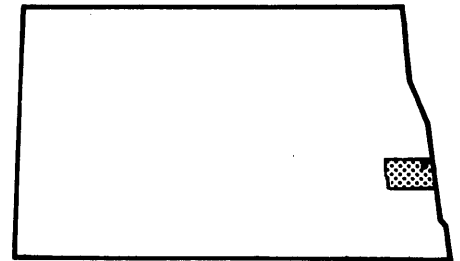


FLOOD INSURANCE STUDY



**CASS COUNTY,
NORTH DAKOTA
RED RIVER OF THE NORTH**



JANUARY 1980

**FEDERAL EMERGENCY MANAGEMENT AGENCY
FEDERAL INSURANCE ADMINISTRATION**

COMMUNITY NUMBER - 380268

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Exhibit 2 - Flood Insurance Rate Map	Township of Pleasant Panel 380263 0025A Township of Wisner Panel 380267 0025A Township of Noble Panel 380268 0025A Township of Stanley Panel 380258 0025A Township of Harwood Panel 380259 0025A Township of Reed Panel 380257 0025A City of Harwood Panel 380338 0001A

FLOOD INSURANCE STUDY

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 incorporated areas of Cass County, North Dakota, affected by the Red River of the North, 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 these incorporated areas 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

Contacts with the U.S. Army Corps of Engineers, the U.S. Soil Conservation Service, the U.S. Geological Survey, and the North Dakota State Water Commission provided information and coordination needed to produce this study.

Final community coordination meetings were held on August 7, 1979, for the Townships of Harwood, Noble, and Wiser; on August 9, 1979, for the Township of Reed, and on August 22, 1979 for the City of Harwood. Attending the meetings were representatives of the Federal Insurance Administration, the study contractor, and the respective townships. Pertinent comments from these meetings have been incorporated into this study.

1.3 Authority and Acknowledgments

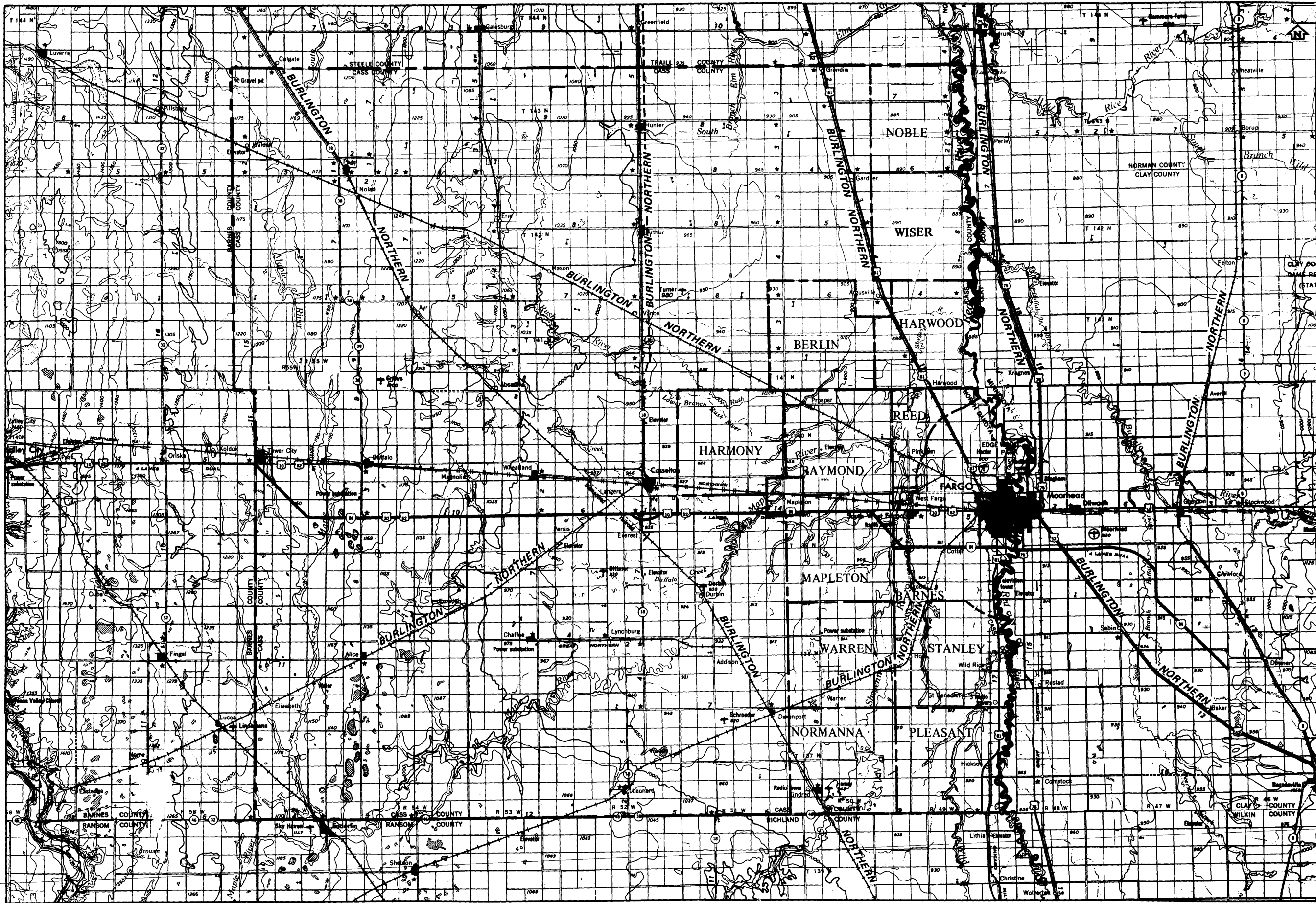
The source of authority for this Flood Insurance Study is the National Flood Insurance Act of 1968, as amended.

