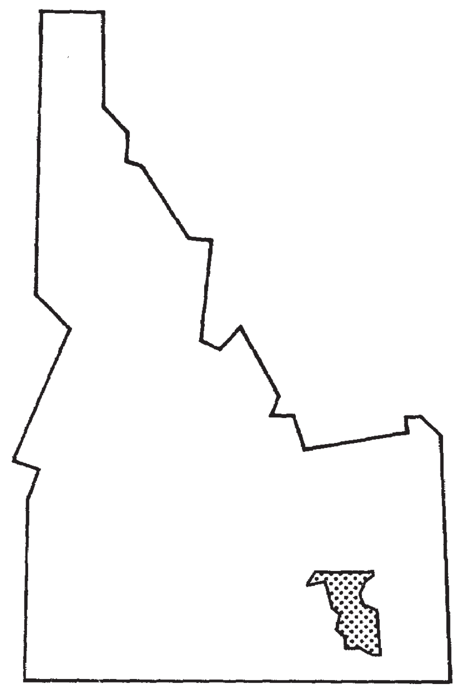
FLOOD INSURANCE STUDY

VOLUME 1 OF 2

BANNOCK COUNTY, IDAHO AND INCORPORATED AREAS



COMMUNITY NAME	COMMUNITY NUMBER
*ARIMO, CITY OF	160128
BANNOCK COUNTY, UNINCORPORATED AREAS	160009
*CHUBBUCK, CITY OF	160162
DOWNEY, CITY OF	160165
INKOM, CITY OF	160010
LAVA HOT SPRINGS, CITY OF	160011
MCCAMMON, CITY OF	160176
POCATELLO, CITY OF	160012

* NO SPECIAL FLOOD HAZARD AREAS IDENTIFIED

REVISED
JULY 22, 2020

Federal Emergency Management Agency
Flood Insurance Study
Number 16005CV001B

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
B	X
C	X

Part or all of this may be revised and republished at any time. In addition, part of this FIS may be revised by a Letter of Map Revision process, which does not involve republication or redistribution of the FIS. 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.

Effective Date: July 7, 2009

Revised Countywide Dates: July 22, 2020

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PUBLISHED SEPARATELY

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FLOOD INSURANCE STUDY
BANNOCK COUNTY, IDAHO AND INCORPORATED AREAS

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study revises and updates information on the existence and severity of flood hazards in the geographic area of Bannock County, including the Cities of Arimo, Chubbock, Downey, Inkom, Lava Hot Springs, McCammon, and Pocatello, Idaho and the unincorporated areas of Bannock County (referred to collectively herein as Bannock 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.

Please note that the Cities of Arimo and Chubbuck are non-floodprone. The Flood Hazard Boundary Map (FHBM) published on August 22, 1975, for the City of Arimo was rescinded after it was determined that that the two streams shown on the FHBM will not flow out of their banks for the one percent annual chance flood.

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.

<u>Pre-Countywide</u>
The original hydrologic and hydraulic analyses for Bannock County and the Cities of Downey, Inkom, Lava Hot Springs, and McCammon were performed by Tudor Engineering Company, for the Federal Emergency Management Agency (FEMA) under Contract No. H-3996. These analyses covered all significant flooding sources in the unincorporated areas of Bannock County and the cities noted above. The work for Inkom and McCammon was completed in July 1977. The work for Downey and Lava Hot Springs was completed in October 1977.

The original hydrologic and hydraulic analyses for the City of Pocatello were performed by the U.S. Army Corps of Engineers, for the Federal Emergency Management Agency (FEMA) under the Inter-Agency Agreement Nos. IAA-H-16-75 and IAA-H-7-76, Project Order Nos. 16 and 29, respectively. That work was completed in March 1978 and covered all significant flooding sources in the City of Pocatello,

The hydraulic analysis for a portion of Pocatello Creek in the City of Pocatello was revised by a Letter of Map Revision dated October 12, 1995. The LOMR was based on updated topographic data and revised hydraulic analyses of the flood having a 1-percent chance of being equaled or exceeded in any given year (base flood). Two areas along Pocatello Creek were revised by the referenced LOMR. The first area was revised based on updated topographic data that extends from approximately 100 feet upstream to approximately 370 feet downstream of Booth Road. The second area was revised based on updated topographic data and a revised hydraulic analysis that extends from Hi-Line Road to just downstream of the Union Pacific Railroad (UPRR) near Portneuf River, a distance of approximately 10,900 feet.

Countywide

The hydraulic analysis and revised floodplain mapping for Rapid Creek was performed by WEST Consultants, Inc. for FEMA under IDIQ Contract No. EMS-2001-CO-0068, Task Order No. 16. This work was completed in November 2007. A revised detailed studied was conducted for Rapid Creek from the U.S Highway 91 bridge upstream to the confluence with the North and West Forks of Rapid Creek. The reach length of the study is approximately 6.3 miles.

1.3 Coordination

Pre-Countywide

The dates of the initial and final CCO meetings held for the previous studies for Bannock County and the incorporated communities within its boundaries are shown in Table 1, "Initial and Final CCO Meetings". They were attended by representatives of FEMA, the communities, Idaho State Department of Water Resources and the study contractor.

Table 1. Initial and Final CCO Meetings

Community	Initial CCO Date	Intermediate CCO Dates	Final CCO Date
Bannock County, Unincorporated Areas	March 26, 1976	August 5, 1976 August 23, 1977	August 24, 1978
Downey, City of	March 26, 1976	August 5, 1976	September 18, 1980
Inkom, City of	March 26, 1976	June 2, 1977	September 6, 1977
Lava Hot Springs, City of	March 26, 1976	August 23, 1977	August 23, 1978
McCammon, City of	March 26, 1976	June 2, 1977	September 6, 1977
Pocatello, City of	February 12, 1975	November 7, 1975 September 16, 1977	February 1, 1979

An initial community coordination meeting for Bannock County and the Cities of Downey, Inkom, Lava Hot Springs, and McCammon was held on March 26, 1976. This meeting was attended by representatives of the cities and county, FEMA and Tudor Engineering. This meeting determined the reaches of needed detailed and approximate study. A second coordination meeting was held for Bannock County and the City of Downey on August 5, 1976 with the county representatives, FEMA and the Idaho Department of Water Resources attending. The study methods and stream segments studied were discussed.

Throughout the course of the original study, valuable assistance was provided by the U.S. Army Corps of Engineers (USACE), Walla Walla District, and the Idaho State Office of the U.S. Soil Conservation Service (SCS). Summaries of the hydrologic analyses performed by the USACE during the preparation of the Floodplain Information reports on the Portneuf River (References 1, 2, and 3), were provided. The U.S. SCS also provided summaries of their hydrologic analyses developed during the preparation of their Flood Hazard Analysis Reports on Marsh Creek and Rapid Creek (References 4 and 5). The hydraulic analyses conducted by the study contractor were coordinated closely with the USACE and the U.S. SCS to ensure compatibility between studies. Additionally, the Downey-Swanlake Highway District and the Portneuf-Marsh Valley Canal Company were contacted for coordination.

An intermediate community coordination meeting for the Cities of Inkom and McCammon was held on June 2, 1977 and was attended by city officials, the study contractor, and FEMA At that meeting, initial floodplain and flood insurance zone mapping was reviewed by all parties, and an opportunity was provided to answer any questions concerning the progress and conclusions of the study. During that meeting, city officials expressed concern about flooding from Sorrell Canyon. Following that meeting, at the request of FEMA, Tudor Engineering conducted a brief reconnaissance of Sorrell Creek. That investigation indicated that the flood hazard from this creek is fairly minimal; therefore, at the request of FEMA, the flood prone area below the mouth of Sorrell Canyon was shown as an approximate study area.

An intermediate community coordination meeting for the unincorporated areas of Bannock County and the City of Lava Hot Springs was held on August 23, 1977 and was attended by representatives of Bannock County, city officials, the study contractor, and FEMA. At that time, initial floodplain and flood insurance zone mapping was reviewed by all parties, and an opportunity was provided to answer any questions concerning the progress and conclusions of the study. During that meeting, county officials mentioned that one small stream tributary to Marsh Creek, which was not studied, was subject to frequent summer cloudburst flooding. At the request of FEMA, this tributary, located 1 mile north of Walker Creek, was subsequently studied by approximate methods, and the information was added to the maps.

A final coordination meeting was held on September 6, 1977 for the Cities of Inkom and McCammon, and was attended by representatives of Tudor Engineering, FEMA and the cities. At that time no others changes were requested to the City of McCammon maps or report. The City of Inkom requested that the study contractor delineate a floodway on Rapid Creek in the lower, alluvial portion of the stream.

A final coordination meeting was held on August 23, 1978 for the City of Lava Hot Springs and was attended by representatives of Tudor Engineering, FEMA and the city. A final coordination meeting was held on August 24, 1978 for Bannock County and was attended by representatives of Tudor Engineering, FEMA and the county. A final coordination meeting was held on September 18, 1980 for the City of Downey and was attended by representatives of Tudor Engineering, FEMA and the city.

An initial coordination meeting for the City of Pocatello was held on February 12, 1975 and was attended by the USACE, FEMA, the State of Idaho Water Resources Department, and the Pocatello Planning Planning Department. That meeting identified the base mapping to be used and the streams to be studied using detailed methods.

An intermediate coordination meeting was held on November 7, 1975 where additional streams requiring detailed study were added to the scope of work. Another intermediate coordination meeting was held for the City of Pocatello on September 16, 1977. At that time, initial floodplain and flood insurance zone mapping was reviewed by all parties, and an opportunity was provided to answer any questions concerning the progress and conclusions of the study. The need to study further floodway delineation on Pocatello Creek and the minor tributaries was raised at this meeting. The final coordination meeting for the City of Pocatello was held on February 1, 1979. That meeting was attended by FEMA, the USACE and representatives from the city.

Countywide
An initial community coordination meeting for Bannock County was held on May 5, 2005. This meeting was attended by representatives of the cities and county, FEMA and WEST Consultants. The results of the study were reviewed at the final Consultation Coordination Officer (CCO) meeting held on September 5, 2008, and attended by representatives of FEMA, the study contractor, Bannock County, the City of Downey, the City of Pocatello and the City of Inkom. All problems raised at that meeting have been addressed in this study.

2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the geographic area of Bannock County, Idaho, including the incorporated communities listed in Section 1.1.

The areas studied by detailed methods were selected with priority given to all known flood hazards and areas of projected development or proposed construction through 1982. The areas studied by detailed methods for the City of Pocatello were selected with priority given to all known flood hazards and areas of projected development or proposed construction through 1983. The scope and methods of study were proposed to, and agreed upon, by FEMA, Bannock County, and the Cities of Downey, Inkom, Lava Hot Springs, McCammon, and Pocatello. Due to the shallow nature of flooding in the City of Downey, as well as the low velocities associated with it, the flooding in Downey was studied using only the 100-year flood. Table 2 lists the streams studied in detail and the included segments.

Table 2. Detailed-Study Streams

Stream Name	Limits of Detailed Study
1. Portneuf River	From Cheyenne Street bridge near Pocatello upstream to 2,100 feet downstream from the Price Road bridge near McCammon
2. Portneuf River	From the US Highway 30N bridge 2 miles downstream from Lava Hot Springs to the Fish Creek County Road Bridge
3. Johnny Creek	From its confluence with the Portneuf River to 3,000 feet upstream
4. Gibson Jack Creek	From its confluence with the Portneuf River to 3,000 feet upstream

Table 2. Detailed-Study Streams (continued)

Stream Name	Limits of Detailed Study
5. Mink Creek	From its confluence with the Portneuf River to 1 mile upstream (2,500 feet southwest of the Bannock Highway bridge)
6. Fort Hall Mine Creek	From its confluence with the Portneuf River to 3,500 feet upstream
7. Rapid Creek	From the Interstate Highway 15 Business Loop bridge to the confluence of the North and West Forks Rapid Creek
8. West Fork Rapid Creek	From its confluence with North Fork Rapid Creek to 1,500 feet downstream of the junction of Buckskin and Hoot Owl Roads
9. North Fork Rapid Creek	From its confluence with the West Fork Rapid Creek to 250 feet downstream of the junction of Rapid Creek and McKee Roads
10. Pocatello Creek	From the Pocatello corporate limits to the confluence of the North and South Forks of Pocatello Creek
11. North Fork Pocatello Creek	From the confluence with the North and South Forks of Pocatello Creek to 1,000 feet west of the boundary between Sections 15 and 16
12. Marsh Creek	From its confluence with the Portneuf River upstream to the Robin Road bridge
13. Walker Creek	From the Marsh Creek Road bridge to 1,200 feet upstream
14. Bell Marsh Creek	From the Marsh Creek Road bridge to 1,700 feet upstream
15. Unnamed Tributary to Marsh Creek (0.5 mile south of Bell Marsh)	From 2,200 feet south of the boundary line between Sections 27 and 34 to 1,700 feet north of the boundary line between Sections 3 and 34
16. Dry Canyon Creek	From 800 feet downstream from Marsh Creek Road to the boundary line between Sections 3 and 4
17. Goodenough Creek	From Marsh Creek Road to 1,800 feet south of the boundary line between Sections 10 and 15

Table 2. Detailed-Study Streams (continued)

Stream Name	Limits of Detailed Study
18. Cottonwood Creek	From Marsh Creek Road to 500 feet upstream
19. Birch Creek	From the bridge on the Marsh Creek Road to Robin Road cutoff to 700 feet upstream from the confluence of Birch and Ellis Creeks
20. Ellis Creek	From the confluence of Birch and Ellis Creeks to 400 feet upstream
21. Rowe Creek	From its confluence with Goodenough Creek to 1,000 feet upstream
22. Downey Drainageway	Within the corporate limits of the City of Downey
23. Trial Creek	Within the corporate limits of the City of Pocatello
24. City Creek	Within the corporate limits of the City of Pocatello
25. Cusick Creek	Within the corporate limits of the City of Pocatello

Approximate analyses were used to study those areas having a low development potential or minimal flood hazards. Table 3 lists the streams and their included segments studied by approximate methods.

Table 3. Approximate-Study Streams

Stream Name	Limits of Approximate Study
1. Portneuf River	From the Fort Hall Indian Reservation boundary (3 miles upstream of American Falls Reservoir) to the corporate limits of Pocatello
2. Portneuf River	From 2,100 feet downstream from the Price Road bridge near McCammon to the US Highway 30N bridge 2 miles downstream from Lava Hot Springs

Table 3. Approximate-Study Streams (continued)

Stream Name	Limits of Approximate Study
3. Portneuf River	From the Fish Creek Road bridge to the Bannock County line
4. North Fork Pocatello Creek	From 1,000 feet west of the boundary of Sections 15 and 16 to 1,500 feet east of the boundary of Sections 14 and 15
5. South Fork Pocatello Creek	From its confluence with the North Fork Pocatello Creek to 100 feet from the southwest corner of the ice skating rink at the ski area
6. Sorrell Creek	From its confluence with the Portneuf River to the corporate limits of Inkom and within the corporate limits of the City of Inkom
7. Indian Creek	From its confluence with the Portneuf River to the Caribou National Forest boundary
8. Jackson Creek	From its confluence with Rapid Creek to 2,000 feet downstream from the junction of Bonneville and Whitworth Roads
9. Marsh Creek	From the Robin Road bridge to Richards Road
10. Dempsey Creek	From its confluence with the Portneuf River to 1,500 feet south of the boundary between Sections 4 and 9
11. Fish Creek	From its confluence with the Portneuf River to a line 800 feet east of the boundary line between Sections 26 and 27
12. Hawkins Creek	From its confluence with Marsh Creek to the boundary line between Sections 33 and 34
13. Downey Drainageway	From the corporate limits of the City of Downey upstream along a drainage swale approximately 0.5 miles
14. Unnamed Tributary to Marsh Creek (1 mile north of Walker Creek)	From its confluence with Marsh Creek to approximately 1,500 feet upstream

2.2 Community Description

Bannock County encompasses an area of 1,125 square miles in southeastern Idaho. Relief ranges from the semi-arid Snake River plains in the northwest to high mountain ranges in the central and southern parts. To the east is Caribou County; the boundary runs roughly along the Portneuf Mountain Range. The northern boundary with Bingham County lies within the Fort Hall Indian Reservation, while Franklin County forms the southern boundary. The Bannock Mountain Range separates Bannock County from Power County to the west and Oneida County to the southwest.

The first explorers who entered the Bannock County area in the early 1800s were trappers in search of beaver pelts. They found an abundance of these animals in the many streams and rivers of the region, and an era of intensive trapping ensued. The beaver population began to show signs of depletion in the early 1830s and, by 1860, virtually all of the trappers had abandoned southeastern Idaho.

The discovery of a few small deposits of gold, silver and lead in the early 1860s brought a renewed influx of explorers and settlers to the region. The mining activity sped the development of another industry which played a major role in opening southeastern Idaho to settlers: transportation. Toll roads and railroads penetrated the area as quickly as rights-of-way could be acquired. In the late 1870s, the first railroad line, the Utah Northern Railroad, was built from Utah, north through the Portneuf and Snake River basins, to the mining districts of western Montana. The Utah Northern Railroad pushed its way down Marsh Creek Valley into the Fort Hall Indian Reservation. Later, the president of the Union Pacific Railroad and J.V. McCammon, an attorney with the US Department of Interior, investigated the development of a railroad line from Wyoming to the northwest. This railroad, the Oregon Shortline, was constructed during the 1880s, and also passed through the Portneuf River Valley. It joined the Utah Northern Railroad not far from where the City of McCammon now sits.

Bingham County was established in 1885, and Bannock County was separated from the southern part of Bingham County in 1893. Pocatello, which had been incorporated in 1889, was declared the county seat for Bannock County, and holds that position to this day.

