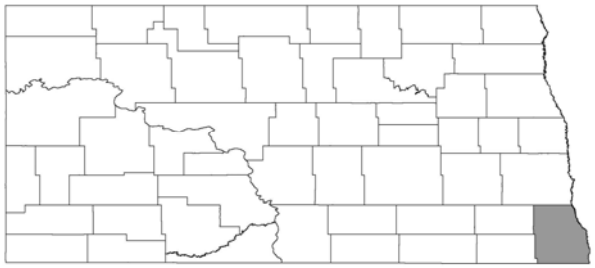
FLOOD INSURANCE STUDY

RICHLAND COUNTY, NORTH DAKOTA
AND INCORPORATED AREAS



Community Name	Community Number	Community Name	Community Number
ABERCROMBIE, CITY OF	380151	IBSEN, TOWNSHIP OF	380672
ANTELOPE, TOWNSHIP OF	380663	LAMARS, TOWNSHIP OF	380658
*BARNEY, CITY OF	380695	LIBERTY GROVE, TOWNSHIP OF	380665
BARRIE, TOWNSHIP OF	380661	*LIDGERWOOD, CITY OF	380237
BELFORD, TOWNSHIP OF	380662	*MANTADOR, CITY OF	380289
BRANDENBURG, TOWNSHIP OF	380622	MOORETON, CITY OF	380304
BRIGHTWOOD, TOWNSHIP OF	380664	MOORETON, TOWNSHIP OF	380654
CENTER, TOWNSHIP OF	380648	MORAN, TOWNSHIP OF	380666
*CHRISTINE, CITY OF	380291	NANSEN, TOWNHSIP OF	380656
*COLFAX, CITY OF	380290	RICHLAND COUNTY	380098
DWIGHT, CITY OF	380320	SUMMIT, TOWNSHIP OF	380671
DWIGHT, TOWNSHIP OF	380657	WAHPETON, CITY OF	380100
EAGLE, TOWNSHIP OF	380688	*WALCOTT, CITY OF	380637
*FAIRMOUNT, CITY OF	380323	WALCOTT, TOWNSHIP OF	380340
FAIRMOUNT, TOWNSHIP OF	380168	WALDO, TOWNSHIP OF	380659
GREAT BEND, CITY OF	380099	*WYNDMERE, CITY OF	380305
GREENDALE, TOWNSHIP OF	380660	WYNDMERE, TOWNSHIP OF	380667
*HANKINSON, CITY OF	380230		

*Non-Floodprone Area

Effective December 18, 2009

Federal Emergency Management Agency

FLOOD INSURANCE STUDY NUMBER
38077CV000A

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.

Selected Flood Insurance Rate Map panels for the community contain information that was previously shown separately on the corresponding Flood Boundary and Floodway Map panels (e.g., floodways, cross sections). In addition, former flood hazard designations have been changed as follows:

Old Zone	New Zone
A1 through A30	AE
V1 through V30	VE
B	X
C	X

Part or all of this Flood Insurance Study may be revised and republished at any time. In addition, part of this Flood Insurance Study may be revised by the Letter of Map Revision process, which does not involve republication or redistribution of the Flood Insurance Study. It is, therefore, the responsibility of the user to consult with community officials and to check the community repository to obtain the most current Flood Insurance Study components.

Initial County-wide FIS Effective Date: December 18, 2009.

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FLOOD INSURANCE STUDY
RICHLAND COUNTY, NORTH DAKOTA AND INCORPORATED AREAS

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study (FIS) revises and updates information on the existence and severity of flood hazards in the geographic area of Richland County, North Dakota, including the Cities of Abercrombie, Dwight, Great Bend, Mooreton, and Wahpeton; the Townships of Antelope, Barrie, Belford, Brandenburg, Brightwood, Center, Dwight, Eagle, Fairmount, Greendale, Ibsen, Lamars, Liberty Grove, Mooreton, Moran, Nansen, Summit, Walcott, Waldo, and Wyndmere; and the unincorporated areas of Richland County (referred to collectively herein as Richland County) 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 hazard data for various areas of the community that will be used to establish actuarial flood insurance rates. This information will also be used by Richland County to update existing floodplain regulations as part of the Regular Phase of the National Flood Insurance Program (NFIP), and by local and regional planners to further promote sound land use and floodplain management. Minimum floodplain management requirements for participation in the National Flood Insurance Program (NFIP) 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.

No special flood hazard areas were identified in the Cities of Barney, Christine, Colfax, Fairmount, Hankinson, Lidgerwood, Mantador, Walcott, and Wyndmere.

1.2 Authority and Acknowledgments

The sources of authority for this FIS are the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

The U.S. Army Corps of Engineers (USACE), St. Paul District, completed the hydrologic and hydraulic analyses for the identification of flood hazards for the City of Wahpeton FIS under Inter-Agency Agreement No. IAA-EMW-E-1506, Project Order No. 1, Amendment 5 in January, 1986.

The USACE, St. Paul District, also completed the hydrologic and hydraulic analyses for the identification of flood hazards for the Center Township FIS under Inter-Agency Agreement No. IAA-EMW-E-1153, Project Order No. 1, Amendment 27 in January 1986.

Updated hydrologic and hydraulic analyses for the Sheyenne River upstream of the Gol Bridge were completed by the USACE, St. Paul District in August, 2005 as part of the Sheyenne River Floodplain Study – Gol Bridge near Kindred, North Dakota to Baldhill Dam.

The hydrologic and hydraulic analysis for this revision was performed by Houston Engineering, Inc. (HEI) for the North Dakota State Water Commission (NDSWC) and the Federal Emergency Management Agency (FEMA) under contract EMD-2006-GR-0676. This study was completed in December, 2007.

Base map information shown on the county-wide DFIRM was derived from 2005 aerial photography obtained from the United States Department of Agriculture-Farm Service Agency. The aerial photography has a pixel resolution of 1 meter. Hydrology information for the county-wide DFIRM was obtained from the United States Geologic Survey (USGS) Hydrography Data Set.

1.3 Coordination

A Pre-Scoping Report was prepared on behalf of FEMA by Michael Baker, Jr., Inc. in September, 2005. As part of the pre-scoping process, communities were contacted by letter with some follow up phone contacts (Reference 27).

The initial Consultation Coordination Officer meeting was held March 9, 2006 in Wahpeton, ND. The meeting was attended by representatives of the NDSWC, FEMA, as well as Richland County, the City of Wahpeton, and Townships of Walcott, Nansen, Fairmount, Greendale, Lamars, and Mooreton. Existing needs for study updates were discussed as well as potential local data contributions and the inclusion of recent updated study information. Communities not in attendance at the meeting were contacted by telephone to discuss their study needs.

The results of this study were reviewed at the final CCO meeting held on November 12, 2008 and attended by representatives of FEMA, the SWC, Richland County, the City of Wahpeton, Interstate Engineering, Ackerman Land Surveying, and Houston Engineering. All issues raised at that meeting have been addressed in this study.

For the original study for the City of Wahpeton, ND, a meeting was held on July 28, 1983 in the City of Wahpeton at which time the study limits and methods were discussed and agreed upon. The meeting was attended by representatives of the City, the ND State Water Commission, and the study contractor. A floodway coordination meeting was held on June 20, 1985. The final coordination meeting was held July 14, 1986 and attended by representatives of the City, FEMA, and the study contractor (Reference 19).

For the original study for Center Township streams requiring detailed study were identified by a FEMA representative during a telephone discussion with USACE representatives in 1983. A floodway coordination meeting was held in the City of Wahpeton on June 20, 1985 and was attended by representatives of the City, the ND State Water Commission, and the USACE. The results of the study were

reviewed during a final coordination meeting on July 14, 1986 that was attended by representatives of the study contractor, FEMA, and the community (Reference 20).

2.0 AREA STUDIED

2.1 Scope of Study

This FIS covers the geographic area of Richland County, North Dakota, including the incorporated communities listed in Section 1.1. The areas studied by detailed methods were selected with priority given to all known flood hazards and areas of projected development.

The original studies for the City of Wahpeton and Center Township included detailed study of 9 miles of the Bois de Sioux River and Red River of the North from the City's downstream corporate limit to the township's upstream limit. The original study for Center Township also included the detailed study of 9.5 miles of the Wild Rice River upstream from State Highway 13. Both streams were mapped as Zone AE with Floodway. Additional areas throughout Richland County were mapped by approximate methods (Reference 19, 20).

In addition to these two studies, a FHBM for the unincorporated areas of Richland County was published and converted to a FIRM by letter dated June 1, 1998. More than 480 miles of approximate Zone A floodplain were mapped for the unincorporated areas. Effective FIRMs are also available for the Townships of Antelope, Barrie, Belford, Brandenburg, Dwight, Fairmount, Mooreton, Moran, Summit, and Walcott. The mapped floodplain on the FIRMs for the Townships is generally the same as the mapped floodplain on the FIRMs for the unincorporated areas of Richland County.

The flood hazard information generated by the USACE, St. Paul District as part of the Sheyenne River Floodplain Study in August 2005, includes a detailed analysis of the Sheyenne River from Baldhill Dam to the Gol Bridge upstream of Kindred. Therefore, the reach of the Sheyenne River in Richland County upstream of the Gol Bridge, originally studied by approximate methods, was converted to a detailed analysis with the flood hazard area mapped as Zone AE with floodway as part of the county-wide DFIRM.

The current study effort also includes new detailed study of 10.5 miles of the Wild Rice River in Walcott Township and 10 miles along the breakout corridor between the Bois de Sioux River upstream of Wahpeton and the Wild Rice River. Both detailed studies result in the flood hazard being mapped as Zone AE with floodway.

Data from the Natural Resources Conservation Service's (NRCS) Wild Rice River and Antelope Creek Floodplain Management Study was used for Zone A refinement along 105 miles of the Wild Rice River and 62 miles of Antelope Creek as part of the county-wide DFIRM (References 32, 33). New approximate Zone A floodplain boundaries were developed for several streams in the former

Lake Traverse Indian Reservation, including Big Slough, Park Lakebed, and Kennedy Slough.

2.2 Community Description

Richland County is located in the southeastern corner of North Dakota, approximately 15 miles south of Fargo, North Dakota. Richland County is bordered by Cass County to the north, Sargent and Ransom Counties to the west, Grant and Roberts Counties, South Dakota to the south, and Wilkin County, MN to the east. The total land area within the county is 1446 square miles. The 2000 population was 17,998. Roughly 65% of the county's population lives in the five principal communities of Wahpeton (8,586), Hankinson (1,058), Lidgerwood (738), Wyndmere (533), and Fairmount (406). The economy of the county depends primarily on agricultural related enterprise (Reference 24).

The Bois de Sioux River and the Red River of the North form the eastern boundary of the county and flow generally northward. The Red River of the North begins at the confluence of the Bois de Sioux and Otter Tail Rivers in Wahpeton, ND. The Sheyenne River crosses the northwest corner of the county flowing generally to the northeast. The Wild Rice River and its primary tributary, Antelope Creek, both flow southeasterly across the central portions of the county before turning generally northward once the flow enters the bed of glacial Lake Agassiz.

The climate of Richland County is typical of the Great Plains, characterized by cold winters and warm summers. Monthly average temperatures range from a low of 9.6 degrees F. in January to a high of 73.1 degrees F. in July. The mean annual temperature is 43.3 degrees F. The average annual precipitation is 20.38 inches. The majority of the precipitation occurs between April and August (Reference 7, 19, 20).

Richland County is located in the Central Lowland province of the Interior Plains. The eastern portion of the county is located on the bed of glacial Lake Agassiz which is characterized by minimal topographic relief. There is little natural drainage on this lake plain, and most of the runoff from the area moves through manmade drains. This flat expanse is interrupted by the Sheyenne Delta, an important aquifer deposit, and the major shorelines of the glacial lake. The Red River of the North and its tributaries are entrenched 30 to 40 feet into the lake plain. The soils of the lake plain are very fertile, consisting of heavy clay loams. Nearly all of the lake plain is cultivated (Reference 2).

2.3 Principal Flood Problems

Low lying areas adjacent to the Bois de Sioux, Red, Sheyenne, and Wild Rice Rivers as well as Antelope Creek are subject to periodic flooding, typically as a result of spring snowmelt and/or rainfall. The flat topography of the glacial Lake Agassiz lakebed exacerbates the flooding problems. The peak flow of record on the Red River at Wahpeton was 12,800 cfs occurring on April 15, 1997 as measured at United States Geological Survey (USGS) Gage No. 05051500. The second ranked peak of 10,500 cfs occurred in 1897. However, the 1997 peak was affected by both upstream reservoirs and a documented breakout flow of

2,200 cfs. Other peaks of note in descending order include 9,340 cfs in 2001, 9,200 cfs in 1960, 8,370 cfs in 1989, 7,130 cfs in 1952, and 7,050 cfs in 1979 (Reference 34).

The peak flow of record on the Wild Rice River at Abercrombie as measured at USGS Gage No. 05053000 was 9,540 cfs in 1969. Other peaks of note in descending order include 9,470 cfs in 1997, 9,320 cfs in 2001, 7,150 cfs in 1989 and 6,000 cfs in 1979 (Reference 34).

The peak flow of record on the Sheyenne River as measured at USGS Gage No. 05059000 at Kindred was 5,970 cfs in 1997. Other peaks of note in descending order include 5,100 cfs in 1996, 4,690 cfs if 1969, 4,640 cfs in 1975, and 4,160 cfs in 1979. All of these peaks include the effects of regulation of flows by Baldhill Dam located north of the City of Valley City. (Reference 34)

2.4 Flood Protection Measures

Temporary dikes have been constructed periodically along the Bois de Sioux and Red Rivers in the Cities of Wahpeton, ND and Breckenridge, MN during flood events. A permanent flood control project for the Cities of Wahpeton and Breckenridge was under construction as part of the Wahpeton/Breckenridge Flood Control Project at the time of this study effort. The Breckenridge Diversion Channel, that diverts the Ottertail River around the City of Breckenridge, has been constructed and is operational. The permanent levees to be constructed as part of the project had not been constructed. The Upstream-Wahpeton Breakout Corridor between the Bois de Sioux and Wild Rice Rivers also serves as a natural flood protection measure for the Cities of Wahpeton and Breckenridge and is accounted for in the design of the Wahpeton/Breckenridge Flood Control Project.

No significant flood protection measures have been constructed in the other Cities, Townships, or unincorporated areas of Richland County.

3.0 ENGINEERING METHODS

For the flooding sources studied by detailed methods 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 that 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 that equals or exceeds the 1-percent-annual-chance flood in any 50-year period is approximately 40 percent (4 in 10); for any 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 by detailed methods affecting the community.

Bois de Sioux River

For the original City of Wahpeton and Center Township Flood Insurance Studies, discharges for the Bois de Sioux developed by the USGS in 1970 for the Breckenridge, MN FIS were used. These flows were determined by analyzing the contributing flows from both the Bois de Sioux River and the Ottertail River using a HEC-2 approximation of the 1969 flood at Wahpeton (Reference 19).

Red River of the North

Discharges for the Red River of the North at Wahpeton, USGS gage No. 05051500, are available since 1942 and were administratively agreed upon in 1971 by the NDSWC, the Minnesota Department of Natural Resources, the USGS and the USACE (Reference 4). An analysis of gage data performed in 1982 by the USACE (Reference 14) using WRC Bulletin 17B (Reference 10) produced results within the confidence limits of the 1971 curve; thus the 1971 discharge-frequency curve was adopted for the original study.

Sheyenne River

In 2004, the USACE performed a revised hydrologic analysis of the Sheyenne River from Baldhill Dam downstream to the Gol Bridge near Kindred, North Dakota. The revised hydrologic analysis was completed because three large floods had occurred since the previous study was completed by the USACE in 1995 for the five foot raise in the flood pool for Baldhill Dam.

The USACE analysis utilized USGS streamgage 05058500 at Valley City, which has a continuous record from 1939 to 1975 and from 1979 to present with annual instantaneous peaks recorded since 1919. The period from 1950 to present is affected by regulation at Baldhill Dam. The USACE has a continuous daily record of reservoir operations at Baldhill Dam since 1950.

The USACE developed a natural conditions annual instantaneous peak frequency curve for Valley City and Baldhill Dam inflow in accordance with the guidelines outlined in Bulleting 17B (Reference 10) and from guidance outlined in E.M. 1110-2-1415 (Reference 23).

The resulting discharges were then routed through the reservoir using a combination of HEC-1 (Reference 29) and spread sheet computations. The reservoir routing was completed by the modified pulse method. The 10-, 2-, 1-, and 0.2-percent chance floods were routed through the downstream reaches using HEC-1 and the Muskingham routing method to determine flood peaks at Valley City, Lisbon, and Kindred. Local contributions were added at each location before routing to the next downstream location. The local contributions at each site were determined using reverse channel routing computations.

Upstream-Wahpeton Breakout Corridor

The COE completed a Revision to the September 2000, Section 205 Flood Reduction Feasibility Study for Breckenridge, MN and Wahpeton, ND. (Reference 25, 26) As part of this study effort, the COE completed a hydrologic analysis for the Red River of the North and the Bois de Sioux River. This included a discharge-frequency analysis using peak flow data from the USGS Gage at Wahpeton in accordance with Bulletin 17B. Those results were then adjusted for the impacts of upstream reservoirs as well as ice. This hydrology was then used in a new hydraulic model of the Bois de Sioux and Red Rivers to assess the impacts of the Wahpeton-Breckenridge Flood Control Project. The hydraulic models included a breakout known to occur south of Wahpeton, where flows from the Bois de Sioux River breakout and travel overland to the Wild Rice River, just west of the City of Wahpeton.

As part of this current study, a new hydraulic model was developed for the breakout corridor. This hydraulic model was ultimately joined with the COE hydraulic model to quantify the discharge through the breakout corridor. The model recognized that flows break out from the Bois de Sioux River at stations 915.0 and 918.5 with flows from station 915.0 dominating during smaller magnitude, more frequent, events and flows from station 918.5 dominating during the larger events. The breakout at station 915.0 flows backward, or up-gradient, through Richland County Drain #55. The breakout at station 918.5 flows overland until the two breakouts join at the intersection of Drain 55 and State Highway 127. State Highway 127 acts as a lateral weir with some of the breakout flow overtopping and proceeding overland to the Wild Rice River, designated “West Breakout”, while the remainder of the breakout flow simply proceeds northerly and discharges back to the Bois de Sioux River, with these returning flows designated “Breakout Reach”.

The USACE developed an updated All-Seasons Hydrologic Frequency Distribution for the Bois de Sioux and the Red River of the North as part of their modeling efforts. They also recognized that peak flows at Wahpeton are often impacted by ice jams in the area. Therefore, the USACE developed separate frequency distribution for those peaks that were ice impacted and those that occurred under open water conditions. The probabilities for these two distributions were then combined to develop an ice affected distribution. As part of the current study effort, the likelihood of ice jams impacting the water surface elevations in the area of the breakouts was examined. Since the water surface elevations in the breakout area resulting from the use of the All Seasons record were higher than either the open water series or the ice affected series and since there has not been a history of ice jams in the area of the breakouts, it was decided that the All-Season record was appropriate for the current study.

