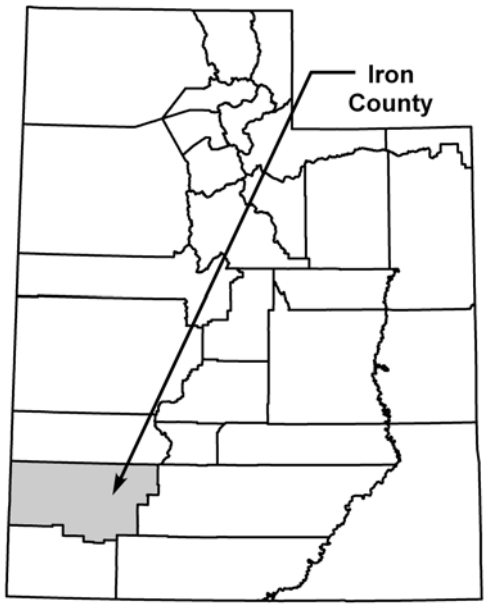
FLOOD INSURANCE STUDY

IRON COUNTY, UTAH
AND INCORPORATED AREAS

COMMUNITY NAME	COMMUNITY NUMBER
* Brian Head, Town of	490082
Cedar City, City of	490074
Enoch, City of	490035
Iron County (Unincorporated areas)	490073
Kanarraville, Town of	490077
Paragonah, Town of	490075
Parowan, City of	490076

* NON-FLOODPRONE



PRELIMINARY

Federal Emergency Management Agency

FLOOD INSURANCE STUDY NUMBER
49021CV000A

NOTICE TO
FLOOD INSURANCE STUDY USERS

Communities participating in the National Flood Insurance Program (NFIP) have established repositories of flood hazard data for floodplain management and flood insurance purposes. This Flood Insurance Study (FIS) 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 zone 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.

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PUBLISHED SEPARATELY:

Flood Insurance Rate Map Index
Flood Insurance Rate Map

FLOOD INSURANCE STUDY
IRON COUNTY, UTAH, 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 Iron County, Utah, including the Cities of Cedar City, Enoch, and Parowan; the Towns of Brian Head, Kanarraville, and Paragonah; and the unincorporated areas of Iron County (referred to collectively herein as Iron 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-risk data for various areas of the community in Iron County that will be used to establish actuarial flood insurance rates and to assist communities in their efforts to promote sound 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.

The Digital Flood Insurance Rate Map (DFIRM) and FIS Report for this countywide study have been produced in digital format. Flood hazard information was converted to meet the FEMA DFIRM database specifications and Geographic Information System (GIS) format requirements. The flood hazard information was created and is provided in a digital format so that it can be incorporated into a local GIS and be accessed more easily by the community.

1.2 Authority and Acknowledgments

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

The hydrologic and hydraulic analyses for this study were performed by Bowen, Collins and Associates, Inc. (BC&A) in association with AMEC Earth and Environmental, Inc. (AMEC), for the State of Utah Department of Public Safety, Office of Emergency Services (OES), under Contract No. 066404. This study was completed in June 2009.

Coal Creek and Quichapa Channel east of Interstate 15 were digitally converted from the April 16, 1984 Flood Insurance Study. Rollins, Brown, and Gunnell, Inc., performed the hydrologic and hydraulic analyses for that study under Contract No. H-4593. The study was completed in August 1982.

The Digital Flood Insurance Rate Map and FIS for the Town of Paragonah were used to map the flood hazards associated with Red Creek and Water Canyon. Leslie & Associates performed the hydrologic and hydraulic analyses for that study under Federal Emergency Management Agency Grant No. EMD-2001-GR-0177.

The base mapping for the study area consists of digital orthographic aerial photography prepared in natural color 1-meter resolution by the National Agricultural Imagery Program (NAIP) dated 2006. All base map and topographic mapping was acquired and/or converted to North American Datum 1983, Utah State Plane, North, survey feet coordinates, North American Vertical Datum of 1988 (NAVD 88). The final DFIRM production was converted to UTM, Zone 12 projection in meters in accordance with FEMA Guidelines & Specifications.

All base mapping for the study, including the aerials, streets, landmarks and other features, was compiled and provided by:

Utah Automated Geographic Reference Center (AGRC)
State Office Building, Room 5130
Salt Lake City, UT 84114
801-538-3665, www.agrc.utah.gov

Use of the base mapping for this project is subject to the terms and conditions of the original source, which may be obtained from the AGRC.

1.3 Coordination

The initial Consultation Coordination Officer (CCO) meeting was held on November 2, 2005, and attended by representatives of FEMA, State of Utah OES, the Study Contractor, Iron County and local communities.

The results of the study will be reviewed at the final CCO meeting. The final CCO meeting will most likely be held in December 2009 or January 2010.

2.0 AREA STUDIED

2.1 Scope of Study

This FIS report covers the geographic area of Iron County, Utah, including the incorporated communities listed in Section 1.1. The areas studied using detailed methods were selected with priority given to all known flood hazards and areas of projected development or proposed construction through 2008.

Approximate study methods were used to generally define flood hazards in those areas having a low development potential or minimal flood hazards. The scope and methods of study were proposed to, and agreed upon, by FEMA and the State of Utah OES.

2.2 Community Description

Iron County is located in semiarid southern Utah. The population of Iron County was estimated to be 46,341 as of July 1, 2008 (Reference 1). Cedar City is the most populous City in the County. It is located approximately 175 miles northeast of Las Vegas, Nevada, and 265 miles south of Salt Lake City, Utah.

The Town of Brian Head is located in the mountains east of Cedar City. All of the other communities mentioned in Section 1.1 are located at the foot of the Hurricane Cliffs along the Interstate 15 corridor.

2.3 Principal Flood Problems

Flooding in Iron County has historically been associated with two types of events: summertime thunderstorms with short duration, high intensity precipitation; and snowmelt events in drainage basins with large mountain watersheds (i.e., Coal Creek, Parowan Creek, and Shoal Creek). In addition, flood potential exists around intermittent lakes, also known as playa lakes, which flood in response to large runoff events. The three most prominent intermittent lakes in Iron County are Quichapa Lake, the Little Salt Lake, and Rush Lake. Flooding around these lakes has required road grades to be raised and has damaged some buildings.

The USGS stream gage for Coal Creek currently has a 78 year period of record. The highest recorded snowmelt flood of 1,820 cfs occurred on May 25, 1973. The highest recorded cloudburst flood of 4,620 cfs occurred on July 23, 1969.

Historic records indicate that summer thunderstorms have caused damaging floods along Coal Creek, below Fiddlers Canyon and Dry Canyon, in the Cross Hollow drainage basin, in small drainage basins of the Hurricane Cliffs located southwest of Cedar City, and in other small drainage basins east of Cedar City. Significant shallow flooding also occurred along Shoal Creek in January 2005 due to a large snowmelt event.

2.4 Flood Protection Measures

Multiple facilities have been constructed to provide flood protection measures to areas in and around Cedar City. The SCS designed and constructed the Greens Lake Watershed Project in 1957 in response to a damaging flood that occurred in that area on July 26, 1956. That project included a system of sediment/debris basins, floodwater detention basins, and a floodway channel that conveys runoff into the Cross Hollow drainage. These facilities are located in the vicinity of the current south I-15 Interchange. Debris/detention facilities were also constructed at the mouths of Dry Canyon, Stephens Canyon, and Fiddlers Canyon in 1999 and 2000. These canyons are located north of the mouth of Cedar Canyon. These flood protection measures were constructed to mitigate alluvial fan flooding hazards below each of the respective canyons.

Channel improvements were completed in 2008 on the reach of Coal Creek between the Center Street Bridge and 300 West Street as part of the Coal Creek Watershed Protection and Flood Protection project funded by the NRCS. Those improvements were completed to increase the conveyance capacity of the channel to where it could safely convey the 1-percent-chance annual flood. Additional improvements have been designed for the reach of Coal Creek from 300 West Street to I-15 to similarly increase the channel conveyance capacity. The improvements downstream of 300 West Street were not constructed when this report was prepared.

Non-structural measures of flood protection are being utilized to aid in the prevention of future flood damage. These are in the form of land use regulations adopted from the Federal Regulations which control building within areas that have a high risk of flooding.

3.0 ENGINEERING METHODS

For the flooding sources studied by detailed methods in the community, standard hydrologic and hydraulic study methods were used to develop the flood-hazard data required for this study. Flood events of a magnitude that is 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 performed to develop peak discharge-frequency relationships for each flooding source studied by detailed methods in Iron County (Reference 2).

Peak discharge-drainage-area relationships for flooding sources studied by detailed methods are presented in Table 1. At some locations the discharge values in the hydraulic model were adjusted to account for reductions in channel capacity and runoff in the overbank that flows away from the channel. See the hydraulic report that was prepared for this project for more details.

It should be noted that new peak discharge values were estimated for Coal Creek in the hydrologic analysis report associated with this study (Reference 2). However, when this Flood Insurance Study was completed, a major project was underway to increase the conveyance capacity of the Coal Creek channel between Center Street and I-15 as described in Section 2.4. Therefore, the floodplain between the mouth of Cedar Canyon and I-15 was digitized from the 1984 FIRM's. The discharge values presented in Table 1 for Coal Creek are from the 1984 FIS. It is anticipated that upon the completion of the Coal Creek Watershed Protection and Flood Protection project that this report, profiles and the associated maps will be updated to reflect the improvements.

Table 1
Summary of Discharges

Flooding Source And Location	Drainage Area (Sq. Miles)	Estimated Peak Discharge (cfs) 10 Percent Annual-Chance	2 Percent Annual-Chance	1 Percent Annual-Chance	0.2 Percent Annual-Chance
Coal Creek					
Near USGS Gaging Station 10242000	80.9	2,900	6,500	8,500	14,000
At Center Street	83.9	2,320[1]	5,305[1]	6,970[1]	11,860[1]
At Interstate 15	86.7	1,410[1]	3,638[1]	4,760[1]	8,740[1]
Cross Hollow					
At Interstate Highway 15	2.6	--	--	345	--
Greens Lake					
At Discharge from Debris Basin #2	0.7	--	--	45	--
Below Confluence with Discharge from Detention Basin #3	2.2	--	--	125	--
North Airport Canal					
At Confluence with Coal Creek	N/A	--	--	633[2]	--
Parowan Creek					
At Canyon Mouth	60.4	--	--	4,900	--
Quichapa Channel					
At Interstate Highway 15	N/A			1,920[2]	
Red Creek					
At Canyon Mouth	18.5	--	--	428	--
Shurtz Creek					
Upstream of Interstate 15	20.8	--	--	3,050	--
Below Confluence with Shurtz Creek Unnamed Tributary	32.1	--	--	3,750	--
Squaw Creek					
At Canyon Mouth	1.6	--	--	415	--
Water Canyon					
At Canyon Mouth	4.7	--	--	181	--

1 – The decrease in discharge with the increase in drainage area is due to overbank storage effects.
2 – The discharges for Quichapa Channel and North Airport Canal are based on culvert capacities at Interstate 15 and North Airport Road, respectively.

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 FIRM [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 tables 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 in conjunction with the data shown on the FIRM.

The U.S. Army Corps of Engineers' HEC-RAS computer program, version 3.1.3, was used to perform the hydraulic modeling for the flooding sources identified in Table 1 (Reference 3). Channel cross sections and dimensions of hydraulic structures in stream channels were field surveyed. Topographic data that was obtained from AGRC (2005 LiDAR) and Cedar City were used to extend surveyed channel cross-sections across the floodplain. Hec-GeoRAS in conjunction with ArcMap 9.2 was used to create georeferenced HEC-RAS models and to map the results of those models.

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1). For stream segments for which a floodway was computed (Section 4.2), selected cross-section locations are also shown on the FIRM.

The normal depth option was used to set the downstream water surface boundary condition in the hydraulic model. The slope for this normal depth calculation was estimated from the lower reach of this stream.

The Manning's "n" values were estimated from aerial photographs of the area and pictures taken from several site visits. The "n" values in the channel represent an aggregate of the channel bottom and the banks of the river and typically ranged from 0.030 to 0.050 in the channel and 0.055 to 0.070 in the overbank. See the hydraulic report that was prepared for this project for more information.

The hydraulic analyses for this study were based on unobstructed flow. The flood elevations shown on the Flood Profiles (Exhibit 1) are thus considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail.

It should be noted that when this Flood Insurance Study was completed, a major project was underway to increase the conveyance capacity of the Coal Creek channel between Center Street and I-15 as described in Section 2.4. The Coal Creek floodplain boundaries between the mouth of Cedar Canyon and I-15 were digitized from the 1984 Flood Insurance Study since a significant portion of the designed improvements have not yet been constructed. It is anticipated that upon completion of the Coal Creek Watershed Protection and Flood Protection project a new hydraulic model will be developed and this report, profiles and the associated maps will be updated to reflect the improvements.

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 used for newly created or revised FIS reports and FIRMs was the National Geodetic Vertical Datum of 1929 (NGVD). With the completion of the North American Vertical Datum of 1988 (NAVD), many FIS reports and FIRMs are now prepared using NAVD as the referenced vertical datum.

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

NGS Information Services
NOAA, N/NGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, Maryland 20910-3282
(301) 713-3242
(301) 713-4172 (fax)

To obtain current elevation, description, and/or location information for benchmarks shown on this map, please contact the Information Services Branch of the NGS at (301) 713-3242, or visit their website at www.ngs.noaa.gov.

In this study, two flooding sources, North Airport Canal and Coal Creek (from the canyon mouth to I-15), were digitized from previous studies referencing the NGVD 29 vertical datum. In accordance with Appendix B of the FEMA *Guidelines and Specifications for Flood Hazard Mapping Partners* conversion factors for both flooding sources were calculated. Table 2 presents the conversion factors.

Table 2
Vertical Datum Conversion Factors

Flooding Source	Maximum Conversion (Ft)	Minimum Conversion (Ft)	Average Conversion (Ft)	Maximum Offset (Ft)
Coal Creek	3.84	3.63	3.74	0.11
North Airport Canal	3.63	3.62	3.62	0.01

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 floodplain 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 floodplains; and a 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 tables, and Summary of Stillwater Elevation tables. Users should reference the data presented in the FIS report as well as additional information that may be available at the local community 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. Between cross sections, the boundaries were interpolated using topographic maps with a contour interval

of 2 feet. The AGRC LiDAR was flown in during the summer of 2005. The Cedar City contours were originally flown in 1995, and have been added to several times since then.

The 1- and 0.2-percent-annual-chance floodplain boundaries are shown on the FIRM. On this map, the 1-percent-annual-chance floodplain boundary corresponds to the boundary of the areas of special flood hazards (Zones A, AE, and AO), 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.

Approximate 1-percent-annual-chance floodplain boundaries in some portions of the study area were taken directly from the Flood Insurance Rate Maps for Iron County, unincorporated areas (Reference 4).

4.2 Floodways

Encroachment on floodplains, such as structures and fill, reduces flood-carrying capacity, increases flood heights and velocities, and increases flood hazards in areas beyond the encroachment itself. One aspect of floodplain management involves balancing the economic gain from floodplain development against the resulting increase in flood hazard. For purposes of the NFIP, a floodway is used as a tool to assist local communities in this aspect of floodplain management. Under this concept, the area of the 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 base flood can be carried without substantial increases in flood heights. Minimum Federal standards limit such increases to 1 foot, provided that hazardous velocities are not produced. The floodways in this study are presented to local agencies as minimum standards that can be adopted directly or that can be used as a basis for additional floodway studies.

The floodways presented in this study were computed for certain stream segments on the basis of equal-conveyance reduction from each side of the floodplain. Floodway widths were computed at cross sections. Between cross sections, the floodway boundaries were interpolated. The results of the floodway computations are tabulated for selected cross sections (see Table 3, Floodway Data). In cases where the floodway and 1-percent-annual-chance floodplain boundaries are either close together or collinear, only the floodway boundary is shown.

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 (WSEL) of the base flood more than 1 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to floodplain development are shown in Figure 1.

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Coal Creek								
A	63,371	125	495	7.4	5,622.1	5,622.1	5,622.1	0.0
B	64,694	93	435	8.4	5,638.2	5,638.2	5,638.2	0.0
C	66,593	87	422	8.6	5,661.4	5,661.4	5,661.4	0.0
D	66,779	99	393	9.3	5,663.7	5,663.7	5,663.7	0.0
E	67,232	95	323	11.3	5,669.9	5,669.9	5,669.9	0.0
F	67,596	82	306	11.9	5,676.2	5,676.2	5,676.2	0.0
G	70,366	497	1,413	3.7	5,715.7	5,715.7	5,716.7	1.0
H	73,466	67	526	11.1	5,772.7	5,772.7	5,772.7	0.0
I	76,366	388	1,199	5.5	5,827.3	5,827.3	5,828.3	1.0
J	78,461	56	522	13.4	5,867.4	5,867.4	5,867.7	0.3

[1] Feet above Rush Lake

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

IRON COUNTY, UT
AND INCORPORATED AREAS

FLOODWAY DATA

COAL CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Cross Hollow								
A	8,759	13	37	9.4	5750.6	5750.6	5750.6	0.0
B	9,253	18	56	6.2	5754.3	5754.3	5754.3	0.0
C	10,336	15	41	8.3	5794.6	5794.6	5794.6	0.0
D	11,383	28	60	5.8	5825.6	5825.6	5825.6	0.0
E	12,073	22	43	8.1	5854.5	5854.5	5854.5	0.0
F	13,013	43	65	5.3	5872.0	5872.0	5872.0	0.0
G	14,468	42	59	5.9	5907.3	5907.3	5907.3	0.0
H	15,355	33	69	5.0	5922.9	5922.9	5922.9	0.0
Greens Lake								
I	18,130	11	25	4.9	6001.3	6001.3	6001.3	0.0
J	18,991	35	51	2.5	6020.6	6020.6	6020.6	0.0
K	19,808	52	49	2.5	6023.6	6023.6	6023.6	0.0
L	20,590	39	27	4.6	6037.0	6037.0	6037.0	0.0
M	21,282	124	98	1.3	6039.4	6039.4	6039.4	0.0
N	21,356	65	32	3.9	6040.0	6040.0	6040.0	0.0
O	22,049	44	34	1.3	6041.2	6041.2	6041.2	0.0
P	23,649	34	28	1.6	6043.6	6043.6	6043.6	0.0
Q	24,850	23	29	1.6	6045.6	6045.6	6045.6	0.0

[1] Feet Above Quichapa Channel

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

IRON COUNTY, UT
AND INCORPORATED AREAS

FLOODWAY DATA

CROSS HOLLOW & GREENS LAKE

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Parowan Creek								
A	29,102	589	1,667	0.7	5,805.4	5,805.4	5,805.4	0.0
B	30,918	103	74	2.2	5,812.0	5,812.0	5,812.0	0.0
C	32,088	419	286	1.6	5,819.5	5,819.5	5,819.5	0.0
D	32,987	292	281	3.2	5,826.1	5,826.1	5,826.1	0.0
E	34,969	31	52	6.6	5,842.3	5,842.3	5,842.3	0.0
F	36,316	43	62	5.5	5,856.5	5,856.5	5,856.5	0.0
G	37,587	26	78	5.4	5,874.3	5,874.3	5,874.3	0.0
H	38,706	27	64	6.8	5,887.5	5,887.5	5,887.5	0.0
I	40,193	138	176	8.2	5,910.3	5,910.3	5,910.3	0.0
J	41,432	76	265	5.5	5,923.4	5,923.4	5,923.4	0.0
K	42,401	40	134	10.9	5,942.5	5,942.5	5,942.5	0.0
L	43,396	36	133	10.9	5,966.7	5,966.7	5,966.7	0.0
M	44,387	42	157	9.3	5,982.6	5,982.6	5,982.6	0.0
N	45,742	41	149	9.8	6,019.7	6,019.7	6,019.7	0.0
O	46,247	145	364	6.8	6,037.1	6,037.1	6,037.1	0.0
P	47,293	46	325	15.0	6,061.8	6,061.8	6,061.8	0.0
Q	48,759	196	1,295	3.8	6,093.4	6,093.4	6,094.4	1.0
R	49,021	183	1,407	3.5	6,103.7	6,103.7	6,104.0	0.3
S	49,595	246	615	8.0	6,126.7	6,126.7	6,127.6	0.9
T	50,964	202	607	8.1	6,161.4	6,161.4	6,162.4	1.0
U	52,521	183	518	9.5	6,198.5	6,198.5	6,198.9	0.4
V	53,880	69	402	12.2	6,237.0	6,237.0	6,237.1	0.1

[1] Feet Above Little Salt Lake

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

IRON COUNTY, UT
AND INCORPORATED AREAS

FLOODWAY DATA

PAROWAN CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Quichapa Channel								
A	6,657	38	113	3.1	5,477.0 [2]	5,477.0	5,477.0	0.0
B	7,726	33	119	2.9	5,479.4 [2]	5,479.4	5,479.4	0.0
C	9,084	34	119	2.9	5,482.2 [2]	5,482.2	5,482.2	0.0
D	10,104	29	133	2.6	5,483.9 [2]	5,483.9	5,483.9	0.0
E	10,547	30	102	3.4	5,485.3 [2]	5,485.3	5,485.3	0.0
F	11,876	24	106	3.7	5,488.9 [2]	5,488.9	5,488.9	0.0
G	13,072	48	150	2.7	5,491.5 [2]	5,491.5	5,491.5	0.0
H	14,375	32	111	3.7	5,494.2 [2]	5,494.2	5,494.2	0.0
I	15,725	33	145	2.9	5,496.9 [2]	5,496.9	5,496.9	0.0
J	16,970	686	182	2.3	5,498.5 [2]			
					5,497.0 [4]	5,497.0	5,497.9	0.9
K	17,934	355	581	2.7	5,500.6 [4]	5,500.6	5,501.6	1.0
L	18,485	310	632	2.4	5,502.7 [4]	5,502.7	5,503.7	1.0
M	19,544	182	421	3.7	5,506.4 [4]	5,506.4	5,506.8	0.4
N	20,846	145	382	4.0	5,510.8 [4]	5,510.8	5,511.7	0.9
O	22,139	322	829	1.9	5,513.9 [4]	5,513.9	5,514.6	0.7
P	22,360	381	714	2.2	5,514.9 [4]	5,514.9	5,515.8	0.9
Q	23,607	553	808	1.9	5,519.3 [4]	5,519.3	5,520.3	1.0
R	25,220	76	561	2.7	5,523.5 [4]	5,523.5	5,524.1	0.6
S	26,720	73	322	2.8	5,524.8 [2]	5,524.8	5,524.8	0.0
T	28,251	33	120	7.6	5,537.2 [2]	5,537.2	5,537.2	0.0
U	29,936	46	217	4.2	5,545.3 [2]	5,545.3	5,545.3	0.0
V	30,261	32	138	6.6	5,546.2 [2]	5,546.2	5,546.2	0.0
W	31,315	40	198	4.6	5,551.3 [2]	5,551.3	5,551.3	0.0
X	32,526	165	374	3.5	5,555.8 [2]	5,555.8	5,555.8	0.0

[1] Feet above Quichapa Lake
[2] With Both Levees Holding
[3] With Only Right Levee Holding
[4] With Only Left Levee Holding