This Flood Insurance Study was prepared by Dames & Moore for the Federal Insurance Administration, under Contract No. H-3952. This work, which was completed in May 1978, covered all significant flooding sources affecting the incorporated areas of Cass County affected by the Red River of the North.

2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the incorporated areas of Cass County, North Dakota, affected by the Red River of the North. The Township of Gardner was originally to be included but was found to be in a non-flood-prone area. The area of study is shown on the Vicinity Map (Figure 1).



DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
 Federal Insurance Administration

CASS COUNTY, ND
RED RIVER OF THE NORTH

VICINITY MAP

FIGURE 1

Flooding caused by overflow of the Red River of the North was studied by detailed methods.

Areas selected for detailed study were selected based on the availability of flooding data.

Those areas studied by detailed methods were chosen with consideration given to all proposed construction and forecasted development through 1983.

2.2 Community Description

Cass County is located on the southeastern border of North Dakota, approximately 120 miles south of the Canadian border. Cass County is bordered on the north by Traill and Steele Counties, on the west by Barnes County, on the south by Ransom and Richland Counties, and on the east by the Red River of the North and Norman and Clay Counties, Minnesota. The county is almost square, having an average east-west width of approximately 42 miles, a north-south length of 42 miles, and an area of 1750 square miles. The entire county is in the Red River of the North basin (Reference 1).

The county includes two general physiographic areas: a glacial lake plain and a glacial moraine. The lake plain, located in the eastern half of the county, was formed by Lake Agassiz. This area is extremely flat, sloping only a few feet per mile eastward near the Red River of the North which forms the eastern border of the county (Reference 1). The basin is very flat due to the uniform deposition of sediment from glacial Lake Agassiz (Reference 2). The flat land surface and small capacity of natural channels results in slow runoff and flooding (Reference 1).

The moraine, located in the western half of the county, is largely an area of gently rolling hills. The streams in the morainal area generally have better defined channels and steeper gradients than those in the lake plain (Reference 1).

