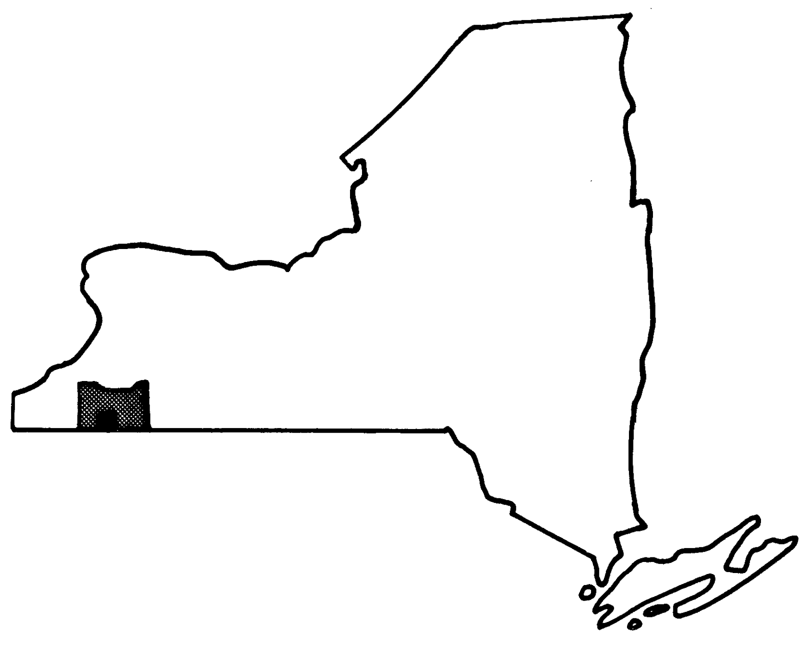
FLOOD INSURANCE STUDY

VILLAGE OF
LIMESTONE,
NEW YORK
CATTARAUGUS COUNTY



OCTOBER 1977

U.S. DEPARTMENT of HOUSING & URBAN DEVELOPMENT
FEDERAL INSURANCE ADMINISTRATION

TABLE OF CONTENTS

TABLE OF CONTENTS - continued

FIGURES

TABLES

EXHIBITS

FLOOD INSURANCE STUDY
VILLAGE OF LIMESTONE, NEW YORK

1.0 INTRODUCTION

1.1 Purpose of Study

The purpose of this Flood Insurance Study is to investigate the existence and severity of flood hazards in the Village of Limestone, Cattaraugus County, New York, and to aid in the administration of the Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. Initial use of this information will be to convert the Village of Limestone to the regular program of flood insurance by the Federal Insurance Administration (FIA). Further use of this information will be made by local and regional planners in their efforts to promote sound land use and flood plain development.

1.2 Coordination

The purpose of this Flood Insurance Study was explained at a meeting held on July 29, 1975, between representatives of the Village of Limestone, the FIA, U. S. Department of Agriculture, Soil Conservation Service, U. S. Army Corps of Engineers, Cattaraugus County Planning Board, and the New York State Department of Environmental Conservation.

A search for basic data was made at all levels of government. The U. S. Geological Survey (USGS) was contacted to obtain contour maps (Reference 1), flow information, and maps showing drainage area boundaries. Flow data was not available from the USGS, since there are no existing flow records in the area.

On April 11, 1976, a meeting was held with officials of the village to obtain additional local input. The final Consultation and Coordination meeting was held on January 5, 1976 where the final draft of the Flood Insurance Study was presented for further local comment.

1.3 Authority and Acknowledgements

The source of authority for this Flood Insurance Study is the National Flood Insurance Act of 1968, as amended.

The hydrologic and hydraulic analyses for this study were done by the New York State Department of Environmental Conservation for the Federal Insurance Administration, under Contract No. H-3856. This work, which was completed in January 1977, covered all flooding sources in Limestone.

2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the incorporated area of the Village of Limestone. The area of study is shown on the Vicinity Map (Figure 1).

Because of scattered development within the flood plain areas, it was agreed between the FIA and the Village of Limestone that those reaches of Nichols Run (0.70 mile) and Tunungwant Creek (1.70 miles) within the village were to be studied in detail. The upper reach of Nichols Run (0.16 mile) was studied by the approximate method because of minimal adjacent development and the well pronounced stream channel. It was also decided that Limestone Brook (0.28 mile) would be studied by approximate methods because of its small drainage area and lack of adjacent development.

The areas studied in detail were chosen with consideration given to all forecasted development and proposed construction for the next five years (through March 1981).

2.2 Community Description

The Village of Limestone is located in the southern portion of the Town of Carrollton, County of Cattaraugus, in southwestern New York State. The village, with a total area of 1.6 square miles, is near the eastern edge of Allegany State Park, and only one mile north of the Pennsylvania State Line. Limestone lies within the Allegheny Plateau, a region of rugged topography with numerous streams and steep-walled valleys. Three streams flow through the village; the principal stream being Tunungwant Creek.

Tunungwant Creek has its origin in Pennsylvania, and meanders north into New York State less than a mile from the Village of Limestone. Within the village, Tunungwant Creek is joined by two tributaries; Nichols Run and Limestone Brook. From the village, Tunungwant

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

VILLAGE OF LIMESTONE, NY
(CATTARAUGUS CO.)

VICINITY MAP

APPROXIMATE SCALE
0 2000 4000 6000 8000 FEET

FIGURE 1

Creek continues to flow north to its confluence with the Allegheny River. The Allegheny which rises in Pennsylvania flows in a wide loop through a portion of New York State and eventually joins with the Monongahela River at Pittsburgh to form the Ohio River.

Tunungwant Creek has a broad, poorly drained flood plain with little development. Limestone Brook also has almost no development along its flood plain. Nichols Run Road parallels Nichols Run and there are numerous residences along the lower reaches of this stream.

From its period of petroleum prosperity in the early 1900s, the population of Limestone has steadily decreased. The 1970 population was 535 which is slightly less than the 1960 population of 539 (Reference 2). Surrounded by the Allegany State Park and Allegany Indian Reservation it is expected that the Village of Limestone will not experience any significant growth in the foreseeable future.

The topography within the village ranges from 1,700 feet above the National Geodetic Vertical Datum of 1929 (NGVD), formerly referred to as mean sea level with the 1929 General Adjustment, in the wooded uplands on the west to 1,400 feet NGVD along Tunungwant Creek at the northern village boundary.

The climate of the village is typical of southwestern New York State with warm summers and winters of moderate to heavy snowfall. Average annual temperature is about 45°F with monthly averages ranging between 24°F and 68°F. Precipitation averages 43 inches annually of which 22 inches becomes runoff.

Some portions of the flood plain within the study area are illustrated by photographs in Figures 2 and 3.

