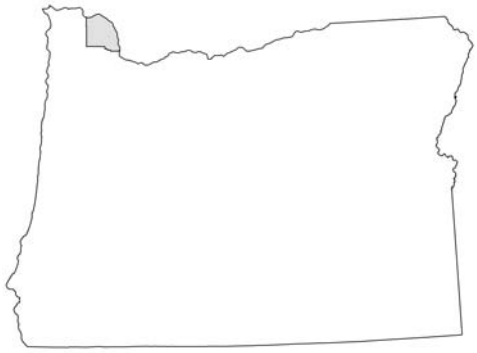
FLOOD INSURANCE STUDY

COLUMBIA COUNTY, OREGON AND INCORPORATED AREAS VOLUME 1 OF 1



COMMUNITY NAME	COMMUNITY NUMBER
CLATSKANIE, CITY OF	410035
COLUMBIA CITY, CITY OF	410036
COLUMBIA COUNTY UNINCORPORATED AREAS	410034
PRESCOTT, CITY OF	410037
RAINIER, CITY OF	410038
SCAPPOOSE, CITY OF	410039
ST. HELENS, CITY OF	410040
VERNONIA, CITY OF	410041

Effective: November 26, 2010

Federal Emergency Management Agency

Flood Insurance Study Number
41009CV000A

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 (FIS) report may not contain all data available within the Community Map Repository. Please contact the Community Map 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 (shaded)
C	X (unshaded)

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

This FIS report was revised on November 26, 2010. User should refer to Section 10.0, Revision Descriptions, for further information. Section 10.0 is intended to present the most up-to-date information for specific portions of this FIS report. Therefore, users of this FIS report should be aware that the information presented in Section 10.0 supersedes information in Sections 1.0 through 9.0 of this FIS report.

Initial Countywide FIS Effective Date: November 26, 2010

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PUBLISHED SEPARATELY

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Flood Insurance Rate Map

FLOOD INSURANCE STUDY
COLUMBIA COUNTY, OREGON UNINCORPORATED 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 Columbia County, including the Cities of Clatskanie, Columbia City, Prescott, Rainier, Scappoose, St. Helens, and Vernonia; and the unincorporated areas of Columbia County (referred to collectively herein as Columbia 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 that will be used to establish actuarial flood insurance rates and to assist the community in its 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.

1.2 Authority and Acknowledgments

The sources of authority for this Flood Insurance Study 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 the U.S. Army Corps of Engineers (USACE), Portland District, for the Federal Emergency Management Agency (FEMA), under Inter-Agency Agreement No. EMW-E-1153, Project Order No. 1, Amendment No. 3. This work, which was completed in January 1986, covered all significant flooding sources affecting the studied areas. The USACE performed a restudy of Scappoose Creek in January 1987 and of Rock Creek and the Nehalem River within the City of Vernonia in 2008.

The update to the countywide study was performed by WEST Consultants, Inc. for the Federal Emergency Management Agency (FEMA) under Contract No. EMS-2001-CO-0068. Work on the update was completed in August 2009.

The digital base mapping information was provided by the Oregon Geospatial Enterprise Office (http://www.oregon.gov/DAS/EISPD/GEO/index.shtml), Oregon Parks and Recreation Department (http://www.oregon.gov/OPRD/), and the United

States Fish and Wildlife Service Portland Office, 911 NE 11th Avenue, Portland, OR 97232-4181. This information was compiled from Oregon Water Resources Department (2006), OR/WA Bureau of Land Management (2000), U.S. Fish and Wildlife Service (2008), Oregon Parks and Recreation Department (2008), Oregon Department of Forestry (2003), PNW Hydrography Framework (2005), National Geodetic Survey (2007), the U.S. Census Bureau (2007), and the U.S. Department of Agriculture Farm Service Agency (2005) at a scale of 1:24,000. The coordinate system used for the production of the FIRM is Universal Transverse Mercator, North American Datum of 1983, Geodetic Reference System 1980. Differences in the datum and spheroid used in the production of FIRMs for adjacent counties may result in slight positional differences in map features at the county boundaries. These differences do not affect the accuracy of information shown on this FIRM.

1.3 Coordination

The dates of the initial, intermediate, and final Consultation Coordination Officer (CCO) meetings held for the previous FIS reports for Columbia County and the incorporated communities within its boundaries are shown in Table 1, "Initial, Intermediate, and Final CCO Meetings". They were attended by representatives of FEMA, the communities, and the study contractor.

Table 1. Initial, Intermediate, and Final CCO Meetings

Community	Initial CCO Date	Intermediate CCO Date	Final CCO Date
Clatskanie, City of	February 22-23,1983	February 1, 1985	December 17-18, 1985
Columbia City, City of	February 22-23,1983	---[1]	September 5, 1986
Columbia County, Unincorporated Areas	February 22-23,1983	May 1, 1986	August 25, 1986
Prescott, City of	February 22-23,1983	---[1]	September 4, 1986
Rainier, City of	February 22-23,1983		September 4, 1986
Scappoose, City of	February 22-23,1983	February 1, 1985	August 25, 1986
St. Helens, City of	February 22-23,1983	July 22, 1985	December 17-18, 1985
Vernonia, City of	February 22-23,1983	May 28, 1985	August 18, 1986

[1]Information not available

The initial coordination meetings were held and attended by representatives of FEMA, county and city officials, and the USACE (the study contractor). The purpose of the initial meetings was to inform the county of its status in the NFIP, to gather all available pertinent data regarding flooding in the county, and to reach an agreement on the areas to be studied.

Final community coordination meetings were held and attended by representatives of Columbia County, incorporated communities, FEMA, and the study contractor.

Except for objections to the Scappoose Creek analysis (which was subsequently restudied) no problems were raised at the meetings.

DFIRM Update

An initial community coordination meeting for Columbia County was held on March 2, 2006. This meeting was attended by representatives of Columbia County; the cities of Clatskanie, Columbia City, Rainier, Scappoose, and St. Helens; FEMA and WEST Consultants, Inc. The preliminary draft of the study was reviewed by each community from whom comments regarding problems were requested. All comments and issues raised have been addressed in this study. A final CCO meeting was offered, but a decision was made by the communities that it was not necessary.

2.0 AREA STUDIED

2.1 Scope of Study

This FIS report covers the geographic area of Columbia County, Oregon, including the incorporated communities listed in Section 1.1.

The flooding sources studied by detailed methods were selected with priority given to all known flood hazards and areas of projected development or proposed construction through January 1991. This study also incorporates a reanalysis of Scappoose Creek from River Mile (RM) 4.11 to RM 10.00 in the vicinity of the City of Scappoose, which was completed on January 1987 by the USACE. It also incorporates a reanalysis of the Nehalem River, Rock Creek, and Rock Creek Overbank within the limits of the City of Vernonia.

Table 2. Flooding Sources Studied by Detailed Methods

Flooding Source	Description of Reach Studied
Clatskanie River	From mouth to Olson Road bridge (RM 3.2, near Clatskanie)
Columbia River	From Clatsop-Columbia County boundary to the Multnomah County boundary (RM 43.9 to RM 96.1)
Conyers Creek	From mouth to RM 1.5 (located within City of Clatskanie)
McNulty Creek	Mouth to Ross Road (RM 2.6) near St. Helens
Milton Creek	Mouth at St. Helens to Brinn Road (RM 8.1) at Yankton
Multnomah Channel	Confluence with Columbia river to the Multnomah-Columbia County boundary
Nehalem River	RM 88.2 to RM 91.2 (near Vernonia)
North Scappoose Creek	Mouth to RM 1.2 (near Scappoose)

Table 2. Flooding Sources Studied by Detailed Methods (continued)

North Scappoose Creek Overflow	Confluence with Scappoose Creek to the divergence from North Scappoose Creek
Rock Creek	Mouth to RM 1.1 (at Vernonia)
Rock Creek Overbank	Confluence with Nehalem River to the divergence from Rock Creek
Scappoose Creek	Downstream of West Lane Road to Raymond Creek Road, near City of Scappoose (RM 4.2 to RM 9.9)

Approximate analyses were used to study areas having a low development potential or minimal flood hazards. Table 3 lists the flooding sources which were studied by approximate methods.

Table 3. Flooding Sources Studied by Approximate Methods

Flooding Source	Description of Reach Studied
Alder Creek	Mouth to approximately 0.1 miles upstream of 5th crossing with Alder Creek Road
Battle Creek	Mouth to approximately 1.0 mile upstream
Beaver Creek 1	From Beaver Slough confluence to Carmel Road
Beaver Creek 2	From Nehalem River confluence to approximately 7,700 feet upstream
Beaver Creek 3	From Nehalem River confluence to 850 feet upstream of Adams Road
Bishop Creek	Mouth to approximately 0.7 miles upstream of Bishop Creek Road
Brush Creek	Mouth to approximately 0.8 miles upstream
Cedar Creek	Confluence with North Scappoose Creek to approximately 0.1 miles upstream of 2nd crossing of Cedar Creek Road
Cedar Creek	Confluence with Nehalem River to approximately 0.2 miles upstream of Weed Creek Road
Clatskanie River	Limit of Detailed Study to approximately 1,700 feet downstream of Bunker Hill Road
Clear Creek	Mouth to approximately 0.6 miles upstream
Conyers Creek	Limit of Detailed Study to approximately 0.3 miles upstream
Cox Creek	Mouth to approximately 214 feet upstream of Boozer Road
Deep Creek	Mouth to approximately 1.5 miles upstream of Deep Creek Road
East Fork Nehalem River	Mouth to approximately 1.5 miles upstream of Scappoose-Vernonia Highway
Endicott Creek	Mouth to approximately 0.5 miles upstream
Fishhawk Creek	Confluence with Nehalem River to Clatsop County Line and Clatsop County Line near Fishhawk Road to Clatsop County Line
Ford Creek	Mouth to approximately 1.0 miles upstream
Girt Creek	Mouth to approximately 0.3 miles downstream of Lentz Road
Goble Creek	Limit of Study on Columbia River to approximately 2.0 miles upstream of Holbrook Road
Honeyman Creek	US Highway 30 to approximately 0.4 miles upstream of Oester Road
Jackson Creek	Santosh Slough to Sattler Drive
Jim George Creek	Mouth to approximately 0.4 miles upstream

Table 3. Flooding Sources Studied by Approximate Methods (continued)

Kenusky Creek	Mouth to approximately 0.8 miles upstream
Little Clatskanie River	Mouth to approximately 0.3 miles upstream
Lizzie Creek	Mouth to approximately 1.2 miles upstream
Lost Creek 1	Beaver Creek confluence to approximately 1,700 feet upstream of Pond Lane
Lost Creek 2	Grit Creek confluence to 3,000 feet upstream of Lentz Road
Lundgren Creek	Mouth to approximately 3,200 feet upstream
McBride Creek	Limit of Study on Columbia River to approximately 0.4 miles upstream
McNulty Creek	Limit of Detailed Study to approximately 0.6 miles upstream of Bennett Road
Milton Creek	Limit of Detailed Study to approximately 1.3 miles upstream of Fays Lane
Nehalem River	Clatsop County Line to Limit of Detailed Study near City of Vernonia northern city limit and from Limit of Detailed Study near City of Vernonia southern city limit to Washington County Line
Flooding Sources	Description of Reach Studied
North Fork Fishhawk Creek	Mouth to approximately 0.7 miles upstream
North Scappoose Creek	Limit of Detailed Study to approximately 0.4 miles upstream of Kingsley Road
Oak Ranch Creek	Mouth to approximately 1.4 miles upstream
Raymond Creek	Limit of Study to approximately 1.2 miles upstream
Rinearson Slough	Railroad to Lewis and Clark Bridge
Rock Creek	Limit of Detailed Study to approximately 2.3 miles upstream of Keasey Road
Salmon Creek	Mouth to approximately 0.9 miles upstream of Brinn Road
Santosh Slough	Mouth to approximately 1.3 miles upstream
South Fork Beaver Creek	Mouth to Apiary Road
South Fork Goble Creek	Mouth to Highland Road
South Scappoose Creek	Limit of Detailed Study to approximately 0.6 miles upstream of Otto Miller Road
Tide Creek	Limit of Study on Columbia River to approximately 0.2 miles upstream of Clark Road

2.2 Community Description

Columbia County is located in northwest Oregon. It is bounded by the Columbia River and the State of Washington on the north and east, by Multnomah County on the southeast, by Washington County on the south, and by Clatsop County on the west. Except for lowlands along the Columbia River and relatively short, narrow valleys along the lower reaches of the streams flowing into the Columbia River, most of the terrain of Columbia County is hilly to mountainous, with the Pacific Coast Range running along the western boundary. The highest point in the county is Clatskanie Mountain, southwest of the City of Clatskanie, at an elevation of 2,053 feet.

The county was established on January 16, 1854. Verifiable facts regarding the early history of Columbia County are few, but it is known that a British warship, commanded by Lt. William Broughton, arrived on a summer day in 1792; its crew was comprised of the first white men to see the timber-lined shores of Columbia County. The county seat is located in the City of St. Helens, approximately 22 miles northwest of Portland. The population of Columbia County in 1984 was 36,000 (Reference 1) and was estimated to be 49,408 in 2008 (Reference 2). The county covers 687 square miles and is considered a rural area because of its low population density (Reference 1).

The economic character of Columbia County is changing from an independent forest products economy to a more diversified economy, with increased ties to the commercial-industrial base of the Portland metropolitan area. Industrialization has accelerated in recent years, but dairy farming and cultivation remain important industries (Reference 1). Local manufacturers produce wood products, perfumes and cosmetics, electronic assembly wire, and pickle relish and sauerkraut. Agricultural and mineral products included livestock, dairy products, fruits, nuts, poultry, stone, sand, and gravel. In addition, the Nehalem River basin is nationally known for its fishing opportunities. Chinook and Coho salmon, and steelhead trout are fished.

The climate of the county is characterized by mild, wet winters and dry summers. Average annual precipitation ranges from approximately 45 inches at the City of St. Helens to approximately 60 inches at the City of Clatskanie, which is closer to the Pacific Coast Range. Approximately 45 percent of the precipitation occurs during the winter. Average temperatures at St. Helens range from 38 degrees Fahrenheit (°F) in January to 66°F in July (References 1 and 3).

The Columbia River forms the eastern and northern borders of Columbia County and has a drainage basin area of 254,000 square miles at the City of St. Helens (Reference 4). Multnomah Channel parallels the southeast county boundary and is one of the outlets of the Willamette River to the Columbia River. The Willamette River has a drainage basin area of 11,200 square miles (Reference 5). The county is covered by smaller drainage basins, which are the source of flows for the Clatskanie and Nehalem Rivers. The soil in the county is generally categorized as brown, moderately deep, silty clay loam over well drained gravel (Reference 6).

The Columbia County Comprehensive Plan indicates that most streams in the county experience moderate streambank erosion, sedimentation, debris accumulation, and the growth of nuisance algae or aquatic plant growth (Reference 7).

City of Clatskanie

The City of Clatskanie is located in the Lower Columbia region of Oregon, approximately 35 miles east of Astoria on Highway 30 and 60 miles northwest of Portland. The population of Clatskanie was 1,528 at the 2000 census and estimated to be 1,710 in 2007 (Reference 2). The area surrounding the City of Clatskanie was settled in 1852 and was first called Bryantville. Clatskanie was shown on the official

post office list as early as 1871, and was incorporated in 1893. The name is of Native American origin and refers to a route that the Clatskanie Indians took to a meeting place. Early development centered on logging and river commerce. Benson rafts, developed in Clatskanie, were constructed by tying logs into large cigar-shaped rafts up to 1,000 feet long, and were used for transport to California.

City of Scappoose

The City of Scappoose is located along US Highway 30 approximately 18 miles northwest of Portland. The population of the City of Scappoose was 4,976 at the 2000 census (Reference 2). The date of settlement of the City of Scappoose is not known, but the first post office was established in 1872 at Johns Landing and was moved to its present location in 1886. The City was incorporated in 1921. Scappoose is of Native American origin and means gravelly plain. The name is appropriate since an aggregate operation north of Scappoose is one of the most productive sites in the Portland metropolitan area.

City of St. Helens

The City of St. Helens is located along US Highway 30 approximately 2 miles south of Columbia City and 23 miles northwest of Portland. The population of the City of St. Helens was 10,019 at the 2000 census (Reference 2). The City of St. Helens was founded in 1844 and was first called New Plymouth, based on a prominent rock that was used as a wharf. Later, it was called Kasenan, in reference to Chief Cassino. In 1850, it was renamed St. Helens because of the proximity of Mount. St. Helens. It was incorporated in 1889.

City of Vernonia

The City of Vernonia is located on the Nehalem River, approximately 34 miles northwest of Portland. The area surrounding the City of Vernonia was settled in 1876, and the city was incorporated in 1891. The city was named for the daughter of the first schoolteacher, Ozias Cherrington. The city grew slowly until the development in 1924 of the then-largest all-electric sawmill in the United States by the Oregon American Lumber Company.

City of Rainier

The City of Rainier is located along US Highway 30 and the Columbia River, approximately 40 miles northwest of Portland. In 2000 the population was 1,687 (Reference 2).

2.3 Principal Flood Problems

The flood history of Columbia County indicates that there are two distinct periods of flooding: winter, when rainstorms cause usually rapid but short rises on the streams within Columbia County; and late spring, when snowmelt from the upper Columbia

basin causes a slow but prolonged rise on the Columbia River along the northern and eastern boundaries of the county. During particularly severe winter storms, flooding usually occurs on many streams throughout the study area. Flooding is caused by heavy rainfall augmented by snowfall at a time when the soil is near saturation. Damaging floods may occur any time between late October and late April. The most severe floods occur in December, January, and February.

Fairly high amounts of rainfall and the impermeability of the underlying geologic strata produce substantial runoff over much of the county. Runoff in various basins differs considerably. Runoff is greater in some basins because clear-cut logging or forest fires have reduced the forest cover. In addition, steeper valley slopes and higher elevations along the basin rim can induce more rainfall.

Some flooding in Columbia County is caused by log jams. Log jams usually occur on the smaller streams in upland areas, where the stream gradient is steep. Flooding from log jams, however, is usually not a serious problem in developed areas.

The largest floods in Columbia County during the past 60 years occurred in 1948, 1964, 1972, 1974, 1996, and 2007. The June 1948 flood along the Columbia River resulted from spring snowmelt in the upper Columbia Basin, had a recurrence interval of 48 years, and was the cause of the inundation of eight drainage districts along the Columbia River in Columbia County. This flood resulted in substantial damage to the Clatskanie central business district and the St. Helens industrial port area (Reference 8). At The Dalles, Oregon, where the nearest gaging station with a reliable discharge measurement is located, this flood event produced a peak discharge of 1,101,000 cubic feet per second (cfs).

Although inundation of the industrial waterfront and port areas of St. Helens still occurs from major flooding from the Columbia River in the late spring and there is coincident flooding on Multnomah Channel, flooding along the Columbia River for the majority of the county is limited due to the relatively high and steeply sloping banks.

Some flooding occurred in 1964, 1972, and 1974 on the Nehalem River, Scappoose Creek, North Fork Scappoose Creek, the Clatskanie River, Conyers Creek, and McNulty Creek. Although no U.S. Geological Survey (USGS) gaging stations are located on these streams (except for the Nehalem River at Foss, Oregon, near RM 10.9), interviews with local residents, flood photographs, and high-water marks indicate that minor flooding occurred on all streams.

A major flood occurred on Scappoose Creek on February 1, 1987, flooding many homes in Scappoose and causing evacuation of about 20 families.

The principle flooding sources in the City of St. Helens, other than the Columbia River and Multnomah Channel, are Milton and McNulty Creeks. Because of intense, heavy rainfall in winter and early spring, flooding can occur for short periods.

According to city officials, the worst flood that occurred on Milton Creek was in December 1955, when several homes were damaged in areas adjacent to the creek. The largest recent flood on McNulty Creek occurred in December 1974; no structures located along the creek were reported to be flooded and flood damage was negligible. Flood elevations on the lower 0.2 miles of McNulty Creek are controlled by backwater from floods on the Columbia River.

The largest floods on the Clatskanie River during the last 30 years occurred in 1956, 1964, 1972, and 1974. These floods, however, caused only minimal property damage and created an inconvenience due to overtopped roads and bridges. The only damaging flood occurred in 1948, when the Columbia River backwater on the Clatskanie River overtopped three downstream drainage districts and flooded part of the Clatskanie central business district near the Nehalem Street Bridge. Completion of upstream reservoirs on the Columbia River during the past 56 years has greatly reduced the flooding potential on in Clatskanie from this source. However, flooding elevations on the lower portions of the Clatskanie River are still controlled by backwater from Columbia River floods. Flooding on Conyers Creek is not well documented and problems are minimal because the floodplain is used mainly for agriculture.

Flooding on the Nehalem River has been severe, with several homes near Vernonia inundated by the 1964, 1972, 1974, 1996, and 2007 floodwaters. Recent major floods occurred on the Nehalem River on February 7-9, 1996 and December 2-4, 2007. Both the 1996 and 2007 flood events resulted from snowmelt, a 12 to 24 hour period of intense rainfall, and strong southerly winds. The USGS gage station 14301000 (Nehalem River near Foss, OR) recorded a maximum discharge of 70,300 cfs on February 8, 1996 and a peak discharge of 52,300 cfs on December 3, 2007. USGS gage station 14299800 (Nehalem River near Vernonia, OR) recorded a peak discharge of 17,600 cfs on December 3, 2007. The West Oregon Electric Cooperative, Inc. office building located in Vernonia, Oregon had approximately 39 inches of flood water during the 1996 flood and 53 inches after the 2007 flood (Reference 9).

2.4 Flood Protection Measures

The Columbia River flood-control system consists of a series of 22 major flood-control-storage reservoirs in both the United States and Canada, upstream of the Willamette River, with a total food-control-storage volume of approximately 40 million acre-feet (Reference 10).

In addition, there are 11 major flood-control reservoirs in the Willamette River Basin with approximately 1.7 million acre-feet of flood storage (Reference 11). Mossy Rock Reservoir on the Cowlitz River also contributes 360,000 acre-feet of flood-control storage (Reference 12). Therefore, the combined total flood storage available upstream of the City of Rainier is approximately 42.1 million acre-feet.

Because major flooding on Multnomah Channel is a direct result of floodflows on

the Columbia and Willamette Rivers, protection from, and prevention of floods is governed by upstream flood-control measures on these streams.

The drainage districts along the Columbia River in the unincorporated areas of Columbia County have levees of varying flood protective capabilities. Thus, safe water levels have been established by the USACE (Reference 13). The safe water level is the highest flood elevation, considering surveillance and minor remedial work, for which reasonable assurance can be given that a levee system will not fail. The determination of the levee safe water level was based on the need for freeboard, structural deficiencies observed in the field, knowledge of levee and foundation materials, and flood-height records. Ten drainage districts along the Columbia River in Columbia County were found to be flooded by the 1-percent-annual-chance flood event, whereas the drainage districts of Sauvie Island, Scappoose, Beaver, Rainier, Midland, and part of John Drainage District are expected to withstand a 1-percent-annual-chance flood event, given proper surveillance and maintenance.