Another factor considered as part of the current study was the construction of the Wahpeton/Breckenridge Flood Control Project. At the time of the current study, the Breckenridge Diversion Channel had been constructed and was operational. The permanent levees to be constructed as part of the project had not yet been constructed. Because the levees remained to be constructed, the project had not yet been certified. Because the Diversion channel was constructed and operational, it was decided to model the system with the channel in place and

operational. Temporary levees exist along the Bois de Sioux River through Wahpeton/Breckenridge. These levees are at a similar location as the proposed permanent levees and have been included in the analysis to determine the breakout discharges.

Wild Rice River

For the original study of the Wild Rice River, completed as part of the Center Township FIS, discharges were developed from a statistical analysis of flow data available for the years 1943 to 1975 at Mantador, North Dakota (USGS Gage No. 05052000) following the guidelines specified in Bulletin 17B (Reference 10). The resulting discharges at Mantador were transferred to Center Township using the drainage basin transfer method with a coefficient of 0.6 (Reference 20).

For the current study of the Wild Rice River in Walcott Township, the hydrology was developed by performing a frequency analysis using the yearly peak flows from USGS Gage #05053000 at Abercrombie for the time period from 1933 and 2002 following the guidelines specified in Bulletin 17B (Reference 10). This time period matches the one used for the hydrology that was developed for the Southern Cass FIS, which is directly downstream from this study area. Discharges were transferred downstream to the study reach using the drainage area ratio method and a mean exponent of 0.57. No additional analysis was performed on the breakouts from the Bois de Sioux River to the Wild Rice River (Upstream-Wahpeton Breakout) as part of this study since these breakouts are included in the stream gage data.

The hydrology for the Zone A Refinement studies along the Wild Rice River and Antelope Creek was developed using USGS stream gage data and procedures contained in the SCS National Engineering Handbook, Section 4, Hydrology.

The resulting peak flows for the Bois de Sioux River, Red River, Sheyenne River, Wild Rice River, and the Upstream-Wahpeton Breakout Corridor are presented in Table 1.

TABLE 1 - SUMMARY OF DISCHARGES

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-PERCENT	2-PERCENT	1-PERCENT	0.2-PERCENT
BOIS DE SIOUX RIVER					
Above Wahpeton	1,967	3,670	5,300	6,200	9,760
RED RIVER OF NORTH					
At Wahpeton	4,010	5,700	9,250	11,000	17,150
SHEYENNE RIVER					
At Gol Bridge near Kindred	5,061[1]	3,460	5,770	7,340	11,930
UPSTREAM-WAHPETON BREAKOUT					
Section 918.5 Breakout	N/A[2]	0	1,638	3,044	12,315
Section 915 Breakout (County Ditch 55)	N/A[2]	0	216	195	6
West Breakout Reach	N/A[2]	0	625	1,346	9,489
Breakout Reach	N/A[2]	0	1,229	1,893	2,832
WILD RICE RIVER					
At ND Highway 46	2,189[3]	5,147	10,858	13,763	21,300
At County State Aid Highway 13	1,605	1,110	2,480	3,190	5,440

[1] Includes 612 square miles of non-contributing. Excludes Devils Lake Basin.
[2]Discharges are a result of breakout flow from the Bois de Sioux River. No breakout flow occurs during the 10-year flood.
[3]Includes 590 square miles of non-contributing.

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. Users should be aware that flood elevations shown on the Flood Insurance Rate Map (FIRM) represent rounded whole-foot elevations and may not exactly reflect the elevations shown on the Flood Profiles or in the Floodway Data table in the FIS report. Flood elevations shown on the FIRM are primarily intended for flood insurance rating purposes. For construction and/or floodplain management purposes, users are cautioned to use the flood elevation

data presented in this FIS report in conjunction with the data shown on the FIRM.

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles. For stream segments for which a floodway was computed, selected cross section locations are also shown on the FIRM.

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.

Bois de Sioux River

For the original studies for the City of Wahpeton and Center Township, the water surface elevations were computed through the use of the USACE HEC-2 step-backwater computer program (Reference 13). Cross section and hydraulic structure data were obtained through field surveys. Roughness factors (Manning's 'n') used for the channel ranged from 0.045 to 0.060 while the overbank values ranged from 0.050 to 0.090. The starting water surface elevations for the Bois de Sioux were determined from the Red River model (Reference 19, 20).

Red River of the North

For the original study for the City of Wahpeton, the water surface elevations were computed through the use of the USACE HEC-2 step-backwater computer program (Reference 13). Cross section and hydraulic structure data were obtained through field surveys. Roughness factors (Manning's 'n') used for the channel ranged from 0.045 to 0.060 while the overbank values ranged from 0.050 to 0.090. Starting water surface elevations for the Red River reach were determined using the slope-area method approximately 5 miles downstream of the study limits.

Sheyenne River

The new USACE study on the Sheyenne River utilized new topography that was acquired in 2000 using Light Detection and Ranging (LIDAR) technology. Cross sections were extracted from the LIDAR data and complemented with hydrographic surveys for the underwater channel geometry. In some instances the underwater portions of the cross sections were completed by interpolation between existing cross sectional data in existing HEC-2 models and the field surveys. For bridges not replaced since the original HEC-2 modeling effort, the HEC-2 bridge data was imported into the HEC-RAS model and checked for reasonableness. Plan information was obtained for new bridge crossings, replaced bridges, and bridges that did not appear correct after importing the HEC-2 data.

The cross section data was used by the USACE to develop a HEC-RAS model of the Sheyenne River from the Gol Bridge southwest of Kindred to Baldhill Dam. The model was calibrated to the high water mark data from the 1965, 1966, 1969, 1979, and 1993 floods by adjusting the roughness and contraction/expansion

coefficients. The resulting Manning's n values ranged from 0.035 to 0.065 for the channel and 0.080 to 0.160 for the over bank areas.

The downstream limit of the hydraulic model is just downstream of the upstream limit of a model recently developed by Pacific International Engineering for flood hazard identification purposes in Cass County. Therefore, the starting water surface elevations were set to match the results of their Cass County study.

Upstream-Wahpeton Breakout

Water surface elevations were computed using the USACE HEC-RAS step-backwater computed program. Cross sections and hydraulic structures were taken from a combination of field survey data and LIDAR data provided by the City of Wahpeton. The cross section geometry for the HEC-RAS model was extracted from a DEM that combined the topographic sources in ArcMap using HEC-GeoRAS. Manning's 'n' values were estimated based on field reconnaissance and photos taken by surveyors and varied from 0.035 to 0.055 for the channel and 0.065 to 0.08 for the overbank areas.

The hydraulic model contains 3 primary reaches, including the Breakout Reach, West Breakout Reach, and County Drain 55 Reach. The downstream boundary condition for the flow re-entering the Bois de Sioux River (Breakout Reach) was taken from the USACE Bois de Sioux HEC-RAS model. For the flow entering the Wild Rice River (West Breakout Reach) the downstream boundary conditions were taken from the flood profiles for the Flood Plain Management Study for the Wild Rice River developed by the USDA Natural Resource Conservation Service.

Wild Rice River

For the original FIS for Center Township, the water surface elevations were computed through the use of the USACE HEC-2 step-backwater computer program (Reference 13). Cross section and hydraulic structure data were obtained through field surveys. Manning's 'n' values used for the channel were 0.040, while 0.070 was used for the overbank areas. Starting water surface elevations were based on normal depth calculations approximately one mile downstream of the study limits (Reference 20).

For the current detailed study within Walcott Township, the water surface elevations were computed using the USACE HEC-RAS step-backwater computer program. (Reference 30) Cross section data from the NRCS's Flood Plain Management Study was supplemented with LIDAR topography acquired in 1998 where available. Hydraulic structure data was updated where necessary through field surveys. Manning's 'n' values used for the channel varied from 0.035 to 0.045 while the overbank values ranged from 0.06 to 0.10. Starting water surface elevations were taken from the modeling of the Wild Rice River completed for the South Cass County FIS (Reference 28).

For the 105 miles of Zone A refinement along the Wild Rice River and 62 miles of Zone A refinement along Antelope Creek, water surface profiles were

computed using the Soil Conservation Service WSP2 computer program. (Reference 32)

3.3 Vertical Datum

All FIS reports and FIRMs are referenced to a specific vertical datum. The vertical datum provides a starting point against which flood, ground, and structure elevations can be referenced and compared. Until recently, the standard vertical datum in use for newly created or revised FIS reports and FIRMs was the National Geodetic Vertical Datum of 1929 (NGVD 29). With the finalization of the North American Vertical Datum of 1988 (NAVD 88), many FIS reports and FIRMs are being prepared using NAVD 88 as the referenced vertical datum.

Flood elevations shown in this FIS report and on the FIRM are referenced to NAVD 88. These flood elevations must be compared to structure and ground elevations referenced to the same vertical datum. For information regarding conversion between the NGVD 29 and NAVD 88, visit the National Geodetic Survey website at http://www/ngs/noaa/gov), or contact the National Geodetic Survey at the following address:

Vertical Network Branch, N/CG13
National Geodetic Survey, NOAA
Silver Spring Metro Center 3
1315 East-West Highway
Silver Spring, Maryland 20910
(301) 713-3191

Temporary vertical monuments are often established during the preparation of a flood hazard analysis for the purpose of establishing local vertical control. Although these monuments are not shown on the FIRM, they may be found in the Technical Support Data Notebook associated with the FIS report and FIRM for this community. Interested individuals may contact FEMA to access these data.

The conversion factor for each stream studied by detailed methods is shown below in Table 2.

Table 2. Stream Conversion Factor

Stream Name	Elevation (feet NAVD above NGVD)
Bois de Sioux River	+0.8
Red River	+0.8
Sheyenne River	+1.0
Wild Rice River, Center Township	+0.8
Wild Rice River, Walcott Township	+1.0
Upstream-Wahpeton Breakout	+0.8

4.0 FLOODPLAIN MANAGEMENT APPLICATIONS

The NFIP encourages State and local governments to adopt sound floodplain management programs. To assist in this endeavor, each FIS report provides 1-percent-annual-chance data, which may include a combination of the following: 10-, 2-, 1-, and 0.2-percent-annual-chance flood elevations; delineations of the 1- and 0.2-percent-annual-chance floodplain boundaries; and 1-percent-annual-chance floodway. This information is presented on the FIRM and in many components of the FIS report, including Flood Profiles, Floodway Data Table and Summary of Stillwater Elevations Table. Users should reference the data presented in the FIS report as well as additional information that may be available at the local map repository before making flood elevation and/or floodplain boundary determinations.

4.1 Floodplain Boundaries

To provide a national standard without regional discrimination, the 1-percent-annual-chance flood has been adopted by FEMA as the base flood for floodplain management purposes. The 0.2-percent-annual-chance flood is employed to indicate additional areas of flood risk in the community. For each stream studied by detailed methods, the 1- and 0.2-percent-annual-chance floodplain boundaries have been delineated using the flood elevations determined at each cross section. For the original study on the Bois de Sioux and Red Rivers, the boundaries between cross sections were photogrammetrically interpolated (Reference 18). For the original study on the Wild Rice River in Center Township, the boundaries between cross sections were interpolated using enlarged USGS quadrangle maps at a scale of 1:400 with a contour interval of 10 feet (Reference 5). For the current study on the Wild Rice River in Walcott Township, the floodplain boundaries between cross sections were defined using a combination of LIDAR-based topographic data and the USGS 30 meter DEM. For the current study on the Sheyenne River, the hydraulic model output was mapped using HEC-GeoRAS and LIDAR-based topography. For the current study on the Upstream-Wahpeton Breakout Corridor, the hydraulic model output was mapped using HEC-GeoRAS and a combination of LIDAR-based topography and the USGS DEM.

The 1- and 0.2-percent-annual-chance floodplain boundaries are shown on the FIRM (Exhibit 2). On this map, the 1-percent-annual-chance floodplain boundary corresponds to the boundary of the areas of special flood hazards (Zones A and AE); and the 0.2-percent-annual-chance floodplain boundary corresponds to the boundary of areas of moderate flood hazards. In cases where the 1- and 0.2-percent-annual-chance floodplain boundaries are close together, only the 1-percent-annual-chance 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 1-percent-annual-chance floodplain boundary is shown on the FIRM (Exhibit 2). For the current Zone A refinement study reaches along the Wild Rice River and Antelope Creek, the floodplain boundaries were defined using field survey data and USGS 7.5-minute quadrangle maps. For the current approximate study in the former Lake

Traverse Indian Reservation the floodplain boundaries were defined using the USGS 10 meter DEM.

4.2 Floodways

Encroachment of 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 1-percent-annual-chance 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 1-percent-annual-chance flood can be carried without substantial increases in flood heights. Minimum Federal standards limit such increases to 1.0 foot, provided that hazardous velocities are not produced. In North Dakota, an increase of 1.0 foot is permitted except for boundary water between North Dakota and Minnesota where floodplain encroachment is limited to a 0.75 foot increase in flood heights above pre-floodway conditions at any point with 0.25 foot increase attributed to Minnesota and 0.5 foot increase attributed to North Dakota. 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 the original FIS for Wahpeton and Center Township represent a community selected alignment. (Reference 19, 20) For the new detailed study along the Wild Rice River in Walcott Township, the floodways were established using an equal encroachment approach with a maximum encroachment of 1.0 foot. Floodway widths were computed at cross sections. Between cross sections, the floodway boundaries were interpolated. The results of the floodway computations have been tabulated for selected cross sections (Table 3). In cases where the floodway and 1-percent-annual-chance floodplain boundaries are either close together or collinear, only the floodway boundary has been shown. For the USACE analysis on the Sheyenne River, where existing floodway limits existed, the new floodway was always drawn at or riverward of the existing flood limits so that the new floodway is not, at any point, more restrictive than the previous floodway. The floodway surcharge was allowed to drop below 1.0 foot in some downstream locations so that more existing structures further upstream could be removed from the floodway.

For the new detailed study along the Upstream-Wahpeton Breakout, the floodways were established using an equal encroachment approach with a maximum encroachment of 1.0 foot. During the initial CCO meeting for the current study, a floodway along the Upstream-Wahpeton Breakout corridor was identified as a project need since the breakout flows from the Bois de Sioux River that pass through the corridor to the Wild Rice River serve as a natural means of flood protection for the cities of Wahpeton, ND and Breckenridge, MN. The presence of these breakout discharges is being accounted for in the design of

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH[2] (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE[3]
					(FEET NAVD)			
Red River of the North/Bois de Sioux River								
A	2,884,760	309/150	4,337	2.5	957.86	957.86	958.61	0.75
B	2,888,460	342/120	4,672	2.4	958.49	958.49	959.24	0.75
C	2,893,620	1267/12	9,745	1.1	959.22	959.22	959.95	0.73
D	2,896,760	400/240	3,961	2.8	959.69	959.69	960.39	0.70
E	2,897,070	410/270	3,944	2.8	959.79	959.79	960.50	0.71
F	2,898,840	1300/85	9,726	1.1	960.18	960.18	960.87	0.69
G	2,904,190	1200/175	10,165	1.1	960.64	960.64	961.31	0.67
H	2,906,730	500/330	5,024	2.2	960.92	960.92	961.63	0.69
I	2,909,190	800/100	8,244	1.3	961.23	961.23	961.93	0.71
J	2,910,560	1630/80	13,916	0.8	961.35	961.35	962.03	0.70
K	2,911,260	400/100	4,178	1.5	961.46	961.46	962.11	0.68
L	2,911,900	393/100	5,210	1.2	961.91	961.91	962.56	0.65
M	2,913,075	500/400	5,677	1.1	961.96	961.96	962.62	0.65
N	2,916,040	630/350	4,465	1.4	962.13	962.13	962.80	0.66
O	2,920,290	2211/2040	13,787	0.4	962.34	962.34	962.97	0.67
P	2,925,540	550/150	4,753	1.3	962.55	962.55	963.15	0.63
Q	2,928,000	407/130	4,015	1.5	962.75	962.75	963.31	0.60
R	2,930,450	400/120	4,133	1.5	963.00	963.00	963.00	0.56

[1]Feet above mouth of the Red River of the North.

[2]Width/width within corporate limits.

[3]0.50 foot increase allowable by North Dakota and 0.25 foot increase allowable by Minnesota for a 0.75 maximum increase total.

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH[2] (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE[3]
					(FEET NAVD)			
Bois de Sioux River								
S	2,932,600	416/300	4,200	1.5	963.2	963.2	963.9	0.7
T	2,933,610	390/190	3,415	1.4	963.3	963.3	964.0	0.7
U	2,936,045	436/330	3,871	1.6	963.5	963.5	964.2	0.7
V	2,939,020	500/170	4,242	1.5	963.9	963.9	964.5	0.6
W	2,941,880	556/420	4,126	1.5	964.2	964.2	964.9	0.7
X	2,944,200	550/150	3,922	1.6	964.6	964.6	965.2	0.6
Y	2,946,735	550/360	3,856	1.6	965.0	965.0	965.5	0.5
Z	2,949,140	650/410	4,225	1.5	965.4	965.4	965.9	0.5

[1]Feet above mouth of the Red River of the North.

[2]Width/width within corporate limits.

[3]0.50 foot increase allowable by North Dakota and 0.25 foot increase allowable by Minnesota for a 0.75 maximum increase total.

