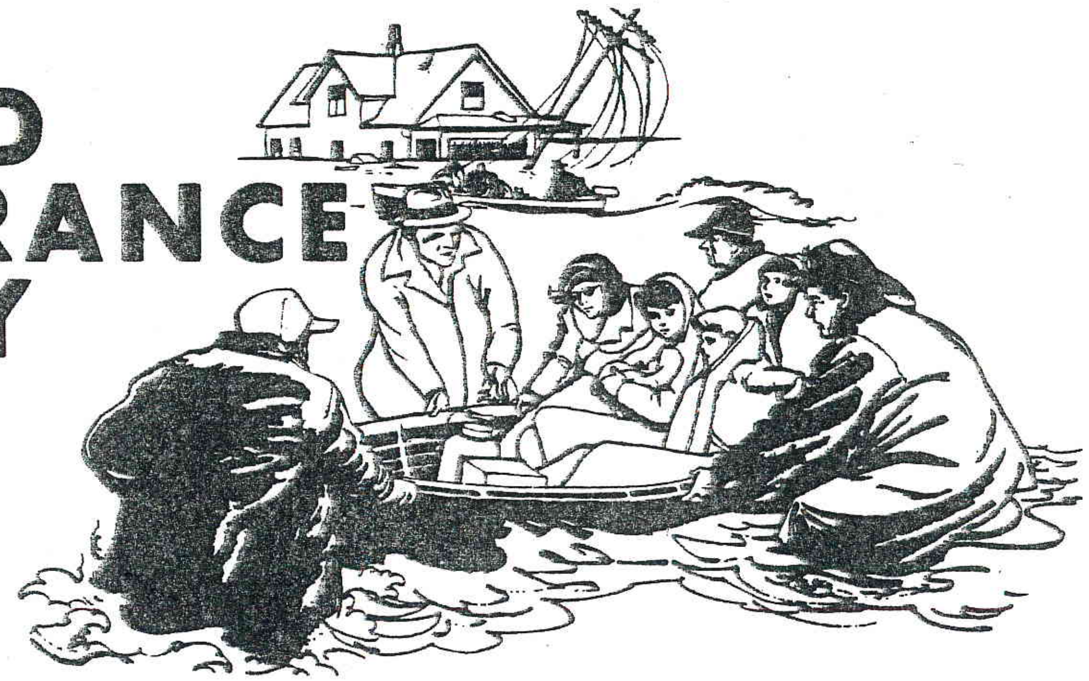
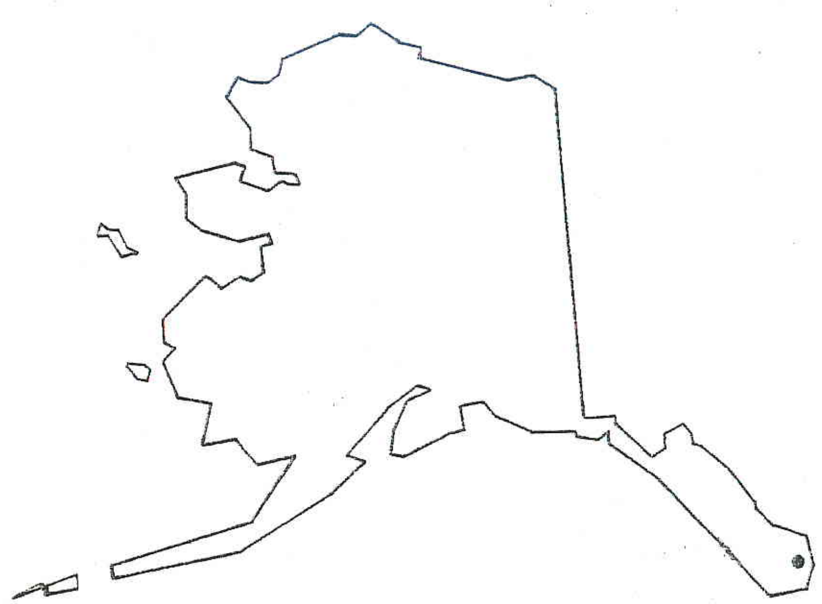
FLOOD INSURANCE STUDY



CITY OF
KETCHIKAN, ALASKA
KETCHIKAN GATEWAY BOROUGH



APRIL 16, 1990

Federal Emergency Management Agency

COMMUNITY NUMBER - 020003

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 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
KETCHIKAN, KETCHIKAN GATEWAY BOROUGH, ALASKA

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study investigates the existence and severity of flood hazards in the City of Ketchikan, Ketchikan Gateway Borough, Alaska 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 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 Acknowledgements

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 performed by the U.S. Army Corps of Engineers (COE), Alaska District for the Federal Emergency Management Agency (FEMA), under Interagency Agreement No. IAA-EMW-87-E-2509. This study was completed in June 1988.

1.3 Coordination

On September 15, 1986, an initial Consultation and Coordination Officer (CCO) meeting was held with representatives of FEMA, the City and Borough of Ketchikan, and the COE. Coordination with City officials and Federal, state and regional agencies produced a variety of information pertaining to floodplain regulations, available community maps, flood history, and other hydrologic data. Vertical control data used to establish the network of elevation reference marks were provided by the City of Ketchikan. On April 4, 1989, the results of the study were reviewed at a final CCO meeting attended by representatives of FEMA, the City and Borough of Ketchikan and the COE.

2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the incorporated area of the City of Ketchikan, Ketchikan Gateway Borough, Alaska. The area of study is shown in the Vicinity Map (Figure 1).

Riverine flooding was studied by detailed methods for the following streams: Ketchikan, Schoenbar, Hoadley, and Carlanna Creeks. The Schoenbar Creek study began at its confluence with Ketchikan Creek while the studies for other streams began at tidewater, and all extended upstream to development limits.

The flooding in areas adjacent to the Tongass Narrows was not covered by this study. Flood boundaries for these areas were computed by approximate methods.

The areas studied by detailed methods were selected with priority given to all known flood hazard areas and areas of projected development or proposed construction through 1992.

The scope and methods of study were proposed to, and agreed upon by, FEMA and the City of Ketchikan.

2.2 Community Description

The Ketchikan Gateway Borough, consisting of approximately 1,250 square miles, with a population of 12,982, is one of the more populated areas in the state of Alaska. The Borough was formed in 1963 to provide a regional government for the Ketchikan area including nearby offshore islands. Ketchikan was incorporated as a city in 1900 as a booming mining town with a population of 800. Today, it is Alaska's fifth largest city with a population of 7,600 and has a diversified economic base with industries in fishing, tourism, timber and pulp (Reference 1).

Ketchikan is located on Revillagigedo Island in Southeast Alaska approximately 650 miles northwest of Seattle, Washington. The city lies just below the 56th parallel in the southeastern part of the state. Prince of Wales Island lies to the west of the city.

The entire southeast region of Alaska is typified by large amounts of rainfall and experiences a maritime climate, due to its proximity to the Pacific Ocean. Ketchikan has a mean annual precipitation of 154 inches with the major portion occurring in the fall. Temperatures are relatively mild with minimal daily variation. Seasonal variations are also minimal, with normal temperatures ranging from 35^{o}F in January to 58^{o}F in August. The mean annual temperature is approximately 46^{o}F.

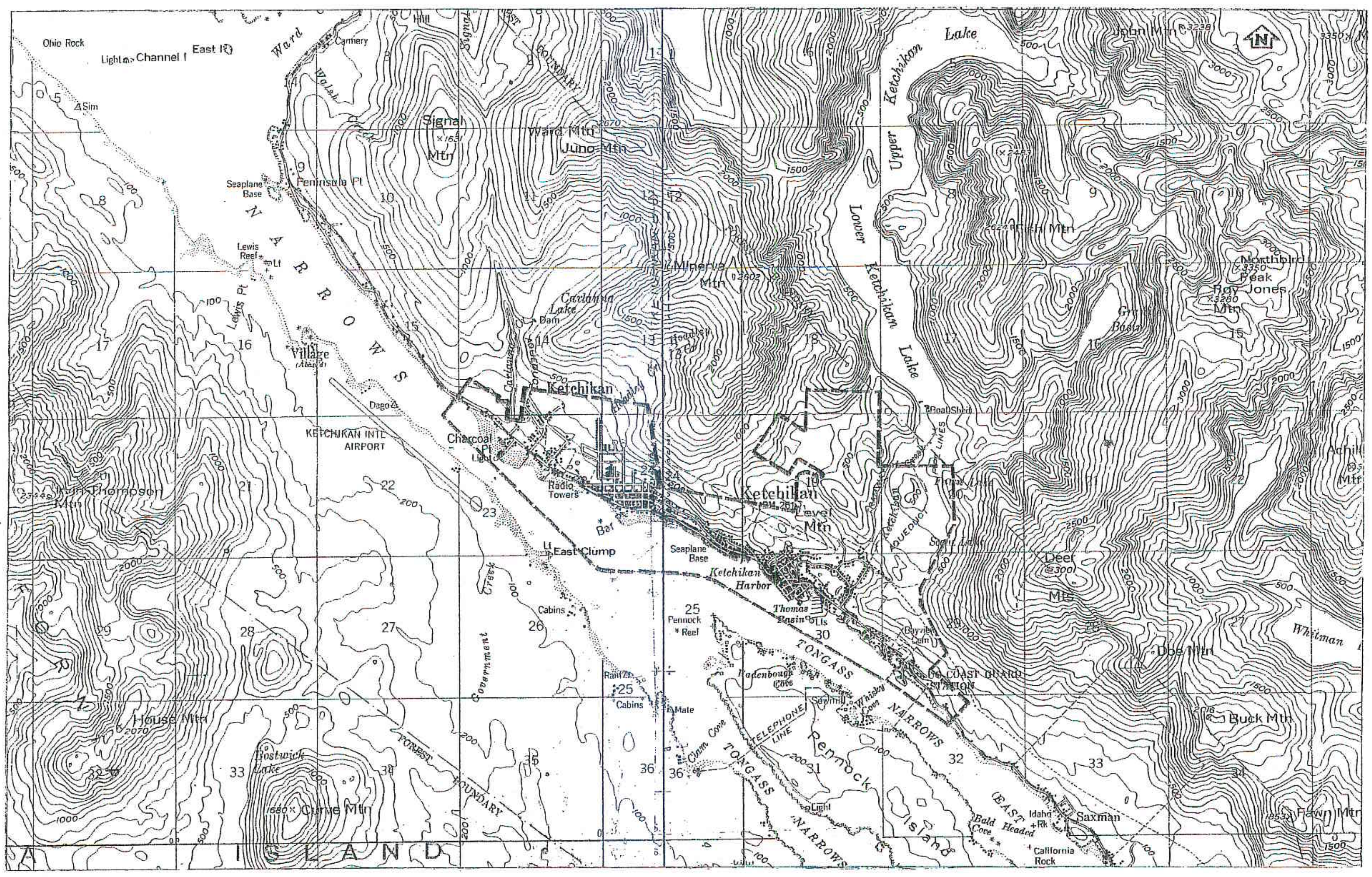


FIGURE 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF KETCHIKAN, AK

(KETCHIKAN GATEWAY BOROUGH)

APPROXIMATE SCALE

1 0 1 2 3 MILES

VICINITY MAP

The creeks in this study originate in the mountains north of Ketchikan, where the peaks lie at 3,000 feet elevation or higher. The watersheds are densely wooded and blanketed with a heavy cover of moss and shrubs. The stream gradients are generally steep and their courses are characterized by boulders, rapids, and waterfalls.