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

IRON COUNTY, UT
AND INCORPORATED AREAS

FLOODWAY DATA

QUICHAPA CHANNEL

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Quichapa Channel								
Y	33114	97	239	6.5	5,560.0 [2]	5,560.0	5,560.0	0.0
Z	33,649	103	450	3.5	5,573.0 [2]	5,573.0	5,573.0	0.0
AA	34,937	60	279	5.6	5,576.6 [2]	5,576.6	5,576.6	0.0
AB	35,549	217	988	1.6	5,577.7 [2]	5,577.7	5,577.7	0.0
AC	36,513	174	416	3.8	5,578.5 [2]	5,578.5	5,578.5	0.0
AD	36,835	45	168	9.4	5,582.4 [2]	5,582.4	5,582.4	0.0
AE	37,114	234	969	1.6	5,584.3 [2]	5,584.3	5,584.3	0.0
AF	37,605	216	243	6.5	5,585.0 [2]			
					5,583.5 [3]	5,583.5	5,583.5	0.0
AG	38,414	49	253	6.2	5,598.2 [2]			
					5,595.0 [3]	5,595.0	5,595.0	0.0
AH	39,505	38	143	11	5,617.7 [2]			
					5,614.9 [3]	5,614.9	5,614.9	0.0
AI	40,914	505	219	7.4	5,632.9 [2]			
					5,632.3 [3]	5,632.3	5,632.3	0.0
AJ	42,361	368	563	3.4	5,650.1 [2]	5,650.1	5,650.1	0.0
AK	42,823	385	225	8.5	5,656.7 [2]	5,656.7	5,656.7	0.0
AL	43,998	179	419	4.6	5,669.5 [2]	5,669.5	5,669.5	0.0
AM	45,141	53	201	9.6	5,681.3 [2]	5,681.3	5,681.3	0.0

[1] Feet Above Quichapa Lake
[2] With Both Levees Holding
[3] With Only Right Levee Holding
[4] With Only Left Levee Holding

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

IRON COUNTY, UT
AND INCORPORATED AREAS

FLOODWAY DATA

QUICHAPA CHANNEL

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Shurtz Creek								
A	10,294	24	70	3.1	5,481.2	5481.2	5481.2	0.0
B	11,351	293	402	3.3	5,487.3	5487.3	5487.3	0.0
C	12,667	328	371	3.5	5,497.6	5497.6	5497.6	0.0
D	13,864	204	274	4.8	5,508.9	5508.9	5508.9	0.0
E	15,502	277	325	4.0	5,526.4	5526.4	5526.4	0.0
F	16,559	29	120	10.9	5,538.5	5538.5	5538.5	0.0
G	18,361	42	186	9.4	5,557.8	5557.8	5557.8	0.0
H	19,390	435	449	4.7	5,568.0	5568.0	5568.0	0.0
I	20,527	229	353	6.4	5,580.8	5580.8	5580.8	0.0
J	21,583	235	564	5.3	5,594.9	5594.9	5594.9	0.0
K	23,193	53	220	10.8	5,615.5	5615.5	5615.5	0.0
L	23,460	46	221	10.8	5,619.8	5619.8	5619.8	0.0
M	24,157	83	267	8.9	5,634.5	5634.5	5634.5	0.0
N	25,256	38	212	11.3	5,652.8	5652.8	5652.8	0.0
O	26,199	39	227	10.5	5,666.2	5666.2	5666.2	0.0
P	27,444	59	214	11.1	5,689.6	5689.6	5689.6	0.0
Q	28,097	92	546	7.4	5,707.2	5707.2	5707.2	0.0
R	28,351	260	1,106	7.3	5,717.1	5717.1	5717.1	0.0
S	28,878	58	294	10.4	5,719.5	5719.5	5719.5	0.0

[1] Feet Above Quichapa Lake

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

IRON COUNTY, UT
AND INCORPORATED AREAS

FLOODWAY DATA

SHURTZ CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
SQUAW CREEK								
A	169	25	45	9.1	5878.9	5878.9	5878.9	0.0
B	312	29	56	7.5	5885.9	5885.9	5885.9	0.0
C	491	32	74	5.6	5895.0	5895.0	5895.0	0.0
D	711	19	52	8.0	5909.3	5909.3	5909.3	0.0
E	951	19	58	7.2	5920.2	5920.2	5920.2	0.0
F	1,233	22	53	7.8	5934.2	5934.2	5934.2	0.0
G	1,815	20	58	7.2	5959.7	5959.7	5959.7	0.0
H	3,148	20	54	7.7	6021.8	6021.8	6021.8	0.0
I	3,667	18	56	7.5	6048.8	6048.8	6048.8	0.0
J	4,359	11	42	9.8	6085.4	6085.4	6085.4	0.0

[1] Feet Above Coal Creek

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

IRON COUNTY, UT
AND INCORPORATED AREAS

FLOODWAY DATA

SQUAW CREEK

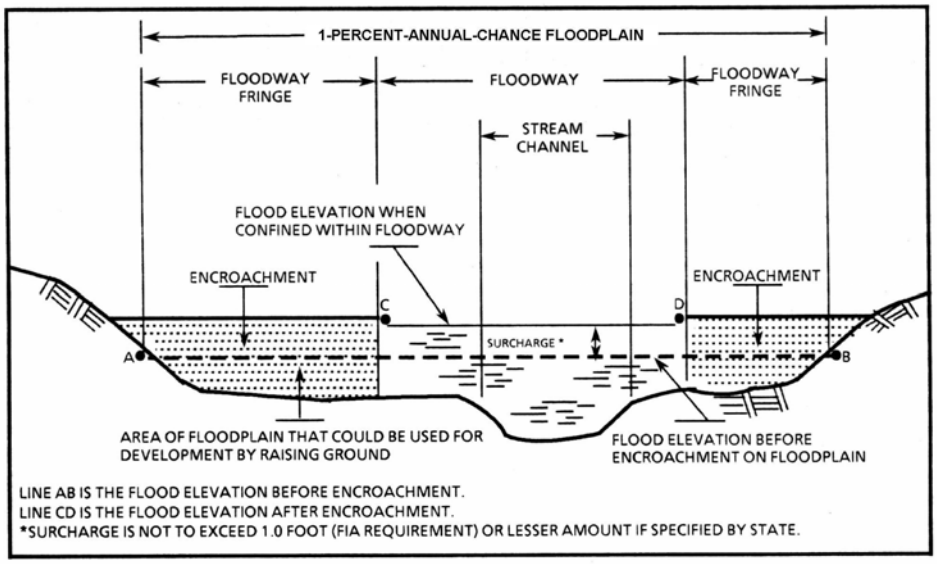


Figure 1. Floodway Schematic

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 rate zone that corresponds to the 1-percent-annual-chance floodplains that are determined in the FIS report by approximate methods. Because detailed hydraulic analyses are not performed for such areas, no base (1-percent-annual-chance) flood elevations (BFEs) or depths are shown within this zone.

Zone AE

Zone AE is the flood insurance rate zone that corresponds to the 1-percent-annual-chance floodplains that are determined in the FIS report by detailed methods. Whole-foot BFEs derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone AO

Zone AO is the flood insurance rate zone that corresponds to areas of 1-percent-annual-chance shallow flooding (usually sheet flow on sloping terrain) where average depths are between 1 and 3 feet. Average whole-foot depths derived from the detailed hydraulic analyses are shown within this zone.

Zone X

Zone X is the flood insurance rate 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 foot, areas of 1-percent-annual-chance flooding where the contributing drainage area is less than 1 square mile

(sq. mi.), and areas protected from the base flood by levees. No BFEs 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 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 Iron County. Utah. Previously, FIRMs were prepared for each incorporated community and the unincorporated areas of the County identified as flood-prone. This countywide FIRM also includes flood-hazard information that was presented separately on Flood Boundary and Floodway Maps (FBFMs), where applicable. Historical data relating to the maps prepared for each community are presented in Table 4 “Community Map History.”

COMMUNITY NAME	INITIAL IDENTIFICATION	FLOOD HAZARD BOUNDARY MAP REVISIONS DATE	FIRM EFFECTIVE DATE	FIRM REVISIONS DATE
* Brian Head, Town of	N/A		N/A	
Cedar City, City of	January 23, 1974	March 5, 1976	October 16, 1984	
Enoch, City of	N/A		N/A	
Iron County (Unincorporated Areas)	April 11, 1978		July 17, 1986	
Kanarraville, Town of	N/A		N/A	
Paragonah, Town of	February 14, 1975		September 24, 1984	June 2, 2005
Parowan, City of	August 16, 1974	December 19, 1975	March 18, 1986	

* NON-FLOODPRONE

TABLE 4

FEDERAL EMERGENCY MANAGEMENT AGENCY

IRON COUNTY, UT
AND INCORPORATED AREAS

COMMUNITY MAP HISTORY

7.0 OTHER STUDIES

This FIS 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.

A floodplain study was prepared in October 1979, by the U.S. Army Corps of Engineers, Sacramento District, for Coal Creek (Reference 5). This study evaluated the same reaches of this flooding source as undertaken by the U.S. Army Crops of Engineers study. There are small differences between this study and the U.S. Army Corps of Engineers floodplain study. It provided the basis of the analysis of Coal Creek; however the flood discharges used in this study were slightly lower than that used by the U.S. Army Corps of Engineers. Therefore, flood boundaries along Coal Creek are slightly more marrow than those shown by the U.S. Army Corps of Engineers in their study.

Additional, the U.S. Geological Survey has published flood-prone area maps for the Cedar City area (Reference 6). The 100-year frequency flood boundaries indicated in this report are in general agreement with those maps. The U.S. Geological Survey analysis was not as detailed as the analysis for this study and thus cannot be expected to be as accurate.

A report, Greens Lake Watershed Project, 1957 (Reference 7), was prepared by the SCS and gives background information concerning the hydrologic and hydraulic data of the area, and discusses the history of flooding in the southern Utah area. It also provided design plans of existing facilities and the designated floodway as constructed.

8.0 LOCATION OF DATA

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

9.0 BIBLIOGRAPHY AND REFERENCES

1. Utah Population Estimates Committee, as published by the Utah Governor's Office of Planning and Budget, 2008.

2. Bowen, Collins and Associates, Inc., Iron County Map Modernization DFIRM and FIS Update Project – Hydrology Report, August, 2007.

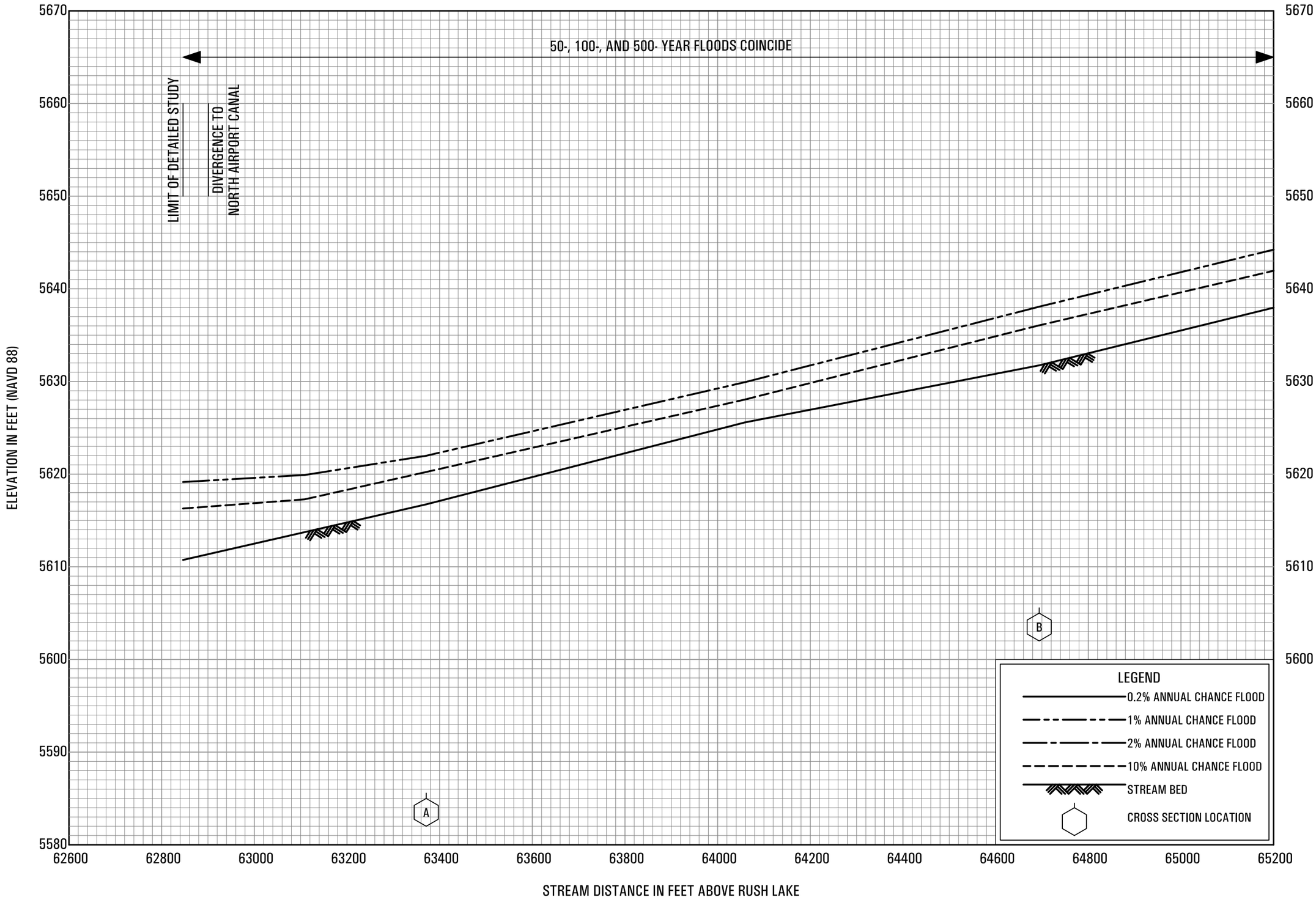
3. Bowen, Collins and Associates, Inc., Iron County Map Modernization DFIRM and FIS Update Project – Hydraulics Report, January, 2008.

4. Federal Emergency Management Agency, Flood Insurance Rate Maps, July 17, 1986.

5. U.S. Department of the Army, Corps of Engineers, Sacramento District, Cloudburst Floodplain Area Cedar City and Vicinity, Coal Creek, Iron County, Utah, Map panels 1 through 4, Scale 1:2,400, Contour Interval 2 feet, 1979.

6. U.S. Department of the Interior, Geological Survey, Flood-Prone Area Maps, Scale 1:24,000, Contour Interval 20 or 40 feet: Cedar City, Utah, 1971.3

7. U.S. Department of Agriculture, Soil Conservation Service, Watershed Work Plan, Greens Lake Watershed, Iron County, Utah, 1957.



FLOOD PROFILES

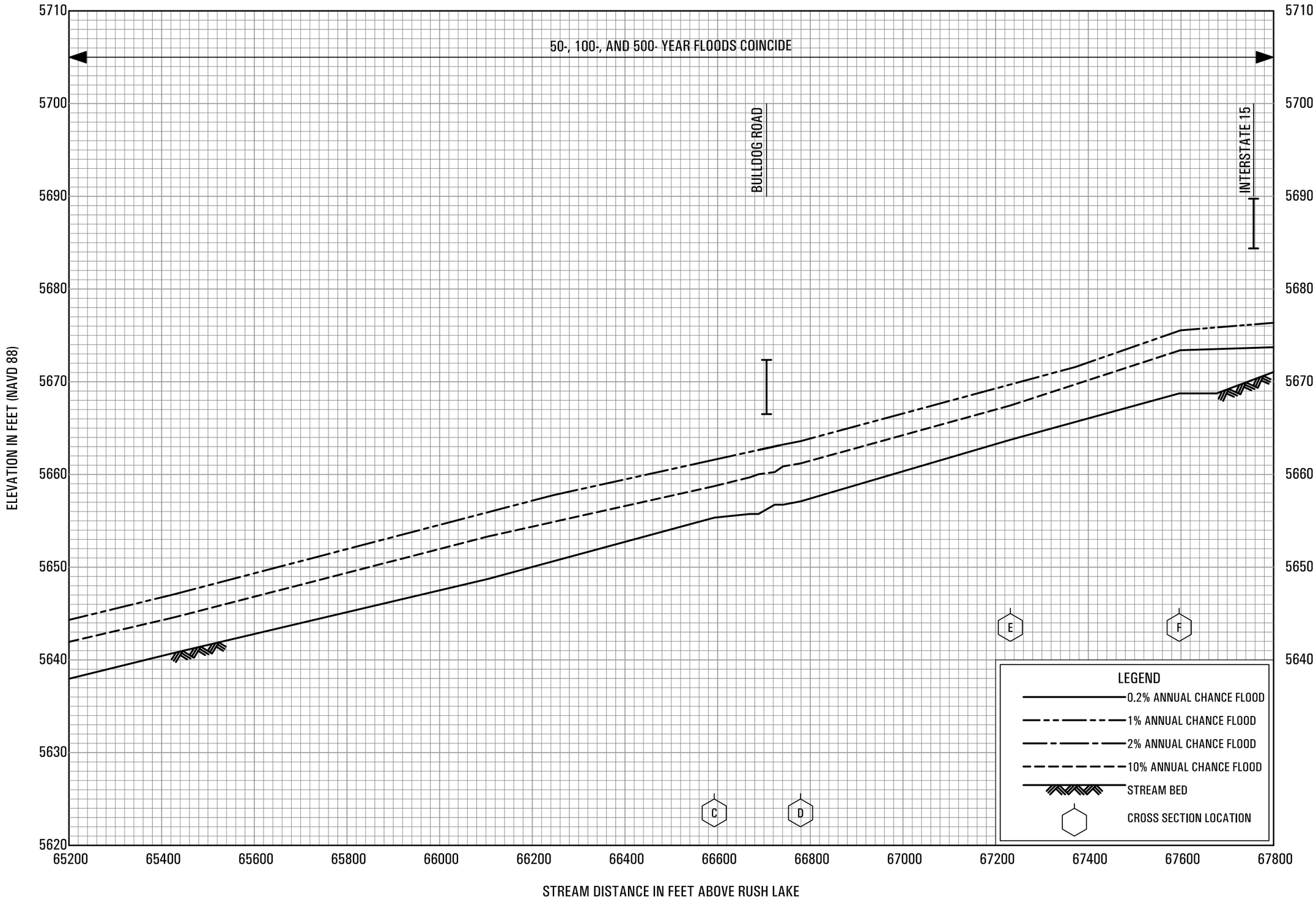
COAL CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

IRON COUNTY, UT

AND INCORPORATED AREAS

01P



FLOOD PROFILES

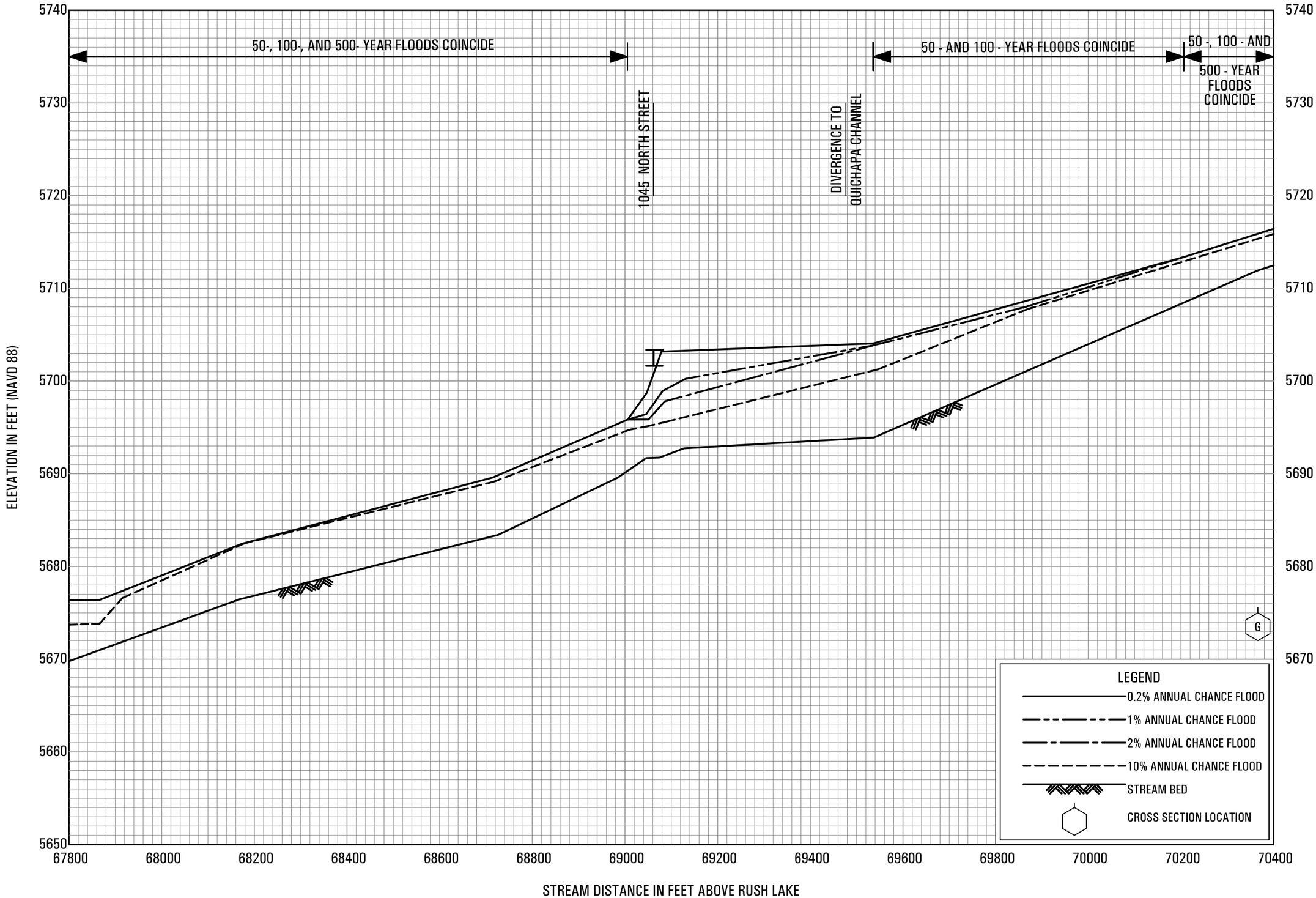
COAL CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