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

RICHLAND COUNTY, ND AND INCORPORATED AREAS

FLOODWAY DATA

BOIS DE SIOUX RIVER

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 NAVD)			
A	389,372	148	2,500	2.9	956.3	956.3	957.3	1.0
B	390,758	190	3,627	2.0	956.5	956.5	957.5	1.0
C	393,670	259	3,450	2.1	956.8	956.8	957.8	1.0
D	396,513	325	4,114	1.8	957.2	957.2	958.1	0.9
E	398,656	386	6,102	1.8	957.5	957.5	958.4	0.9
F	400,580	183	2,624	2.8	957.8	957.8	958.6	0.8
G	403,126	374	3,020	2.4	958.4	958.4	959.1	0.7
H	404,076	188	2,761	2.7	958.6	958.6	959.4	0.7
I	406,412	271	3,758	2.0	959.0	959.0	959.7	0.7
J	408,557	231	2,691	2.7	959.4	959.4	960.0	0.6
K	409,982	162	2,500	2.9	959.8	959.8	960.4	0.6
L	412,237	333	5,256	1.4	960.3	960.3	960.9	0.6
M	414,454	168	2,703	2.7	960.7	960.7	961.2	0.6
N	416,544	220	2,798	2.6	961.0	961.0	961.5	0.5
O	418,562	245	2,925	2.5	961.4	961.4	961.9	0.5
P	420,405	370	3,227	2.3	961.9	961.9	962.3	0.4
Q	422,145	177	2,597	2.8	962.3	962.3	962.7	0.4
R	425,287	510	4,763	1.5	962.9	962.9	963.3	0.4
S	426,785	160	2,396	3.1	963.1	963.1	963.5	0.4
T	429,253	488	4,270	1.7	963.9	963.9	964.3	0.4
U	430,824	299	2,715	2.7	964.4	964.4	964.8	0.5
V	432,747	275	3,603	2.0	964.7	964.7	965.3	0.6
W	435,772	251	2,919	2.5	965.3	965.3	965.8	0.5
X	437,935	394	4,009	1.8	965.7	965.7	966.2	0.5
Y	439,910	219	2,535	2.9	966.0	966.0	966.5	0.5
Z	443,880	1177	9,746	0.8	966.9	966.9	967.3	0.5
AA	446,982	1172	4,898	1.5	967.5	967.5	967.9	0.4
AB	449,600	298	3,748	2.0	968.4	968.4	968.7	0.4
AC	455,458	1196	8,843	0.8	969.2	969.2	969.6	0.3

[1]Feet above downstream confluence with the Red River of the North

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

RICHLAND COUNTY, ND AND INCORPORATED AREAS

FLOODWAY DATA

SHEYENNE RIVER

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 NAVD)			
AD	457,228	552	7,305	1.3	969.4	969.4	969.7	0.3
AE	458,291	209	2,287	3.2	969.6	969.6	969.8	0.3
AF	461,255	1212	6,604	1.1	970.6	970.6	971.0	0.4
AG	462,354	1229	9,396	0.8	970.8	970.8	971.2	0.4
AH	463,158	1000	6,659	1.1	971.0	971.0	971.4	0.4
AI	464,728	673	4,712	1.6	971.6	971.6	971.9	0.3
AJ	466,439	1507	5,883	1.3	972.2	972.2	972.5	0.4
AK	470,652	1760	5,053	1.5	973.0	973.0	973.4	0.4
AL	472,788	1594	12,083	0.8	973.4	973.4	973.8	0.4
AM	474,722	2451	11,642	0.6	973.7	973.7	974.1	0.4
AN	476,943	1015	5,655	1.3	974.4	974.4	974.4	0.1
AO	479,885	1349	6,855	2.1	975.0	975.0	975.0	0.0
AP	481,880	623	5,796	1.3	975.2	975.2	975.3	0.1
AQ	483,900	186	1,994	3.7	975.5	975.5	975.6	0.1
AR	486,448	323	5,925	2.2	976.2	976.2	976.4	0.2
AS	487,736	106	1,741	4.2	976.6	976.6	977.0	0.4
AT	489,695	902	6,649	1.1	977.6	977.6	978.1	0.5
AU	491,496	1078	5,054	1.5	978.2	978.2	978.6	0.5
AV	493,616	748	4,657	1.6	979.0	979.0	979.4	0.4
AW	495,937	438	3,996	1.9	979.5	979.5	980.1	0.6
AX	497,264	378	2,675	2.7	979.9	979.9	980.7	0.8
AY	500,037	1163	9,008	0.8	980.9	980.9	981.6	0.7
AZ	501,399	852	7,942	0.9	981.1	981.1	981.7	0.7
BA	502,907	140	1,961	3.7	981.3	981.3	982.0	0.7
BB	505,650	1767	8,989	1.2	982.5	982.5	983.2	0.7
BC	507,299	573	5,641	1.5	982.9	982.9	983.6	0.7
BD	510,293	1770	5,894	1.3	983.9	983.9	984.5	0.6
BE	513,634	2662	6,409	1.1	984.9	984.9	985.7	0.7
BF	515,431	614	5,392	2.1	985.3	985.3	986.2	1.0

[1]Feet above downstream confluence with the Red River of the North

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

RICHLAND COUNTY, ND AND INCORPORATED AREAS

FLOODWAY DATA

SHEYENNE RIVER

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 NAVD)			
BG	518,864	2611	10,162	0.7	986.5	986.5	987.3	0.8
BH	521,427	1855	7,320	1.0	987.0	987.0	987.8	0.8
BI	524,381	1281	5,519	1.3	987.8	987.8	988.7	1.0
BJ	526,599	1064	5,371	1.4	988.6	988.6	989.5	0.9
BK	529,692	784	5,307	1.5	989.5	989.5	990.3	0.8

[1]Feet above downstream confluence with the Red River of the North

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

RICHLAND COUNTY, ND
AND INCORPORATED AREAS

FLOODWAY DATA

SHEYENNE RIVER

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 NAVD)			
Breakout								
A	1,896	600	1,945	0.1	963.9	963.9	964.0	0.1
B	4,270	209	176	1.2	963.9	963.9	964.0	0.1
C	6,010	115	255	0.9	965.3	965.3	965.3	0.0
D	9,812	2,186	7,352	0.2	965.3	965.3	965.4	0.1
E	11,841	1,850	5,862	0.3	965.4	965.4	965.4	0.1
F	12,680	2,300	6,068	0.3	965.4	965.4	965.5	0.1
G	15,001	2,500	9,448	0.3	965.5	965.5	965.5	0.0
H	17,847	4,000	15,403	0.2	965.5	965.5	965.5	0.0
I	18,686	3,997	15,524	0.2	965.5	965.5	965.6	0.0
J	23,063	2,684	11,591	0.2	965.5	965.5	965.6	0.1
K	28,591	1,042	6,867	0.4	965.7	965.7	965.8	0.1
L	32,800	2,500	5,509	0.6	965.8	965.8	966.0	0.2
M	33,649	2,450	7,768	0.4	965.9	965.9	966.3	0.4

[1]Feet above confluence with Bois de Sioux River

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

RICHLAND COUNTY, ND
AND INCORPORATED AREAS

FLOODWAY DATA

UPSTREAM WAHPETON BREAKOUT - BREAKOUT REACH

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 NAVD)			
County Drain #55								
A	1,233	864	2,963	0.1	965.7	965.7	965.7	0.0
B	2,432	65	369	0.5	965.7	965.7	965.7	0.0
C	4,852	56	337	0.6	965.7	965.7	965.8	0.1

[1]Feet above intersection of Highway 27 and County Drain #55

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

RICHLAND COUNTY, ND
AND INCORPORATED AREAS

FLOODWAY DATA

UPSTREAM WAHPETON BREAKOUT - COUNTY DRAIN #55 REACH

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 NAVD)			
West Breakout								
A	525	975	5,454	0.3	954.8	954.8	955.4	0.6
B	3,927	750	6,198	0.3	954.9	954.9	955.5	0.6
C	4,878	800	6,985	0.2	954.9	954.9	955.5	0.6
D	7,142	600	2,849	0.6	954.9	954.9	955.5	0.6
E	11,344	400	2,211	0.7	955.0	955.0	955.8	0.7
F	12,342	500	2,195	0.7	955.1	955.1	955.8	0.7
G	12,661	350	1,947	0.8	955.1	955.1	955.9	0.7
H	13,901	530	2,277	0.7	955.2	955.2	955.9	0.7
I	15,641	362	1,398	1.2	955.3	955.3	956.0	0.7
J	16,293	484	1,480	1.1	956.5	956.5	957.4	0.9
K	17,772	950	3,180	0.5	956.6	956.6	957.5	1.0
L	20,359	665	2,137	0.8	956.6	956.6	957.6	1.0
M	20,988	774	2,645	0.6	957.9	957.9	958.7	0.8
N	21,620	594	1,651	1.0	957.9	957.9	958.7	0.8
O	22,094	500	1,724	0.9	957.9	957.9	958.8	0.8
P	24,381	583	1,665	1.0	958.1	958.1	959.0	0.9
Q	26,258	469	1,567	1.0	958.3	958.3	959.2	0.9
R	26,933	450	2,007	0.8	959.8	959.8	960.2	0.3
S	29,307	1,202	3,068	0.5	959.9	959.9	960.4	0.4
T	31,853	657	2,614	0.9	960.0	960.0	960.6	0.5
U	32,481	3,227	11,447	0.2	962.4	962.4	962.9	0.4
V	35,214	2,906	12,265	0.1	962.4	962.4	962.9	0.4
W	37,665	3,247	8,470	0.1	962.5	962.5	962.9	0.4
X	38,367	2,450	10,237	0.1	963.3	963.3	963.5	0.3
Y	41,283	2,108	5,343	0.1	963.3	963.3	963.6	0.3
Z	43,567	1,534	4,234	0.1	963.3	963.3	963.6	0.3
AA	44,258	1,367	4,865	0.1	964.7	964.7	964.7	0.0

[1]Feet above confluence with Wild Rice River.

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

RICHLAND COUNTY, ND
AND INCORPORATED AREAS

FLOODWAY DATA

UPSTREAM WAHPETON BREAKOUT - WEST BREAKOUT REACH

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 NAVD)			
A	109,730	367	5791	2.4	923.0	923.0	923.9	0.9
B	110,882	1056	10382	1.3	923.3	923.3	924.3	1.0
C	112,936	750	9168	1.5	923.7	923.7	924.7	0.9
D	114,173	750	10371	1.3	923.9	923.9	924.8	0.9
E	115,865	715	9274	1.5	924.2	924.2	925.0	0.8
F	117,033	481	7505	1.8	924.4	924.4	925.2	0.8
G	118,026	295	6126	2.3	924.6	924.6	925.4	0.8
H	119,423	691	10636	1.3	924.8	924.8	925.6	0.9
I	121,389	345	5806	2.4	925.0	925.0	925.8	0.9
J	123,224	1022	12004	1.2	925.2	925.2	926.1	0.9
K	125,294	571	8420	1.6	925.4	925.4	926.3	0.9
L	126,596	351	6131	2.2	925.6	925.6	926.5	0.9
M	127,879	588	8805	1.6	925.8	925.8	926.7	0.9
N	128,004	483	7730	1.8	926.0	926.0	926.9	0.9
O	128,713	483	8272	1.7	926.1	926.1	927.0	0.9
P	129,625	328	6260	2.2	926.2	926.2	927.1	0.9
Q	130,281	680	7560	1.8	926.4	926.4	927.3	0.9
R	131,587	355	7420	1.9	926.6	926.6	927.6	0.9
S	133,866	393	6794	2.0	927.0	927.0	928.0	1.0
T	136,093	502	9,158	1.5	927.3	927.3	928.3	1.0
U	136,171	520	9,444	1.5	927.3	927.3	928.3	1.0
V	139,090	746	12,336	1.1	927.5	927.5	928.5	1.0
W	140,505	538	8,633	1.6	927.6	927.6	928.6	1.0
X	141,893	577	9,131	1.5	927.8	927.8	928.8	1.0
Y	143,789	424	7537	1.8	928.0	928.0	929.0	1.0
Z	146,868	1149	18076	0.8	928.3	928.3	929.3	1.0
AA	147,042	1183	19290	0.7	928.3	928.3	929.3	1.0
AB	149,265	534	8348	1.7	928.4	928.4	929.4	1.0
AC	150,057	556	9664	1.4	928.5	928.5	929.5	1.0

[1]Feet above confluence with the Red River of the North.

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 NAVD)			
AD	151,956	830	13544	1.0	928.6	928.6	929.6	1.0
AE	153,921	737	12108	1.1	928.7	928.7	929.7	1.0
AF	155,884	752	11859	1.2	928.8	928.8	929.8	1.0
AG	156,015	996	13041	1.1	928.8	928.8	929.8	1.0
AH	158,100	817	11782	1.2	929.0	929.0	930.0	1.0
AI	160,545	384	7126	1.9	929.3	929.3	930.2	1.0
AJ	161,477	740	12550	1.1	929.4	929.4	930.4	1.0
AK	166,722	1738	23849	0.6	929.6	929.6	930.6	1.0
AL	166,848	1850	15269	0.9	929.6	929.6	930.6	1.0

[1]Feet above confluence with the Red River of the North.

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 NAVD)			
Wild Rice River								
A	219	256	1,985	1.6	957.5	957.5	958.1	0.6
B	3,000	405	2,251	1.4	958.0	958.0	958.5	0.5
C	7,340	300	1,860	1.7	958.6	958.6	959.0	0.4
D	9,160	400	2,654	1.2	959.1	959.1	959.5	0.4
E	12,620	360	1,958	1.6	959.5	959.5	959.8	0.3
F	16,270	700	2,343	1.4	959.9	959.9	960.3	0.4
G	19,730	605	3,593	0.9	960.2	960.2	960.8	0.6
H	23,370	300	1,836	1.7	960.6	960.6	961.1	0.5
I	26,910	210	1,754	1.8	961.3	961.3	961.7	0.4
J	31,600	550	2,923	1.1	962.1	962.1	962.4	0.3
K	34,737	300	2,171	1.5	962.5	962.5	962.8	0.3
L	37,150	483	2,770	1.2	962.7	962.7	963.0	0.3
M	40,370	350	1,947	1.6	963.0	963.0	963.3	0.3
N	42,630	400	2,334	1.4	963.3	963.3	963.6	0.3
O	43,850	415	3,008	1.1	963.5	963.5	963.8	0.3
P	46,200	400	2,178	1.5	963.6	963.6	963.9	0.3
Q	48,700	400	2,742	1.2	964.1	964.1	964.4	0.3

[1]Feet above centerline of State Highway 13 west.

the Wahpeton/Breckenridge Flood Control Project. In defining the floodway along the Upstream-Wahpeton Breakout, the lateral structure optimization for the State Highway 127 overflow was left on for the hydraulic analysis to account for potentially higher discharges if the breakout flow path is encroached. This results in higher breakout discharges during the floodway run than during the FIS model run.

The area between the floodway and 1-percent-annual-chance floodplain boundaries is termed the floodway fringe. The floodway fringe encompasses the portion of the floodplain that could be completely obstructed without increasing the water-surface elevation of the 1-percent-annual-chance 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 1.

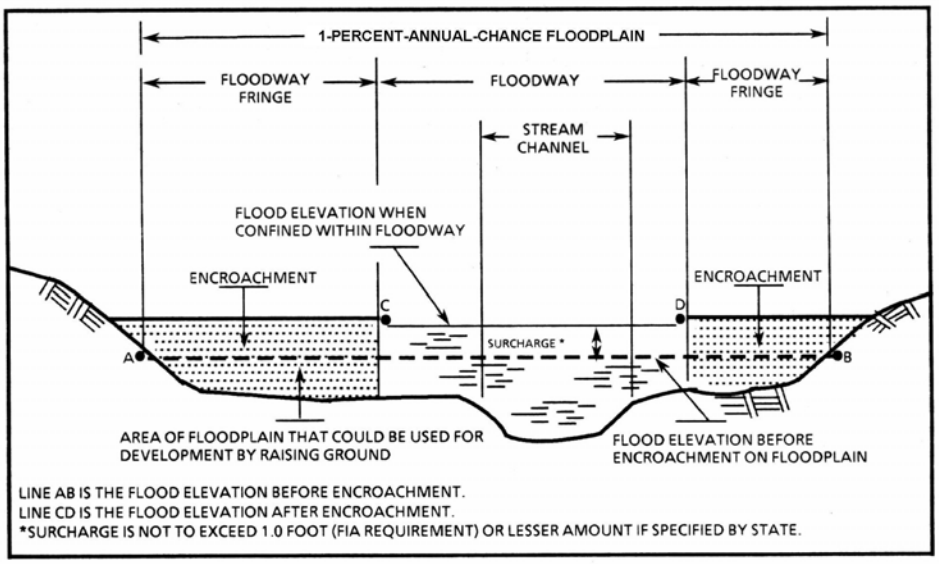

Figure 1, “Floodway Schematic”

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 risk zone that corresponds to the 1-percent-annual-chance floodplains that are determined in the FIS by approximate methods. Because detailed hydraulic analyses are not performed for such areas, no BFE's or base flood depths are shown within this zone.

Zone AE

Zone AE is the flood insurance risk zone that corresponds to the 1-percent-annual-chance floodplains that are determined in the FIS by detailed methods. In most instances, whole –foot BFE's derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone X

Zone X is the flood insurance risk zone that corresponds to areas outside the 0.2-percent-annual-chance floodplain, areas within the 0.2-percent-annual-chance floodplain, areas of 1-percent-annual-chance flooding where average depths are less than 1 ft., areas of 1-percent-annual-chance flooding where the contributing drainage area is less than 1 sq. mi., and areas protected from the 1-percent-annual-chance flood by levees. No BFE's or depths are shown within this zone.

6.0 FLOOD INSURANCE RATE MAP

The FIRM 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 1-percent-annual-chance floodplains that were studied by detailed methods, shows selected whole-foot BFEs or average depths. Insurance agents use the zones and BFEs 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 1- and 0.2-percent-annual-chance floodplains, floodways, and the locations of selected cross sections used in the hydraulic analyses and floodway computations.

The countywide FIRM presents flooding information for the entire geographic area of Richland County. Previously, FIRMs were prepared for each incorporated community and the unincorporated areas of the county identified as floodprone. The countywide FIRM also includes flood hazard information that was presented separately on Flood Boundary and Floodway Maps, where applicable. Historical data relating to the maps prepared for each community are presented in Table 4, Community Map History.

7.0 OTHER STUDIES

FIS reports were published for the City of Wahpeton and Center Township on June 4, 1987. No previous studies have been prepared for the other communities. This report either supersedes or is compatible with all previous studies published on streams studied in this report and should be considered authoritative for the purposes of the NFIP.

8.0 LOCATION OF DATA

Information concerning the pertinent data used in the preparation of this study can be obtained by contacting FEMA, Federal Insurance and Mitigation Division, Denver Federal Center, Building 710, P.O. Box 25267, Denver, Colorado 80225-0267.