The climate is generally of the continental type, with warm summer days, cool summer nights, and cold, snowy winters. Mean temperatures at Fargo, North Dakota, vary from 7.3°F in January to 71.4°F in July, with extremes ranging from 95°F to -35°F (Reference 3). Average annual precipitation ranges from approximately 20 inches near the Red River of the North to approximately 18 inches at the western edge of the county (Reference 1). Most precipitation falls as rain in the spring and summer months (Reference 2).

The Red River of the North is formed at the confluence of the Otter Tail and Bois de Sioux Rivers at Breckenridge, Minnesota, and Wahpeton, North Dakota. From this point, the Red River of the North flows northward along the Minnesota-North Dakota boundary for a distance of 394 miles to the International Boundary. At Emerson, Manitoba, on the International Boundary, the river drains an area of approximately 40,070 square miles. The Red River of the North then flows

north-northeastward 155 miles, discharging into Lake Winnipeg, which is then drained by the Nelson River into Hudson Bay (Reference 2).

2.3 Principal Flood Problems

The Red River of the North basin exhibits a number of unusual characteristics which make it particularly susceptible to flooding. Because the basin is so flat, it allows water to spread out and inundate vast areas adjacent to the river. The northward direction of flow is a unique and important element in the overall flood pattern of the river. The melting season begins in the southern sections and progresses slowly northward, tending to synchronize the flood peak on the Red River of the North with the peaks of its tributaries, progressively increasing flood stages. Also, as the spring runoff moves northward, it often encounters sections on the river which are locked by ice, causing minor localized increases in flood stages (Reference 2).

Numerous large floods have occurred in the Red River of the North basin since the inception of flood data collection, the largest of these being the floods of 1882, 1897, 1950, 1965, 1966, and 1969 (Reference 2). The maximum recorded flood occurred on April 7, 1897, and the most recent flood occurred on April 15, 1969 (Reference 3). Estimated frequencies have not been determined for any of these floods, however, it has been determined that both the 1950 and 1969 floods had recurrence intervals of less than 100 years (Reference 2).

2.4 Flood Protection Measures

Flood damage reduction measures presently in use which benefit Cass County to some degree include Orwell Reservoir on the Otter Tail River, and Lake Traverse at the headwaters of the Bois de Sioux River. These effects were considered in the determination of flooding in this study.

Drainage in parts of the lake plain has been modified by ditches, channel modifications, and diversions (Reference 1).

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 equalled or exceeded once on the average during any 10-, 25-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for flood plain management and for flood insurance premium rates. These events, commonly termed the 10-, 25-, 100-, and 500-year floods, have a 10, 4, 1, and 0.2 percent chance, respectively, of being equalled 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 occurrence) in any 50-year period is approximately 40 percent (4 in 10), and for any 90-year period, the risk increases to approximately 60 percent (6 in 10). The analyses reported here reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

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

Flood frequency information for the Red River of the North was developed utilizing data from a U.S. Geological Survey gaging station located on the Red River of the North at the City of Fargo's water plant on Fourth Street, 25 miles upstream from the mouth of the Sheyenne River at Mile 453 (Reference 4); and the U.S. Geological Survey gaging stations on the Red River of the North at Wahpeton, North Dakota, and Halstad, Minnesota (Reference 1).

Peak discharge-drainage area relationships for Red River of the North are shown in Table 1.

The flood discharge estimates were based on interpretation of flow data after these data were correlated between stations. The statistical approach used in determining the floodflow frequency was in accordance with standards accepted by the U.S. Water Resources Council (Reference 5), the Minnesota Department of Natural Resources, and the North Dakota State Water Commission (Reference 2).

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
Red River of the North At Fargo, North Dakota	6,210	10,300	22,300	29,000	50,000

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 profiles for the Red River of the North for the 10-, 25-, 100-, and 500-year frequency floods were developed utilizing data from the Flood Insurance Studies for Fargo, North Dakota, and Cass County, North Dakota (References 4 and 1, respectively).

