No base flood elevations or depths are shown within this zone.

Zone D

Zone D is the flood insurance rate zone that corresponds to unstudied areas where flood hazards are undetermined, but possible.

6.0 FLOOD INSURANCE RATE MAP

The FIRM is designed for flood insurance and floodplain management applications.

For flood insurance applications, the map designates flood insurance rate zones as described in Section 5.0 and, in the 100-year floodplains that were studied by detailed methods, shows selected whole-foot base flood elevations or average depths. Insurance agents use the zones and base flood elevations in conjunction with information on structures and their contents to assign premium rates for flood insurance policies.

For floodplain management applications, the map shows by tints, screens, and symbols, the 100- and 500-year floodplains. Floodways and the locations of selected cross sections used in the hydraulic analyses and floodway computations are shown where applicable.

7.0 OTHER STUDIES

A FIS has been prepared for the Town of Bradford (Reference 8).

Because it is based on more up-to-date analyses, this FIS supersedes the previously printed FIS for the Village of Bradford (Reference 7).

8.0 LOCATION OF DATA

Information concerning the pertinent data used in preparation of this study can be obtained by contacting FEMA, Mitigation Division, J. W. McCormack Post Office and Courthouse Building, Room 462, Boston, Massachusetts 02109.

9.0 BIBLIOGRAPHY AND REFERENCES

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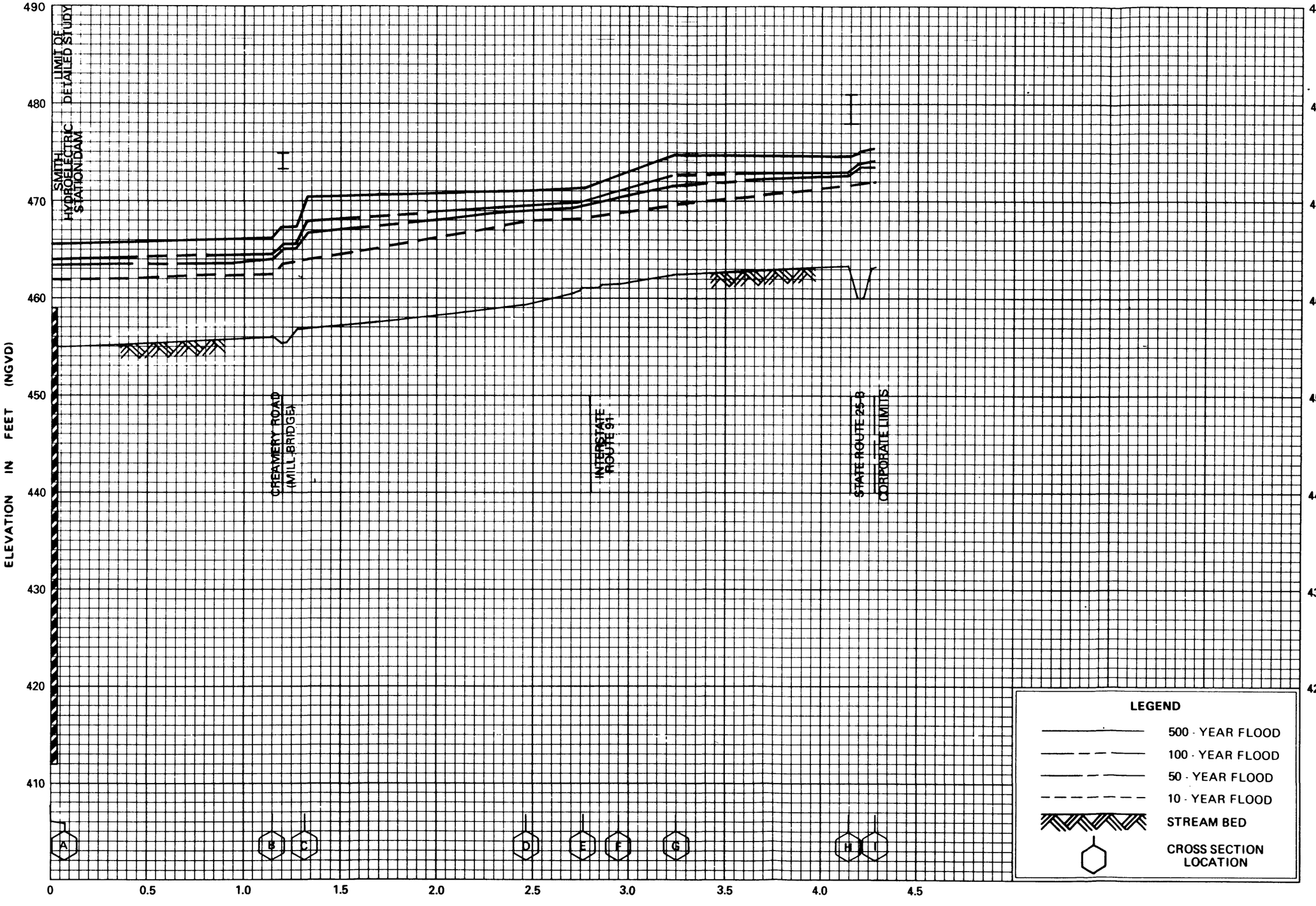

FLOOD PROFILES

WAITS RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

VILLAGE OF BRADFORD, VT

(ORANGE CO.)

01P