COMMUNITY NAME	INITIAL IDENTIFICATION	FLOOD HAZARD BOUNDARY MAP REVISION DATE(S)	FLOOD INSURANCE RATE MAP EFFECTIVE DATE	FLOOD INSURANCE RATE MAP REVISION DATE(S)
ABERCROMBIE, CITY OF	December 18, 2009	N/A	December 18, 2009	
ANTELOPE, TOWNSHIP OF	February 3, 1981	N/A	August 5, 1986	December 18, 2009
BARNEY, CITY OF*	N/A	N/A	N/A	
BARRIE, TOWNSHIP OF	February 3, 1981	N/A	September 18, 1986	December 18, 2009
BELFORD, TOWNSHIP OF	February 3, 1981	N/A	August 19, 1986	December 18, 2009
BRANDENBURG, TOWNSHIP OF	January 3, 1983	N/A	April 1, 1986	December 18, 2009
BRIGHTWOOD, TOWNSHIP OF	December 18, 2009	N/A	December 18, 2009	
CENTER, TOWNSHIP OF	December 28, 1982	N/A	June 4, 1987	December 18, 2009
CHRISTINE, CITY OF*	N/A	N/A	N/A	
COLFAX, CITY OF*	N/A	N/A	N/A	
DWIGHT, CITY OF	December 18, 2009	N/A	December 18, 2009	
DWIGHT, TOWNSHIP OF	February 3, 1981	N/A	September 29, 1986	December 18, 2009
EAGLE, TOWNSHIP OF	December 18, 2009	N/A	December 18, 2009	
FAIRMOUNT, CITY OF*	N/A	N/A	N/A	
FAIRMOUNT, TOWNSHIP OF	January 3, 1983	N/A	April 1, 1986	December 18, 2009
GREAT BEND, CITY OF	July 30, 1976	N/A	June 1, 1998	December 18, 2009
GREENDALE, TOWNSHIP OF	December 18, 2009	N/A	December 18, 2009	
HANKINSON, CITY OF*	N/A	N/A	N/A	
IBSEN, TOWNSHIP OF	December 18, 2009	N/A	December 18, 2009	
LAMARS, TOWNSHIP OF	December 18, 2009	N/A	December 18, 2009	
LIBERTY GROVE, TOWNSHIP OF	December 18, 2009	N/A	December 18, 2009	
LIDGERWOOD, CITY*	N/A	N/A	N/A	
MANTADOR, CITY OF*	N/A	N/A	N/A	
MOORETON, CITY OF	December 18, 2009	N/A	December 18, 2009	
MOORETON, TOWNSHIP OF	February 3, 1981	N/A	September 18, 1986	December 18, 2009
MORAN, TOWNSHIP OF	February 3, 1981	N/A	September 18, 1986	December 18, 2009
NANSEN, TOWNSHIP OF	December 18, 2009	N/A	December 18, 2009	
RICHLAND COUNTY	February 3, 1981	N/A	June 1, 1998	December 18, 2009
SUMMIT, TOWNSHIP OF	February 3, 1981	N/A	August 19, 1986	December 18, 2009
WAHPETON, CITY OF	June 28, 1974	N/A	June 4, 1987	December 18, 2009
WALCOTT, CITY OF*	N/A	N/A	N/A	
WALCOTT, TOWNSHIP OF	December 28, 1982	N/A	September 29, 1986	December 18, 2009
WALDO, TOWNSHIP OF	December 18, 2009	N/A	December 18, 2009	
WYNDMERE, CITY OF*	N/A	N/A	N/A	
WYNDMERE, TOWNSHIP OF	December 18, 2009	N/A	December 18, 2009	

*Non-Floodprone Area

TABLE 4

FEDERAL EMERGENCY MANAGEMENT AGENCY

RICHLAND COUNTY, ND
AND INCORPORATED AREAS

COMMUNITY MAP HISTORY

9.0 BIBLIOGRAPHY AND REFERENCES

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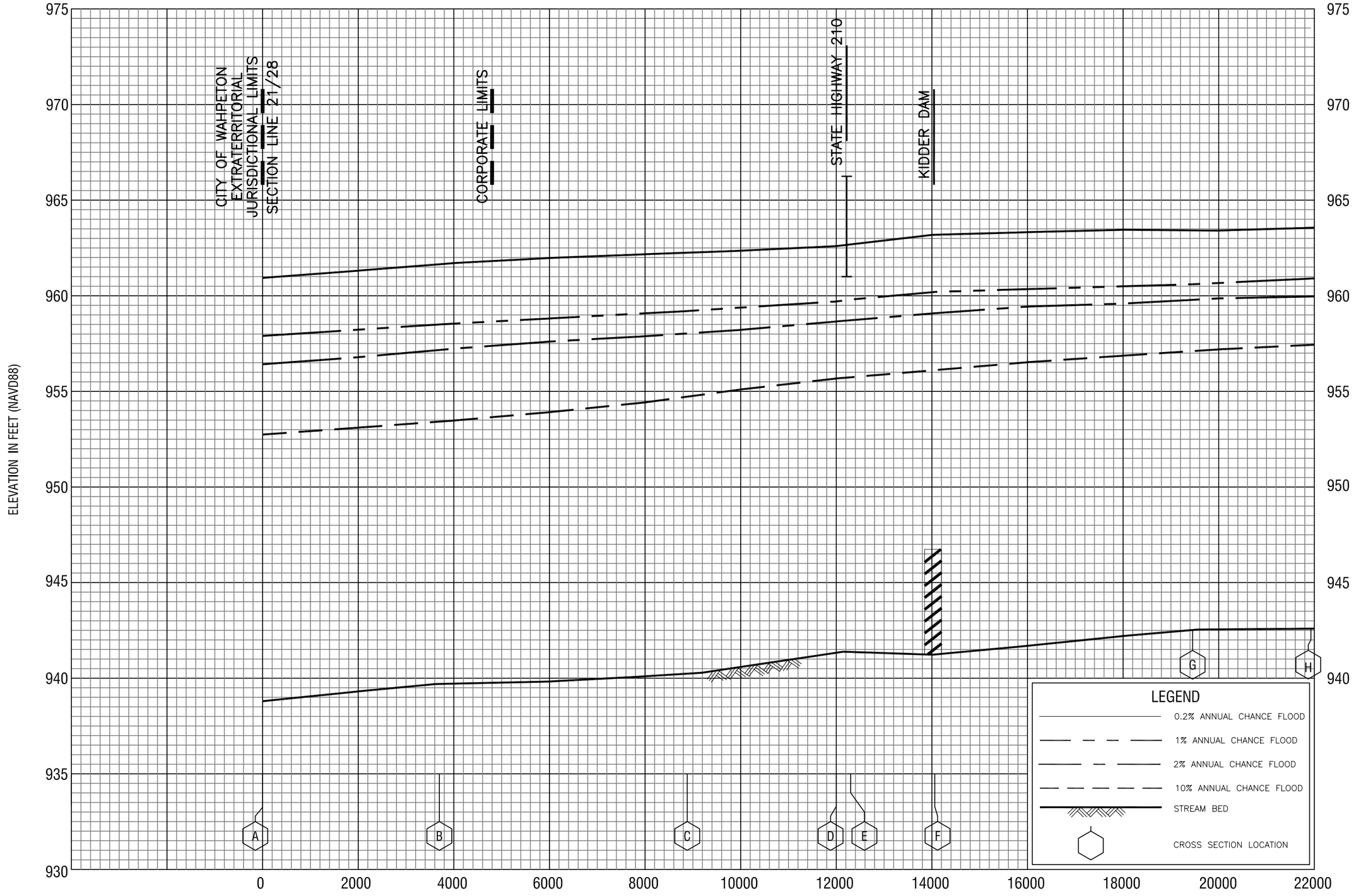


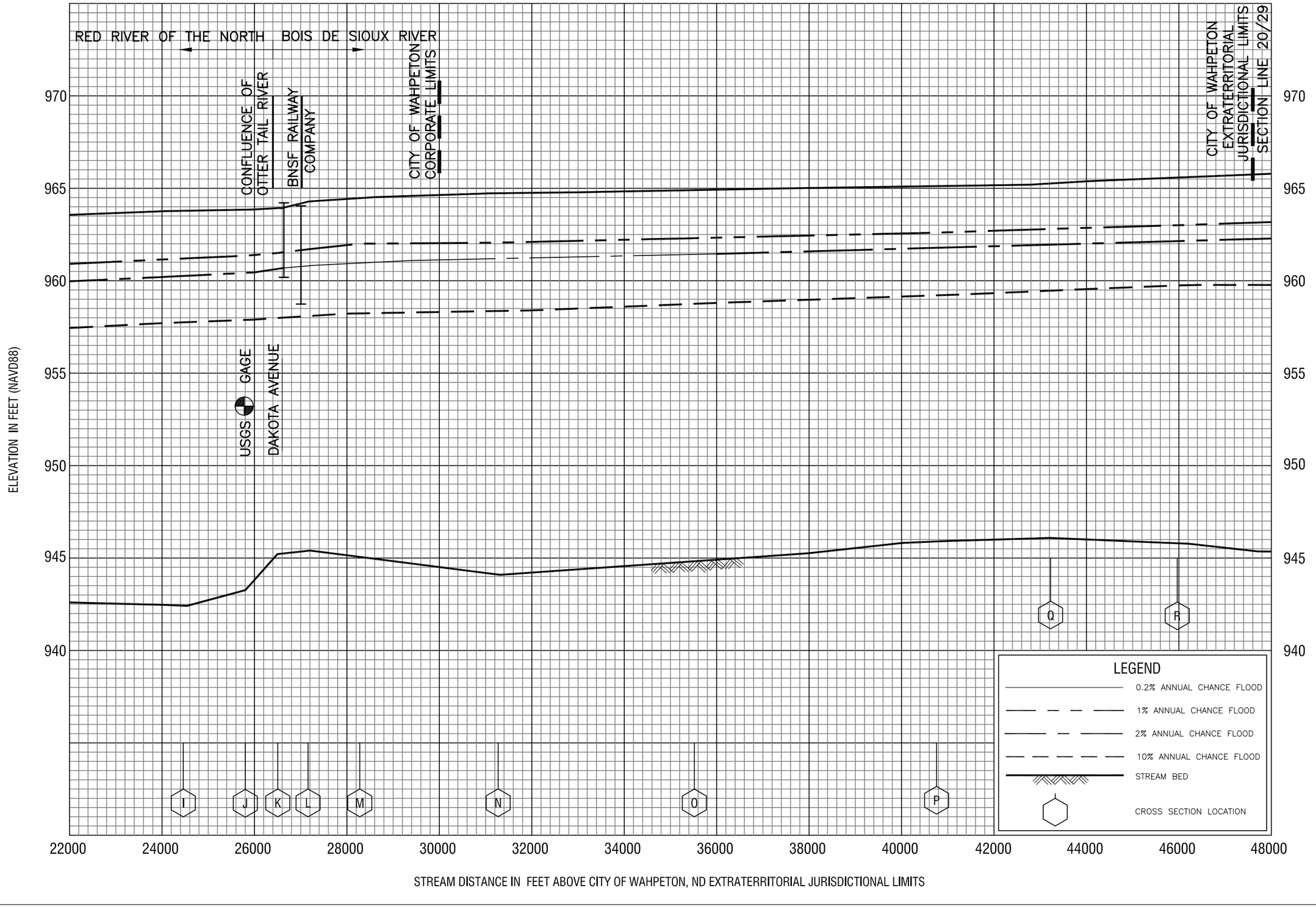
FLOOD PROFILES

RED RIVER OF THE NORTH

FEDERAL EMERGENCY MANAGEMENT AGENCY

RICHLAND COUNTY, ND AND INCORPORATED AREAS

01P



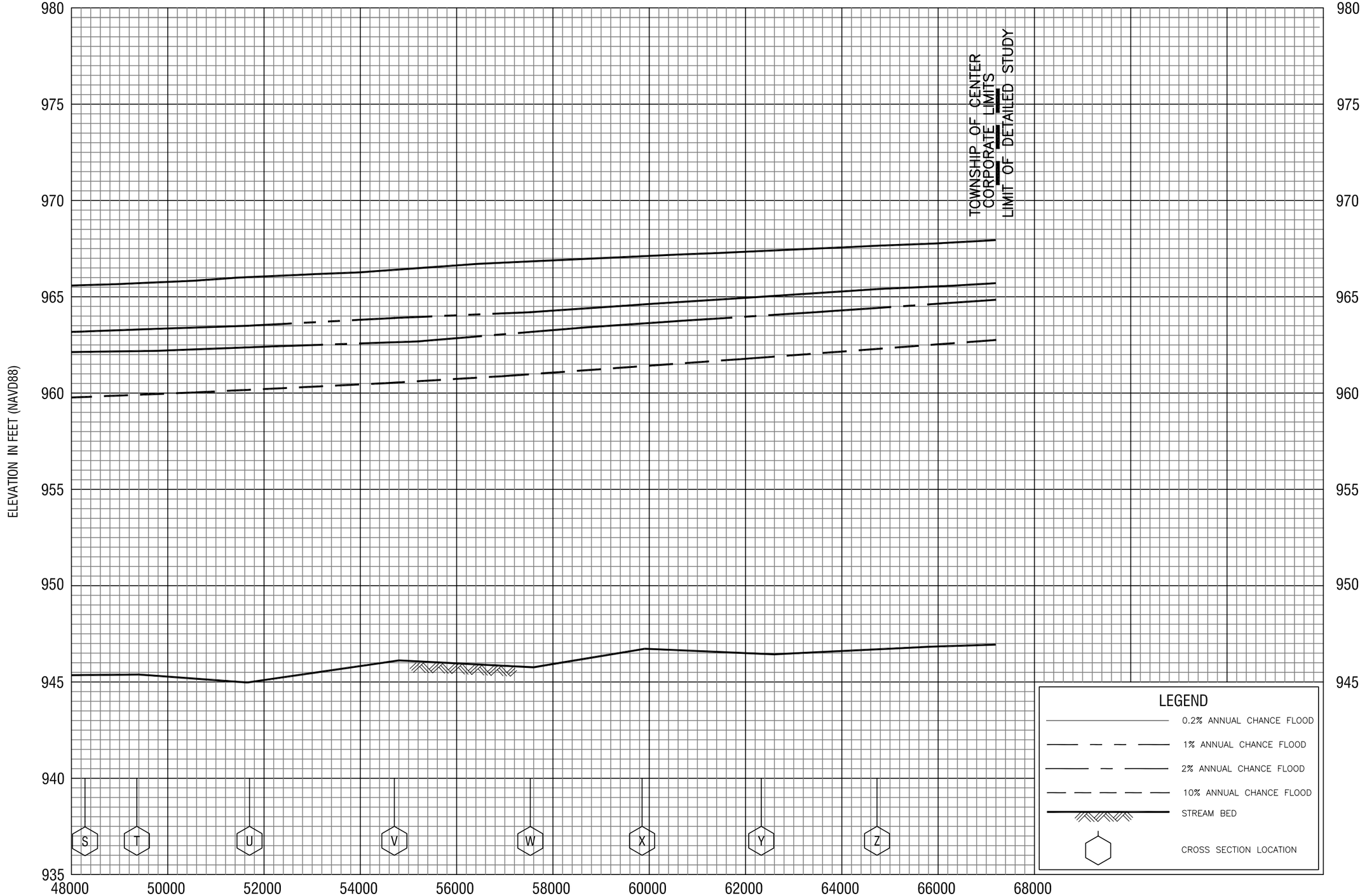
FLOOD PROFILES

RED RIVER OF THE NORTH - BOIS DE SIOUX RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

RICHLAND COUNTY, ND
AND INCORPORATED AREAS

02P



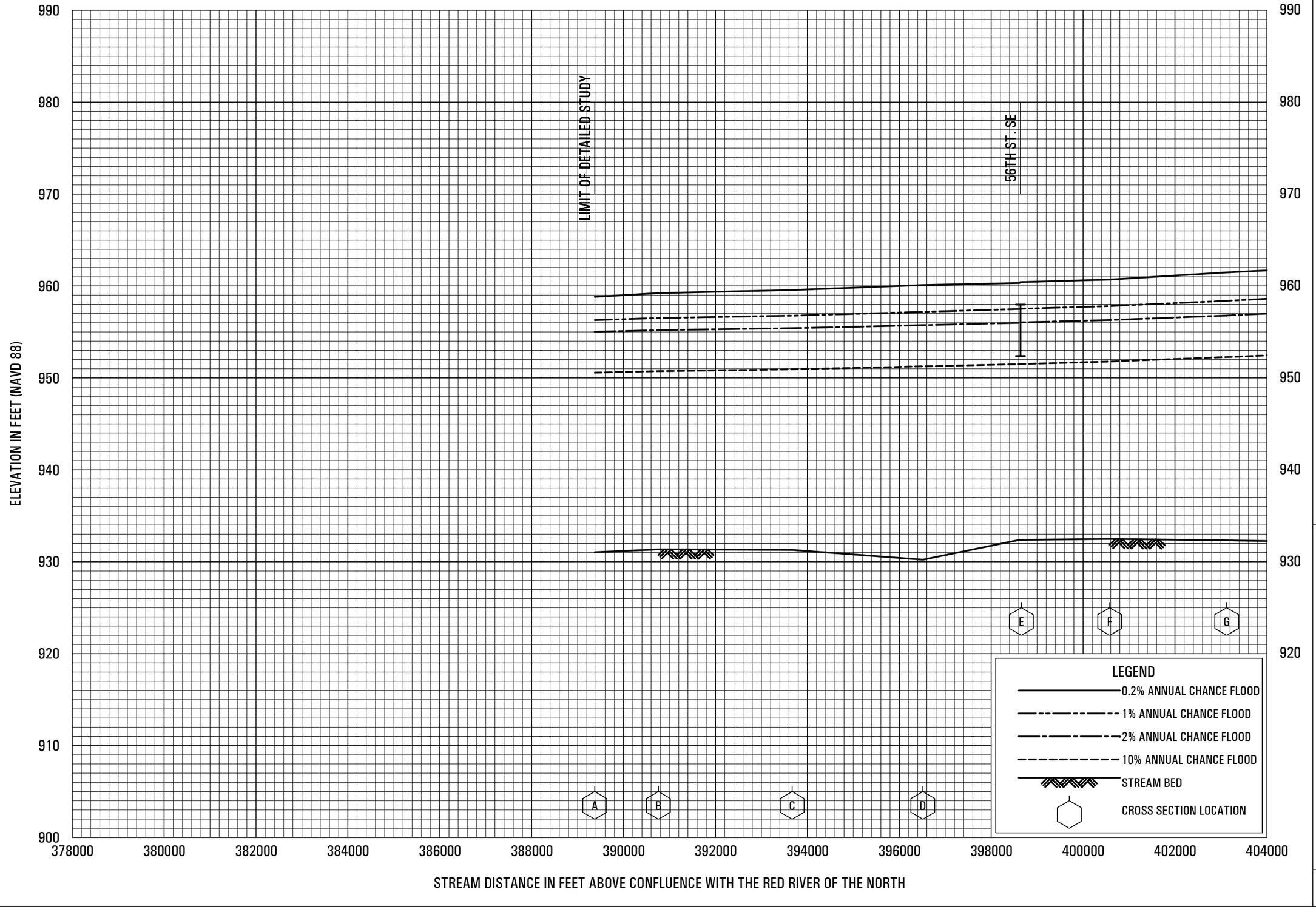
FLOOD PROFILES

BOIS DE SIOUX RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

RICHLAND COUNTY, ND
AND INCORPORATED AREAS

03P



FLOOD PROFILES

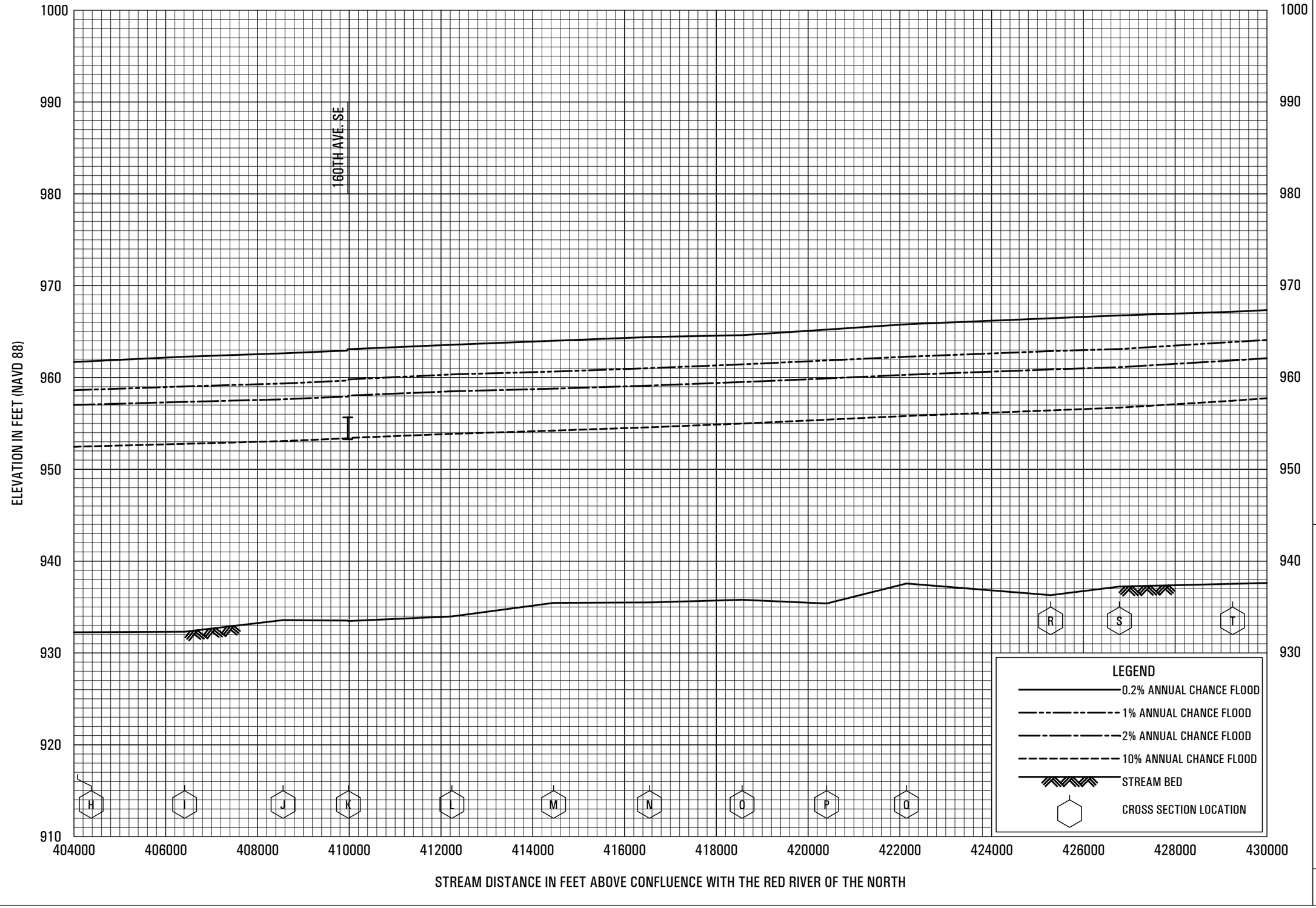
SHEYENNE RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