Although the perimeter levee of a particular drainage district may be capable of withstanding large floods, major rainstorms could cause extensive interior ponding in low areas if runoff exceeds the capacity of the dewatering-drainage pumps. A levee system at Clatskanie, which extends into the unincorporated area on the north bank of the Clatskanie River, is owned jointly by the City and private interests. Some commercial and agricultural development and a lumber yard are protected by this levee system. There is a 0.8-mile-long levee system tied into the Burlington Northern Railroad Bridge at RM 0.8, which extends upstream to the Nehalem Street Bridge at RM 1.6. Results of the hydraulic study indicated that a 1-percent-annual-chance flood on the Clatskanie River would overtop this levee near RM 1.6.

The Sauvie Island Improvement District is the only accredited levee system in Columbia County. The remaining thirteen levee systems are currently undergoing accreditation. During the interim, the levees are considered provisionally accredited according to the agreement between FEMA and Columbia County dated July 18, 2007.

Nonstructural measures (comprehensive land use plans, flood hazard zoning ordinances, and building permits) are being used to aid in the prevention of future flood damage. The County Comprehensive Plan and zoning ordinances (enacted June 1983 and updated August 1984) follow the FEMA guidelines for controlling development within the 1-percent-annual-chance floodplain. The County ordinance states that all new structures must be built 1.5 feet above the 1-percent-annual-chance flood elevation (Reference 7). The County requires building permits, and reviews those permits to see if the provisions of the flood hazard zoning ordinance have been met. This ensures that sites are reasonably safe from flooding. The County also processes building permits from commercial structures in the incorporated communities, except in Scappoose and St. Helens.

In the City of Scappoose, a flood hazard zoning ordinance was enacted in April 1983 and controls development within the 1-percent-annual-chance floodplain. That

ordinance was part of the Comprehensive Plan enacted by the City on the same date. Scappoose requires building permits, and reviews those permits to see that provisions of the flood hazard zoning ordinance are followed. This ensures that sites are reasonably safe from flooding.

In the City of St. Helens, a zoning ordinance was enacted in October 1978, and follows the FEMA guidelines for controlling development within the 1-percent-annual-chance floodplain by stating that all new structures must be built 1.0 foot above the 1-percent-annual-chance flood elevation or, if commercial or industrial, built to be watertight and waterproof within the floodplain. St. Helens also requires building permits, and reviews those permits to see that provisions of the flood hazard ordinance have been met. This ensures that sites are reasonably safe from flooding.

There is only one stream gaging station in the Nehalem River basin, at RM 10.9 on the main stem of Nehalem River near Foss, Oregon. The discharges for the Nehalem River and Rock Creek were developed by a correlation method based on a basinwide standard project flood (SPF) study completed in 1975 by the USACE, Portland District. The Forecasts for precipitation are available from the National Weather Service. Flood warning and stage forecasting for the Columbia River are proved by the National Weather Service River Forecast Center in Portland, Oregon. These warnings and forecasts are disseminated through the Portland Weather Service Forecast Office.

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 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-annual-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 chance annual 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 the peak discharge-frequency relationships for each flooding source studied by detailed methods affecting the

community, except the Columbia River.

There are no stream gage stations on the Clatskanie River, Conyers Creek, McNulty Creek, Scappoose Creek, or Lost Creek. The frequency discharges for these streams were developed using the USGS regional analyses (Reference 14). The frequency discharges developed by this procedure were checked by a Myers enveloping curve which was prepared for the 1-percent-annual-chance event in northwestern Oregon.

The hydrologic analyses for Milton Creek were performed by the U.S. Soil Conservation Service (SCS). Because there are no stream gages on Milton Creek, the SCS developed discharge frequency curves for nine stream gages in surrounding drainage areas in northwestern Oregon and southwestern Washington using the standard log-Pearson Type III statistical procedure, as described in the U.S. Water Resources Council's Bulletin 17B (Reference 15). Regression equations of peak discharge versus drainage area were developed for several storm frequencies using the discharge-frequency relationship for the nine gages (Reference 16).

SPF was determined through a rainfall-runoff analysis of the Nehalem River basin using the SSARR Watershed Model as the modeling tool. The SPF was developed at several locations within the basin as part of the modeling procedure. The discharge-frequency relationship at the Foss stream gage station was determined by statistical methods from observed streamflow data based on U.S. Water Resources Council guidelines (Reference 15). Discharge-frequency data at other locations in the basin were based on the relationship at Foss and the relative magnitude of the SPF throughout the basin. If the SPF was known at location A, the following equation was used to translate a specific discharge (Q Freq) at Foss to another location in the basin:

$$\frac{Q_{Freq}}{SPF}\text{(Foss)} = \frac{Q_{Freq}}{SPF}\text{(Location A)}$$

For this study, the specific location of interest is the Nehalem River near the City of Vernonia, both just upstream and downstream of Rock Creek (RM 90.7). The SPF was not developed for the upstream reach by the SSARR model. The SPF on the Nehalem River below Coon Creek (RM 89.6), however, was delineated in the model.

The procedure for this analysis was to estimate an SPF peak discharge for the Nehalem River and Rock Creek at Vernonia by a drainage area correlation with the Nehalem River below Coon Creek, then translate the discharge-frequency relationship on the Nehalem River at Foss to the Nehalem River at Vernonia with the equation shown above.

For the 2008 Flood Hazard Study (FHS) of Vernonia, Oregon, the USACE, Portland District performed a flood frequency study to relate the magnitude of discharges in the Nehalem River and Rock Creek to a probability of occurrence or exceedance. A HEC-HMS version 3.0.1 rainfall-runoff-routing model was calibrated to the

December 2007 flood event as recorded by the USGS gage No. 14299800 on the upper Nehalem River. NOAA Atlas 2 isopluvial maps of depth-duration-frequency rainfall were utilized to define the 0.002, 0.01, 0.02, and 0.1 annual exceedance probability (AEP) precipitation hyetographs. These hyetographs were applied to the calibrated HEC-HMS model and peak flows were computed (Reference 17).

Peak discharge-drainage area relationships for flooding sources studied in detail in Columbia County are shown in Table 4, Summary of Discharges.

Analyses were carried out to establish the peak elevation-frequency relationships for the Columbia River. The stage-discharge relationship for the Columbia River near Columbia County is influenced by ocean tides. Thus, flood frequencies are more reliably determined for stages than for discharges and combined probability stage-frequency curves were developed for multiple locations on the Columbia River, including four within the reach of Columbia County: RM 50, RM 60, RM 68 at Cowlitz River, and RM 87 at St. Helens. These curves were based on the statistical combination of stage-frequency curves for fall-winter floods and spring-summer floods and used to produce combined probability stage-frequency water-surface profiles (Reference 18). Those profiles were prepared for the Multnomah County, Oregon and Clark County, Washington Flood Insurance Studies (References 5 and 19). Columbia River discharges were estimated, then used in the USACE HEC-2 step-backwater computer program (Reference 20), which was calibrated to reproduce the above-mentioned Columbia River flood profiles. Multnomah Channel discharges were derived by a trial-and-error correction process using the USACE HEC-2 computer program model of Columbia River – Multnomah Channel – Willamette River (to the junction of Multnomah Channel).

Elevations for floods of the selected recurrence intervals on the Columbia River are shown in Table 5, Summary of Elevations.

Table 4. Summary of Discharges

Flooding Source and Location	Drainage Area (Square Miles)	Peak Discharges (cfs) 10-percent-annual-chance	2-percent-annual-chance	1-percent-annual-chance	0.2-percent-annual-chance
Clatskanie River					
At Confluence with Beaver Slough	94.3	5,560	8,380	9,700	13,000
Downstream of Confluence of Fall Creek	93.5	5,520	8,320	9,630	12,800
Upstream of Confluence of Fall Creek	90.2	5,350	8,060	9,330	12,500
Downstream of Confluence of Conyers Creek	89.3	5,300	7,980	9,240	12,400
Upstream of Confluence of Conyers Creek	77.4	4,670	7,040	8,150	11,000
At Olson Road	76.8	4,650	7,000	8,100	10,800
Conyers Creek					
At Confluence with Clatskanie River	11.9	900	1,360	1,570	2,100
Downstream of Confluence of Unnamed Tributary	11.2	860	1,290	1,490	1,980
Upstream of Confluence of Unnamed Tributary	9.8	760	1,140	1,320	1,800
At Upstream Study Limits	8.7	690	1,030	1,200	1,590
McNulty Creek					
At Mouth	8.3	440	690	810	1,130
Downstream of Confluence of Unnamed Tributary	7.6	420	660	770	1,050
Upstream of Confluence of Unnamed Tributary	6.7	390	600	710	960
At Ross Road	6.3	370	570	670	930
Milton Creek					
At Mouth	32	3,220	4,090	4,400	5,020
At Pittsburg Road	--[1]	2,070	2,630	2,830	3,230

--[1] Data Not Available

Table 4. Summary of Discharges

Flooding Source and Location	Drainage Area (Square Miles)	Peak Discharges (cfs) 10-percent-annual-chance	2-percent-annual-chance	1-percent-annual-chance	0.2-percent-annual-chance
Nehalem River					
Downstream of Confluence with Coon Creek	185	14,920	25,430	31,037	47, 523
Downstream of Confluence with Rock Creek Overflow	160	13,068	22,345	27,585	42,631
Downstream of Confluence of Rock Creek	160	13,068	22,307	26,174	34,332
Upstream of Confluence of Rock Creek	70	7,822	13,417	16,462	25,245
Rock Creek					
Rock Creek at City of Vernonia boundary	63	5,246	8,928	11,123	17,386
Scappoose Creek					
At West Lane Road	60.2	3,470	5,270	6,120	8,300
At Confluence of North Scappoose Creek	28.2	1,930	2,900	3,360	4,450
At Raymond Creek Road	22.5	1,660	2,480	2,870	3,800
North Scappoose Creek					
At Confluence with Scappoose Creek	32.0	1,990	3,020	3,510	4,800
Upstream Limits of Detailed Study	31.1	1,940	2,950	3,420	4,650

Table 5. Summary of Elevation

Flooding Source and Location	Drainage Area	Elevation (Feet NAVD 88) 10-percent-annual-chance	2-percent-annual-chance	1-percent-annual-chance	0.2-percent-annual-chance
Columbia River					
Near the City of St. Helens (RM 87)	254,000	21.9	25.2	26.4	29.0
Near the City of Rainier (RM 68)	256,700	17.4	19.5	20.4	22.7
Near downstream end of Walker Island (RM 60)	256,700	15.6	17.2	18.0	19.7
Near the City of Clatskanie (RM 50)	256,900	13.8	15.1	15.7	17.0

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of flooding from the sources studied were carried out to provide estimates of flood elevations for 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 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.

Hydraulic analyses for all streams studied by detailed methods, except Milton Creek, were performed using the USACE HEC-2 step-backwater computer program (Reference 20). Columbia River flood profiles for selected recurrence intervals were plotted directly from the combined stage-frequency curves previously described. Hydraulic analyses of Milton Creek were performed by the SCS using the WSP2 computer program (Reference 21). The USACE HEC-2 program was used to prepare Multnomah Channel flood profiles, which connect corresponding Columbia and Willamette River combined probability flood profiles downstream and upstream of Sauvie Island.

The Columbia River and Multnomah Channel cross sections were based on USACE condition surveys, dated 1974 and 1976, measured by hydrographic survey methods and topographic maps (References 22 and 23). Cross sections for Milton Creek were field surveyed by the SCS in 1982.

Cross sections for all other streams came from a composite of channel data obtained from the USACE field surveys and overbank data taken from topographic maps (Reference 24 and 25). All bridges were field checked to obtain elevation data and structural geometry.

Locations of selected cross sections used in the hydraulic analyses are shown on the

Flood Profiles (Exhibit 1). For stream segments where a floodway was computed (Section 4.2), selected cross section locations are also shown on the FIRM.

Hydraulic roughness values (Manning's "n") for detailed study streams were first estimated from field observations. The "n" values were then adjusted to match high-water marks where available. The range of Manning's "n" values for detailed streams is as follows:

Table 6. Range of Manning's Roughness Values

Stream	Channel	Overbank
Clatskanie River	0.035	0.040 - 0.100
Columbia River	0.026 – 0.032	0.050 - 0.10
Conyers Creek	0.070	0.100 - 0.141
McNulty Creek	0.030 – 0.150	0.150 - 0.154
Milton Creek	0.030 – 0.125	0.035 - 0.085
Nehalem River	0.040 – 0.060	0.080 - 0.120
Rock Creek	0.35 – 0.04	0.08 - 0.9
Scappoose Creek	0.035 – 0.085	0.035 - 0.25
North Scappoose Creek	0.050 – 0.080	0.140

For all streams studied in detail, except the Columbia River, the starting water-surface elevations were obtained using the normal-depth routine of the USACE HEC-2 computer program (Reference 20).

Starting water-surface elevations for the Columbia River flood profiles were chosen to match the appropriate combined probability stage-frequency curve at the Clatsop-Columbia County boundary.

The hydraulic analyses for North Fork Scappoose Creek were complicated by the fact that the stream is perched. Floodflows greater than the 10-percent-annual-chance flood would overtop the right bank and flow independently to Scappoose Creek. Hence, the 2-, 1-, and 0.2-percent-annual-chance flood discharges are larger at the upstream study limits (RM 1.17) than the downstream study limits (RM 0.0), despite the additional contributing floodflows from the downstream drainage areas. The flow in the right overbank area is shallow sheet flooding, with flood depths averaging 1.0 foot.

After the February 1, 1987 flooding on Scappoose Creek, High Water Marks (HWM) were obtained by the USACE and compared to a restudy of Scappoose Creek. With one exception, they were all within approximately 0.2 foot of the revised 1- percent-annual-chance water-surface profile (WSP). The February 1, 1987 HWM were used to calibrate the hydraulic analysis of South Scappoose Creek.

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.

In 2008 the USACE one-dimensional, open channel, step-backwater program HEC-RAS 3.1.3 was used to calculate water surface elevations along the Nehalem River and Rock Creek within the Corporate Boundary of the City of Vernonia. Cross section geometry was a composite of data from the August 1988 effective modeling and new survey data in areas where new flow paths were observed during flooding in December 2007. The resulting model was calibrated to HWM data collected following the December 2007 flooding and run with the flows of selected recurrence intervals determined by the hydrologic analysis. A coincident peak assumption was applied at the confluence of the Nehalem River and Rock Creek for the model runs. The calibrated model was used to compute flood elevation profiles and inundation extents for the 1- and 0.2-percent-annual-chance floods (Reference 17).

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 (NVGD 29). With the completion of the North American Vertical Datum of 1988 (NAVD 88), many FIS reports and FIRMs are now prepared using NAVD 88 as the referenced vertical datum.

Flood elevations shown in this FIS report and on the FIRMs 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 and NAVD, visit the National Geodetic Survey (NGS) 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
135 East-West Highway
Silver Spring, Maryland 20910-3282
(302) 713-3242
(301) 713-4172 (fax)

The conversion factor from NGVD 29 to NAVD 88 for all flooding sources in Columbia County is +3.42 feet.

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 the FIRMs for this community. Interested individuals may contact FEMA to access these data.

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

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-percent-annual-chance and 0.2-percent-annual-chance floodplains; 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 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 at scales of 1:60,000 with a contour interval of 5 feet; 1:24,000 with contour intervals of 10 feet and 4 feet; and 1:48,000 with a contour interval of 4 feet (References 22, 23, 24, and 25).

The 1- and 0.2-percent-annual-chance floodplain boundaries are shown on the FIRMs. On these maps, 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.

The approximate floodplain boundaries along all streams except Lost Creek were

taken directly from the Flood Hazard Boundary Map for Columbia County, Oregon (Reference 26). The floodplain boundaries for Lost Creek were developed using the topographic maps cited previously.

Countywide Update

As part of the update, floodplain boundaries for McNulty Creek, Milton Creek and portions of the Columbia River were redelineated using contour data provided by the City of St. Helens. The data consisted of topographic mapping with a vertical contour interval of two feet (Reference 27). The data were derived from aerial photography flown in 1995 and revised in 2001 for areas that experienced additional development.

As part of the update, floodplain boundaries were digitized from the effective FIRM panels. Aerial photography (Reference 28) was used to adjust floodplain and floodway boundaries where appropriate.

LOMRs 07-10-0169P and 93-10-042P were incorporated into the FIRM. LOMR 07-10-0169P adjusted cross section locations on McNulty Creek within the City of St. Helens. LOMR 93-10-042P revised the area protected by levee from the 1-percent-annual-chance flood on the Columbia River.

In accordance with FEMA Procedure Memorandum 36 (Reference 29), profile baselines have been included in all areas of detailed study. Profile baselines are shown in the location of the original stream centerline or original profile baseline without regard to the adjusted floodplain position on the new base map. This was done to maintain the relationship of distances between cross sections along the profile baseline between hydraulic models, flood profiles, and floodway data tables.

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 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. 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 7, 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 floodway on the Columbia River between RM 56 and RM 77.8 was previously calculated for the Flood Insurance Studies for the City of Kelso, Washington; the City of Longview, Washington; and Cowlitz County, Washington and was used for this FIS with a few modifications, including establishment of side channels at Crims Island and Sandy Island, and recognition of dredged material deposited along the Rainier waterfront during the Mt. St. Helens emergency (References 12, 30, and 31).

Floodways were not computed on the Columbia River downstream of RM 56, on Conyers Creek, on Milton Creek from RM 0.0 to RM 1.8 and from RM 3.0 to RM 8.1, or on Multnomah Channel downstream of RM 6.9.

Coincident peaks and model geometry with combined Nehalem River and Rock Creek were utilized for the Floodway Analysis. The existing floodway widths were initially entered and determined to be inadequate. A method 4 analysis with a target of 0.3 ft provided a basis for analysis that was refined with method 1 to produce a maximum rise of 1.0 ft at all cross sections. No floodway encroachments were modeled inside of the channel banks (Reference 17).

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 1-percent-annual-chance 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.

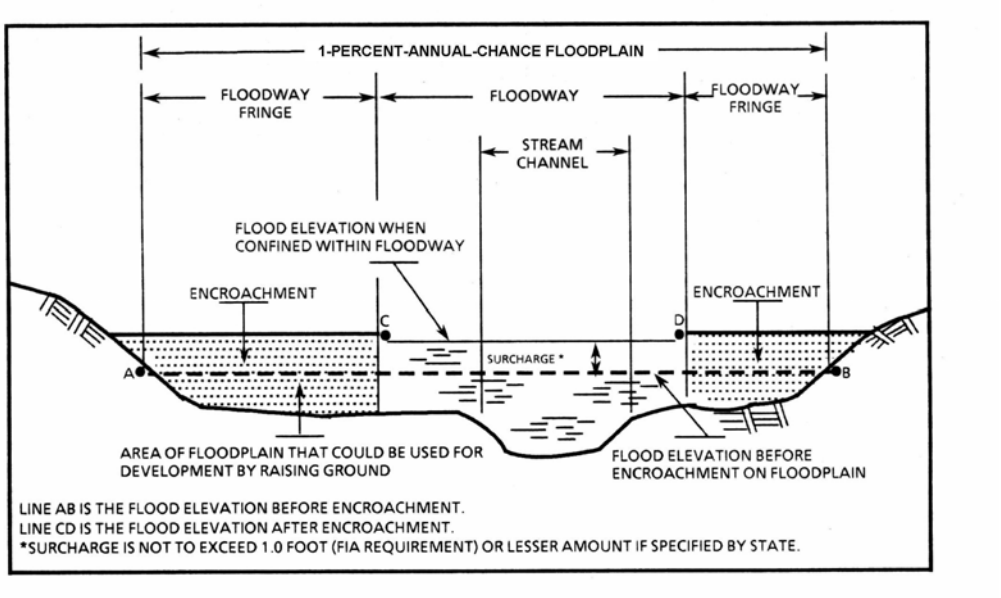

Figure 1. Floodway Schematic

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET/SEC)	REGULATORY (FEET NAVD)	WITHOUT FLOODWAY (FEET NAVD)	WITH FLOODWAY (FEET NAVD)	INCREASE (FEET)
Clatskanie River								
A	0.12	136	1,708	5.7	15.7	9.9[2]	10.3[2]	0.4
B	0.78	218	2,008	4.8	15.7	12.8[2]	13.0[2]	0.2
C	1.05	148	1,628	5.7	15.7	13.8[2]	14.0[2]	0.2
D	1.30	135	1,694	5.5	15.7	14.8[2]	14.9[2]	0.1
E	1.57	112	1,385	6.7	15.8	15.8	15.9	0.1
F	1.79	400	2,665	3.5	17.7	17.7	17.8	0.1
G	1.94	275	2,155	4.3	18.0	18.0	18.4	0.4
H	2.03	135	1,698	5.4	18.2	18.2	18.7	0.5
I	2.14	195	1,872	4.4	19.7	19.7	19.9	0.2
J	2.32	345	2,982	2.7	19.8	19.8	20.5	0.7
K	2.51	512	3,729	2.2	20.1	20.1	20.8	0.7
L	2.72	690	4,912	1.7	20.4	20.5	21.2	0.7
M	2.93	500	3,631	2.2	20.5	20.5	21.3	0.8
N	3.16	99	1,404	5.8	20.7	20.7	21.7	1.0
O	3.19	105	1,448	5.6	21.1	21.1	21.8	0.7

[1] Miles above confluence with Beaver Slough [2]Elevation computed without consideration of backwater from Columbia River

TABLE 7

FEDERAL EMERGENCY MANAGEMENT AGENCY

COLUMBIA COUNTY, OR
AND INCORPORATED AREAS

FLOODWAY DATA

CLATSKANIE RIVER

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH[2] (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET/SEC)	REGULATORY (FEET NAVD)	WITHOUT FLOODWAY (FEET NAVD)	WITH FLOODWAY (FEET NAVD)	INCREASE (FEET)
Columbia River								
A	56.00	3,520 / 2,630	159,582	4.5	16.9	16.9	17.5	0.6
B	56.76	5,090 / 4,530	208,398	4.1	17.1	17.1	17.7	0.6
C	57.38	3,300 / 2,450	150,147	4.8	17.2	17.2	17.8	0.6
D	58.00	3,450 / 2,300	162,809	5.2	17.3	17.3	17.9	0.6
E	58.38	3,690 / 1,680	165,873	5.1	17.5	17.5	18.1	0.6
F	58.85	2,620 / 1,590	131,759	5.6	17.6	17.6	18.2	0.6
G	59.57	2,240 / 1,890	120,604	6.1	17.9	17.9	18.4	0.5
H	60.36	3,850 / 1,100	155,587	4.8	18.2	18.2	18.9	0.7
I	62.40	2,440 / 1,300	122,804	5.7	18.8	18.8	19.5	0.7
J	64.25	2,880 / 1,690	151,168	5.6	19.4	19.4	20.1	0.7
K	66.10	2,558 / 1,250	142,896	5.9	19.8	19.8	20.6	0.8
L	67.19	2,558 / 1,310	140,837	6.0	20.1	20.1	21.0	0.9
M	67.75	2,850 / 1,170	151,988	5.6	20.3	20.3	21.3	1.0
N	68.00	3,450 / 1,180	148,010	5.7	20.3	20.3	21.3	1.0
O	68.80	2,380 / 1,200	129,633	5.4	20.8	20.8	21.7	0.9
P	70.17	2,850 / 1,200	136,851	5.1	21.3	21.3	22.2	0.9
Q	71.93	2,700 / 920	152,989	5.4	21.8	21.8	22.7	0.9
R	72.66	2,157 / 740	137,571	6.0	22.0	22.0	22.9	0.9
S	73.57	3,170 / 1,900	172,734	4.7	22.5	22.5	23.4	0.9
T	74.19	3,800 / 2,930	199,080	4.1	22.7	22.7	23.5	0.8
U	74.76	3,300 / 1,640	177,780	4.7	22.8	22.8	23.6	0.8
V	75.57	3,910 / 3,300	189,057	4.3	23.1	23.1	23.9	0.8
W	76.28	4,110 / 2,120	183,256	4.5	23.3	23.3	24.2	0.9
X	76.95	2,860 / 1,820	159,934	5.1	23.4	23.4	24.2	0.8
Y	77.76	2,440 / 1,610	136,070	6.0	23.6	23.6	24.4	0.8
Z	78.33	2,280 / 1,325	142,746	5.7	23.8	23.8	24.6	0.8

