FLOOD INSURANCE STUDY

CITY OF COLD SPRING, MINNESOTA
STEARNS COUNTY

AUGUST 1977

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

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FLOOD INSURANCE STUDY

1.1 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 City of Cold Spring, Stearns County, Minnesota, 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 Cold Spring 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

Liaison was maintained with Barr Engineering, the private consulting firm engaged in a Flood Insurance Study for adjacent areas in Stearns County. Flow-frequency data, profiles, and flood outlines were furnished to this firm to provide for continuity of data between adjacent studies.

An initial coordination meeting was held with city officials and a representative of the Minnesota Department of Natural Resources (state coordinating agency) to inform the city of the impending study and request assistance in identifying areas of known flood potential. Areas selected for detailed study were identified at this meeting.

Upon the completion of flood boundary outlines, a meeting was held with the City Planning Commission and a representative of the Minnesota Department of Natural Resources to discuss the floodway concept and minimum standard requirements. The city was provided with copies of the flood outlines for their use in establishing floodways.

The flow-frequency estimate for the 100-year flood on the Sauk River was coordinated with the U. S. Army Corps of Engineers to eliminate all possible future conflicts.

A final community coordination meeting was held on July 26, 1976, to review the results of the study. In

attendance were city officials and representatives from the U. S. Geological Survey, Federal Insurance Administration, and Minnesota Department of Natural Resources. No objections to the study results were raised 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 the U.S. Geological Survey for the Federal Insurance Administration, under Inter-Agency Agreement No. IAA-H-17-75, Project Order No. 7. This work, which was completed in August 1976, covered all flooding sources affecting the City of Cold Spring, Minnesota.

2.0 AREA STUDIED

2.1 Scope of Study

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

Floods caused by overflow of the Sauk River were studied in detail. Brewery Creek was studied by approximate methods because flood plain areas, other than the backwater reach from the Sauk River, are largely undeveloped. The detailed and approximate study areas were chosen with consideration given to all proposed developments through 1981.

2.2 Community Description

Cold Spring, located in central Minnesota about 16 miles southwest of St. Cloud, has a population of 2006 according to the 1970 census. The community is situated in the south-central part of Stearns County. The economy of the area is based primarily on agriculture and industry. Its proximity to the expanding St. Cloud metropolitan area will contribute to a steady growth rate.

The Sauk River, which flows through the southeast quarter of the city, has a drainage area of 832 square miles. A small tributary stream, Brewery Creek, passes through the northern half of the community and empties into the Sauk River at the east corporate limits.