The portion of Ketchikan Creek included in the study extends from Thomas Basin in the east channel of Tongass Narrows upstream to a point just above the city power house aqueduct. The total length of this portion is approximately 4200 feet. The creek winds through a park and residential area to the business district and thence into Thomas Basin.

The floodplain of Ketchikan Creek is occupied primarily by residential units and some business establishments. There is also a park located in the upper reaches of the study area. The present development is moderate to heavy, and serious damage can be expected during flooding. There are six stream crossings of Ketchikan Creek, each utilizing bridges. Numerous pile-supported structures, a fish ladder and pipelines suspended beneath bridges are present and obstruct the free flow of water in Ketchikan Creek. Fallen timber, boulders and debris further obstruct the stream.

Schoenbar Creek is a tributary to Ketchikan Creek; the area studied extends upstream 3,300 feet from their confluence. Schoenbar Creek flows through a residential area with numerous culverts that obstruct high flows.

The portion of Hoadley Creek included in the study extends from a point located just upstream of its confluence with Tongass Narrows to a point approximately 2,200 feet upstream. The stream flows generally to the southwest through some residential areas, past the Ketchikan Memorial Hospital under the North Tongass Highway and then under some pile-supported structures to its confluence with Tongass Narrows. The floodplain of Hoadley Creek is narrow and the residential development that now exists in the area is only minor in nature. In addition to homes, access roads, streets and utility lines are subject to flooding and the resulting damages. There is ample high ground on each side of the stream, however, which provides safe building areas. There are three major stream crossings of Hoadley Creek. One of the crossings is the North Tongass Highway bridge, another is a culvert under a roadway fill at Baranof Street, and the third is a culvert under a roadway fill at Jackson Street. Although the present development in the Hoadley Creek area is minor, it is increasing fairly rapidly, especially in the upper reaches of the creek.

The portion of Carlanna Creek included in the study is approximately 950 feet long and extends upstream from Tongass Narrows to a point within a steep canyon. The remainder of the stream is within this canyon, or is within the watershed of Carlanna Lake, a source of water supply for the city of Ketchikan. Access and development is prohibited by the City for areas within this latter portion of the watershed. Lands adjacent to Carlanna Creek are only moderately developed. Presently, there is a mobile home court, some industrial property and a Ketchikan public utilities powerhouse adjacent to the stream. There is also one highway bridge which crosses the stream in the study area.

2.3 Principal Flood Problems

Factors affecting flooding are natural obstructions to floodflows including trees, brush, and other vegetation growing along the stream banks in floodplain areas. Manmade encroachments on or over the stream, such as the roads and bridges, can also create more extensive flooding than would otherwise occur. During floods, trees, brush and other vegetation growing in the floodplain impede floodflows, thus creating backwater and increasing flood heights. Trees and other debris may be washed away and carried downstream to collect at the bridges or other obstructions. As floodflows increase, masses of debris could break loose and surge downstream until another obstruction is encountered. In general, obstructions restrict floodflows and result in overbank flows, unpredictable areas of flooding, possible destruction of the bridge and any pile-supported structures and an increased velocity of flow immediately downstream. It is impossible to predict the degree or location of the accumulation of debris; therefore, for the purpose of this report, it was necessary to assume that there would be no accumulation of debris along the stream or at the bridges, in the development of the flood profiles.

Ketchikan and Schoenbar Creeks

Occasional flooding along Ketchikan Creek in the city of Ketchikan has occurred in past years. Some information is available relative to the flooding that occurred in December 1982. Overbank flows during this flood caused some damages in the upper reaches of the creek. Also, high velocity flows associated with low tides caused scouring around bridge and building piles near the mouth of the creek. One building collapsed when the piling settled and another building was damaged by differential pile settling and was later condemned. A number of other floods have occurred; however, flooding has been confined primarily to slight overbank flooding and erosion. The hydropower dam upstream survived the October 1973 and December 1982 floods without damage.

Carlanna Creek

Very little information is available concerning historical floods in Ketchikan, since records of past floods are meager and, in most cases, non-existent. A multitude of information is available, however, relative to the flooding that occurred in October 1973 when Carlanna Lake dam failed. Damage estimates for this event exceeded the two million dollar figure. Other floods which have occurred have generally been confined to slight overbank flooding and erosion. High flows occur primarily as a result of intense precipitation which may occur anytime during the fall and winter months. The greatest potential for rainfall is in the fall. During winter months, rapid snowmelt can contribute heavily to high flows. River stages can rise from normal levels to extreme flood peaks in a relatively short period of time. Floods are of comparatively short duration, characterized by high velocities in the main channel and lower velocities in overbank area.

Three types of flooding can occur on Carlanna Creek. The first is a result of storm-related runoff. Such flooding could occur at any time due to the abundant rainfall in the Ketchikan area. The second form of flooding is the result of timber and debris jams occurring at random locations along the stream. Although the amount of flow in the stream might be substantially less than flood predictions, the resulting level of flooding can be higher. The third type of flooding that can occur is the result of a dam failure. The past Carlanna Lake dam failure is an example of this type of flooding. The intensity of flooding will vary, depending on the rate at which a dam fails. However, much higher flood stages can occur than those reached in the two previously mentioned types of flooding. Carlanna Lake dam has been rebuilt since its failure and a similar failure would be very unlikely. The COE, Alaska District, inspected the dam in June 1978 as part of the National Dam Safety Program and found no deficiencies.

Figures 2 through 7 show damages to structures and roads in Ketchikan caused by the 1973 flood.

2.4 Flood Protection Measures

There is one existing structure on Ketchikan Creek built specifically for flood control purposes. This is the concrete floodwall along Park Street just below Harris Street bridge, which was built by the City. Another structure, also built by the City, is the water supply and hydroelectric power dam at Ketchikan Lake. The full volume of the reservoir is required for power. The only flood control benefits derived are those incidental to water storage for power generation. This volume of storage is very small compared to the volumes of water during major flood events.

FIGURE 1 - View of lower reach of Hoadley Creek with Tongass Narrows in background. Note encroachment on the stream.

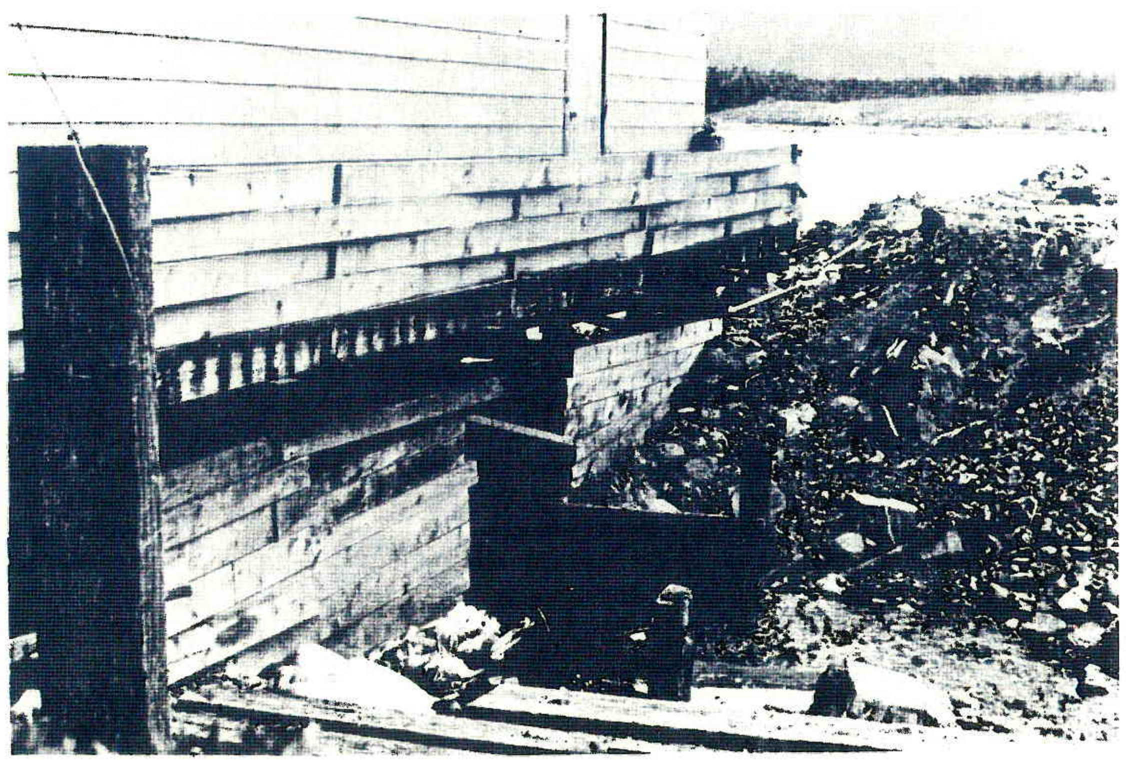


FIGURE 2 - Another view of the encroachment on Hoadley Creek at its confluence with Tongass Narrows.