[1] Miles above mouth [2] Width / width within Columbia County

TABLE 7

FEDERAL EMERGENCY MANAGEMENT AGENCY

COLUMBIA COUNTY, OR AND INCORPORATED AREAS

FLOODWAY DATA

COLUMBIA RIVER

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH[2] (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET/SEC)	REGULATORY (FEET NAVD)	WITHOUT FLOODWAY (FEET NAVD)	WITH FLOODWAY (FEET NAVD)	INCREASE (FEET)
Columbia River								
AA	78.91	2,730 / 1,900	153,976	5.3	24.1	24.1	24.9	0.8
AB	79.67	3,780 / 1,830	179,054	4.6	24.5	24.5	25.2	0.7
AC	80.38	3,275 / 1,100	161,490	5.1	24.6	24.6	25.3	0.7
AD	80.87	2,730 / 1,220	145,256	5.6	24.7	24.7	25.4	0.7
AE	81.47	2,920 / 1,500	147,068	5.6	24.9	24.9	25.7	0.8
AF	81.97	3,070 / 1,520	159,836	5.1	25.0	25.0	25.9	0.9
AG	82.44	3,130 / 1,380	168,986	4.9	25.2	25.2	26.2	1.0
AH	82.94	2,900 / 1,640	161,186	5.1	25.3	25.3	26.3	1.0
AI	83.43	2,640 / 1,400	149,511	5.5	25.4	25.4	26.4	1.0
AJ	83.83	3,220 / 1,220	169,770	4.8	25.6	25.6	26.6	1.0
AK	84.20	2,765 / 1,390	146,674	5.6	25.7	25.7	26.6	0.9
AL	84.62	3,000 / 2,070	151,134	5.4	25.9	25.9	26.8	0.9
AM	85.21	2,800 / 2,000	155,124	5.3	26.1	26.1	27.1	1.0
AN	85.72	3,460 / 2,338[3]	174,275	4.7	26.2	26.2	27.2	1.0
AO	86.27	3,650 / 2,040	189,553	4.3	26.4	26.4	27.4	1.0
AP	86.79	4,100 / 1,950	156,134	4.8	26.5	26.5	27.5	1.0
AQ	87.29	4,700 / 2,140	158,438	4.7	26.5	26.5	27.5	1.0
AR	87.52	5,000 / 2,400	188,152	4.0	26.8	26.8	27.8	1.0
AS	88.75	3,800 / 1,265[3]	148,987	5.0	27.0	27.0	28.0	1.0
AT	89.43	3,500 / 945[4]	159,074	4.7	27.2	27.2	28.2	1.0
AU	90.23	3,930 / 1,090	167,183	4.4	27.4	27.4	28.4	1.0
AV	91.00	4,800 / 2,668[4]	169,233	4.4	27.6	27.6	28.6	1.0
AW	91.77	4,570 / 2,999[4]	177,151	4.2	27.9	27.9	28.9	1.0
AX	92.34	3,089 / 2,468[4]	155,475	4.8	27.9	27.9	28.9	1.0
AY	93.00	2,880 / 1,758[4]	159,220	4.7	28.1	28.1	29.1	1.0
AZ	94.00	3,050 / 2,274[4]	141,666	5.3	28.2	28.2	29.2	1.0

[1] Miles above mouth [2] Width / width within Columbia County
[3] Width within study area reflects political boundaries as of June 2009 [4] Includes width of levee to landward toe

TABLE 7

FEDERAL EMERGENCY MANAGEMENT AGENCY

COLUMBIA COUNTY, OR AND INCORPORATED AREAS

FLOODWAY DATA

COLUMBIA RIVER

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH[2] (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET/SEC)	REGULATORY (FEET NAVD)	WITHOUT FLOODWAY (FEET NAVD)	WITH FLOODWAY (FEET NAVD)	INCREASE (FEET)
Columbia River								
BA	95.00	2,650 / 1,476[3]	141,851	5.3	28.6	28.6	29.6	1.0
BB	96.00	3,300 / 1,480	157,503	4.8	28.9	28.9	29.9	1.0

[1] Miles above mouth [2] Width / width within Columbia County
[3] Width Within Study Area Reflects Political Boundaries as of June 2009

TABLE 7

FEDERAL EMERGENCY MANAGEMENT AGENCY

COLUMBIA COUNTY, OR
AND INCORPORATED AREAS

FLOODWAY DATA

COLUMBIA RIVER

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET/SEC)	REGULATORY (FEET NAVD)	WITHOUT FLOODWAY (FEET NAVD)	WITH FLOODWAY (FEET NAVD)	INCREASE (FEET)
McNulty Creek								
A	0.00	400	5,057	0.2	26.1	24.4[2]	25.1[2]	0.7
B	0.08	125	1,120	0.7	26.1	24.4[2]	25.1[2]	0.7
C	0.10	80	849	1.0	27.3	27.3	28.0	0.7
D	0.30	44	235	3.4	35.8	35.8	36.8	1.0
E	0.50	39	144	5.6	60.2	60.2	60.2	0.0
F	0.68	121	279	2.8	67.2	67.2	67.6	0.4
G	0.84	105	272	2.8	75.2	75.2	75.3	0.1
H	0.92	61	158	4.9	82.8	82.8	82.8	0.0
I	1.05	44	225	3.4	85.0	85.0	85.4	0.4
J	1.41	67	340	2.3	89.6	89.6	90.3	0.7
K	1.83	40	217	3.3	95.1	95.1	95.8	0.7
L	1.91	40	242	2.9	96.6	96.6	97.0	0.4
M	2.10	47	264	2.7	98.9	98.9	99.6	0.7
N	2.39	41	333	2.0	100.9	100.9	101.7	0.8
O	2.64	23	180	3.7	103.6	103.6	104.4	0.8

[1] Miles above mouth [2] Elevation computed without consideration of backwater from Columbia River

TABLE 7

FEDERAL EMERGENCY MANAGEMENT AGENCY

COLUMBIA COUNTY, OR
AND INCORPORATED AREAS

FLOODWAY DATA

MCNULTY CREEK

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET/SEC)	REGULATORY (FEET NAVD)	WITHOUT FLOODWAY (FEET NAVD)	WITH FLOODWAY (FEET NAVD)	INCREASE (FEET)
Milton Creek								
A	9,680	57	483	9.1	79.0	79.0	80.0	1.0
B	10,580	120	614	7.2	86.6	86.6	87.1	0.5
C	11,830	46	366	12.0	98.2	98.2	99.2	1.0
D	12,144	85	351	12.5	104.7	104.7	104.7	0.0
E	12,310	95	718	6.1	105.2	105.2	106.2	1.0
F	12,590	93	800	5.5	105.8	105.8	106.3	0.5
G	12,740	122	521	8.5	106.1	106.1	106.1	0.0
H	13,210	115	502	8.8	110.7	110.7	111.2	0.5
I	14,360	59	363	12.1	127.9	127.9	128.9	1.0
J	15,315	89	550	8.0	134.9	134.9	135.4	0.5
K	16,020	105	556	7.9	140.4	140.4	140.9	0.5
L	41,275	107	744	3.1	222.7	222.7	223.2	0.5
M	41,960	95	533	4.3	223.6	223.6	224.1	0.5
N	42,300	40	744	3.1	224.6	224.6	225.1	0.5

[1] Feet above confluence with Multnomah Channel

TABLE 7

FEDERAL EMERGENCY MANAGEMENT AGENCY

COLUMBIA COUNTY, OR
AND INCORPORATED AREAS

FLOODWAY DATA

MILTON CREEK

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET/SEC)	REGULATORY (FEET NAVD)	WITHOUT FLOODWAY (FEET NAVD)	WITH FLOODWAY (FEET NAVD)	INCREASE (FEET)
Multnomah Channel								
AO[2]	0.72	760 / 240[3]	37,028	3.5	26.5	26.5	27.5	1.0
A	6.88	3,333[4]	73,126	1.8	28.2	28.2	29.2	1.0
B	7.39	3,340[4]	73,447	1.8	28.2	28.2	29.2	1.0
C	9.00	5,226[4]	108,948	1.2	28.5	28.5	29.5	1.0
D	11.17	935[4]	29,109	4.5	28.6	28.6	29.6	1.0
E	12.68	800 / 185[3,4]	30,914	4.2	29.1	29.1	30.1	1.0

[1] Miles above confluence with Columbia River [2] Cross Section at mouth coincident with cross section AO of Columbia River
[3] Width / width within Columbia County [4] Includes width of levee to landward toe

TABLE 7

FEDERAL EMERGENCY MANAGEMENT AGENCY

COLUMBIA COUNTY, OR
AND INCORPORATED AREAS

FLOODWAY DATA

MULTNOMAH CHANNEL

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET/SEC)	REGULATORY (FEET NAVD)	WITHOUT FLOODWAY (FEET NAVD)	WITH FLOODWAY (FEET NAVD)	INCREASE (FEET)
Nehalem River								
A	88.24	623	3,229	6.5	604.6	604.6	605.2	0.6
B	88.42	431	3,337	8.7	605.5	605.5	606.2	0.7
C	88.61	350	2,605	8.7	607.0	607.0	607.5	0.5
D	88.81	600	2,617	7.5	608.7	608.7	608.9	0.2
E	89.06	534	2,847	7.6	609.7	609.7	610.4	0.7
F	89.24	202	3,341	9.3	610.5	610.5	611.5	1.0
G	89.28	245	3,435	8.8	610.8	610.8	611.8	1.0
H	89.56	330	3,519	7.6	613.1	613.1	613.7	0.6
I	90.00	224	3,471	8.0	615.6	615.6	616.1	0.5
J	90.25	214	3,390	8.1	616.9	616.9	617.3	0.4
K	90.46	143	2,591	10.7	617.7	617.7	618.1	0.4
L	90.59	391	3,686	6.1	619.6	619.6	620.0	0.4
M	90.63	397	3,942	6.0	619.7	619.7	620.3	0.6
N	90.76	400	2,840	4.3	620.3	620.3	620.9	0.6
O	90.79	445	3,087	4.8	620.3	620.3	620.9	0.6
P	91.06	172	1,584	8.6	620.6	620.6	621.2	0.6
Q	91.27	175	1,994	7.3	622.7	622.7	623.0	0.3

[1] Miles above mouth

TABLE 7

FEDERAL EMERGENCY MANAGEMENT AGENCY

COLUMBIA COUNTY, OR
AND INCORPORATED AREAS

FLOODWAY DATA

NEHALEM RIVER

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET/SEC)	REGULATORY (FEET NAVD)	WITHOUT FLOODWAY (FEET NAVD)	WITH FLOODWAY (FEET NAVD)	INCREASE (FEET)
North Scappoose Creek								
A	1,310	107	348	8.8	44.4	44.4	44.7	0.3
B	1,960	81	514	5.9	49.0	49.0	49.2	0.2
C	2,090	91	362	8.4	50.8	50.8	50.8	0.0
D	3,275	80	388	7.6	57.4	57.4	57.8	0.4
E	3,965	99	512	6.7	62.3	62.3	62.3	0.0
F	4,665	210	864	4.0	66.6	66.6	67.4	0.8
G	5,215	180	631	5.4	70.4	70.4	71.2	0.8
H	5,425	129	558	6.1	72.6	72.6	72.9	0.3
I	5,755	99	602	5.7	74.4	74.4	75.0	0.6
J	6,285	101	371	9.2	78.1	78.1	78.1	0.0

[1] Feet above confluence with Scappoose Creek

TABLE 7

FEDERAL EMERGENCY MANAGEMENT AGENCY

COLUMBIA COUNTY, OR
AND INCORPORATED AREAS

FLOODWAY DATA

NORTH SCAPPOOSE CREEK

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET/SEC)	REGULATORY (FEET NAVD)	WITHOUT FLOODWAY (FEET NAVD)	WITH FLOODWAY (FEET NAVD)	INCREASE (FEET)
North Scappoose Creek Overflow								
A	720	171	294	1.6	46.7	44.1[2]	45.1[2]	1.0
B	1,090	122	138	3.3	47.6	47.6	47.8	0.2
C	1,480	132	281	1.6	49.3	49.3	50.2	0.9
D	1,690	152	100	4.6	51.5	51.5	52.0	0.5
E	1,890	202	230	2.0	55.6	55.6	56.4	0.8

[1] Feet above confluence with Scappoose Creek [2] Elevation computed without consideration of backwater from Scappoose Creek

TABLE 7

FEDERAL EMERGENCY MANAGEMENT AGENCY

COLUMBIA COUNTY, OR
AND INCORPORATED AREAS

FLOODWAY DATA

NORTH SCAPPOOSE CREEK OVERFLOW

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET/SEC)	REGULATORY (FEET NAVD)[2]	WITHOUT FLOODWAY (FEET NAVD)	WITH FLOODWAY (FEET NAVD)	INCREASE (FEET)
Rock Creek								
A	0.06	492	1,842	2.0	620.4	620.4	621.0	0.6
B	0.09	500	2,888	2.5	620.4	620.4	621.0	0.6
C	0.17	500	2,548	2.5	620.5	620.5	621.1	0.6
D	0.25	494	2,148	3.1	620.5	620.5	621.1	0.6
E	0.28	443	2,022	3.6	620.6	620.6	621.5	0.9
F	0.31	387	1,757	4.3	620.6	620.6	621.4	0.8
G	0.38	500	4,049	2.4	621.1	621.1	622.0	0.9
H	0.49	500	3,630	2.4	621.2	621.2	622.0	0.8
I	0.60	500	3,642	2.7	621.2	621.2	622.1	0.9
J	0.78	416	1,462	5.0	621.2	621.2	622.1	0.9
K	0.92	500	2,948	3.3	622.2	622.2	622.9	0.7
L	1.06	372	2,686	4.1	622.5	622.5	623.1	0.6

[1] Miles above confluence with Nehalem River [2] Elevations computed including influence of Nehalem River

TABLE 7

FEDERAL EMERGENCY MANAGEMENT AGENCY

COLUMBIA COUNTY, OR
AND INCORPORATED AREAS

FLOODWAY DATA

ROCK CREEK

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET/SEC)	REGULATORY (FEET NAVD)	WITHOUT FLOODWAY (FEET NAVD)	WITH FLOODWAY (FEET NAVD)	INCREASE (FEET)
Scappoose Creek								
A	-2,881	1,160	7,352	0.8	27.4	23.2[2]	24.2[2]	1.0
B	-931	199	1,478	4.1	27.4	24.9[2]	25.9[2]	1.0
C	0	114	928	6.6	28.3	28.3	28.8	0.5
D	900	350	2,421	2.5	30.1	30.1	30.7	0.6
E	1,300	290	1,933	3.2	30.4	30.4	31.1	0.7
F	1,650	300	1,108	5.5	30.9	30.9	31.7	0.8
G	1,780	390	2,404	2.5	32.8	32.8	33.2	0.4
H	2,880	170	1,218	5.0	34.8	34.8	35.5	0.7
I	3,440	155	707	8.7	36.5	36.5	37.4	0.9
J	3,770	205	955	6.4	40.0	40.0	40.0	0.0
K	4,050	200	1,158	5.3	40.9	40.9	41.0	0.1
L	4,690	480	1,975	3.1	42.1	42.1	42.1	0.0
M	5,100	180	726	4.6	42.5	42.5	42.5	0.0
N	6,160	130	709	4.7	44.2	44.2	44.5	0.3
O	6,340	79	566	5.9	44.5	44.5	44.9	0.4
P	6,570	95	684	4.9	45.6	45.6	46.3	0.7
Q	6,760	94	767	4.4	46.2	46.2	47.0	0.8
R	7,021	100	858	3.9	47.3	47.3	47.5	0.2
S	7,581	150	1,474	2.3	47.8	47.8	48.4	0.6
T	7,785	82	810	4.1	48.3	48.3	48.8	0.5
U	8,301	164	1,341	2.5	49.2	49.2	49.4	0.2
V	8,741	220	550	6.1	49.4	49.4	49.7	0.3
W	9,756	220	1,944	1.7	50.5	50.5	51.3	0.8
X	11,156	214	1,338	2.5	51.2	51.2	52.0	0.8
Y	12,476	210	1,034	3.2	52.7	52.7	53.7	1.0
Z	14,702	100	766	4.4	56.4	56.4	57.3	0.9

[1] Feet from West Lane Road [2] Elevation computed without consideration of backwater from Columbia River

TABLE 7

FEDERAL EMERGENCY MANAGEMENT AGENCY

COLUMBIA COUNTY, OR
AND INCORPORATED AREAS

FLOODWAY DATA

SCAPPOOSE CREEK

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET/SEC)	REGULATORY (FEET NAVD)	WITHOUT FLOODWAY (FEET NAVD)	WITH FLOODWAY (FEET NAVD)	INCREASE (FEET)
Scappoose Creek								
AA	16,952	170	1,195	2.6	58.5	58.5	59.3	0.8
AB	20,752	100	734	4.2	62.6	62.6	63.4	0.8
AC	21,822	30	326	9.6	66.4	66.4	66.4	0.0
AD	22,472	230	1,460	2.0	67.1	67.1	68.0	0.9
AE	24,172	224	925	3.2	69.3	69.3	70.3	1.0
AF	25,522	200	842	3.6	73.7	73.7	74.6	0.9
AG	26,052	270	606	4.9	77.0	77.0	77.6	0.6
AH	26,722	242	611	4.9	80.8	80.8	81.2	0.4
AI	27,388	210	606	4.9	84.9	84.9	84.9	0.0
AJ	27,738	160	437	6.8	87.2	87.2	87.3	0.1
AK	28,038	231	390	7.4	89.7	89.7	90.2	0.5
AL	28,107	246	1,575	1.8	91.9	91.9	92.6	0.7

[1] Feet from West Lane Road

TABLE 7

FEDERAL EMERGENCY MANAGEMENT AGENCY

COLUMBIA COUNTY, OR
AND INCORPORATED AREAS

FLOODWAY DATA

SCAPPOOSE CREEK

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 the areas of 1-percent-annual-chance shallow flooding (usually sheet flow on sloping terrain) where average depths are between one and three 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 of 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, and areas protected from the 1-percent-annual-chance flood by levees. No BFEs or depths are shown within this zone.

Table 8 lists the flood insurance zones that each community is responsible for regulating.

Table 8. Flood Insurance Zones Within Each Community

Community	Flood Zone(s)
City of Clatskanie	A, AE, X
City of Columbia City	A, AE, X
City of Prescott	AE, X
City of Rainier	A, AE, X
City of Scappoose	A, AE, X
City of St. Helens	AE, X
City of Vernonia	A, AE, X
Columbia County	A, AE, AO, X

6.0 FLOOD INSURANCE RATE MAP

The Flood Insurance Rate Map 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-percent-annual-chance 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 Columbia County. 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 9, "Community Map History."

COMMUNITY NAME	INITIAL IDENTIFICATION	FLOOD HAZARD BOUNDARY MAP REVISION DATE(S)	FLOOD INSURANCE RATE MAP EFFECTIVE DATE	FLOOD INSURANCE RATE MAP REVISION DATE(S)
Clatskanie, City of	December 7, 1973	---	September 29, 1986	August 16, 1988
Columbia City, City of	December 21, 1973	---	June 5, 1985	August 16, 1988
Columbia County, Unincorporated Areas	January 17, 1975	---	August 23, 1977	August 16, 1988
Prescott, City of	January 10, 1975	---	August 16, 1988	---
Rainier, City of	May 24, 1974	---	October 13, 1981	August 16, 1988
Scappoose, City of	May 17, 1974	---	December 19, 1975	August 16, 1988
St. Helens, City of	November 30, 1973	---	September 29, 1986	August 16, 1988
Vernonia, City of	November 30, 1973	---	March 5, 1976	August 16, 1988

-- Data Not Available

TABLE 9

FEDERAL EMERGENCY MANAGEMENT AGENCY

COLUMBIA COUNTY, OR
AND INCORPORATED AREAS

COMMUNITY MAP HISTORY

7.0 OTHER STUDIES

The SCS prepared a floodplain management report for Milton Creek in the vicinity of the City of St. Helens (Reference 16). The water-surface profiles and flooded-area maps from that study were used in this study.

A 1980 USACE Floodplain Information Report for the Columbia River in the vicinity of the Lewis River contained data in the form of water-surface profiles, floodways, and actual floodplain areas (Reference 32). The 9-mile reach covered in the study was used in this FIS, with modifications to the floodway.

The results of a 1981 USACE Floodplain Information Report for Rock Creek were used in this study (Reference 33). A portion of the Nehalem River covered by the 1981 report was updated by the USACE in 1984 for use in this study. This was superseded by the 2008 USACE reanalysis of the Nehalem River, Rock Creek, and Rock Creek Overbank within the limits of the City of Vernonia (Reference 17).

The results of a 1973 Flood Hazard Study prepared by the USACE, Portland District, for Scappoose Creek and its two forks were noted by Scappoose residents to contain several discrepancies between data contained in the report and actual floodplain areas (Reference 34). A portion of the reaches covered in that report was updated by the USACE in December 1975 (Reference 35).

This study is based on more recent, detailed analyses for all streams than those presented in the Flood Insurance Studies for Clatsop, Multnomah, and Washington Counties, Oregon and Cowlitz and Clark Counties, Washington (References 5, 19, 31, 36, and 37). Therefore, this study does not agree with those previously published studies.

8.0 LOCATION OF DATA

Information concerning the pertinent data used in the preparation of this study can be obtained by contacting FEMA, Mitigation Division, Federal Regional Center, 130 228th Street, SW, Bothell, Washington 98021-9796.

9.0 BIBLIOGRAPHY AND REFERENCES

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17. U.S. Army Corps of Engineers, unpublished report, Portland District, Flood Elevation Study of the Nehalem River and Rock Creek within the Corporate Boundary of the City of Vernonia, 2009

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22. U.S. Army Corps of Engineers, Portland District, Columbia River Below Portland, Oregon, Topographic Planimetric Maps, Scale 1:60.000, Contour Interval 5 Feet, Drawing Numbers CL-52-1/2 to 22, 1963

23. U.S. Department of the Interior, Geological Survey, 7.5-Minute Series, Topographic Maps; Scale 1:24,000, Contour Interval 10 feet; Deer Island, Oregon-Washington (1954), Photo Revised (1970); Kalama, Oregon-Washington (1953), Photo Revised (1970); Rainier, Oregon-Washington, (1953), Photo Revised (1970); Sauvie Island, Oregon-Washington (1961), Photo Revised (1970); St. Helens, Oregon-Washington (1954) Photo Revised (1975).

