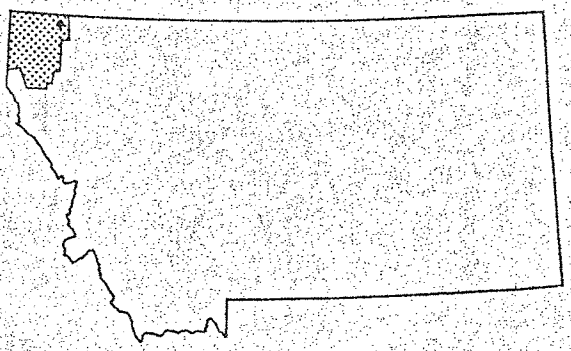
FLOOD INSURANCE STUDY

TOWN OF EUREKA, MONTANA

LINCOLN COUNTY



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JANUARY 1979

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

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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 Town of Eureka, Lincoln County, Montana, and to aid in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. Initial use of this information will be to convert Eureka to the regular program of flood insurance by the Federal Insurance Administration. Further use of the information will be made by local and regional planners in their efforts to promote sound land use and flood plain development.

1.2 Coordination

Streams requiring detailed and approximate study were identified in a prestudy community meeting held in Libby, Montana, on April 14, 1976. The meeting was attended by personnel of the Federal Insurance Administration; Montana Department of Natural Resources, Floodway Management Bureau; U.S. Department of Agriculture; Kootenai National Forest Service; HKM Associates (the study contractor); Lincoln County; and, the Town of Eureka.

Contacts were made by the study contractor in an effort to coordinate activities and accumulate pertinent information. The following agencies and offices were contacted in addition to those mentioned above: U.S. Geological Survey; Tobacco Valley Newspaper; Eureka and Lincoln County Libraries; Montana Department of Highways; Burlington Northern Railway; and U.S. Army Corps of Engineers, Seattle District.

Hydrologic analyses and flood profiles for the Tobacco River in Eureka were coordinated by the study contractor with those developed by the U.S. Geological Survey and the U.S. Soil Conservation Service.

A final community coordination meeting was held on June 14, 1978, attended by representatives of the Federal Insurance Administration, the study contractor, and the State Department of Natural Resources. No problems were encountered at this meeting.

1.3 Authority and Acknowledgments

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 performed by HKM Associates, for the Federal Insurance Administration, under Contract No. H-4026. This work, which was completed in October 1977, covered all significant flooding sources affecting the Town of Eureka.

2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the incorporated area of the Town of Eureka, Lincoln County, Montana. The area of study is shown on the Vicinity Map (Figure 1).

Floods caused by the overflow of the Tobacco River were studied in detail.

Sinclair Creek near Eureka was designated as a stream to be studied by approximate methods. However, because the Tobacco River branches upstream of the corporate limits and shares a similar channel with Sinclair Creek for the high-magnitude floods (particularly the 100-year flood, which is associated with the approximate study criteria), the detailed study results for the Tobacco River are applicable to the Sinclair Creek reach located within the corporate limits.

Those areas studied by detailed methods were chosen with consideration given to all proposed construction and forecasted development through 1982.

2.2 Community Description

The Town of Eureka, located in northeastern Lincoln County, in northwestern Montana, is considered to be one of the three most important towns in the county. For many years, Eureka was one of the chief lumbering centers in Montana and had one of the largest lumber mills. After this large mill burned, however, lumbering gradually declined, although it is still one of the main industries. Eureka is surrounded by unincorporated areas of Lincoln County, and most of the ranching and farming areas in the county are located nearby.

Eureka had an estimated 1973 population of 1258, which is an increase of 63 over the 1970 census (Reference 1) and 29 over the 1960 census (Reference 2). It is projected that, for the next 15 years, Eureka will continue its present rate of growth. Future growth for the area should take place in the northwestern part of the city and out of the Tobacco River bottom.

The Tobacco River originates in the Salish Mountains in the Kootenai National Forest and flows northwesterly and westerly until it empties into Lake Koocanusa (Kootenai River prior to the completion of Libby Dam in 1973). The Tobacco River maintains relatively steep channel slopes in the mountains and foothills, and gradually flattens in the valley areas near Eureka and further west to the lake.