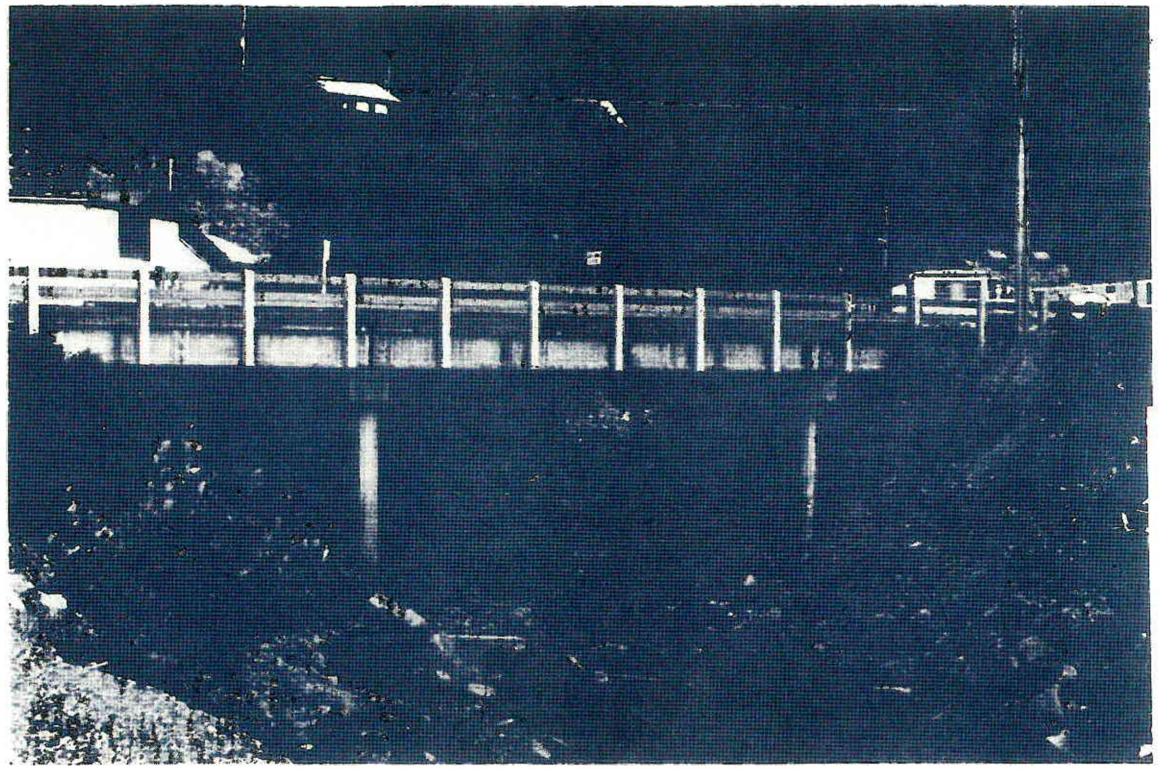


FIGURE 3 - View looking upstream at North Tongass Highway Bridge over Carlanna Creek during the summer of 1973.

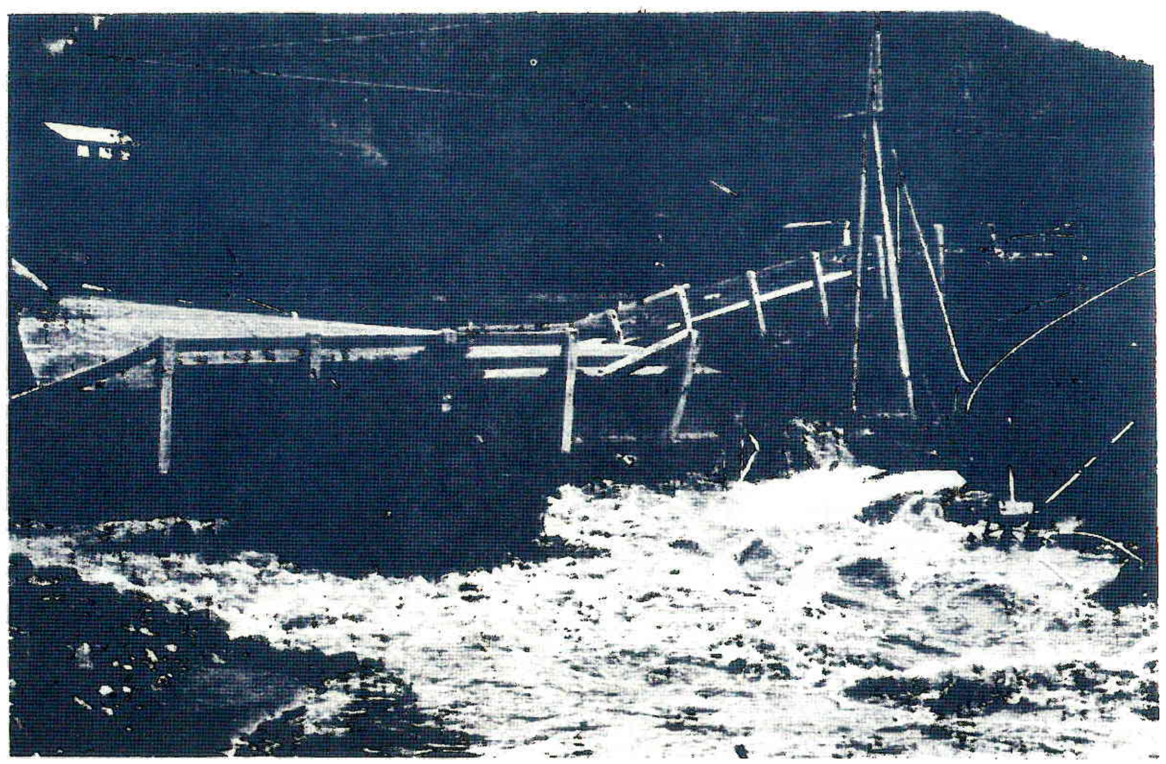


FIGURE 4 - The flood of October 1973 destroyed the North Tongass Highway Bridge.

FIGURE 5 - Debris swept down to collect at the North Tongass Highway Bridge during the October 1973 flood.

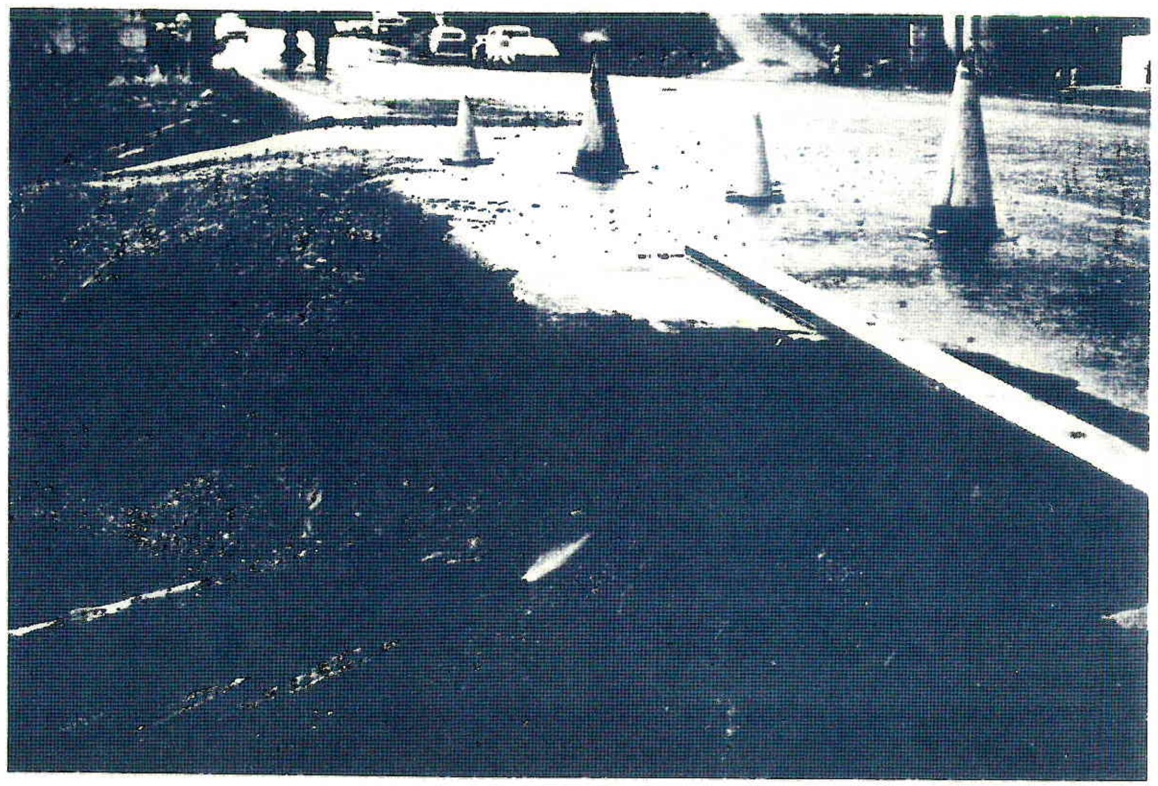


FIGURE 6 - Typical of the erosion damage caused by the high velocity flows during the October 1973 flood.

There are no existing flood control structures on Hoadley Creek, and much of its watercourse is within a gully. A narrow floodplain is developed because of the Creek's steep slope and high flow velocities. These velocities can make erosion a serious problem during flooding.

There are no existing flood control structures on Carlanna Creek. One structure, a rock-filled timber crib dam was built over 25 years ago to supply water for Ketchikan. This dam failed in October 1973, causing an estimated 2.2 million dollars in damages. It has since been rebuilt but is not designed for flood control since it has limited storage. Due to its steep slope and high velocities, Carlanna Creek has a narrow floodplain. With these high velocities, erosion can become a major problem, as was demonstrated during the October 1973 flood.

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 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 peak discharge-frequency relationships for each flooding source studied in detail affecting the community.

Ketchikan Creek is the only gaged stream in this study. It had nine years of record before being discontinued in 1967.