24. U.S. Army Corps of Engineers, Portland District, Orthophoto Topographic Maps, Scale 1:24,000, Contour Interval 4 feet: Clatskanie River (August 4, 1981); Rock Creek (April 25, 1981); Scappoose Creek (July 3, 1971)

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32. U.S. Army Corps of Engineers, Portland District, Floodplain Information, Columbia

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35. U.S. Army Corps of Engineers, Special Flood Hazard Information, Pan Profile Sheets, Scappoose Creek, Oregon, December 1975

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10.0 REVISION DESCRIPTIONS

This section has been added to provide information regarding significant revisions made since the original FIS was printed. Future revisions may be made that do not result in the republishing of the FIS report. To assure that any user is aware of all revisions, it is advisable to contact the community repository of flood-hazard data located at the address listed below. Please refer to the Columbia County, Oregon FIRM Map Index (41009CIND0A) for other community repositories within Columbia County.

Columbia County Land Development Services
230 Strand Street
St. Helens, Oregon 97051

Table 10 summarizes the flooding sources updated since the original study was completed.

Table 10. Revised Study Descriptions

Flooding Source	Community	Limits of Study	Revision Date	Panel No.
Nehalem River	City of Vernonia	2007 Corporate Limits	February 2008	41009C0377D 41009C0384D
Rock Creek	City of Vernonia	2007 Corporate Limits	February 2008	41009C0377D 41009C0384D
Scappoose Creek	City of Scappoose and Columbia County Unincorporated Areas	Unknown	January 1987	41009C0444D 41009C0463D 41009C0465D

10.1 First Revision

The update was completed in August 2009 by WEST Consultants, Inc. for FEMA

under Contract No. EMS-2001-CO-0068.

This update combined the Flood Insurance Rate Maps for Columbia County and incorporated communities into the countywide format. Under the countywide format, FIRM panels have been produced using a single layout format for the entire area within the county instead of separate layout formats for each community. The single-layout format facilitates the matching of adjacent panels and depicts the flood-hazard area within the entire panel border, even in areas beyond a community's corporate boundary line. In addition, under the countywide format this single FIS report provides all associated information and data for the entire county area.

As part of this revision, the format of the map panels has changed. In the new format, all base flood elevations, cross sections, zone designations, and floodplain and floodway boundary delineations are shown on the FIRM. Some of the flood insurance zone designations were changed to reflect the new format. Areas previously shown as numbered Zone A were changed to Zone AE. Areas previously shown as Zone B were changed to Zone X (shaded). Areas previously shown as Zone C were changed to Zone X (unshaded). In addition, all Flood Insurance Zone Data Tables were removed from the FIS report and all zone designations and reach determinations were removed from the profile panels.

All flood elevations shown in this FIS report and on the FIRM panels were converted from NGVD 29 to NAVD 88. The conversion factor is +3.42 feet.

As part of the update, floodplain boundaries for McNulty Creek, Milton Creek and portions of the Columbia River were redelineated using contour data provided by the City of St. Helens. The data consisted of topographic mapping with a vertical contour interval of two feet (Reference 27). The data were derived from aerial photography flown in 1995 and revised in 2001 for areas that experienced additional development.

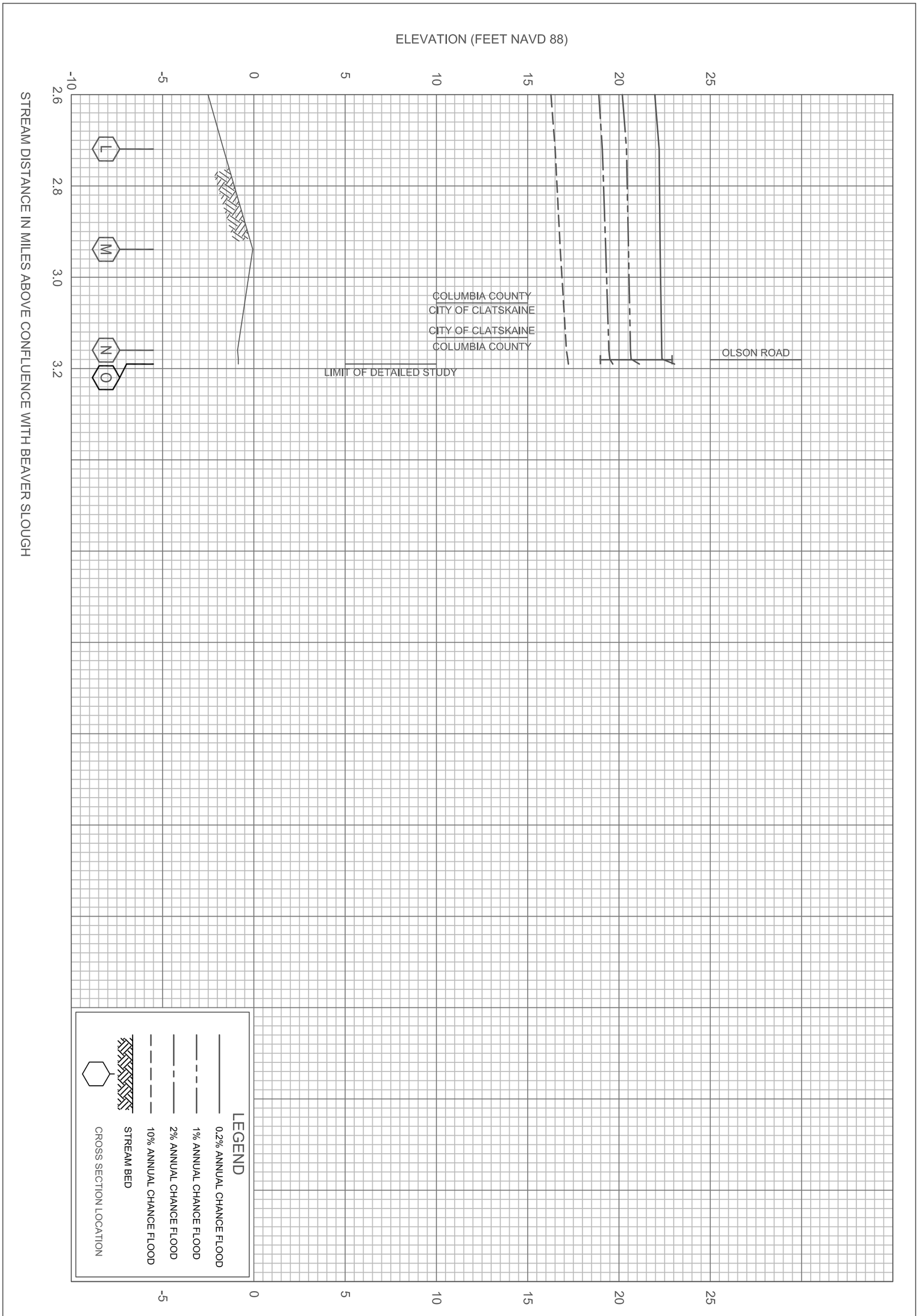
As part of the update, floodplain boundaries were digitized from the effective FIRM panels. Aerial photography (Reference 28) was used to adjust floodplain and floodway boundaries where appropriate.

For the 2008 Flood Hazard Study (FHS) of Vernonia, Oregon, the USACE, Portland District performed a flood frequency study to relate the magnitude of discharges in the Nehalem River and Rock Creek to a probability of occurrence or exceedance. A HEC-HMS version 3.0.1 rainfall-runoff-routing model was calibrated to the December 2007 flood event as recorded by the USGS gage No. 14299800 on the upper Nehalem River. NOAA Atlas 2 isopluvial maps of depth-duration-frequency rainfall were utilized to define the 0.002, 0.01, 0.02, and 0.1 annual exceedance probability (AEP) precipitation hyetographs. These hyetographs were applied to the calibrated HEC-HMS model and peak flows were computed. The USACE one-dimensional, open channel, step-backwater program HEC-RAS 3.1.3 was used to calculate water surface elevations along the Nehalem River and Rock Creek within the Corporate Boundary of the City of Vernonia. Model geometry was based on

combining the HEC-2 models developed on the Nehalem River and Rock Creek from the August 1988 effective Flood Insurance Study with new surveys to accommodate flow paths observed during flooding in December 2007. The resulting model was calibrated to HWM data collected following the December 2007 flooding and run with the flows of selected recurrence intervals determined by the hydrologic analysis. A coincident peak assumption was applied at the confluence of the Nehalem River and Rock Creek for the model runs. The calibrated model was used to compute the flood elevation profiles for all of the selected recurrence intervals as well as the inundated areas for the 1- and 0.2-percent-annual-chance floods within the corporate limits of Vernonia (Reference 17).

LOMRs 07-10-0169P and 93-10-042P were incorporated into the FIRM. LOMR 07-10-0169P adjusted cross section locations on McNulty Creek within the City of St. Helens. LOMR 93-10-042P revised the area protected by levee from the 1-percent-annual-chance flood on the Columbia River.

In accordance with FEMA Procedure Memorandum 36 (Reference 29), profile baselines have been included in all areas of detailed study. Profile baselines are shown in the location of the original stream centerline or original profile baseline without regard to the adjusted floodplain position on the new base map. This was done to maintain the relationship of distances between cross sections along the profile baseline between hydraulic models, flood profiles, and floodway data tables.



02P

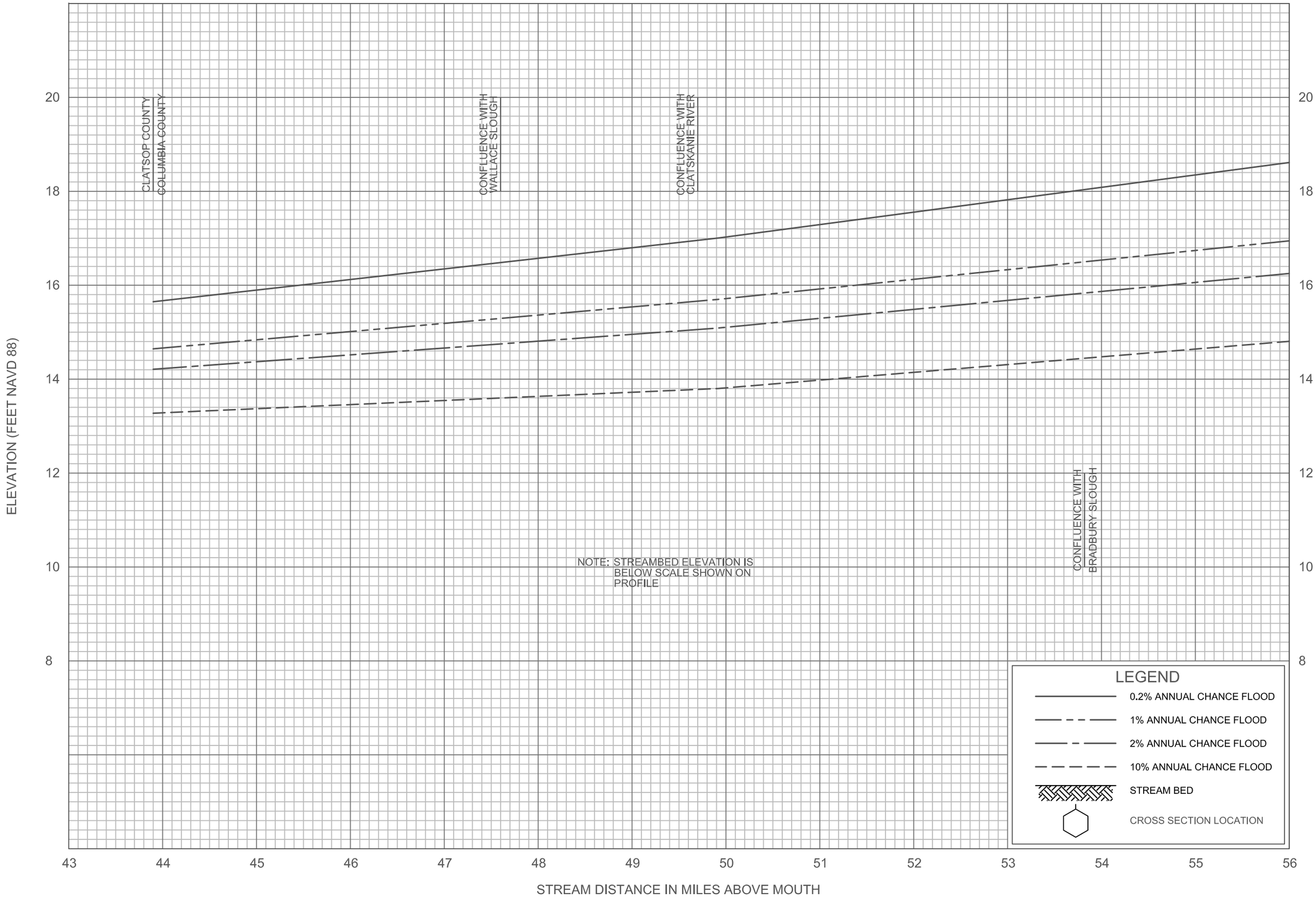
FEDERAL EMERGENCY MANAGEMENT AGENCY

COLUMBIA COUNTY, OR

AND INCORPORATED AREAS

FLOOD PROFILES

CLATSKANIE RIVER



FLOOD PROFILES

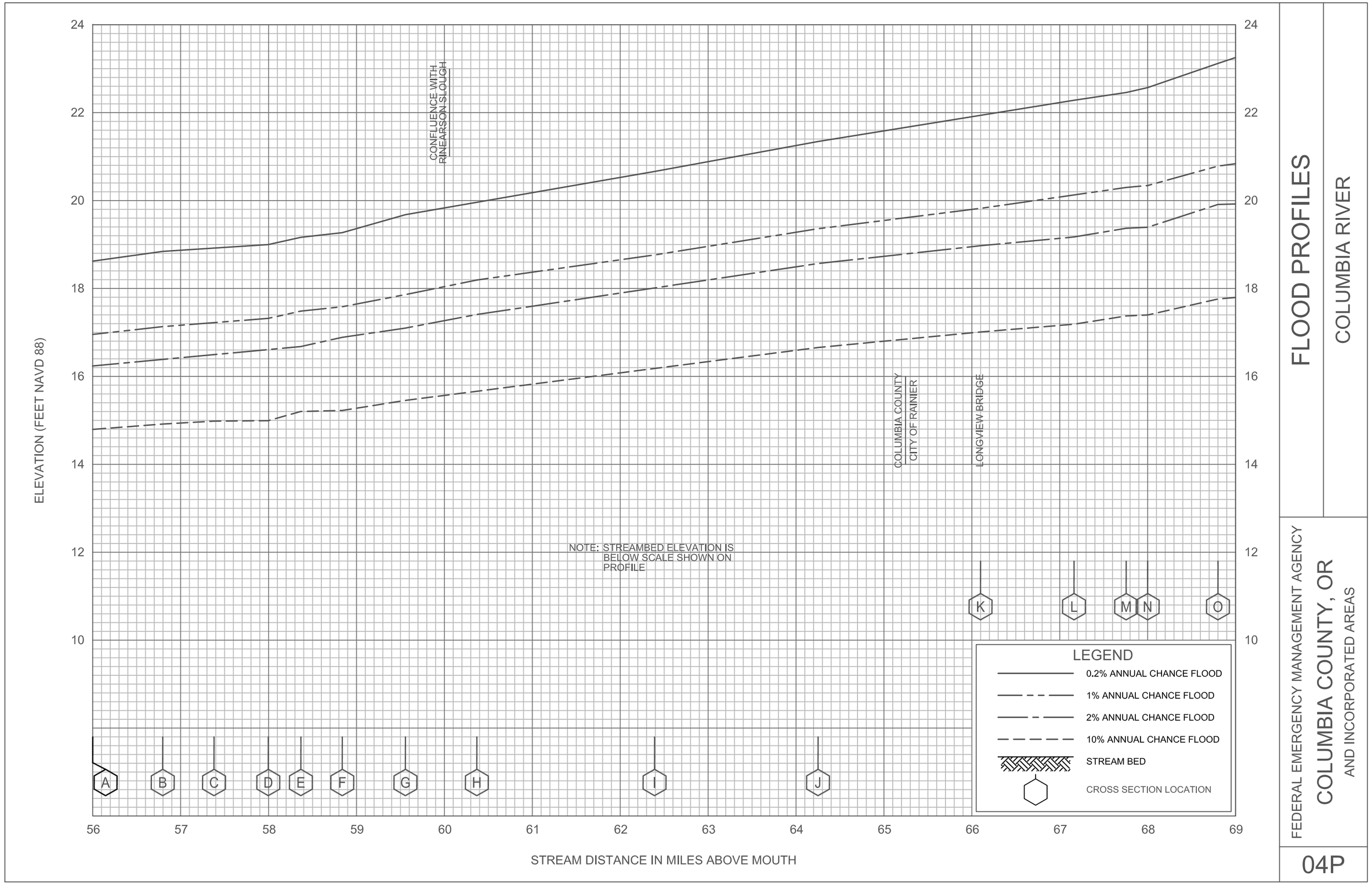
COLUMBIA RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

COLUMBIA COUNTY, OR

AND INCORPORATED AREAS

03P



FLOOD PROFILES

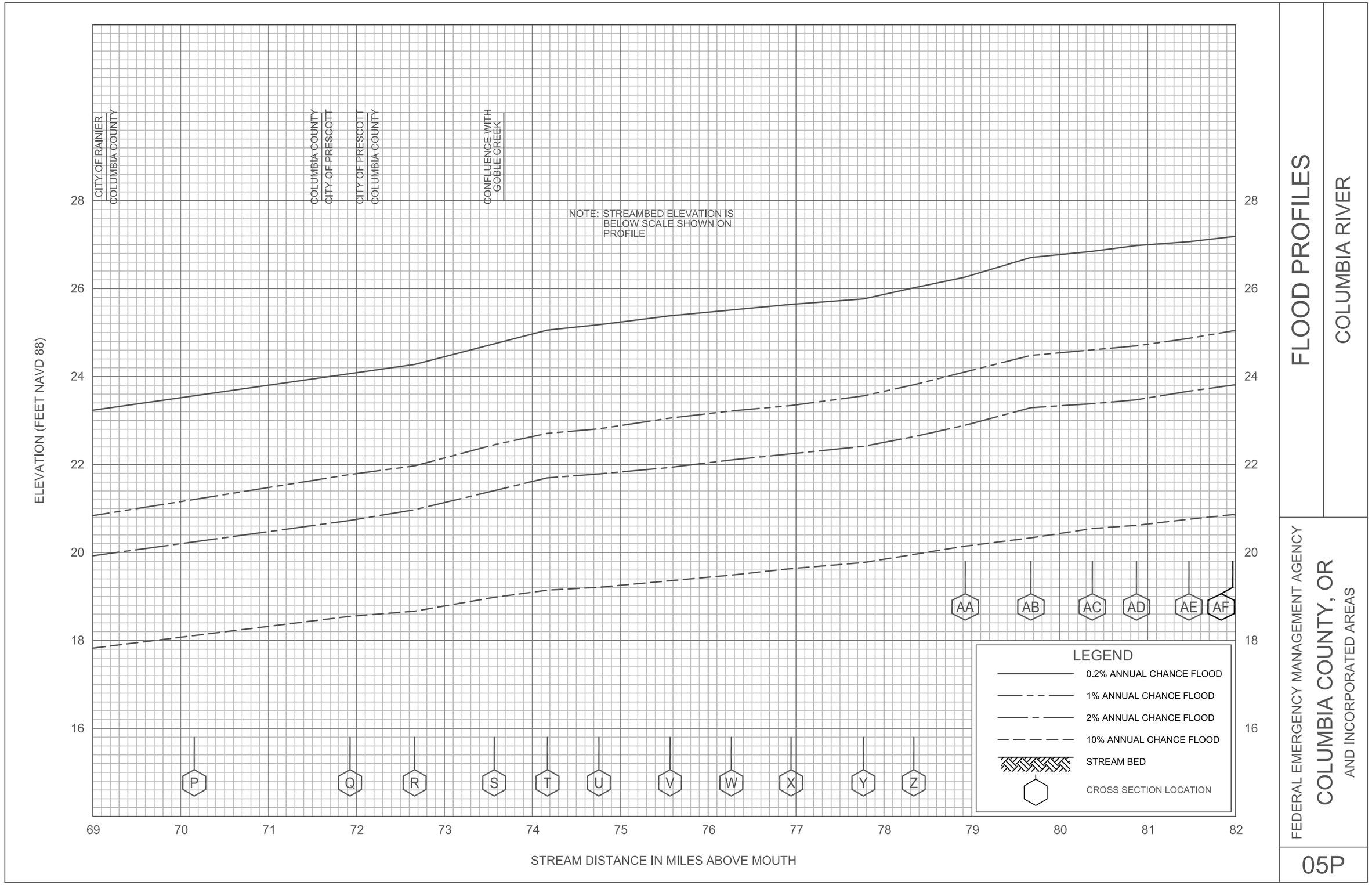
COLUMBIA RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