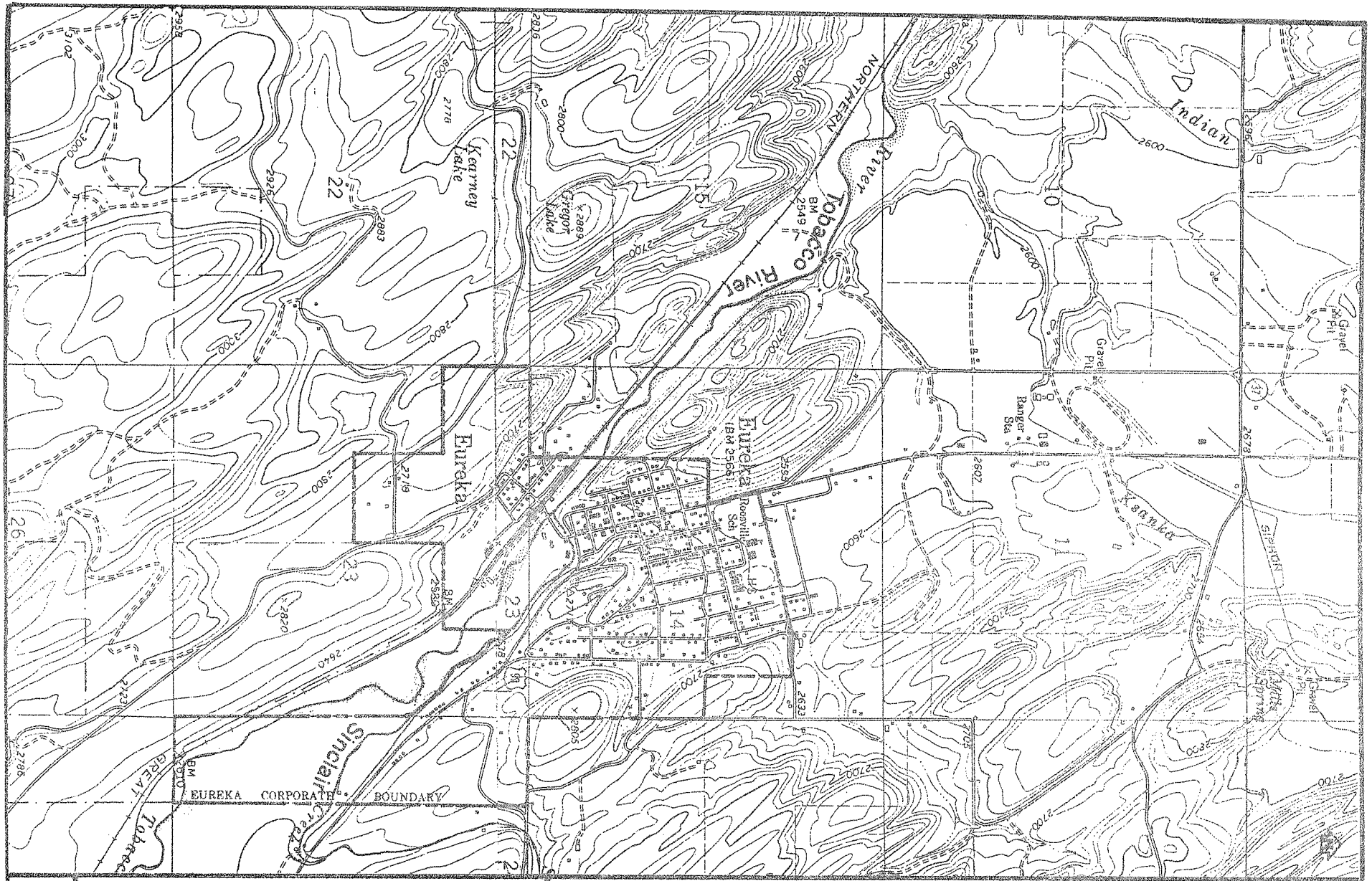

FIGURE 1

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT

Federal Insurance Administration

TOWN OF EUREKA, MT

(LINCOLN CO.)