Several methods were used to estimate flood frequencies for the streams in this study. The U.S. Geological Survey (References 2 & 3) and U.S. Forest Service (Reference 4) have developed regression equations to estimate peak flow frequencies for streams in various parts of Alaska. These equations along with COE Regional Frequency Program (Reference 5) were used to develop floodflow frequencies. The COE Regional Frequency Program was used to analyze peak flow data from gaged streams in the Ketchikan area in accordance with guidance outlined in the Bulletin No. 17B (Reference 6). Each method is based on observed floodflows from a number of gaged streams in the Ketchikan area. The observed floodflows were caused by either rainfall, snowmelt, or rainfall and snowmelt. The flood frequency data for Carlanna, Hoadley, and Schoenbar Creeks were derived from the methods referenced above. Ketchikan Creek flood frequencies were based on the COE Regional Frequency Program, as the results from this method best fit the observed flood peaks on Ketchikan Creek. The other methods provided results that were unrealistic in light of the observed peaks.

A summary of drainage area-peak discharge relationships for the streams analyzed in this study are shown in Table 1, Summary of Discharges.

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 data for the backwater analyses were obtained from topographic maps compiled from aerial photographs (Reference 7). Below-water cross section data was obtained by field survey. All bridges and culverts on the creeks that were studied in detail were surveyed to obtain elevation data and structural geometry. Cross sections for the streams studied by detailed methods were located at close intervals above and below bridges and culverts and at places where changes in ground relief and land use occurred.

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1). For stream segments where a floodway was computed (Section 4.2), selected cross section locations are also shown on the Flood Insurance Rate Map (Exhibit 2). Water-surface profiles were computed for the portions of the streams studied by detailed methods using the COE HEC-2 step-backwater computer program (Reference 8). This program computes the water surface elevations for stream channels at any cross section for either subcritical or supercritical flow conditions. The effects of various types of structures such as bridges, culverts, weirs, and embankments are considered in the computations.

Table 1. Summary of Discharges

Flooding Source and Location	Drainage Area (Square Miles)	Peak Discharges (Cubic Feet per Second) 10-Year	50-Year	100-Year	500-Year
Ketchikan Creek At mouth	13.5	4200	5950	6800	8200
Schoenbar Creek At mouth	1.5	620	795	880	1130
Hoadley Creek At mouth	1.03	390	515	570	690
Carlanna Creek At mouth	2.6	795	1100	1230	1560

Starting water surface elevations for Carlanna, Hoadley, and Ketchikan Creeks were based on the mean high tide level in the Ketchikan area. The starting water surface elevation used for Schoenbar Creek was based on backwater computations of Ketchikan Creek to which Schoenbar Creek is a tributary. Average August-November flows on Ketchikan Creek were used for the computations.

Channel and overbank roughness factors (Manning's "n") used in the hydraulic computations were chosen using engineering judgment based on field observations of the stream channel and overbank areas. Roughness factors for all culverts were taken from published data. The "n" values chosen for each stream are as follows:

FLOODING SOURCE	CHANNEL "n"	OVERBANK "n"
Ketchikan Creek	0.035-0.045	0.075-0.100
Schoenbar Creek	0.035-0.075	0.030-0.090
Hoadley Creek	0.045-0.075	0.080-0.100
Carlanna Creek	0.035-0.040	0.035-0.075

The hydraulic analyses assume that all structures such as culverts and bridges will remain intact and unobstructed. No roads were assumed to wash out.

A portion of Hoadley Creek starting approximately 500 feet upstream from Baranof Avenue and extending to the study limits near Jackson Street was done by approximate methods. This section of Hoadley Creek flows over waterfalls and cascades and cannot be easily modeled. Two cross sections were taken in a short stretch of the stream where no falls were present. These were put into the COE HEC-2 model. The average flow area of the two sections was used for the remainder of the creek up to Jackson Street. A rating curve for the Jackson Street crossing was used to delineate the 100-year flood boundaries in that area. The study included the drainage ditch that flows down the north side of Jackson Street into Hoadley Creek. There are a number of culverted driveways that cross the ditch. 36" and 42" diameter culverts were used throughout this area. Rating curves for 36" and 42" culverts were developed from surveyed data and applied to all the 36" and 42" culverts along the ditch to delineate the 100-year flood boundaries.

Approximate flood boundaries for coastal areas adjacent to Tongass Narrows were determined by approximate analysis of tide gage information. The flood boundaries in this area extend approximately to the 22-foot Mean Lower Low Water (MLLW) contour. *

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 MLLW Datum. Elevation reference marks used in this study are shown on the maps; the description of the marks are presented in Elevation Reference Marks (Exhibit 3).

4.0 FLOODPLAIN MANAGEMENT APPLICATION

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- and 500-year floodplain boundaries and 100-year floodway 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. The 0.2-percent annual channel (500-year) flood is employed to indicate additional areas of flood risk in the community. For each stream studied in detail, the 100- and 500-year floodplain boundaries 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 1:200, with a contour interval of 2 feet (Reference 7).

The 100- and 500-year floodplain boundaries are shown on the Flood Insurance Rate Map (Exhibit 2). On this map, the 100-year floodplain boundary corresponds to the boundary of the areas of special flood hazards (Zones A, AE, AH, and AO); 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 Flood Insurance Rate Map (Exhibit 2.)

The approximate flood boundaries were delineated using flood elevations determined at cross sections obtained from ground surveys, and map and photographic interpretation. Between cross sections, the boundaries were interpolated using topographic maps (Reference 7).

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 a substantial increase in flood heights. Minimum Federal standards limit such increases to 1.0 foot, provided that hazardous velocities are not produced. The floodways in this study are presented to local agencies as minimum standards that can be adopted directly or that can be used as a basis for additional floodway studies.

The floodways presented in this study were computed from 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 at selected cross sections (Table 3). In cases where the floodway and 100-year floodplain boundaries are either close together or collinear, only the floodway boundary has been shown. The four creeks in this study are quite steep and exhibit high velocities while passing the estimated 100-year discharge. Flow is supercritical in sections of each stream. High velocities have caused or contributed to a bridge failure on Carlanna Creek during a past flood by eroding footings and abutments. The floodplain at the sections that flow under supercritical conditions is confined within the banks or does not extend far beyond the top of banks. No encroachments were made on the Carlanna Creek 100-year floodplain. The stream flows under supercritical conditions and exhibits very high velocities. The unencroached floodplain is mainly confined within the banks. For the most part the floodways developed in this study are at or near the creek banks. The large number of cross sections on Ketchikan and Hoadley Creeks with a zero or small rise in water surface elevation is due to the 100-year floodplain not extending far beyond the top of the banks.

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 floodplain that could be completely obstructed without increasing the water-surface elevation of the 100-year flood 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 8.

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY (FEET MLLW[2])	WITHOUT FLOODWAY (FEET MLLW[2])	WITH FLOODWAY (FEET MLLW[2])	INCREASE
Ketchikan Creek								
A	846	52	419	16.2	25.0	25.0	25.0	0.0
B	1,136	65	763	8.9	44.9	44.9	45.7	0.8
C	1,221	61	441	15.4	46.8	46.8	47.0	0.2
D	1,531	57	460	14.8	51.0	51.0	51.5	0.5
E	1,849	65	623	10.9	57.9	57.9	57.9	0.0
F	2,211	120	1,402	4.8	59.8	59.8	59.8	0.0
G	2,738	90	937	7.3	60.5	60.5	60.7	0.2
H	3,026	90	858	7.9	61.2	61.2	61.2	0.0
I	3,809	115	954	7.1	72.3	72.3	72.3	0.0
J	4,089	51	416	16.3	78.9	78.9	78.9	0.0

[1] In Feet Above Steadman Street
[2] Mean Lower Low Water Datum (MLLW)

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

KETCHIKAN, AK
(KETCHIKAN GATEWAY BOROUGH)

FLOODWAY DATA

KETCHIKAN CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET MLLW[2])			
Hoadley Creek								
A	217	23	66	8.6	23.7	23.7	23.7	0.0
B	524	23	61	9.3	53.3	53.3	53.3	0.0
C	824	55	82	7.0	69.5	69.5	69.5	0.0
D	1,022	31	71	8.0	76.7	76.7	76.7	0.0
E	1,422	25	63	9.1	94.6	94.6	94.6	0.0
F	1,629	52	513	1.1	132.0	132.0	132.0	0.0
G	1,863	46	284	2.0	132.0	132.0	132.0	0.0
H	2,088	21	60	9.5	153.3	153.3	153.3	0.0
I	2,128	16	55	10.4	171.5	171.5	171.5	0.0

[1]In Feet Above Mouth
[2]Mean Lower Low Water Datum (MLLW)

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

KETCHIKAN, AK
(KETCHIKAN GATEWAY BOROUGH)

FLOODWAY DATA

HOADLEY CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION (FEET MLLW[3])			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Schoenbar Creek								
A	0	42	121	7.3	59.9	52.4[2]	52.4[2]	0.0
B	430	50	386	2.3	65.8	65.8	66.7	0.9
C	783	57	279	3.2	68.6	68.6	69.4	0.8
D	1,032	34	220	4.0	68.9	68.9	69.7	0.8
E	1,088	83	429	2.1	27.0	72.0	72.7	0.7
F	1,296	24	159	5.5	72.1	72.1	72.7	0.6
G	1,483	30	152	5.8	74.0	74.0	74.7	0.7
H	1,602	25	149	5.9	78.1	78.1	78.1	0.0
I	1,886	25	150	5.9	86.8	86.8	86.8	0.0
J	2,299	29	116	7.6	94.2	94.2	95.2	1.0
K	2,599	40	143	6.1	102.9	102.9	102.9	0.0
L	3,255	45	103	8.5	115.8	115.8	115.8	0.0

[1] In Feet Above Confluence With Ketchikan Creek
[2] Elevation Computed Without Consideration of Backwater Effects From Ketchikan Creek
[3] Mean Lower Low Water Datum (MLLW)