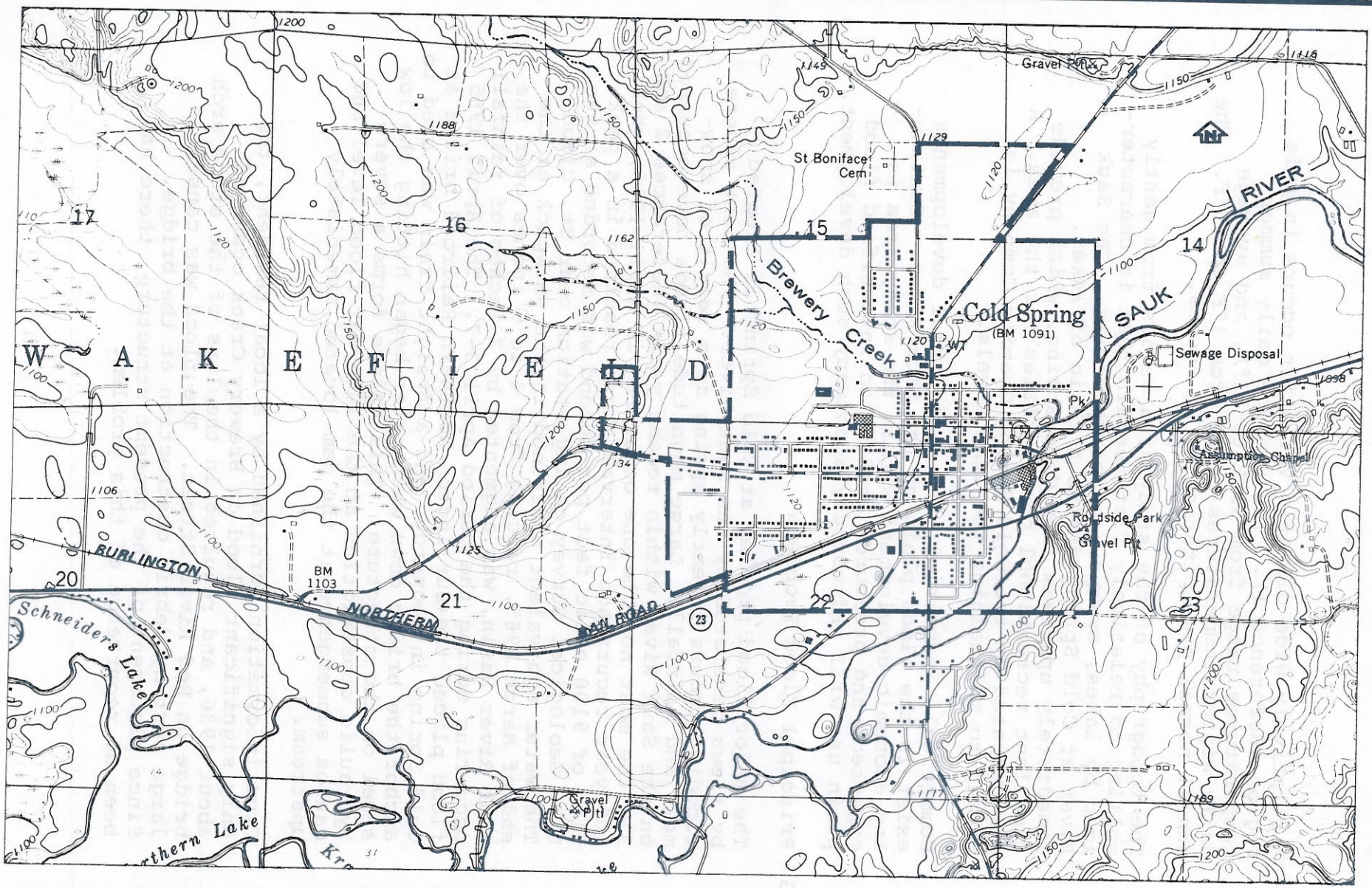

FIGURE 1

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

CITY OF COLD SPRING, MN

(STEARNS CO.)

APPROXIMATE SCALE

1000 0 2000 4000 6000 FEET

VICINITY MAP

A relatively wide climatic variation occurs in this region (Reference 1). The average daily summer temperatures range from 55°F to 83°F, and average daily winter temperatures range from 1°F to 25°F. The annual normal precipitation is 25 inches.

The topography of the study area varies from gently rolling to relatively flat terrain that is characterized by lakes, swamps, and marshy areas. The Sauk River at Cold Spring drains a chain of lakes, immediately upstream from Cold Spring, which provide excellent recreational opportunities for the area. A dam operated by the Cold Spring Granite Company is an aid to maintaining the lake levels.

Commerical, industrial, and residential developments exist in the flood plain of the Sauk River. Continuing economic development within the study area is expected, and pressures leading to intensified flood plain use will undoubtedly accompany such development.

2.3 Principal Flood Problems

The major flood problem at Cold Spring is created by flows generated by the Sauk River. The most severe flooding occurs in early spring as a result of snowmelt and rainfall. Large magnitude floods have occurred on the Sauk River within recent years (References 2 and 3), the most notable one occurring in April 1965, when a 100-year recurrence interval storm resulted in a peak flow of 9100 cubic feet per second was recorded at the U.S. Geological Survey gaging station near St. Cloud. The water equivalent contained in the snowpack at the end of March 1965, ranging from 4 to 9 inches over the Sauk River Basin, was augmented by 2 inches of rainfall occurring during the period April 3-7. The April 1965 flood placed the Burlington Northern Railroad bridge at Cold Spring in jeopardy, and a freight train was used to anchor the bridge down when water began hitting the low steel on the structure. This bridge forms a severe hydraulic constriction at the 100-year flood level and causes submergence at the dam located immediately upstream.

From information furnished by a local resident, the only significant flood on Brewery Creek occurred about 1936, and resulted in the loss of the stone arch bridge on Red River Street. The flood was caused in large part by debris obstruction at the bridge. Since placement of the present structure, there has been no recurrence of this problem.