VICINITY MAP

The mountainous character of the region and its wide elevation ranges within short distances both help to produce large variations in climate. Except for the higher mountain ridges and cultivated or populated valley bottoms, Lincoln County has extensive heavy forests, which is indicative of a moist climate. Of all Montana counties, the climate of Lincoln County is closest to Pacific Maritime; but, continental (cold winters, warm summers) effects are experienced for at least a few days every year. Winters are neither as wet nor as warm as pure Pacific coast types; however, the summer coastal tendency for dry summers is clearly evident. The Pacific Northwest characteristic of warm midsummer days is also found in the Lincoln County portion of the Kootenai Valley. Annual average temperatures throughout the county show a fairly wide range. For Eureka, the January average is approximately 20°F, the July average is approximately 67°F, and the annual average is approximately 45°F.

Precipitation in this area is more abundant than in most Montana counties, especially along the mountain ranges. Around Eureka, the continental characteristics are evident, with a little more than one-half of the yearly average precipitation coming during the April-September growing season. Annual average precipitation in the valley is typically a semi-arid total of approximately 13 inches, with well over 20 inches in the mountainous secitons. For the county, in general, snowfall averages run from 50 to 60 inches in the valley bottoms to several hundred inches along the mountains. The mountain snowfall is an important contribution to the pronounced spring and early summer runoff maximums observed on all streams in the county which rise in mountainous country.

The northwest corner of Montana, where Eureka is located, has a much lower thunderstorm frequency than areas to the east; when thunderstorms occur in the county, they are usually less forceful than elsewhere in the state. In fact, if one recognizes that heavy mountain snowfall is a normal part of the county winter climate complex, it may be concluded that really severe storms are rare in most of Lincoln County.

Lincoln County has been influenced by alpine glaciation. Some areas are covered with material that was picked up, mixed, and redeposited either by the ice or by water from the ice as it melted. The variations in the soils result from alterations of geologic material by climate and living organisms, especially vegetation. The length of time these forces have been active and the topography on which the action has occurred also contribute to these variations.

Most of the Tobacco River watershed is characterized by alluvial soils along the streams and gray wooded soils (alfisols) in the mountain regions. In the mountain regions, vegetation consists mainly of coniferous forest. A dark surface layer of less than 4 inches may be present just under the forest litter and, in its absence, a light grey to white zone that is from 4 to 12 inches thick

lies just beneath the litter. The subsoil, a mixture of surface soil and substratum, may extend to depths of 3 to 4 feet. The major clay accumulation lies below this zone of mixing, and may extend to depths of 6 feet in extreme samples.

The Tobacco River (combined with Sinclair Creek) passes through a relatively undeveloped and sparsely inhabited area between the Burlington Northern Railroad embankment on the south and the major portion of Eureka on the north. There is only one major commercial enterprise, some historical buildings, and a park located on the flat flood plains.

2.3 Principal Flood Problems

Low-lying areas of the Town of Eureka are subject to periodic flooding caused by overflow of the Tobacco River. The most severe flooding along the Tobacco River occurs in the mid-winter months and early spring as a result of snowmelt and heavy rains. Occasionally, ice jams cause some overbank flooding.

During the January 1974 flood in northwestern Montana, the Tobacco River left its banks in places and deposited ice in the low-lying areas near the Lincoln County Electric Coop and the park. However, the maximum discharge measured for 1974 at a local U.S. Geological Survey gage occurred in June, not in January. In fact, the June 1974 event is the largest for the gaging station period of record. A prerecord flow of 2970 cubic feet per second for May 1948 is considered to be the largest flow for the reporting period (Reference 3).

Rapid snowmelt and rainfall is occasionally experienced in isolated sections of Eureka, causing insignificant shallow flooding. The areas experiencing this phenomenon are usually located in low points of sloping terrain.

2.4 Flood Protection Measures

The flood protection works along the Tobacco River and Sinclair Creek are minimal. Natural topographic features contain the flows on the north side and either natural topographic features or a northern railroad embankment control flooding on the south side.

3.0 ENGINEERING METHODS

For 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. 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 flooding sources.

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 gaging station on the Tobacco River, located 1.8 miles northwest (downstream) of Eureka, provided peak flow measurement information. The gage has been operated since September 1958, which provided 17 years of recorded flows. A prerecord flow measurement for the 1948 event was included as part of the data set because it appeared to be comparatively homogeneous. Thus, the total annual peak flow series included 18 events. A log-Pearson Type III analysis (Reference 4) was performed on the above records using a regional skew factor of -0.15 as suggested by the U.S. Geological Survey.