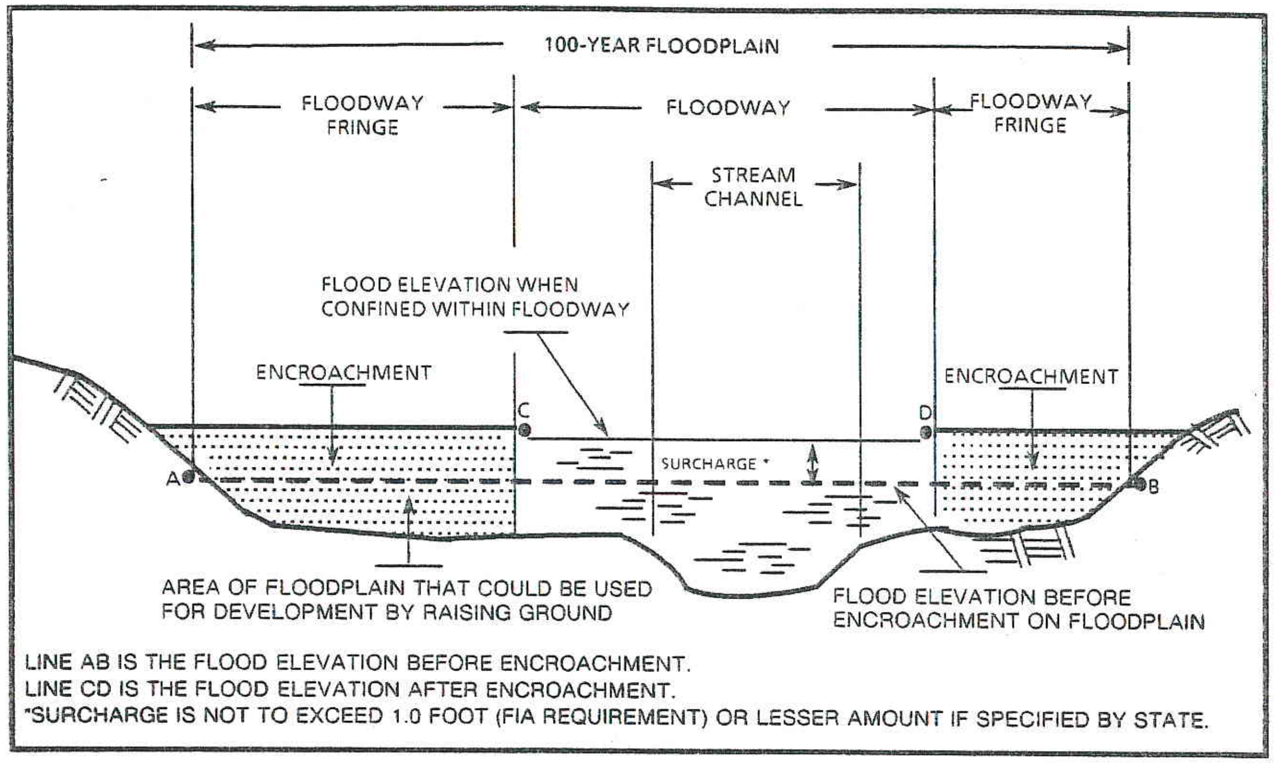
TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

KETCHIKAN, AK
(KETCHIKAN GATEWAY BOROUGH)

FLOODWAY DATA

SCHOENBAR CREEK



Floodway Schematic

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 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 determined in the Flood Insurance Study by detailed methods. 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, 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.

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- and 500 year floodplains, the floodways, and the locations of selected cross sections used in the hydraulic analyses and floodway computations.

7.0 OTHER STUDIES

There are Flood Plain Information Reports on the streams in Ketchikan dated June 1974 which were prepared with 1965 city maps and no hydraulic modeling (Reference 9).

8.0 LOCATION OF DATA

Information concerning the pertinent data used in the preparation of this study can be obtained by contacting the Natural and Technological Hazards Division, FEMA, Federal Regional Center, 130 228th Street, S.W., Bothell, Washington 98021-9796.

9.0 BIBLIOGRAPHY AND REFERENCES

1. Alaska Department of Community and Regional Affairs, Population Research, July 1, 1987.

2. U.S. Department of Interior, U.S. Geological Survey, Estimation of Selected Flow and Water-Quality Characteristics of Alaska Streams, Anchorage, Alaska, June 1985.

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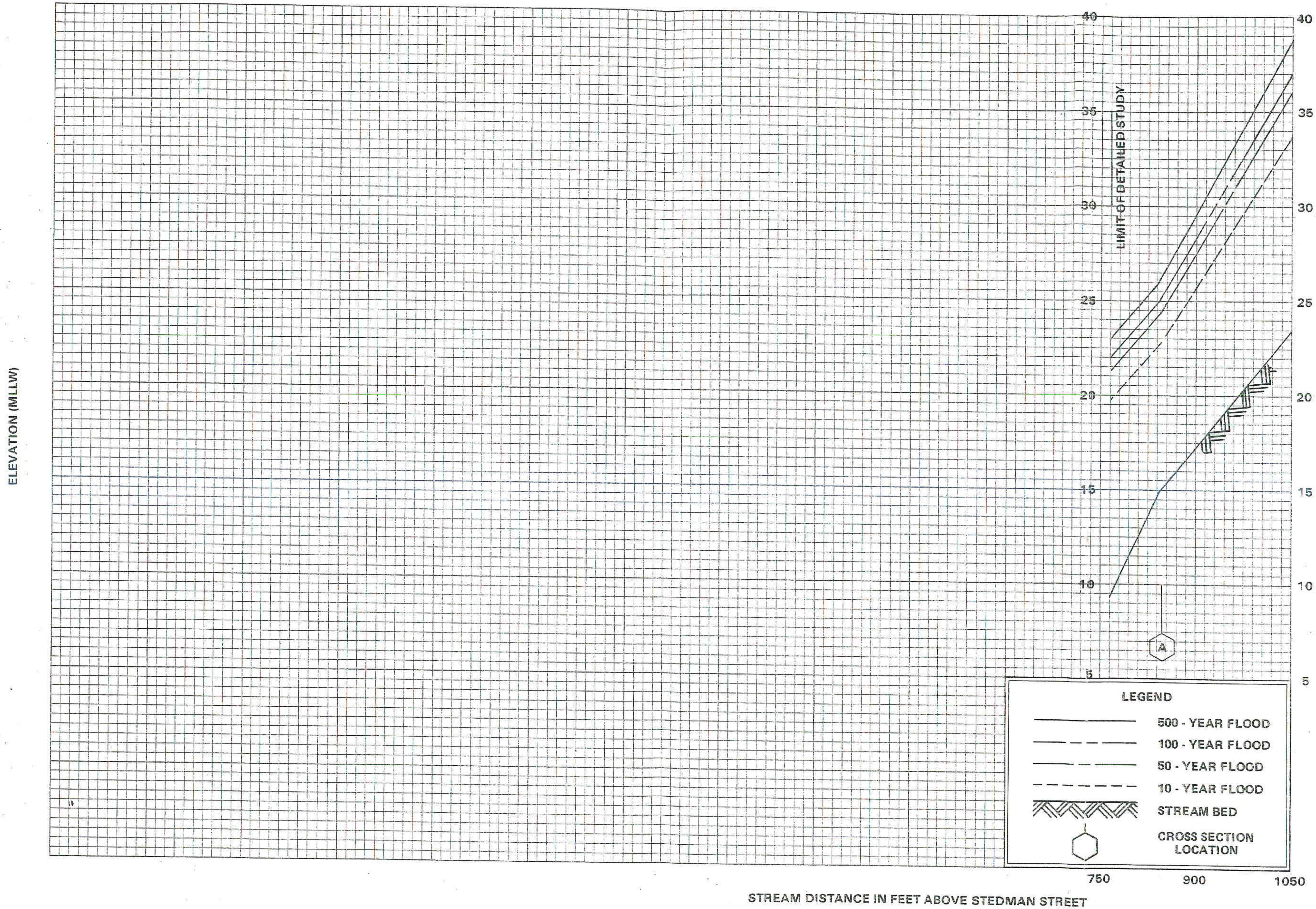
6. U.S. Department of Interior, U.S. Geological Survey, Guidelines for Determining Flood Flow Frequencies Bulletin #17B, 1982.

7. Ketchikan Gateway Borough Natural Features, 1"-100' topographical mapping, Ketchikan, Alaska, January 1987.

8. U.S. Army Corps of Engineers, Hydrologic Engineering Center, HEC-2 Water Surface Profiles, Generalized Computer Program, Davis, California, April 1984.9. U.S. Army Corps of Engineers, Floodplain Information Reports, Volume I: Ketchikan Creek, Volume II: Hoadley Creek, Volume III: Carlanna Creek, June 1974.