COLUMBIA COUNTY, OR

AND INCORPORATED AREAS

04P



FLOOD PROFILES

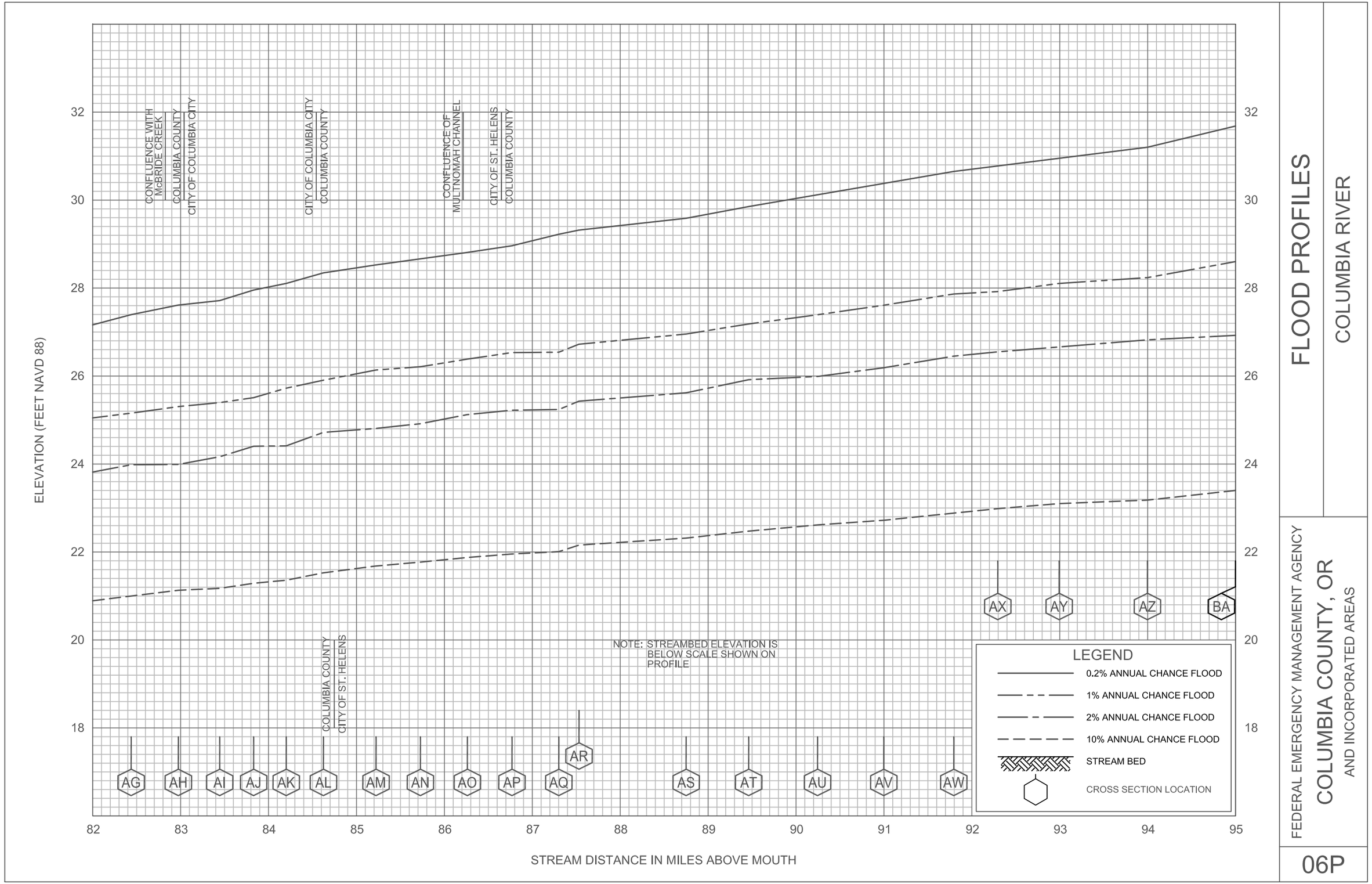
COLUMBIA RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

COLUMBIA COUNTY, OR

AND INCORPORATED AREAS

05P



FLOOD PROFILES

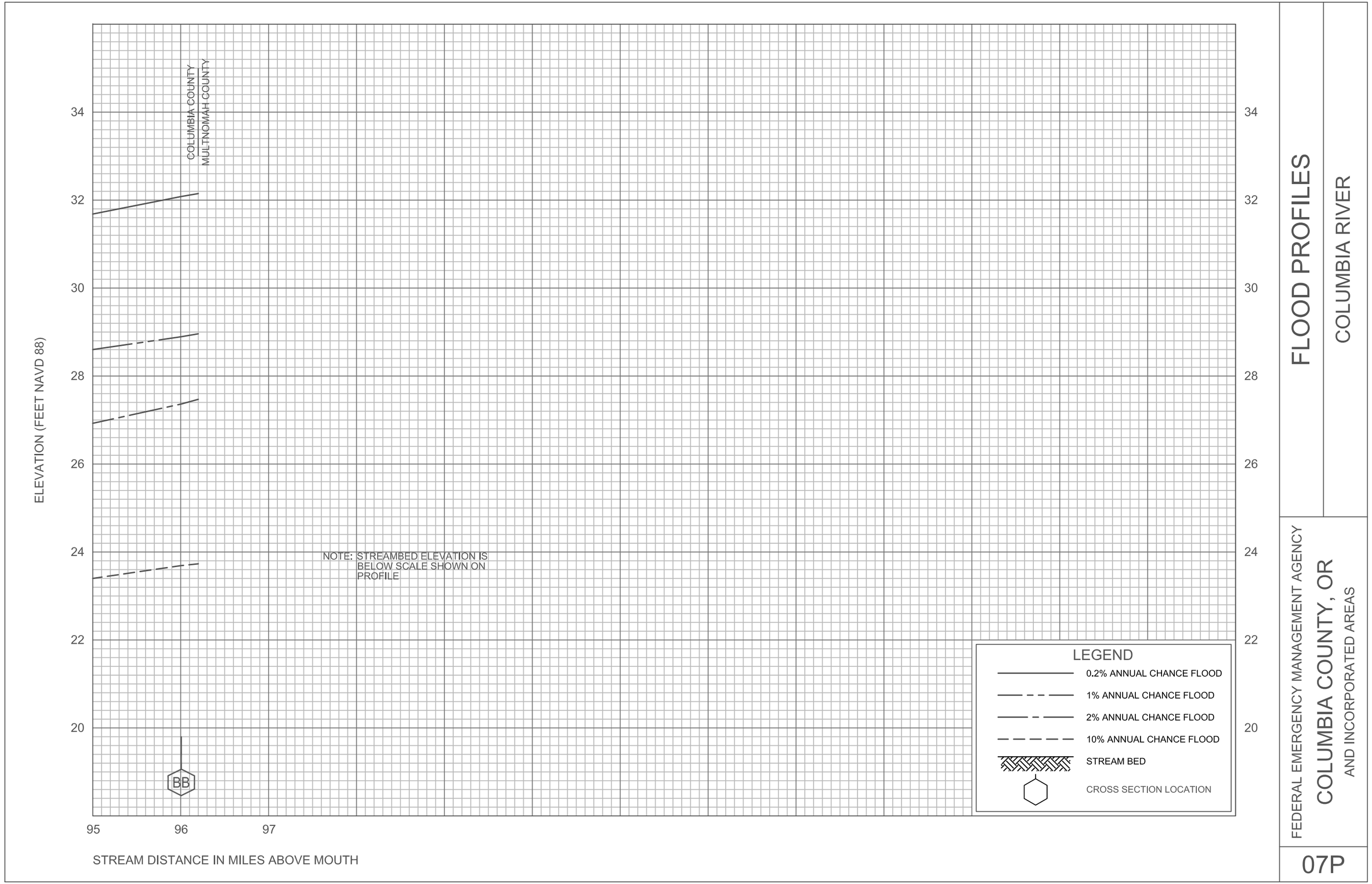
COLUMBIA RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

COLUMBIA COUNTY, OR

AND INCORPORATED AREAS

06P



FLOOD PROFILES

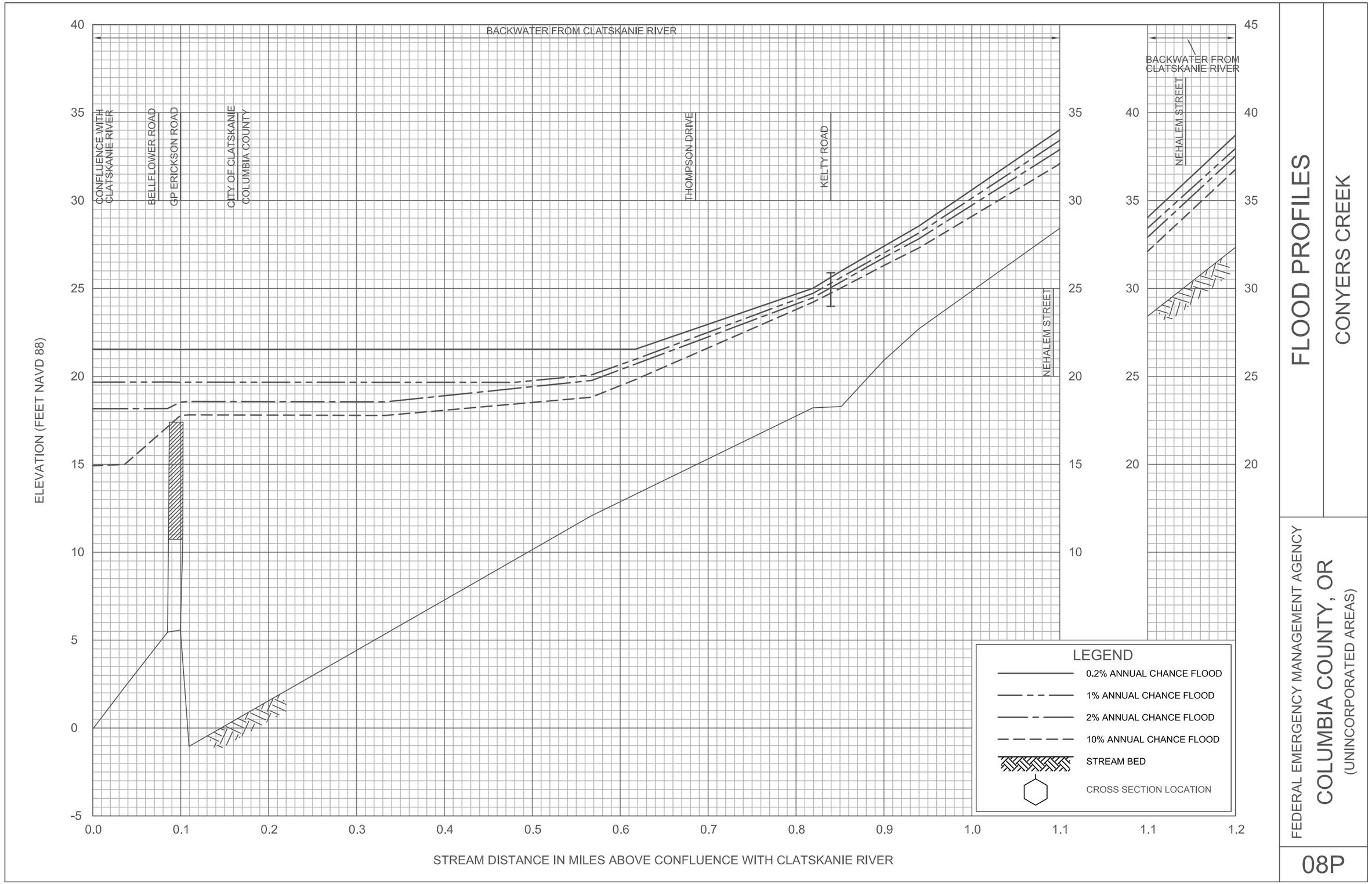
COLUMBIA RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

COLUMBIA COUNTY, OR

AND INCORPORATED AREAS

07P



FLOOD PROFILES

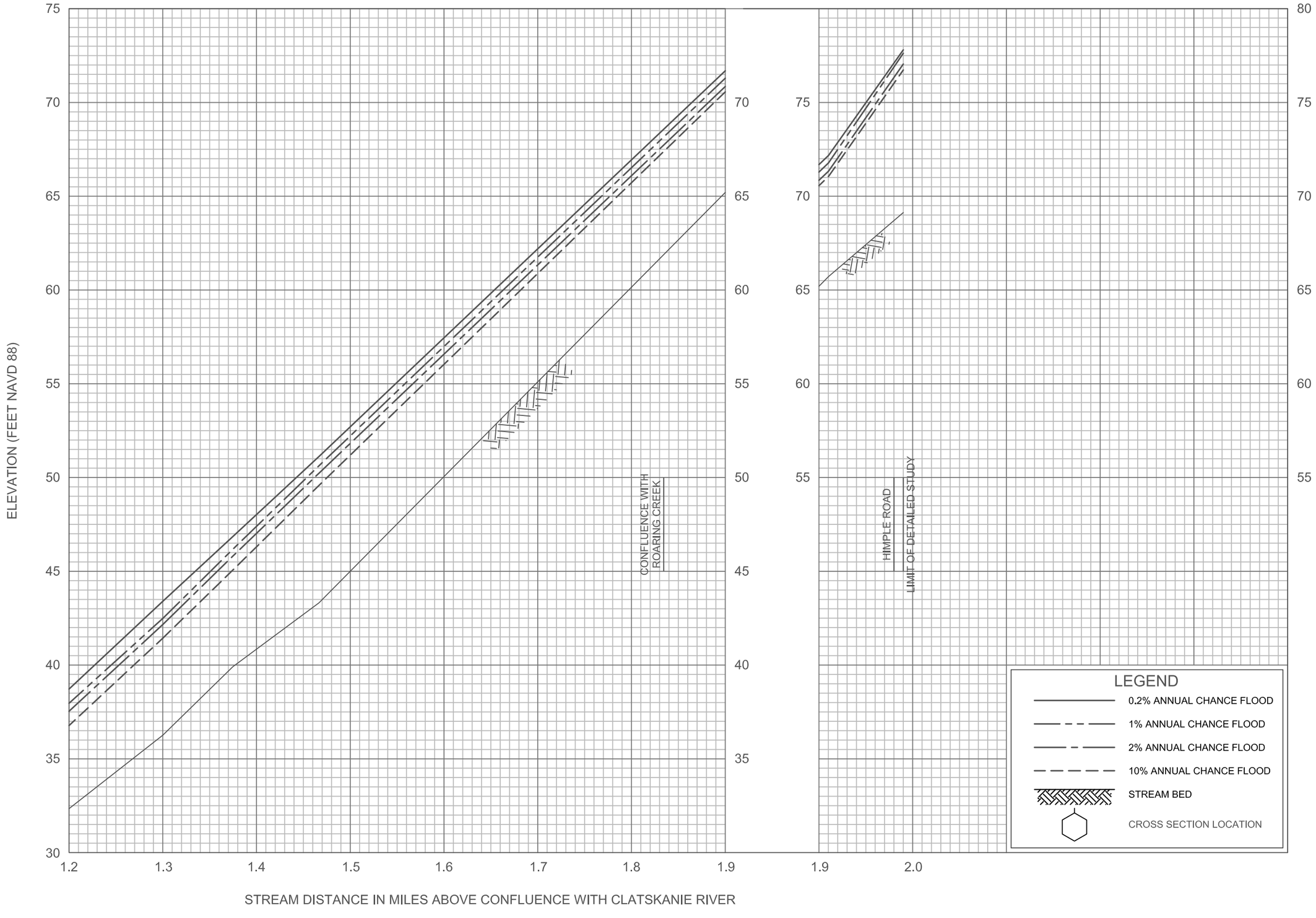
CONYERS CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

COLUMBIA COUNTY, OR

(UNINCORPORATED AREAS)

08P



FLOOD PROFILES

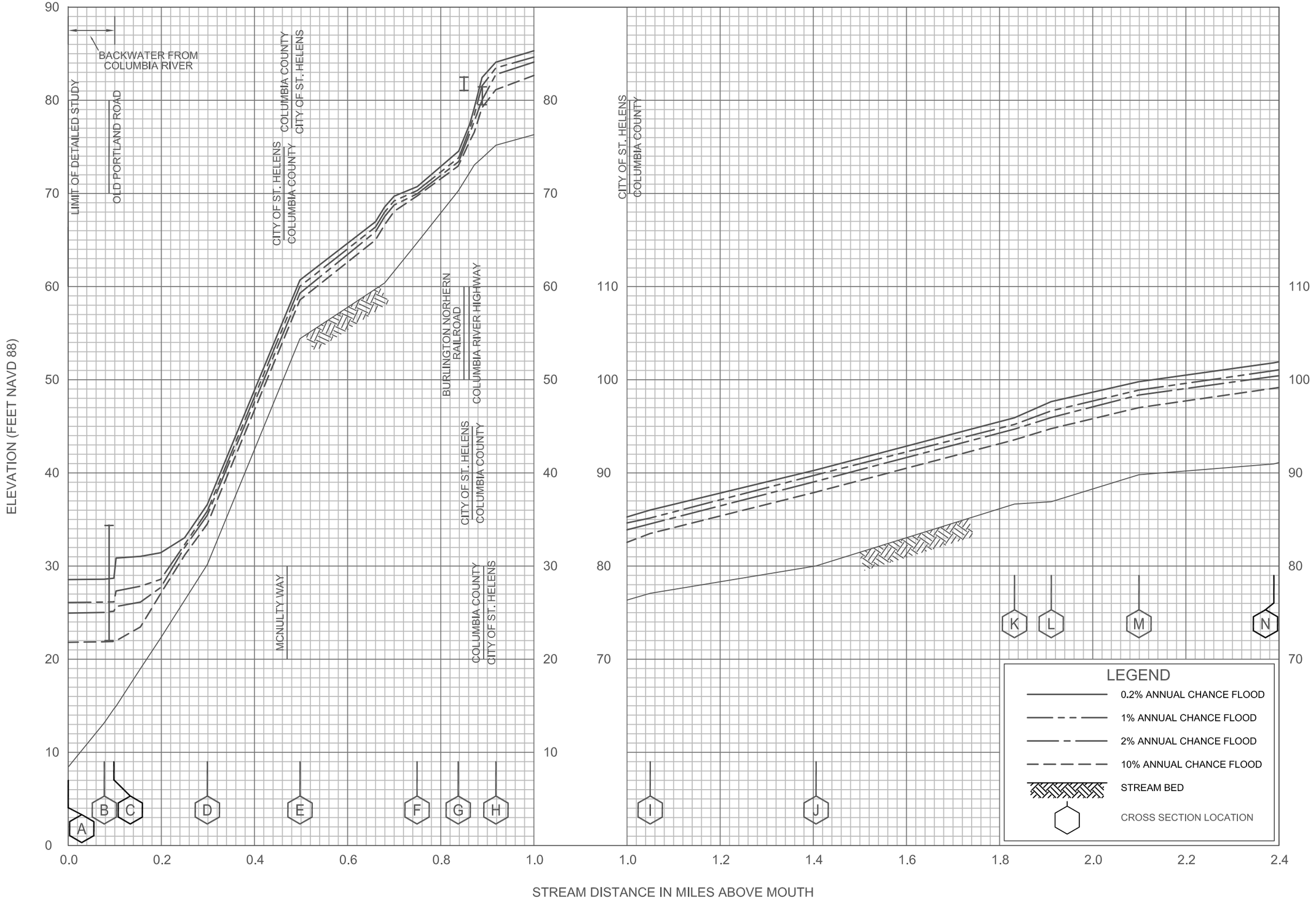
CONYERS CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

COLUMBIA COUNTY, OR

(UNINCORPORATED AREAS)

09P



FLOOD PROFILES

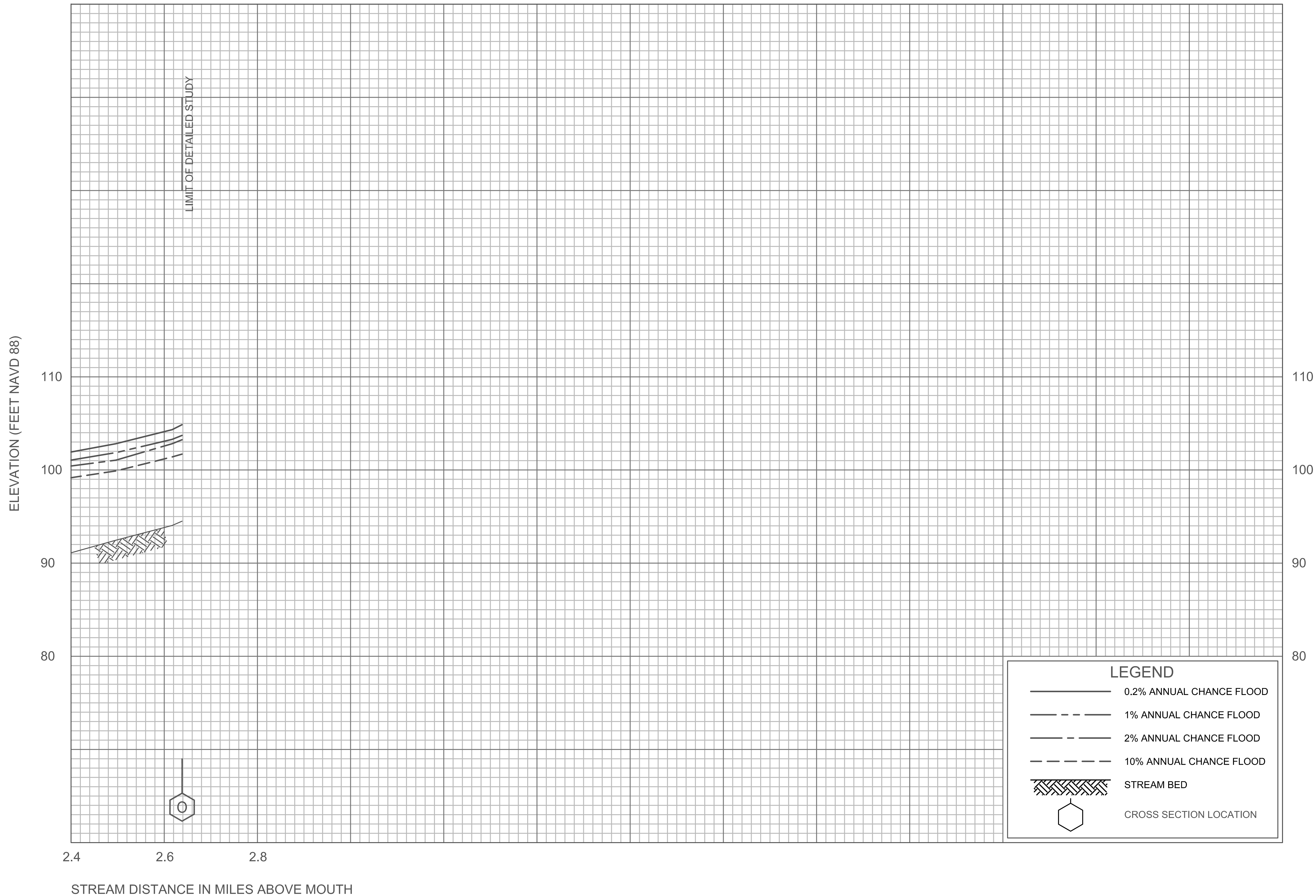
McNULTY CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