IRON COUNTY, UT

AND INCORPORATED AREAS

02P



FLOOD PROFILES

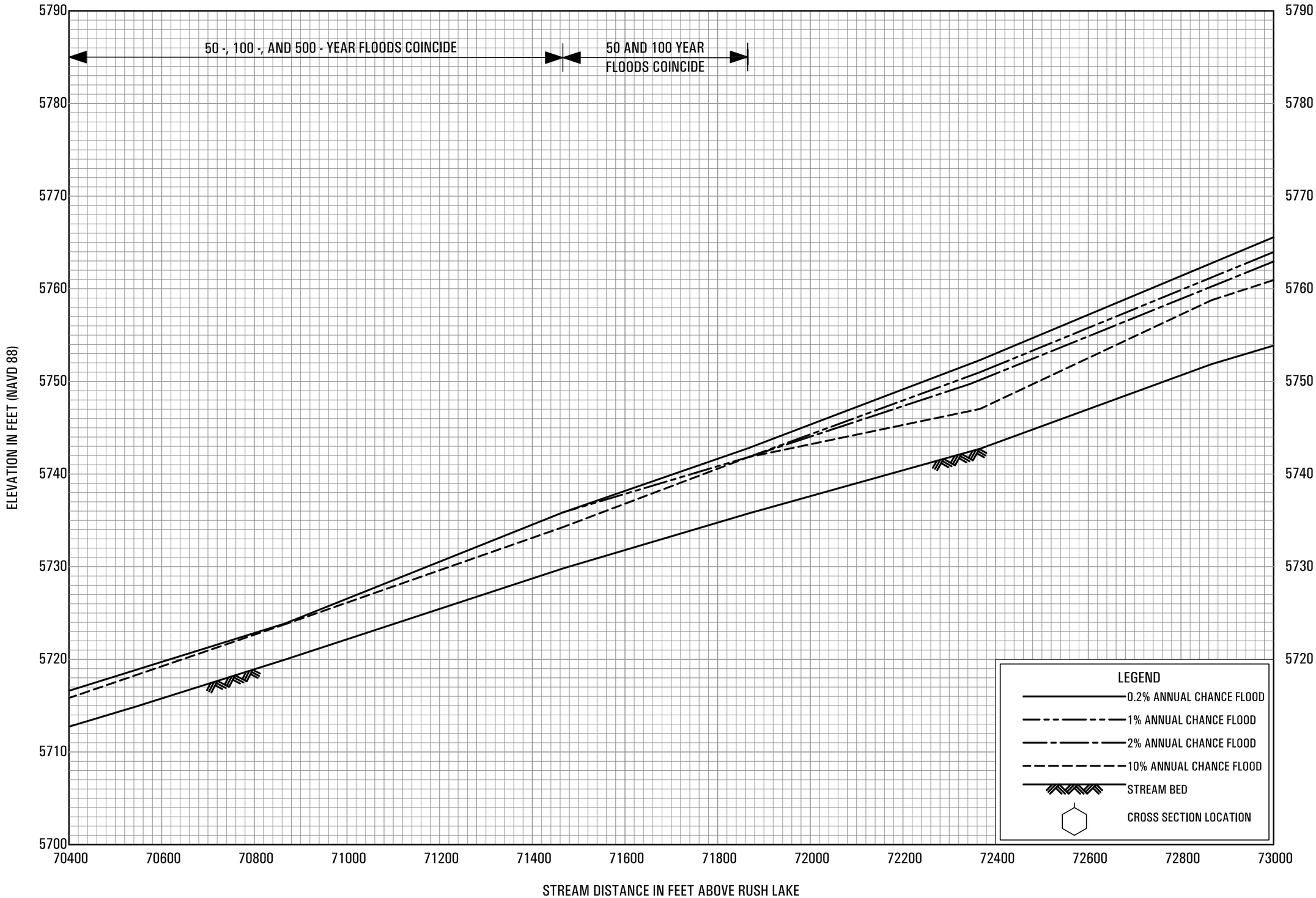
COAL CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

IRON COUNTY, UT

AND INCORPORATED AREAS

03P



FLOOD PROFILES

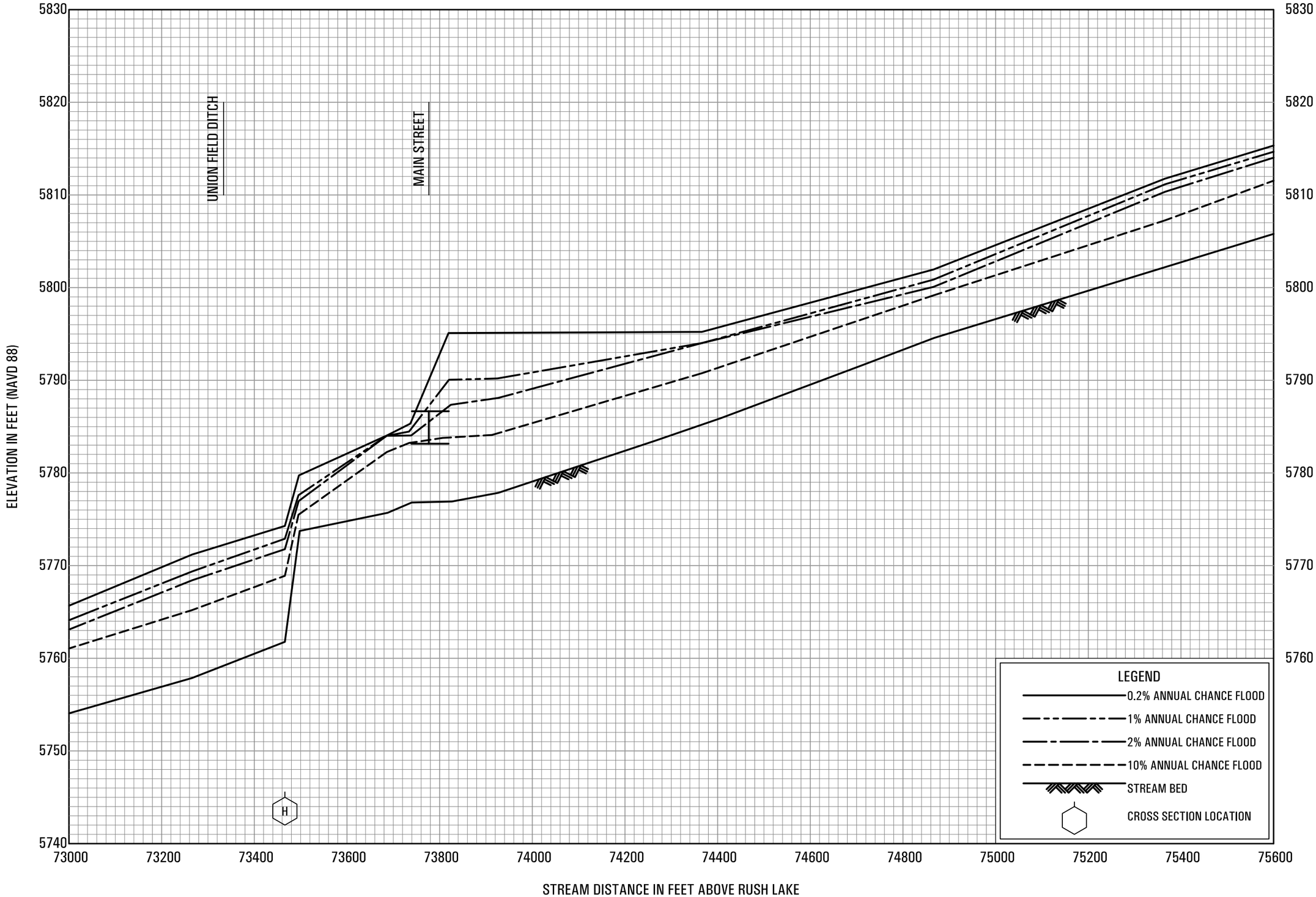
COAL CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

IRON COUNTY, UT

AND INCORPORATED AREAS

04P



FLOOD PROFILES

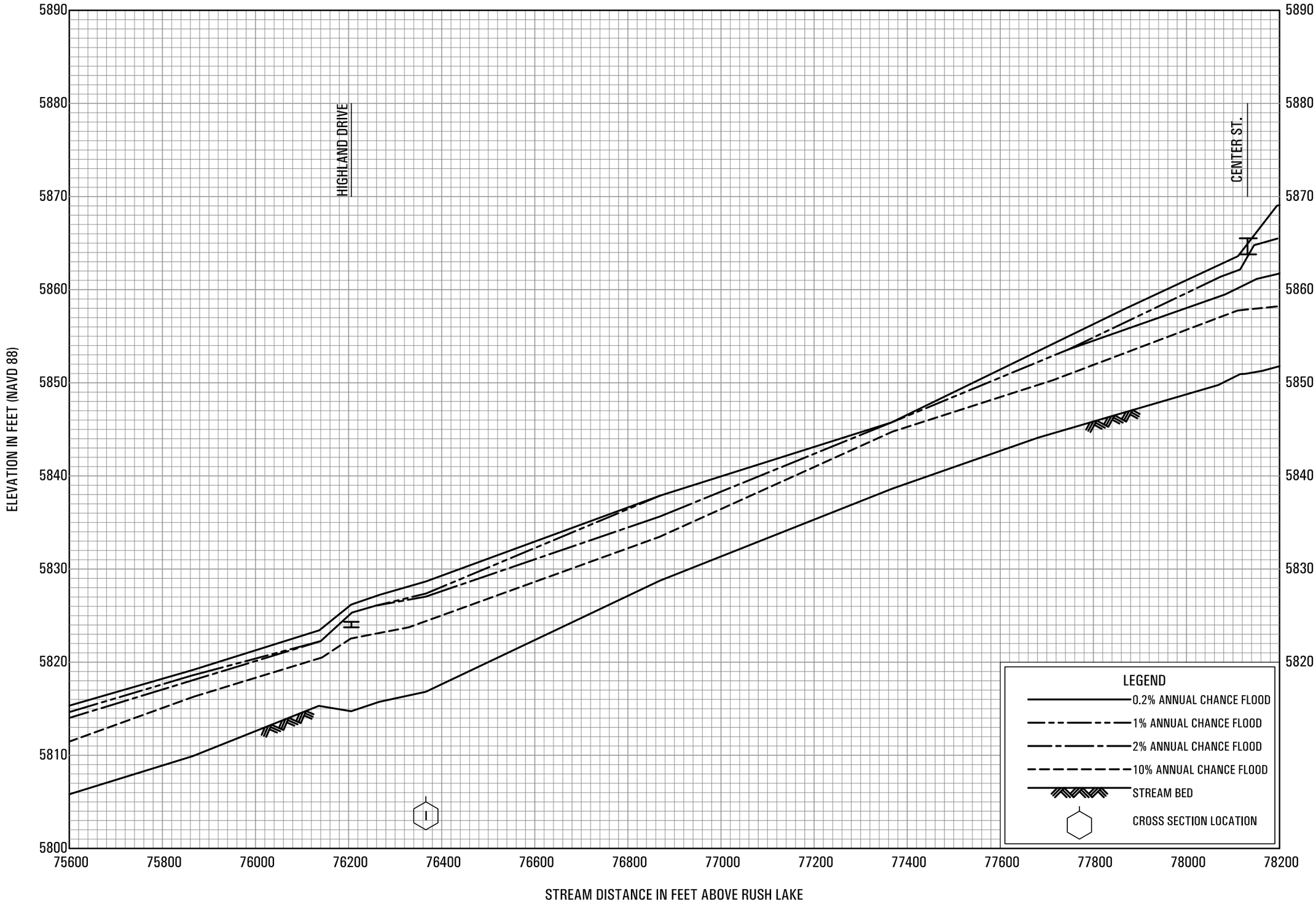
COAL CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

IRON COUNTY, UT

AND INCORPORATED AREAS

05P



FLOOD PROFILES

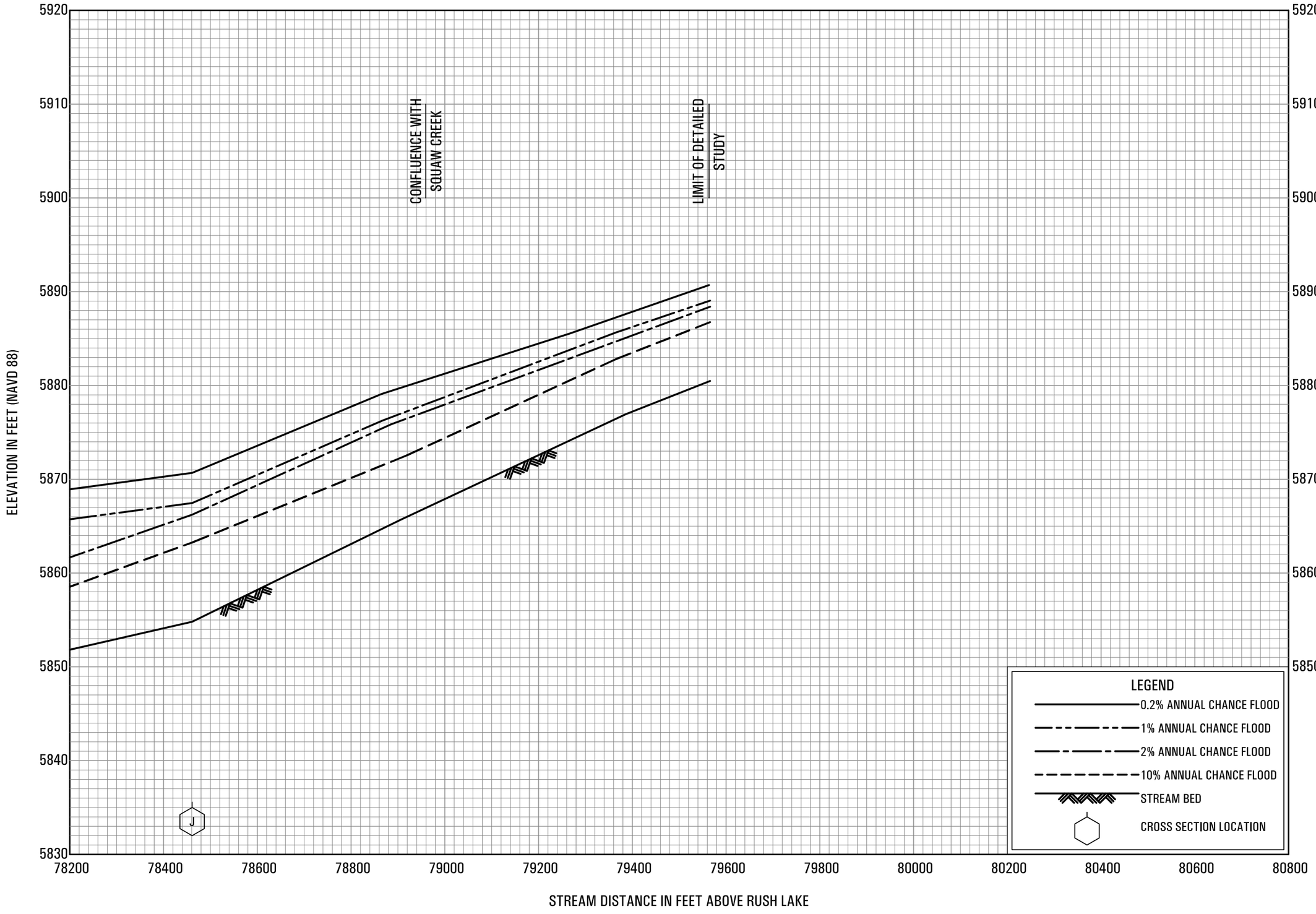
COAL CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