With the depletion of mineral resources in the 1890s, farming and ranching became the predominant occupation for the settlers. Because of its strategic location at the crossroads of major rail and inter-state highway systems, Pocatello developed into an important manufacturing and transportation center, and is often referred to as the "Gate City" of Idaho. However, most of the residents in the rural areas surrounding Pocatello continue to make their living on small farms and ranches. In addition, numerous small businesses, such as service stations, motels, and restaurants, are located along the major transportation arteries in Bannock County. These businesses cater to tourists, who are attracted to the area for the beautiful scenery and the modern recreational complex at Lava Hot Springs.

The topography of Bannock County is dominated by the Portneuf Mountain Range, which runs north to south along the eastern boundary, and by the Bannock Range which runs north to south along the county's western boundary. The valleys of both the Portneuf River and Marsh Creek in the south run north to south down the center of Bannock County, forming the dividing line between these two mountain ranges. Elevations range from a low of approximately 4,400 feet at the American Falls Reservoir in the north to 9,270 feet at the crest of Bonneville Peak, located in the Portneuf Mountain Range, in the central part of the county. The average elevation for the county as a whole is approximately 6,000 feet.

The mountainous areas of Bannock County generally have very pronounced relief, with deep canyons and steep slopes. In contrast, many valley areas are abnormally wide and flat when considering the size of the watersheds that they form. These valley areas include Marsh Valley along Marsh Creek and Gem and Portneuf Valleys east of the Portneuf Mountain Range, along the Portneuf River. It is believed that these valley areas have played a major role in causing some of the worst historical floods on the Portneuf River and Marsh Creek. Changing elevation brings about a change in climate. As the elevation rises, the temperature decreases and the precipitation increase. Normal annual precipitation varies from an average of less than 10 inches northwest of Pocatello to over 30 inches in the higher elevations, with an average for the county of approximately 16 inches. July, August, and September are somewhat drier than the remaining months; but, in general, the distribution of rainfall is fairly uniform throughout the year. During the winter, much of this precipitation falls as snow in the higher elevations, particularly above 5,500 feet. Snow depth on the upper mountain slopes are frequently in excess of 50 inches by early spring. Temperatures at the Pocatello Airport average 47.0°F for the year and vary from 22.3º in January to 72.4ºF in July. Recorded temperature extremes are 105ºF and -31°F. At high elevations, the temperature figures may be 10 to 20°F lower than the Pocatello data.

Most of Bannock County is in the Portneuf River watershed. The Portneuf River originates in Caribou County and flows south into Bannock County approximately 7 miles north of Lava Hot Springs along the east face of the Portneuf Mountain Range. Just upstream of Lava Hot Springs, the river swings to the west and flows along a narrow cut through the Portneuf Mountain Range to the vicinity of McCammon, where it changes direction and flows northward along the west face of the Portneuf Mountain Range. At Inkom, the river changes direction again and flows west approximately 5 miles before swinging to the northwest. The river passes through Pocatello and empties into the Snake River at American Falls Reservoir in the northwest corner of Bannock County. The Portneuf River has a total drainage area of approximately 520 square miles.

Marsh Creek is relatively uniform throughout its length. It has a gentle slope, and a very sinuous channel, with numerous marshland areas located along its course. Marsh Creek originates in areas of high elevation in the southern end of the Portneuf Mountain Range near Downey, and flows north through the center of Bannock County, joining the Portneuf River just east of Inkom.

Two streams outside the Portneuf River watershed originate in Bannock County: The streams, tributaries to the Blackfoot River, are Ross Creek and South Fork Ross Fork Creek and originate in the northeast part of the county. A tributary to the Bear River, Cottonwood Creek, has its headwater in southeast Bannock County.

The geology of Bannock County varies considerably. Upstream from Pocatello, the Portneuf River Valley approaches canyon-like conditions, with steep mountains rising from both banks of the Portneuf River. The canyon is underlain with relatively impervious folded quartzites with a later filling of highly pervious, intra-canyon basalt flows and alluvial material. Subsequent erosion and deposition have produced a great alluvial fan containing gravels, cobbles, and boulders at the valley's mouth, where it enters the Snake River Valley. These alluvial deposits extend upstream as valley fill and alternate with the eroded remnants of intra-canyon basalt. The basalts become more prevalent upstream from Pocatello and have disrupted the stream course of both the Portneuf River and Marsh Creek.

The soils of Bannock County vary considerable due to the influence of varying geological and physiographical conditions. Most of the soils are well drained, but vary from rocky and extremely thin on steep mountain slopes and above exposed basalt deposits to very deep loams in the valleys.

Vegetation throughout Bannock County varies as well. The plains areas in the north are sparsely covered with sage and desert grasses. Progressing southward, the desert gives way to farmlands and rangelands, principally along the Portneuf River and Marsh Creek Valleys. The mountainous areas are covered by rangelands on most ridges and south-facing slopes, with abundant stands of Douglas fir and quaking aspen trees in canyon areas and on north-facing slopes.

Approximately 67 percent of the land in Bannock County is privately owned, with the remaining 33 percent under government control. Federal land comprises 27 percent of Bannock County, with 11 percent controlled by the US Bureau of Land Management and 16 percent by National Forests. The State of Idaho controls 7 percent, of which 6 percent is endowment lands, 0.5 percent Fish and Game, and 0.5 percent Parks and Recreation lands. Bannock County owns approximately 0.5 percent and municipalities own another 0.5 percent of the total land area in Bannock County.

Most of the county's population lives in or near Pocatello, with relatively few people located in the southern half of the county. In 2000, 68 percent of the county's total population lived in Pocatello. An additional 17 percent lived in other incorporated communities, with the remaining 15 percent in unincorporated county areas. Population growth from 2000 to 2006 was 3.8 percent. This resulted in an estimated total population in 2006 of approximately 78,443 (Reference 6). Most future growth should occur in areas within commuting distance of Pocatello a significant percentage of this growth is likely to occur in or adjacent to floodplain areas.

At present, floodplain development in Bannock County includes residential, agricultural and a few industrial structures. The most significant form of future floodplain development is expected to be single-family residential structures, together with a few multi-family dwellings and small commercial buildings. Very little developable land remains within Pocatello, so active housing construction is taking place on the hillsides surrounding the city; in nearby canyons along Mink, Rapid, and Pocatello Creeks; and, along the Portneuf River as far south as McCammon. Many of these dwellings, particularly in areas close to Pocatello, are of high monetary value. A potential is thus developing for financially disastrous future floods in many of these areas.

The City of Downey

The City of Downey is located in southeastern Idaho, at the southern end of Bannock County. Downey is in the Portneuf River basin near the upper end of Marsh Creek. Nearby communities include Arimo and McCammon, which are located, respectively, 9 and 17 miles north along Interstate Highway 15, and Preston, which is 27 miles south-east along US Highway 91.

Development in Marsh Valley began in the 1860s when a few settlers established farming and sawmill operations. Marsh Valley was originally within the Fort Hall Indian

Reservation, which accounted for its somewhat limited development until 1889. At that time the area was opened for settlement.

Several small towns immediately came into being, among which were Cambridge, Garden, and Grant. Downey was originally an extension of the Town of Cambridge. Settlement in Downey began at approximately the same time as the construction of a railroad line through the area in the early 1890s. Downey was named for a former director of the Union Pacific Railroad.

The economy of Downey is based largely on agriculture. The cultivation of wheat and oats and production of range livestock and dairy cattle are of primary importance. There is no industrial development in Downey. Commercial development is limited as well. Some small stores and other business establishments cater primarily to the agricultural industry of the area. Floodplain development is largely residential and includes such agricultural out buildings as barns and sheds.

The population of Downey is reasonably stable. The 1990 census reported a population of 626, the 2000 census recorded 613 inhabitants or a decrease of approximately 2 percent (Reference 6).

Downey is at the upper end of Marsh Valley where the elevation is approximately 4,860 feet. To the east, the north-south-trending Portneuf Range ascends to peak elevations of approximately 9,000 feet near Downey. The Bannock Range lies west of Downey, also trends in the north-south direction, and has peak elevations of approximately 9,000 feet near the city.

Downey is situated on a relatively flat plateau between the Portneuf Range and Marsh Creek. It is outside the Marsh Creek floodplain, but intercepts runoff from a series of small basins draining the western slopes of the Portneuf Range. These basins have an aggregate drainage area of approximately 15 square miles. In addition, an irrigation diversion on Marsh Creek, southeast of Downey, introduces additional flow to the Downey area, which also can contribute to flooding. All of these floodwater sources are intercepted by the Portneuf-Marsh Valley Canal, which flows along the base of Portneuf Range. The canal flows from north to south and parallels the mountains as it passes through the eastern side of Downey. A bypass structure 1 mile north of the city is capable of diverting much of the canal water into a wasteway canal. This canal flows from east to west, and is used to irrigate farm land northwest of Downey. Henceforth, in this study, it will be referred to as the Portneuf-Marsh Valley Wasteway Canal.

The normal annual precipitation for the Marsh Creek basin is approximately 15 inches. Distribution of precipitation throughout the year is fairly uniform. During the winter, much of this precipitation falls as snow in the higher elevations, particularly above 5,000 feet. Temperatures in the Downey area range from a January average of 22.3ºF to the July average of 72.4ºF. The average for the year is 47.0ºF, while the record extremes are 105ºF and -31ºF (Reference 7).

The Portneuf Range contains small basins that drain into the Downey area. At higher elevations, the basins are almost entirely rangeland. At lower elevations, the basins have agricultural uses. Many of these agricultural areas are left fallow in the winter, which tends to increase runoff more than if the land were left in its natural condition.

City of Inkom

The City of Inkom is located in southeastern Idaho, in the northern half of Bannock County. Inkom lies within the Portneuf River basin, at the mouth of Rapid Creek. Nearby communities include Pocatello, which lies 10 miles to the northwest; McCammon, 9 miles to the south; and Lava Hot Springs, 20 miles to the southeast.

The Portneuf Valley was originally buffalo rangeland claimed by the Bannock and Shoshone Indians. It was largely ignored by early settlers and bypassed by the Oregon Trail and other wagon roads of the mid-1880s. It was approximately 1865 before the first stage and freight traffic began to roll down the Portneuf Valley. This route was used to carry supplies from Utah north to the mining district of western Montana. The city of Inkom had its earliest beginnings as a stage stop along this trail.

In the 1870s, the volume of traffic along the trail had swelled to such a degree that construction of a narrow gage railroad line, called the Utah Northern Railroad, was initiated. The Oregon Shortline Railroad, which also passed through this area, was constructed in the 1880s.

The first actual settlement of Inkom began in 1895. On June 17, 1902, surrounding reservation land was opened for homesteading, and Inkom, as a farming community, began to grow. In January 1903, an application was made for a post office. In the next 12 to 15 years, almost all of the available farmland was put under the plow.

Through the years, the area's economy has developed from a variety of activities. The Union Pacific Railroad, although presently not as big an economic factor as in the past, has one of the largest railroad centers west of the Mississippi River in the nearby City of Pocatello. Pocatello also serves as a major manufacturing center for southeastern Idaho, with plants for the processing of phosphate ore and fertilizer, food-processing establishments, flour mills, and fabricated steel products facilities. The Portneuf Valley surrounding Inkom is an active, dry farm and irrigate agricultural center. The most important farm products include livestock, potatoes, wheat, oats, and dairy products; thus, Inkom serves somewhat as a commercial center for nearby farms, and, to a great extent, as a bedroom community for the industries located in Pocatello.

Inkom, as well as other rural areas of the Portneuf River Valley, was experiencing fairly substantial population growth in the early to mid 1970's. However, in 2000, Inkom's population was 738, a 4 percent reduction over the 1990 population of 769 (Reference 6).

The Ash Grove Portland Cement Company plant is the only heavy industry in the City of Inkom. Commercial development is fairly limited, with some small stores, service stations, and restaurants.

Agricultural, residential, and industrial development are all present in the Portneuf River floodplain. Both agricultural and residential development are present in the Rapid Creek floodplain. However, the Sorrell Creek floodplain is almost entirely limited, at present, to pastureland.

The City of Inkom is located in the Portneuf River Valley, at the mouth of Rapid Creek, at an elevation of approximately 4,525 feet. The Pocatello Mountain Range, which Rapid Creek drains, is located northwest of Inkom. To the east, the Portneuf Mountain Range is found and reaches an elevation of 9,270 feet at the crest of Bonneville Peak just southeast of

Inkom. To the south, Marsh Creek flows into the Portneuf River just upstream of Inkom. Marsh Creek drains the eastern slope of the Bannock Mountain Range.

The Portneuf River in the vicinity of Inkom has a fairly sinuous channel with a wide, flat floodplain. For the most part, the rest of the river follows this same pattern, although this pattern is broken with narrow, steep canyon reaches in some areas.

The Rapid Creek basin, a major tributary to the Portneuf River, occupies a 58 square mile area and flows generally from north to south. It joins the Portneuf River at Inkom. The Rapid Creek basin is bounded on the east by the Portneuf Mountain Range and on the west by the Portneuf Mountain Range. The elevation ranges from approximately 4,520 feet at the mouth to 8,120 feet in the headwaters. Approximately 65 percent of the total basin area is rangeland, with grasses and sage the most abundant plant forms. The upper portions of the basin are partially forested, particularly on north-facing slopes and in canyons. Aspen and Douglas fir are the predominant tree species. The remaining land area is dry cropland, with a very small area of irrigated farmland along the lower reaches of Rapid Creek.

Precipitation amounts and distributions in the Rapid Creek basin are very similar to those of the Portneuf River basin. Soil types and distributions are also very similar to those in the Portneuf River basin.

Sorrel Creek drains a 2.6 square mile area of the Portneuf Mountain Range immediately north of Inkom. The mouth of the canyon located just above Interstate 15, toward the west end of the city. The basin ranges in elevation from approximately 4,600 feet at the canyon mouth to 6,200 feet, with a basin mean elevation of approximately 5,300 feet. Almost the entire basin is rangeland and pastureland, with only a few timber stands located in canyon areas at the highest elevations. Normal annual precipitation, as with much of the region, is approximately 16 inches, with a fairly uniform distribution throughout the year. Soils are loamy to silty and of moderate depth in flat areas, changing to thin and rocky on steep slopes.

<u>City of Lava Hot Springs</u>

The City of Lava Hot Springs is located in eastern Bannock County. The city is within the Portneuf River basin, along the main stem of the Portneuf River which flows from east to west though the community. Fish Creek empties into the Portneuf River approximately 300 feet inside the eastern corporate limits. Nearby communities include Soda Springs, 25 miles east, on US Highway 30; Downey, 20 miles south; McCammon, 11 miles west; and Pocatello, 35 miles northwest.

Long before the settlers came to this area, the Native Americans discovered the hot springs in the area which is now Lava Hot Springs. Believing the waters to be hallowed and possessed with supernatural powers, the early tribal chiefs set aside the hot springs as neutral territory for all Native Americans to enjoy. Trappers entered the area around 1812, and, in 1860, the Hudson Bay Company set up a headquarters in Lava Hot Springs.

The land around Lava Hot Springs was given by the Native Americans to the US Government in 1902 and was ceded to the State of Idaho in 1904. At this time, 187.2 acres of land surrounding the hot springs were set aside for the benefit of the people of Idaho. The town that grew up rapidly around the hot springs was called Dempseyville. This name was later changed to Lava Hot Springs. In 1912, the State built facilities for the public to use when visiting the hot springs; in 1917, and outdoor pool was built.

In 1935, the Lava Hot Springs Foundation was established to oversee operation of the facilities and the 178 acres of State-owned land surrounding them. Although most land in Lava Hot Springs is still owned by the State of Idaho, the Foundation has statutory authority to lease the land to private citizens for periods of up to 99 years. During the period a lease is in effect, the Foundation is not responsible for the land involved or any structures on the land.

Although there are numerous small farms and ranches along the length of the Portneuf River near Lava Hot Springs, the city's economy revolves principally around tourism attracted by the Foundation recreation complex. In addition, people employed in Pocatello are beginning to emigrate with their families out of the city and into the rural areas and small towns along the Portneuf River Valley. This is increasing pressure for floodplain development along the river. In 2000, the population of Lava Hot Springs was found to be 521, up 24 percent from the 1990 census figure of 420 (Reference 6).

There is no heavy industry in Lava Hot Springs. Commercial development centers around small stores, restaurants, motels, and service stations catering to tourists. Most development in the Portneuf River floodplain in Lava Hot Springs is residential and commercial, consisting largely of single-family dwellings, apartment houses, trailer courts, and motels.

Lava Hot Springs is situated in the Portneuf River Valley at an elevation of approximately 5,050 feet. The Portneuf Mountain Range is to the west. The Fish Creek Mountain Range, which has a north-south orientation, lies to the east. Fish Creek, which drains this range, empties into the Portneuf River at the east end of the corporate area of Lava Hot Springs.

Upstream of Lava Hot Springs, the Portneuf River is controlled for irrigation purposes by two impoundments: 23,695 acre-foot Portneuf Reservoir and 685 acre-foot Chesterfield Reservoir, both located on the upper reaches of the river. These reservoirs are operated for irrigation purposes only and have no flood control capability.

Fish Creek drains a roughly rectangular basin with an area of 22 square miles. Most of the basin is in steep mountain terrain, with a few flat valley areas along the creek. Elevations range from 5,100 feet at the mouth to 8,330 feet at the crest of Baldy Mountain.

Normal annual precipitation in the Fish Creek basin is approximately 18 inches, with a fairly uniform distribution of precipitation throughout the year. As with the rest of the Portneuf River basin, much of this falls as snow during the winter at higher elevations.

Much of the Fish Creek basin is rangeland and farmland, particularly at lower elevations. Some stands of aspen and Douglas fir trees exist at higher elevations, particularly on north-facing slopes and in canyons. Soils are similar to the rest of the Portneuf River basin.