2.3 Principal Flood Problems

Due to the steep terrain of the surrounding area, the Village of Limestone is subject to flash flooding from cyclonic disturbances of high intensity, even if such storms are of short duration. The most frequent floods result from these disturbances in winter or early spring, augmented by melting snow. The close proximity of the village to the Allegheny River also causes further complications from the backwater effects of the river, during periods of high flow. These backwater effects on Tunungwant Creek are usually caused by ice jams occurring at bridge openings on the Allegheny River. Due to the lack of data on this condition, exact elevation differences caused by the ice jams cannot be evaluated.

Tunungwant Creek at Limestone
(Looking North at River Street)

Figure 2

Nichols Run at Limestone
(Looking East at Main Street)

Figure 3

Reports of local residents also indicate that the flooding problems in the village have become more severe since the completion of channel improvements to Tunungwant Creek. These improvements are located upstream of the Village of Limestone from the City of Bradford, Pennsylvania to the New York-Pennsylvania State Line.

2.4 Flood Protection Measures

There are no formalized flood protection measures and no flood control structures within the study area. The U. S. Army Corps of Engineers (COE) has investigated several times the possibility of a flood protection project for Limestone, but they have determined that such work cannot be economically justified (Reference 3).

3.0 ENGINEERING METHODS

For flooding sources studied in detail in the community, standard hydraulic and hydrologic study methods were used to determine the flood hazard data required for this study. Floods having recurrence intervals of 10, 50, 100, and 500 years have been selected as having special significance for flood plain management and for flood insurance premium rates. The analyses reported here reflect current conditions in the watersheds of the streams.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency relationships for floods of the selected recurrence intervals for each stream studied in detail in the community.

A regional analysis using USGS stream gaging records (References 4 and 5) for maximum peak flow data was prepared by the New York State Department of Environmental Conservation (Reference 6). This analysis established the peak discharges for floods of the selected recurrence intervals at various locations along the waterways of the Allegheny River Basin within the boundary of the State of New York for uncontrolled drainage areas larger than five square miles. For drainage areas of less than five square miles, a Bureau of Public Roads technique (Reference 7) was used to establish the selected discharges.

The statistical procedures used in the regional analysis are those presented by Leo R. Beard (Reference 8). The methodology conforms with the uniform technique for determining flood flow frequencies as set forth by the Hydrology Committee of the Water Resources Council (Reference 9).

A Summary of Discharges for Tunungwant Creek and Nichols Run is shown in Table 1.

TABLE 1 - SUMMARY OF DISCHARGES

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
TUNUNGWANT CREEK					
Upstream Corporate Limit	141.7	8,933	13,646	15,883	21,516
Midpoint between Nichols Run and Limestone Brook	147.1	9,231	14,102	16,414	22,235
Downstream Corporate Limit	154.8	9,650	14,741	17,157	23,243
NICHOLS RUN					
Confluence with Tunungwant Creek	4.2	406	620	720	978

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of streams studied in detail in the community were carried out to provide estimates of the elevations of floods of the selected recurrence intervals along each of these streams.

Cross sections were located at close intervals above and below bridges, at control sections along the stream length, and at significant changes in ground relief, land use, or land cover.

Reach lengths for the channel were measured along the centerline between stations, excluding the length of oxbow diversions. Between cross sections B and C on Tunungwant Creek, the reach length was measured along the approximate flow line for out-of-bank flow. Overbank reach lengths were measured along the approximate centerline of the effective out-of-channel flow area.

Roughness coefficients (Manning's "n") were assigned on the basis of on-site field inspections and ground level photographs. These photographs were compared with USGS calibrated photographs (Reference 10) taking into consideration channel conditions, overbank vegetation and land use. The "n" values for Tunungwant Creek varied from 0.040 for the channel to 0.055 for overbank areas indicating the relative uniformity of the watercourse. For Nichols Run the overbank "n" value was 0.060 while "n" for the channel varied from 0.022 to 0.035.

Flood profiles were drawn showing computed water-surface elevations to an accuracy of 0.5 foot for floods of the selected recurrence intervals (Exhibit 1). Water-surface elevations of floods of the selected recurrence intervals were computed through the use of the U. S. Army Corps of Engineers HEC-2 Step Backwater Computer Program (Reference 11). All elevations are measured from the National Geodetic Vertical Datum of 1929; elevation reference marks used in the study are shown on the maps.

Flood elevations in the village are often raised by ice jams during spring thaws; the hydraulic analyses for this study, however, are based only on the effects of unobstructed flow. The flood elevations as shown on the profiles are thus considered valid only if hydraulic structures in general remain unobstructed.

For Limestone Brook, which was studied by approximate methods, estimates of the discharge and slope and a field review of the brook were used to determine the 100-year flood limits.

4.0 FLOOD PLAIN MANAGEMENT APPLICATIONS

A prime purpose of the National Flood Insurance Program is to encourage state and local governments to adopt sound flood plain management programs. This Flood Insurance Study, therefore, includes a flood boundary map designed to assist communities in developing sound flood plain management measures.

4.1 Flood Boundaries

In order to provide a national standard without regional discrimination, the 100-year flood has been adopted by the FIA as the base flood for purposes of flood plain management measures. The 500-year flood is employed to indicate additional areas of flood risk in the community.

For each stream studied in detail, the boundaries of the 100- and the 500-year floods have been delineated using the flood elevations determined at each cross section; between cross sections, the boundaries were interpolated using topographic maps, developed for this study from aerial photographs at a scale of 1"=400', with a contour interval of 5 feet (Reference 12). In cases where the 100-year and 500-year flood boundaries are close together, only the 100-year boundary has been shown.

For the stream studied by approximate methods, the boundary of the 100-year flood was developed by estimating the discharge and slope and by inspecting the brook in the field. These boundaries were developed using both the aerial photographs and a USGS quadrangle (Reference 1).

The boundaries of the 100- and 500-year floods are shown on the Flood Boundary and Floodway Map (Exhibit 2). Small areas within the flood boundaries may lie above the flood elevations, and therefore, not be subject to flooding; owing to limitations of the map scale, such areas are not shown.

4.2 Floodways

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

The floodways in this report are presented to local agencies as minimum standards that can be adopted or that can be used as a basis for additional studies.

The floodways presented in this study were computed on the basis of equal conveyance reduction from each side of the flood plain. The results of these computations are tabulated at selected cross sections of each stream studied in detail (Table 2).

As shown on the Flood Boundary and Floodway Map (Exhibit 2), the floodway widths were determined at cross sections; between cross sections, boundaries were interpolated. In cases where the floodway and the 100-year boundaries are close together, only the floodway boundary has been shown.