RICHLAND COUNTY, ND

AND INCORPORATED AREAS

04P



FLOOD PROFILES

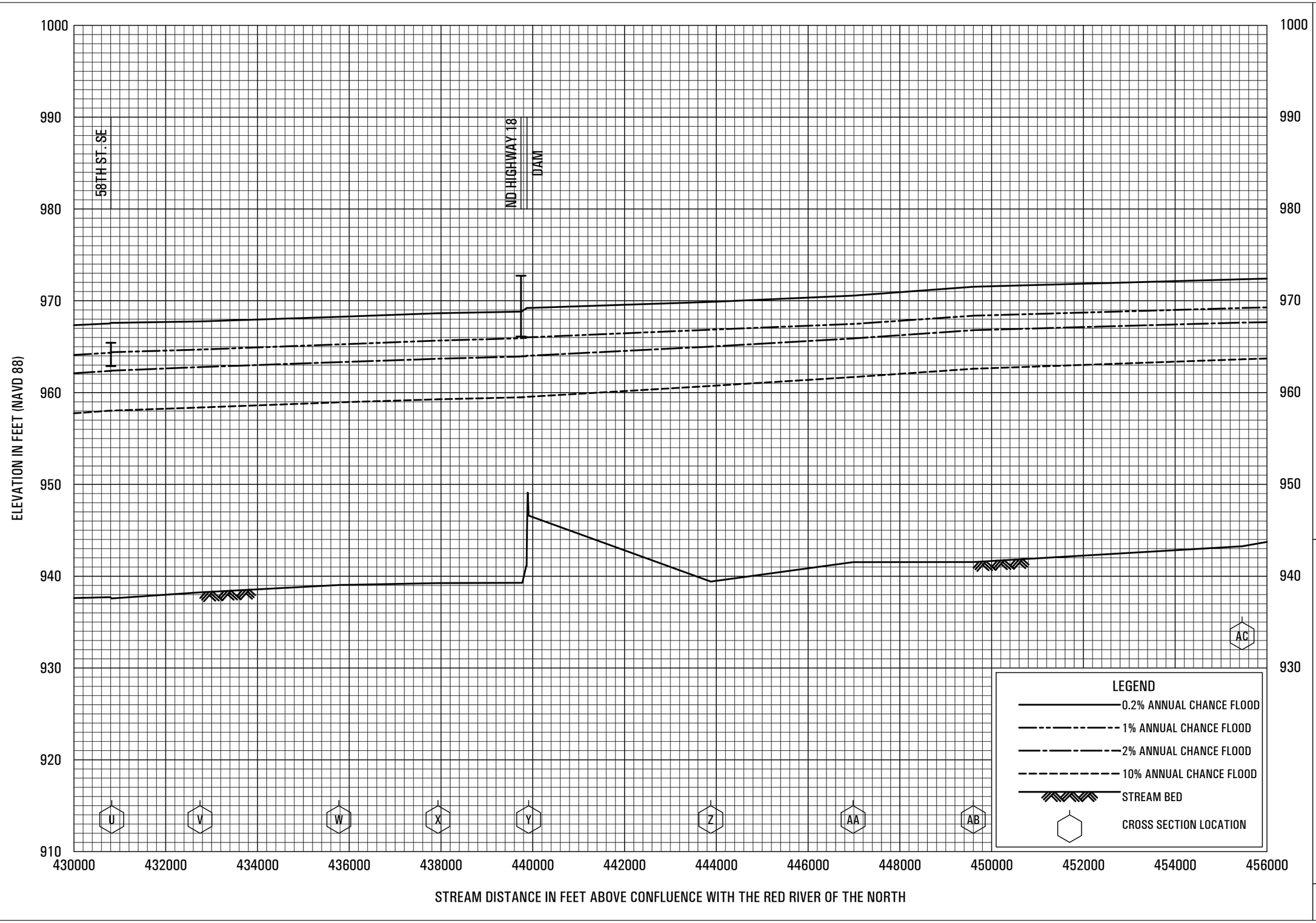
SHEYENNE RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

RICHLAND COUNTY, ND

AND INCORPORATED AREAS

05P



FLOOD PROFILES

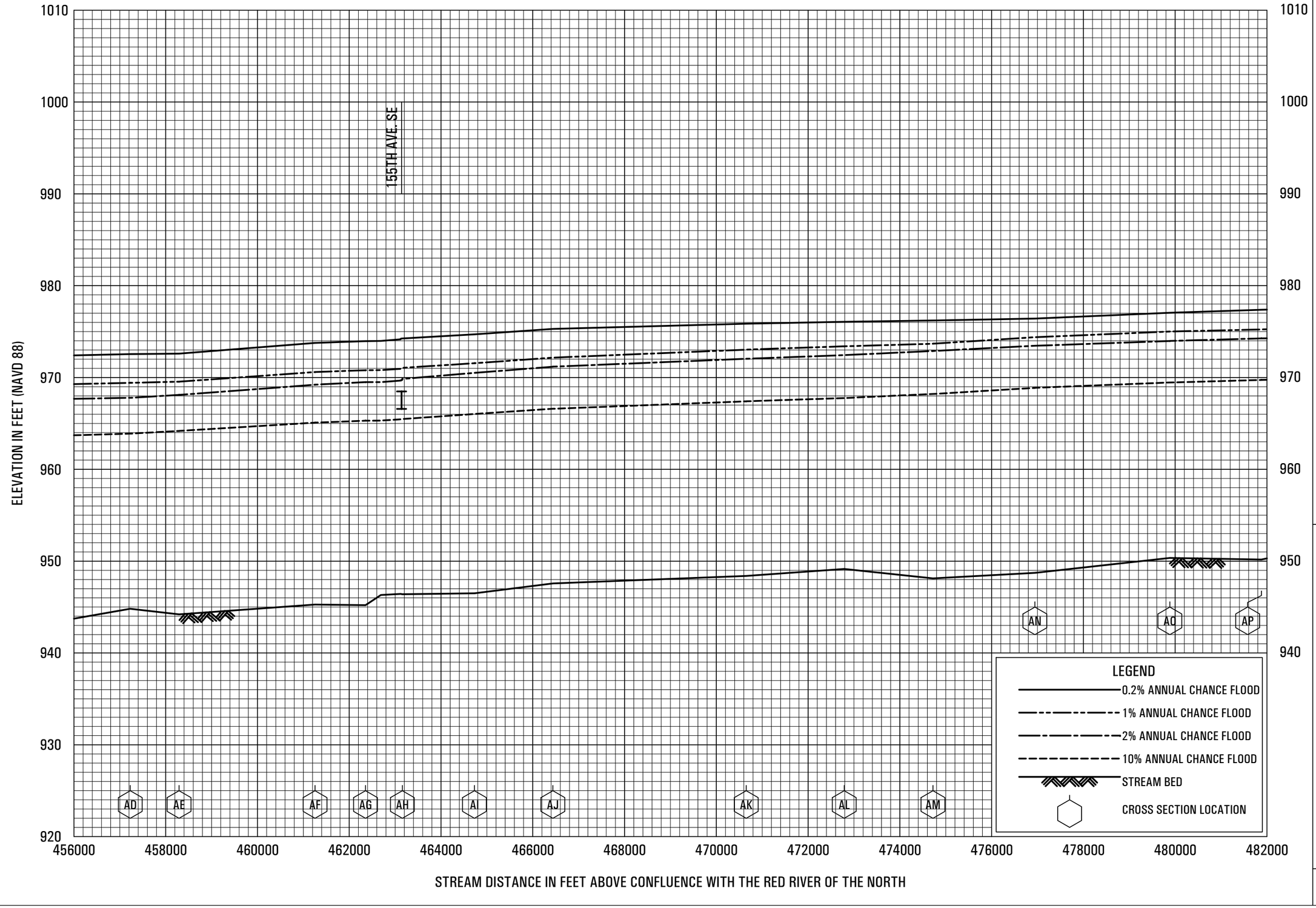
SHEYENNE RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

RICHLAND COUNTY, ND

AND INCORPORATED AREAS

06P



FLOOD PROFILES

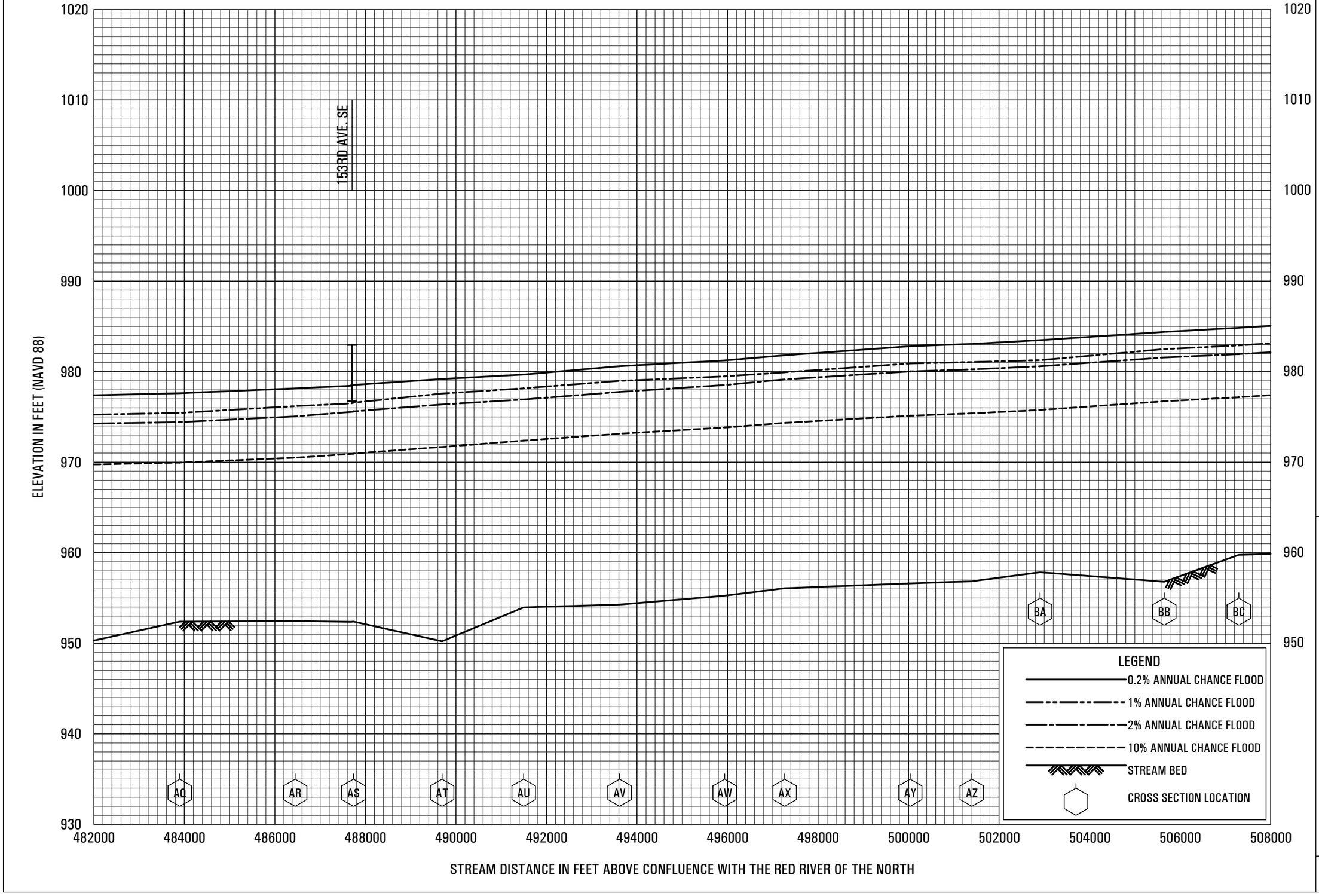
SHEYENNE RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

RICHLAND COUNTY, ND

AND INCORPORATED AREAS

07P



FLOOD PROFILES

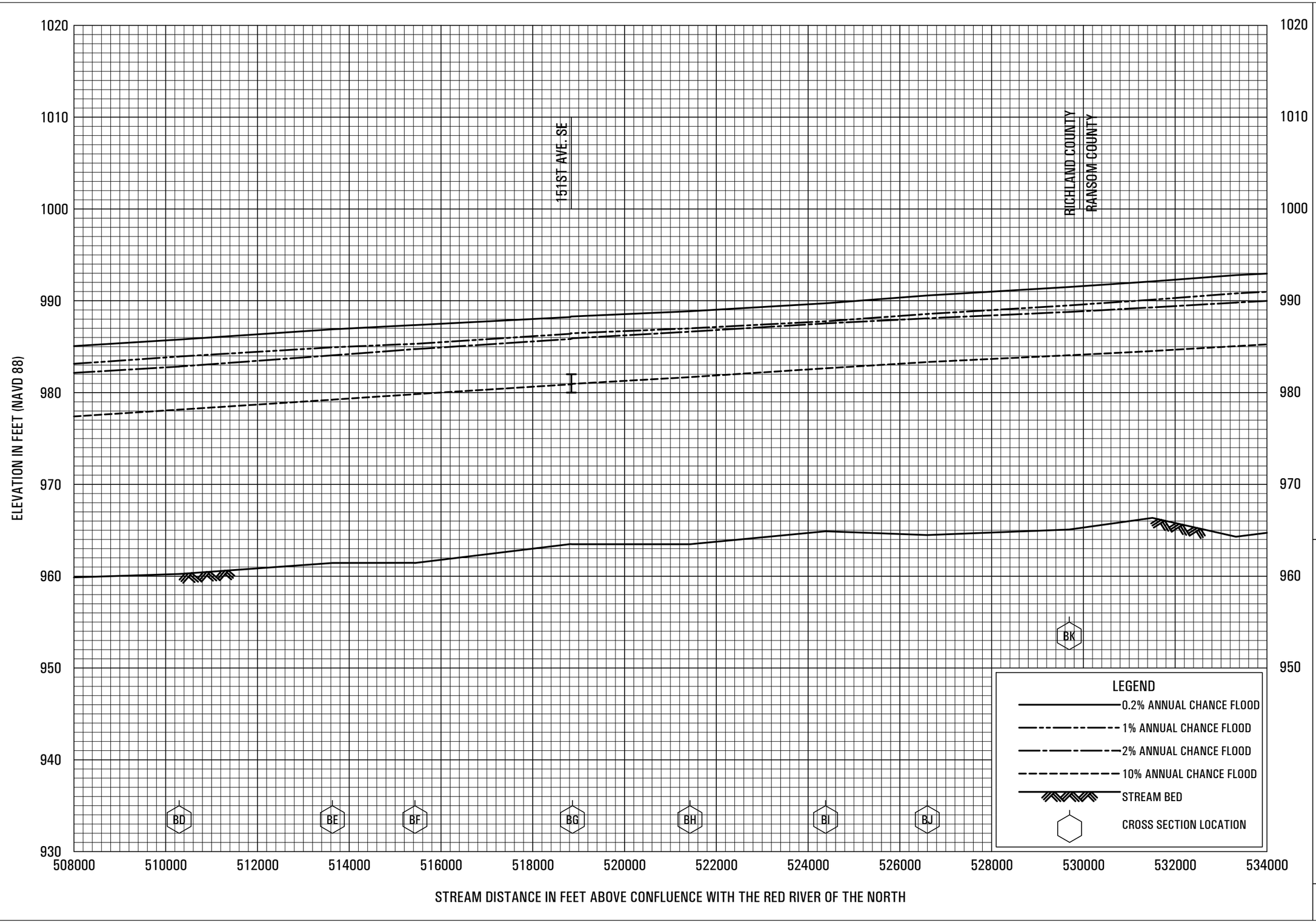
SHEYENNE RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

RICHLAND COUNTY, ND

AND INCORPORATED AREAS

08P



FLOOD PROFILES

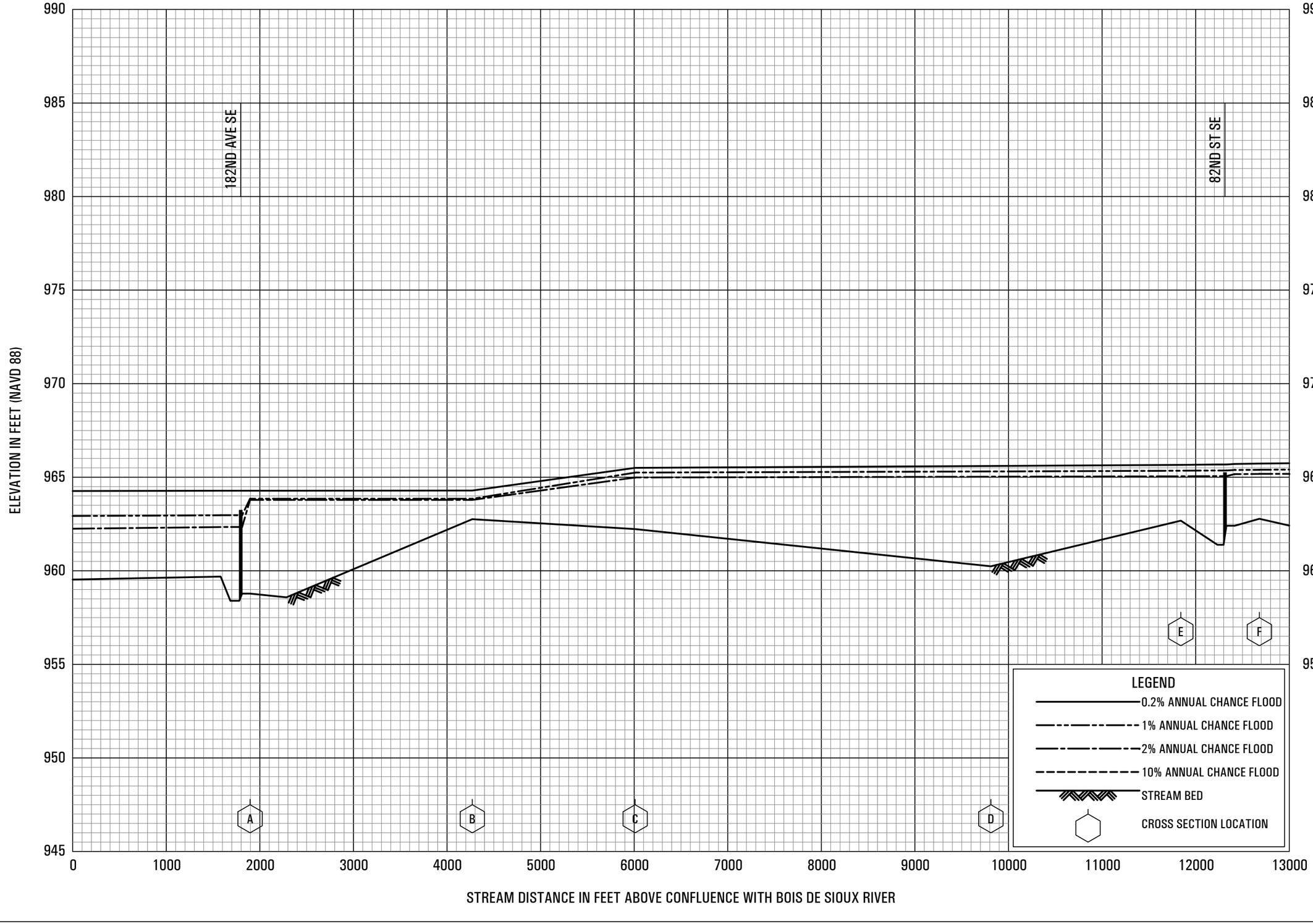
SHEYENNE RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