City of McCammon

The city of McCammon is located in the center of Bannock County. It lies within the Portneuf River basin, along the main stem of the Portneuf River. Nearby communities include Lava Hot Springs, 11 miles to the southeast along us Highway 30N; Arimo, 6 miles south along Interstate Highway 15; and Inkom and Pocatello, located 9 miles and 20 miles, respectively, to the northwest.

McCammon had its origin in the 1870s, during the period of active railroad construction in the Portneuf River basin. Originally established as a construction camp for the Oregon Shortline Railroad, McCammon was named after the attorney who was instrumental in its establishment. With its economy largely supported by the two railroads, the town grew rapidly. Additional growth in the McCammon area occurred in the early 1900s after the Portneuf River valley was opened for homesteading. Since then, the importance of agriculture has steadily increased and the importance of the railroads has decreased. Currently, McCammon's economy is based largely on agriculture, with range and dairy livestock production and such crops as sugar beets, wheat, oats, and potatoes of primary importance in the surrounding valley areas. However, there was a trend for people employed in the Pocatello area to move out of the city and into the rural areas and small towns of the Portneuf River valley and commute to their jobs in the city. However, this trend has not continued. The population of McCammon in 2000 was reported as 805 residents (Reference 6), an 11 percent increase over the value of 722 reported in 1990 (Reference 6).

There is no heavy industry in McCammon, and only one small light industry. Commercial development is fairly limited as well, with some small stores located in the downtown area and several gas stations and restaurants located along US Highway 30 near Interstate Highway 15. Most development in the Portneuf River floodplain is agricultural, consisting largely of barns and sheds; however, several residential dwellings are located in this area. McCammon is situated in the center of the Portneuf River valley at an elevation of approximately 4,770 feet. To the east is the Portneuf Mountain Range. Marsh Creek basin, which flows from south of McCammon north to its confluence with the Portneuf River near Inkom, is to the west of the Portneuf River valley. Marsh Creek drains the east slope of the Bannock Mountain Range, which also is oriented from north to south.

The Portneuf River immediately south of McCammon is a sluggish stream with a wide, flat floodplain and a sinuous channel. Overbank regions in some areas have dense stands of willow trees, but much of it is open pasture. Toward the north end of town, the river drops abruptly over a 12-foot waterfall and enters a steep, narrow canyon which opens up again north of the corporate limits. This pattern of sluggish channel portions in wide, flat floodplain areas, alternating with narrow, steep canyons areas, is typical of much of the Portneuf River.

City of Pocatello

The City of Pocatello is located in northern Bannock County. The city lies in the lower Portneuf River basin and is approximately 190 miles southeast of Boise, Idaho, and 12 miles east of the American Falls Reservoir on the Snake River. It is surrounded by unincorporated land of Bannock County.

Founded in 1882 as a railroad service point, Pocatello grew rapidly to become a major railroad junction for the Union Pacific Railroad. The settlement was incorporated as a village in 1889 and as a city in 1892. When the State legislature created Bannock County in 1893, Pocatello was named county seat. Land for the city was named after the Bannock Indian Chief, Chief Pocatello.

The economic life of Pocatello includes a variety of activities. The Union Pacific Railroad, although not as big an economic factor as in the past, has one of the largest railroad centers west of the Mississippi in Pocatello and still employs a large proportion of the workers of the city. The manufacturing sector of the area includes plants for the processing of phosphate ore and fertilizer, food processing establishments, cement plants, flour mills, and fabricated steel products. Pocatello is also a trade center and shipping point for the surrounding agricultural area and is engaged in other related agricultural activities. The most important farm products include livestock, potatoes, wheat, oats, sugar beets, and dairy products. Chief minerals for the area are phosphate rock for fertilizer and limestone for cement.

In the area of transportation, Pocatello is served by Interstate Highways 15 and 15W, the Union Pacific Railroad, and multiple airlines.

The 2000 population of Pocatello was 51,466. The 1990 population of Pocatello was 46,080. From 1990 to 2000 the population increased by 11.7 percent (Reference 6).

The city is drained by Pocatello Creek, which flows west through the northern portion of the city to its confluence with the Portneuf River, which flows northwest. Several smaller creeks flow into the Portneuf River and form alluvial fans at their confluence. Some of these creeks include Cusick, Johnny, Trail, and City.

The Portneuf River floodplain is approximately 45 percent residential, with the remainder either undeveloped or having such functions as golf courses and farmland. Pocatello Creek upstream of Interstate Highway 15 is sparsely developed; while, downstream of Interstate Highway 15, there is heavy residential development, with some commercial development. City Creek is undeveloped except for approximately two city blocks of residential area which are near the confluence with the Portneuf River. Trail Creek, Cusick Creek, and Johnny Creek have residential and commercial development within the alluvial fans to their confluence with the Portneuf River.

In general, the climate of the area is warm in the summer with cool nights and cold in the winter with moderate degrees of snowfall in the valleys and substantially more snowfall in the nearby mountains. Temperature extremes range from a -30ºF to 101ºF. The mean annual precipitation is 10.85 inches. Snow depths of 2 to 3 feet are common during the winter season. The mean elevation in the basin is 5,860 feet, ranging from 4,350 feet at American Falls Reservoir to 9,280 feet at the top of Oxford Peak, which lies at the southern extremity of the Portneuf River basin.

The vegetation in the basin is typical of semi-arid areas, with scrub trees, bunch grasses, ad sagebrush. However, forests cover some of the high elevations on the eastern part of the basin, and irrigation farming is practiced in the stream valleys.

2.3 Principal Flood Problems

Flooding in Bannock County in the past has been due to a number of different causes; however, the majority can be classified into one of three types: winter rain floods, spring snowmelt floods, and summer thunderstorm floods.

Winter rain floods in Bannock County have occurred in the past only when a rare sequence of climatic conditions has developed during the winter. First, a fairly moist fall and early winter seems to be required, in order to build up high soil moisture levels. Second, a midwinter period of abnormally cold conditions is required, typically lasting from 1 to 2 weeks. During this period, the ground becomes frozen; as a result, it may become nearly impermeable. Often, some snow cover exists over much of the Portneuf River basin during this cold period. If the cold weather is rapidly replaced by a warm and rainy period, unusually heavy runoff rates will occur from areas of low elevation (below approximately 5,500 feet) within the Portneuf River basin, particularly in the open valley areas of the

Marsh, Portneuf, and Gem Valleys. Nearly all major floods on the Portneuf River and Marsh Creek, including the 1911, 1962, and 1963 floods, have been due to conditions of this type. Most of these floods occurred in February. It is likely that future floods of magnitude comparable to the 1-percent-annual-chance flood on the Portneuf River and Marsh Creek would be of the winter rain flood type. At the US Geological Survey stream gaging station on the Portneuf River at Pocatello, the 1911, 1962, and 1963 floods had peaks and approximate recurrence intervals of 2,900 cubic feet per second (cfs) (33 years), 2,990 cfs (33 years), and 2,510 cfs (25 years), respectively. In comparison, the 1-percent-annual chance flood would have a peak discharge of 5,500 cfs at the Pocatello gaging station. Damage estimates are not available for the 1911 flood, but damages for the 1962 and 1963 floods were approximately $3,000,000 and $2,000,000, respectively, in Bannock County. Most of the damage was limited to urban areas in Pocatello, Inkom, and Lava Hot Springs in both years. Information on past floods was obtained from US Geological Survey Water Supply Papers (Reference 8) and from US Army Corps of Engineers Floodplain Information reports (References 1, 2, 3, 4 and 5).

Spring snowmelt floods normally occur in either May or June, the result of abnormally rapid snowmelt during warm weather periods, which are occasionally accompanied by warm rainfall. Usually, the peaks have not been more than from 25 to 50 percent greater than the average of high flows that occur for a week or more. The recession of stream flows following the peak flow has been fairly slow. Spring snowmelt floods on the Portneuf River have been quite common in the past, but usually are only moderate in magnitude. The largest flood of record of this type occurred in May 1917, and had a peak flow estimated at 2,200 cfs at the Pocatello gaging station. The recurrence interval of this flood was approximately 18 years; no estimate of damages is available for this flood. As with winter rain floods, spring snowmelt floods primarily affect the Portneuf River and Marsh Creek.

The third type of flood that occurs in Bannock County is summer thunderstorm floods. These have affected many small basins in southeastern Idaho in the past, but have not caused significant flows on either the Portneuf River or Marsh Creek. They have occurred in the past during hot summer weather periods when a moist, unstable airflow has existed in southeast Idaho. During these conditions, small, but intense thunderstorms developed during the afternoon and evening. Extremely heavy rainfall accompanies these thunderstorms, often with intensities in excess of 1.0 inch per hour. Runoff from these events is abrupt and extremely rapid and occasionally results in flash floods. Channel flows rise to exceptionally high levels over a period of 1 to 3 hours and recede as rapidly as they rose. During peak flow conditions, large quantities of mud, boulders, brush, and other debris are carried by the water and may be deposited behind channel obstructions. Most floods of this type occurred in July and August in Bannock County, although such conditions can develop during other months. It is likely that future floods of a magnitude comparable to the 1-percent-annual-chance flood in all small basins in Bannock County would be of the summer thundershower type. Thunderstorm floods can develop high flow rates in small basins. For example, a flood on August 12, 1961, in a 2.8 square mile tributary to Green Canyon near Inkom, produced a peak flow later estimated at 3,060 cfs (Reference 9). A flow of this magnitude would be disastrous if it occurred in a populated canyon. Damaging thunderstorm floods have occurred on Pocatello, Rapid, Arkansas, and Sorrell Creeks, among others; no damage estimates for any of these floods are available.

In addition to floods of these three main types, local flooding has occurred in Bannock County, with lower flows due to ice jams or debris blockage behind channel obstructions. Ice jams on the Portneuf River near Pocatello are a frequent winter hazard, particularly during, or immediately following, an unusually cold period. This problem has also occurred on Rapid Creek near Inkom. At such times, flood depths upstream of this obstruction can become much greater than would otherwise be expected for the given flow rate.

City of Downey

Flooding in Downey is caused by local drainage from a series of small basins on the west slope of Portneuf Range east of the city. This drainage is intercepted by the Portneuf-Marsh Valley Wasteway Canal at a natural swale 1 mile north of Downey. A 60-inch culvert located under the canal enables all but very high flows to continue on west past the canal. Such high flows, however, can overtop the culvert and fill the canal. Also, smaller flows from other areas north of the swale can be intercepted by the canal and diverted south within the canal. At the swale, a check structure enables all or part of the canal flow to drop into the Portneuf-Marsh Valley Wasteway Canal. Here it joins with drainage from the 60-inch culvert under the main canal.

Flooding of any consequence in Downey has occurred three times: in February 1962, February 1963, and February 1980. However, local flooding of agricultural fields near the swale north of town occurs nearly every year. In 1962 and, also, to a lesser extent in 1963, the canal and wasteway canal were filled beyond their capacity with storm runoff. Overflows occurred at points where the capacity was reduced due to low banks or channel constrictions such as culverts. Debris blockage at channel constrictions and ice within the canals, likewise contribute to the flooding problems. It is estimated that the 1962 flood had a peak discharge of approximately 160 cfs. No estimate is available for the 1963 flood. It is believed, however, to have a similar, but slightly lower, peak discharge. Interviews with persons living in Downey at this time, revealed that little flooding occurred in 1963, and most of the 1962 flooding was very shallow. For the most part, flood depths during the 1962 flood were most likely in the range of 6 to 18 inches. There are no damage estimates available for the 1962 or 1963 floods in Downey. Residents interviewed, however, cited minimal damage. It is estimated that the 1962 and 1963 floods were approximately equivalent to a 2-percent-annual-chance flood event. In comparison, the 1-percent-annual chance flood would have a peak flow of 230 cfs. Both the 1962 and 1963 floods were due to rain falling on frozen ground. Flooding also occurred in Downey in February 1980, but information was not available as to the extent of damage.

It is likely that a future flood of magnitude comparable to the 1-percent-annual chance flood would be due to conditions similar to that described previously.

City of Inkom

Flooding in the City of Inkom is caused by overflow from the Portneuf River, Rapid Creek, and Sorrell Creek. Nominal bankfull capacity for the Portneuf River at Inkom is approximately 900 cfs. In the 68 years of record at the US Geological Survey stream gage at Pocatello (near the Carson Street Bridge), this flow has been exceeded 25 times. There is no record of flooding prior to 1897.

Nominal bankfull capacity of Rapid Creek in Inkom is approximately 600 cfs, although localized flooding may occur with lower discharges due to accumulation of debris at channel obstructions. A stream gage was located on Rapid Creek for a period of six years between 1980 and 1986. The maximum recorded peak discharge was 1,150 cfs on May 25, 1981. Prior to the installation of the gage, a number of floods occurred in the basin, and, in several cases, estimates of their peak discharges were made. The largest published pre-gage peak flow estimate for Rapid Creek in Inkom was made at the Jackson Creek Road Bridge on February 1, 1963, by the US Geological Survey, for which a flow of 526 cfs was reported (Reference 9). However, the peak flow for a cloudburst flood that occurred on August 24, 1977, was estimated based on high-water marks surveyed the next day at the Jackson Creek Road Bridge. This estimated peak was 625 cfs. A similar flood occurred on August 26, 1955, and is believed to have had a similar peak flow. At least 15 damaging floods have occurred on Rapid Creek since 1950 in or upstream of Inkom.

In comparison, the 1-percent-annual chance flood for Rapid Creek would have a peak discharge of 1,750 cfs and the 0.2-percent-annual chance flood would have a peak flow of 2,730 cfs. Information on past flooding on Rapid Creek was obtained from US Geological Survey streamflow records (Reference 9) and from a U.S. Soil Conservation Service Flood Hazard Analysis Report (Reference 10).

Past floods on Rapid Creek have been of two different types. The first is winter rain floods, of the type discussed for flooding on the Portneuf River. The February 1962 and February 1963 floods on Rapid Creek were both of this type. The second type of event is summer thunderstorm floods. The majority of floods reported for Rapid Creek since 1950 have been of this type. They have occurred during hot summer weather periods, particularly in July and August. It is likely that future floods of magnitude comparable to the 1-percent-annual chance flood (1,750 cfs) would be of the summer thundershower type.

Floods on Rapid Creek in the past have been aggravated by the accumulation of either ice (during winter floods) or debris (during summer floods) at channel obstructions. These phenomena have resulted in significantly higher water-surface elevations just upstream of the obstructions than would otherwise be expected for the given flow rate. In December 1964, for example, an ice jam at the Interstate Highway 15 Bridge in Inkom caused flooding in town in that area, even though streamflows were only moderate at the time.

Sorrell Creek is a third source of flooding in Inkom. The stream, which drains a small canyon north of the city and to the west of Rapid Creek, is subject to occasional thunderstorm floods. Large winter floods are not likely to occur on Sorrell Creek. Since construction of a flow diversion structure just above Interstate Highway 15 in 1974, most flow from Sorrell Creek during an intense flood will be diverted into Rapid Creek; however, a discharge of approximately 300 to 400 cfs from Sorrell Creek can still flow through a culvert under Interstate Highway 15 and cause flooding in the northwest end of Inkom. There is little historical record of past thunderstorm floods from Sorrell Creek; however, a flood from Sorrell Creek occurred on July 20, 1973, producing a peak flow of approximately 530 cfs. In comparison, the 1-percent-annual chance flow for Sorrell Creek would be 1,500 cfs. No damage estimates are available for the 1973 flood.

<u>City of Lava Hot Springs</u>
Flooding in Lava Hot Springs is caused by overflows from the Portneuf River and Fish Creek. Nominal bankfull capacity of the Portneuf River at Lava Hot Springs is approximately 3,000 cubic feet per second (cfs) above the Main Street Bridge, 2,000 cfs from that bridge to the downstream end of the floodwall in town, and 1,100 cfs downstream of the floodwall.

In the 61 years of record at the USGS stream gage at Topaz (near Lava Hot Springs), 1,100 cfs has been exceeded five times. There is little record of flooding prior to 1911, but it is believed that a large flood occurred in 1897. The three largest flows of record at the Topaz gage occurred in 1911, 1962, and 1963. The estimated natural discharges and approximate recurrence intervals for these three floods are 3,300 cfs (50 years), 3,690 cfs (62 years) and 2,400 cfs (33 years), respectively. The instantaneous observed peaks at the Topaz gage in 1962 and 1963 were 6,140 cfs and 7,120 cfs, respectively. These extremely high flows occurred for a very short period of time and were caused in both years by failure of US Highway 30 road fill between Lava Hot Springs and the gage. These abnormally high peak flows were limited to areas downstream of Lava Hot Springs, so peak flows in the city were close to the 3,690 cfs and 2,400 cfs natural discharges. In comparison, the 1-percent-annual chance flood would have a peak discharge of 4,750 cfs at Lava Hot Springs. The largest flood of record due to spring snow melt floods occurred in May 1917 and had a peak flow estimated at 1,030 cfs at the Topaz gaging station.

The 1962 and 1963 floods caused extensive damage to various buildings and road crossings in Lava Hot Springs. Total damages to the urban area of Lava Hot Springs from the 1962 flood were estimated at $794,000 (Reference 11). No damage estimate is available for the 1963 flood. The Main Street and Center Street river crossings, which were road fills over large culverts prior to the 1962 flood, were both lost during the flood. The Main Street crossing was dynamited by the Army National Guard to alleviate flooding along Main Street caused by backwater from the bridge; the Center Street crossing was washed out. Both were replaced by bridges following the flood and remained intact through the 1963 flood. Severe floods on the Portneuf River in 1962 and 1963 inundated the bathhouse and pool and caused considerable damage to the facilities.

Fish Creek is subject to two types of floods: summer thunderstorm floods and winter rain floods similar to those discussed for the Portneuf River. Spring snowmelt conditions are not likely to generate significant floods from Fish Creek.