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

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 the stream studied in detail, the boundaries of the 100- and 500-year floods have been delineated using topographic maps at a scale of 1:24,000, with a contour interval of 5 feet (Reference 6).

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

Flood boundaries are indicated on the Flood Insurance Rate Maps for the individually affected communities. On these maps, the 100-year flood boundary corresponds to the boundary of the areas of special flood hazards (Zone A14); and the 500-year flood boundary corresponds to the boundary of the areas of moderate flood hazards (Zone B).

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

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. Floodways were not developed as they were beyond the scope of this study.

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 incorporated areas of Cass County, North Dakota.

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:

<u>Average Difference Between 10- and 100-year Floods</u>	<u>Variation</u>
Less than 2 feet	0.5 foot
2 to 7 feet	1.0 foot
7.1 to 12 feet	2.0 feet
More than 12 feet	3.0 feet

The location of the reach determined for the flooding source of the incorporated areas of Cass County affected by the Red River of the North are shown on the Flood Profiles (Exhibit 1) and summarized in Table 2.

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 FHF's 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 incorporated areas of Cass County affected by the Red River of the North were divided into zones, each having a specific flood potential or hazard. Each zone was assigned one of the following flood insurance zone designations:

FLOODING SOURCE	Communi- ties	ELEVATION DIFFERENCE ¹ BETWEEN 1% (100-YEAR) FLOOD AND			FLOOD HAZARD FACTOR	ZONE	BASE FLOOD ELEVATION ² (FEET NGVD)
		10% (10-YEAR)	4% (25-YEAR)	0.2% (500-YEAR)			
Red River of the North Reach 1	Noble Twp., Wiser Twp., Harwood Twp., Reed Twp., Stanley Twp., Pleasant Twp., City of Harwood	-6.89	-4.08	1.07	070	A14	Varies - See Map

¹Weighted Average ²Rounded to Nearest Foot

TABLE 2

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

CASS COUNTY, ND

RED RIVER OF THE NORTH

FLOOD INSURANCE ZONE DATA

RED RIVER OF THE NORTH

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 A14:	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 each community are summarized in Table 2.

5.4 Flood Insurance Rate Map Description

The Flood Insurance Rate Maps for the incorporated areas of Cass County affected by the Red River of the North are, for insurance purposes, the principal result of the Flood Insurance Study. These maps (published for each affected community) contain 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. These maps are developed in accordance with the latest flood insurance map preparation guidelines published by the Federal Insurance Administration.

6.0 OTHER STUDIES

The majority of data used in this Flood Insurance Study was taken directly from two studies: A Type 15 Flood Insurance Study for Cass County, North Dakota, and the Red River of the North Regional Flood Analysis (References 1 and 2, respectively).

Additional information was obtained from the Flood Insurance Studies for Fargo, North Dakota, and West Fargo, North Dakota (References 4 and 7, respectively), and a Flood Plain Information report on the Red River of the North (Reference 3).

The Flood Hazard Factors in this Flood Insurance Study do not agree exactly with the Fargo and West Fargo, North Dakota, Flood Insurance Studies due to the longer length of stream used to compute Flood Hazard Factors; however, base flood elevations do agree with this study.

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, Building 710, Denver Federal Center, Lakewood, Colorado 80225.

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(1959); Kindred, North Dakota (1959); Argusville, North Dakota (1963), Photorevised (1976); Perley, Minnesota-North Dakota (1963); Gardner, North Dakota (1963); Georgetown, Minnesota-North Dakota (1963); Casselton Southeast, North Dakota (1961), Photorevised (1971); Arthur Southeast, North Dakota (1966); Mapleton, North Dakota (1961)