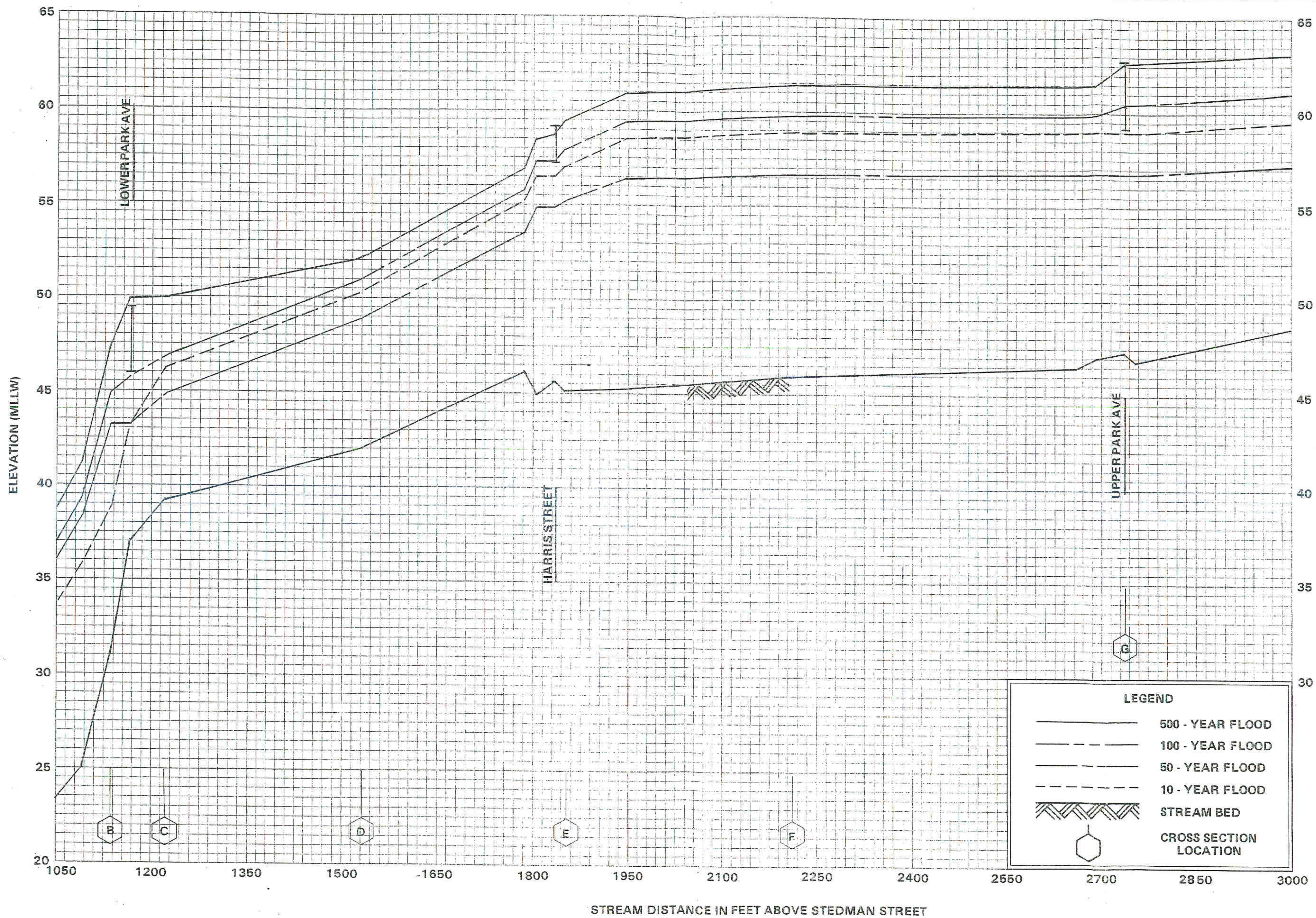
FLOOD PROFILES

KETCHIKAN CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF KETCHIKAN, AK
(KETCHIKAN GATEWAY BOROUGH)

01P



FLOOD PROFILES

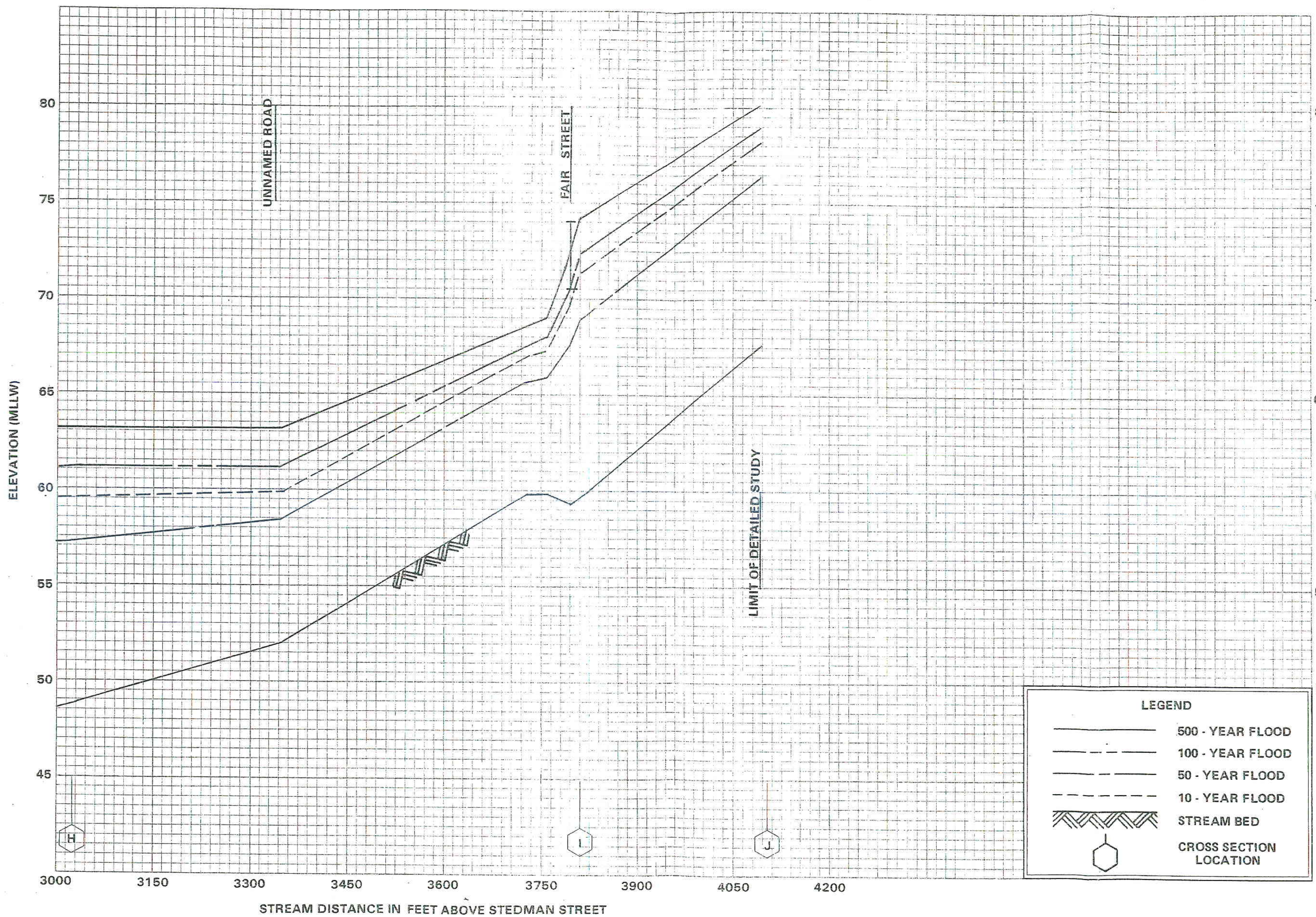
KETCHIKAN CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF KETCHIKAN, AK

(KETCHIKAN GATEWAY BOROUGH)

02P



FLOOD PROFILES

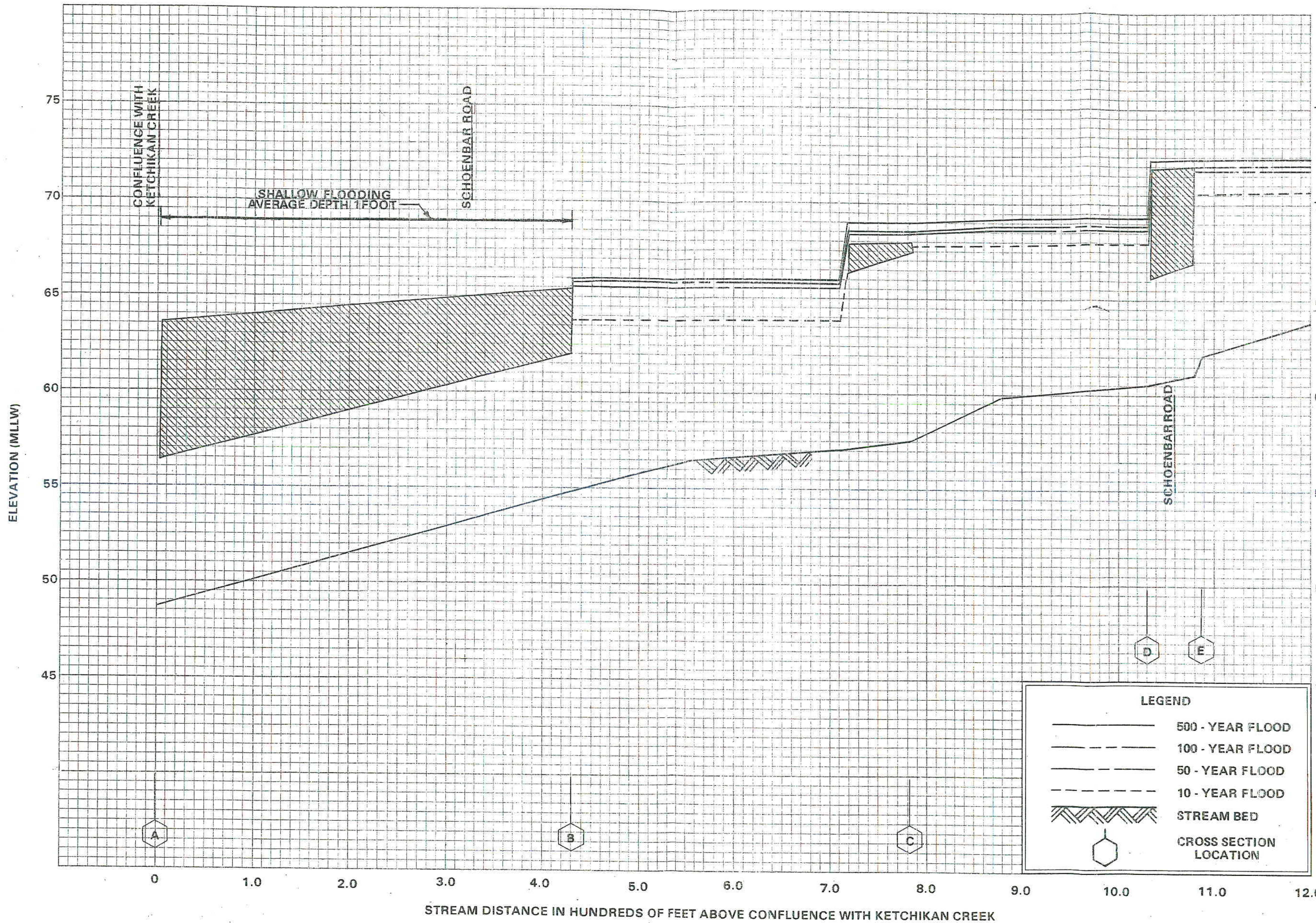
KETCHIKAN CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF KETCHIKAN, AK

(KETCHIKAN GATEWAY BOROUGH)