Although there are no records of damaging thunderstorm floods in the past on Fish Creek, these have occurred in the vicinity. For example, a thunderstorm flood that occurred August 1, 1960 in Jenkins Canyon, 5 miles west of Lava Hot Springs, generated an estimated 2,350 cfs from a 5.5 square mile drainage area (Reference 9).

The largest flow of record on Fish Creek occurred during the February 1963 winter rain flood. The peak flow from Fish Creek was estimated at 1,360 cfs (Reference 9). There is no record of damages associated with this flow.

City of McCammon

Flooding in McCammon is caused by overflows from the Portneuf River. Nominal bankfull flow on the Portneuf River at McCammon City is approximately 1,000 cubic feet per second (cfs). It is likely that the peaks at McCammon were close to the estimated natural flows of 3,690 and 2,400 cfs for 1962 and 1963, respectively. In comparison, the 1-percent-annual-chance flood would have a peak discharge of 5,100 cfs at McCammon.

City of Pocatello

The longest record of streamflows for the Portneuf River is at Pocatello, where a continuous record has been kept since 1917. Also, incomplete records were kept for the periods from 1897 to 1899 and from 1911 to 1917. The gage location prior to the construction of the Pocatello Flood Control Project in 1968 was just above the West Fremont Street Bridge. The present gage location is just below the West Carson Street Bridge at the lower end of the flood control project. Other gages in the Portneuf River basin are located on the Portneuf River, 4 miles west of Lava Hot Springs; on Marsh Creek near McCammon' and, on South

Fork Pocatello Creek, near Pocatello.

Approximately 80 percent of the annual peak discharges in the lower Portneuf River have occurred during spring snowmelt. The 1962 and 1963 peaks were actually recorded, while the 1911 peak is an estimate. Crest stages, discharges, and occurrences for the known floods on the Portneuf River equaling or exceeding bankfull stage of 7.0 feet or 1,130 cfs at the Pocatello gage are shown in Table 4.

The 1962 flood was caused by frozen ground conditions with some snow in the valleys followed by rapid warming and substantial rain. Most of the runoff was generated in areas below 6,000 feet in elevation, with frozen ground increasing the percentage of runoff far beyond normal occurrences. This flood exceeded bankfull stage for 5 days, with the peak reaching 2,990 cfs. Total monetary damages in the entire Portneuf River basin were estimated to be $3,485,000 with $1,041,000 of that attributed to the City of Pocatello. Most of this damage was in the area now served by the Pocatello Flood Control Project.

The following are excerpts from the Idaho State Journal, Pocatello, concerning the 1962 flood:

> …with the Portneuf River continuing its relentless rise to an all time high, Pocatello and neighboring communities buckled down today in an all out effort to prevent what could be the greatest disaster in the city's history.
>
> The Portneuf River, which rose steadily for more than 72 hours hit a peak early this morning and began dropping slightly, bringing the first relief in more than three days to flood-weary Pocatello.
>
> Best official estimates placed the number of homes now under water at about 450, including those located south of Pocatello.

The February 1963 winter rainstorm flood occurred in a 4-day period, with flow exceeding bankfull stage on February 1, reaching a flood peak of 2,470 cfs on February 3, and subsiding back to bankfull by February 5. Conditions causing flooding were frozen ground combined with 5 to 8 inches of snow in the valleys, followed by rapid warming and substantial rain. The following excerpts appeared in the February 3 issue of the Idaho State Journal, Pocatello.

> Pocatello appeared to be winning its battle Saturday night against the second disastrous flood here within a year. …about 100 houses in Pocatello had been abandoned to the water.
>
> In Pocatello residents began the weary task of washing out mud and silt washed in by the flood waters. Many residents were heard to say they just recently completed making repairs to their homes from the 1962 flood, only to have the same thing happen again.

Ice jam flooding has occurred on the Portneuf River in the past when temperatures drop into the sub-zero range for several weeks and are followed by a warming period. The ice jams may cause flooding with flows of much less magnitude than the 1- or 0.2-percent-annual-chance floods. The information on ice jam floods is very scanty and the prediction of frequency would not be feasible. The flooding is caused by obstruction of the channel and the most likely problem areas would be at bridges and low-velocity channel reaches.

The main obstructions to flood flow in all of the tributary floodplain reaches are the road crossings and buildings. The flood flow of Johnny Creek may cover the area between the Cheyenne Avenue road fill and the left bank levee at the beginning of the Pocatello Flood Control Project. Most of the flood flows entering this area will be forced through the two 54-inch culverts in the levee just upstream of Cheyenne Avenue Bridge. Irrigation ditches in the floodplain areas and debris carried by the flood waters are other actors that will affect flood flow.

For small areas subject to thunderstorm floods that occur very rapidly, it is practically impossible to have meaningful flood forecasting. The best that can be done is to provide warnings when thunderstorms are likely to occur in the vicinity of Pocatello.

There are no stream gage records on any of the four tributary areas. However, interviews with local residents indicated that past floods have occurred and are of two types - general rain and snowmelt floods and flash floods from thunderstorms. Due to the small size and steepness of the tributary areas, thunderstorm floods will produce much higher peak discharges than will general rain and snowmelt floods.

Table 4
Floods above Bankfull Stage, In Order of Magnitude,
Portneuf River Near Pocatello, Idaho

Order Number	Date of Crest	Gage Height[1] (Feet)	Stage Elevation (Feet)	Estimated Peak Discharge (Cubic Feet per Second)	Average Recurrence Interval (Years)
1.	February 14, 1962	11.3	4,448.3	2,990[1]	34
2.	February 1, 1911	11.1	4,448.1	2,990[1]	33
3.	February 3, 1963	10.1	4,447.1	2,470[1]	24
4.	May 17, 1917	9.4	4,446.4	2,200[1]	20
5.	May 18, 1897	8.8	4,445.8	1,880[1]	14
6.	May 23, 1922	7.9	4,444.9	1,510[1]	9
7.	May 10, 1921	7.8	4,444.8	1,500[1]	8
8.	May 23, 1912	7.3	4,444.3	1,240[1]	6
9.	May 14, 1971	9.6	4,428.0	1,580[2]	10
10.	May 9, 1972	8.2	4,426.6	1,260[2]	6
11.	May 19, 1975	9.4	4,427.8	1,540[2]	9

[1] All stages and discharges refer to the West Fremont Street Bridge gage, which was used prior to construction of the Pocatello Flood Control Project in 1968. Zero for gage is equal to an elevation of 4,436.98 feet (NGVD29). Bankfull stage was 7.0 feet.

[2] After construction of Pocatello Flood Control Project, bankfull stage is 17 feet. Zero of gage equals 4,418.41 ft (NGVD29). The gage is located 1,400 feet downstream from the West Carson Street Bridge.

2.4 Flood Protection Measures

Existing flood protection measures in Bannock County include structural measures, flood warnings, and floodplain management. Although several studies have been made for major flood control works in the Portneuf River basin, none have thus far proved economically feasible. The largest flood control project in Bannock County is a 7.2 mile-long levee and concrete channel system, constructed on the Portneuf River in 1968 by the US Army Corps of Engineers, to provide protection for the City of Pocatello and some unincorporated areas of Bannock County. The flood control project consists of a concrete-lined channel which changes shape at both ends to become a trapezoidal earth channel with rock revetment and levees. Much of the Portneuf River in Pocatello has been included in this project. This system is designed for a peak flow of 6,000 cfs and will contain the 1-percent-annual-chance flood (5,500 cfs), but not the 0.2- percent-annual-chance flow (14,500 cfs). This levee system is currently undergoing accreditation. During the interim, the levees are considered to be provisionally accredited according to the agreement between FEMA and the City of Pocatello signed April 12, 2007.

There have been some efforts by local citizens to reduce the potential for flooding in Downey. The wasteway diversion and underpass culvert for the wasteway canal have been extensively modified to allow better control of diversion and to provide a more reliable method of passing wasteway flows under the canal. A long, low dike was constructed in an area east of the city following the 1962 flood. This dike intercepts some of the local runoff that caused flooding during the 1962 event, and diverts it toward the wasteway canal. The dike gives below 1-percent-annual-chance flood protection, but only in the eastern section of the city. There are several serious problems with these flood control works. First, there is no plan of operation for control of floodflows at the diversion structure of the canal. Thus, whether or not high flows in the canal are diverted into the wasteway depends on a number of unpredictable variables. Secondly, regardless of how the diversion structure is operated, some Downey residents will be inundated during a 1-percent-annual-chance flood. There simply is not adequate capacity in the canal system to handle flows of this magnitude.

In the City of Inkom, a short floodwall was constructed along the Portneuf River to protect the Idaho Portland Cement Company. This floodwall does not protect the cement company from flows on the order of the 1-percent-annual-chance flood, nor does it provide protection for any floods on the north side of the river.

Sorrel Creek above Inkom, however, has been significantly modified in recent years by structures that provide protection for flows on the order of magnitude of the 1-percent-annual-chance flood. When Interstate Highway 15 was constructed through Inkom during the summer of 1964, a large weir and flow collection structure was installed at the mouth of the canyon just above the highway. The structure diverts flow into a 60-inch diameter concrete culvert under the highway. The structure has a capacity of approximately 300 to 400 cfs. Any flows from Sorrell Creek greater than this amount will split, with approximately 300 to 400 cfs passing under the highway and the remainder flowing down a flume structure that passes under Rapid Creek Road and discharges into Rapid Creek. The flume has a capacity of approximately 100 to 1,200 cfs; therefore, during a 1-percent-annual-chance flood (with a total flow of 1,500 cfs), from 300 to 400 cfs would flow under Interstate Highway 15 in the culvert and from 1,100 to 1,200 cfs would flow down the flume. A small percentage of the flows carried by the flume (no more than 200 cfs) might overtop the flume at Rapid Creek Road and cause some localized flooding in the immediate vicinity of the road bridge.

Other channel improvements include a concrete floodwall constructed by the State of Idaho in 1964 to protect the Lava Hot Springs Foundation's swimming pool-recreation complex during floods. This floodwall provides protection only on the north side of the river. It provides no protection for either residential or commercial structures located on the south side of the river. Furthermore, the floodwall may be overtopped with a flow of only 2,000 cfs, which is approximately a 4-percent-annual-chance flood.

Flood warnings for the Portneuf River Basin are prepared by the National Weather Service River Forecast Center in Portland, Oregon. These warnings are transmitted through the Boise National Weather Service Office to the Pocatello national Weather Service Office for local dissemination to county officials, radio and television stations, and local newspapers. Stage forecasts are prepared for the US Geological Survey stream gaging station at Pocatello, and can be extrapolated to other locations in the basin, when high water stages are expected; observations of river stages are made at strategic locations, and are coordinated through the Bannock County Civil Defense Office. Flood fighting, evacuation, and rescue activities are coordinated on a county-wide basis with local public agencies. Little warning should be expected for floods on any of the tributaries of the Portneuf River, particularly from summer thunderstorms. The National Weather Service does make regional thunderstorm forecasts when conditions indicate they are likely; however, it is not possible to predict where these storms will occur or how much runoff to expect. River stages at Lava Hot Springs are provided seasonally by a local observer.

Another measure for providing flood protection from future floods is floodplain management. By restricting development in hazardous floodplain areas, flood related damage is prevented from occurring from all but the extremely large floods. Bannock County has enacted a floodplain management ordinance, known as "Bannock County, Idaho, Interim Flood Plain Zoning Ordinance", (adopted April 12, 1976), which defines the floodplain areas in Bannock County and specifies land use permitted in these areas.

3.0 ENGINEERING METHODS

For the flooding sources studied by detailed methods in the community, standard hydrologic and hydraulic study methods were used to determine the flood-hazard data required for this study. Flood events of a magnitude that are expected to be equaled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for floodplain management and for flood insurance rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10-, 2-, 1-, and 0.2-percent chance, respectively, of being equaled or exceeded during any year. Although the recurrence interval represents the long-term, average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than 1 year are considered. For example, the risk of having a flood that equals or exceeds the 100-year flood (1-percent chance of annual exceedence) in any 50-year period is approximately 40 percent (4 in 10); for any 90-year period, the risk increases to approximately 60 percent (6 in 10). The analyses reported herein reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish peak discharge-frequency relationships for each flooding source studied by detailed methods affecting the community.

Stream gage records were available for the Portneuf River at Pocatello and at Topaz, with periods of record of 68 years and 61 years, respectively. Flow discharges recorded for these stations were previously analyzed statistically by the US Army Corps of Engineers for use in floodplain Information studies covering a reach from just upstream of Pocatello to 3,000 feet upstream of McCammon (References 1, 2, and 3).

A review and updating of that analysis was made, using the standard procedure of log-Pearson Type III curve fitting as described by the US Water Resources Council (Reference 12). Due to technical considerations, the new frequency curve varied somewhat from that derived earlier by the US Army Corps of Engineers. The newly developed 1-percent-annual-chance flow was 50 percent lower than the 1-percent-annual-chance flow used by the US Army Corps of Engineers; however, to maintain regional consistency in the hydrology of the Portneuf River basin, the Federal Emergency Management Agency elected to adopt the US Army Corps of Engineers frequency curve.

The peak discharges for floods of the selected recurrence intervals in the City of Lava Hot Springs are somewhat lower that those reported for the Topaz gaging station. This is because discharges upstream of the confluence points of Fish and Demsey Creek have been reduced by amounts equivalent to the tributaries respective inflows. The estimated flow rate for each tributary during peak flow stages on the Portneuf River was determined by establishing a basin flow model for the February 1962 flood, based on peak flow measurements made at the time. The 1962 flow rates used in the model were extrapolated to determine conditions during the 10-, 2-, 1-, and 0.2-percent annual chance flood.

Data from the above mentioned gages was also used to calculate peak discharges for the Portneuf River in the City of Pocatello. Values of the 10-, 2-, 1-, and 0.2-percent-annual-chance peak discharges were obtained from a log-Pearson Type III distribution of annual peak flow data (Reference 13) using Statistical Methods in Hydrology (Reference 14).

Streamgage records were also available for Marsh Creek near McCammon, with a period of record of 21 years. Flow discharge records for this station were previously analyzed statistically by the US Soil Conservation Service for use in a Flood hazard Analysis study (Reference 4).

No stream gage records were available for any other basins studied in the unincorporated areas of Bannock County. These basins are relatively small; thus, they are susceptible to summer thunderstorm flooding. Six of these basins were analyzed using rainfall-runoff modeling. These include Pocatello, South Fork Pocatello, Johnny, Gibson Jack, Mink, and Fort Hall Mine Creeks. Synthetic unit hydrographs were generated for each basin using the Snyder Method (Reference 15). Typical thunderstorm-rainfall sequences for each basin were simulated using National Weather Service procedures and published precipitation-frequency data (Reference 16). Loss rates were based on an earlier unpublished analysis conducted by the US Army Corps of Engineers in several southern Idaho basins.

The US Soil Conservation Service previously conducted a hydrologic analysis of Rapid Creek for a Flood Hazard Analysis study (Reference 5). No stream gage records are available for Rapid Creek, so the US Soil Conservation Service's analysis was made using two different regional analysis techniques. The first technique was a procedure called PO-2, developed by the US Soil Conservation Service Regional Technical Service Center in Portland, Oregon; this procedure has not been verified for thunderstorm floods in southern Idaho. The second technique consisted of plotting all known peak flow estimates for small basins in southern Idaho on a graph of drainage area-versus-discharge. Smoothed curves of flood frequency were plotted as a third parameter on this graph, for floods of 20-, 10-, 4-, 2-, and 1-percent-annual-chance. For the 20-, and 10-percent-annual-chance floods, the placement of the curves was partially verified by information on the frequency of the overtopping of road culverts. The 1-percent-annual-chance flood was established as an enveloping curve, assuming that none of the observed floods in southern Idaho could have exceeded a 1-percent-annual-chance flood. The 4- and 2-percent-annual-chance flood curves were positioned by plotting the 10- and 1- percent-annual-chance flows on log-probability graph paper and assuming a straight-line (zero skew) relationship for floods on Rapid Creek. The two regional analysis techniques produced similar results for the 1- percent-annual-chance flows, but drastically different for the 20- and 10- percent-annual-chance flows. The PO-2 procedure generally produced higher flows. The US Soil Conservation Service decided to adopt the regional frequency discharge-drainage area graph for their study, rather than the PO-2 procedure.

Agreement was reached during preparation of this Flood Insurance Study between the study contractor and the Idaho State office of the U.S. Soil Conservation Service as to a reasonable 0.2-percent-annual-chance flood frequency curve on their frequency-discharge-drainage area graph. Several attempts were also made by the study contractor to verify the U.S. Soil Conservation Service determination using different methods of analysis. These included a statistical probability, or risk, analysis; a regional frequency analysis; and a standard synthetic unit hydrograph for a rainfall-runoff model of the Rapid Creek basin (References 17 and 18). Rainfall totals for the rainfall-runoff model were based on procedures and data published by the National Weather Service (Reference 16), while loss rates were based on a special investigation of thunderstorm loss rates conducted by the U.S. Army Corps of Engineers, Walla Walla District. All three analysis techniques were in agreement with the flow used by the U.S. Soil Conservation Service for the 10-percent-annual-chance flow, but the 2-, 1-, and 0.2-percent-annual-chance flows developed by the study contractor were 24, 40, and 36 percent lower, respectively, than the U.S. Soil Conservation Service's flows at the mouth of Rapid Creek. However, due to the inherent uncertainty in hydrologic analysis of thunderstorm runoff, the Federal Emergency Management Agency elected to adopt the U.S. Soil Conservation Service's frequency curve.

The regional frequency discharge-drainage area graph was also used by the US Soil Conservation Service for determining flood flows on seven tributaries to Marsh Creek, including Walker, Bell Marsh, Dry Canyon, Goodenough, Rowe, Cottonwood, Birch, and Ellis Creeks, as well as an unnamed tributary to Marsh Creek near Bell Marsh Creek.