IRON COUNTY, UT

AND INCORPORATED AREAS

06P



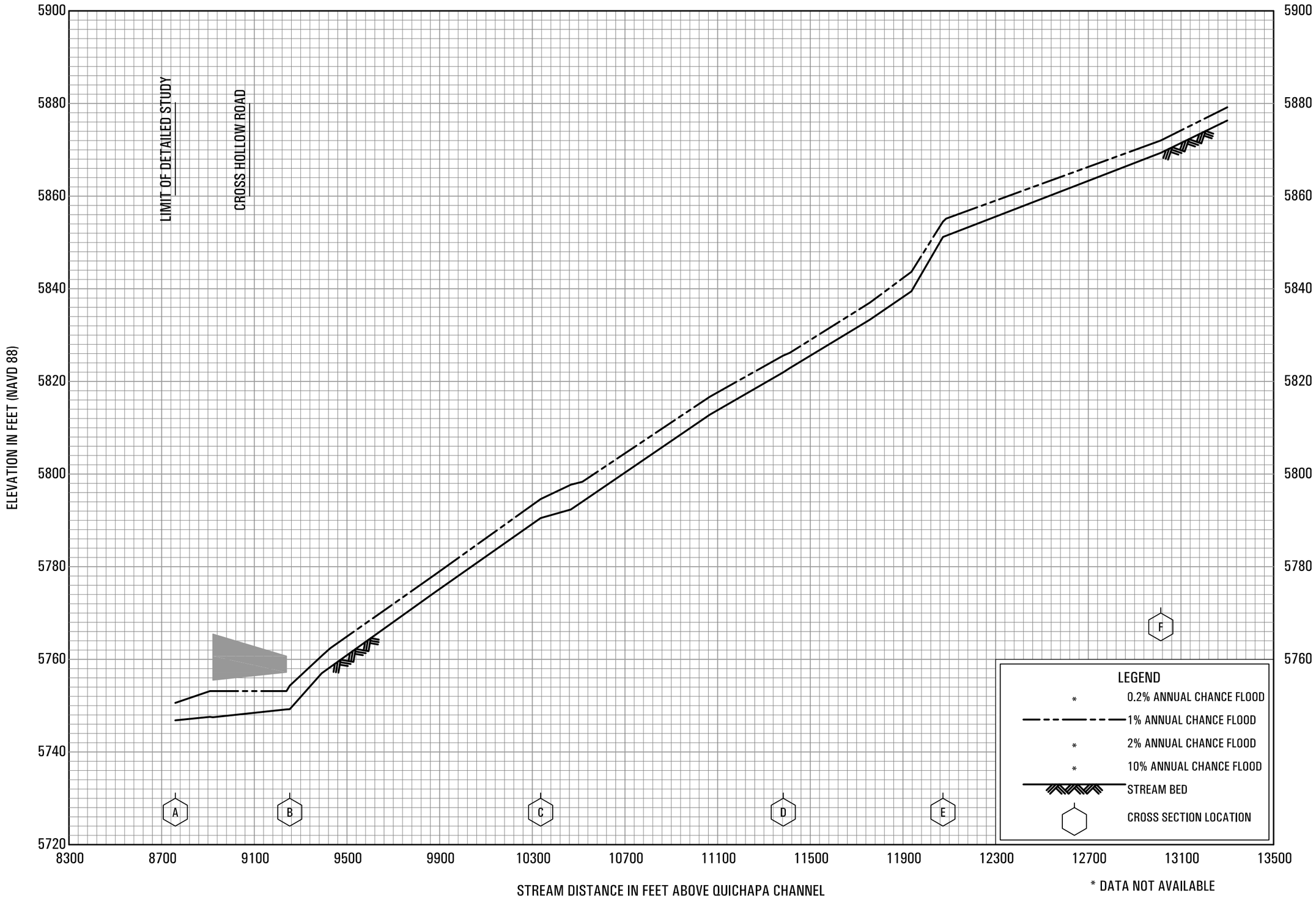
FLOOD PROFILES

COAL CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

IRON COUNTY, UT

AND INCORPORATED AREAS



FLOOD PROFILES

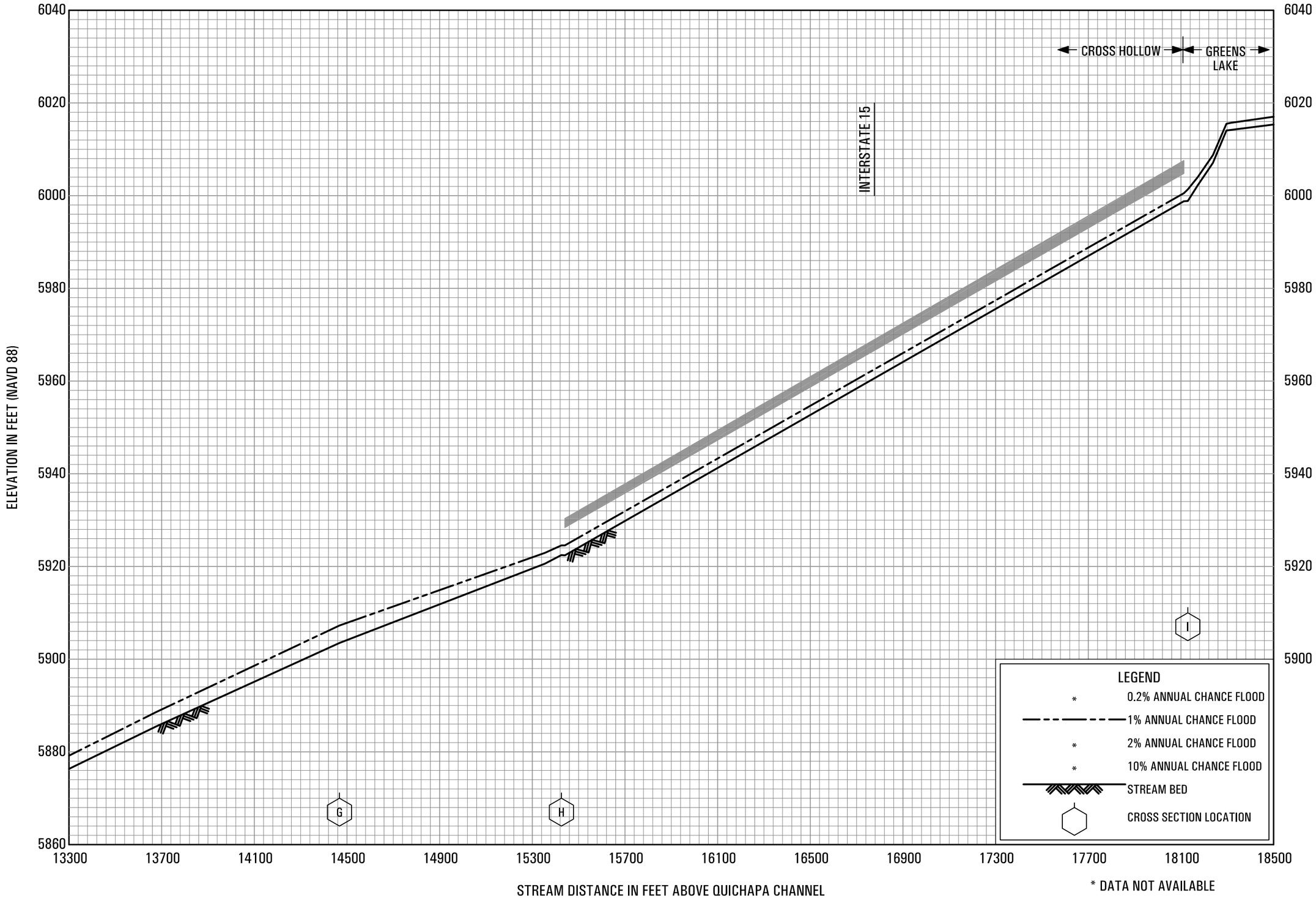
CROSS HOLLOW

FEDERAL EMERGENCY MANAGEMENT AGENCY

IRON COUNTY, UT

AND INCORPORATED AREAS

08P



FLOOD PROFILES

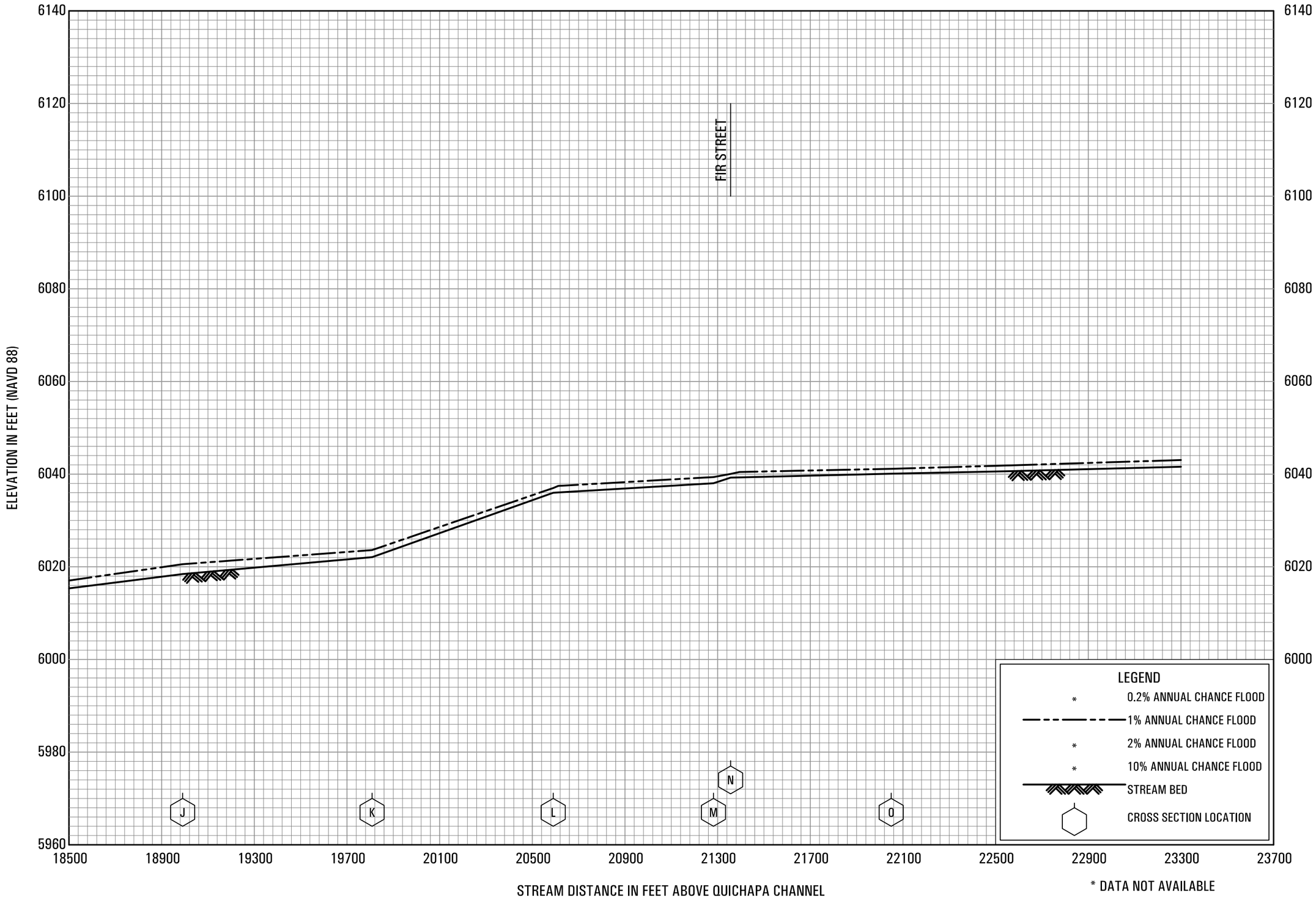
CROSS HOLLOW & GREENS LAKE

FEDERAL EMERGENCY MANAGEMENT AGENCY

IRON COUNTY, UT

AND INCORPORATED AREAS

09P



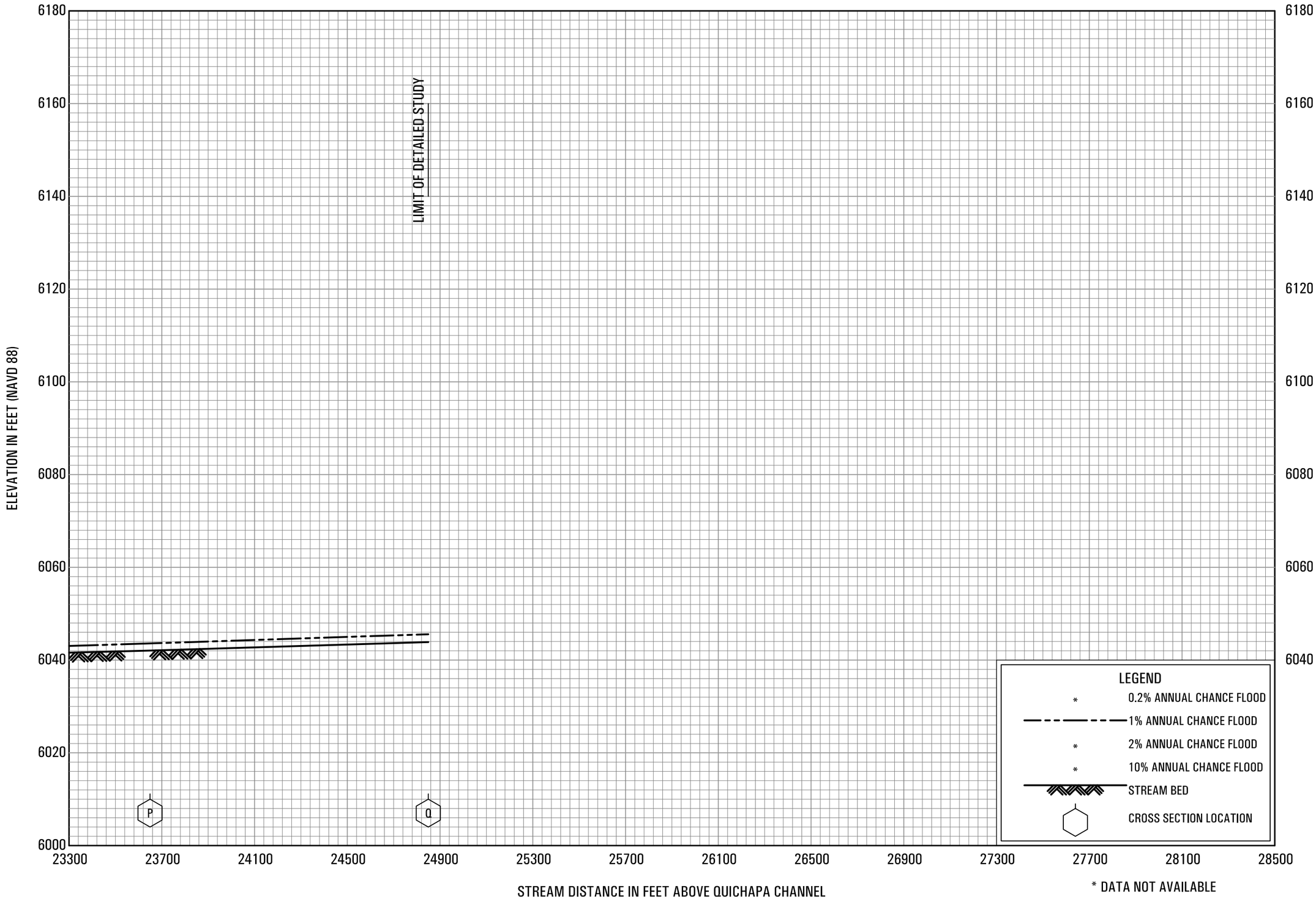
FLOOD PROFILES

GREENS LAKE

FEDERAL EMERGENCY MANAGEMENT AGENCY

IRON COUNTY, UT

AND INCORPORATED AREAS



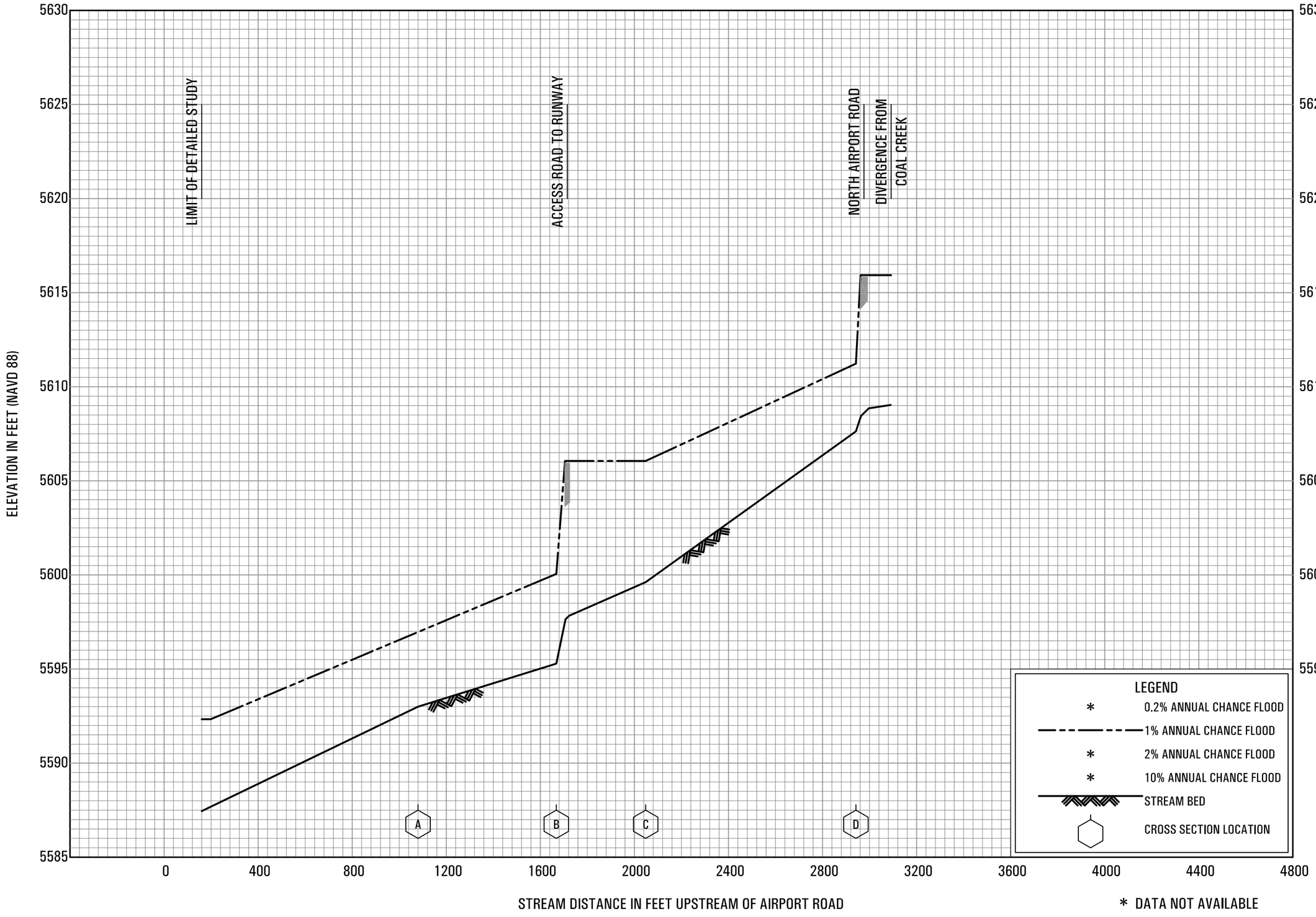
FLOOD PROFILES

GREENS LAKE

FEDERAL EMERGENCY MANAGEMENT AGENCY

IRON COUNTY, UT

AND INCORPORATED AREAS



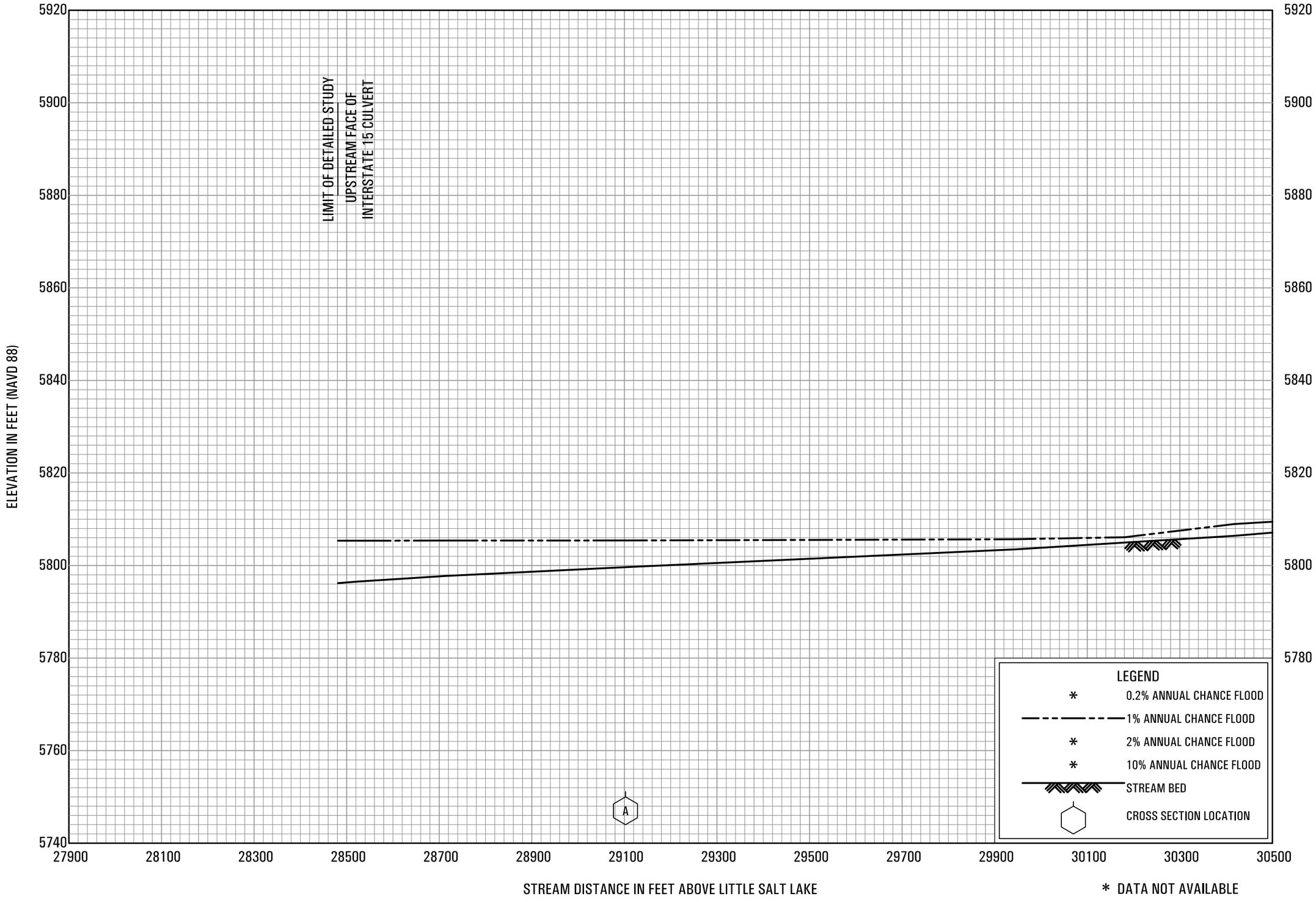
FLOOD PROFILES

NORTH AIRPORT CANAL

FEDERAL EMERGENCY MANAGEMENT AGENCY

IRON COUNTY, UT

AND INCORPORATED AREAS



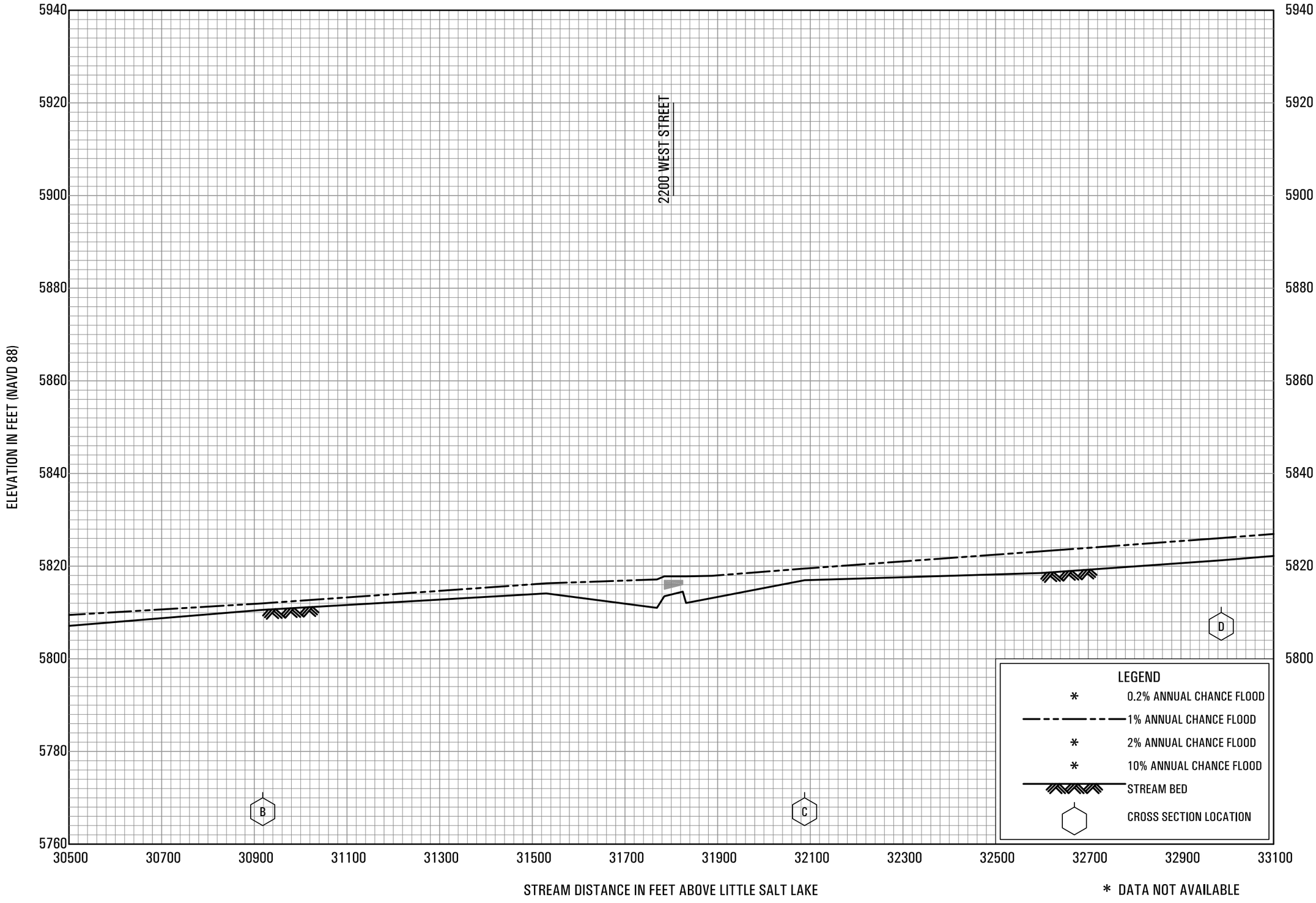
FLOOD PROFILES

PARAWON CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

IRON COUNTY, UT

AND INCORPORATED AREAS



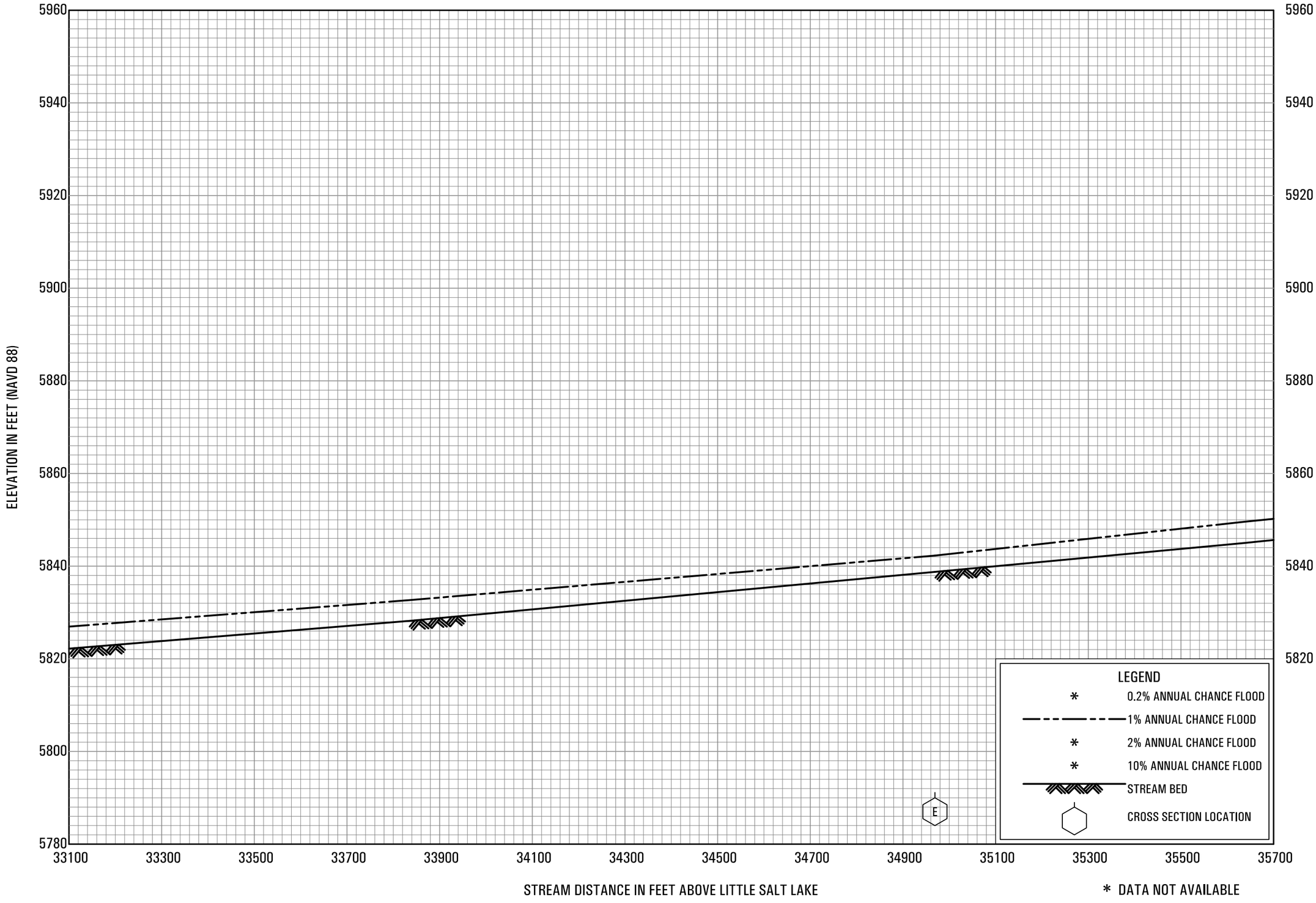