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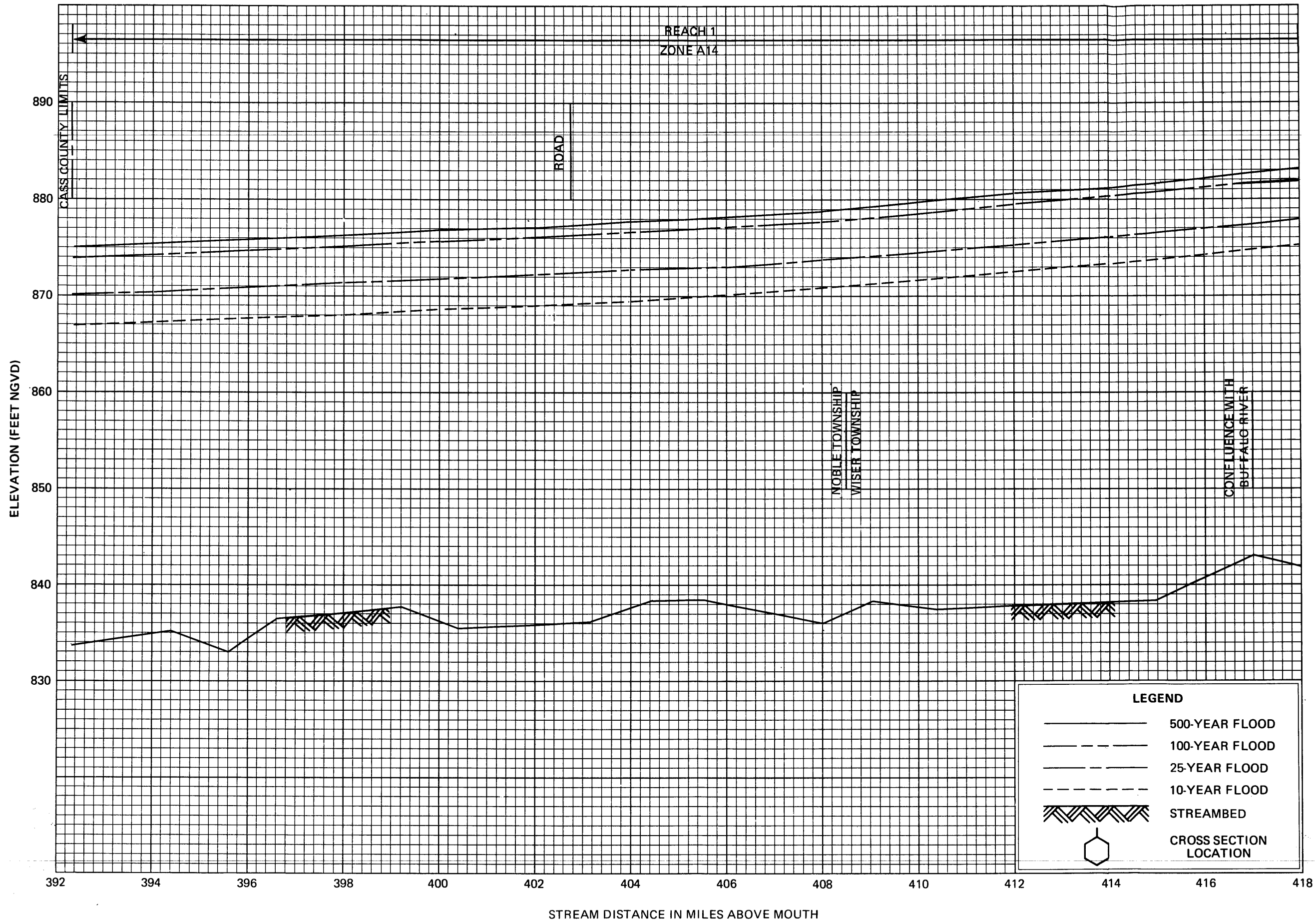