Seven of the remaining small basins in Bannock County were analyzed using a regionalized 1-percent-annual-chance, thunderstorm-flood peak flow-versus-drainage area curve developed by the study contractor. The curve was developed by plotting the peak discharges for 1-percent-annual-chance thunderstorms in 19 basins in Bannock County ranging from 1 to 60 square miles in area versus their drainage areas. Each of the 19 thunder-storm-flood peaks was based on Snyder method synthetic rainfall-runoff modeling. The six basins analyzed with the use of this curve include Sorrell, Indian, Jackson, Hawkins, Dempsey, and Fish Creeks, as well as an unnamed tributary to Marsh Creek near Walker Creek.

The drainageway near City of Downey was analyzed in a different way; due to the flat topography of the area, it was felt that thunderstorm runoff was unlikely to be a significant source of flooding. Due to the shallow nature of flooding in Downey, only the 1-percent-annual-chance flood was studied.

It was concluded that the 1-percent-annual-chance discharge for this drainageway would be due to floods caused by frozen ground, similar to those affecting Marsh Creek and the Portneuf River. Because no stream gage records or historical flood peak measurements are available for this drainageway, a regional comparison approach was used to obtain the magnitude of the 1-percent-annual-chance flood for the Downey drainage-way.

The first step in this analysis was to determine what the unit (flow per square mile) flood discharges were for some nearby basins similar to those causing flooding at Downey. Flows in these basins were measured during the 1962 flood. These unit flows were weighted according to their similarity and proximity to the Downey basins, and an average discharge per square mile was determined for the 1962 flood on the Downey drainageway. The peak flow was determined to be 130 cfs for the 15.4 square mile contributing basin at Downey. The peak flow, also considering flow into the Downey area from the Portneuf-Marsh Valley Canal and the diversion of flow out of Marsh Creek into the area, was estimated at 160 cfs.

The next step was to check the frequency of the 1962 event on the Portneuf River at Topaz and Marsh Creek near McCammon, which are the two closest stream gaging stations. This check showed that the 1962 flood was between a 50- and 60-year recurrence interval event at both stations. Because the 1962 flood in the Downey drainageway was the largest event according to area residents, it could have also been a 50- to 60-year recurrence interval flood. Because the conditions required to cause major winter flooding in these basins are likely to cover a large area, it was assumed that, if a 1-percent-annual-chance event occurred on the Portneuf River or Marsh Creek, an event with a similar recurrence interval would occur at Downey.

The last step in the study was to compare the ratios of the 1962 floodflows with the predicted 1-percent-annual-chance flows at the two gaging stations. The two ratios were almost identical, and there seemed to be no dependency on basin area, which varied from 570 square miles for the Topaz gage to 355 square miles for the Marsh Creek gage. This ratio was applied to the 1962 flow in the Downey drainageway to obtain a 1-percent-annual-chance discharge of 175 cfs. An assumed discharge of 25 cfs was added to this figure to account for diversion of Marsh Creek flow into the Downey area, and a discharge of 30 cfs was added for flow carried into the Downey area within the Portneuf-Marsh Valley Canal.

Frequency-discharge data for Trail Creek, City Creek, Pocatello Creek, Cusick Creek, and Johnny Creek were developed using National Weather Service Technical Paper No. 40 to determine specific frequency rainfall amounts (Reference 19). The specific rainfall data were applied to Snyder's Synthetic Unit Hydrographs for each drainage basin (Reference 18). The peak discharges were bulked to account for suspended sediments and debris. These five small drainages are susceptible to intense thunderstorms.

The 1 percent annual chance peak discharges for Fish Creek and Sorrell Creek were based on regionalized peak flow-versus-drainage area curves developed for thunderstorm floods in small basins by computing synthetic thunderstorm floods for numerous basins in Bannock County.

Countywide Revision

The effective flows for Rapid Creek were originally developed and provided in the document "Rapid Creek Flood Hazard Analyses" for Bannock County, ID (Reference 5). The U.S. Soil Conservation Service (SCS) employed several analytical methods to arrive at estimates of flood frequency and magnitude. No stream data were available for Rapid Creek at the time of the analysis. The SCS used their in-house procedure called PO-2 as well as plots of all known peak flow estimates for small basins in southern Idaho on a drainage area versus discharge graph. Flood frequency curves were plotted on these data. The 1-percent-annual-chance frequency curve was plotted as an enveloping curve assuming that none of the recorded peak flows had exceeded a 1-percent-annual-chance flood. In addition, the estimated flows for Rapid Creek were 'bulked" to account for sediment and debris loading. However, the amount of "bulking" was not provided in the SCS document. Also, changes in future land use conditions were considered in the estimates of peak flows. Again, no detail on how land use was considered was provided in the SCS document.

In addition to the analysis conducted by the Soil Conservation Service, the study contractor conducted an independent analysis of the hydrology using statistical probability, a regional frequency analysis, and a standard synthetic unit hydrograph for a rainfall-runoff model in order to verify the U.S. Soil Conservation Service estimates. The study contractor's estimate of the 1-percent-annual-chance peak discharge was 40 percent lower than the estimate made by the U.S. Soil Conservation Service. The Federal Emergency Management Agency (FEMA) elected to use the U.S. Soil Conservation Service estimate of 7,500 cfs for the 1-percent-annual-chance peak discharge on Rapid Creek (Reference 20).

A memorandum dated March 10, 2002 from Michael Baker Jr. to Mr. Joseph Weber at FEMA Region X (Reference 21) addresses the Idaho State Floodplain Administrator's concern that the effective FIS estimate for the 1-percent-annual-chance peak discharge of 7,500 cfs for Rapid Creek is too large. The memo summarizes the analysis conducted by the Idaho State Floodplain Administrator to evaluate the reasonableness of the effective hydrology for Rapid Creek. The memo also details the additional analysis conducted by Michael Baker Jr. to further evaluate the peak discharge values.

Data for the additional analysis came from effective FIS base flood discharges for other streams in Bannock County, base flood discharges developed from regression equations provided in U.S. Geological Survey (USGS) Open File Report (OFR) 81-909 (Reference 22), and maximum recorded discharges and base flood discharges developed from statistical analysis of gaging stations in or near Bannock County. A gaging station installed on Rapid Creek collected data between 1980 and 1986 for a total of 6 years. Peak annual flows were also estimated for the 1955, 1963, and 1977 floods resulting in 9 years of combined peak flow data for the Rapid Creek gage.

The memo states that the Rapid Creek watershed has a mean annual precipitation (MAP) of 16 inches and a mean basin elevation (MBE) of approximately 6,300 feet. The criteria used to select gaging stations in basins with watershed characteristics similar to Rapid Creek were as follows: MAP of 10 to 24 inches, and MBE of 4,900 to 7,000 feet. With these criteria, eight gaging stations were selected using OFR 81-909 as the data source for MAP and MBE. A regression analysis was conducted using these data resulting in a base flood discharge of 1,900 cfs for Rapid Creek. The memo also states that the gaging station record, albeit only 9 years, indicates that the base flood discharge is about 1,860 cfs. The memo concludes that the State Floodplain Administrator has a valid argument that the effective discharge is too high and that "a more detailed hydrologic analysis of base flood discharges for Rapid Creek…appears warranted".

WEST Consultants used annual peak discharges from selected gaging stations in nearby basins with watershed characteristics similar to Rapid Creek to develop a set of proposed regression equations. The MBE criterion used in the 2002 memo was also used for the proposed hydrology analysis. However, the MAP was adjusted from a range of 10 to 24 inches to a range of 10 to 30 inches as the estimate for MAP in the Rapid Creek basin was revised to 19 inches. The revised value for MAP was determined by approximation from an isohyetal map for the state of Idaho for the period 1961-1990 (Reference 23). In addition to MBE and MAP, Forest cover was also included as a selection criterion. A forest cover estimate of approximately 19 percent was determined for the Rapid Creek watershed from recent aerial photos. The forest cover criterion for selecting gaging stations from watersheds similar to the Rapid Creek basin ranged from 8 to 29 percent.

Data for basin characteristics (MAP, MBE, and forest cover) came from the USGS Water-Resources Investigations Report (WRIR) 02-4170 (Reference 24), which was published shortly after the 2002 memo previously described. The potential number of gaging stations available for the analysis was limited to stations with 10 or more years of record within Regions 7b and 8 as delineated in WRIR 02-4170. Although spatially close in proximity, Region 0 was not considered in this analysis as it is an undefined area in WRIR 02-4170 with a significant amount of flow attributed to ground water.

Estimates of MAP at some gaging stations changed significantly from OFR 81-909 to WRIR 02-4170. MAP values listed in OFR 81-909 were developed from a grid-overlay method on a 1930-1957 NOAA mean annual precipitation map. MAP values listed in WRIR 02-4170 came from a more recent 1961-1990 mean annual precipitation map produced at the University of Idaho. MAP values for both reports for selected gaging stations are shown in Table 5.

Only MAP values from WRIR 02-4170 were used in the analysis. Also, some stations listed in OFR 81-909 were not included in WRIR 02-4170. The seven gaging stations selected for the analysis are listed in Table 6 along with corresponding criteria values.

Table 5. Comparison of USGS Reports WRIR 02-4170 and OFR 81-909 MAP values.

Gaging Station No.	1961-1990 MAP (inches) (WRIR 02-4170)	1930-1957 MAP (inches) (OFR 81-909)
10119000	13.20	24
13054400	16.55	20
13057940	16.61	--[1]
13062700	20.00	18
13075000	14.30	19
13079200	17.39	35
13092000	14.46	15

[1]Data not available

Table 6. Summary of watershed and climatic characteristics and flood peak discharges for selected gaging stations in the vicinity of Rapid Creek.

Station No.	Period of Record (years)	Drainage Area (sq. mi.)	Mean Basin Elev. (feet)	Mean Annual Precipitation (inches)	Forested Area (percent)	10-percent-annual-chance peak discharge	2-percent-annual-chance peak discharge	1-percent-annual-chance peak discharge	0.2-percent-annual-chance peak discharge
10119000	32	107	6,070	13.2	8.10	425	1,050	1,480	3,040
13029500	22	108	7,018	26.7	59.3	1,490	1,980	2,160	2,530
13054400	19	17.5	6,552	16.6	15.7	453	1,270	1,820	3,800
13057940	21	431	6,423	16.6	19.2	1,720	2,810	3,290	4,440
13062700	16	14.3	6,881	20.0	28.3	707	1,240	1,510	2,250
13075100	9	57.2	6,300	19.0	15.0	934	1,400	1,600	2,090
13079200	36	81.6	6,350	14.5	9.40	411	574	636	766

The U.S. Army Corps of Engineers Flood Frequency Analysis (FFA) software (Reference 25) was used to determine flood frequency flows at each of the selected seven gaging stations using a standard Log-Pearson III analysis. A set of regression equations were then developed using the FFA estimates. Both drainage area and mean annual precipitation were used as independent variables in the initial analysis. However, after review of the initial results and discussion with Will Thomas at Michael Baker Jr., it was concluded that not including MAP as an independent variable in the analysis was warranted due to the small sample size. Therefore, only the drainage basin area variable was used for development of the regression equations.

The 1-percent-annual chance flood developed from a Log-Pearson Type III flood frequency analysis for Rapid Creek (using 9 years of record) is 1,600 cfs. This is approximately 9% less than the proposed regression estimate. However, the proposed regression estimate is considered to be a more reliable approximation because it is based on the observed annual peaks at both the Rapid Creek gage and 6 additional gaging stations that have between 16 and 36 years of record and watershed characteristics that are considered similar to those of Rapid Creek. Therefore, the following regression equations were used for computing the 10-, 2-, 1-, and 0.2-percent-annual-chance peak discharges for Rapid Creek.

Percent-Annual-Chance	Regression Equations	Peak Discharge (cfs)
10	$243.85\ DA^{0.2791}$	755
2	$607.63\ DA^{0.2069}$	1,400
1	$842.75\ DA^{0.1805}$	1,750
0.2	$1653.6\ DA^{0.1238}$	2,730

Hydrologic studies of Portneuf River near Pocatello were performed by the USACE in 1964, 1987, and 2011. For the second revision (see Section 10.2), the 2011 study by USACE was utilized for the hydrologic analysis and subsequent floodplain delineations. These studies use the assumption that there are two primary and fundamentally different and independent types of causes driving peak discharges on the Portneuf River; winter rainfall on snow and spring snowmelt.The results of these analyses have a 1% annual chance discharge lowered by 40.9% from 5,500 cfs down to 3,250 cfs (Reference 51). Peak discharge-drainage area relationships for streams in Bannock County are shown in Table 7.

Table 7. Summary of Discharges

Flooding Source and Location	Drainage Area (square miles)	Peak Discharges (cubic feet per second) 10-Percent-Annual-Chance	2-Percent-Annual-Chance	1-Percent-Annual-Chance	0.2-Percent-Annual-Chance
Portneuf River					
At Cross Section J	1,220	1,550	2,570	3,250	5,750
At Cross Section BD	612	1,530	2,540	3,200	5,650
At Cross Section CY	570	1,200	3,200	5,000	12,400
At Cross Section DE	520	1,090	3,030	4,750	11,700
At Cross Section DM	498	1,050	2,960	4,600	11,400
Pocatello Creek					
At Mouth	21.9	900	2,700	3,600	5,300
At Cross Section A	16.1	800	2,600	3,300	5,000
City Creek					
At Mouth	4.2	1,100	1,800	2,700	4,200
Trail Creek					
At Mouth	3.5	1,000	1,600	2,500	3,800
Cusick Creek					
At Mouth	2.0	460	870	1,000	1,320
Johnny Creek					
At Country Club Drive	1.5	54	124	163	282
Gibson Jack Creek					
At Cross Section A	9.8	850	2,000	2,400	3,250
Mink Creek					
At Cross Section A	50.0	860	2,750	3,650	5,250
Fort Hall Mine Creek					
At Cross Section A	3.0	810	1,650	1,950	2,450

Table 7. Summary of Discharges (continued)

Flooding Source and Location	Drainage Area (square miles)	Peak Discharges (cubic feet per second) 10-Percent-Annual-Chance	2-Percent-Annual-Chance	1-Percent-Annual-Chance	0.2-Percent-Annual-Chance
Rapid Creek					
At Inkom	57	755	1,400	1,750	2,730
North Fork Rapid Creek					
At Cross Section BM	9.1	680	2,700	5,000	9,200
At Cross Section BU	2.7	360	1,350	2,550	4,800
West Fork Rapid Creek					
At Cross Section A	11.5	760	3,000	5,500	10,000
At Cross Section G	8.1	640	2,550	4,750	8,600
At Cross Section L	6.1	560	2,150	4,100	7,500
Marsh Creek					
At Cross Section A	399	680	1,260	1,560	2,510
At Cross Section AK	363	650	1,200	1,490	2,410
At Cross Section BB	342	630	1,170	1,450	2,340
Walker Creek					
At Cross Section A	9.2	740	2,760	5,220	13,620
Bell Marsh Creek					
At Cross Section A	7.4	6,50	2,440	4,600	12,150
Unnamed Tributary to Marsh Creek (0.5 Mile South of Bell Marsh Creek)					
At Cross Section A	1.7	270	1,060	1,940	5,580
Dry Canyon Creek					
At Cross Section A	1.2	220	870	1,570	4,630
Goodenough Creek					
At Cross Section A	9.1	730	2,740	5,180	13,510

Table 7. Summary of Discharges (continued)

Flooding Source and Location	Drainage Area (square miles)	Peak Discharges (cubic feet per second) 10-Percent-Annual-Chance	2-Percent-Annual-Chance	1-Percent-Annual-Chance	0.2-Percent-Annual-Chance
Rowe Creek					
At Cross Section A	1.5	240	970	1,760	5,130
Cottonwood Creek					
At Cross Section A	1.0	200	780	1,430	4,270
Birch Creek					
At Cross Section A	5.8	560	2,110	3,960	10,610
Ellis Creek					
At Cross Section A	2.5	340	1,310	2,420	6,810
Local Drainage (City of Downey)					
At Portneuf-Marsh Valley Wasteway Canal	15.4	NA	NA	230	NA

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of flooding from the sources studied were carried out to provide estimates of the elevations of floods of the selected recurrence intervals. Users should be aware that flood elevations shown on the FIRM 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.

Pre-Countywide

Water-surface elevations for the Portneuf River and Pocatello, Johnny, Gibson Jack, Mink and Fort Hall Mine Creeks were computed with the use of the US Army Corps of Engineers HEC-2 step-backwater computer program (References 26, 27 and 28). For Rapid, West Fork Rapid, Marsh, Walker, Bell Marsh, Dry Canyon, Rowe, Goodenough, Cottonwood, Ellis, and Birch Creeks, as well as an unnamed tributary to Marsh Creek near Bell Marsh Creek, water-surface elevations were computed using the US Soil Conservation Service's WSP-2 step-backwater computer program (Reference 29).

Cross sections for the backwater analysis of the Portneuf River near Lava Hot Springs and the Pocatello Creek were developed through field surveys. Cross sections for the lower reaches on the Portneuf River and on Johnny, Gibson Jack, Mink and Fort Hall Mine Creeks were previously surveyed by the US Army Corps of Engineers for Floodplain Information reports on these streams (References 1, 2, and 3).

Cross section data for Portneuf River (in the City of Pocatello) and Pocatello and City Creeks were obtained from aerial photographs at a scale of 1:12,000 (Reference 30); the below-water sections were obtained by field measurements. All bridges and culverts were surveyed to obtain elevation data and structural geometry.

Analysis of the hydraulic characteristics of the Portneuf River at McCammon for flood flows of the selected recurrence intervals was previously made by Tudor Engineering Company for a US Army Corps of Engineers Floodplain Information report (Reference 2). Water surface elevations were computed through use of the US Army Corps of Engineers HEC-2 step-backwater computer program (References 26, 28, and 31).