RICHLAND COUNTY, ND

AND INCORPORATED AREAS

09P



FLOOD PROFILES

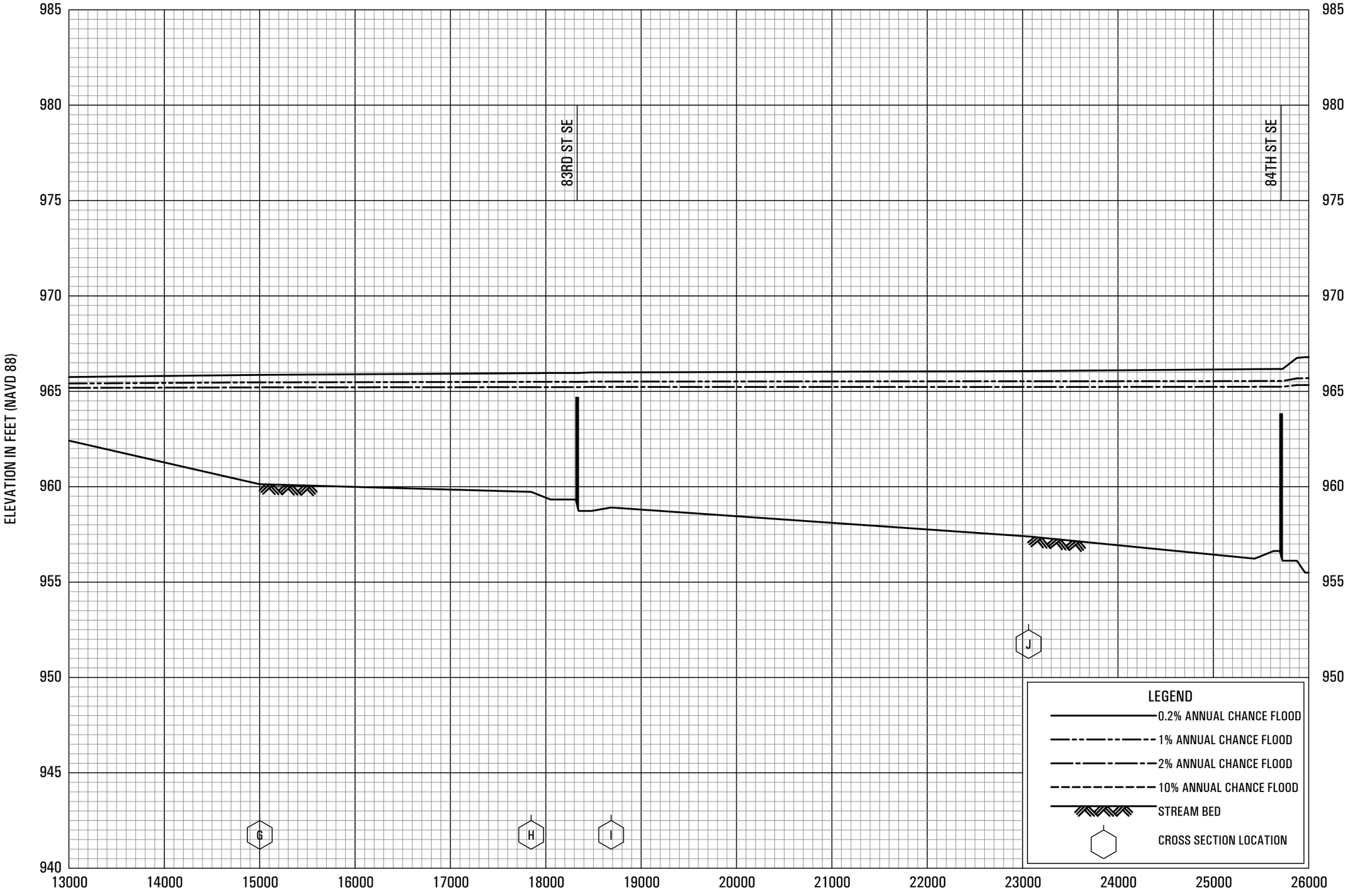
UPSTREAM WAHPETON BREAKOUT - BREAKOUT REACH

FEDERAL EMERGENCY MANAGEMENT AGENCY

RICHLAND COUNTY, ND

AND INCORPORATED AREAS

10P



FLOOD PROFILES

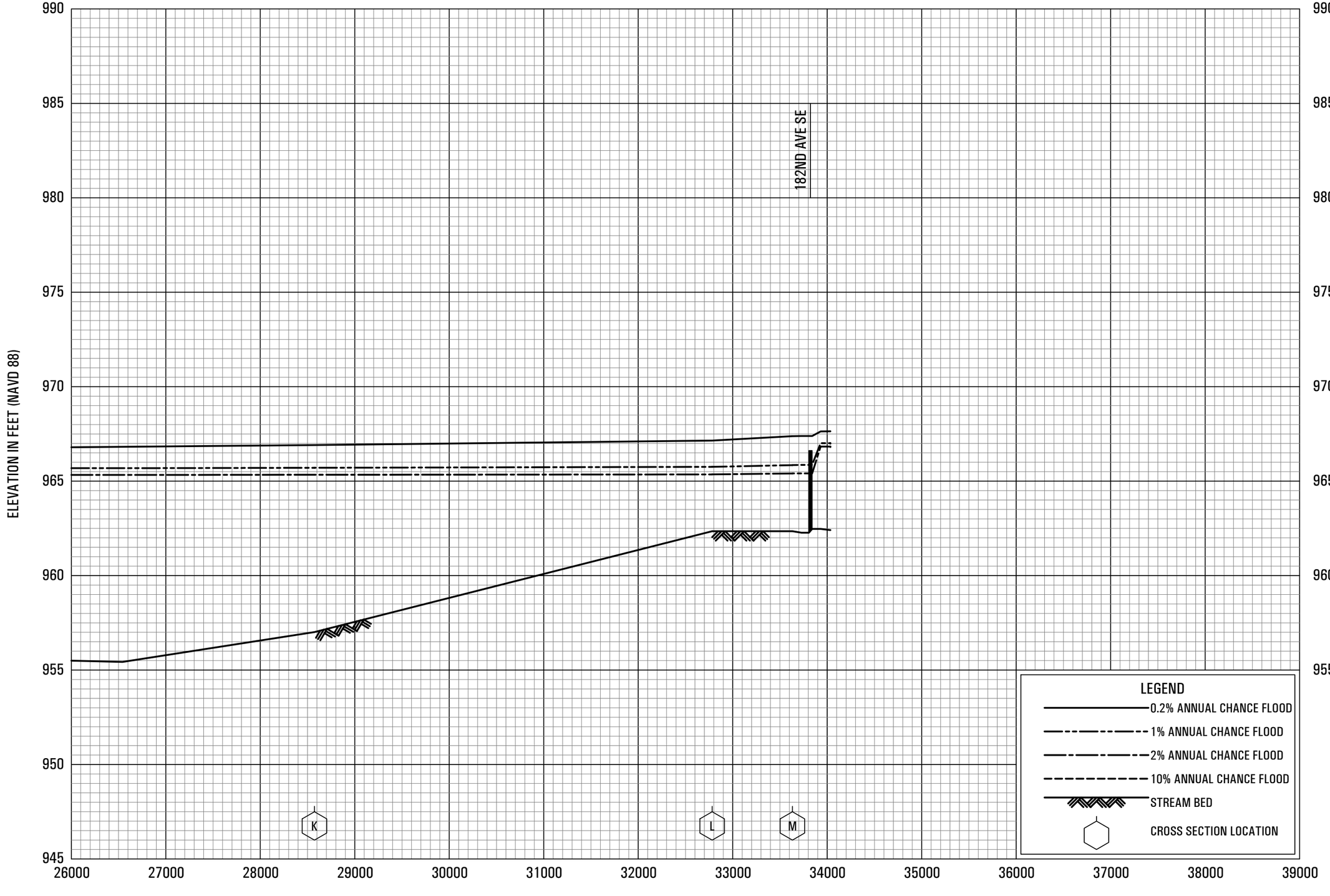
UPSTREAM WAHPETON BREAKOUT - BREAKOUT REACH

FEDERAL EMERGENCY MANAGEMENT AGENCY

RICHLAND COUNTY, ND

AND INCORPORATED AREAS

11P



FLOOD PROFILES

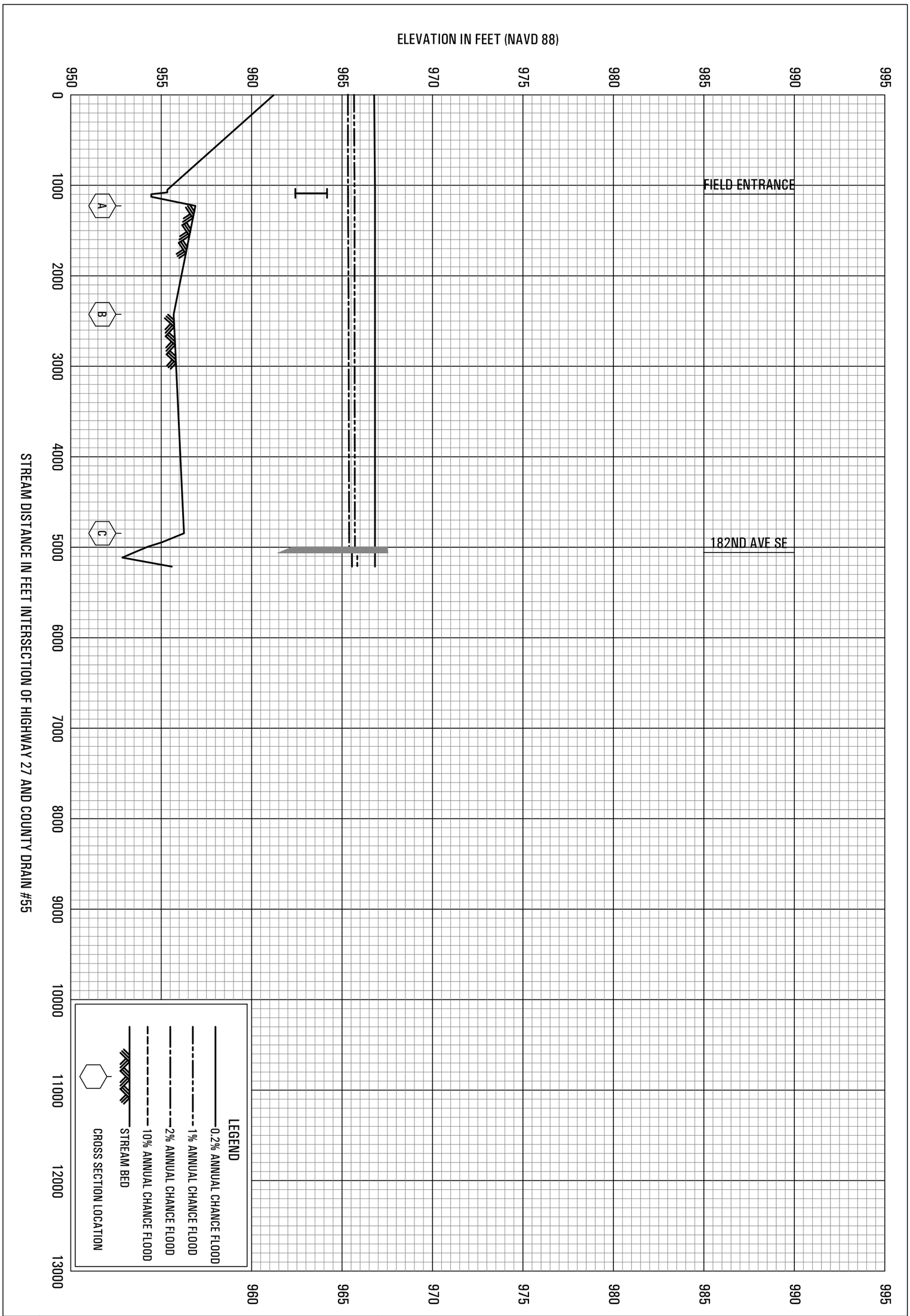
UPSTREAM WAHPETON BREAKOUT - BREAKOUT REACH

FEDERAL EMERGENCY MANAGEMENT AGENCY

RICHLAND COUNTY, ND

AND INCORPORATED AREAS

12P



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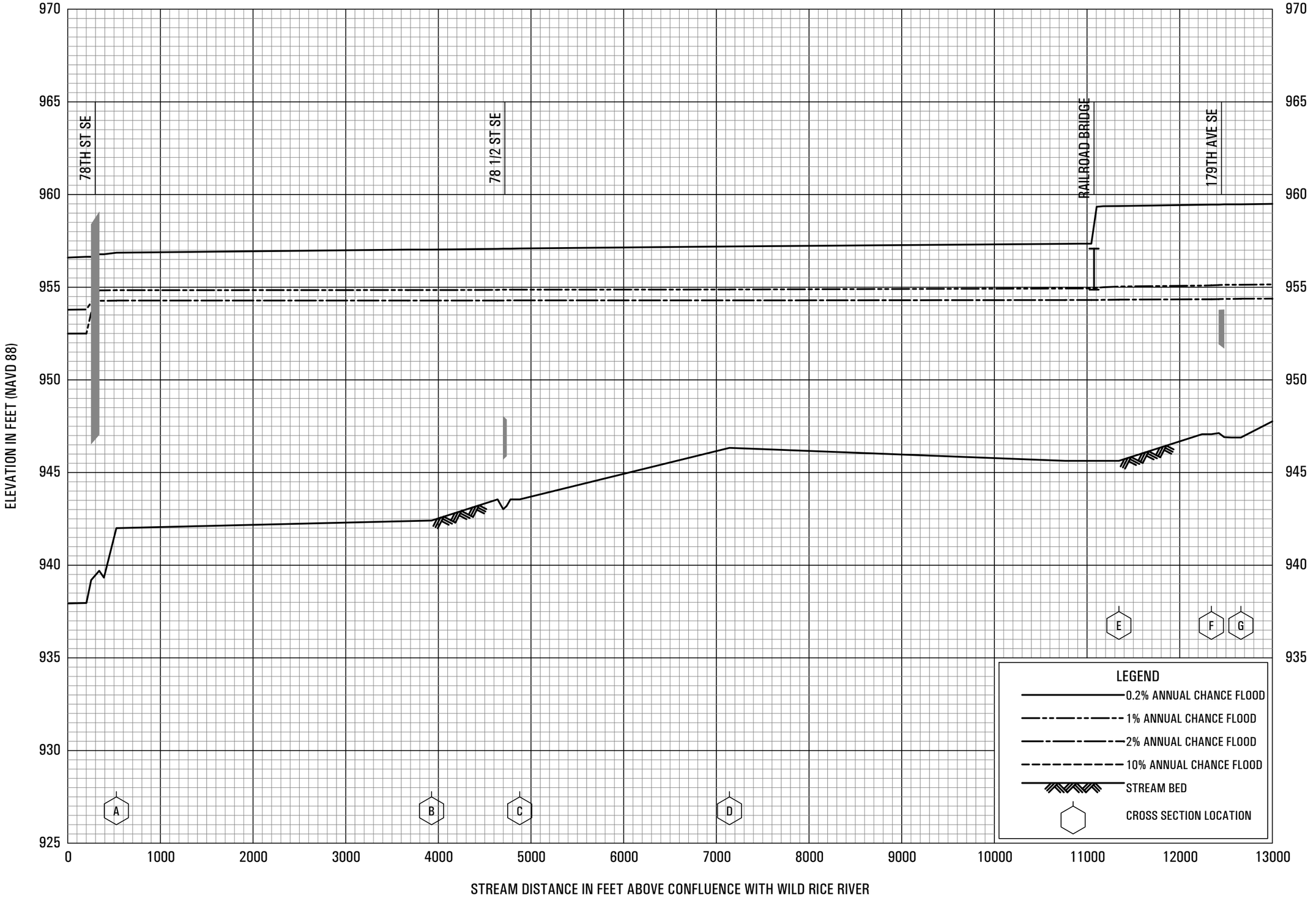
FEDERAL EMERGENCY MANAGEMENT AGENCY