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION		
CROSS SECTION	DISTANCE	WIDTH (FT.)	SECTION AREA (SQ. FT.)	MEAN VELOCITY (F.P.S.)	WITH FLOODWAY (NGVD 1929)	WITHOUT FLOODWAY (NGVD 1929)	DIFFERENCE (FT.)
Tunungwant Creek							
A	0[1]	2,016	8,775	1.95	1399.9	1398.9	1.0
B	950[1]	2,117	9,908	1.73	1400.3	1399.4	0.9
C	2,875[1]	1,505[3]	7,421	2.15	1401.1	1400.1	1.0
D	4,050[1]	1,447	5,230	3.05	1403.8	1403.0	0.8
E	5,750[1]	1,706	10,177	1.57	1404.5	1403.6	0.9
F	7,350[1]	1,370	6,348	2.52	1405.1	1404.2	0.9
G	8,950[1]	568[4]	3,512	4.52	1406.3	1405.4	0.9
Nichols Run							
A	1,100[2]	35	87	8.30	1400.9	1400.7	0.2
B	1,668[2]	30	116	6.22	1407.6	1407.1	0.5
C	2,268[2]	48	131	5.51	1410.0	1409.8	0.2
D	2,443[2]	34	81	8.91	1412.0	1412.0	0.0
E	3,043[2]	78	133	5.43	1420.9	1420.5	0.4
F	3,468[2]	60	118	6.10	1426.0	1425.2	0.8

[1] FEET ABOVE CORPORATE LIMITS [2] FEET ABOVE CONFLUENCE
[3] FLOODWAY WIDTH DOES NOT INCLUDE FLOODWAY ON NICHOLS RUN
[4] A PORTION OF THE FLOODWAY IS LOCATED OUTSIDE THE CORPORATE LIMITS

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

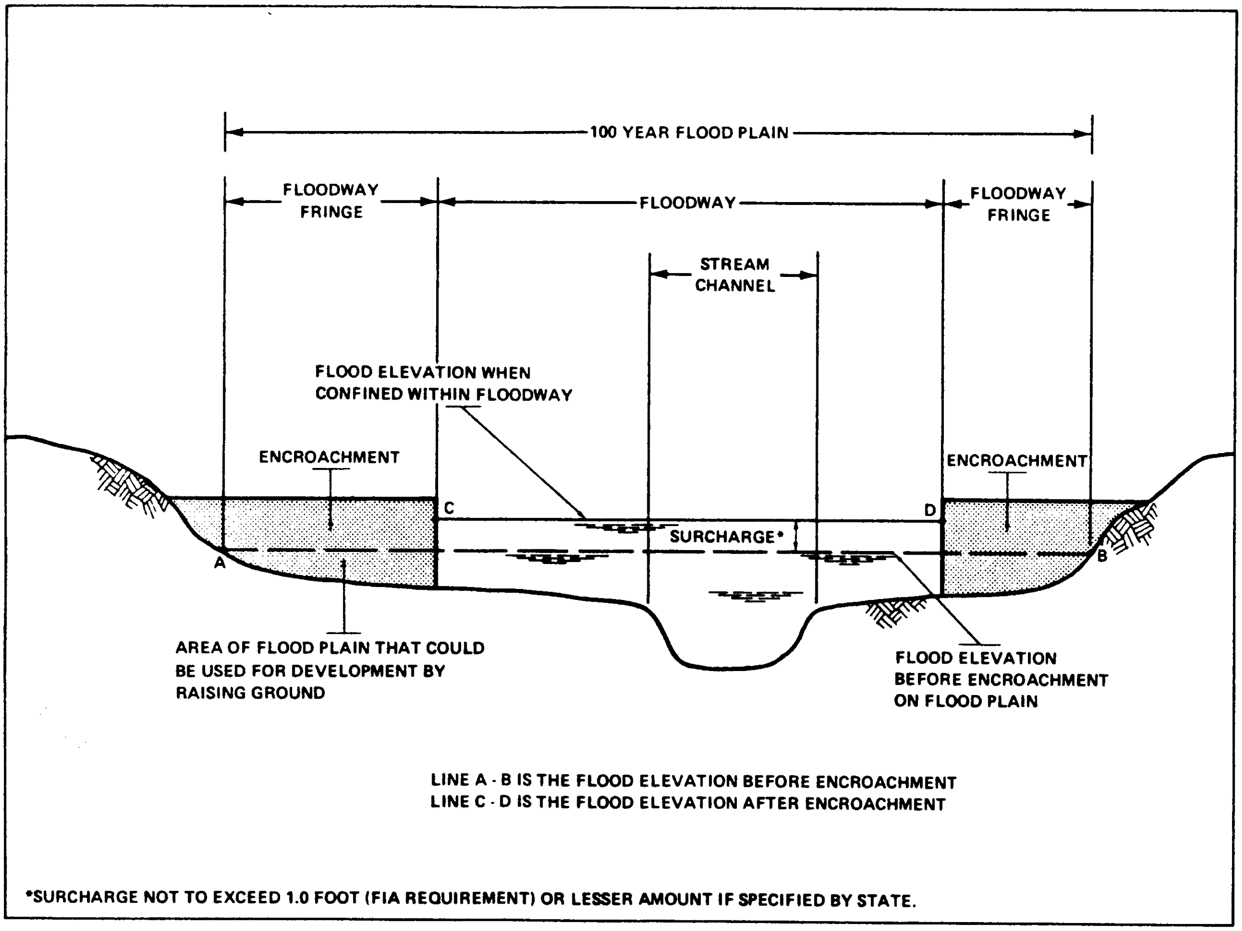
VILLAGE OF LIMESTONE, NY
(CATTARAUGUS CO.)

FLOODWAY DATA

TUNUNGWANT CREEK AND NICHOLS RUN

TABLE 2

The area between the floodway and the boundary of the 100-year flood is termed the floodway fringe. The floodway fringe thus encompasses the portion of the flood plain that could be completely obstructed without increasing the water-surface elevation of the 100-year flood more than one foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to flood plain development are shown in Figure 4.



FLOODWAY SCHEMATIC Figure 4

5.0 INSURANCE APPLICATION

In order to establish actuarial insurance rates, the FIA has developed a process to transform the data from the engineering study into flood insurance criteria. This process includes the determination of reaches, Flood Hazard Factors (FHFs) and flood insurance zone designations for each flooding source affecting the Village of Limestone.

5.1 Reach Determinations

Reaches are defined as lengths of watercourses having relatively the same flood hazard, based on the average weighted difference in water-surface elevations of the 10- and 100-year floods. For this study, this difference did not have a variation greater than that indicated in the following table for more than 20 percent of the reach.

Average Difference Between 10- and 100-year Floods	Variation
Less than 2 feet	0.5 foot

Three reaches meeting this criterion were required to establish flood insurance zones for the Village of Limestone. One reach is located on Tunungwant Creek and the other two are located along Nichols Run. The locations of the reaches are shown on the Flood Profiles (Exhibit 1).

5.2 Flood Hazard Factors

The FHF is the FIA device used to correlate flood information with insurance rate tables. Correlations between property damages from floods and their FHFs are used to set actuarial insurance premium rate tables based on FHFs from 005 to 200.