FLOOD PROFILES

PARAWON CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

IRON COUNTY, UT

AND INCORPORATED AREAS



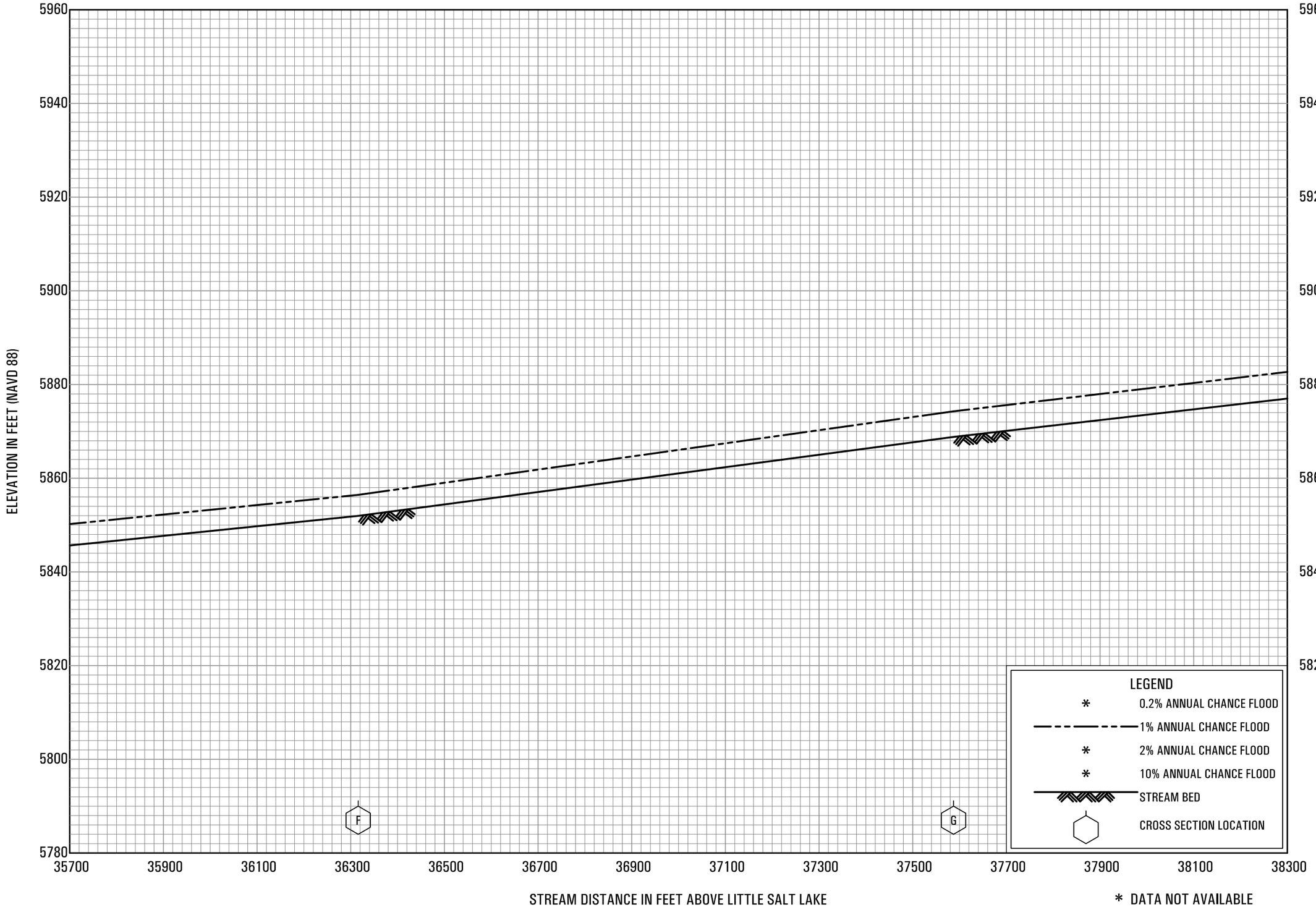
FLOOD PROFILES

PARAWON CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

IRON COUNTY, UT

AND INCORPORATED AREAS



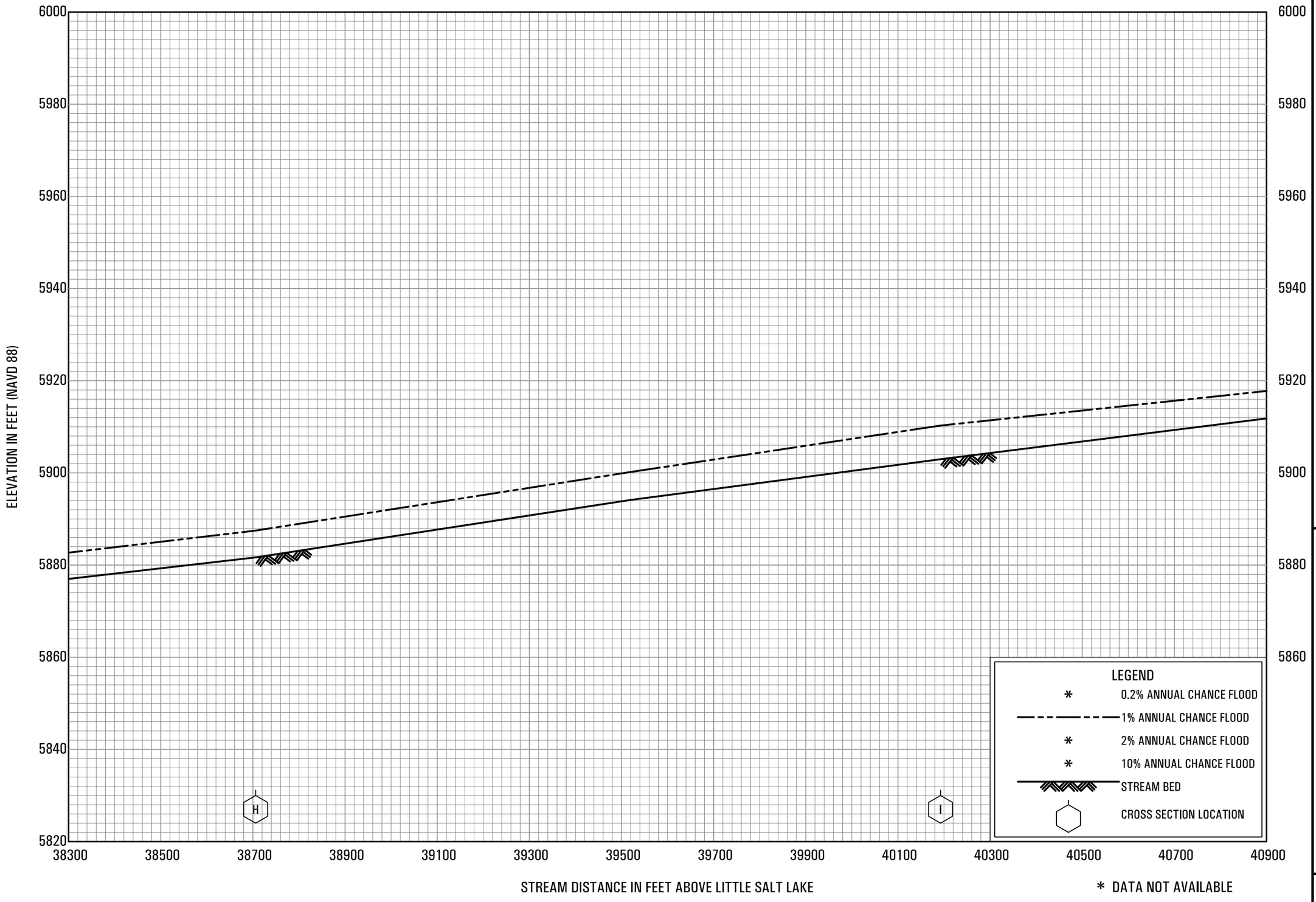
FLOOD PROFILES

PARAWON CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

IRON COUNTY, UT

AND INCORPORATED AREAS



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IRON COUNTY, UT

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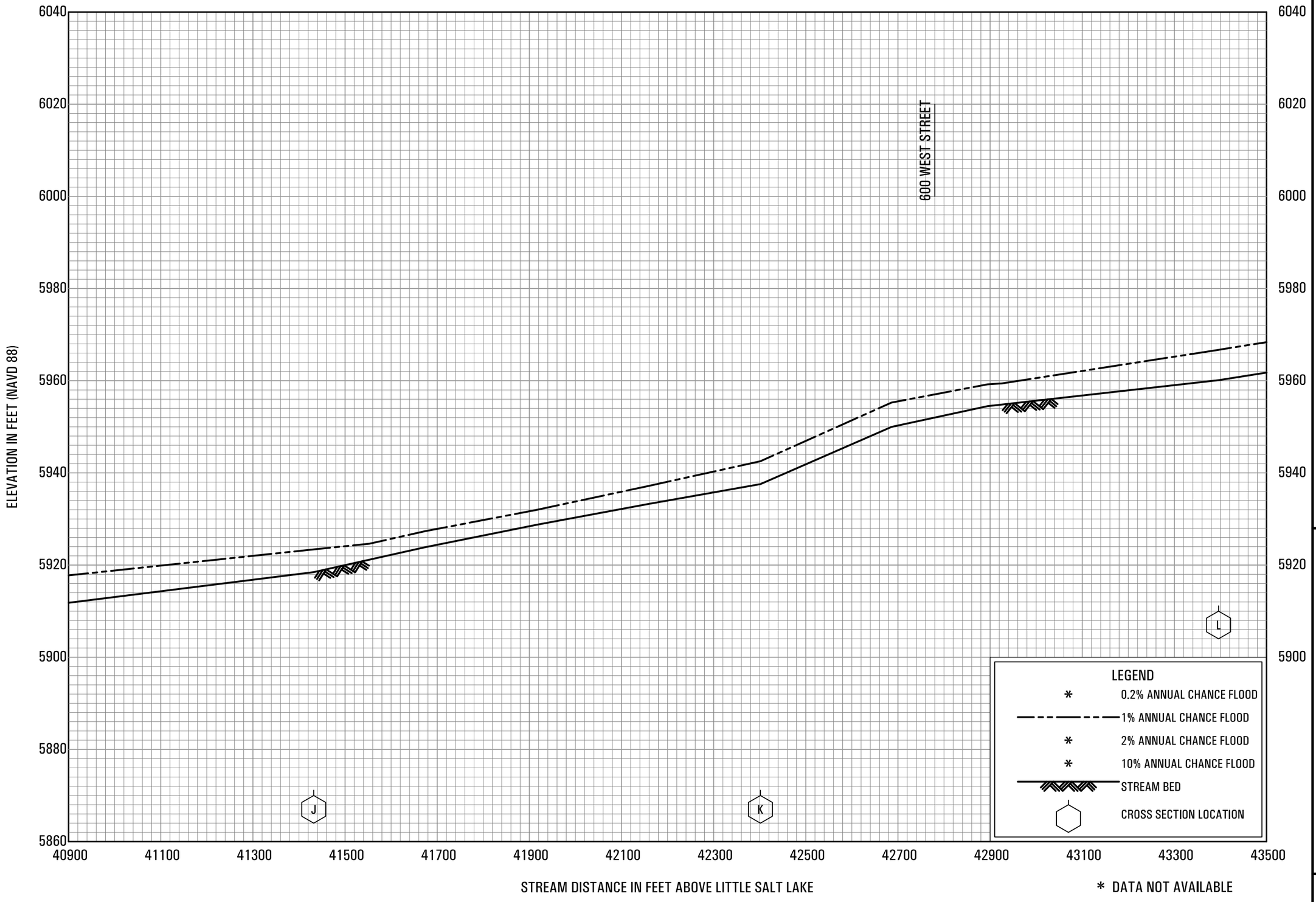

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PARAWON CREEK

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IRON COUNTY, UT

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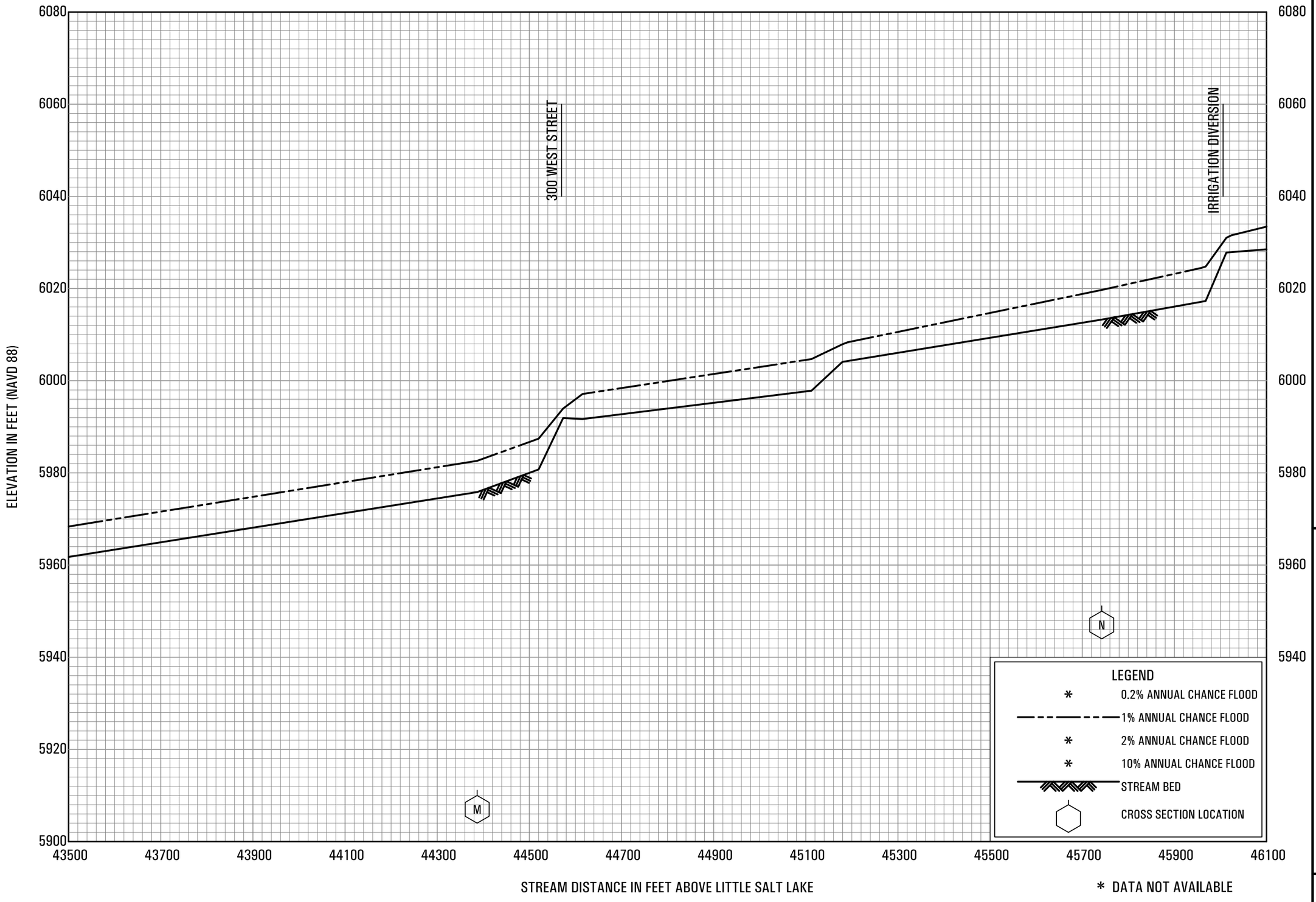

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IRON COUNTY, UT

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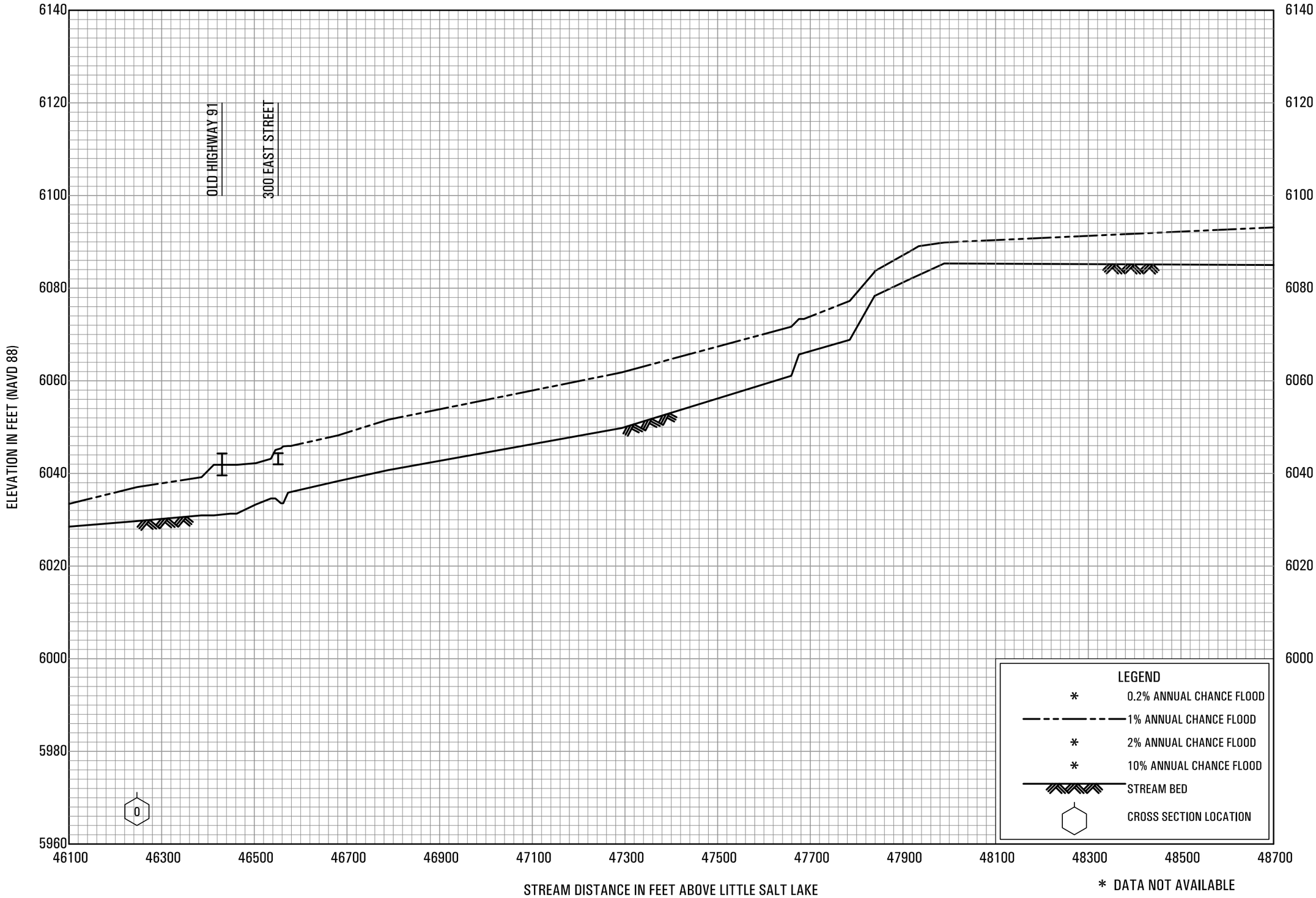

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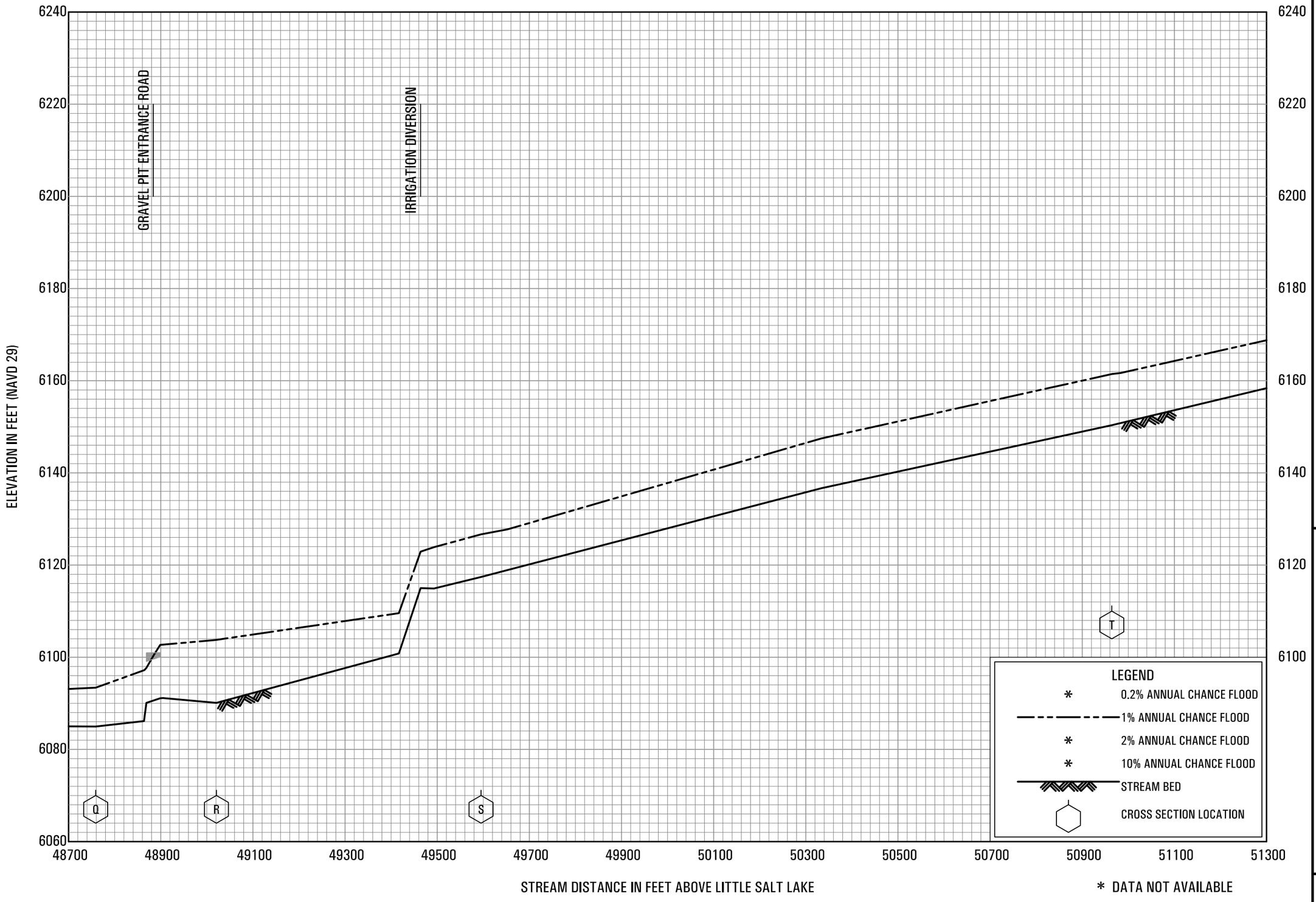

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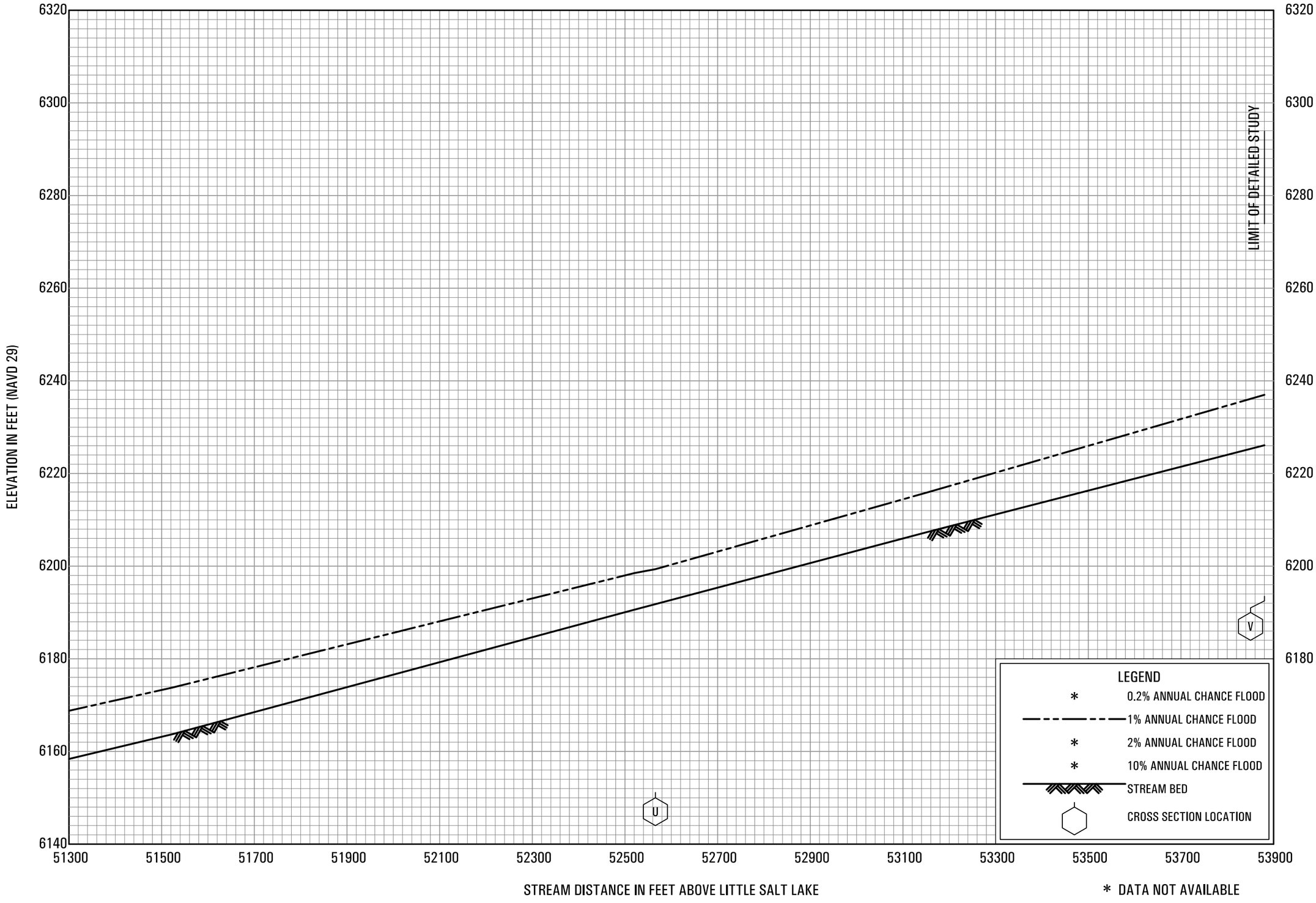