Along the Portneuf River in the City of Pocatello, much of the 1-perent annual chance flood will be contained within the levee system. However, the 0.2-percent-annual-chance flood will top the levee and flood a portion of this area.

When the computed water-surface elevation is near the critical depth elevation, unstable flow conditions can be expected. For cross sections at which unstable flow conditions is expected, the elevations as presented on the Flood Profiles (Exhibit 1) are the computed elevations at critical depth plus 40 percent of the velocity head at critical depth. The resulting depth is equal to 1.1 times critical depth for triangular channels, and, therefore, is a conservatively high approximation for other channel shapes (Reference 32).

Channel and overbank roughness factors (Manning's "n") for the back-water computations on the Portneuf River near Lava Hot Springs and on Pocatello Creek were determined by field evaluation. Roughness factors for the lower reaches of the Portneuf River and on

Johnny, Gibson Jack, Mink, and Fort Hall Mine Creeks were previously determined by the U.S. Army Corps of Engineers during preparation of the previously mentioned Floodplain Information reports (References 1, 2, and 3). Roughness factors for all other streams studied in detail in Bannock County were previously determined by the U.S. Soil Conservation Service during preparation of their Flood Hazard Analysis reports. Ranges of values for streams are summarized in Table 8.

Table 8. Roughness Coefficients

	Roughness Coefficients	
Stream	Channel	Overbank
Portneuf River		
Pocatello-McCammon	0.013-0.055	0.040-0.100
Near Lava Hot Springs	0.050-0.065	0.035-0.085
Pocatello Creek	0.020-0.075	0.050-0.150
Johnny Creek	0.050	0.050
Gibson Creek	0.040	0.050
Mink Creek	0.040	0.050
Fort Hall Mine Creek	0.050	0.050
Rapid Creek	0.050-0.098	0.025-0.125
West Fork Rapid Creek	0.025-0.065	0.045-0.095
Marsh Creek	0.024-0.075	0.030-0.095
Walker Creek	0.055-0.100	0.040-0.075
Bell Marsh Creek	0.040-0.050	0.040-0.065
Unnamed Tributary to Marsh Creek Near Bell Marsh Creek`	0.029-0.045	0.025-0.065
Dry Canyon Creek	0.028-0.045	0.025-0.055
Goodenough Creek	0.025-0.045	0.030-0.060
Rowe Creek	0.025	0.045-0.060
Cottonwood Creek	0.035-0.069	0.030-0.065
Birch Creek	0.035-0.065	0.025-0.100
Ellis Creek	0.050-0.055	0.055-0.075
City Creek	0.035	0.045
Canals (City of Downey)	0.020-0.025	0.050-0.080

To assure consistency with previously published data, profile distances used in the Flood Insurance Study for the Portneuf River and Gibson Jack, Mink, and Fort Hall Mine Creeks were taken from the US Army Corps of Engineers Floodplain Information reports (References 1, 2, 3); therefore, they may not be reflected on the maps.

Profile distances for those streams studied previously by the U.S. Soil Conservation Service were taken from U.S. Soil Conservation Service's reports (References 4 and 5) and are based on field surveys. These distances may not be reflected on the maps due to the map scale.

Starting water-surface elevations for all floods on each stream were found by using a normal depth analysis at the farthest downstream cross section with the exception of Marsh Creek. The backwater analysis of Marsh Creek was based on flood elevations computed for the Portneuf River. It was assumed that for floods of each recurrence interval on Marsh Creek, the same recurrence interval flood would simultaneously occur on the Portneuf River. Based on historical flow comparisons, this relationship appears to be approximately correct. For each flood, an average water-surface elevation between cross sections CP and CQ on the

Portneuf River was used as the downstream boundary condition for the Marsh Creek backwater analysis.

A section of Pocatello Creek downstream of Booth Road was modified through the LOMR process. The updated topographic information shown downstream of Booth Road (Reference 33) was used for the first area of revision. Cross-sectional data were developed from the referenced topographic information combined with cross-sectional data from the HEC-2 model (Reference 28) used to develop the information in the previous Flood Insurance Study (Reference 34) in order to develop a revised HEC-2 model (Reference 35). The discharges, starting water-surface elevation, and roughness coefficients (Manning's "n") were taken from the HEC-2 model for the previous Flood Insurance Study. As a result of the updated topographic information, the base flood elevations (BFEs) increased, the width of the flood plain decreased, and the floodway data has been modified for the referenced portion of Pocatello Creek. The maximum increase in BFE, 4 feet, and the maximum decrease in Special Flood hazard Area width, approximately 40 feet, both occur at Booth Road. The floodway data was revised at Booth Road to modify the floodway section area, mean velocity, and base flood water-surface elevation, both with and without floodway.

The lower reaches of several streams studied in detail are on alluvial fans. Once the banks are overtopped in these areas, floodwaters can spread over large areas of land or concentrate in areas not previously flooded. Depths and velocities during different floods of equal magnitude can range from approximately zero to dangerously high velocities at any given location. Floods in such areas are hazardous and quite unpredictable. The possibility always exists for new channels to form anywhere across the alluvial fan area during a large magnitude flood. Due to the uncertainty of the flow path followed by future floods in these alluvial fan areas, water-surface profiles are not shown below the mouths of the canyons. These streams include: Johnny, Gibson Jack, Mink, Fort Hall Mine, Rapid, Walker, Bell Marsh, Dry Canyon, Goodenough, Cottonwood and Birch Creeks, an unnamed tributary to Marsh Creek near Bell Marsh Creek, Trail Creek, City Creek, Pocatello Creek, Cusick Creek, and Johnny Creek.

The 1-percent-annual-chance flood determination for Pocatello Creek, City Creek, Trail Creek, Cusick Creek, and Johnny Creek on the alluvial fans was accomplished on an individual basis, using the definition for the 1-percent-annual-chance flood on an alluvial fan, which is that the most probable path of the damaging initial flood wave and the probable magnitude of flooded area that will occur following the initial flood wave. The 1-percent-annual-chance floods were determined based on the amount of obstruction to the flood wave. In areas of very little obstruction, the 1-percent-annual-chance flood was determined by measuring a 20-degree angle on each side of a line projected in the direction of flow of the stream. The 1-percent-annual-chance flood would be the area between the two lines made by the 20-degree angles. Where there is a high amount of obstructions, the flood wave would be dampened due to the obstructions. Once the flood wave is dampened, it would reduce in height. On the Johnny Creek alluvial cone, the water reaches relatively high velocities.

Analysis of the hydraulic characteristics of areas studied by approximate methods were carried out to provide an estimate of the area inundated by the 1-percent-annual-chance flood. For each segment studied by approximate methods on the Portneuf River and Marsh Creek, this analysis was made through the use of Flood Prone Area Maps prepared by the US Geological Survey (Reference 36). In some areas, the flood limits shown by the US Geological Survey have been changed based on the results of backwater analyses on the streams in nearby areas, and on the extent of flooding shown on aerial photographs taken during the 1962 flood (Reference 37). For all other areas studied by approximate methods in Bannock County, flood limits were established by computing normal depth for typical cross sections on the streams. These cross sections were developed from measurements on US Geological Survey quadrangle topographic maps (Reference 38). For the lower segments of both Indian and Sorrell Creeks, this process was assisted by stereo-pair analysis of aerial photographs of the Portneuf Valley obtained from the Idaho State Highway Department (Reference 39). Roughness factors for these areas were determined by field inspection.

During the course of the study, it was determined that, flooding will be contained within the channel upstream of the alluvial cone area on City Creek.

The hydraulic analysis of the 1-percent-annual-chance discharge on Fish Creek was based on a normal depth computation for a typical cross section of the stream. The cross section information was taken from a US Geological Survey quadrangle map at a scale of 1:24,000, with a contour interval of 40 feet (Reference 38).

Analysis of the hydraulic characteristics of the Downey floodplain was carried out to provide estimates of only the 1-percent-annual-chance water-surface elevations in the floodplain areas. Because of the shallow nature of the flooding in Downey, standard backwater analysis was not suitable. A three part analysis technique was used to get the required water-surface elevations.

The first step was to check the capacity of the main canal and wasteway at several key locations. These locations were chosen because reduced channel capacity could lead to overflows a these points. The capacity of these points was determined by normal depth analysis.

The next step was to route the floodflows through the canals and to determine the quantity of floodwater that would overflow in the different reaches.

The third step was to route the overflows from the canals through the floodplain areas by using normal-depth analysis techniques, and to determine water-surface elevations in these areas. Based on cross sections obtained by Forsgren, Perkins, and Associates, Engineers, a topographic map of Downey was constructed with a contour interval of 2 feet (Reference 39). Floodflows were routed through Downey with this map, and the determined water-surface elevations were based on anticipated flow depths.

Cross sections of the canals and cross sections of the shallow flooding areas were determined by field surveys. Canal and floodplain roughness factors (Manning's "n") used in the hydraulic computations were determined through field inspection of the area. The n values used are show in Table 8.

Approximate analysis of the hydraulic characteristics of Sorrell Creek was carried out to provide and estimate of the area inundated by the 1-percent-annual-chance flood. Determination of the approximate capacities of the concrete culvert under the Interstate Highway 15 and its flume was based on hand calculations made following a field investigation of these structures. Floodwaters that would be discharged through the concrete culvert during a 1-percent-annual-chance flood were routed to the Portneuf River by stereo-pair analysis of aerial photograph of the area (Reference 40).

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1). For stream segments for which a floodway was computed (Section 4.2), selected cross section locations are also shown on the Flood Insurance Rate Map (Exhibit 2).

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. Additional exceptions to this assumption were made as follows: the farm bridge downstream of Interstate 15 on Portneuf River was assumed washed out by the 1- and 0.2-percent-annual-chance floods; the bridge located near cross section GL on the Portneuf River was in a deteriorated condition and therefore it was assumed that the superstructure would be washed away by the 0.2-percent-annual-chance flood; and the bridges located at cross sections EW and EZ. Following a field evaluation previously made by Tudor Engineering Company for the US Army Corps of Engineers, it was assumed that the bridge at cross section EW would be washed out by the 1- and 0.2-percent-annual-chance floods, and the bridge at cross section EZ would be washed out the 0.2-percent-annual-chance flood.

Flood profiles were drawn showing computed water-surface elevations to an accuracy of 0.5 foot for floods of the selected recurrence intervals (Exhibit 1).

Countywide
The updated hydraulic analysis for Rapid Creek was conducting by converting the existing WSP-2 hydraulic model to HEC-RAS and using the above revised peak discharges. Geometry data for hydraulic structures in the WSP-2 model had been modified to provide only one-third of the original hydraulic opening to account for blockage by sediment and/or debris. The data in the model were not sufficient for input into the bridge geometry tables within HEC-RAS; therefore a field investigation was conducted to determine the effective hydraulic opening for each structure. Following the same logic as the original modeling, the effective hydraulic opening was reduced to one-third the measured opening within HEC-RAS. Floodways encroachment stations were determined for the 1-percent-annual-chance discharge using a maximum allowable rise of 1 foot. Floodway data are shown in Table 10.

All elevations are referenced to the North American Vertical Datum of 1988 (NAVD). Elevation reference marks (ERMs) and their descriptions are shown on the maps. ERMs shown on the FIRM represent those used during the preparation of this and previous Flood Insurance Studies. The elevations associated with each ERM were obtained and/or developed during FIS production to establish vertical control for determination of flood elevations and floodplain boundaries shown on the FIRM. Users should be aware that these ERM elevations may have changed since the publication of this FIS. To obtain up-to-date elevation information on National Geodetic Survey (NGS) ERMs shown on this map, please contact the Information Services Branch of the NGS at (301) 713-3242, or visit their website at www.ngs.noaa.gov. Map users should seek verification of non-NGS ERM monument elevations when using these elevations for construction or floodplain management purposes.

3.3 Vertical Datum

All FIS reports and FIRMS are referenced to a specific vertical datum. The vertical datum provides a starting point against which flood, ground, and structure elevations can be referenced and compared. Until recently, the standard vertical datum used for newly created or revised FIS reports and FIRMs was the National Geodetic Vertical Datum of 1929 (NGVD 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.

To accurately convert flood elevations for the streams and rivers in Bannock County from the current NGVD 29 datum to the newer NAVD 88 datum, the following procedure was implemented. Locations at the upstream and downstream ends of each flooding source, as well as at an intermediate location between these two end points, were evaluated using the COE CORPSCON (Reference 41) vertical datum conversion software. At each of the three points CORPSCON calculated the difference between NGVD 29 and NAVD 88 elevations. These three conversion factors were averaged to develop an average conversion factor for each flooding source. The final NAVD 88 elevations reported herein were computed by adding the calculated average conversion factor to the existing NGVD 29 data. Table 9 shows the conversion factor for each stream studied in detail.

Table 9. Vertical Datum Conversion Factors

	Conversion from NGVD 29 to NAVD 88 (feet)			
Stream Name	Minimum Conversion	Maximum Conversion	Average Conversion[1]	Maximum Offset
Portneuf River (Sections A-FC)	3.44	3.53	3.48	0.05
Portneuf River (Sections FD-GR)	3.59	3.66	3.63	0.04
Pocatello Creek	3.44	3.60	3.52	0.08
Marsh Creek	3.42	3.55	3.49	0.08
Rapid Creek	3.38	3.59	3.49	0.11
W.F. Rapid Creek	3.57	3.62	3.59	0.03
N.F. Rapid Creek	3.59	3.67	3.63	0.05
Bell Marsh Creek	3.50	3.51	3.51	0.01
Birch Creek	3.56	3.57	3.56	0.01
Cottenwood Creek	3.56	3.57	3.56	0.01
Dry Canyon Creek	3.53	3.54	3.54	0.01
Ellis Creek	3.56	3.57	3.56	0.01
Fort Hall Mine Creek	3.46	3.50	3.48	0.02
Gibson Jack Creek	3.40	3.43	3.41	0.02
Goodenough Creek	3.55	3.56	3.55	0.01
Mink Creek	3.41	3.43	3.42	0.01
Rowe Creek	3.56	3.56	3.56	0.00
Unnamed Tributary to Marsh Creek	3.51	3.52	3.52	0.01
Walker Creek	3.44	3.46	3.45	0.01

[1] Used to convert elevation data from NGVD 29 to NAVD 88.

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 the NAVD, visit the National Geodetic Survey website at www.ngs.noaa.gov, or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, N/NGS12
National Geodetic Survey
SSMC-3, #9202

1315 East-West Highway
Silver Spring, Maryland 20910-3282
(301) 713-3242
(301) 713-4172 (fax)

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 provides 1-percent-annual-chance floodplain data, which may include a combination of the following: 10-, 2-, 1-, and 0.2-percent-annual-chance flood elevations; delineations of the 1- and 0.2-percent-annual-chance floodplains; and 1-perent-annual-chance floodway. This information is presented on the FIRM and in many components of the FIS, including Flood Profiles, Floodway Data tables and Summary of Stillwater Elevation tables. Users should reference the data presented in the FIS 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 (100-year) flood has been adopted by FEMA as the base flood for floodplain management purposes. The 0.2-percent-annual-chance (500-year) 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 boundary of the 1-percent-annual-chance flood was previously interpolated by the US Army Corps of Engineers (on the Portneuf River, Reference 1) and by the U.S. Soil Conservation Service (on Marsh Creek, tributaries to Marsh Creek and Rapid Creek, References 4 and 5) and using topographic maps at a scale of 1:2,400, 1:4,800 and 1:62,500, with contour intervals of 2, 4, 8, 20, 40 and 50 feet (Reference 38, 42, 43, and 44).

The 1- and 0.2-percent-annual-chance floodplain boundaries are shown on the Flood Insurance Rate Map (Exhibit 2). On this map, the 1-percent-annual-chance floodplain boundary corresponds to the boundary of the areas of special flood hazards (Zones A, AE, AH, 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.

Pocatello Creek, Trail Creek, City Creek, Cusick Creek, and Johnny Creek have formed alluvial fans where they flow from the incised, steep, sloped streambeds to the open and much milder sloped streambeds. The fact an alluvial fan is present indicates that there is potential for flooding over the entire fan; therefore, the 1- and 0.2-percent-annual-chance floodplains have included the entire alluvial fan. These areas were delineated on topographic maps at a scale of 1:2400, with contour intervals of 4 and 8 feet (Reference 42).

A portion of the floodplain for Pocatello Creek was revised through the LOMR process using topographic data submitted by the City of Pocatello Engineering Department (Reference 43). As a result of the updated topographic data and a revised hydraulic analysis of the alluvial fan characteristics of the area, the flood hazards increased and decreased from Hi-Line Road to just downstream of the UPRR. From Hi-Line Road to Park Avenue, a distance of approximately 900 feet, the width of the SFHA increased. The maximum increase in SFHA width, approximately 500 feet, occurs at Park Avenue. From Park Avenue to just downstream of the UPRR, a distance of approximately 10,000 feet, the flood hazard decreased, and the zone has been re-designated for Zone AO (Depth 1) to Zone X (shaded), an area subject to base flooding with an average depth of less than 1 foot. The extent of the area designated as Zone X increased, and includes the area bounded approximately by Quinn Road to the north, Jefferson Avenue to the east, Oak Street to the south, and the UPRR to the west.

Flood boundaries for the sheet flow area in the City of Lava Hot Springs were taken from a previous study prepared by the US Army Corps of Engineers (Reference 2).

Flood boundaries of the 100-year flow on Fish Creek were drawn based on its estimated flow depth and using topographic maps at a scale of 1:62,500, with a contour interval of 50 feet (Reference 44) as guides.