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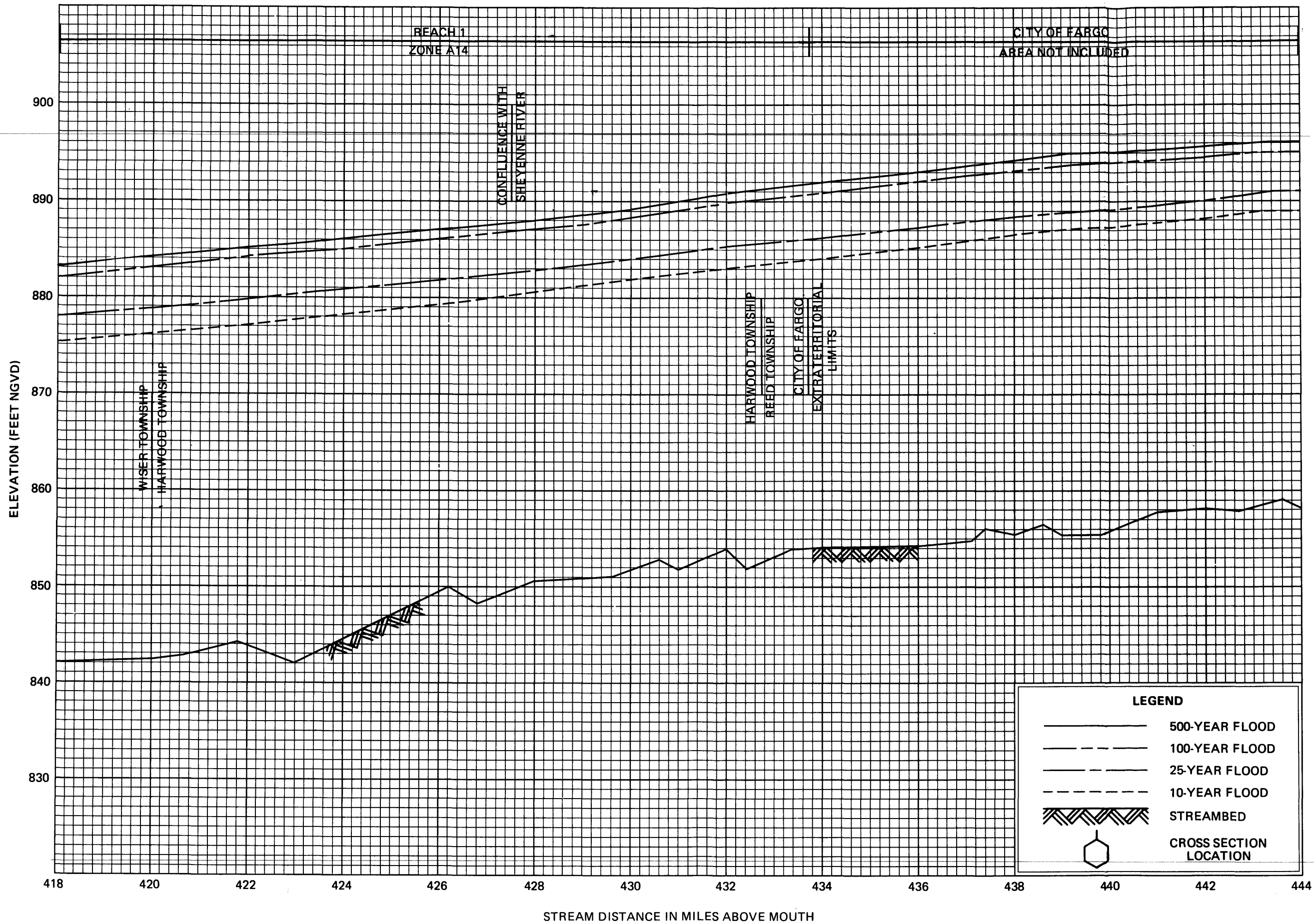