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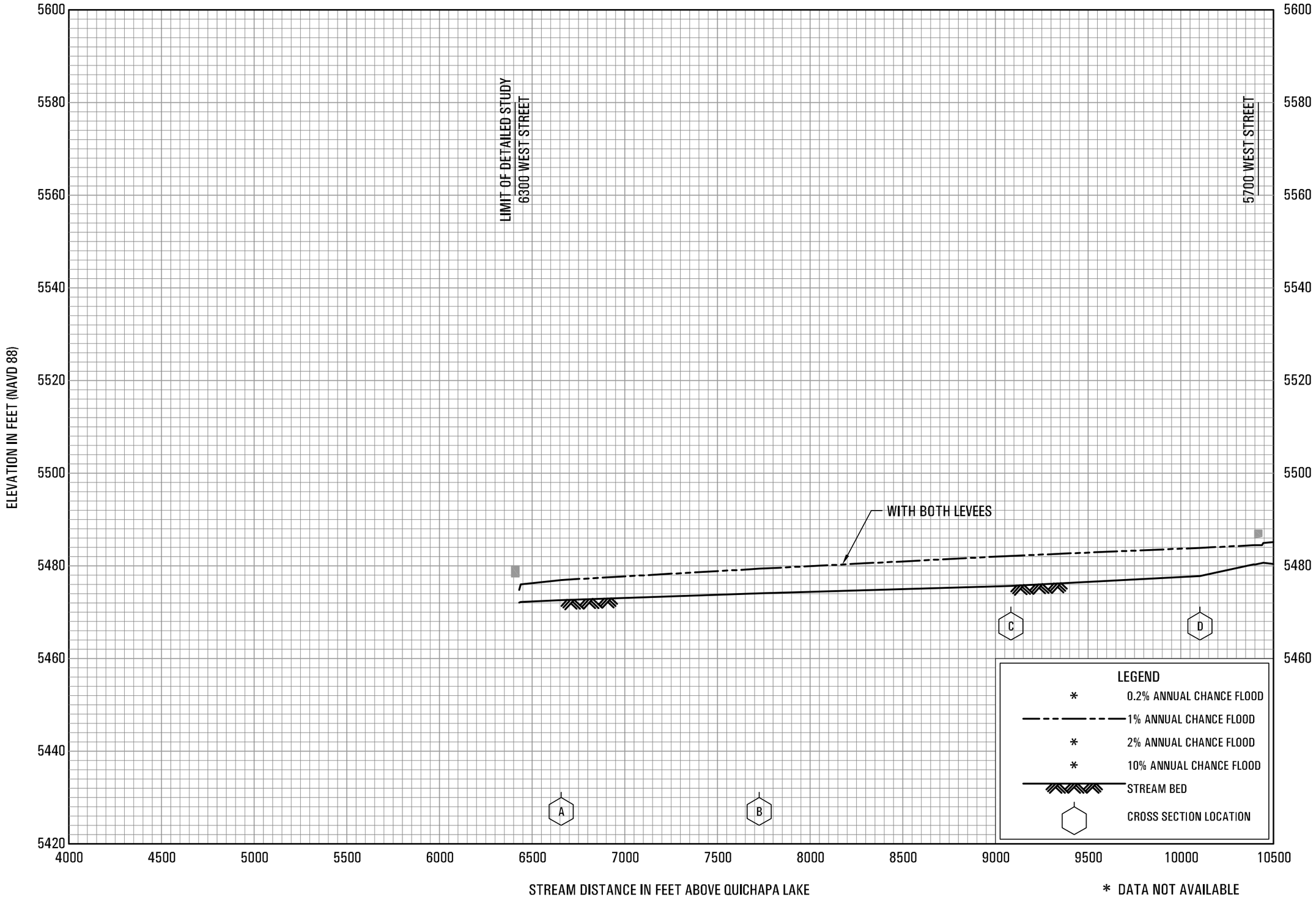

FLOOD PROFILES

QUICHAPA CHANNEL

FEDERAL EMERGENCY MANAGEMENT AGENCY

IRON COUNTY, UT

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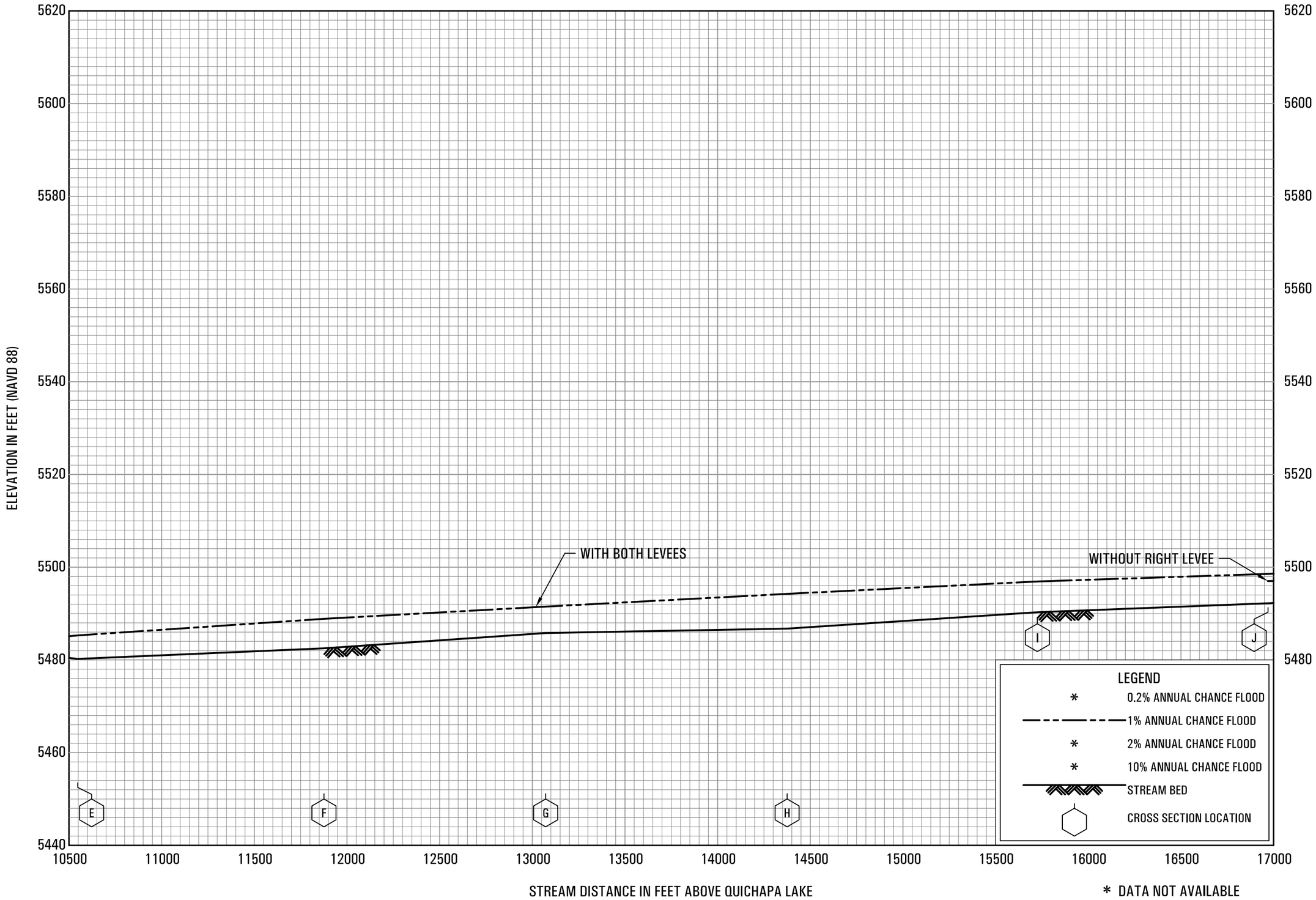

FLOOD PROFILES

QUICHAPA CHANNEL

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IRON COUNTY, UT

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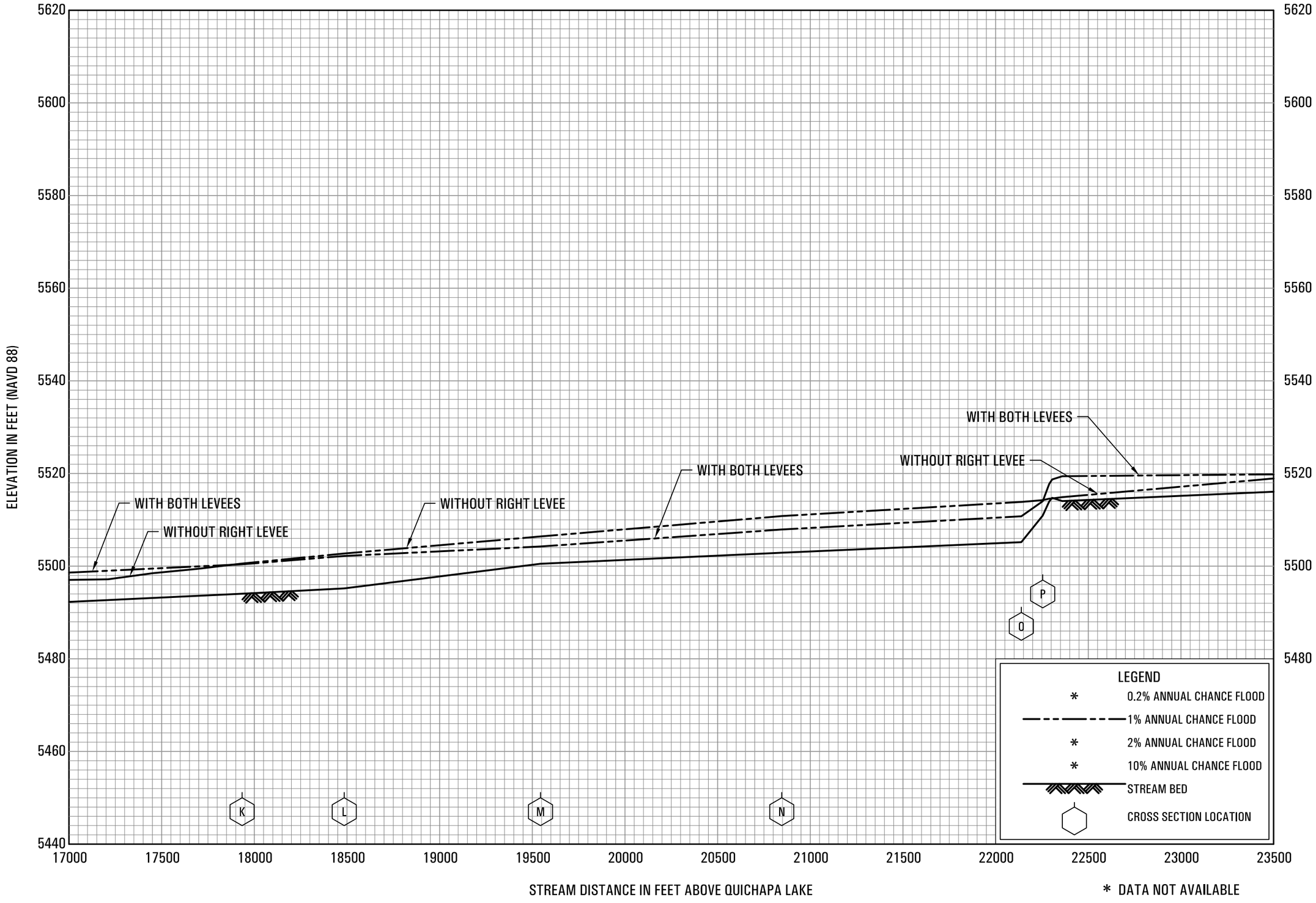

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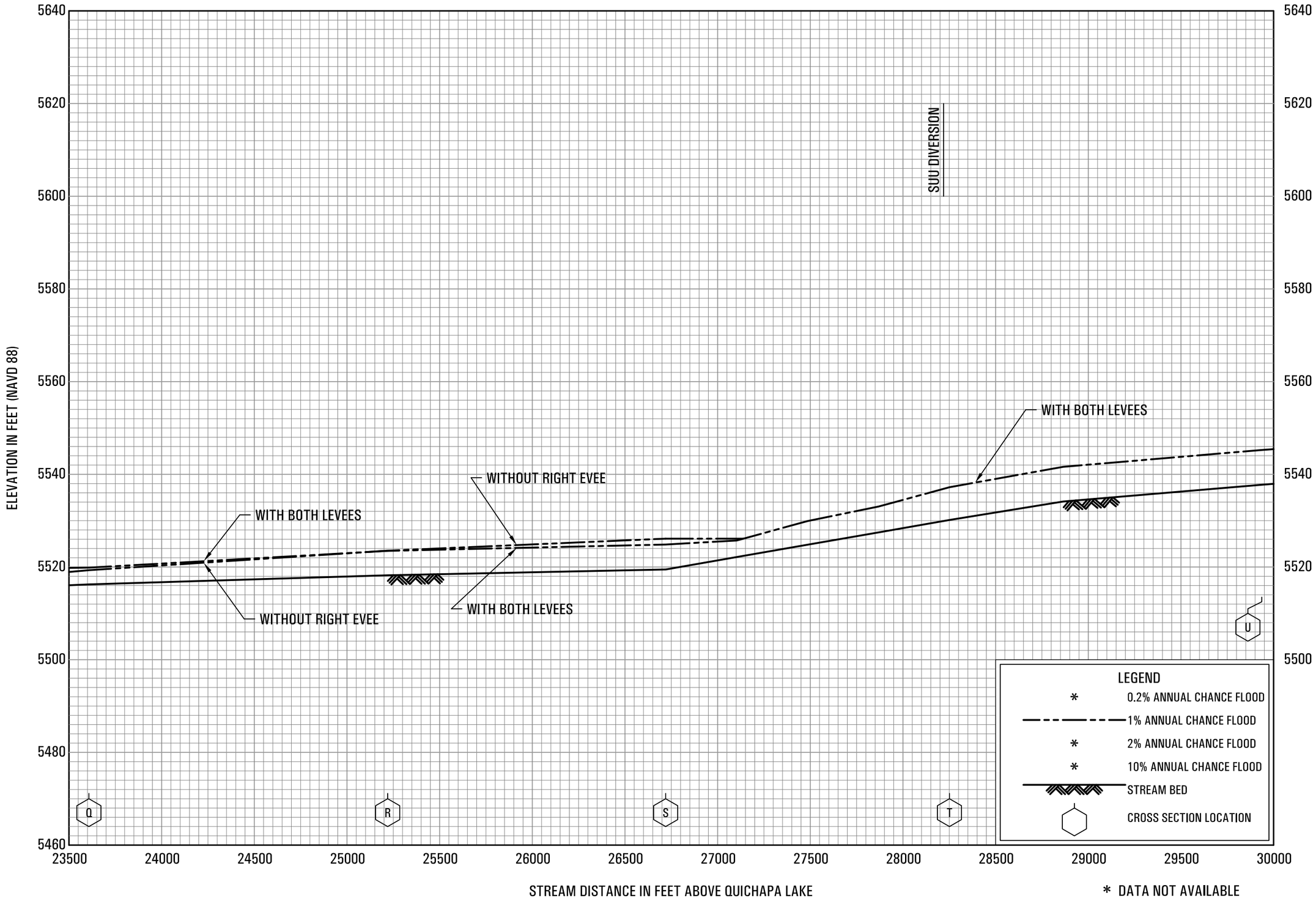

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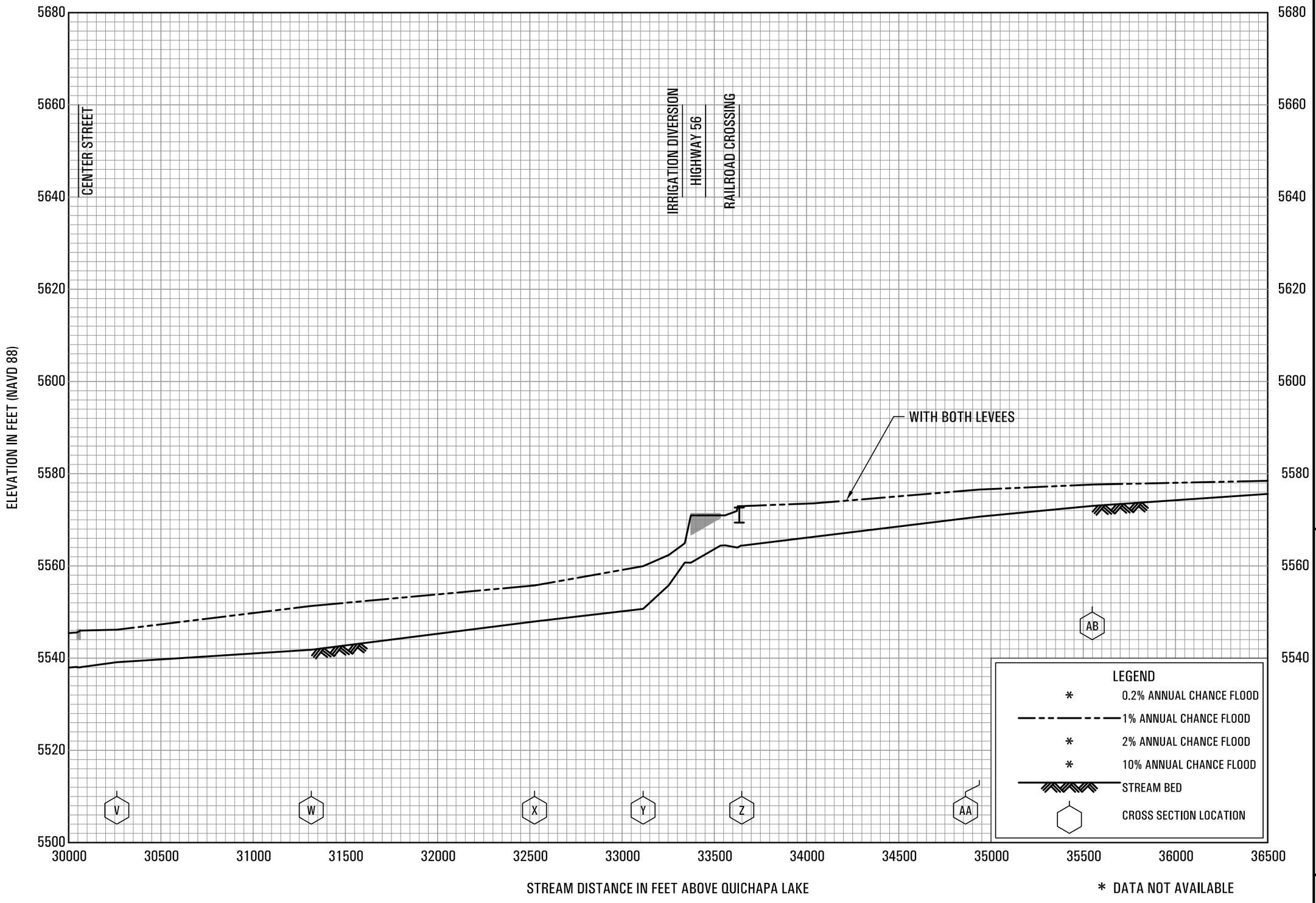

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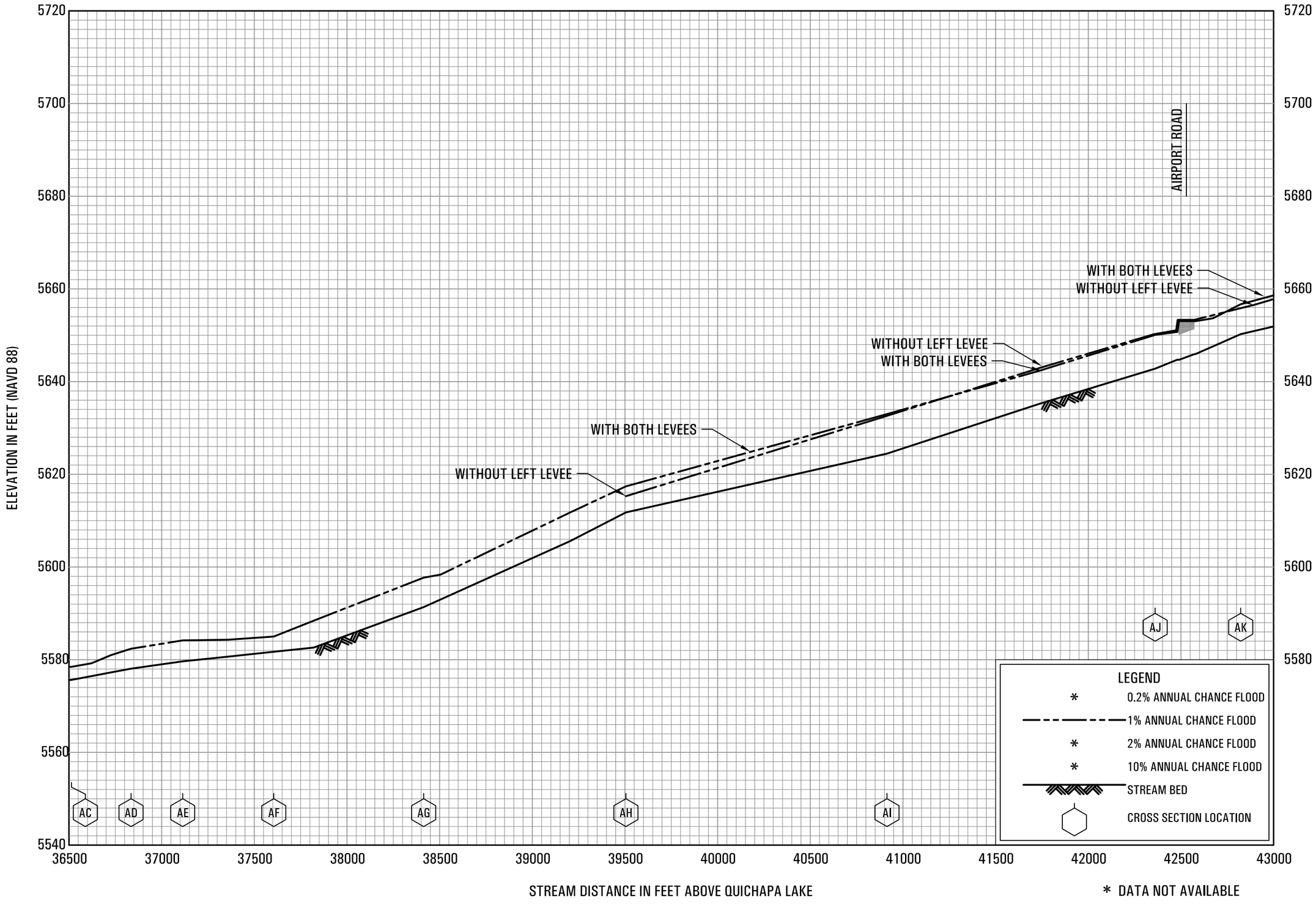