Because the length of record was too short to use the log-Pearson Type III statistical analysis exclusively, several other flood frequency-determination methods were implemented. Regional regression relationships developed by Dr. E. R. Dodge for the Montana Department of Highways and the U.S. Geological Survey (References 5 and 6, respectively) were used. The U.S. Soil Conservation Service precipitation-runoff technique (Reference 7) was also used. The three different approaches were weighted according to level of reliability and significance to obtain values for the 10-, 50-, 100-, and 500-year peak discharges.

Peak discharge-drainage area relationships for Tobacco River are shown in Table 1.

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
Tobacco River					
At Gage	440	2700	3830	4360	5460
At Eureka	410	2590	3670	4180	5230

3.2 Hydraulic Analyses

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

Water-surface elevations were developed using the U.S. Army Corps of Engineers HEC-2 step-backwater computer model (Reference 8). Elevations were determined for the 10-, 50-, 100-, and 500-year floods.

Stream cross sections were located using available topographic mapping at a scale of 1:24,000, with contour intervals of 20 and 40 feet (Reference 9), and aerial photographs at a scale of 1:12,000 (Reference 10). Most cross section data for the Tobacco River, including both below-water and overbank areas, were obtained by field measurements. However, additional cross sections were occasionally required, which necessitated in-office development using field control information and the best topographic mapping (Reference 9). This last method of data estimation was implemented in lieu of using the U.S. Army Corps of Engineers HEC-2 computer program cross section interpolation capability (Reference 8). It appeared that the HEC-2 computer program technique was not adequately sensitive to the area's rapidly changing channel morphology and flood conditions.

Hydraulic structures were field measured unless data summaries and/or plans were available to define elevations and geometry. Three structures are located in the detailed study area: the Dewey Avenue bridge over the Tobacco River; the Dewey Avenue bridge over Sinclair Creek; and the Burlington Northern Railroad bridge along the Tobacco River in the upstream sections of the area studied.

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 is computed (Section 4.2), selected cross section locations are also shown on the Flood Boundary and Floodway Map (Exhibit 2).

Roughness coefficients (Manning's "n") were estimated by field inspection and aerial photograph review (Reference 10). Roughness value selection was made using any one of a combination of the following approaches, depending on the reach in question: (1) detailed development and weighting considering all factors affecting the value of "n"; (2) consultation of tables with typical "n" values for channels of various types; (3) comparision and familiarity with certain channel hydraulics and associated roughness coefficients; and (4) comparision to work previously completed by the U.S. Geological Survey on indirect flow measurement exercises. For the Tobacco River, channel roughness values ranged from 0.036 to 0.045; overbank values ranged from 0.030 for pasture and cultivated areas to 0.090 for timbered and heavy undergrowth areas.

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).

Starting water-surface elevations were obtained for the appropriate flood events using a stage-discharge rating curve. The rating curve was developed using information at the U.S. Geological Survey gaging station located approximately 1.8 miles northwest of Eureka. The hydraulic model was then stepped upstream through a series of manually estimated cross sections to the beginning of the detailed study. However, it was found that critical depth was experienced for all flood frequency events between the gaging station site and the start of the detailed study; therefore, the rating curve at the gaging station site was found to be of limited significance in developing the model.

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

It is felt that a relatively important limitation in the study was the number of field-measured cross sections that were allowed because of budgetary constraints. This statement is based on the fact that the HEC-2 computer model would frequently interpolate cross sections throughout the study reach. The Tobacco River has a relatively steep bed slope and occasionally experiences rather significant changes in channel morphology and flow conditions.

The flood study for Sinclair Creek within the Eureka corporate limits was reduced from detailed to approximate classification by the Federal Insurance Administration midway through the study. However, the Sinclair Creek channel is shared by the Tobacco River during high flows, and it is felt that the Tobacco River flooding and stage would be the controlling situation in the reach.

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. Each 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 Federal Insurance Administration 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 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 at scale of 1:24,000, with contour intervals of 20 and 40 feet (Reference 9).

Another possible limitation is the fact that flood plain boundary verification was rather difficult for the more severe events because the associated floodflows have not been experienced within the short period of record and prerecord period (1948 to 1976).