FLOOD PROFILES

RED RIVER OF THE NORTH

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

CASS COUNTY, ND
RED RIVER OF THE NORTH

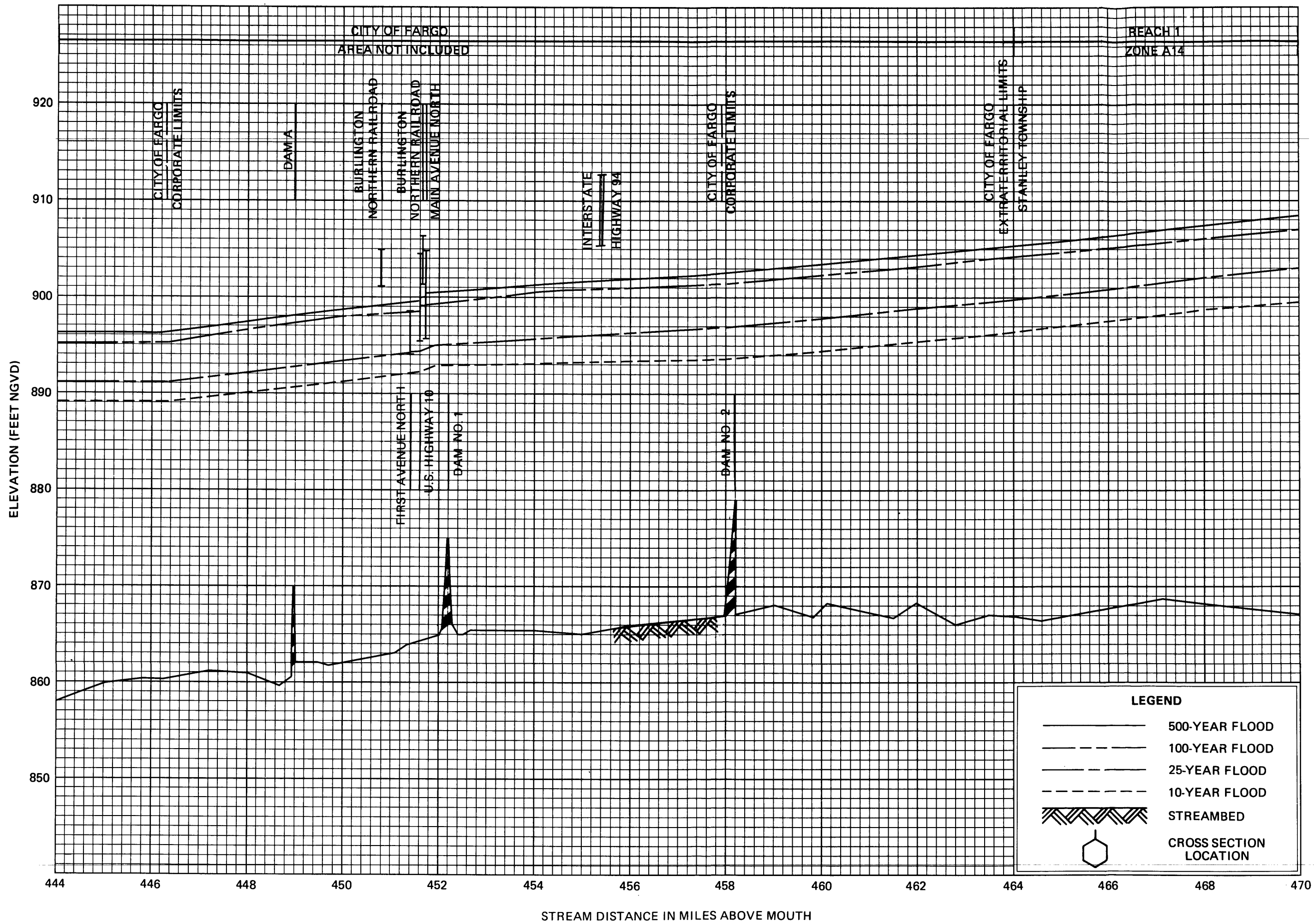


FLOOD PROFILES

RED RIVER OF THE NORTH

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

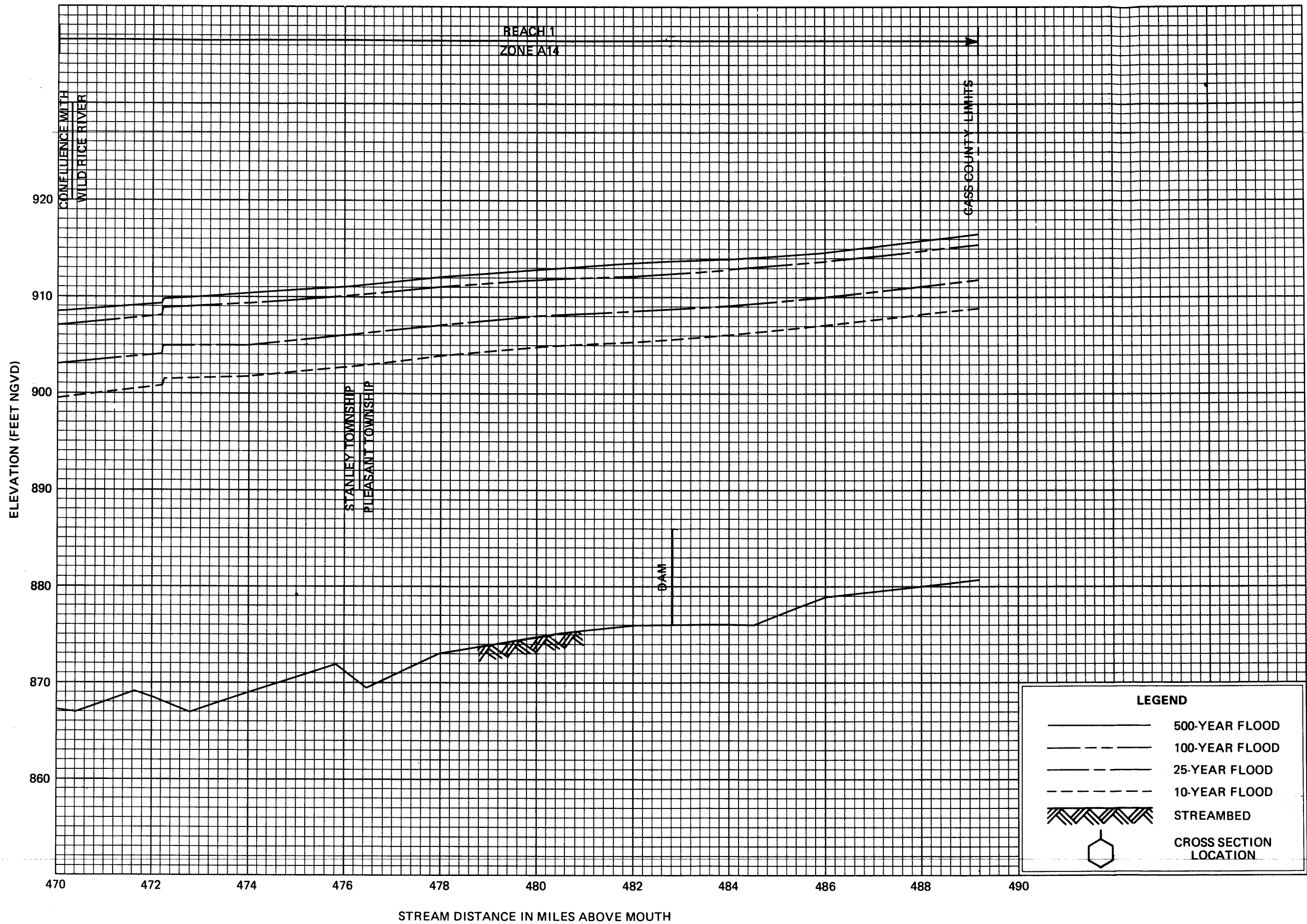
CASS COUNTY, ND
RED RIVER OF THE NORTH



LEGEND	
	500-YEAR FLOOD
	100-YEAR FLOOD
	25-YEAR FLOOD
	10-YEAR FLOOD
	STREAMBED
	CROSS SECTION LOCATION

FLOOD PROFILES
RED RIVER OF THE NORTH

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FLOOD PROFILES

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