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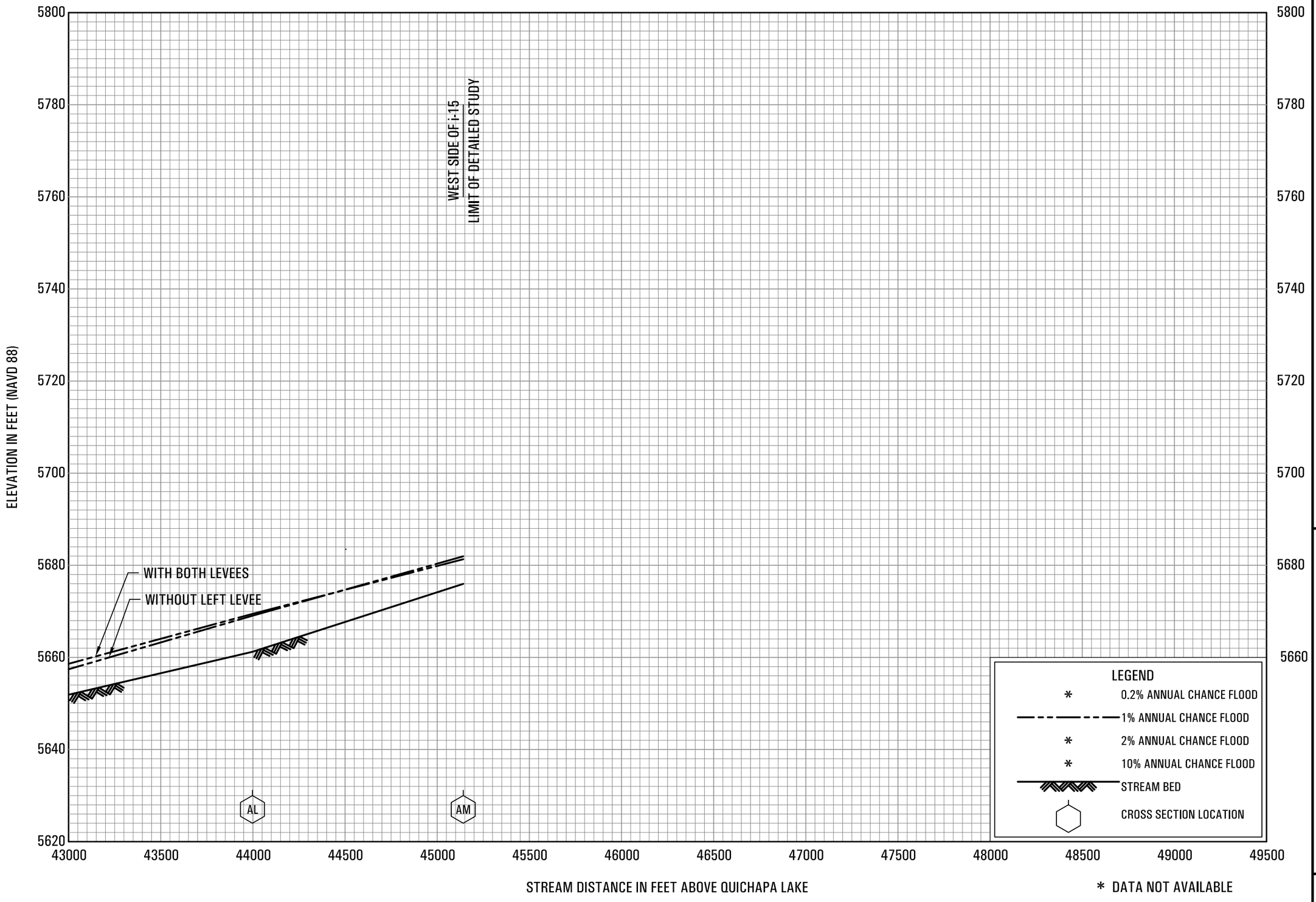

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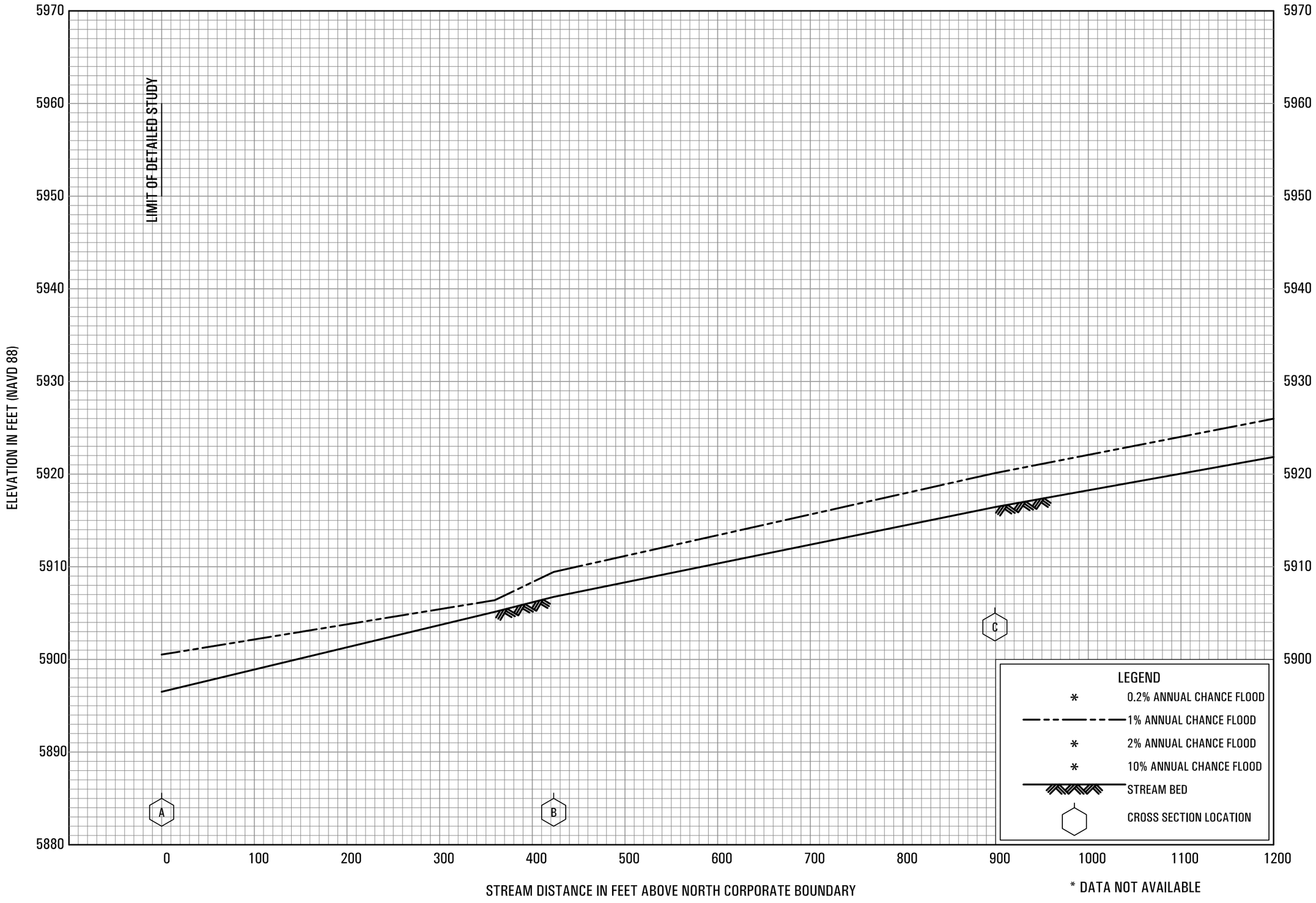

FLOOD PROFILES

RED CREEK

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IRON COUNTY, UT

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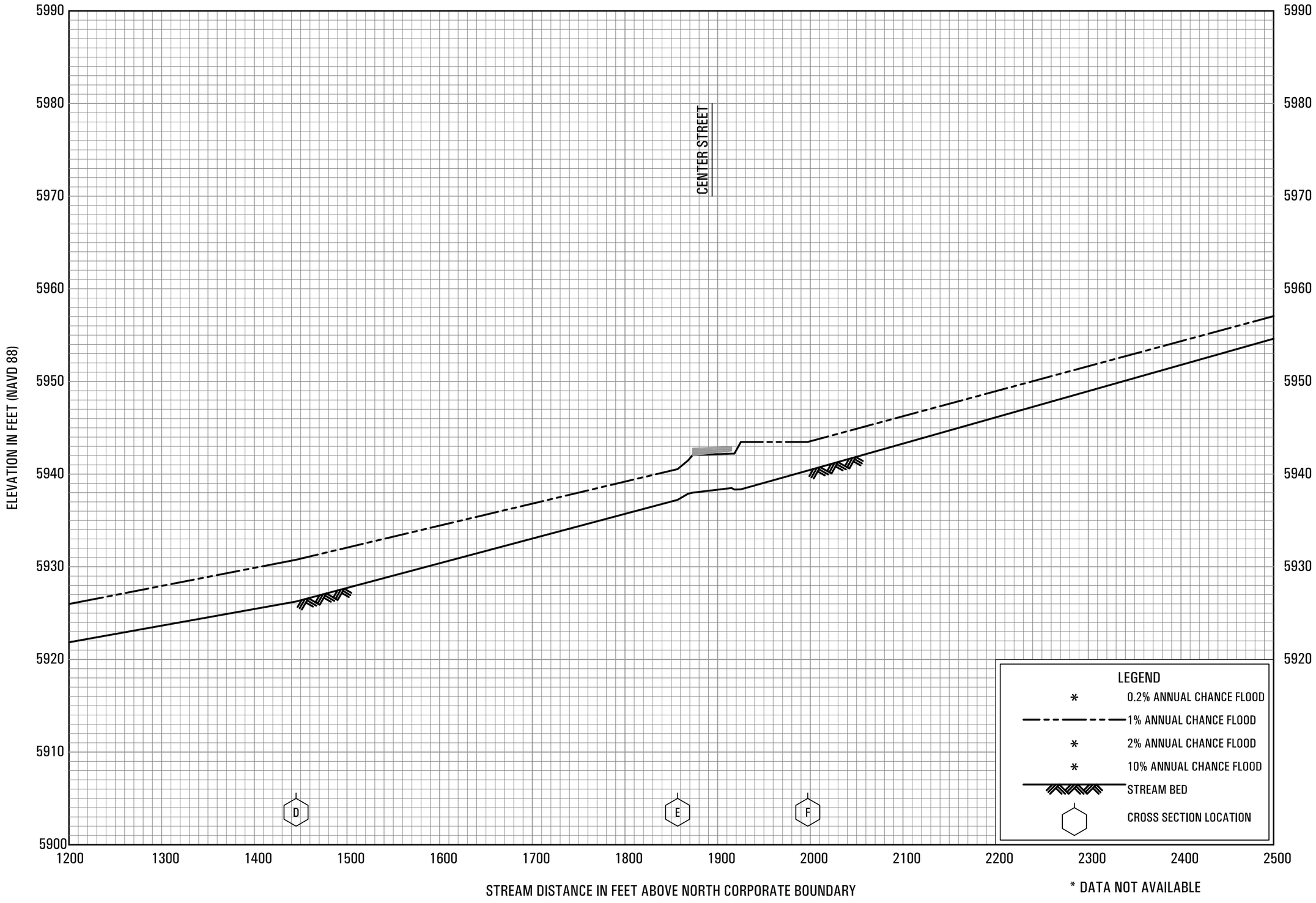

FLOOD PROFILES

RED CREEK

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IRON COUNTY, UT

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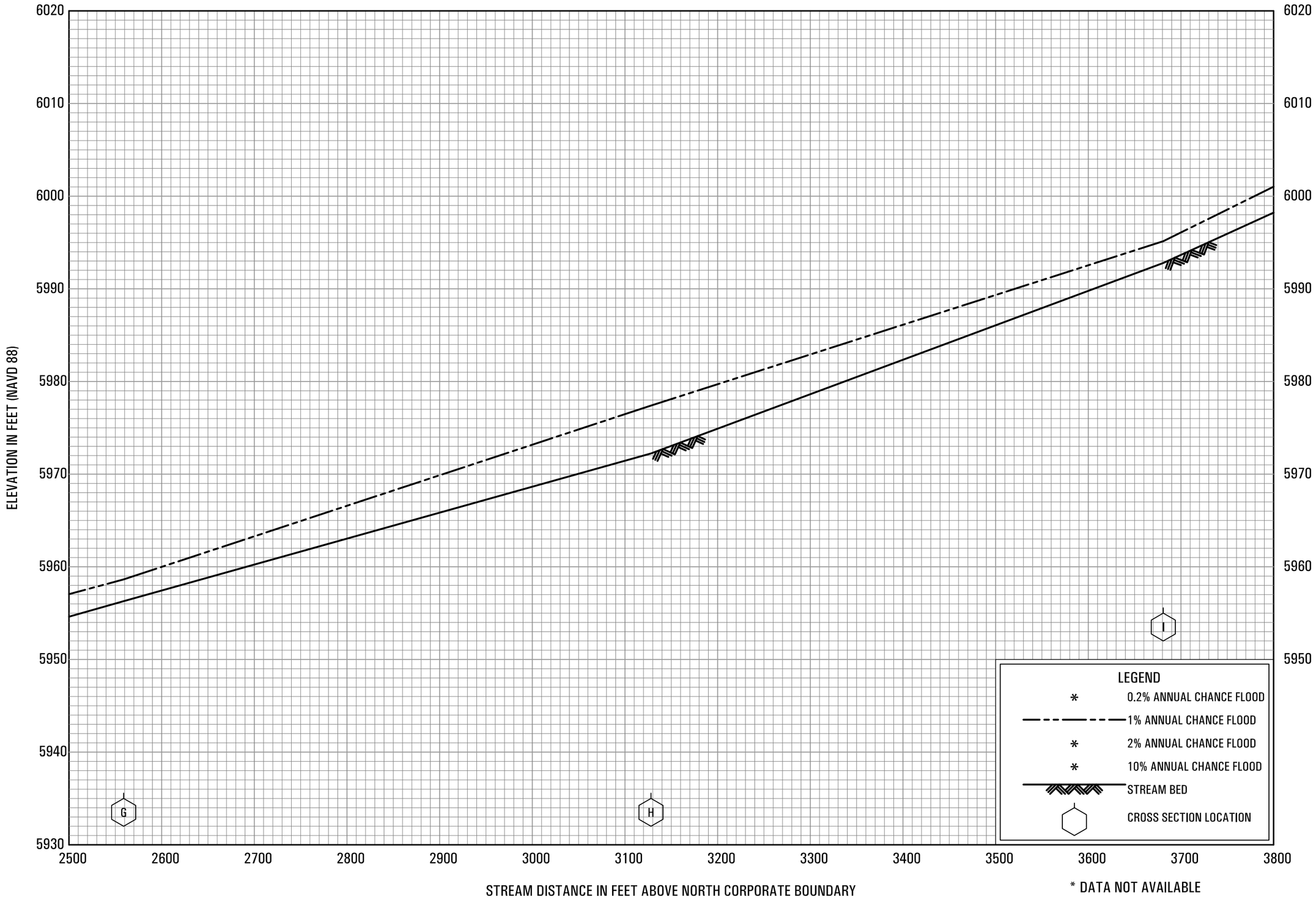

FLOOD PROFILES

RED CREEK

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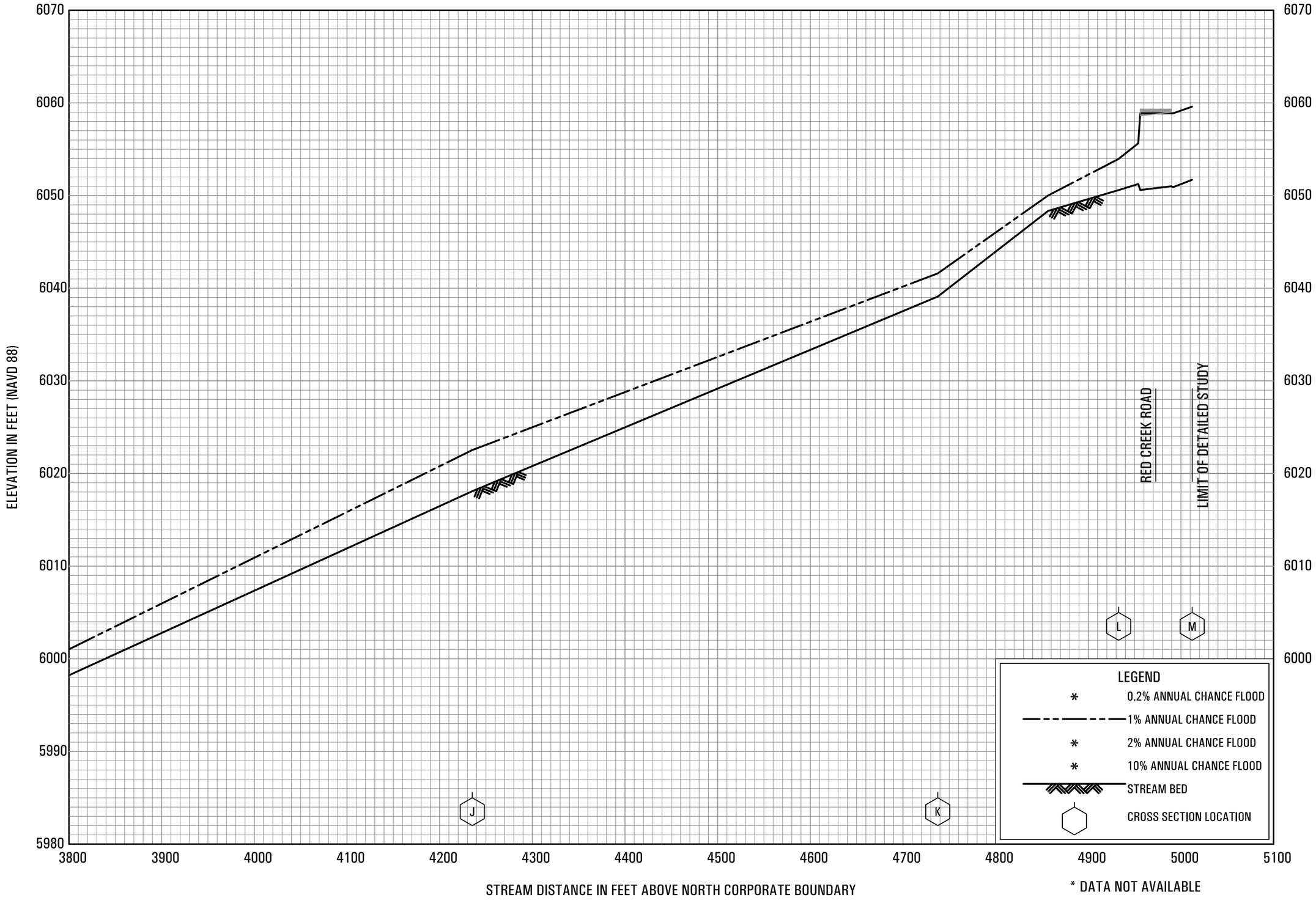

FLOOD PROFILES

RED CREEK

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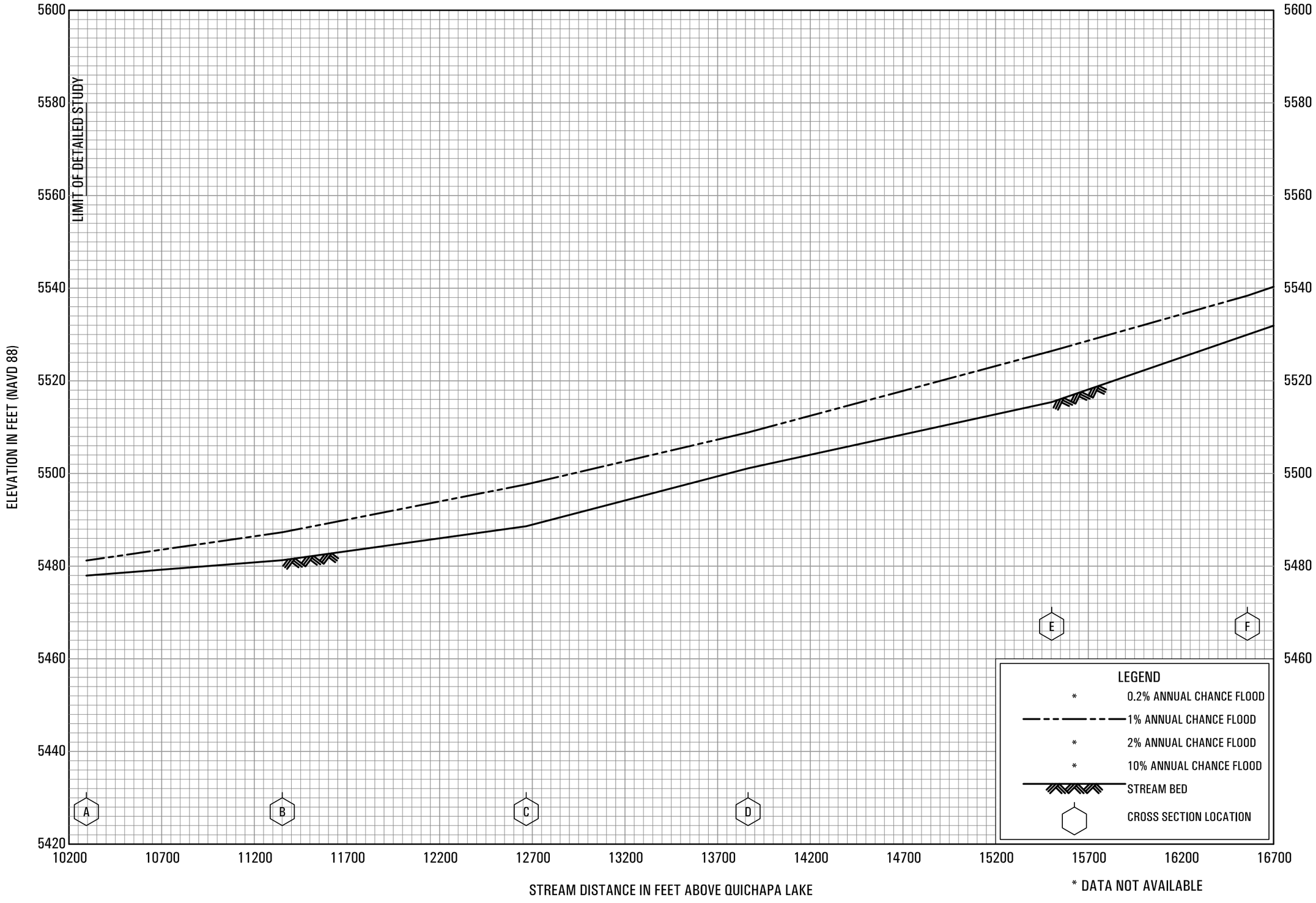