Floodplain delineation for flows from Sorrell Creek below the mouth of the concrete culvert under Interstate Highway 15 was based on stereo-pair analysis of aerial photograph of Inkom prepared by the Idaho State Highway Department (Reference 40). US Geological Survey topographic maps at a scale of 1:24,000, with a contour interval of 20 feet (Reference 38), were used to delineate the flooding in this area.

For the streams studied by approximate methods, only the 1-perncet-annual-chance floodplain boundary is shown on the Flood Insurance Rate Map (Exhibit 2).

Approximate 100-year floodplain boundaries in some portions of the study area were taken directly from the Flood Hazard Boundary Maps for Bannock County, Idaho (Unincorporated Areas), City of McCammon, City of Lava Hot Springs, and City of Pocatello (References 45, 46, 47 and 48, respectively).

Countywide Update

For the countywide update, floodplain boundaries for portions of Pocatello Creek, Gibson-Jack Creek, Portneuf River and Mink Creek were revised based on new topographic mapping at a scale of 1:1,200 with a contour interval of 2 feet (Reference 43)

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 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 10). In cases where the floodway and 1-percent-annual-chance floodplain boundaries are either close together or collinear, only the floodway boundary is shown. Floodway widths for portions of Gibson-Jack Creek, Pocatello Creek, North Fork Pocatello Creek and the Portneuf River within the City of Pocatello were revised during the countywide update as a result of revisions to the floodplain and floodway boundaries based on new topographic mapping. Floodway widths shown in Table 10 were modified accordingly. The original floodway widths can be obtained from the backup data for this study as described in Section 8.0.

Floodways are generally not applicable in alluvial fan areas because of the uncertainty surrounding the hydraulics of alluvial fan areas; therefore, no floodways were computed for Trail, City, Cusick, and Johnny Creeks, and portions of Pocatello Creek. On eight streams, including Gibson Jack, Birch, Cottonwood, Goodenough, Dry Canyon, Bell Marsh, and Walker Creeks and an unnamed tributary to Marsh Creek, the floodway was computed by normal procedures but stopped at the mouth of the canyon. There was not enough information available to show a floodway below this point. The absence of a floodway in these alluvial fan areas should not be interpreted to mean that these areas are safe for residential or commercial construction, since high flow velocities in these areas may occur during floods. On Mink Creek, standard floodway computations were made in canyon areas from cross section A to E; but a floodway was also shown from the Portneuf River upstream to cross section A. in the latter reach, a floodway was delineated in areas likely to sustain high velocities during flood. This floodway was established by field evaluation of the area, and is not based on standard conveyance reduction computations. Finally, on Fort Hall Mine Creek, standard floodway computations were made for cross section A to B; and downstream of A, field evaluated floodways based on high velocity hazards were delineated. For this creek, three principal flood paths were identified, and each was given a separate floodway.

The floodways computed for Pocatello Creek are based on standard hydraulic computations; due to the steep topography of the canyon, computed velocities are very high. At all cross sections, floodway encroachments were stopped when resulting channel velocities exceeded 5.0 feet per second, even if less than 1.0 foot of rise resulted. Additionally, in the area where Interstate Highway 15 crosses Pocatello Creek, the floodway was delineated based on the past and the expected flow path, and was agreed upon by the Federal Insurance Administration, the study contractor, and city officials.

Due to the shallow nature of the flooding in Downey, no floodways were determined.

The area between the floodway and 1-percent-annual-chance floodplain boundaries is termed the floodway fringe. The floodway fringe encompasses the portion of the floodplain that could be completely obstructed without increasing the water-surface elevation of the 1-percent-annual-chance flood more than 1 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to floodplain development are shown in Figure 1.

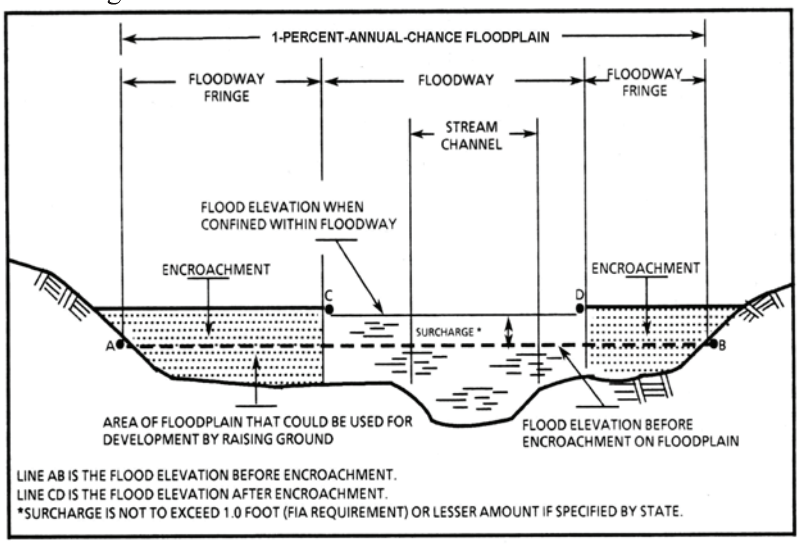

Figure 1. Floodway Schematic

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)
Bell Marsh Creek								
A	1,727	308	--[2]	--[2]	4,631.5	4,631.5	4,632.5	1.0
B	2,215	273	--[2]	--[2]	4,642.8	4,642.8	4,643.8	1.0
C	2,613	162	--[2]	--[2]	4,657.3	4,657.3	4,658.3	1.0
D	3,019	118	--[2]	--[2]	4,670.5	4,670.5	4,671.5	1.0
E	3,536	55	--[2]	--[2]	4,693.9	4,693.9	4,694.9	1.0
Birch Creek								
A	1,433	145	--[2]	--[2]	4,637.9	4,637.9	4,638.9	1.0
B	2,333	87	--[2]	--[2]	4,653.0	4,653.0	4,654.0	1.0
C	3,598	122	--[2]	--[2]	4,691.0	4,691.0	4,692.0	1.0
D	3,799	64	--[2]	--[2]	4,693.2	4,693.2	4,694.2	1.0
E	4,473	54	--[2]	--[2]	4,705.5	4,705.5	4,706.5	1.0
F	5,375	35	--[2]	--[2]	4,725.6	4,725.6	4,726.6	1.0
G	6,156	43	--[2]	--[2]	4,740.2	4,740.2	4,741.2	1.0
H	6,714	48	--[2]	--[2]	4,764.8	4,764.8	4,765.8	1.0
I	6,883	27	--[2]	--[2]	4,770.0	4,770.0	4,771.0	1.0
Cottonwood Creek								
A	1,440	29	--[2]	--[2]	4,684.4	4,684.4	4,685.4	1.0
B	1,994	60	--[2]	--[2]	4,721.1	4,721.1	4,722.1	1.0
Dry Canyon Creek								
A	3,323	451	--[2]	--[2]	4,731.0	4,731.0	4,732.0	1.0
B	4,273	34	--[2]	--[2]	4,770.1	4,770.1	4,771.1	1.0
C	4,874	68	--[2]	--[2]	4,797.5	4,797.5	4,798.5	1.0
D	5,556	169	--[2]	--[2]	4,839.1	4,839.1	4,840.1	1.0
E	5,984	22	--[2]	--[2]	4,869.4	4,869.4	4,870.4	1.0

[1]Feet above mouth [2]Data not available

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

BANNOCK COUNTY, IDAHO AND INCORPORATED AREAS

FLOODWAY DATA

BELL MARSH CREEK BIRCH CREEK COTTONWOOD CREEK DRY CANYON 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)
Ellis Creek								
A	83	74	–[2]	–[2]	4,746.2	4,746.2	4,747.2	1.0
B	320	34	–[2]	–[2]	4,752.4	4,752.4	4,753.4	1.0
Fort Hall Mine Creek								
A	3,220	226[3]	222	8.8	4,650.6	4,650.6	4,650.6	0.0
B	3,700	62	199	9.8	4,675.4	4,675.4	4,675.4	0.0
Gibson Jack Creek								
A	2,392	482	–[2]	–[2]	4,540.7	4,540.7	4,540.7	0.0
B	2,637	237	–[2]	–[2]	4,549.8	4,549.8	4,549.8	0.0
C	2,805	166	–[2]	–[2]	4,556.9	4,556.9	4,556.9	0.0
D	3,000	166	–[2]	–[2]	4,564.3	4,564.3	4,564.3	0.0
Goodenough Creek								
A	2,444	675	–[2]	–[2]	4,657.7	4,657.7	4,658.7	1.0
B	3,023	232	–[2]	–[2]	4,677.2	4,677.2	4,678.2	1.0
C	3,552	111	–[2]	–[2]	4,693.1	4,693.1	4,694.1	1.0
D	4,932	90	–[2]	–[2]	4,735.5	4,735.5	4,736.5	1.0
E	5,752	55	–[2]	–[2]	4,763.7	4,763.7	4,764.7	1.0
F	6,521	39	–[2]	–[2]	4,790.0	4,790.0	4,791.0	1.0

[1]Feet above mouth [2]Data not available [3]Combined total width for two sets of floodways

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

BANNOCK COUNTY, IDAHO AND INCORPORATED AREAS

FLOODWAY DATA

ELLIS CREEK - FORT HALL MINE CREEK - GIBSON JACK CREEK - GOODENOUGH 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)
Marsh Creek								
A	1,343	426	--[2]	--[2]	4,532.8 [3]	4,525.5	4,526.5	1.0
B	3,830	550	--[2]	--[2]	4,532.8 [3]	4,526.2	4,527.2	1.0
C	5,484	274	--[2]	--[2]	4,532.8 [3]	4,527.2	4,528.2	1.0
D	6,962	208	--[2]	--[2]	4,532.8 [3]	4,528.2	4,529.2	1.0
E	8,012	359	--[2]	--[2]	4,532.8 [3]	4,528.7	4,529.7	1.0
F	10,784	270	--[2]	--[2]	4,532.8 [3]	4,530.3	4,531.3	1.0
G	13,921	269	--[2]	--[2]	4,532.8 [3]	4,531.0	4,532.0	1.0
H	16,768	254	--[2]	--[2]	4,533.1	4,533.1	4,533.4	0.3
I	17,838	153	--[2]	--[2]	4,533.7	4,533.7	4,534.7	1.0
J	19,395	245	--[2]	--[2]	4,535.2	4,535.2	4,536.2	1.0
K	20,916	253	--[2]	--[2]	4,536.1	4,536.1	4,537.0	0.9
L	22,460	180	--[2]	--[2]	4,537.2	4,537.2	4,538.2	1.0
M	23,379	174	--[2]	--[2]	4,538.5	4,538.5	4,539.5	1.0
N	24,175	52	--[2]	--[2]	4,541.9	4,541.9	4,542.9	1.0
O	24,838	36	--[2]	--[2]	4,544.3	4,544.3	4,545.3	1.0
P	25,730	73	--[2]	--[2]	4,547.0	4,547.0	4,548.0	1.0
Q	28,529	357	--[2]	--[2]	4,548.4	4,548.4	4,549.4	1.0
R	30,365	227	--[2]	--[2]	4,549.1	4,549.1	4,550.1	1.0
S	31,408	259	--[2]	--[2]	4,550.7	4,550.7	4,551.7	1.0
T	33,554	139	--[2]	--[2]	4,554.6	4,554.6	4,555.6	1.0
U	35,649	324	--[2]	--[2]	4,557.5	4,557.5	4,558.5	1.0
V	36,897	52	--[2]	--[2]	4,563.2	4,563.2	4,564.2	1.0
W	37,328	67	--[2]	--[2]	4,566.7	4,566.7	4,567.7	1.0
X	39,004	133	--[2]	--[2]	4,571.7	4,571.7	4,572.7	1.0

[1]Feet above mouth [2]Data not available [3]Backwater from Portneuf River

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

BANNOCK COUNTY, IDAHO AND INCORPORATED AREAS

FLOODWAY DATA

MARSH 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)
Marsh Creek (continued)								
Y	40, I53	210	--[2]	--[2]	4,572.7	4,572.7	4,573.7	1.0
Z	41,114	660	--[2]	--[2]	4,572.8	4,572.8	4,573.8	1.0
AA	43,119	742	--[2]	--[2]	4,572.8	4,572.8	4,573.8	1.0
AB	44,551	197	--[2]	--[2]	4,573.7	4,573.7	4,574.7	1.0
AC	46,398	455	--[2]	--[2]	4,574.1	4,574.1	4,575.1	1.0
AD	49,660	776	--[2]	--[2]	4,574.3	4,574.3	4,575.3	1.0
AE	51,665'	450	--[2]	--[2]	4,574.9	4,574.9	4,575.9	1.0
AF	55,675	182	--[2]	--[2]	4,577.7	4,577.7	4,578.7	1.0
AG	56,751	273	--[2]	--[2]	4,579.0	4,579.0	4,580.0	1.0
AH	58,688	107	--[2]	--[2]	4,585.1	4,585.1	4,586.1	1.0
AI	59,902	62	--[2]	--[2]	4,591.0	4,591.0	4,592.0	1.0
AJ	61,720	67	--[2]	--[2]	4,595.7	4,595.7	4,596.7	1.0
AK	63,195	512	--[2]	--[2]	4,596.1	4,596.1	4,597.1	1.0
AL	64,635	420	--[2]	--[2]	4,596.3	4,596.3	4,597.3	1.0
AM	67,526	196	--[2]	--[2]	4,596.9	4,596.9	4,597.9	1.0
AN	69,007	189	--[2]	--[2]	4,597.2	4,597.2	4,598.2	1.0
AO	70,837	479	--[2]	--[2]	4,597.4	4,597.4	4,598.4	1.0
AP	72,767	420	--[2]	--[2]	4,597.5	4,597.5	4,598.5	1.0
AQ	75,458	523	--[2]	--[2]	4,597.8	4,597.8	4,598.8	1.0
AR	77,761	448	--[2]	--[2]	4,601.1	4,601.1	4,602.1	1.0
AS	80,684	596	--[2]	--[2]	4,601.1	4,601.1	4,602.1	1.0
AT	83,016	1,024	--[2]	--[2]	4,601.1	4,601.1	4,602.1	1.0
AU	86,295	867	--[2]	--[2]	4,601.1	4,601.1	4,602.1	1.0
AV	88,962	1,006	--[2]	--[2]	4,601.1	4,601.1	4,602.1	1.0

[1]Feet above mouth [2]Data not available

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

BANNOCK COUNTY, IDAHO AND INCORPORATED AREAS

FLOODWAY DATA

MARSH 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)
Marsh Creek (continued)								
AW	90,783	1,001	--[2]	--[2]	4,601.2	4,601.2	4,602.2	1.0
AX	93,033	375	--[2]	--[2]	4,606.1	4,606.1	4,607.1	1.0
AY	94,866	228	--[2]	--[2]	4,610.7	4,610.7	4,611.7	1.0
AZ	96,119	263	--[2]	--[2]	4,614.4	4,614.4	4,615.4	1.0
BA	98,082	230	--[2]	--[2]	4,624.8	4,624.8	4,625.8	1.0
BB	98,828	471	--[2]	--[2]	4,624.8	4,624.8	4,625.8	1.0
BC	100,980	1,308	--[2]	--[2]	4,624.8	4,624.8	4,625.8	1.0
BD	103,104	1,369	--[2]	--[2]	4,624.8	4,624.8	4,625.8	1.0
BE	104,390	1,287	--[2]	--[2]	4,624.8	4,624.8	4,625.8	1.0
BF	106,787	1,081	--[2]	--[2]	4,624.9	4,624.9	4,625.9	1.0
BG	109,174	808	--[2]	--[2]	4,624.9	4,624.9	4,625.9	1.0
BH	110,912	483	--[2]	--[2]	4,624.9	4,624.9	4,625.9	1.0
BI	112,162	635	--[2]	--[2]	4,624.9	4,624.9	4,625.9	1.0
BJ	114,647	1,233	--[2]	--[2]	4,625.0	4,625.0	4,626.0	1.0
Mink Creek								
A	3,420	150	532	6.9	4,530.6	4,530.6	4,530.8	0.2
B	4,310	100	398	9.2	4,543.0	4,543.0	4,543.0	0.0
C	5,280	100	360	10.1	4,557.0	4,557.0	4,557.0	0.0
D	5,810	100	388	9.4	4,569.0	4,569.0	4,569.1	0.1
E	6,210	90	358	10.2	4,576.6	4,576.6	4,576.6	0.0

[1]Feet above mouth [2]Data not available

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

BANNOCK COUNTY, IDAHO AND INCORPORATED AREAS

FLOODWAY DATA

MARSH CREEK MINK 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)
Pocatello Creek								
A	12,100	178	618	5.8	4,543.5	4,543.5	4,544.5	1.0
B	12,520	94	381	9.5	4,552.7	4,552.7	4,553.3	0.6
C	12,860	73	585	6.2	4,557.1	4,557.1	4,558.1	1.0
D	13,180	73	334	10.8	4,562.0	4,562.0	4,562.0	0.0
E	13,530	406	1,283	2.8	4,563.6	4,563.6	4,564.5	0.9
F	13,581	389	388	9.3	4,590.4	4,590.4	4,590.4	0.0
G	14,151	1090	527	6.8	4,591.8	4,591.8	4,591.8	0.0
H	14,202	1269	12,088	0.3	4,592.4	4,592.4	4,592.4	0.0
I	14,502	266	2,703	1.3	4,592.4	4,592.4	4,592.4	0.0
J	14,892	242	941	3.8	4,592.4	4,592.4	4,592.4	0.0
K	15,132	132	390	9.2	4,595.2	4,595.2	4,596.2	1.0
L	15,532	102	362	9.9	4,603.1	4,603.1	4,604.1	1.0
M	15,722	80	360	10	4,608.1	4,608.1	4,609.0	0.9
N	16,017	64	331	10.9	4,615.6	4,615.6	4,616.4	0.8
O	16,357	73	309	11.7	4,623.1	4,623.1	4,624.0	0.9
P	16,557	77	368	9.8	4,626.4	4,626.4	4,626.9	0.5
Q	16,767	80	341	10.6	4,633.6	4,633.6	4,634.4	0.8
R	17,057	68	327	11	4,641.1	4,641.1	4,642.0	0.9
S	17,432	144	486	7.4	4,649.4	4,649.4	4,650.3	0.9
T	17,802	87	428	8.4	4,659.6	4,659.6	4,660.6	1.0
U	17,927	139	468	7.7	4,661.4	4,661.4	4,662.3	0.9
V	18,247	260	611	5.9	4,665.7	4,665.7	4,666.2	0.5
W	18,547	335	1497	2.4	4,674.7	4,674.7	4,674.7	0.0
X	18,947	61	311	11.6	4,683.0	4,683.0	4,684.0	1.0