In cases where the 100- and 500-year flood boundaries are close together, only the 100-year flood boundary has been shown.

Flood boundaries for the 100- and 500-year floods are shown on the Flood Boundary and Floodway Map (Exhibit 2).

Approximate flood boundaries for Sinclair Creek were taken from the U.S. Soil Conservation Service's Flood Prone Area Map (Reference 11).

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 and increases flood heights, thus increasing 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 National 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 be carried without substantial increases in flood heights. As minimum standards, the Federal Insurance Administration limits such increases in flood heights to 1.0 foot, provided that hazardous velocities are not produced.

In Montana, encroachment in the flood plain is limited to that which will cause an increase in flood heights of 0.5 foot. Thus, at the recommendation of the State of Montana, a floodway having no more than a 0.5-foot surcharge has been delineated for this study.

A floodway was computed for Eureka even though relatively high and hazardous velocities exist in most of the Tobacco River study reaches. The reason for this is that the area of most concern for the community is located immediately upstream of the Dewey Avenue bridge where the flood plain is quite wide and the velocities are more reasonable.

The floodway for the Tobacco River was computed on the basis of equal conveyance reduction from each side of the flood plain. The floodway was computed assuming no ice jamming near the Dewey Avenue bridge and park area. The results of these computations are tabulated at selected cross sections for each stream segment for which a floodway is computed (Table 2).

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

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 0.5 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to flood plain development are shown in Figure 2.