The FHF for a reach is the average weighted difference between the 10- and 100-year flood water-surface elevations expressed to the nearest one-half foot, and shown as a three-digit code. For example, if the difference of water-surface elevations between the 10- and 100-year floods is 0.7 foot, the FHF is 005; if the difference is 1.4 feet, the FHF is 015; if the difference is 5.0 feet, the FHF is 050. When the difference between the 10- and 100-year water-surface elevations is greater than 10.0 feet, accuracy for the FHF is to the nearest foot.

5.3 Flood Insurance Zones

After the determination of reaches and their respective FHFs, the entire incorporated area of Limestone was divided into zones, each having a specific flood potential or hazard. Each zone was assigned one of the following flood insurance zone designations:

Zone A:	Special Flood Hazard Areas inundated by the 100-year flood, determined by approximate methods; no base flood elevations shown or FHFs determined.
Zones A1, A2:	Special Flood Hazard Areas inundated by the 100-year flood, determined by detailed methods; base flood elevations shown, and zones subdivided according to FHFs.
Zone B:	Areas between the Special Flood Hazard Area and the limits of the 500-year flood, including areas of the 500-year flood plain that are protected from the 100-year flood by dike, levee, or other water control structure; and areas subject to certain types of 100-year shallow flooding where depths are less than 1.0 foot. Zone B is not subdivided.
Zone C:	Areas not subject to flooding by the 500-year flood, including areas that are protected from 500-year floods by dike, levee, or other water control structure; Zone C is not subdivided.

Table 3, "Flood Insurance Zone Data," summarizes the flood elevation differences, FHFs, flood insurance zones, and base flood elevations for each flooding source studied in detail in the Village of Limestone.

5.4 Flood Insurance Rate Map Description

The Flood Insurance Rate Map for the Village of Limestone is, for insurance purposes, the principal result of the Flood Insurance Study. This map (published separately) contains the official delineation of flood insurance zones and base flood elevation lines. Base flood elevation lines show the locations of the expected

FLOODING SOURCE	PANEL[1]	ELEVATION DIFFERENCE[2] BETWEEN 1.0% (100-YEAR) FLOOD AND			FHF	ZONE	BASE FLOOD ELEVATION[3]
		10% (10 YR.)	2% (50 YR.)	0.2% (500 YR.)			
Tunungwant Creek							
Reach 1	0001B	−1.2	−0.3	0.6	010	A2	Varies
Nichols Run							
Reach 1	0001B	−1.2	−0.4	1.0	010	A2	Varies
Reach 2	0001B	−0.4	−0.2	0.3	005	A1	Varies

[1] FLOOD INSURANCE RATE MAP PANEL
[2] WEIGHTED AVERAGE
[3] ROUNDED TO NEAREST FOOT – SEE MAP

TABLE 3

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

VILLAGE OF LIMESTONE, NY
(CATTARAUGUS CO.)

FLOOD INSURANCE ZONE DATA

TUNUNGWANT CREEK AND NICHOLS RUN

whole-foot water-surface elevations of the base (100-year) flood. This map is developed in accordance with the latest flood insurance map preparation guidelines published by the FIA.

6.0 OTHER STUDIES

Flood Insurance Studies are currently underway by the New York State Department of Environmental Conservation for other communities in the Allegheny Basin including the Town of Carrollton, Cattaraugus County in which the Village of Limestone is situated. A preliminary study on the portion of Tunungwant Creek in New York State was performed in 1950 by the COE in relation to a channel improvement project conducted in the reach of Tunungwant Creek from Bradford, Pennsylvania downstream to the state line. The results from the preliminary study do not disagree with this present study.

This study is authoritative for purposes of the Flood Insurance Program and the data presented here either supersede or are compatible with previous determinations.

7.0 LOCATION OF DATA

All data necessary to reproduce the Flood Insurance Study are being retained on file for five years (through March 1981) at the New York State Department of Environmental Conservation, 50 Wolf Road, Albany, New York 12233. These data include base maps, topographic maps, cross section survey data, backwater computations, and other supporting information.

8.0 BIBLIOGRAPHY AND REFERENCES

1. U. S. Geological Survey, 7.5 Minute Series Topographic Maps, Scale 1:24,000, Contour Interval 20 feet: Limestone, New York (1961) and Knapp Creek, New York (1961).

2. U. S. Department of Commerce, Bureau of Census, 1970 Census of Population, Number of Inhabitants, New York (Washington, D. C., U. S. Government Printing Office), 1971.

3. New York State Department of Environmental Conservation, Office of Water Management, Complaint and Request Files, Tunungwant Creek, 1930-1976.

4. U. S. Geological Survey, Water Resources Data for New York (and Pennsylvania), (Part 1 - Surface Water Records) Annual.

5. U. S. Geological Survey, Surface Water Supply of the United States, Part 3 (Ohio River Basin), (Periodic Summary).

6. New York State Department of Environmental Conservation, Allegheny River Basin - Peak Flow Regionalized Analysis, December 1975 (unpublished).

7. Potter, W. D., "Use of Indices in Estimating Peak Rates of Runoff," Public Roads, Vol. 28, No. 1 - pages 1-8, April 1954.

8. Beard, L. R., Statistical Methods in Hydrology, U. S. Army Corps of Engineers District, Sacramento, January 1972.

9. U. S. Water Resources Council, Guidelines for Determining Flood Flow Frequency, Bulletin No. 17, Hydrology Committee, March 1976.