RICHLAND COUNTY, ND

AND INCORPORATED AREAS

FLOOD PROFILES

UPSTREAM WAHPETON BREAKOUT - COUNTY DRAIN #55 REACH



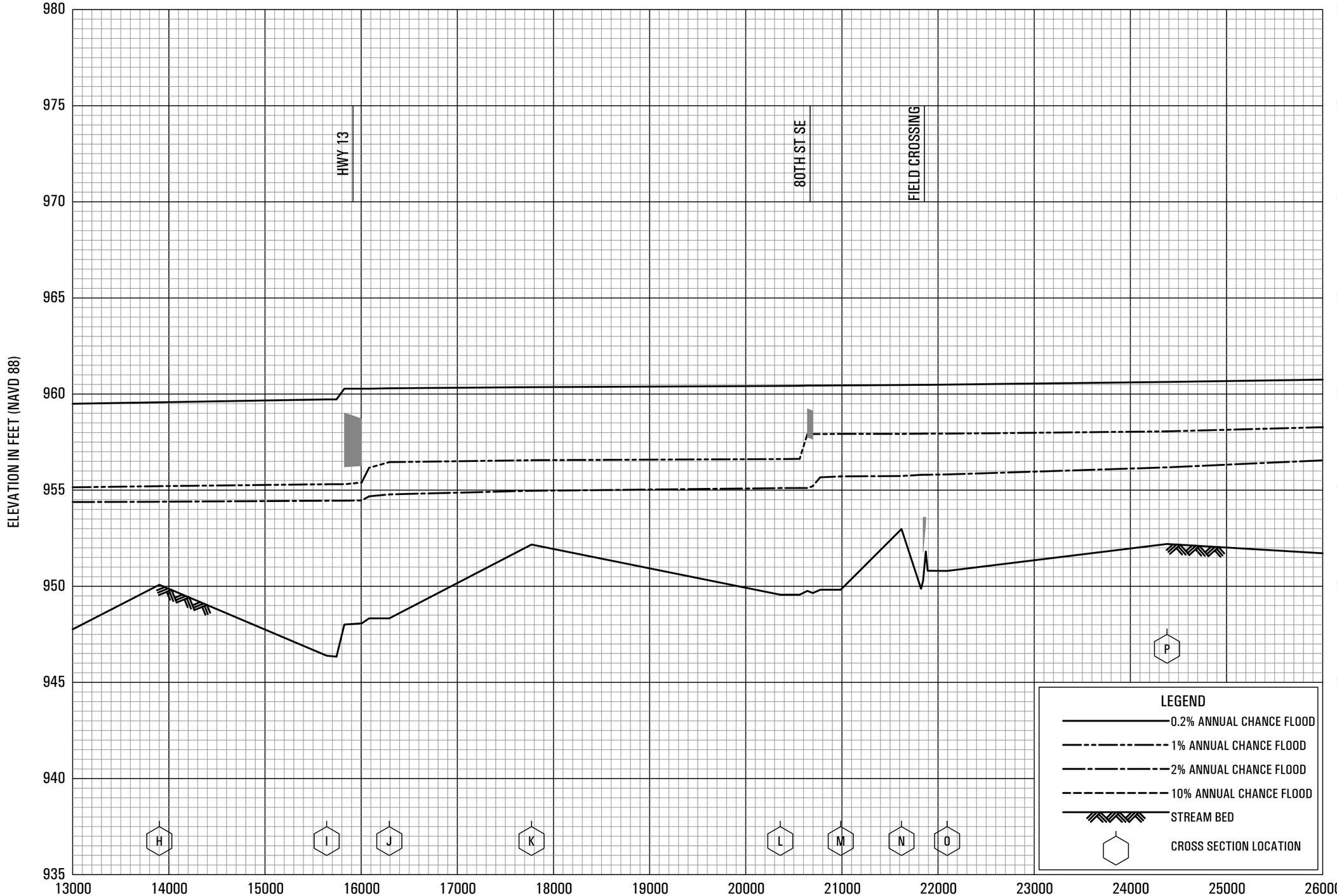
FLOOD PROFILES

UPSTREAM WAHPETON BREAKOUT - WEST BREAKOUT REACH

FEDERAL EMERGENCY MANAGEMENT AGENCY

RICHLAND COUNTY, ND

AND INCORPORATED AREAS



FLOOD PROFILES

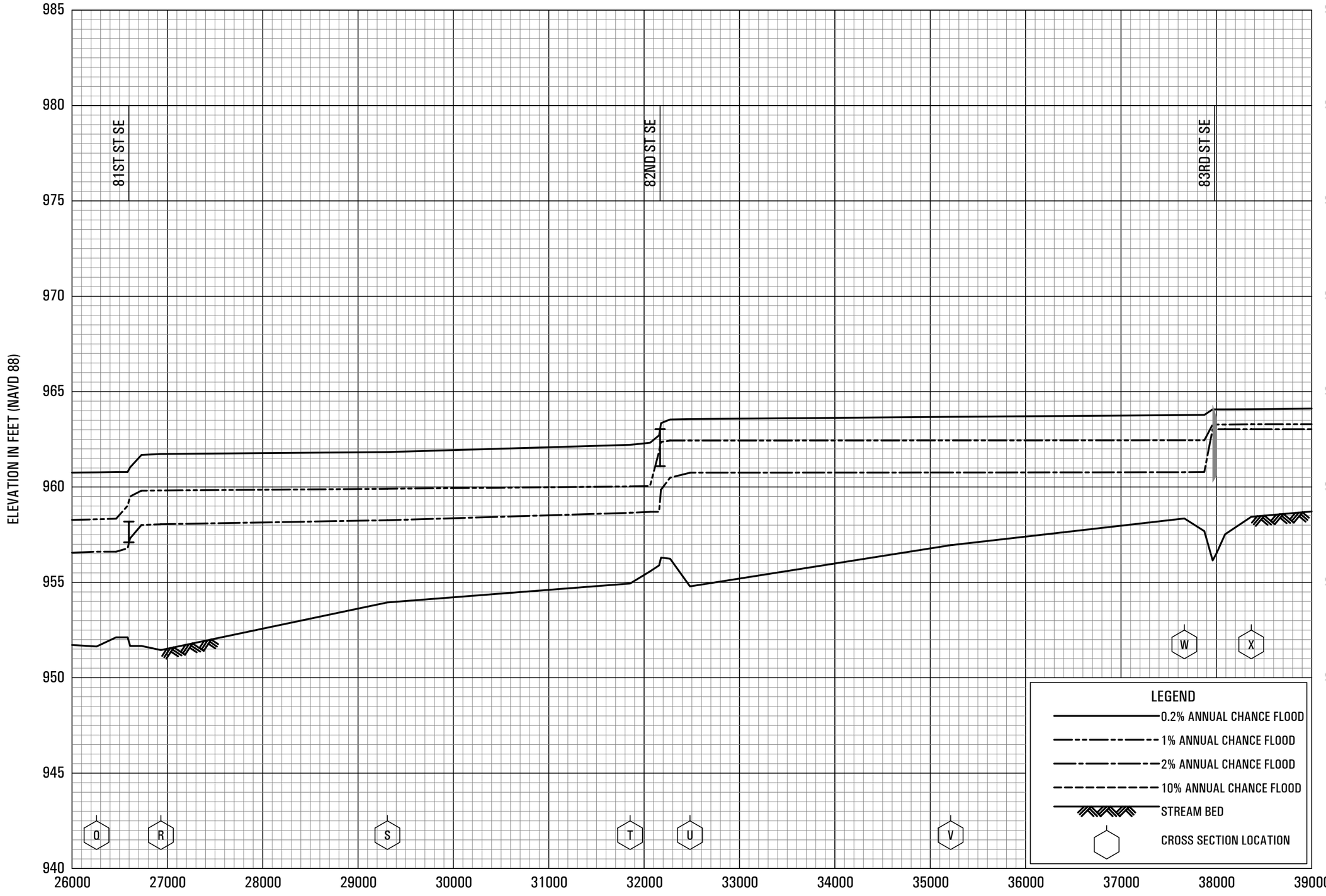
UPSTREAM WAHPETON BREAKOUT - WEST BREAKOUT REACH

FEDERAL EMERGENCY MANAGEMENT AGENCY

RICHLAND COUNTY, ND

AND INCORPORATED AREAS

15P



FLOOD PROFILES

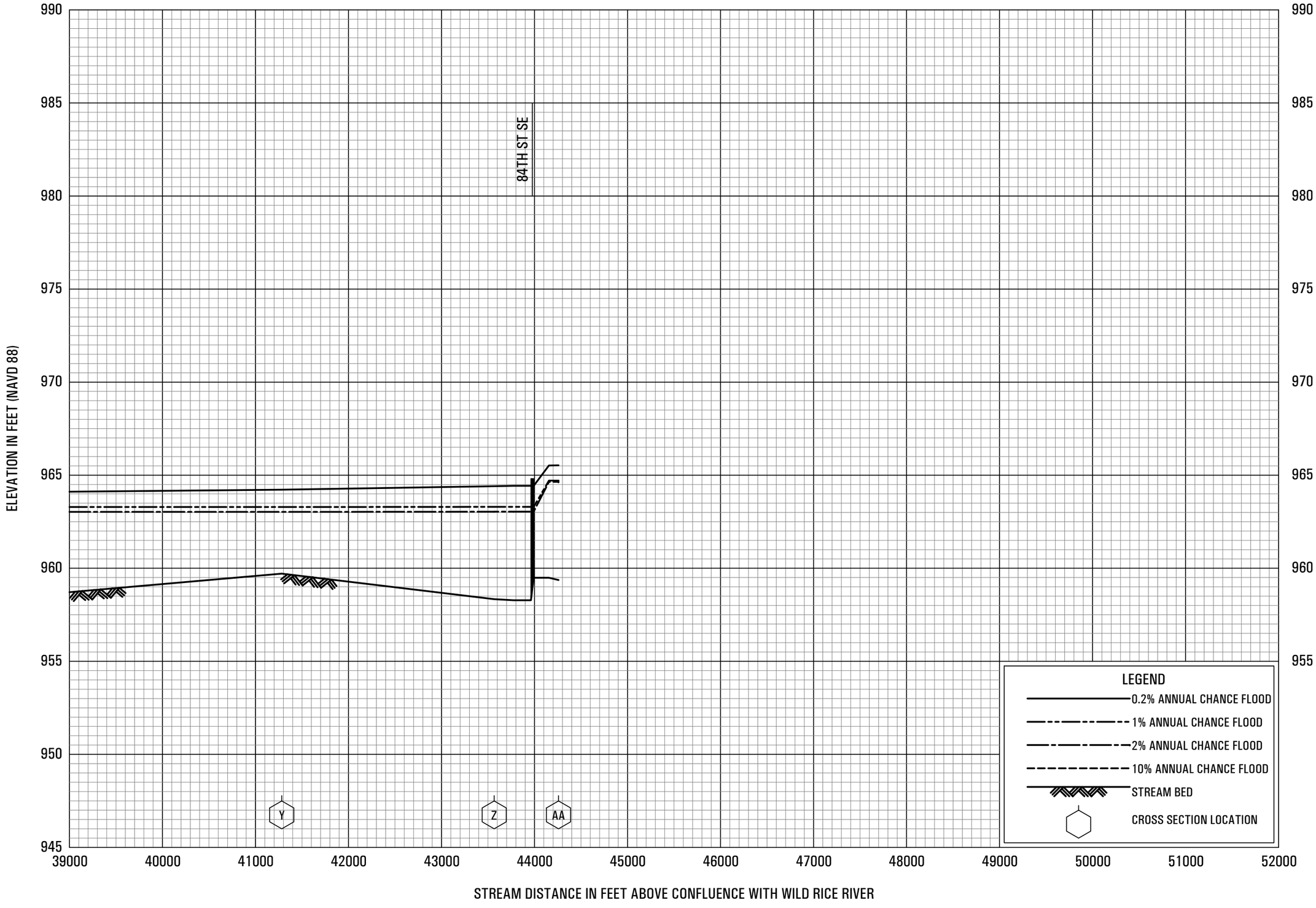
UPSTREAM WAHPETON BREAKOUT - WEST BREAKOUT REACH

FEDERAL EMERGENCY MANAGEMENT AGENCY

RICHLAND COUNTY, ND

AND INCORPORATED AREAS

16P



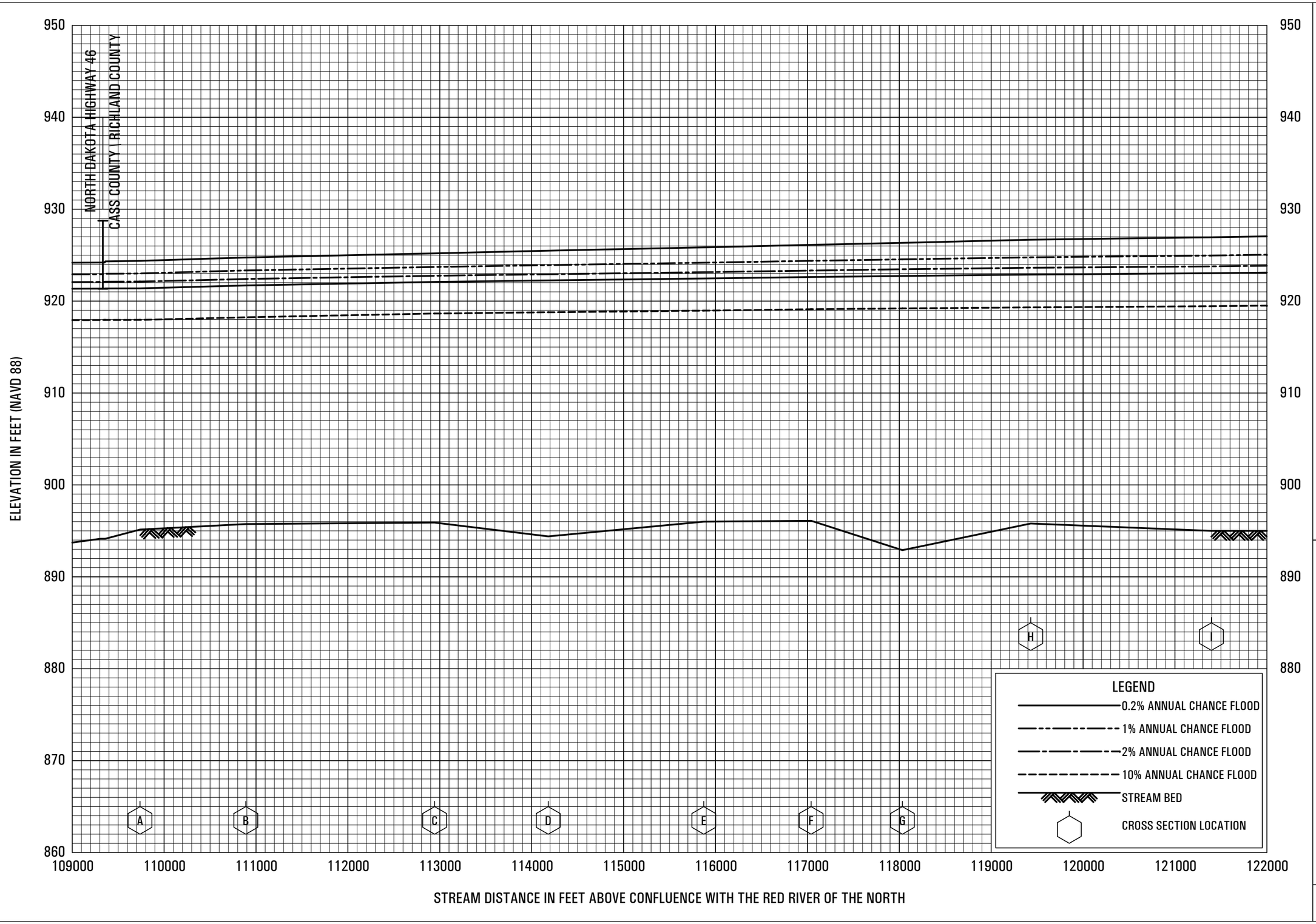
FLOOD PROFILES

UPSTREAM WAHPETON BREAKOUT - WEST BREAKOUT REACH

FEDERAL EMERGENCY MANAGEMENT AGENCY

RICHLAND COUNTY, ND

AND INCORPORATED AREAS



FLOOD PROFILES

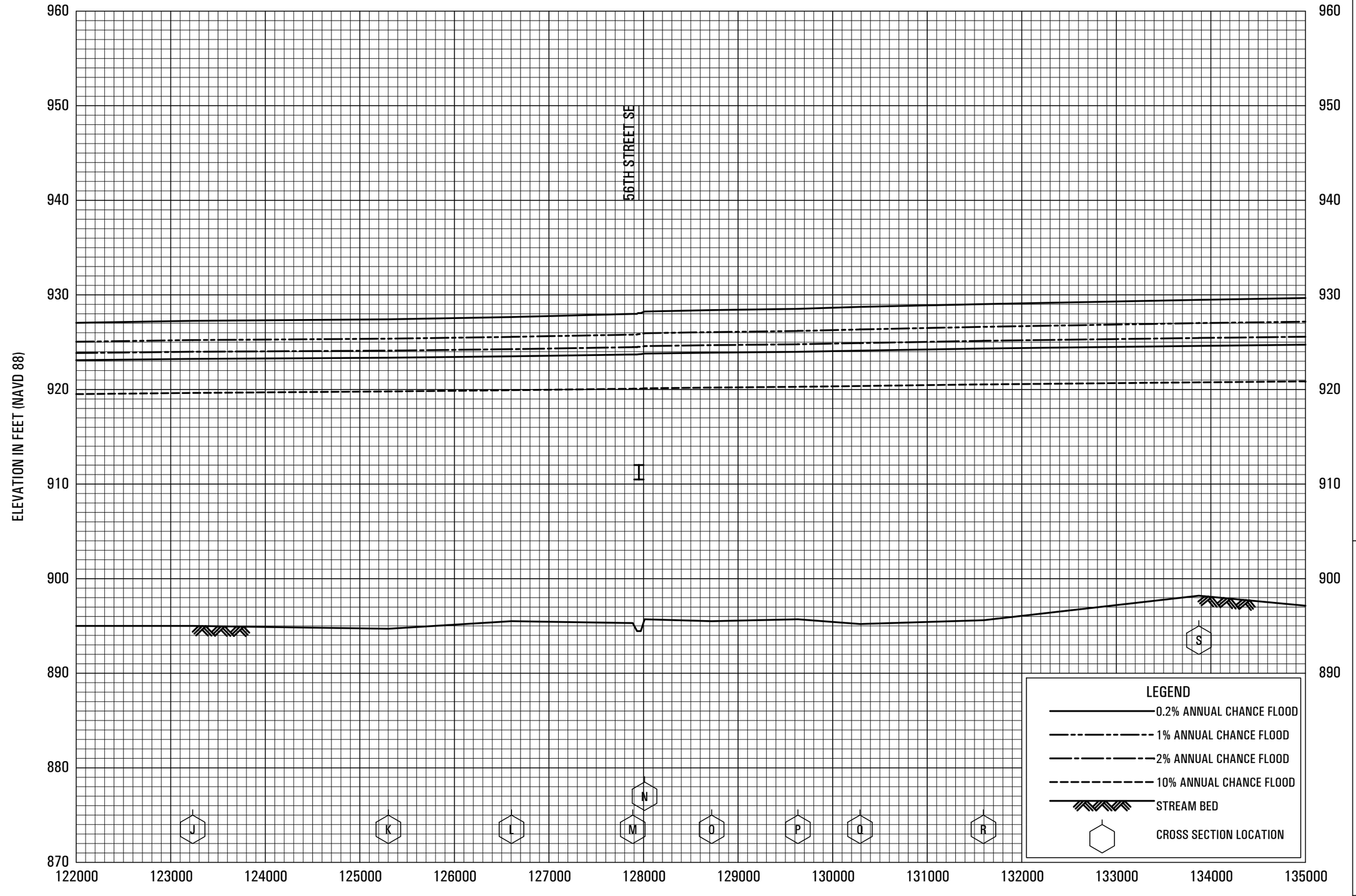
WILD RICE RIVER - WALCOTT TOWNSHIP

FEDERAL EMERGENCY MANAGEMENT AGENCY

RICHLAND COUNTY, ND

AND INCORPORATED AREAS

18P



ELEVATION IN FEET (NAVD 88)