COLUMBIA COUNTY, OR

AND INCORPORATED AREAS

10P



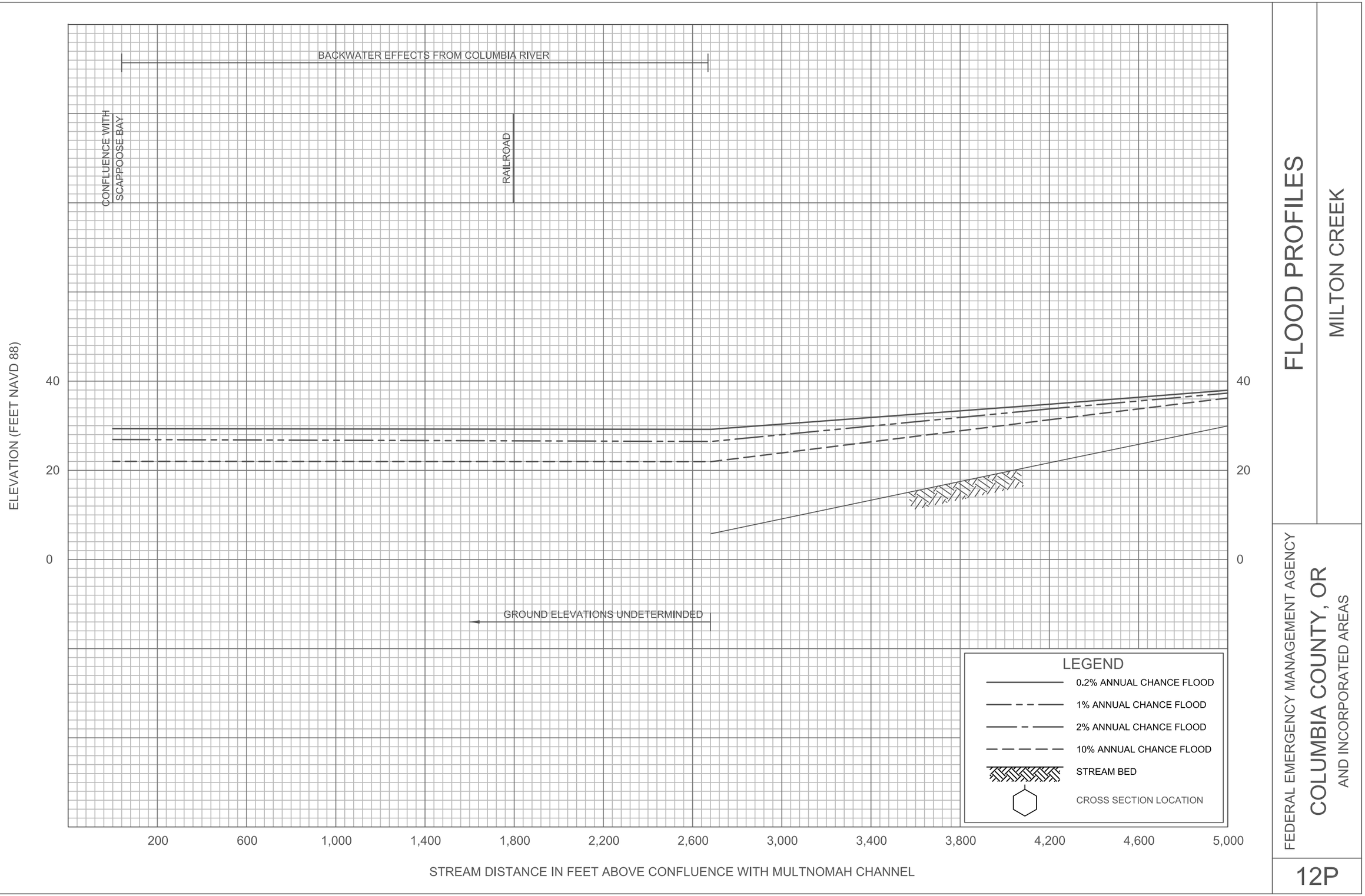
FLOOD PROFILES

McNULTY CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

COLUMBIA COUNTY, OR

AND INCORPORATED AREAS



FLOOD PROFILES

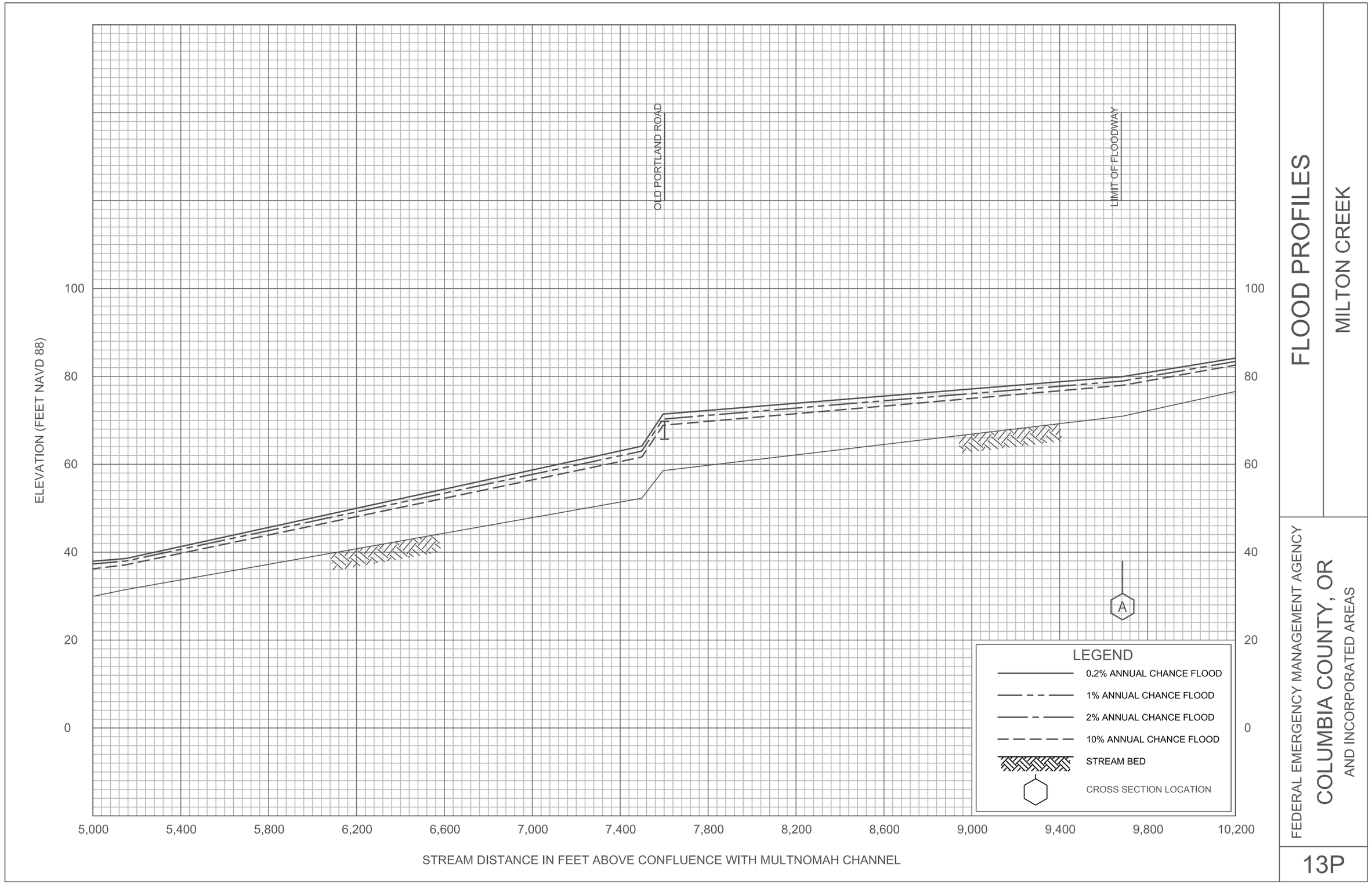
MILTON CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

COLUMBIA COUNTY, OR

AND INCORPORATED AREAS

12P



FLOOD PROFILES

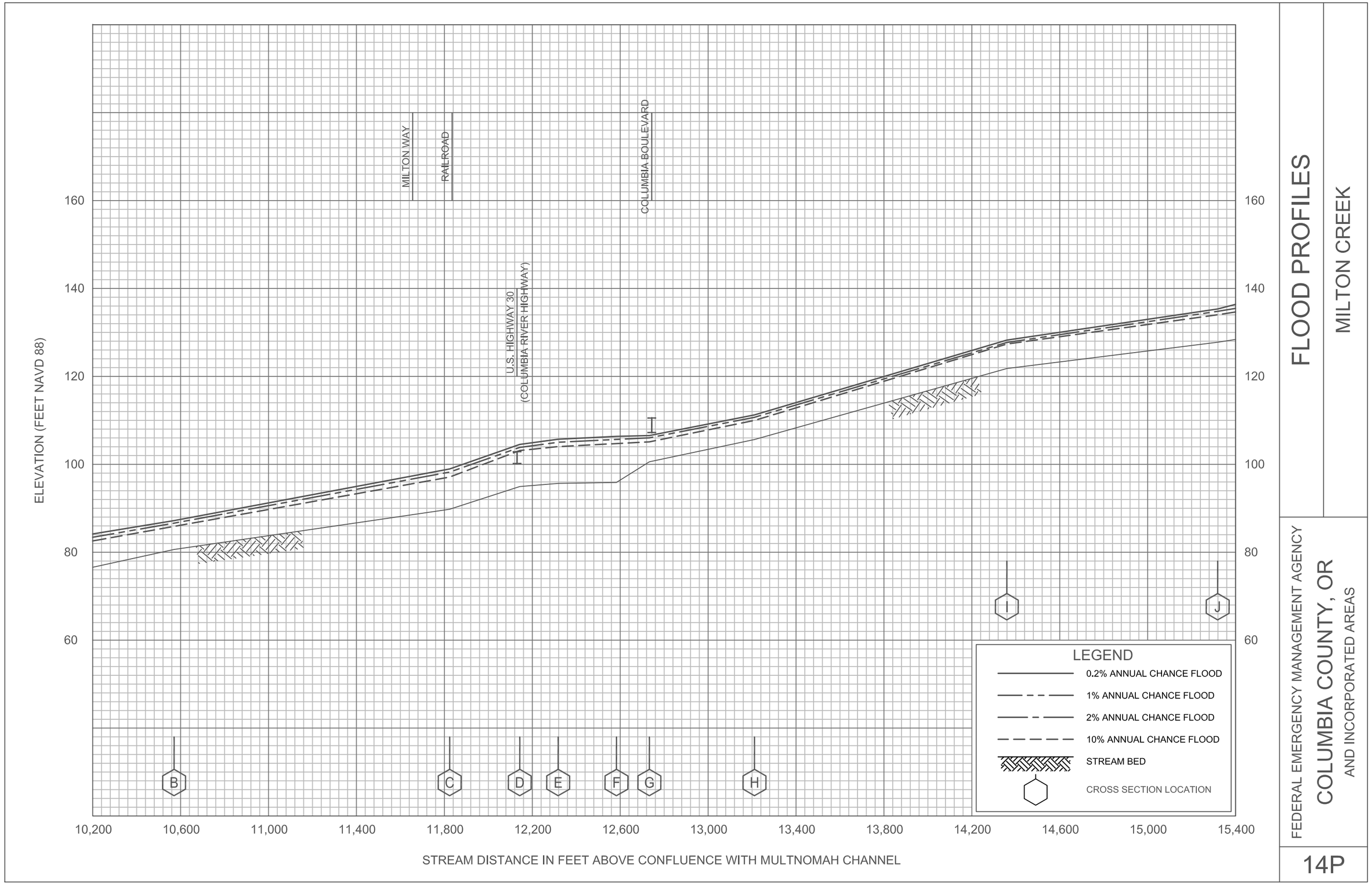
MILTON CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

COLUMBIA COUNTY, OR

AND INCORPORATED AREAS

13P



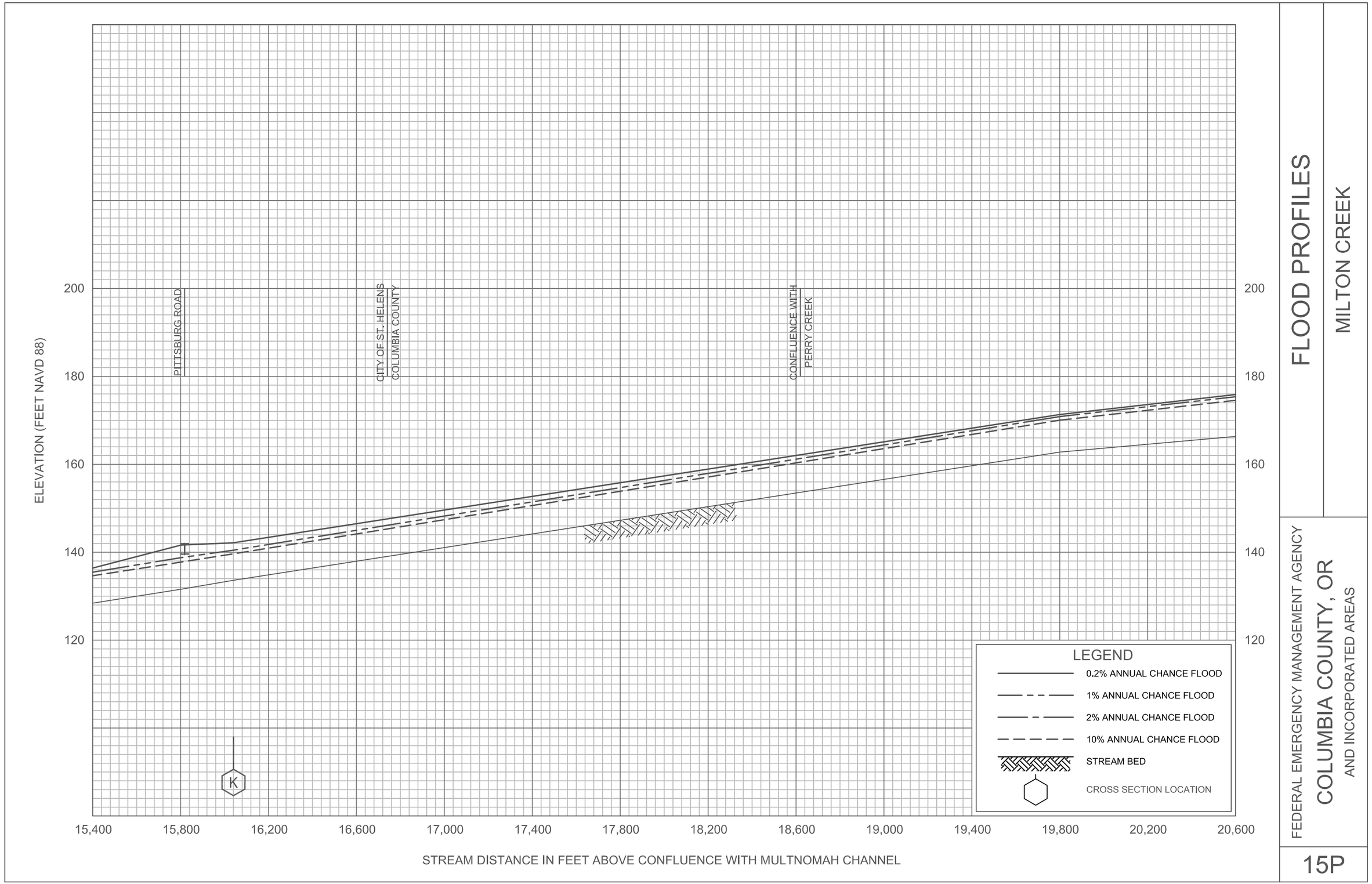
FLOOD PROFILES

MILTON CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

COLUMBIA COUNTY, OR

AND INCORPORATED AREAS



FLOOD PROFILES

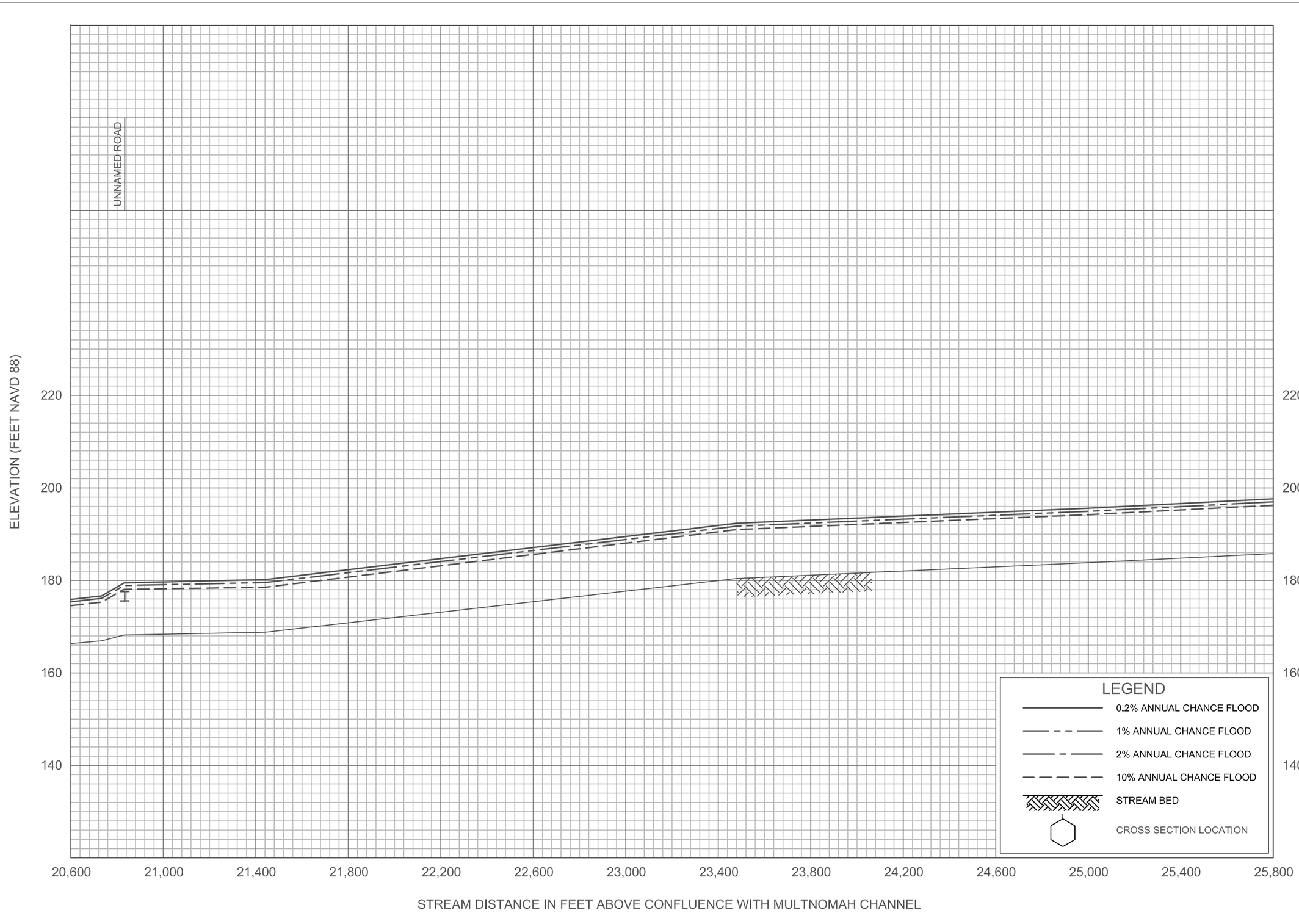
MILTON CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

COLUMBIA COUNTY, OR

AND INCORPORATED AREAS

15P



FLOOD PROFILES

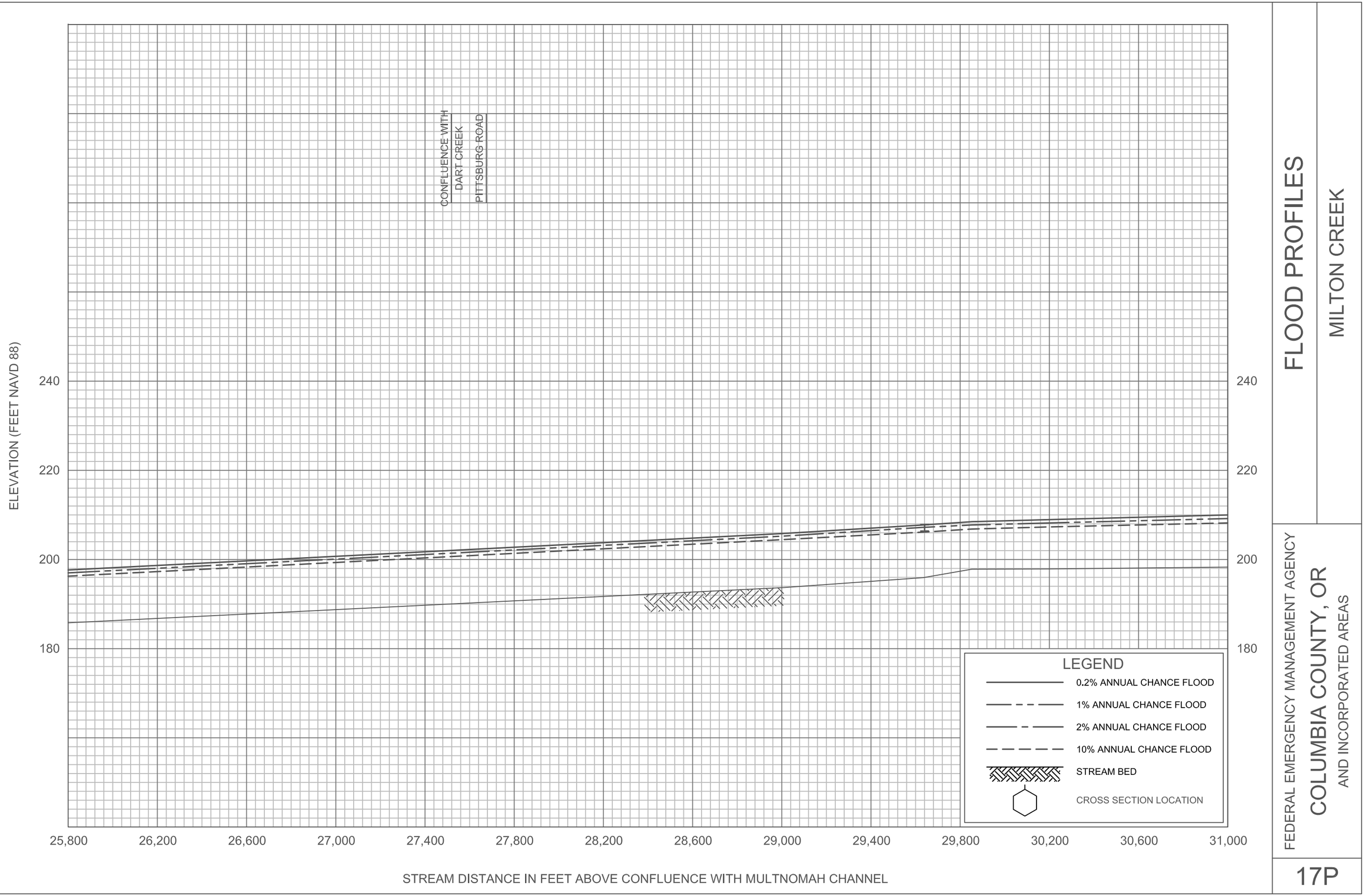
MILTON CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