10. U. S. Geological Survey, Roughness Characteristics of Natural Channels, Water Supply Paper 1849, 1967.

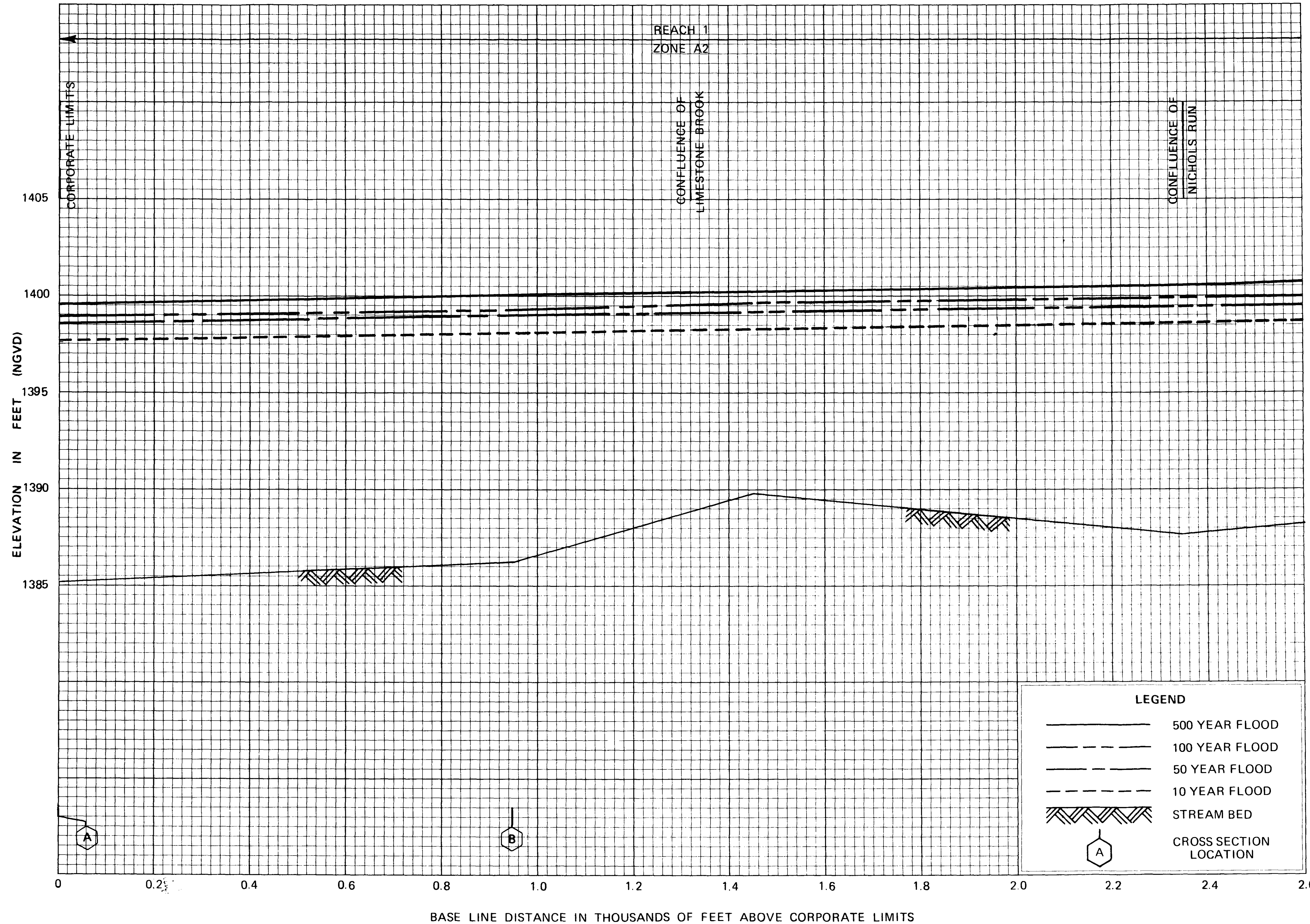
11. U. S. Army Corps of Engineers, Hydrologic Engineering Center, HEC-2 Water Surface Profiles, Generalized Computer Program, Davis, California, October 1973.

12. Lockwood, Kessler, Bartlett. Aerial Photographs, Scale 1:4,800 Contour Interval 5 feet, unpublished, New York, New York, 1975.

Allegheny River Basin Regional Water Resources Planning Board, Alternatives for Water Resources Development and Management, March 1971.

Allegheny River Basin Regional Water Resources Planning Board, Draft of Comprehensive Water Resources Plan for the Allegheny River Basin, May 1975.

U. S. Army Corps of Engineers, Cross Section Data for Portions of the Allegheny River Basin (Unpublished).



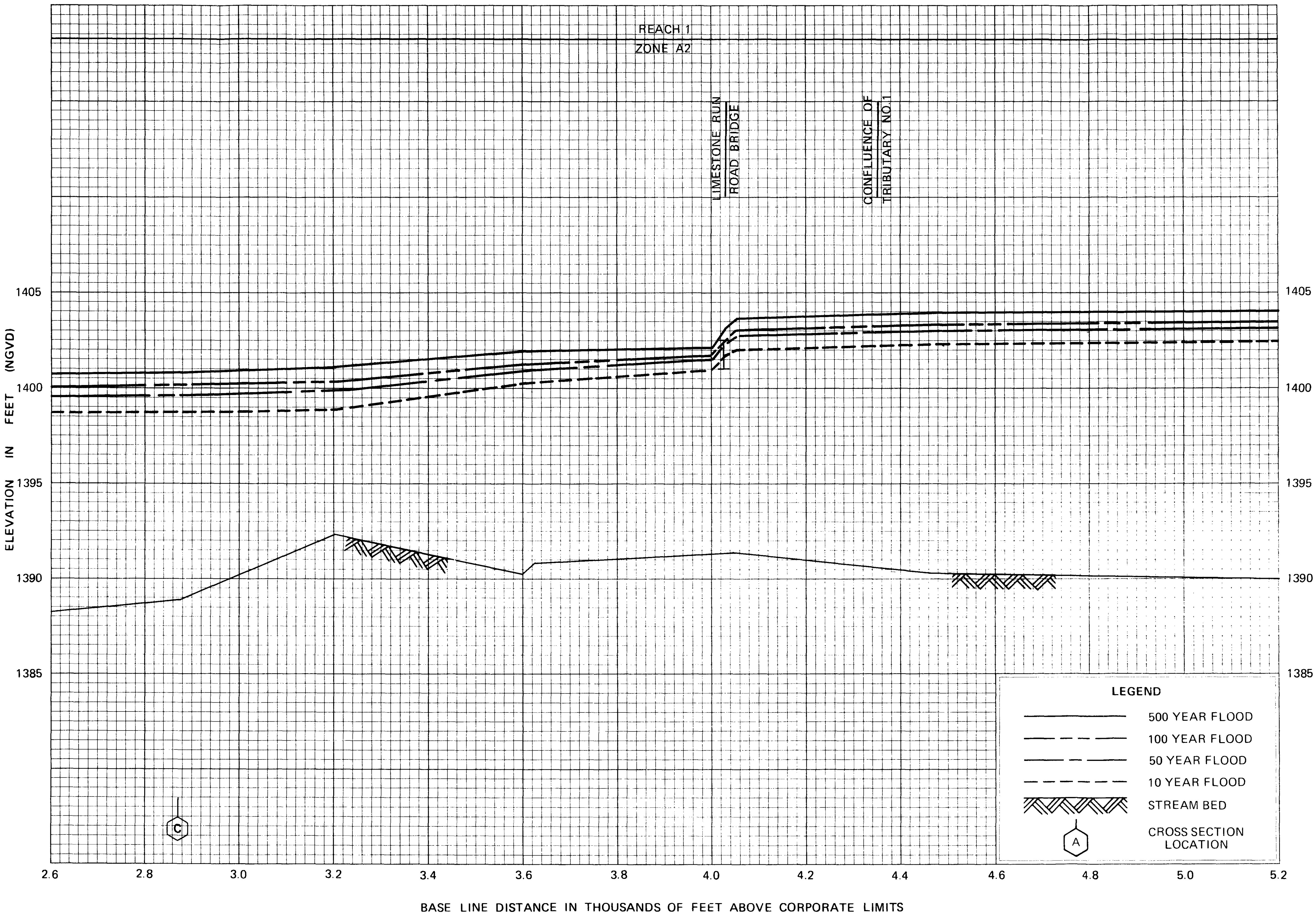
FLOOD PROFILES

TUNUNGWANT CREEK

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

VILLAGE OF LIMESTONE, NY
(CATTARAUGUS CO.)