2.4 Flood Protection Measures

No flood protection in the form of physical structures, such as dikes or retaining walls, have been constructed in Cold Spring.

3.0 ENGINEERING METHODS

For the flooding source studied in detail in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. 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 the Sauk River.

A gaging station on the Sauk River, located about 16 miles downstream at St. Cloud, was the principal source of data for defining discharge-frequency relationships for the river. The gage was operated briefly during the period 1909-12, and has been in continuous operation since 1930 (Reference 4). Values of the 10-, 50-, 100-, and 500-year peak discharges were derived for the gaged site by a log-Pearson Type III analysis, according to the methods outlined by the Water Resources Council (Reference 5), using a regionalized coefficient of -0.20 for skewness of the logarithms. Coordination with the study contractor engaged in studying the adjacent areas in Stearns County resulted in a small adjustment to the upper end of the frequency curve. The adjustment at the 100-year recurrence interval was only 3 percent. Flow-frequency values were then transferred upstream to Cold Spring on the basis of drainage area ratios to the 0.6 power.

Drainage area-peak discharge relationships for the study area are compared with maximum known peak discharges on nearby streams having similar hydrologic characteristics in Figure 2.

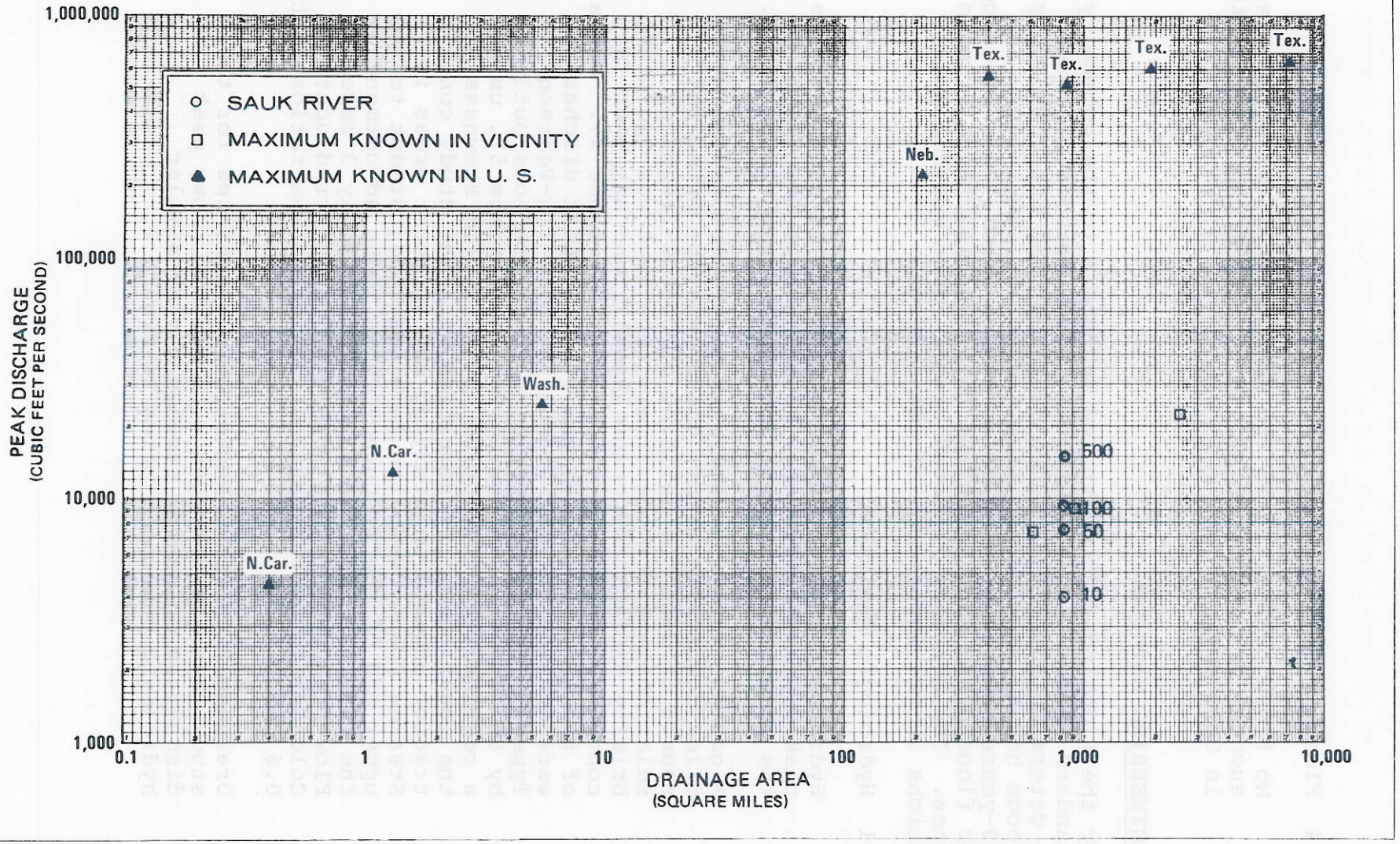

FIGURE 2

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

CITY OF COLD SPRING, MN
(STEARNS CO.)

FREQUENCY-DISCHARGE, DRAINAGE AREA CURVES

SAUK RIVER

3.2 Hydraulic Analyses

Analyses of the hydralic 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 detail.

Overbank cross section data were obtained by photogrammetric compilation from 1975 aerial photography; the below-water sections were obtained by field survey. All bridges and dams were surveyed to obtain elevation data and structural geometry. Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Boundary and Floodway Map (Exhibit 3).

Roughness coefficients (Manning's "n") were estimated by field inspection at each cross section and then adjusted on the basis of historical profile data. The range in "n" values was from a low of 0.024 in the main channel to a high of 0.18 in the overbank area.

Water-surface profiles for floods of the selected recurrence intervals were computed through use of the U.S. Army Corps of Engineers HEC-2 step-backwater computer program (Reference 6). Discharge measurements were made and profile points established in the study area to document the flood that occurred during April 1975. This information, together with high-water marks for the floods of 1965 and 1969, were used to develop stage-discharge curves throughout the study reach. Calibration of the computer model was then accomplished by the adjustment of "n" values, so as to reproduce the known historical flood profiles.