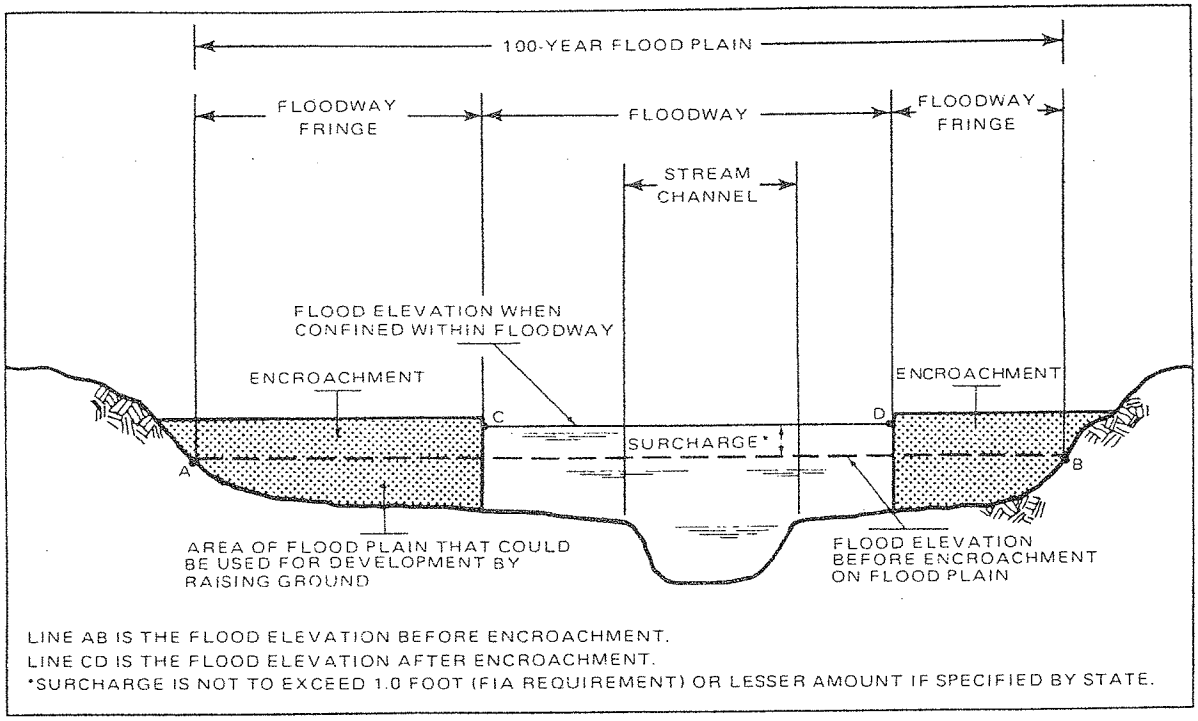

Figure 2. Floodway Schematic

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION		
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	WITH FLOODWAY	WITHOUT FLOODWAY (FEET NGVD)	DIFFERENCE
Tobacco River							
A	13,310	158	966	4.3	2,560.8	2,560.5	0.3
B	13,550	119	505	7.7	2,561.1	2,560.8	0.3
C	13,575	119	512	7.6	2,561.2	2,560.9	0.3
D	13,675	282	1,154	3.4	2,562.5	2,562.5	0.0
E	14,650	326	1,034	3.8	2,563.6	2,563.4	0.2
F	15,700	216	610	6.4	2,566.4	2,566.4	0.0
G	20,400	297	754	5.5	2,586.2	2,586.1	0.1

[1]Feet Above Mouth

TABLE 2

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

TOWN OF EUREKA, MT
(LINCOLN CO.)

FLOODWAY DATA

TOBACCO RIVER

5.0 INSURANCE APPLICATION

In order to establish actuarial insurance rates, the Federal Insurance Administration 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, and flood insurance zone designations for each flooding source studied in detail affecting the Town of Eureka.

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 between the 10- and 100-year floods. This difference does 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

One reach meeting the above criterion was required for Tobacco River, the flooding source of Eureka. The location of the reach is shown on the Flood Profiles (Exhibit 1).

5.2 Flood Hazard Factors

The Flood Hazard Factor (FHF) is the Federal Insurance Administration device used to correlate flood information with insurance rate tables. Correlations between property damage from floods and their FHF 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 between water-surface elevations of 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 Flood Hazard Factors, the entire incorporated area of the Town of Eureka 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 Flood Hazard Factors determined.
Zone A2:	Special Flood Hazard Areas inundated by the 100-year flood, determined by detailed methods; base flood elevations shown, and zones subdivided according to Flood Hazard Factors.
Zone B:	Areas between the Special Flood Hazard Areas 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; also areas subject to certain types of 100-year shallow flooding where depths are less than 1.0 foot; and areas subject to 100-year flooding from sources with drainage areas less than 1 square mile. Zone B is not subdivided.
Zone C:	Areas of minimal flooding.

The flood elevation differences, Flood Hazard Factors, flood insurance zones, and base flood elevations for each flooding source studied in detail in the community are summarized in Table 3.

5.4 Flood Insurance Rate Map Description

The Flood Insurance Rate Map for the Town of Eureka 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 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 Federal Insurance Administration.

6.0 OTHER STUDIES

No other detailed studies have been completed for the Tobacco River and the Eureka area. The U.S. Geological Survey and the U.S. Soil Conservation Service have done preliminary work in Lincoln County for the

FLOODING SOURCE	PANEL[1]	ELEVATION DIFFERENCE[2] BETWEEN 1% (100-YEAR) FLOOD AND			FLOOD HAZARD FACTOR	ZONE	BASE FLOOD ELEVATION (FEET NGVD)[3]
		10% (10-YEAR)	2% (50-YEAR)	0.2% (500-YEAR)			
Tobacco River Reach 1	0005	-1.2	-0.3	0.6	010	A2	Varies - See Map

[1]Flood Insurance Rate Map Panel [2]Weighted Average [3]Rounded to Nearest Foot

TABLE 3

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

TOWN OF EUREKA, MT
(LINCOLN CO.)

FLOOD INSURANCE ZONE DATA

TOBACCO RIVER

purpose of developing Flood-Prone Area Maps. For the Eureka area in particular, the U.S. Soil Conservation Service developed the flood plain boundary information for the Federal Insurance Administration and published the results in March 1974 (Reference 11).

During the study contractor's reconnaissance trip, it was mentioned that local U.S. Forest Service personnel have been actively working on some regional hydrology studies (concentrated efforts in regression equation development using detailed field investigations, including channel and overbank geomorphic interpretations). However, the study contractor was unable to obtain this literature following personal and letter correspondence contacts.

This study is authoritative for the purposes of the National Flood Insurance Program; data presented herein either supersede or are compatible with all previous determinations.

7.0 LOCATION OF DATA

Survey, hydrologic, hydraulic, and other pertinent data used in this study can be obtained by contacting the office of the Federal Insurance Administration, Regional Director, Room 311, 909 17th Street, Denver, Colorado 80202.

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