COLUMBIA COUNTY, OR

AND INCORPORATED AREAS

16P



FLOOD PROFILES

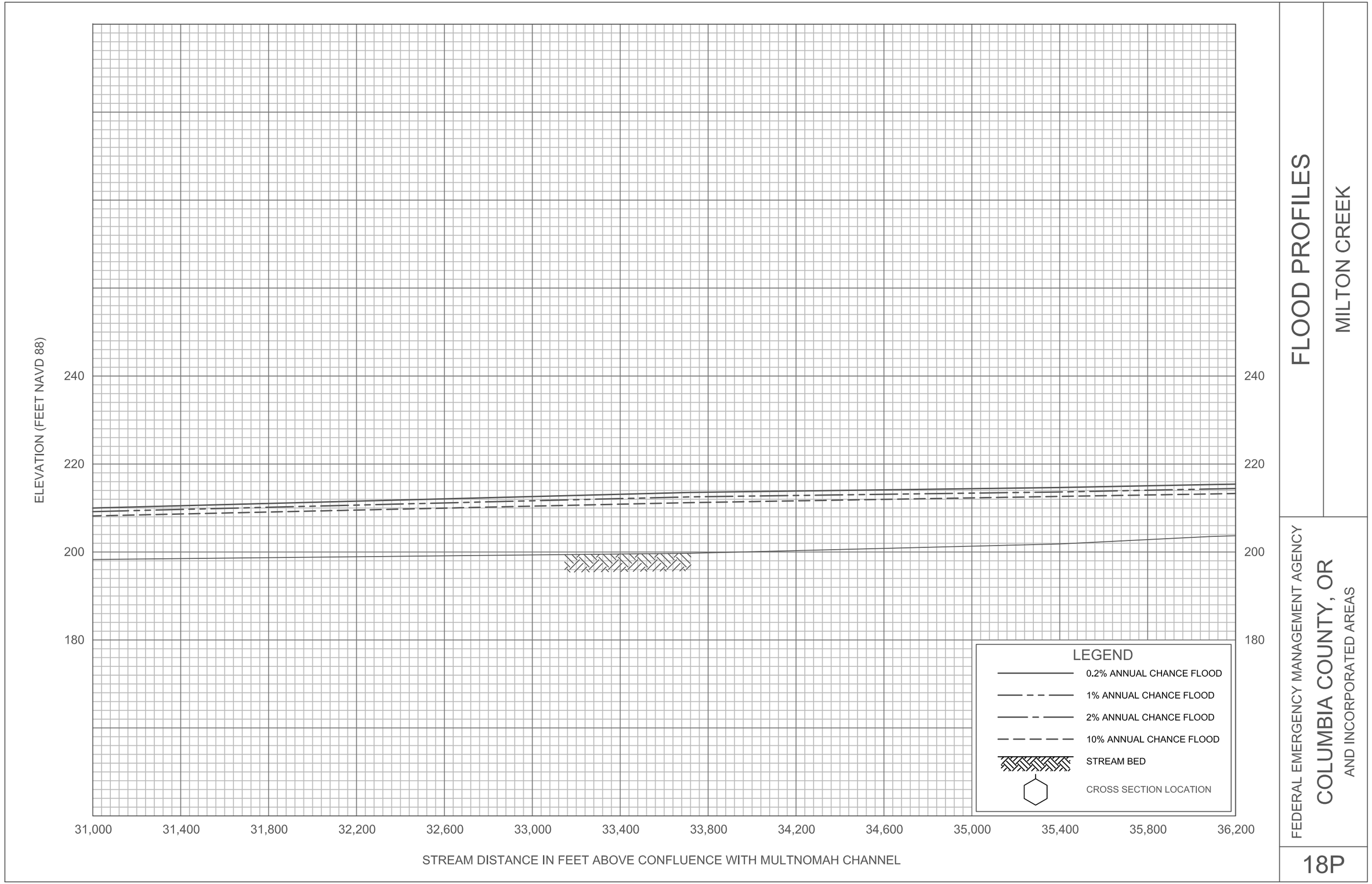
MILTON CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

COLUMBIA COUNTY, OR

AND INCORPORATED AREAS

17P



FLOOD PROFILES

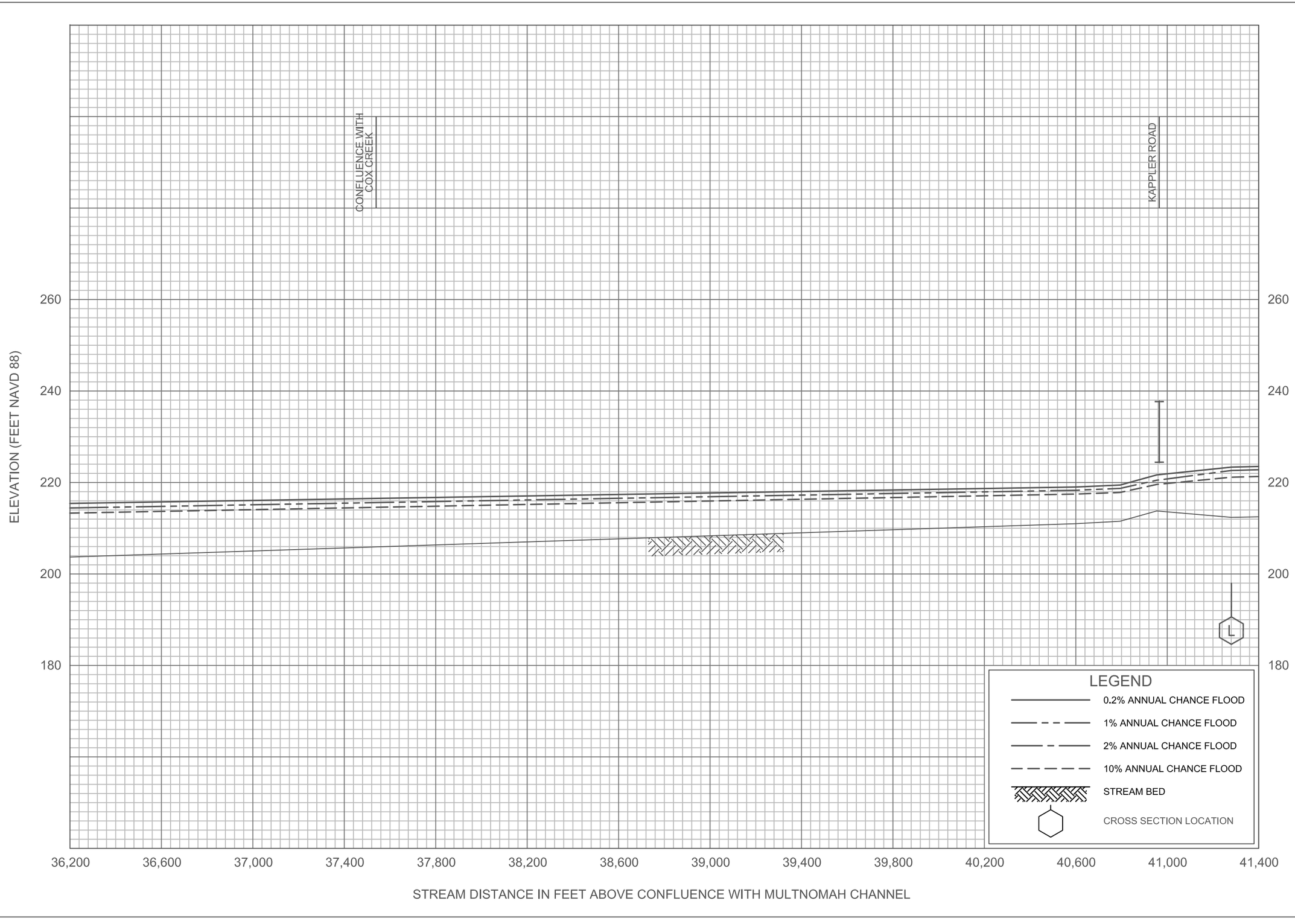
MILTON CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

COLUMBIA COUNTY, OR

AND INCORPORATED AREAS

18P



FLOOD PROFILES

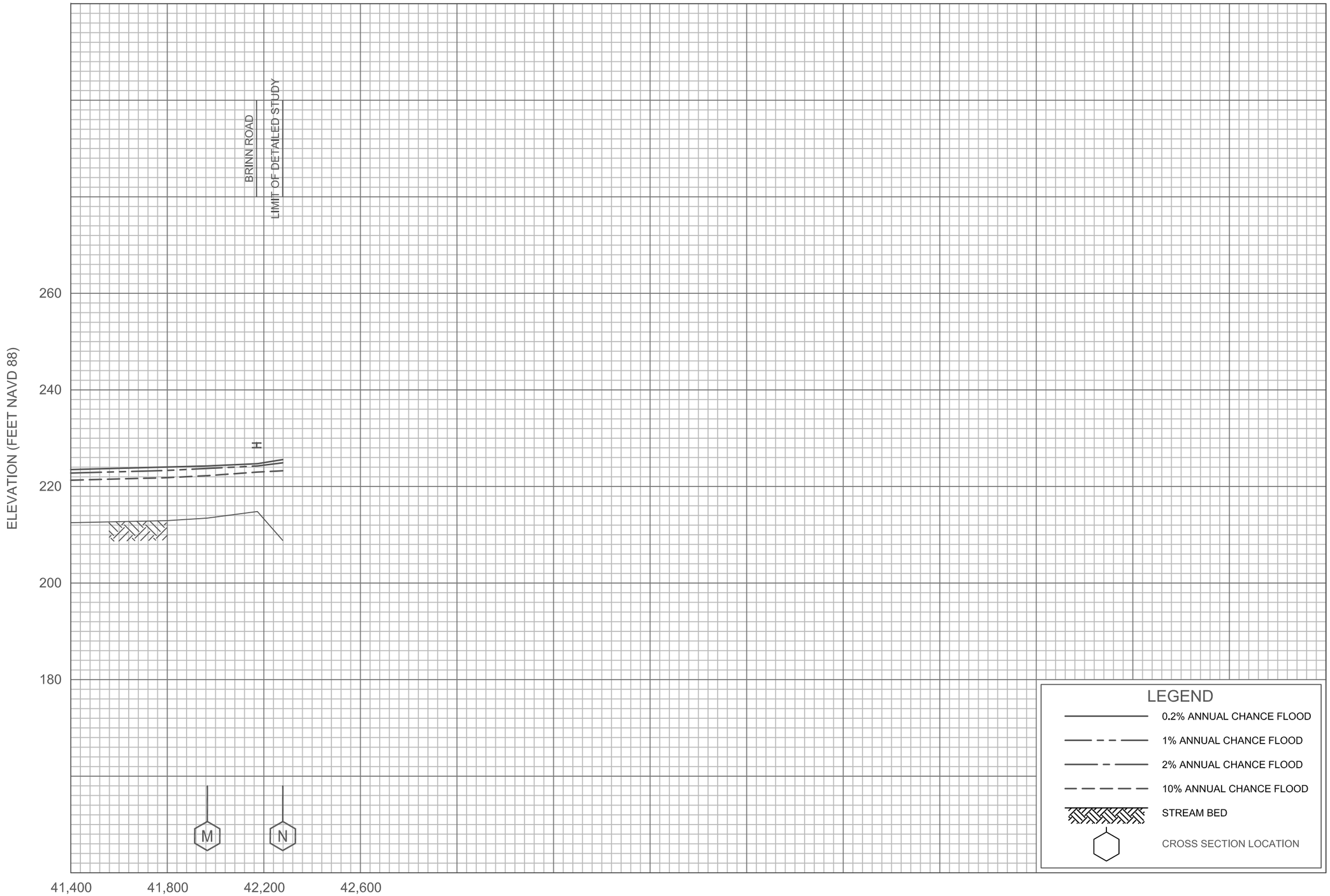
MILTON CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

COLUMBIA COUNTY, OR

AND INCORPORATED AREAS

19P



FLOOD PROFILES

MILTON CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

COLUMBIA COUNTY, OR

AND INCORPORATED AREAS

FLOOD PROFILES

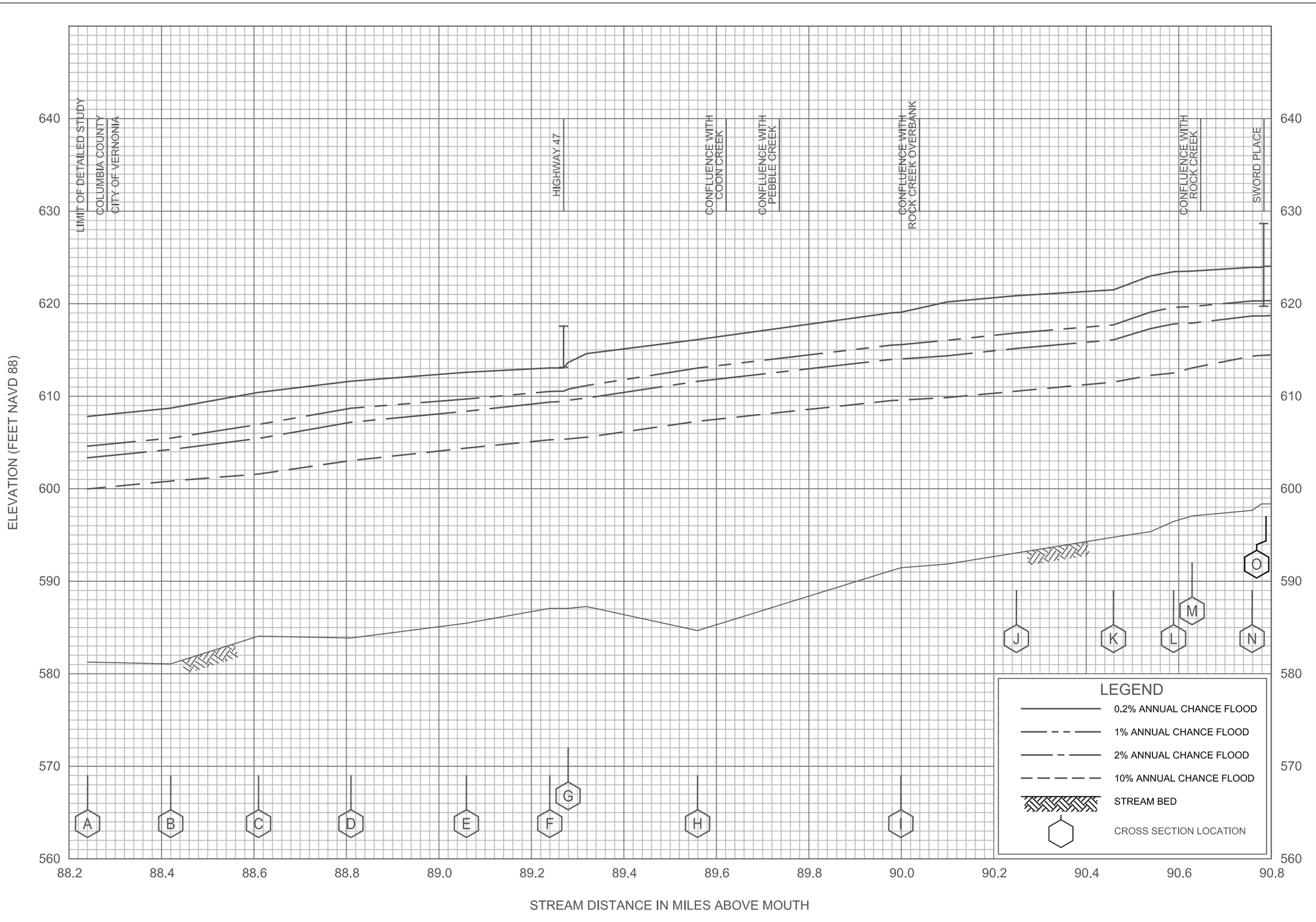
MULTNOMAH CHANNEL

FEDERAL EMERGENCY MANAGEMENT AGENCY

COLUMBIA COUNTY, OR

AND INCORPORATED AREAS

21P



FLOOD PROFILES

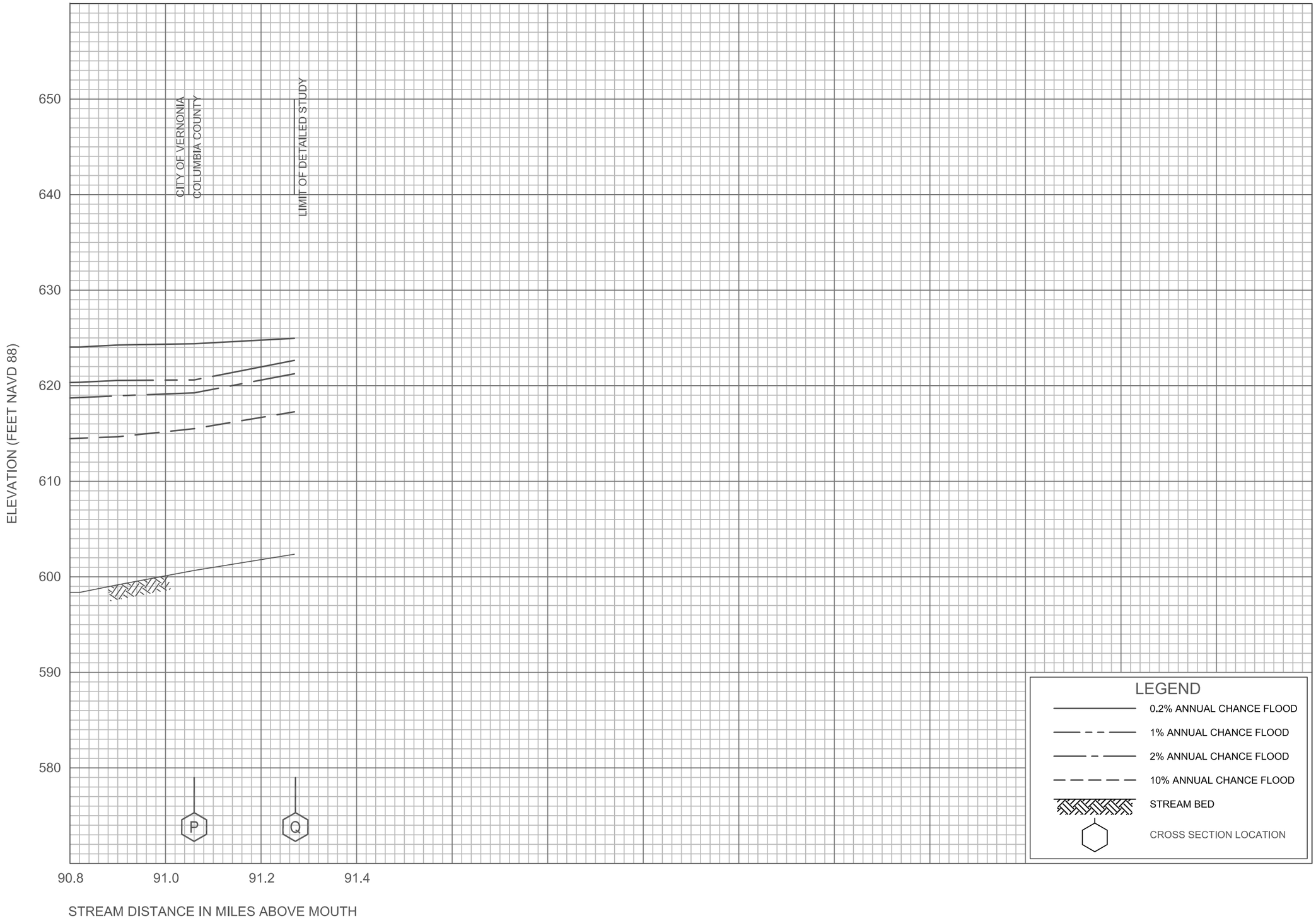
NEHALEM RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

COLUMBIA COUNTY, OR

AND INCORPORATED AREAS

22P



FLOOD PROFILES

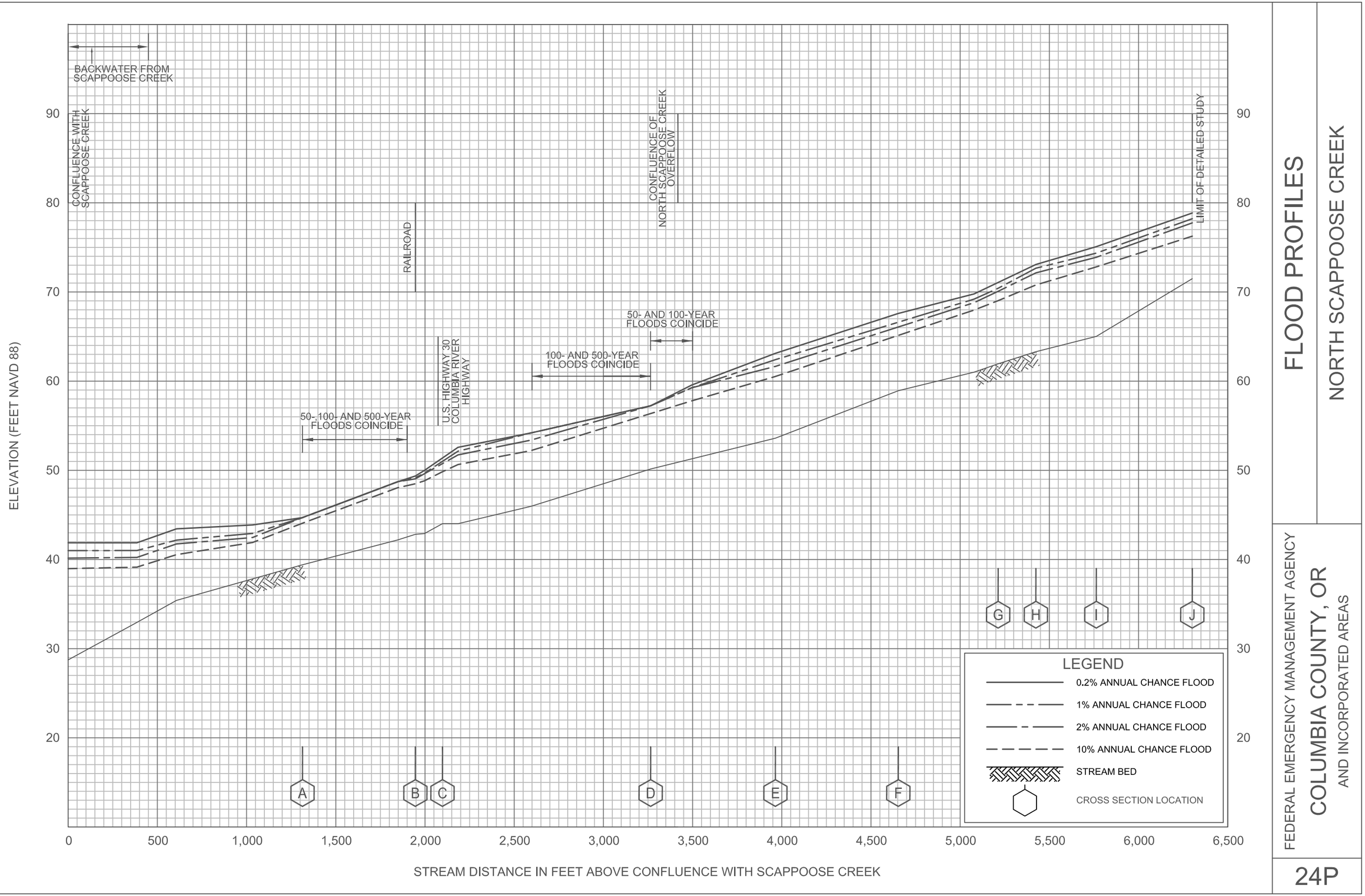
NEHALEM RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