03P



FLOOD PROFILES

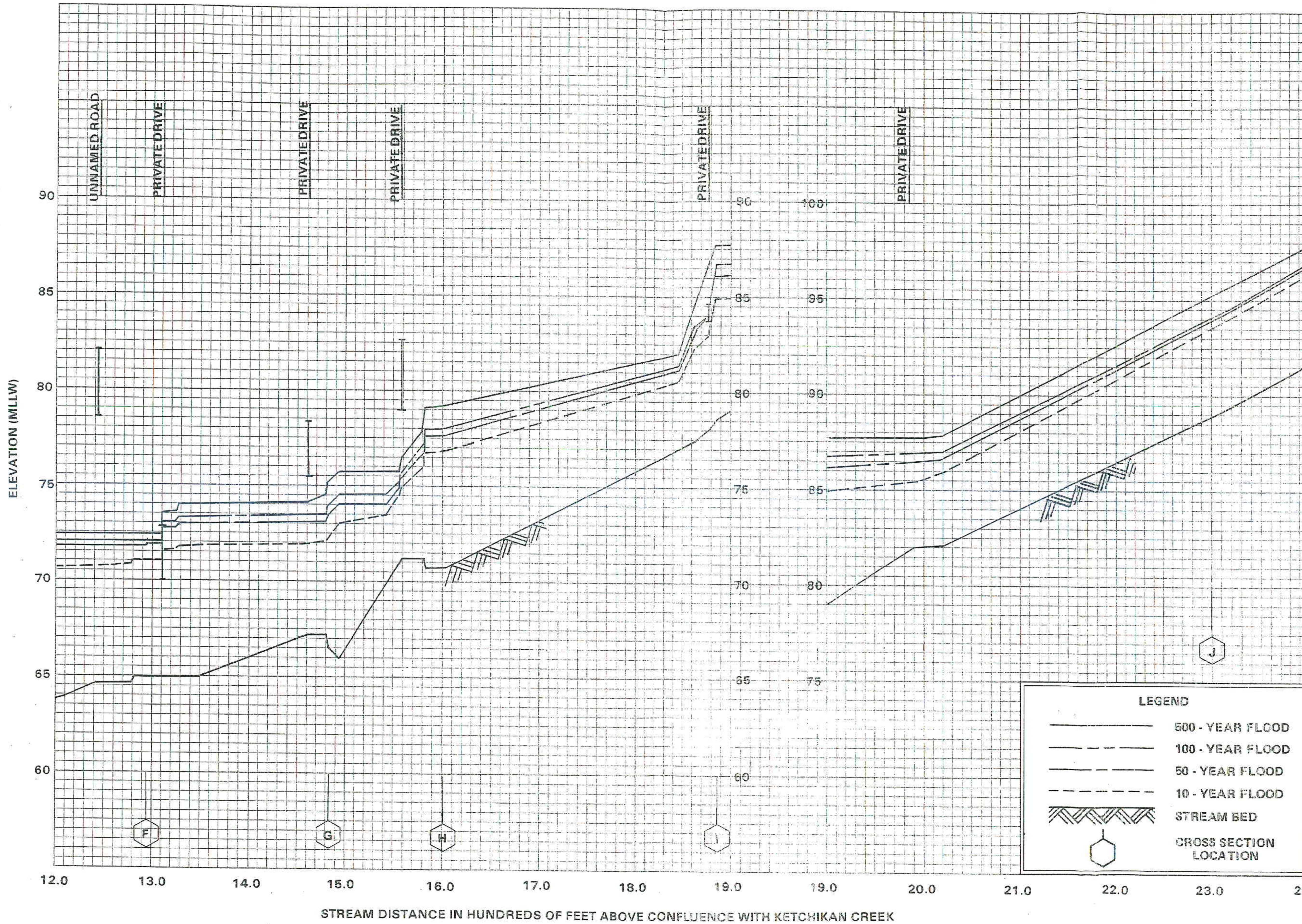
SCHOENBAR CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF KETCHIKAN, AK

(KETCHIKAN GATEWAY BOROUGH)

04P



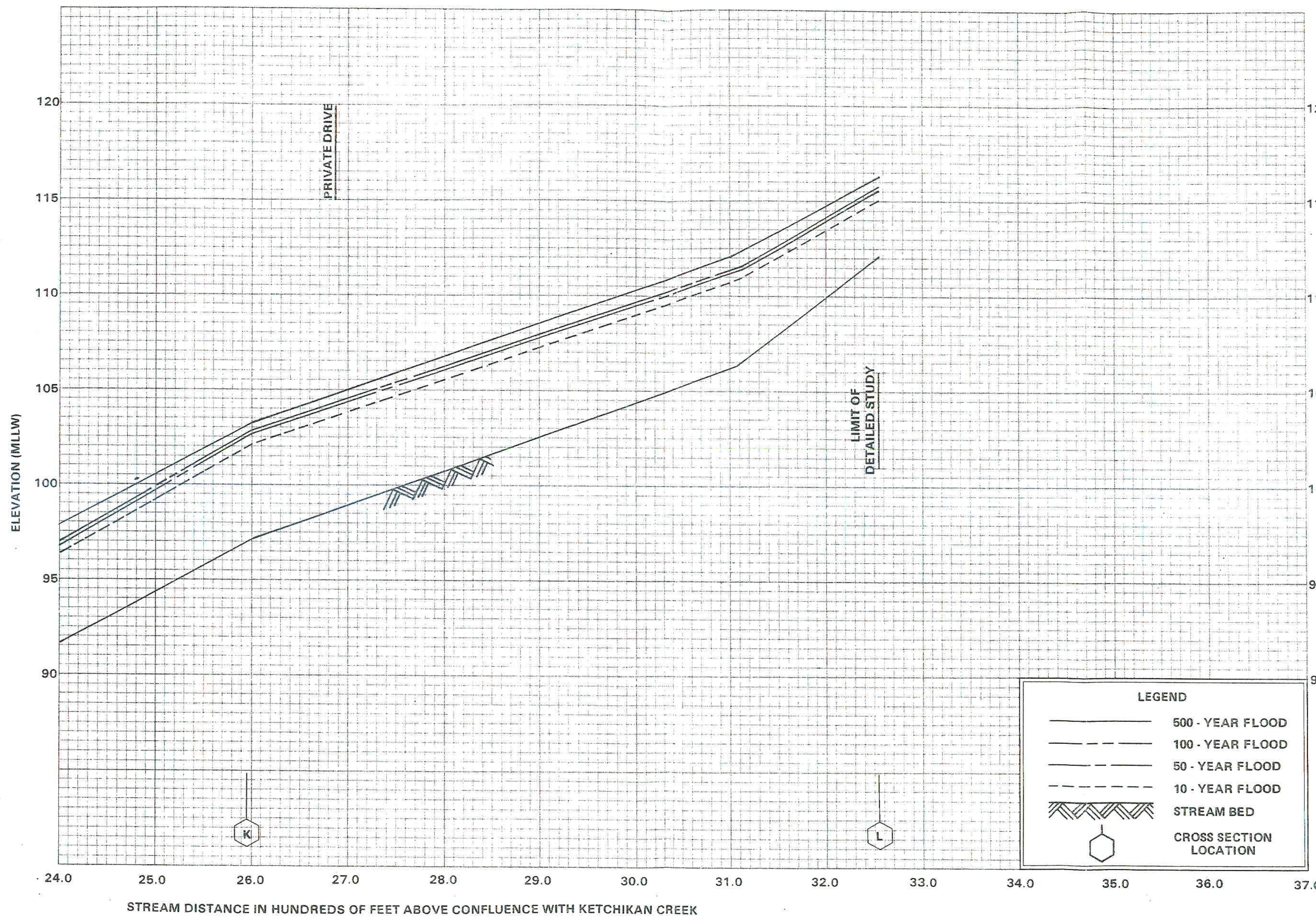
FLOOD PROFILES

SCHOENBAR CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF KETCHIKAN, AK
(KETCHIKAN GATEWAY BOROUGH)

05P



FLOOD PROFILES

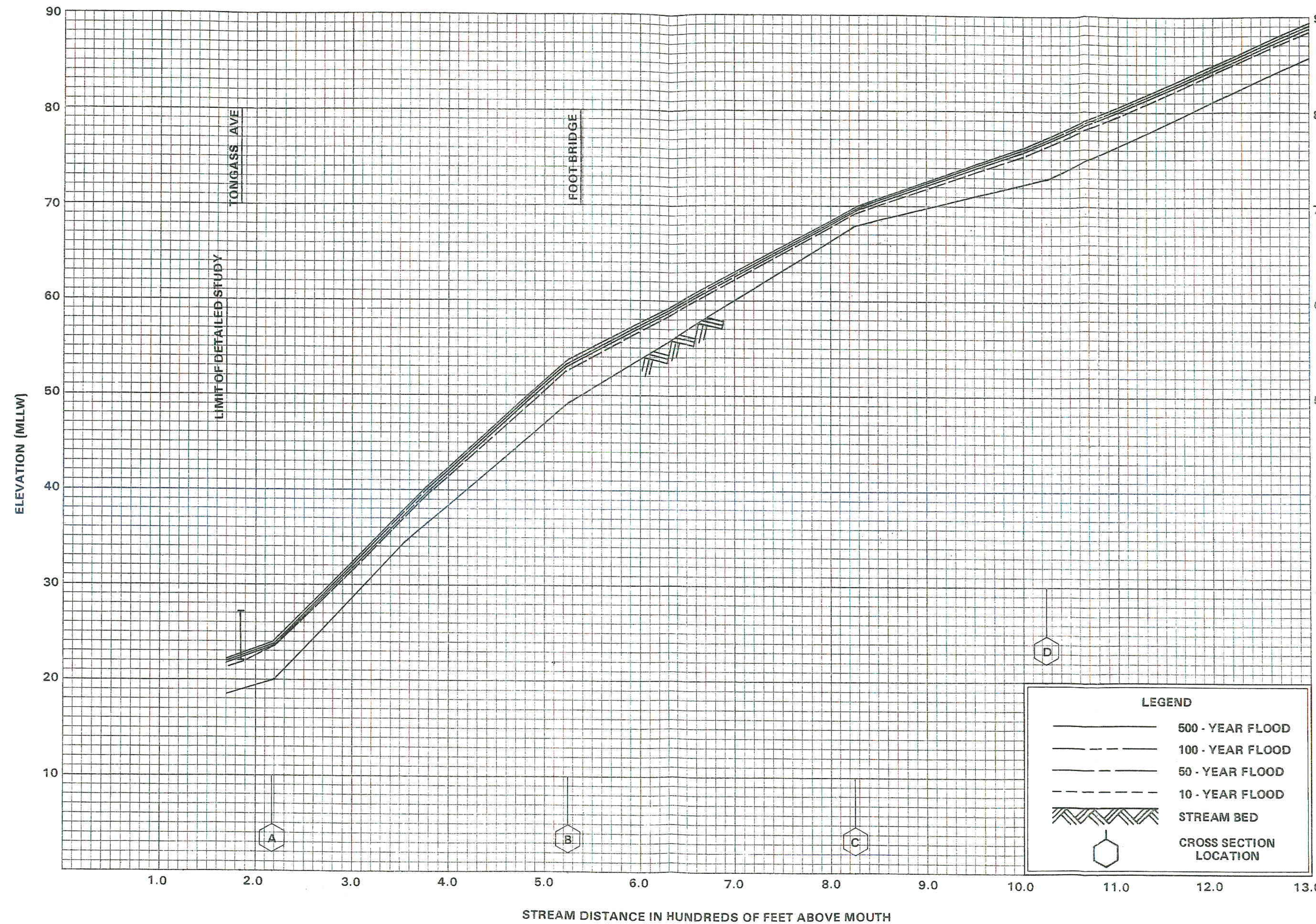
SCHOENBAR CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF KETCHIKAN, AK