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). All elevations are measured from National Geodetic Vertical Datum of 1929 (NGVD). Elevation reference mark descriptions used in the study are shown on the maps.

Flood elevations in the city may be 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.

Flood boundaries for Brewery Creek were determined by approximate methods using depth of flooding curves developed for flood-prone area mapping.

Backwater effects from the Sauk River are apparent near the mouth of Brewery Creek.

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.

Boundaries of the 100-year and 500-year floods along the Sauk River were delineated by photogrammetric means. For this purpose, flood elevations at locations between cross sections were supplied to the photogrammetric contractor, in addition to those determined at the cross sections, so as to improve the accuracy of the flood outlines. Flood boundaries were compiled directly onto planimetric maps at a scale of 1:6000. In cases where the 100-year and 500-year flood boundaries are close together, only the 100-year boundary has been shown. Flood boundaries along Brewery Creek, where approximate methods were used, were outlined on a topographic map at a scale of 1:24,000, with a contour interval of 10 feet.

Flood boundaries are indicated on the Flood Insurance Rate Map (Panel 0001). On this map, the 100-year flood boundary corresponds to the boundary of the areas of special flood hazards (Zone A5); and the 500-year flood boundary corresponds to the boundary of areas of moderate flood hazards (Zone B).

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 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 Minnesota, however, flood plain regulations (Minnesota Regulation NR 85) adopted in accordance with the authority granted in Minnesota Statutes 1969, statue section 104.05, limit the increases in flood heights to 0.5 foot, which is the maximum limiting value used in this study.

City officials of Cold Spring have designated a floodway for the Sauk River for all areas under their jurisdiction. It is the intent of community officials to incorporate this floodway designation into the city zoning ordinances. The results of the floodway analysis, tabulated at selected cross sections, show that the designated floodway will meet minimum Federal and State standards (Table 1). The effects of any permissible encroachment on the flood plain upstream from the Cold Spring Granite Company Dam are virtually negligible because of the enlarged channel capacity in the impounded area.

Designated floodway limits are shown on the Flood Boundary and Floodway Map (Exhibit 3).