FLOOD PROFILES

SHURTZ CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

IRON COUNTY, UT

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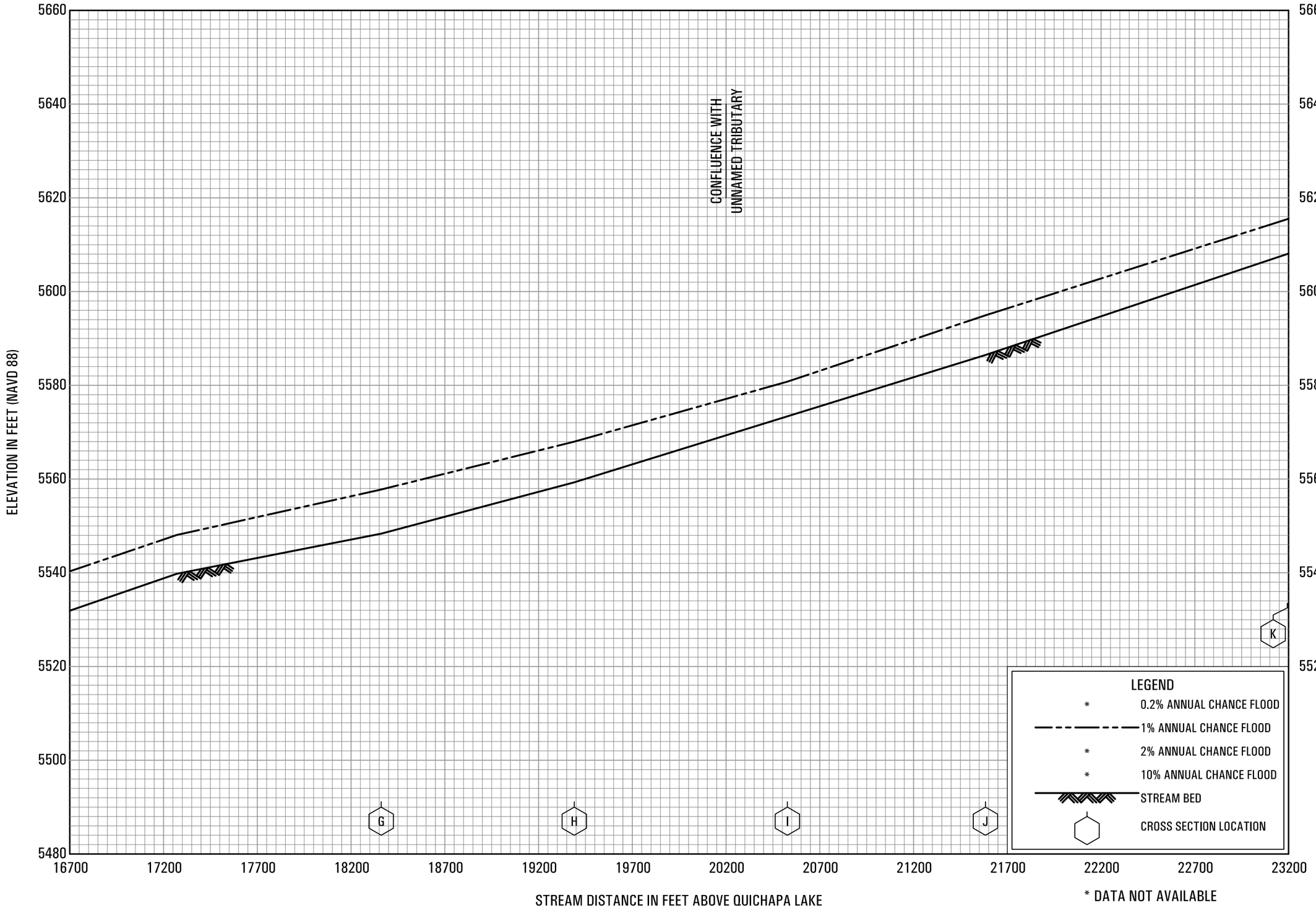

FLOOD PROFILES

SHURTZ CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

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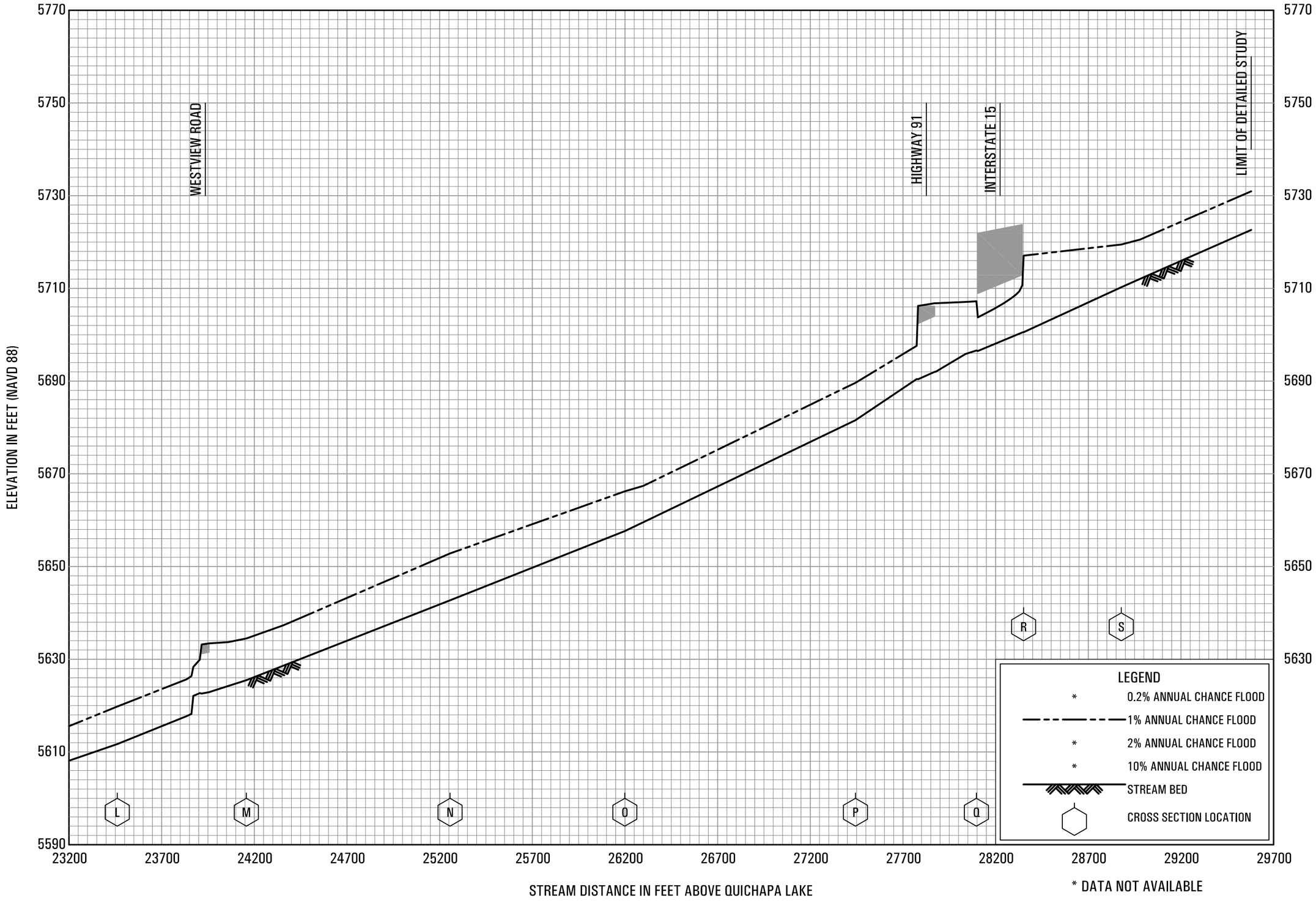

FLOOD PROFILES

SHURTZ CREEK

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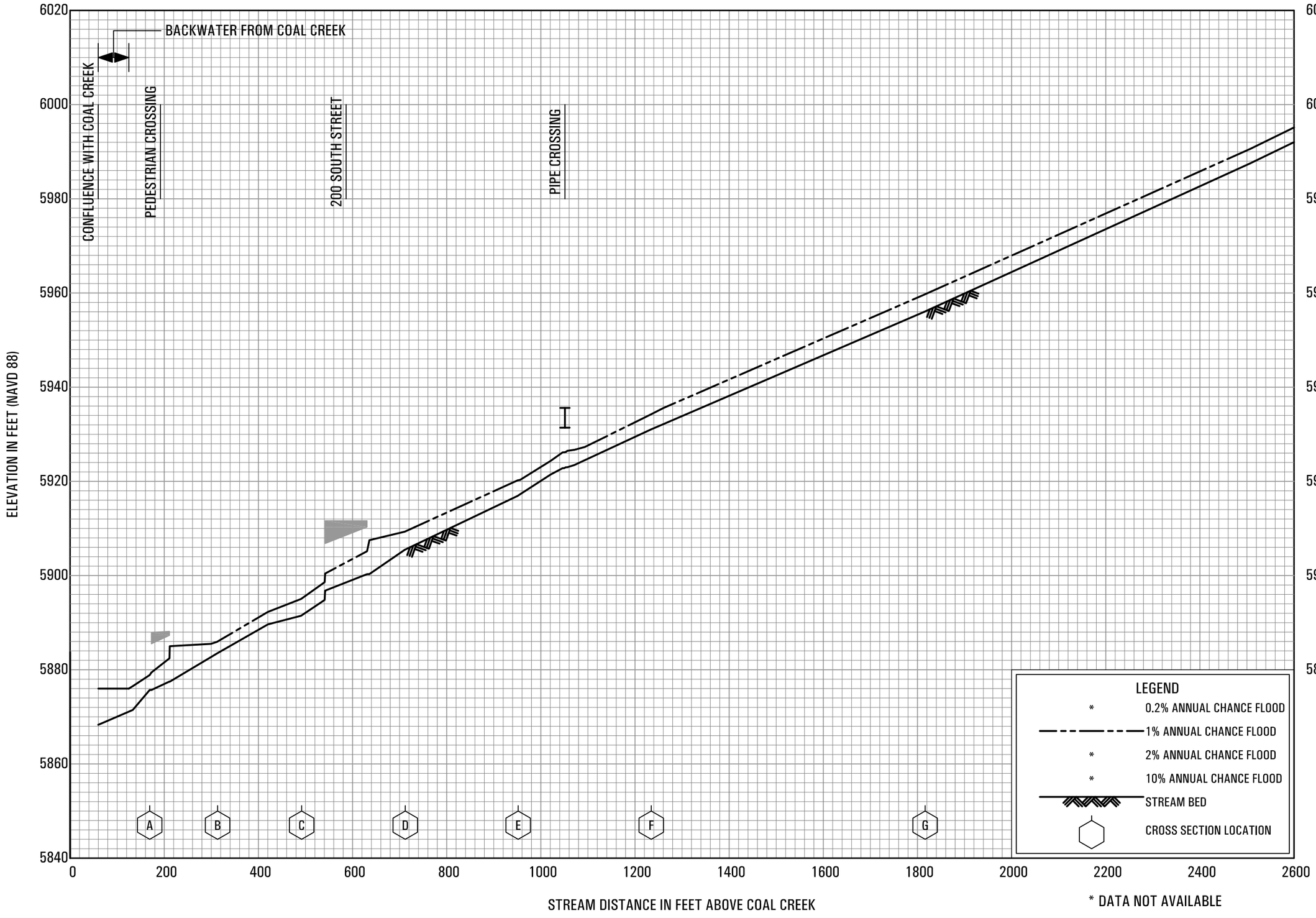

FLOOD PROFILES

SQUAW CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

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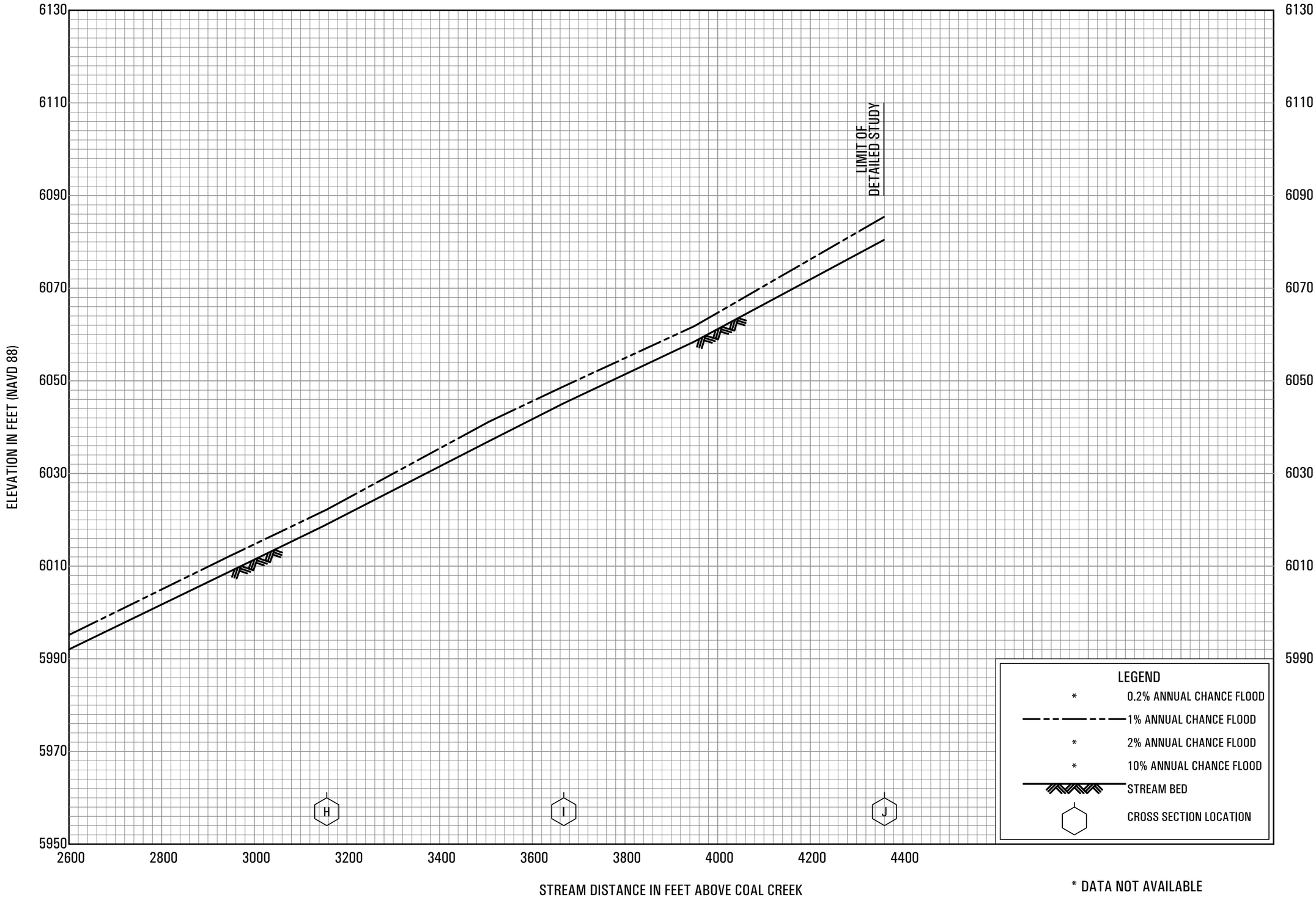

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FLOOD PROFILES

SQUAW CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

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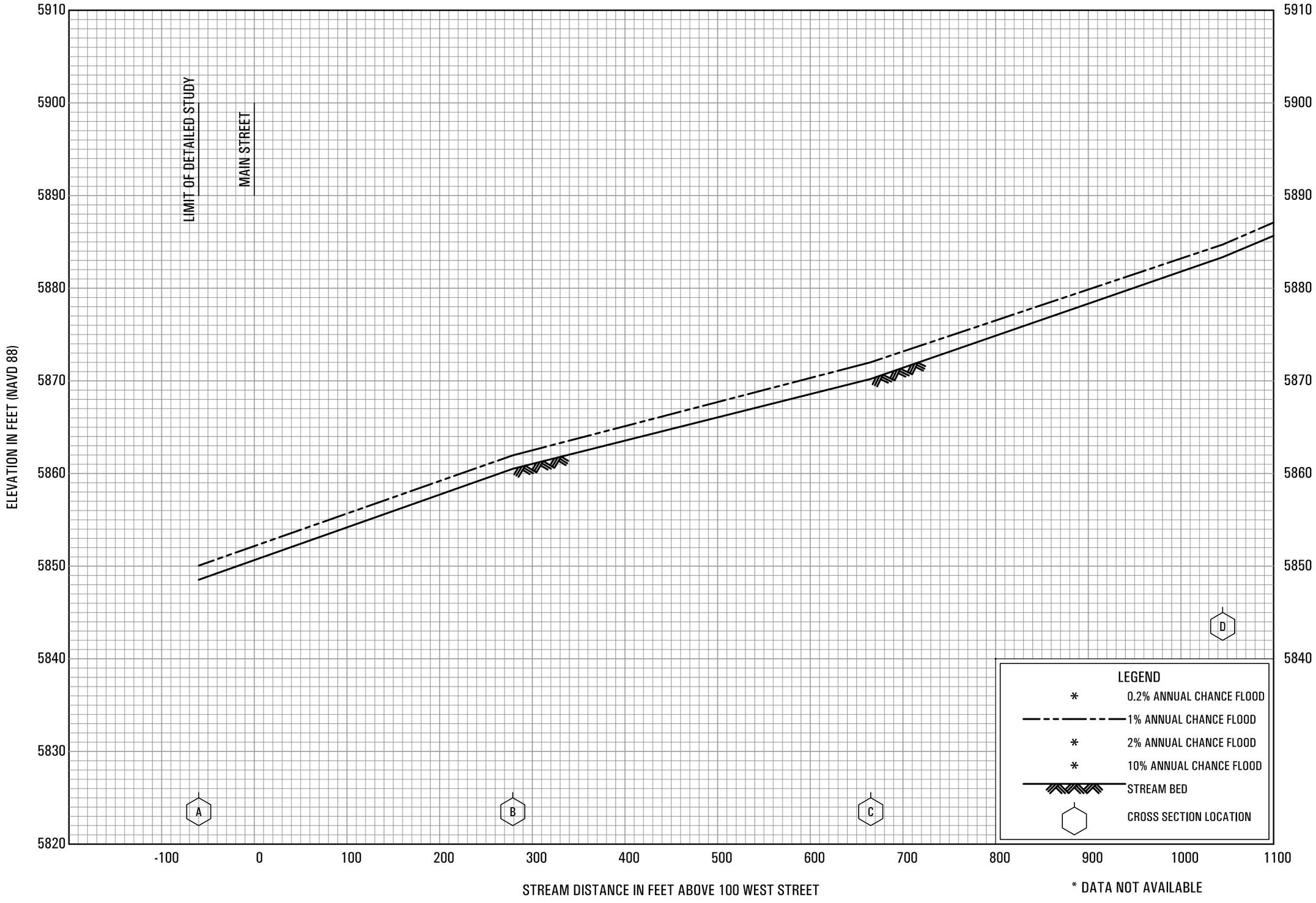

FLOOD PROFILES

WATER CANYON

FEDERAL EMERGENCY MANAGEMENT AGENCY

IRON COUNTY, UT

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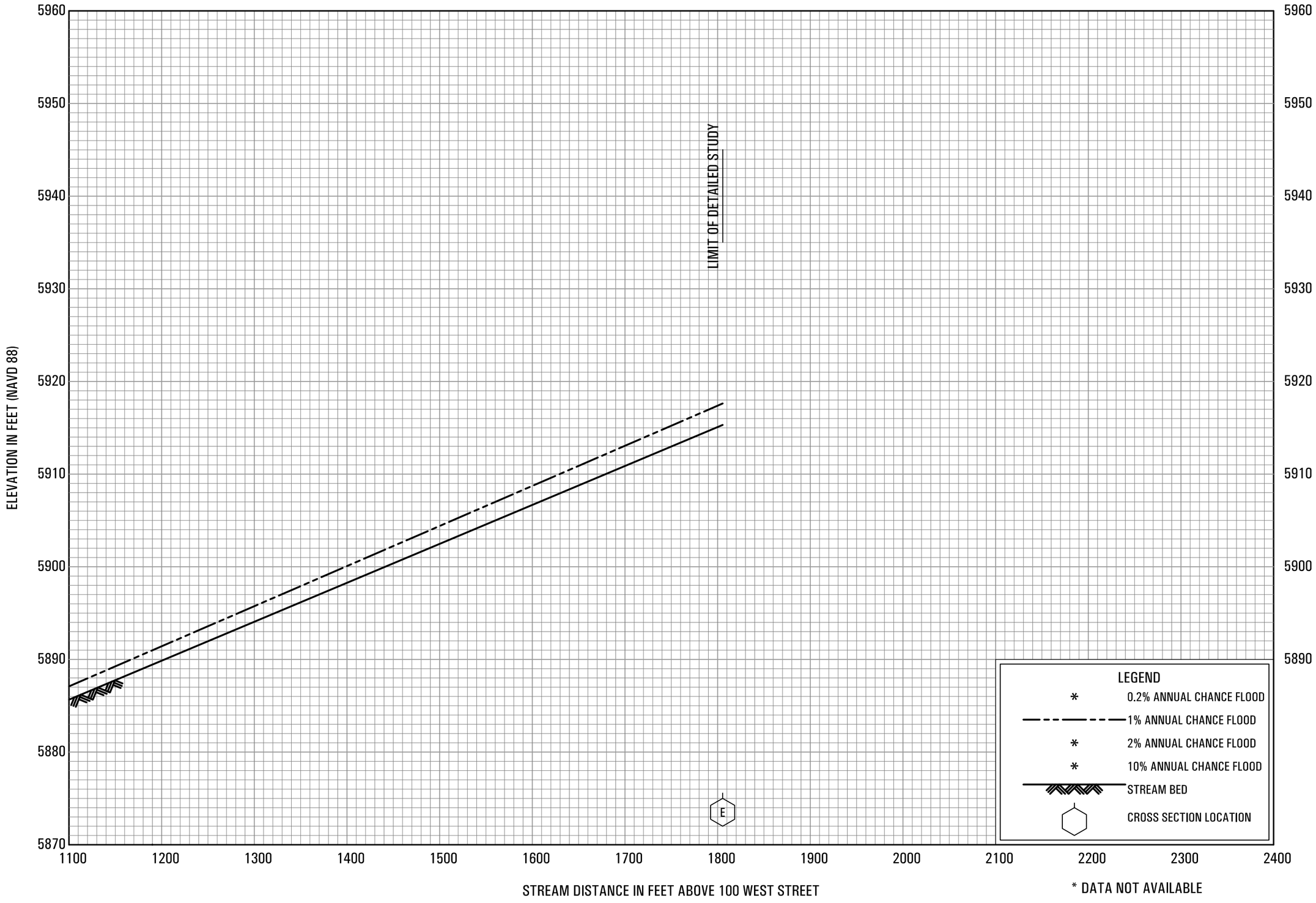

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FLOOD PROFILES

WATER CANYON

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IRON COUNTY, UT

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