STREAM DISTANCE IN FEET ABOVE CONFLUENCE WITH THE RED RIVER OF THE NORTH

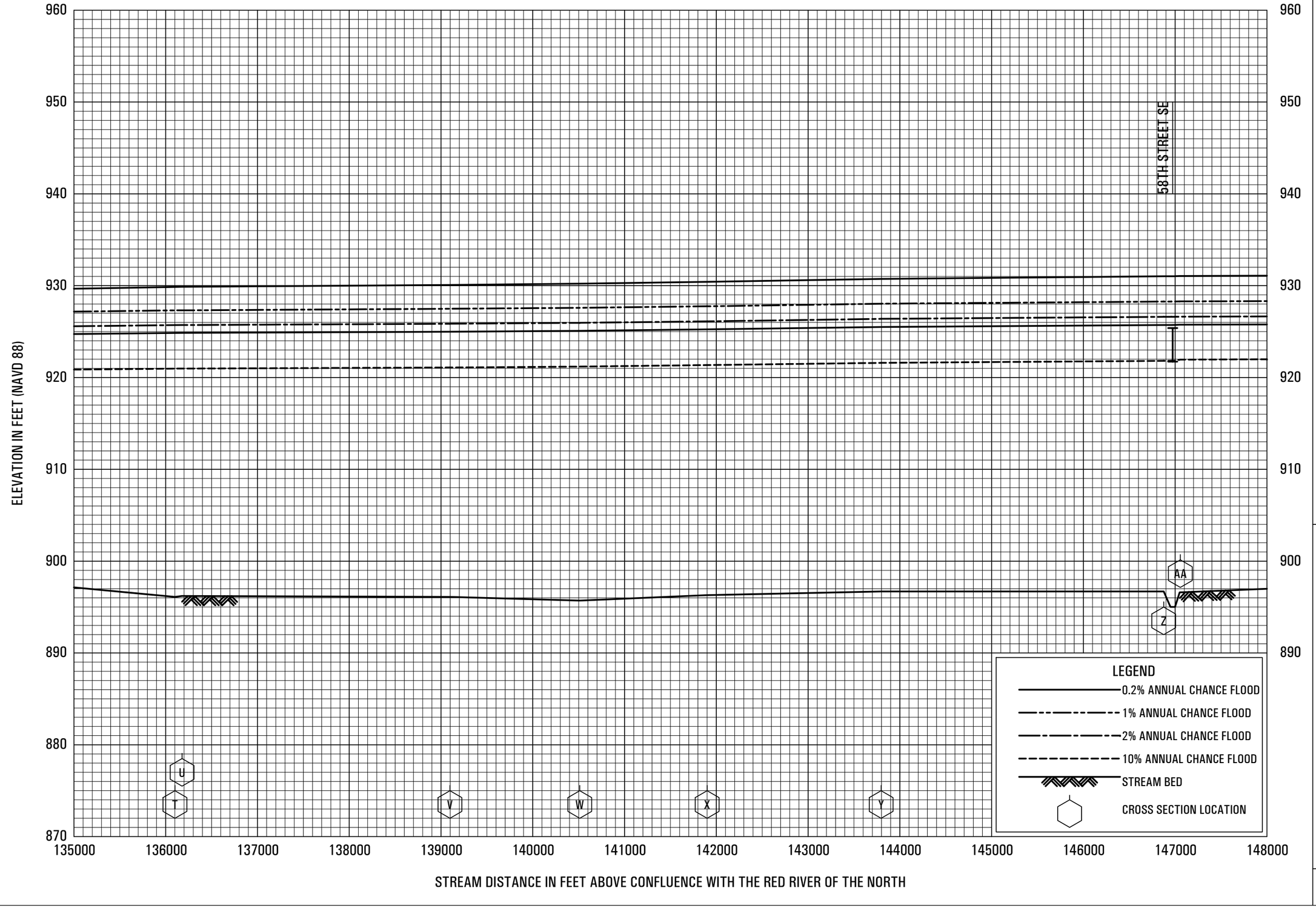
FLOOD PROFILES

WILD RICE RIVER - WALCOTT TOWNSHIP

FEDERAL EMERGENCY MANAGEMENT AGENCY

RICHLAND COUNTY, ND

AND INCORPORATED AREAS



FLOOD PROFILES

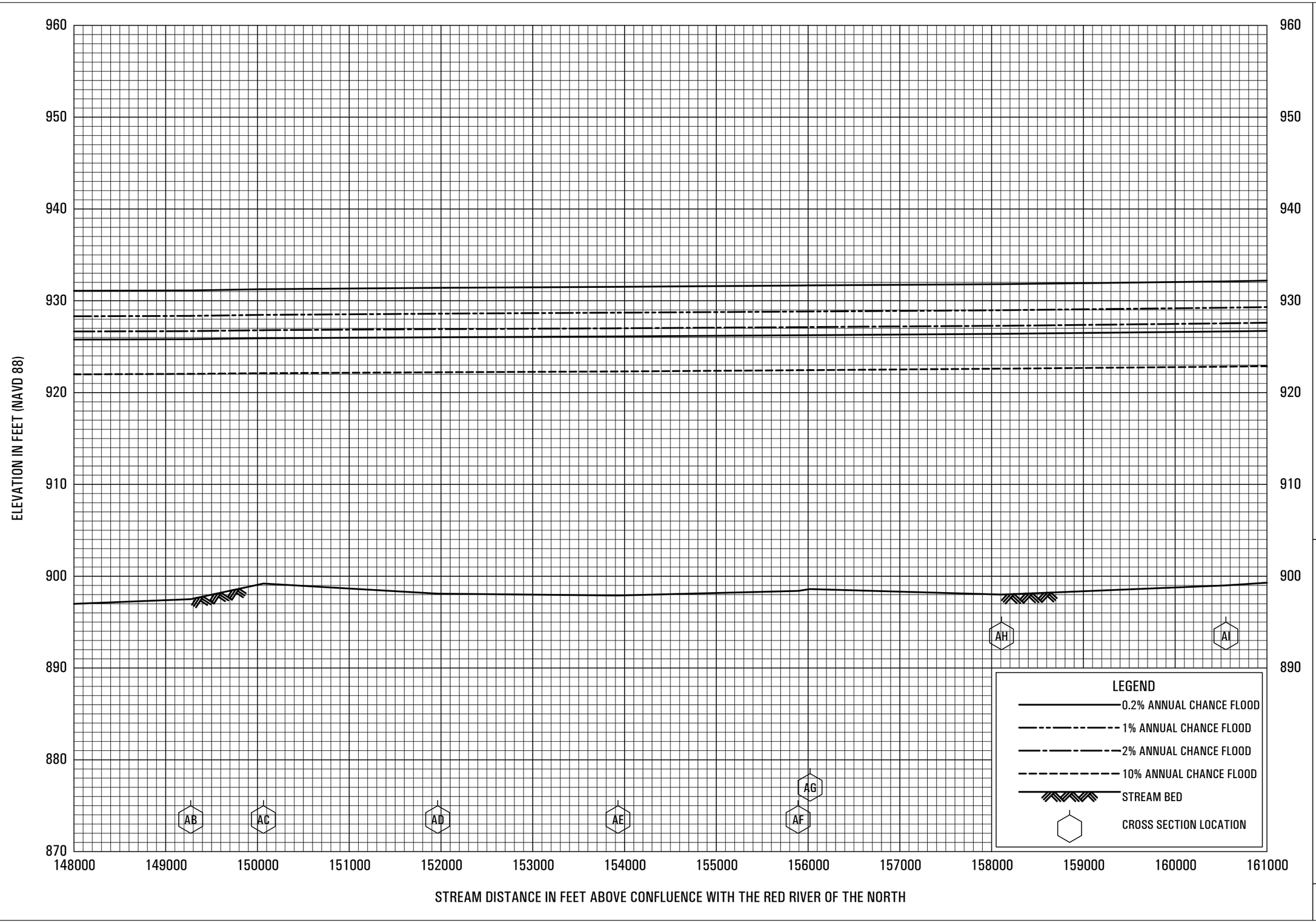
WILD RICE RIVER - WALCOTT TOWNSHIP

FEDERAL EMERGENCY MANAGEMENT AGENCY

RICHLAND COUNTY, ND

AND INCORPORATED AREAS

20P



FLOOD PROFILES

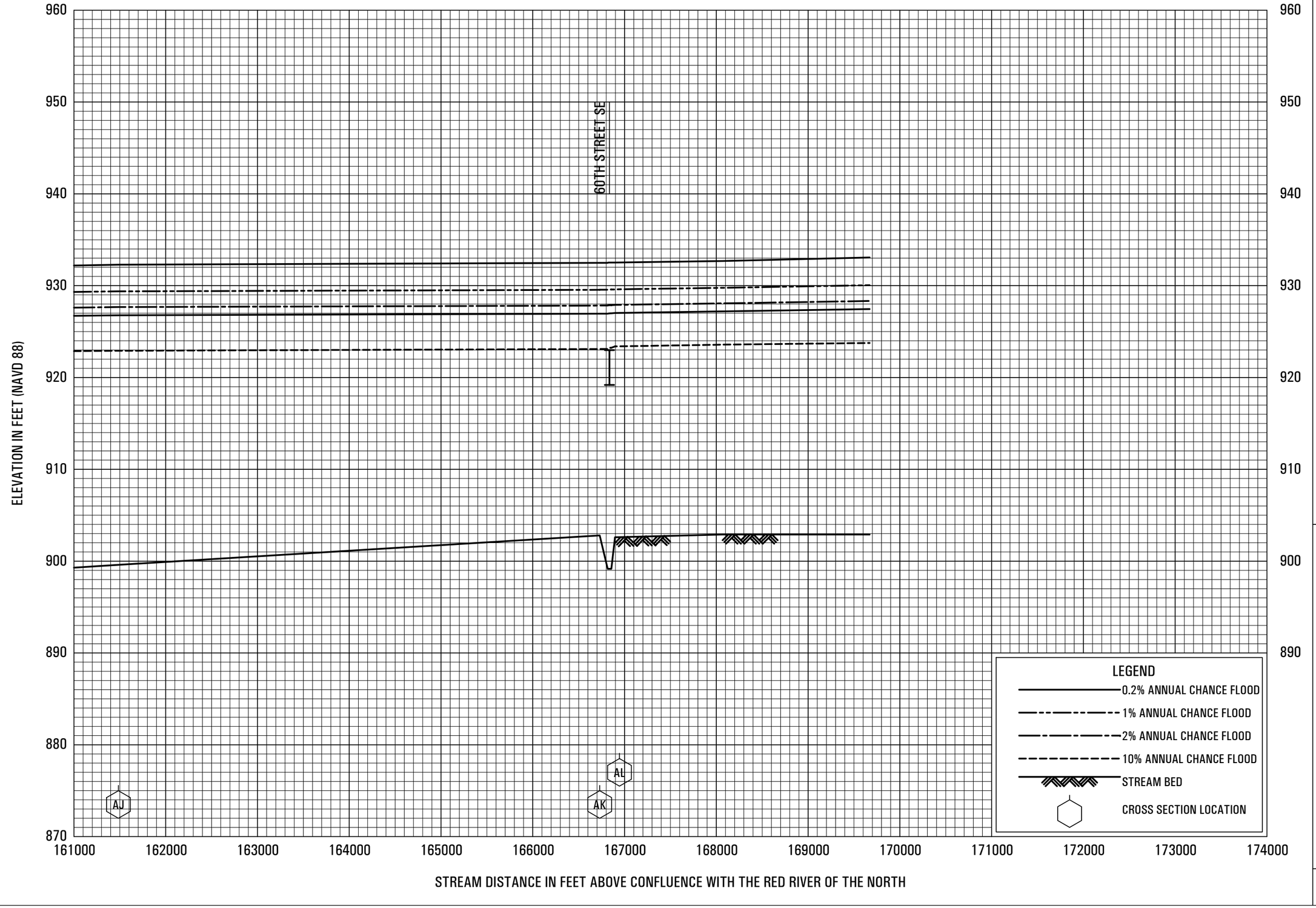
WILD RICE RIVER - WALCOTT TOWNSHIP

FEDERAL EMERGENCY MANAGEMENT AGENCY

RICHLAND COUNTY, ND

AND INCORPORATED AREAS

21P



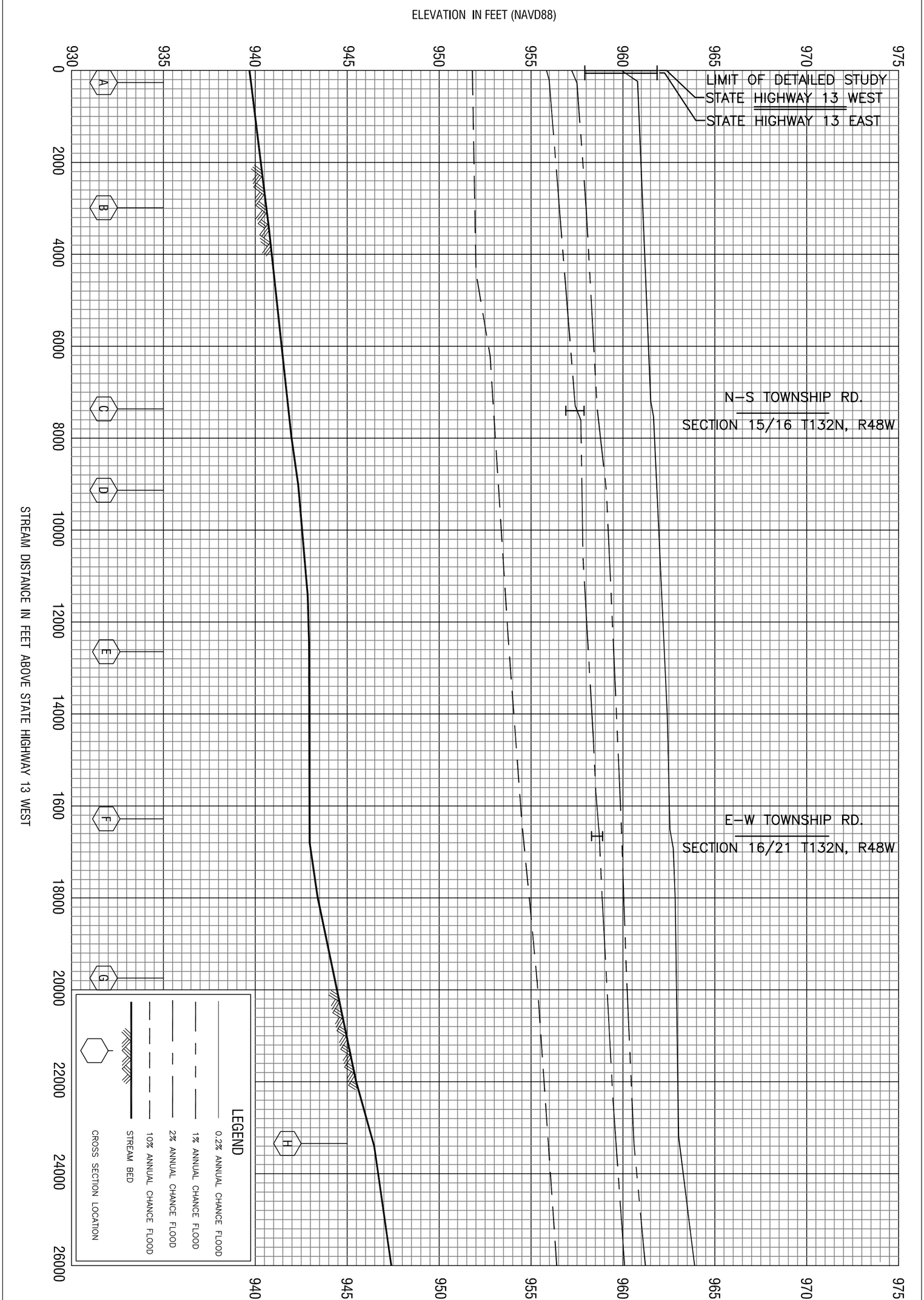
FLOOD PROFILES

WILD RICE RIVER - WALCOTT TOWNSHIP

FEDERAL EMERGENCY MANAGEMENT AGENCY

RICHLAND COUNTY, ND

AND INCORPORATED AREAS



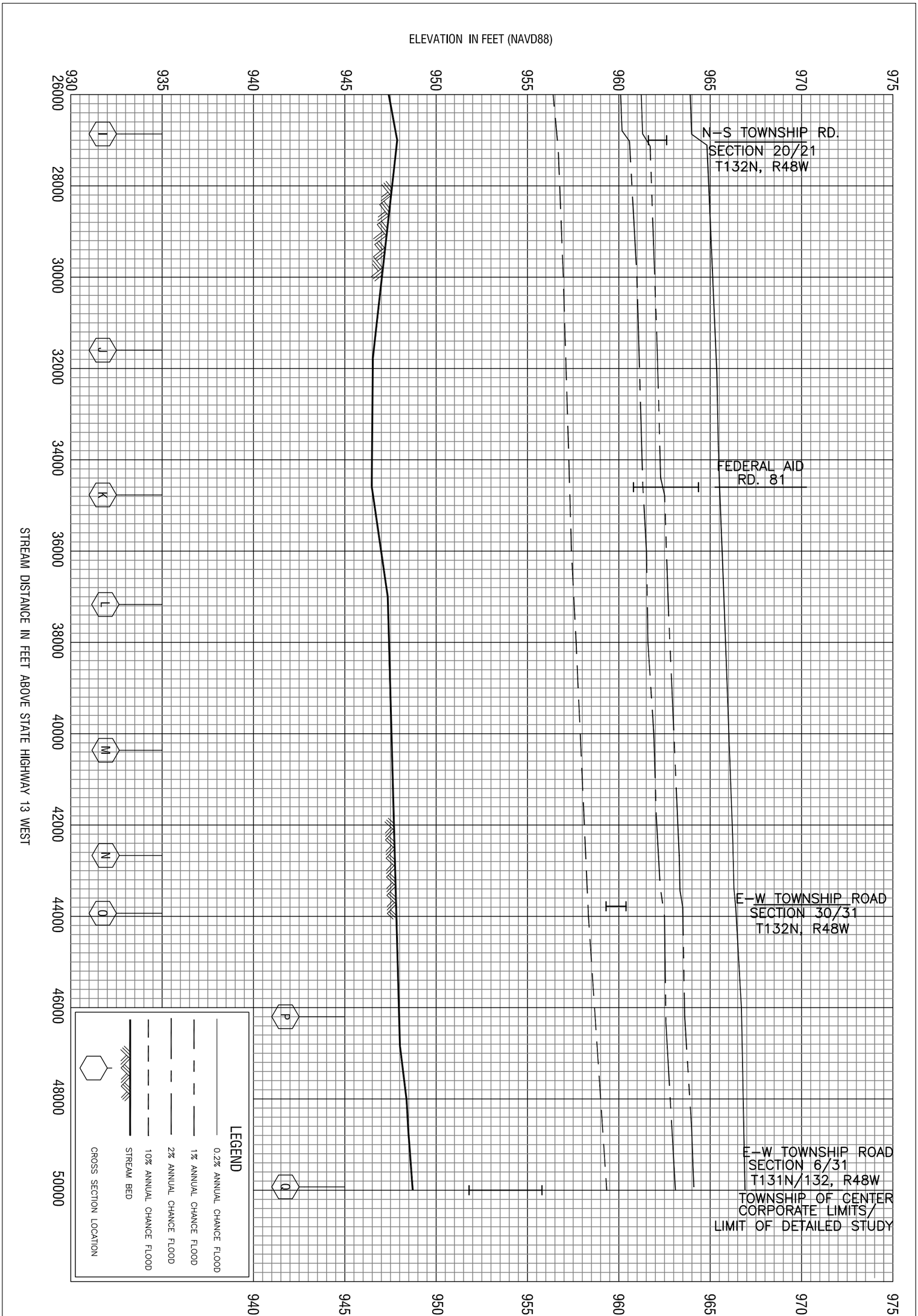
23P

FEDERAL EMERGENCY MANAGEMENT AGENCY

RICHLAND COUNTY, ND
AND INCORPORATED AREAS

FLOOD PROFILES

WILD RICE RIVER - CENTER TOWNSHIP



24P

FEDERAL EMERGENCY MANAGEMENT AGENCY

RICHLAND COUNTY, ND
AND INCORPORATED AREAS

FLOOD PROFILES

WILD RICE RIVER - CENTER TOWNSHIP