(KETCHIKAN GATEWAY BOROUGH)

06P



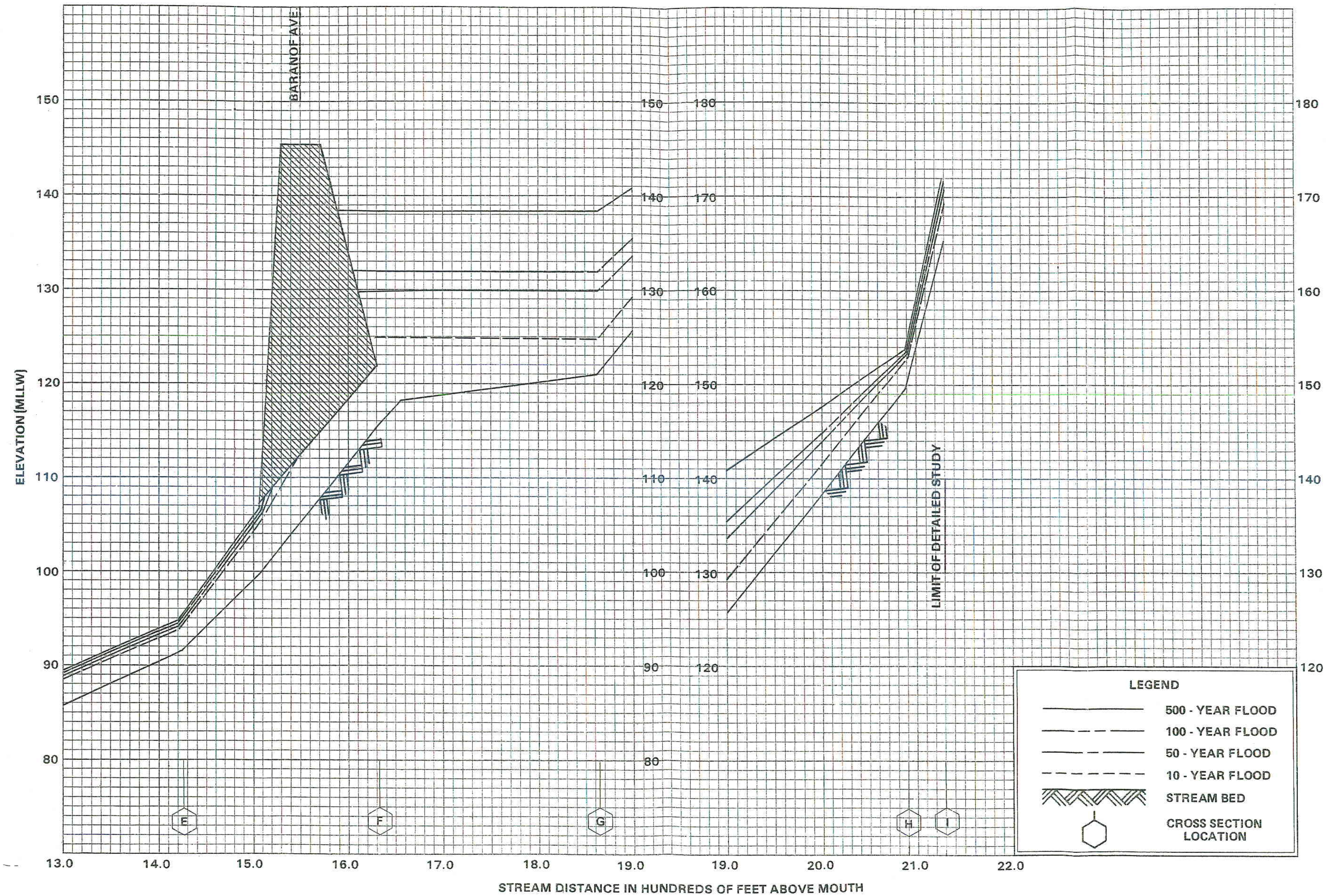
FLOOD PROFILES

HOADLEY CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF KETCHIKAN, AK (KETCHIKAN GATEWAY BOROUGH)

07P



FLOOD PROFILES

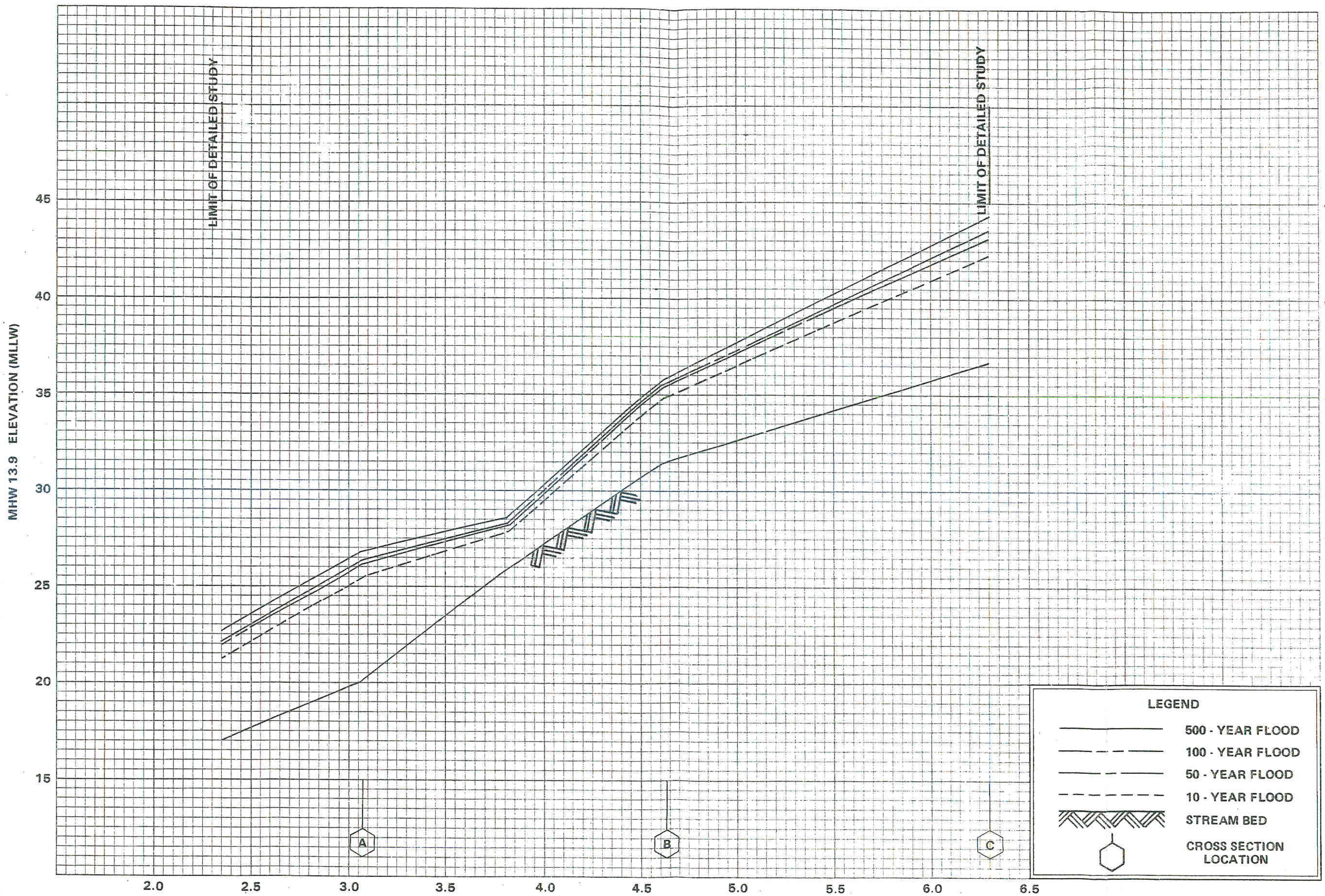
HOADLEY CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF KETCHIKAN, AK

(KETCHIKAN GATEWAY BOROUGH)

08P



FLOOD PROFILES

CARLANNA CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF KETCHIKAN, AK
(GATEWAY BOROUGH)

09P

EXHIBIT 3

Elevation Reference Marks

Datum is Mean Lower Low Water (MLLW)

Reference Mark	Elevation (feet MLLW)	Description of Location
RM 1	59.03	City of Ketchikan Bench Mark C-30. Top bolton fire hydrant near intersection of Park and Harris Street at Bridge.
RM 2	116.60	City of Ketchikan Bench Mark nail in powerpole at intersection of Fairly Chasm and Schoenbar Roads.
RM 3	289.09	City of Ketchikan TBM (pp#1005) spike in side of powerpole at intersection of Lincoln and Jackson Street.

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