01P



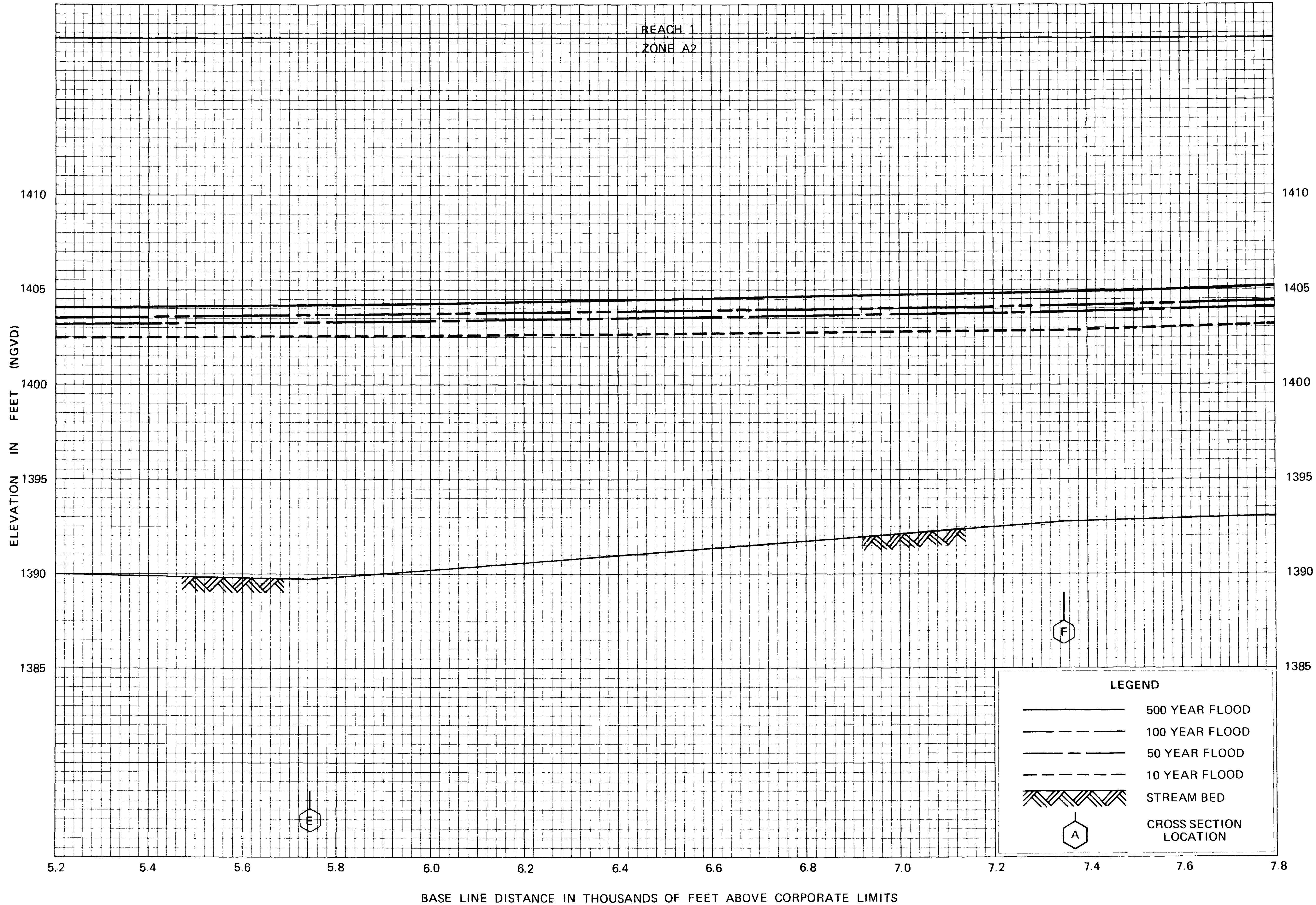
FLOOD PROFILES

TUNUNGWANT CREEK

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

VILLAGE OF LIMESTONE, NY
(CATTARAUGUS CO.)