COLUMBIA COUNTY, OR

AND INCORPORATED AREAS

23P



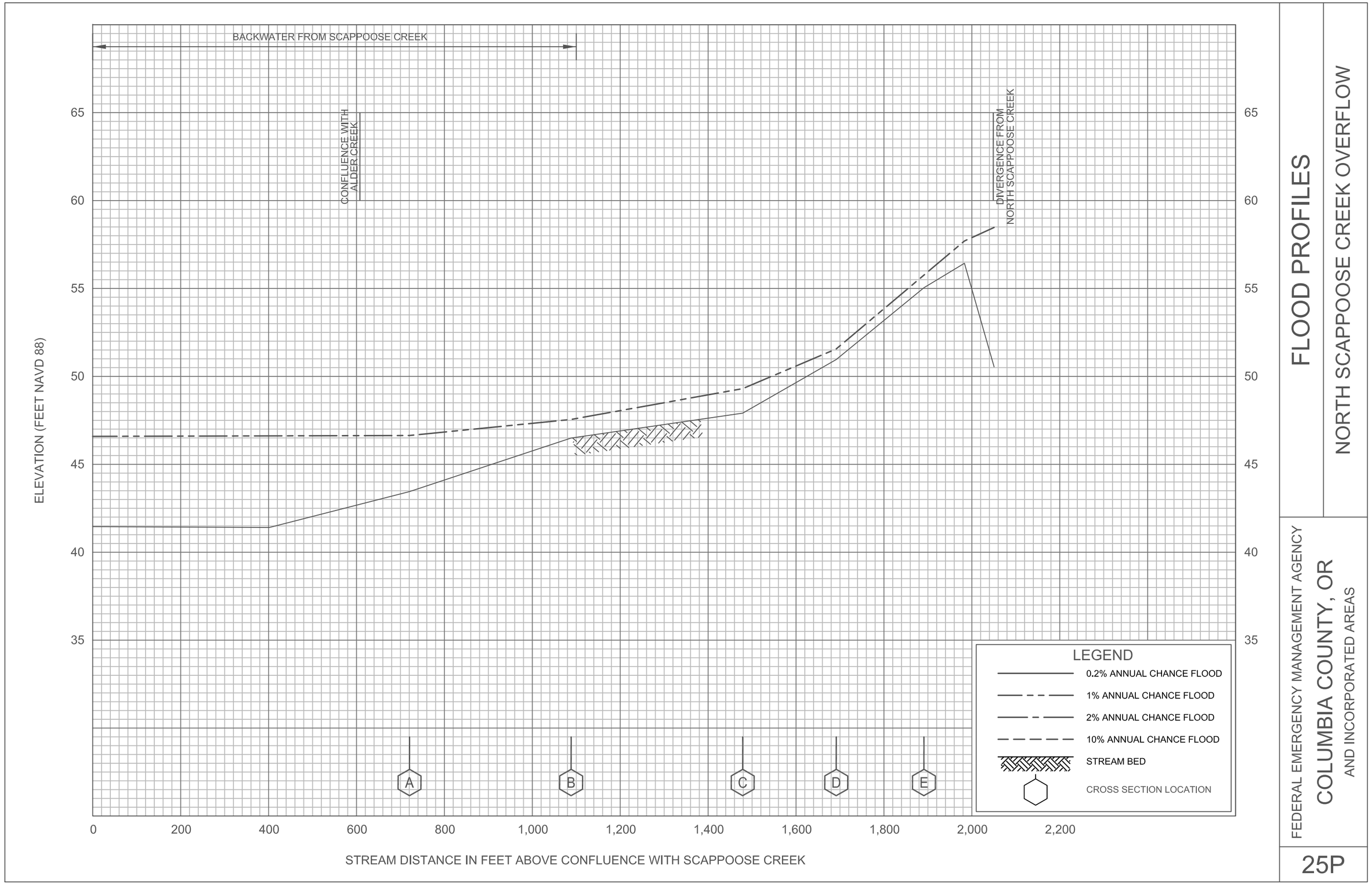
FLOOD PROFILES

NORTH SCAPPOOSE CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

COLUMBIA COUNTY, OR

AND INCORPORATED AREAS



FLOOD PROFILES

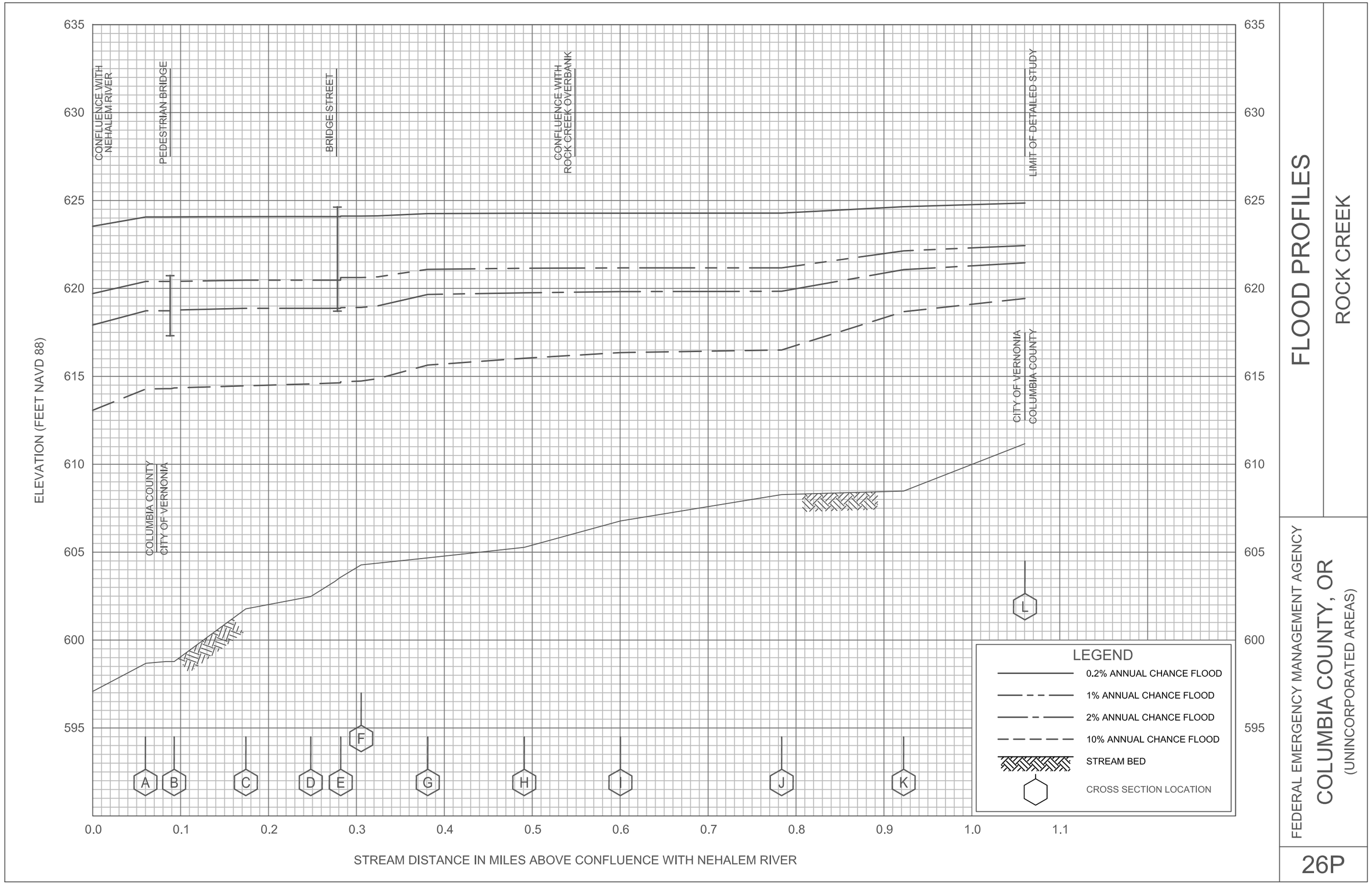
NORTH SCAPPOOSE CREEK OVERFLOW

FEDERAL EMERGENCY MANAGEMENT AGENCY

COLUMBIA COUNTY, OR

AND INCORPORATED AREAS

25P



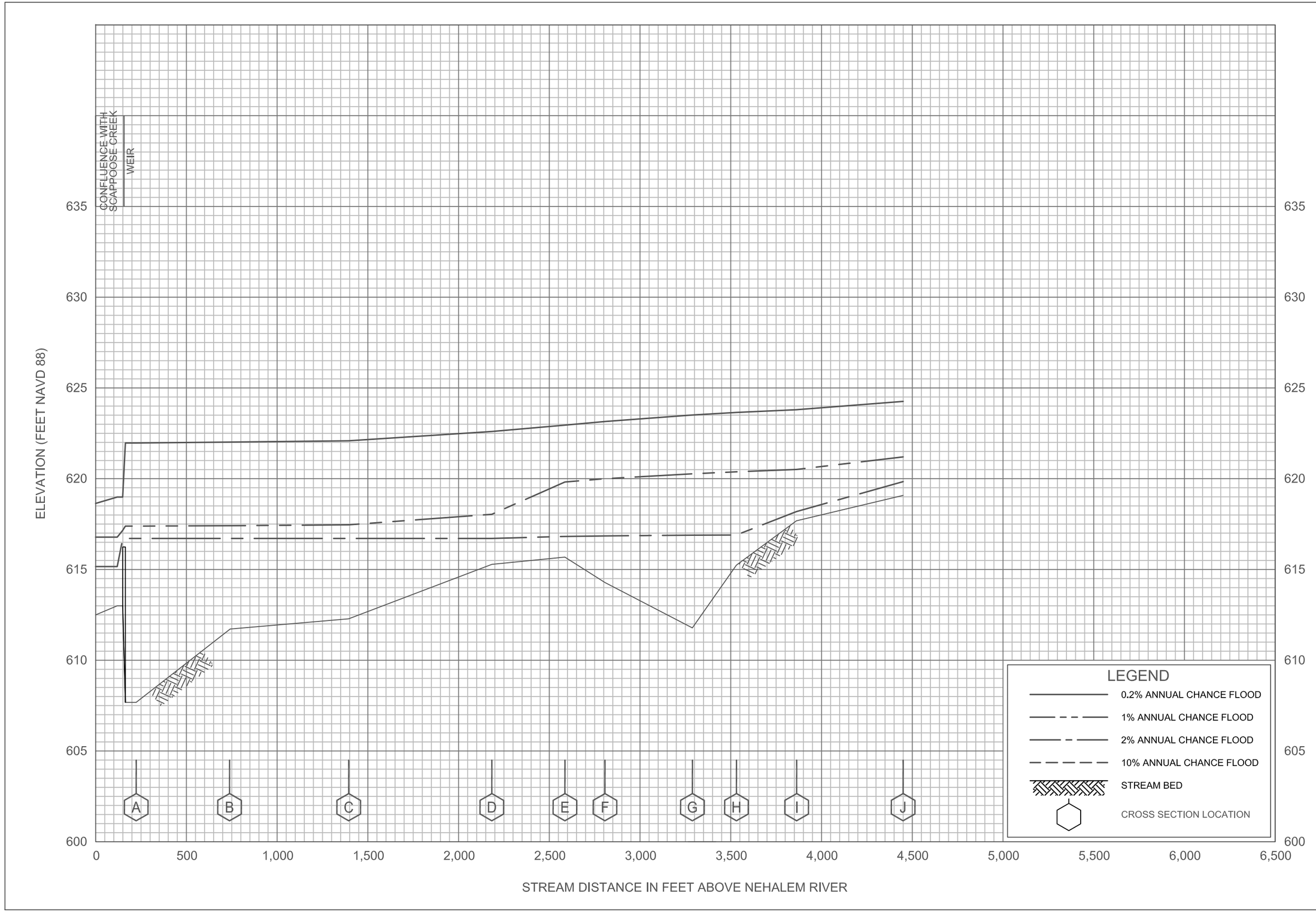
FLOOD PROFILES

ROCK CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

COLUMBIA COUNTY, OR

(UNINCORPORATED AREAS)



FLOOD PROFILES

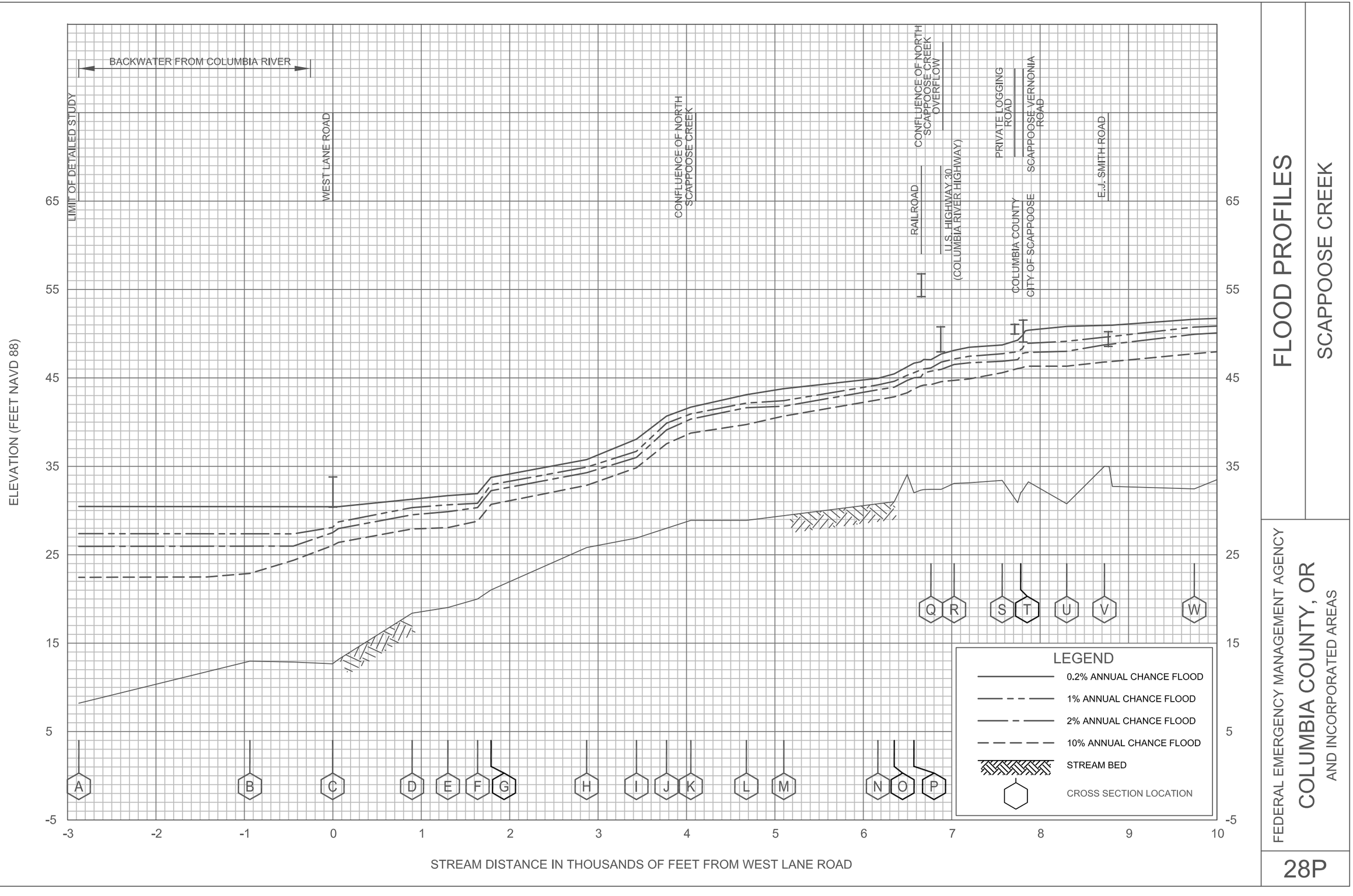
ROCK CREEK OVERBANK

FEDERAL EMERGENCY MANAGEMENT AGENCY

COLUMBIA COUNTY, OR

AND INCORPORATED AREAS

27P



FLOOD PROFILES

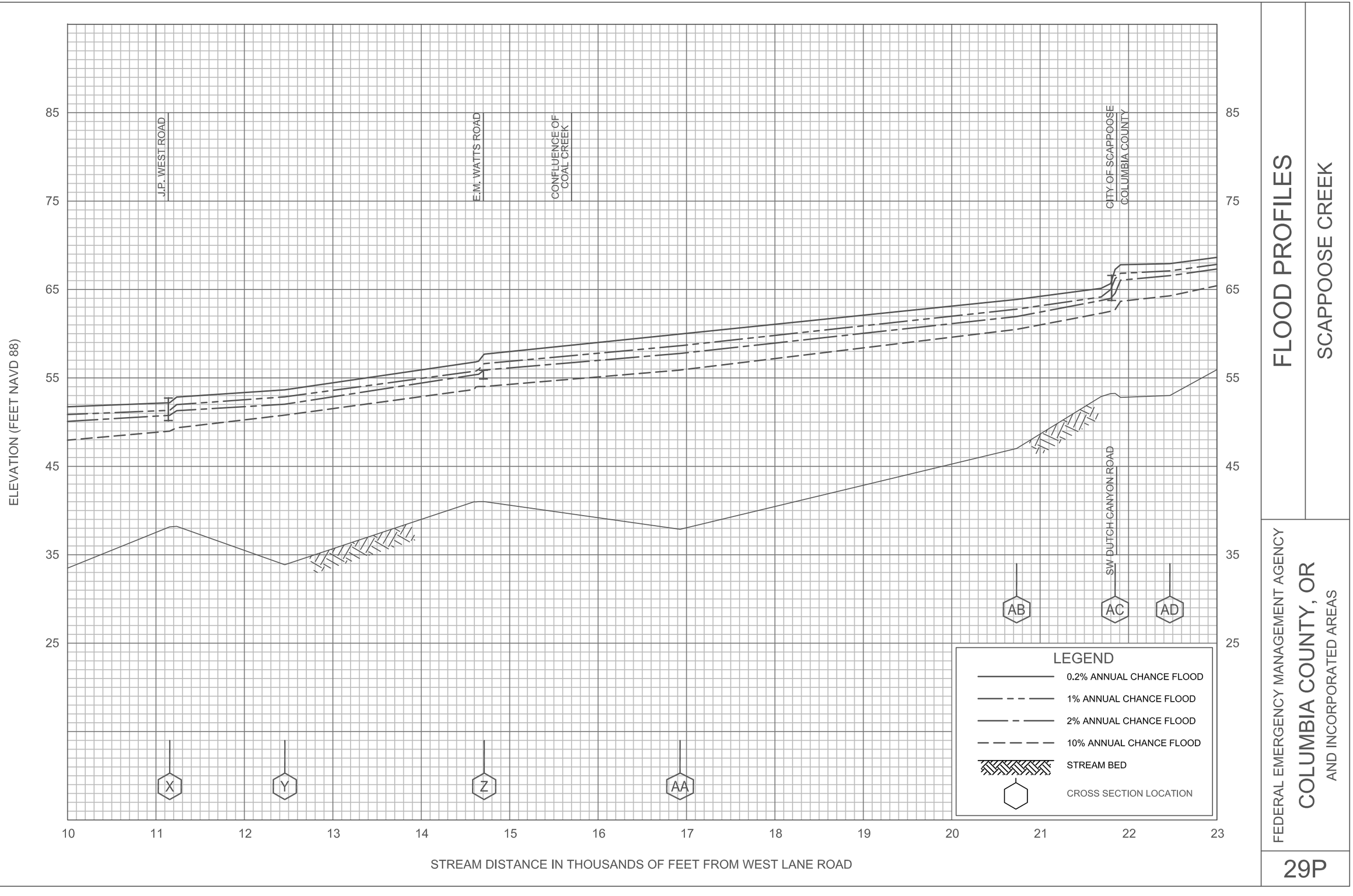
SCAPPOOSE CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

COLUMBIA COUNTY, OR

AND INCORPORATED AREAS

28P



FLOOD PROFILES

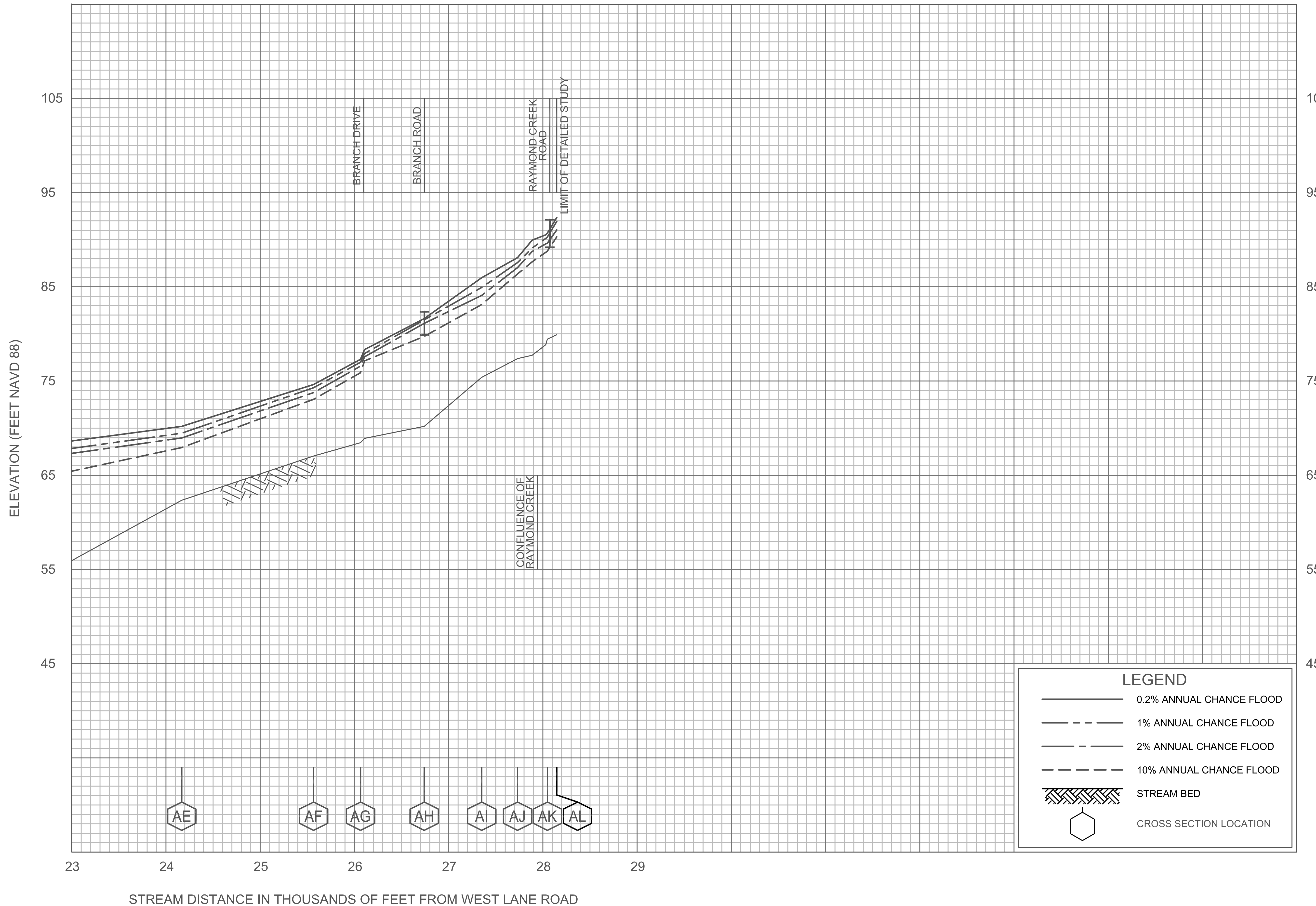
SCAPPOOSE CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

COLUMBIA COUNTY, OR

AND INCORPORATED AREAS

29P



FLOOD PROFILES

SCAPPOOSE CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

COLUMBIA COUNTY, OR

AND INCORPORATED AREAS