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 the specified amount at any point. Typical relationships between the floodway and the floodway fringe and their significance to flood plain development are shown in Figure 3.

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION		
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	WITH FLOODWAY	WITHOUT FLOODWAY (FEET NGVD)	DIFFERENCE
SAUK RIVER							
A	20.75	249[2]	2030	4.6	1084.6	1084.1	0.5
B	20.89	560	3450	2.7	1085.2	1084.7	0.5
C	21.06	292	2880	3.3	1085.6	1085.1	0.5
D	21.09	183	1980	4.7	1085.6	1085.1	0.5
E	21.13	268	2610	3.6	1091.1	1091.1	0.0
F	21.25	148	2430	3.9	1091.2	1091.2	0.0
G	21.29	573	5750	1.6	1091.6	1091.6	0.0
H	21.42	644	7570	1.2	1091.6	1091.6	0.0
I	21.55	415[2]	4820	1.9	1091.6	1091.6	0.0

[1]Miles Above Mouth
[2]Part of Floodway Outside the Corporate Limits

TABLE 1

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

CITY OF COLD SPRING, MN
(STEARNS COUNTY)

FLOODWAY DATA

SAUK RIVER

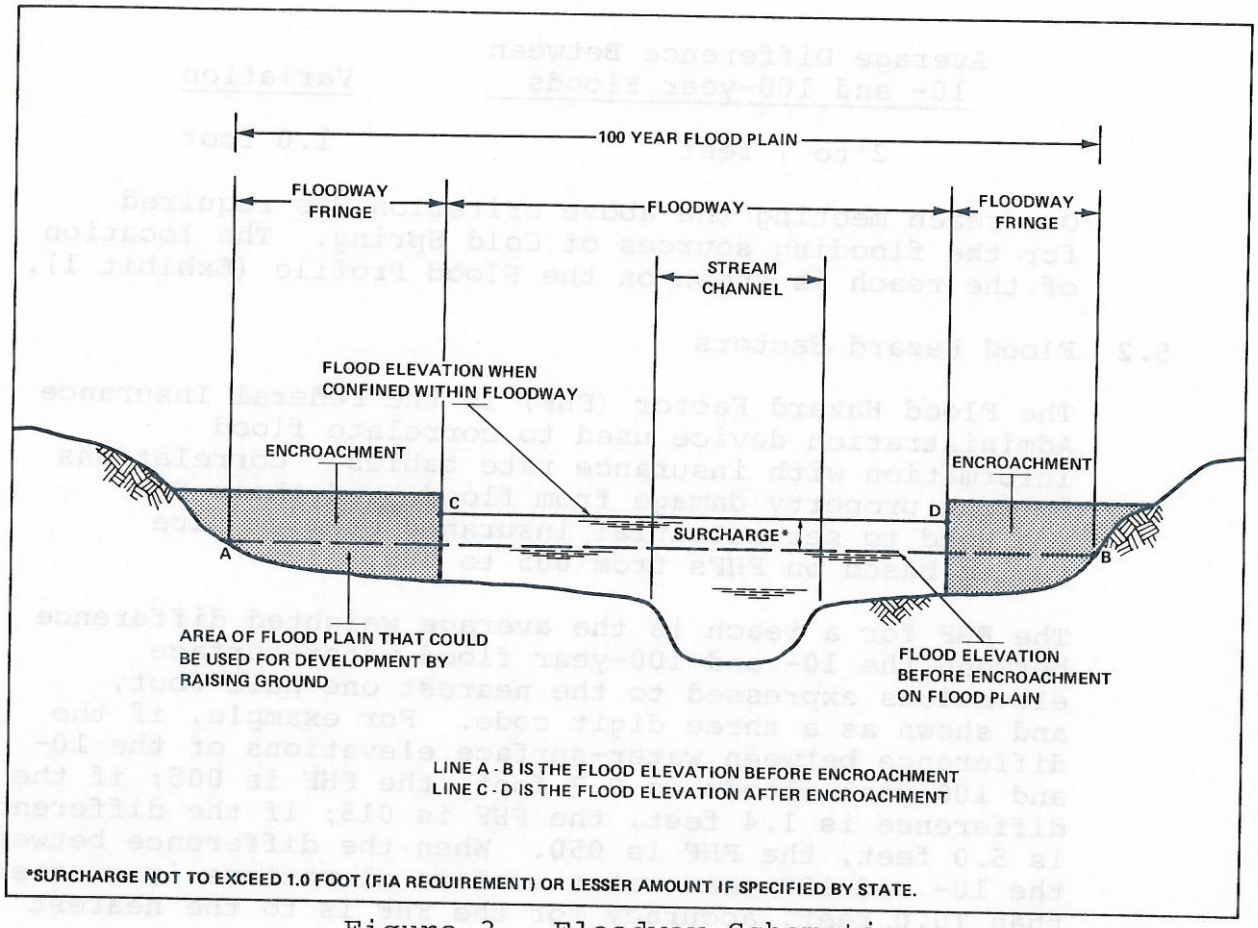

Figure 3. Floodway Schematic

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 City of Cold Spring.

5.1 Reach Determination

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
2 to 7 feet	1.0 foot

One reach meeting the above criterion was required for the flooding sources of Cold Spring. The location of the reach is shown on the Flood Profile (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 Cold Spring 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 or Flood Hazard Factors determined.

Zone A5: 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 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; not subdivided.

Table 2, "Flood Insurance Zone Data," summarizes the flood elevation differences, Flood Hazard Factors, flood insurance zones, and base flood elevations for the flooding source studied in detail in the community.

5.4 Flood Insurance Rate Map Description

The Flood Insurance Rate Map for the City of Cold Spring 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 elevation 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

A Flood Insurance Study involving the Sauk River in adjacent areas upstream and downstream from Cold Spring is being prepared, but has not yet been published. It is being prepared by Barr Engineering Company of Minneapolis, Minnesota.

This Flood Insurance Study is authoritative for purposes of the Flood Insurance Program and the data presented here supersede all previous determinations.

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)			
SAUK RIVER Reach 1	01	-2.5	-0.8	+3.0	025	A5	Varies-See Map

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

TABLE 2

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

CITY OF COLD SPRING, MN
(STEARNS COUNTY)

FLOOD INSURANCE ZONE DATA

SAUK RIVER

7.0 LOCATION OF DATA

Survey, hydrologic, hydraulic, and other pertinent data used in this study are on file at the district office of the U.S. Geological Survey, Water Resources Division, 1033 Post Office Building, St. Paul, Minnesota 55101. Data will be available for a minimum of 10 years.