02P



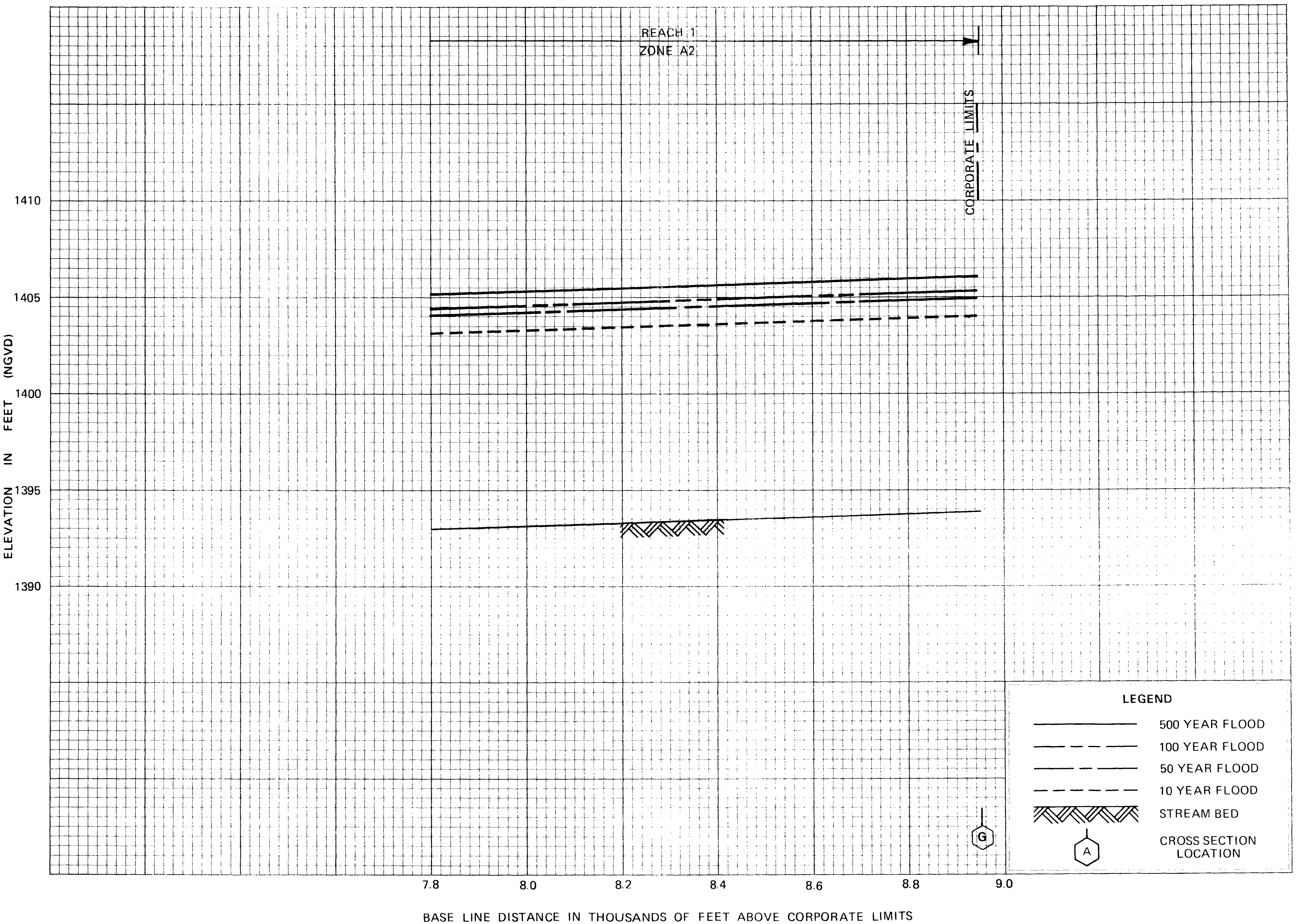
FLOOD PROFILES

TUNUNGWANT CREEK

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

VILLAGE OF LIMESTONE, NY
(CATTARAUGUS CO.)

03P



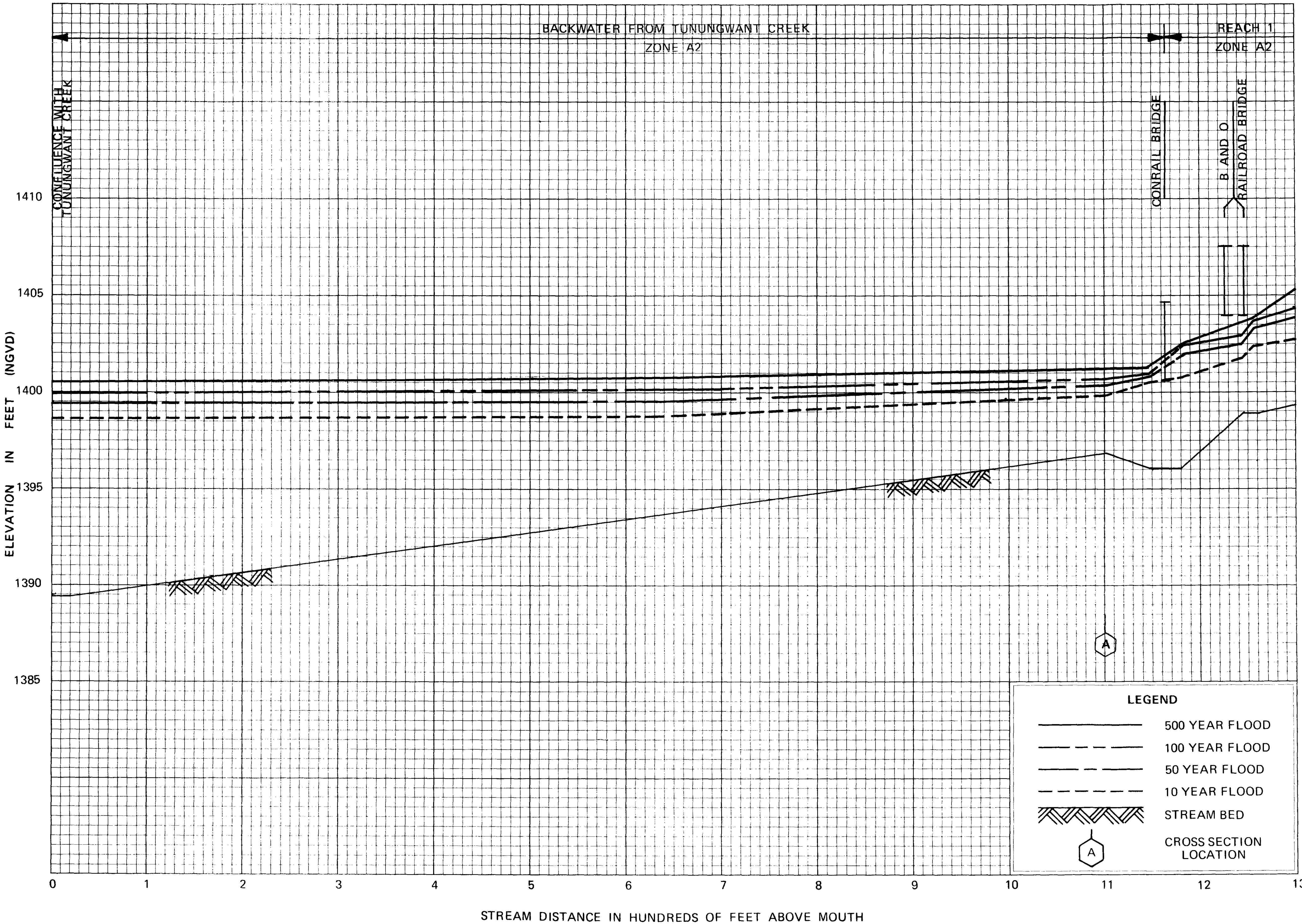
FLOOD PROFILES

TUNUNGWANT CREEK

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

VILLAGE OF LIMESTONE, NY
(CATTARAUGUS CO.)