8.0 BIBLIOGRAPHY AND REFERENCES

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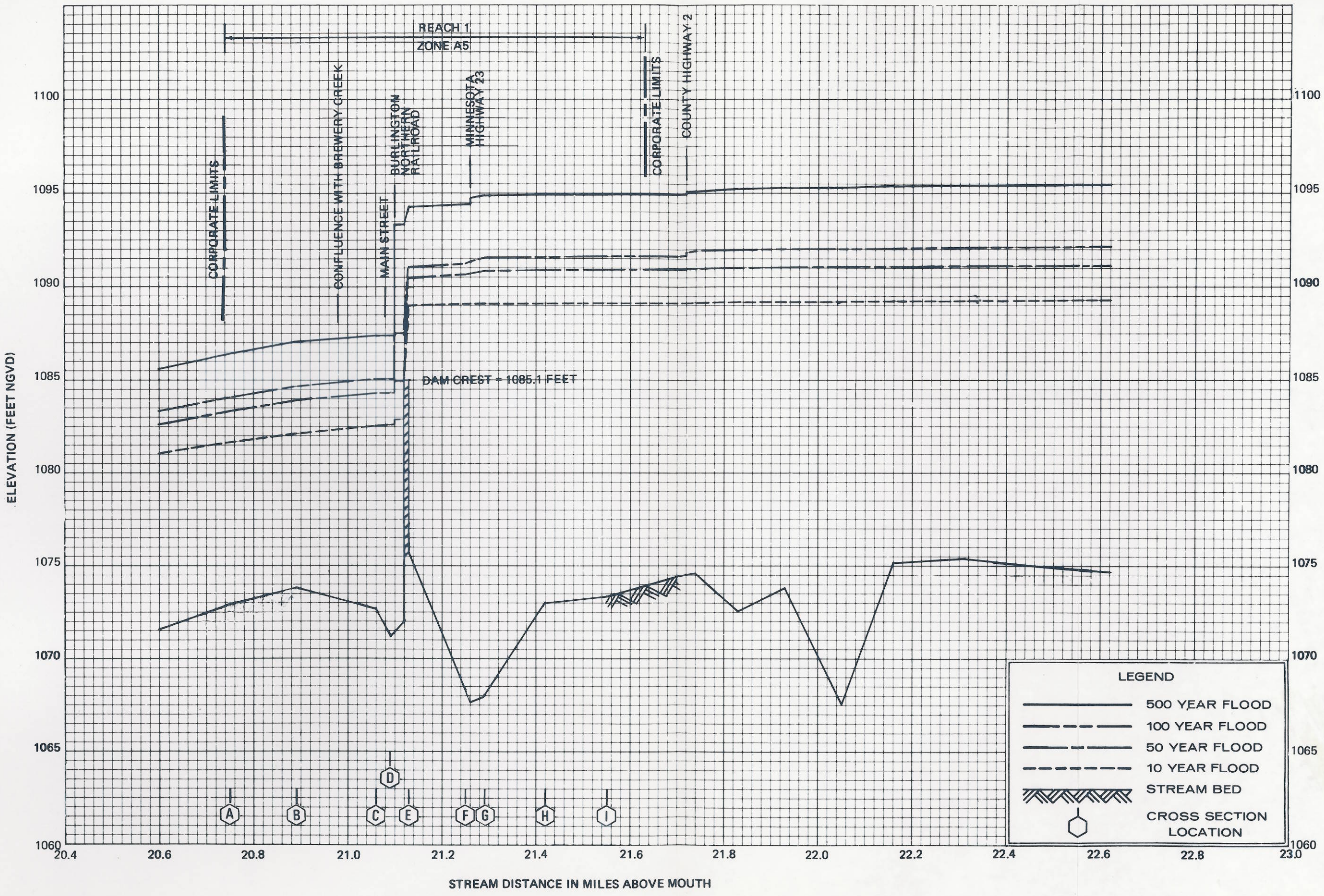
2. U. S. Geological Survey, Water Supply Paper 1850-A, Floods of March-May 1965 in the Upper Mississippi River Basin, D. B. Anderson, and I. L. Burmeister. 1970

3. ----------, Open-File Report, Floods of April-May 1969 in Upper Midwestern United States, D. B. Anderson and H. H. Schwob, 1970

4. ----------, Water Resources Data for Minnesota, Annual Reports

5. Water Resources Council, "A Uniform Technique for Determining Flood Flow Frequencies", Bulletin 15, December 1967

6. U. S. Army Corps of Engineers, Hydrologic Engineering Center, HEC-2 Water-Surface Profiles, Generalized Computer Program, Davis, California, 1972



FLOOD PROFILES

SAUK RIVER

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

CITY OF COLD SPRING, MN
(STEARNS CO.)

01P

ELEVATION REFERENCE MARKS

REFERENCE MARK	PANEL	ELEVATION (FEET NGVD)	LOCATION DESCRIPTION
RM 1	01	1100.42	At northeast corner of Red River Street North and Second Street North; top of fire hydrant.
RM 2	01	1097.23	At northeast corner of Red River Street South and First Street South; top of fire hydrant.
RM 3	01	1090.78	Along Burlington Northern Railway track at bridge over Sauk River, in top of north side of west abutment; U.S. Coast and Geodetic Survey disc stamped BM M 18, 1933.
RM 4	01	1094.29	At northwest corner of Second Avenue South and Third Street South; head of 3/8 inch lag screw in south face of power pole.
RM 5	01	1094.54	Along south side of Minnesota Highway 23, 0.4 mile southwest of junction with County Highway 2, directly south of large brown house to north; head of 3/8 inch lag screw, 1 foot above ground, in northwest face of power pole.
RM 6	01	1097.41	At northeast corner of Fourth Street South and Fifth Avenue South; top of fire hydrant.
RM 7	01	1096.06	At northeast corner of Red River Street South and Fifth Street South; top of fire hydrant.

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

CITY OF COLD SPRING, MN
(STEARNS COUNTY)

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