04P



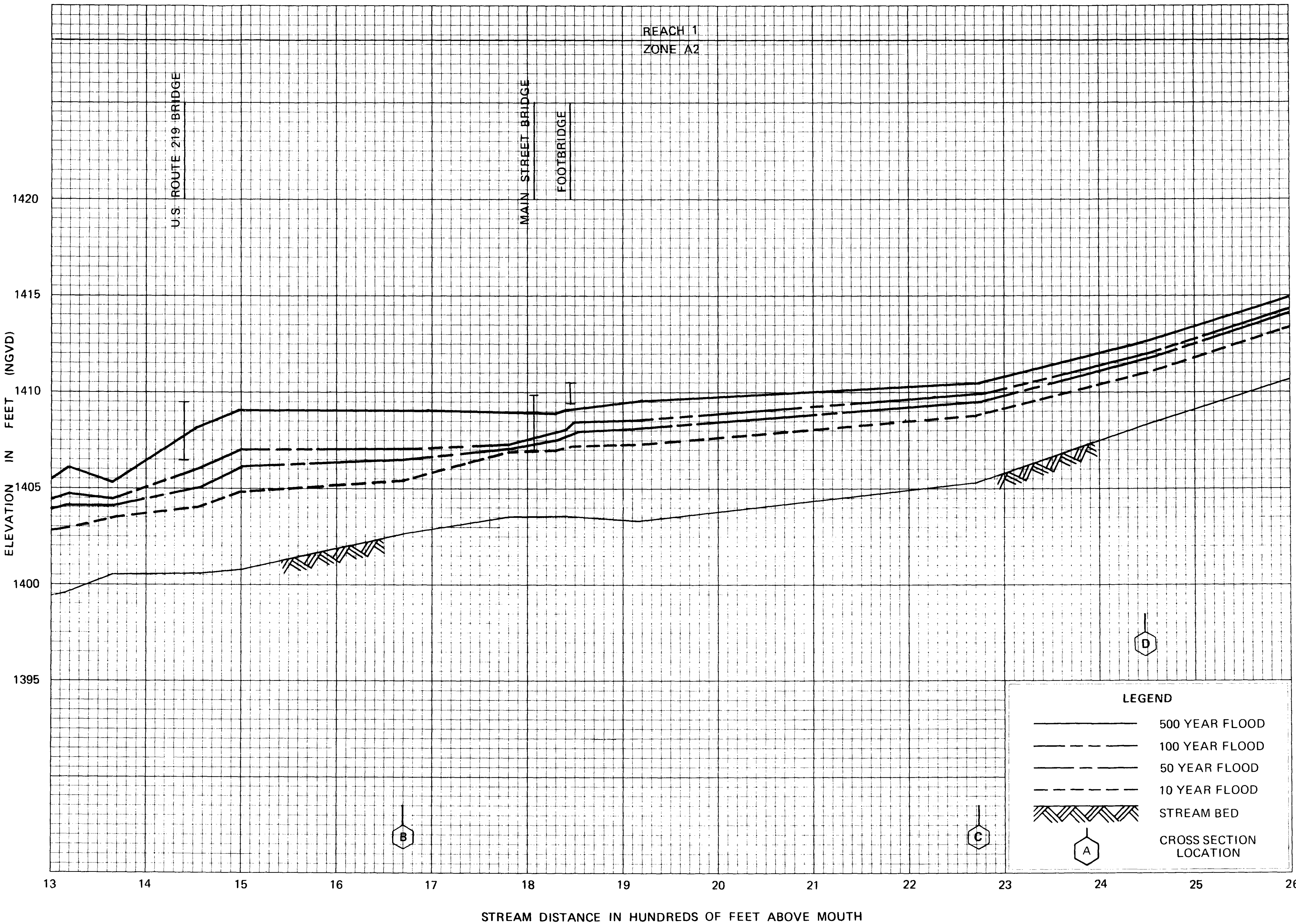
FLOOD PROFILES

NICHOLS RUN

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

VILLAGE OF LIMESTONE, NY
(CATTARAUGUS CO.)

05P



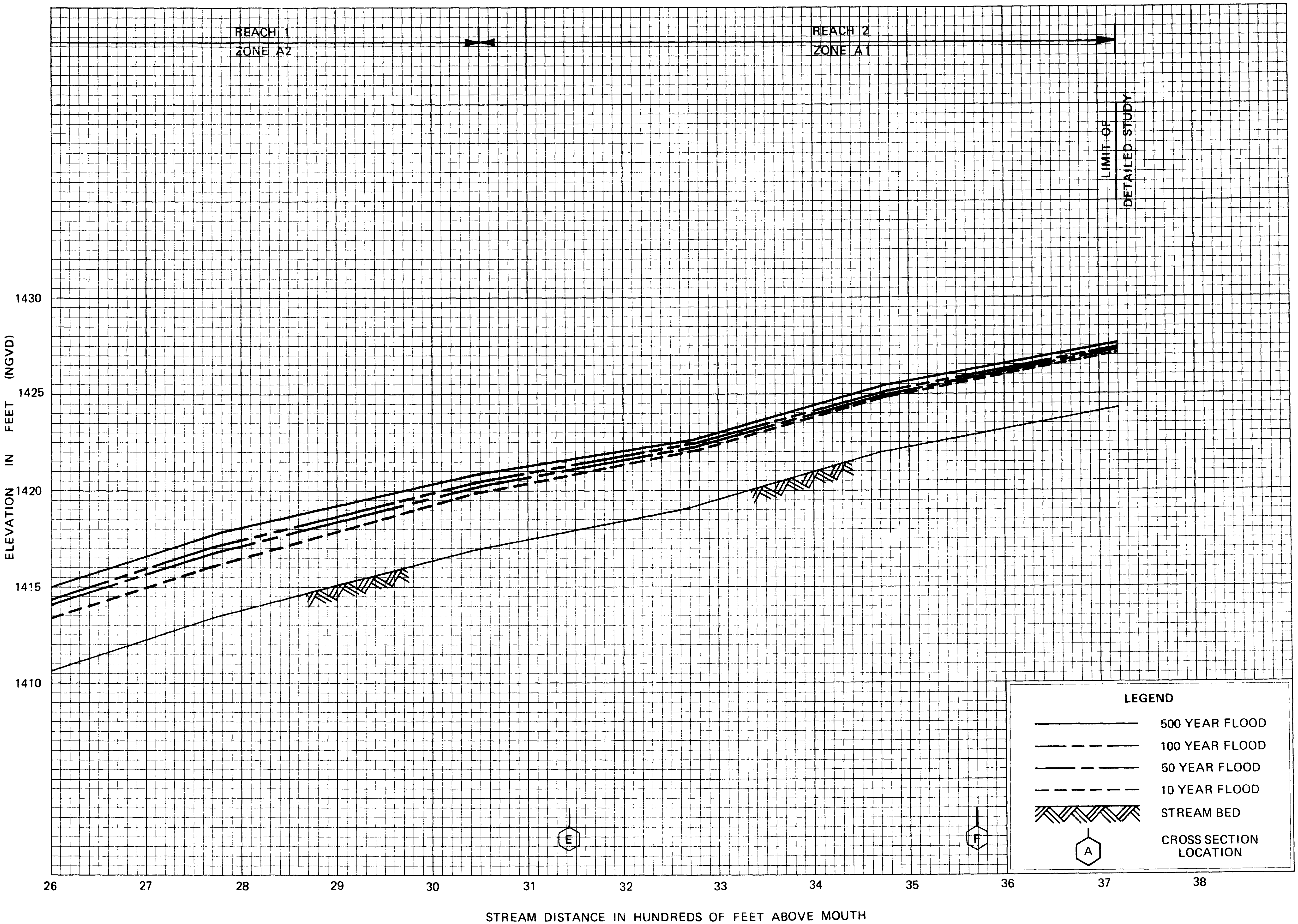
FLOOD PROFILES

NICHOLS RUN

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

VILLAGE OF LIMESTONE, NY
(CATTARAUGUS CO.)

06P



FLOOD PROFILES

NICHOLS RUN

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

VILLAGE OF LIMESTONE, NY
(CATTARAUGUS CO.)

07P