[1]Feet above mouth

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

BANNOCK COUNTY, IDAHO AND INCORPORATED AREAS

FLOODWAY DATA

POCATELLO CREEK

FLOODING SOURCE		FLOODWAY			1 PERCENT ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET/SEC)	REGULATORY (FEET NAVD)	WITHOUT FLOODWAY (FEET NAVD)	WITH FLOODWAY (FEET NAVD)	INCREASE (FEET)
Pocatello Creek (continued)								
Y	19,300[1]	118	500	6.6	4,691.5	4,691.5	4,691.5	0.0
Z	19,775[1]	200	607	5.4	4,704.6	4,704.6	4,704.8	0.2
AA	20,075[1]	265	679	4.9	4,711.4	4,711.4	4,711.4	0.0
AB	20,800[1]	130	436	7.6	4,728.1	4,728.1	4,728.2	0.1
AC	21,700[1]	47	442	7.5	4,748.1	4,748.1	4,748.1	0.0
AD	22,200[1]	200	593	5.6	4,758.0	4,758.0	4,758.1	0.1
AE	22,750[1]	78	576	5.7	4,770.5	4,770.5	4,770.5	0.0
AF	23,375[1]	85	375	8.8	4,784.3	4,784.3	4,784.4	0.1
AG	24,400[1]	80	369	8.9	4,807.4	4,807.4	4,807.4	0.0
AH	25,280[1]	180	427	7.7	4,838.4	4,838.4	4,838.4	0.0
AI	25,950[1]	110	436	7.57	4,856.9	4,856.9	4,856.9	0.0
North Fork Pocatello Creek								
AJ	26,745[2]	145	644	5.12	4,873.0	4,873.0	4,873.0	0.0
AK	27,180[2]	140	433	7.62	4,885.0	4,885.0	4,885.0	0.0
AL	27,730[2]	83	509	6.48	4,900.0	4,900.0	4,900.0	0.0
AM	28,355[2]	64	504	6.55	4,924.5	4,924.5	4,924.5	0.0
AN	28,680[2]	120	462	7.14	4,934.0	4,934.0	4,934.0	0.0
AO	29,380[2]	180	733	4.5	4,943.7	4,943.7	4,943.9	0.2
AP	29,680[2]	170	529	6.24	4,947.0	4,947.0	4,947.1	0.1
AQ	29,855[2]	93	524	6.3	4,953.0	4,953.0	4,953.0	0.0
AR	30,185[2]	97	542	6.09	4,960.4	4,960.4	4,960.5	0.1
AS	30,410[2]	130	621	5.31	4,962.9	4,962.9	4,963.1	0.2
AT	31,110[2]	100	379	8.71	4,975.7	4,975.7	4,975.7	0.0

[1]Feet above mouth
[2]Feet above mouth of Pocatello Creek

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

BANNOCK COUNTY, IDAHO AND INCORPORATED AREAS

FLOODWAY DATA

POCATELLO CREEK — NORTH FORK POCATELLO 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 Fork Pocatello Creek (continued)								
AU	32,010	115	434	7.6	4,997.1	4,997.1	4,997.3	0.2
AV	32,385	184	566	5.83	5,007.7	5,007.7	5,008.4	0.7
AW	33,010	97	511	6.46	5,036.0	5,036.0	5,036.1	0.1
AX	33,335	74	421	7.84	5,044.0	5,044.0	5,044.2	0.2
AY	34,510	106	432	7.64	5,074.3	5,074.3	5,075.0	0.7
AZ	35,335	14 5	555	5.95	5,096.1	5,096.1	5,096.3	0.2
BA	36,085	115	382	8.64	5,123.0	5,123.0	5,123.0	0.0
BB	36,585	175	820	4.02	5,136.6	5,136.6	5,136.9	0.3
BC	37,135	95	433	7.62	5,151.7	5,151.7	5,151.7	0.0
BD	37,585	115	454	7.27	5,170.4	5,170.4	5,170.4	0.0

[1]Feet above mouth of Pocatello Creek

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

BANNOCK COUNTY, IDAHO AND INCORPORATED AREAS

FLOODWAY DATA

NORTH FORK POCATELLO CREEK

LOCATION		FLOODWAY			1% ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION (FEET NAVD88)			
CROSS SECTION	DISTANCE [1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET/SEC)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
A	58,118	57	476	6.8	4,427.9	4,427.9	4,427.9	0.0
B	59,138	81	627	5.2	4,429.9	4,429.9	4,430.3	0.4
C	59,840	60	493	6.6	4,430.8	4,430.8	4,431.1	0.3
D	60,253	69	561	5.8	4,431.8	4,431.8	4,432.0	0.2
E	60,871	94	807	4.0	4,432.9	4,432.9	4,433.1	0.2
F	61,624	170	1,071	3.0	4,433.4	4,433.4	4,433.5	0.1
G	62,750	152	1,104	2.9	4,433.6	4,433.6	4,434.0	0.4
H	63,461	144	1,140	2.9	4,433.8	4,433.8	4,434.5	0.7
I	63,971	86	825	3.9	4,434.1	4,434.1	4,434.7	0.6
J	64,615	77	766	4.2	4,434.4	4,434.4	4,434.9	0.5
K	65,130	82	714	4.5	4,434.7	4,434.7	4,435.2	0.5
L	65,540	75	646	5.0	4,435.0	4,435.0	4,435.5	0.5
M	65,686	55	612	5.2	4,435.3	4,435.3	4,435.7	0.4
N	65,920	40	453	7.1	4,435.3	4,435.1	4,435.5	0.4
O	66,123	40	450	7.1	4,435.3	4,435.1	4,435.6	0.5
P	66,549	40	442	7.2	4,435.3	4,435.3	4,435.7	0.4
Q	66,898	40	437	7.3	4,435.4	4,435.4	4,435.7	0.3
R	67,150	40	321	10.0	4,435.4	4,431.3	4,432.2	0.8
S	67,326	40	203	15.8	4,435.4	4,433.9	4,433.9	0.0
T	67,733	40	204	15.7	4,435.4	4,435.1	4,435.1	0.0

[1] Feet above the confluence with American Falls Reservoir

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

BANNOCK COUNTY, ID

AND INCORPORATED AREAS

FLOODWAY DATA

FLOODING SOURCE: PORTNEUF RIVER (WITH LEVEE)

LOCATION		FLOODWAY			1% ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION (FEET NAVD88)			
CROSS SECTION	DISTANCE [1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET/SEC)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
U	67,878	40	204	15.7	4,435.5	4,435.5	4,435.5	0.0
V	68,019	40	204	15.7	4,435.9	4,435.9	4,435.9	0.0
W	68,148	40	203	15.8	4,436.2	4,436.2	4,436.2	0.0
X	68,538	40	205	15.6	4,437.5	4,437.5	4,437.5	0.0
Y	69,190	40	201	15.9	4,439.2	4,439.2	4,439.2	0.0
Z	69,571	40	194	16.5	4,440.1	4,440.1	4,440.1	0.0
AA	69,903	40	235	13.6	4,442.3	4,442.3	4,442.3	0.0
AB	70,367	40	278	11.5	4,443.8	4,443.8	4,443.8	0.0
AC	70,692	40	184	17.4	4,443.8	4,441.7	4,441.7	0.0
AD	71,075	40	262	12.2	4,444.8	4,444.8	4,444.8	0.0
AE	71,420	40	270	11.9	4,445.4	4,445.4	4,445.4	0.0
AF	71,812	40	271	11.8	4,445.9	4,445.9	4,445.9	0.0
AG	72,255	40	272	11.8	4,446.5	4,446.5	4,446.5	0.0
AH	72,595	40	271	11.8	4,446.9	4,446.9	4,446.9	0.0
AI	73,101	40	274	11.7	4,447.5	4,447.5	4,447.5	0.0
AJ	73,498	86	657	4.9	4,449.7	4,449.7	4,449.7	0.0
AK	73,968	84	585	5.5	4,450.1	4,450.1	4,450.1	0.0
AL	75,053	85	709	4.5	4,451.4	4,451.4	4,451.4	0.0
AM	76,173	96	783	4.1	4,452.2	4,452.2	4,452.2	0.0
AN	77,408	114	878	3.6	4,453.1	4,453.1	4,453.1	0.0

[1] Feet above the confluence with American Falls Reservoir

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

BANNOCK COUNTY, ID

AND INCORPORATED AREAS

FLOODWAY DATA

FLOODING SOURCE: PORTNEUF RIVER (WITH LEVEE)

LOCATION		FLOODWAY			1% ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION (FEET NAVD88)			
CROSS SECTION	DISTANCE [1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET/SEC)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
AO	78,430	88	740	4.3	4,453.5	4,453.5	4,453.6	0.1
AP	79,461	85	638	5.0	4,454.3	4,454.3	4,454.4	0.1
AQ	80,577	75	600	5.3	4,455.4	4,455.4	4,455.5	0.1
AR	81,258	65	583	5.5	4,456.1	4,456.1	4,456.2	0.1
AS	81,601	76	738	4.3	4,456.8	4,456.8	4,456.8	0.0
AT	82,212	102	807	4.0	4,457.1	4,457.1	4,457.2	0.1
AU	83,158	80	740	4.3	4,457.7	4,457.7	4,457.7	0.0
AV	84,237	73	673	4.8	4,458.4	4,458.4	4,458.4	0.0
AW	85,082	83	752	4.3	4,459.1	4,459.1	4,459.1	0.0
AX	86,206	91	754	4.2	4,459.8	4,459.8	4,459.9	0.1
AY	87,648	70	528	6.1	4,460.9	4,460.9	4,460.9	0.0
AZ	88,619	82	627	5.1	4,462.3	4,462.3	4,462.4	0.1
BA	89,740	73	575	5.6	4,463.4	4,463.4	4,463.5	0.1
BB	89,868	73	473	6.8	4,463.6	4,463.6	4,463.6	0.0
BC	90,606	63	654	4.9	4,465.0	4,465.0	4,465.0	0.0
BD	92,149	161	622	5.1	4,466.3	4,466.3	4,467.0	0.7

[1] Feet above the confluence with American Falls Reservoir

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

BANNOCK COUNTY, ID

AND INCORPORATED AREAS

FLOODWAY DATA

FLOODING SOURCE: PORTNEUF RIVER (WITH LEVEE)

LOCATION		FLOODWAY			1% ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION (FEET NAVD88)			
CROSS SECTION	DISTANCE [1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET/SEC)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
A	58,118	57	476	6.8	4,427.9	4,427.9	4,427.9	0.0
B	59,138	81	627	5.2	4,429.9	4,429.9	4,430.3	0.4
C	59,840	60	493	6.6	4,430.8	4,430.8	4,431.1	0.3
D	60,253	69	561	5.8	4,431.8	4,431.8	4,432.0	0.2
E	60,871	94	807	4.0	4,432.9	4,432.9	4,433.1	0.2
F	61,624	170	1,071	3.0	4,433.4	4,433.4	4,433.5	0.1
G	62,750	152	1,104	2.9	4,433.6	4,433.6	4,434.0	0.4
H	63,461	144	1,140	2.9	4,433.8	4,433.8	4,434.5	0.7
I	63,971	86	825	3.9	4,434.1	4,434.1	4,434.7	0.6
J	64,615	77	766	4.2	4,434.4	4,434.4	4,434.9	0.5
K	65,130	82	714	4.5	4,434.7	4,434.7	4,435.2	0.5
L	65,540	75	646	5.0	4,435.0	4,435.0	4,435.5	0.5
M	65,686	55	612	5.2	4,435.3	4,435.3	4,435.7	0.4
N	65,920	40	453	7.1	4,435.3	4,435.1	4,435.5	0.4
O	66,123	40	450	7.1	4,435.3	4,435.1	4,435.6	0.5
P	66,549	40	442	7.2	4,435.4	4,435.4	4,435.7	0.3
Q	66,898	40	437	7.3	4,435.4	4,435.4	4,435.7	0.3
R	67,150	40	321	10.0	4,435.4	4,431.3	4,432.2	0.8
S	67,326	40	203	15.8	4,435.4	4,433.9	4,433.9	0.0
T	67,733	40	205	15.6	4,435.4	4,435.1	4,435.1	0.0

[1] Feet above the confluence with American Falls Reservoir

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

BANNOCK COUNTY, ID

AND INCORPORATED AREAS

FLOODWAY DATA

FLOODING SOURCE: PORTNEUF RIVER (NATURAL VALLEY)

LOCATION		FLOODWAY			1% ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION (FEET NAVD88)			
CROSS SECTION	DISTANCE [1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET/SEC)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
U	67,878	40	205	15.6	4,435.5	4,435.5	4,435.5	0.0
V	68,019	40	204	15.6	4,435.9	4,435.9	4,435.9	0.0
W	68,148	40	203	15.8	4,436.2	4,436.2	4,436.2	0.0
X	68,538	40	205	15.6	4,437.4	4,437.4	4,437.5	0.1
Y	69,190	40	201	15.9	4,439.2	4,439.2	4,439.2	0.0
Z	69,571	40	194	16.5	4,440.1	4,440.1	4,440.1	0.0
AA	69,903	40	233	13.8	4,442.2	4,442.2	4,442.2	0.0
AB	70,367	40	279	11.5	4,443.8	4,443.8	4,443.8	0.0
AC	70,692	40	184	17.4	4,443.8	4,441.7	4,441.7	0.0
AD	71,075	40	263	12.2	4,444.9	4,444.9	4,444.9	0.0
AE	71,420	40	270	11.8	4,445.4	4,445.4	4,445.4	0.0
AF	71,812	40	271	11.8	4,445.9	4,445.9	4,445.9	0.0
AG	72,255	40	272	11.7	4,446.5	4,446.5	4,446.5	0.0
AH	72,595	40	271	11.8	4,446.9	4,446.9	4,446.9	0.0
AI	73,101	40	274	11.7	4,447.5	4,447.5	4,447.5	0.0
AJ	73,498	86	657	4.9	4,449.7	4,449.7	4,449.7	0.0
AK	73,968	84	585	5.5	4,450.1	4,450.1	4,450.1	0.0
AL	75,053	85	709	4.5	4,451.4	4,451.4	4,451.4	0.0
AM	76,173	96	783	4.1	4,452.1	4,452.1	4,452.2	0.1
AN	77,408	114	878	3.6	4,453.0	4,453.0	4,453.1	0.1

[1] Feet above the confluence with American Falls Reservoir

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

BANNOCK COUNTY, ID

AND INCORPORATED AREAS

FLOODWAY DATA

FLOODING SOURCE: PORTNEUF RIVER (NATURAL VALLEY)

LOCATION		FLOODWAY			1% ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION (FEET NAVD88)			
CROSS SECTION	DISTANCE [1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET/SEC)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
AO	78,430	88	740	4.3	4,453.4	4,453.4	4,453.6	0.2
AP	79,461	85	638	5.0	4,454.3	4,454.3	4,454.4	0.1
AQ	80,577	75	600	5.3	4,455.4	4,455.4	4,455.5	0.1
AR	81,258	65	583	5.5	4,456.1	4,456.1	4,456.2	0.1
AS	81,601	76	738	4.3	4,456.7	4,456.7	4,456.8	0.1
AT	82,212	102	807	4.0	4,457.2	4,457.2	4,457.2	0.0
AU	83,158	80	740	4.3	4,457.5	4,457.5	4,457.7	0.2
AV	84,237	73	673	4.8	4,457.9	4,457.9	4,458.4	0.5
AW	85,082	83	752	4.3	4,458.7	4,458.7	4,459.1	0.4
AX	86,206	91	754	4.2	4,459.4	4,459.4	4,459.9	0.5
AY	87,648	70	528	6.1	4,460.7	4,460.7	4,460.9	0.2
AZ	88,619	82	627	5.1	4,461.8	4,461.8	4,462.4	0.6
BA	89,740	73	575	5.6	4,463.1	4,463.1	4,463.5	0.4
BB	89,868	73	473	6.8	4,463.3	4,463.3	4,463.6	0.3
BC	90,606	63	654	4.9	4,464.8	4,464.8	4,465.0	0.2
BD	92,149	161	620	5.2	4,466.0	4,466.0	4,467.0	1.0

[1] Feet above the confluence with American Falls Reservoir

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

BANNOCK COUNTY, ID

AND INCORPORATED AREAS

FLOODWAY DATA

FLOODING SOURCE: PORTNEUF RIVER (NATURAL VALLEY)

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)
Portneuf River (continued)								
BE	93,667	247	984	5.6	4,471.0	4,471.0	4,472.0	1.0
BF	95,119	316	1831	3	4,473.2	4,473.2	4,474.2	1.0
BG	96,730	85	712	7.7	4,474.9	4,474.9	4,475.7	0.8
BH	98,208	286	1836	3	4,477.3	4,477.3	4,478.1	0.8
BI	100,901	570	2446	2.3	4,478.4	4,478.4	4,479.3	0.9
BJ	102,721	102	733	7.5	4,479.5	4,479.5	4,480.4	0.9
BK	104,291	66	613	9.0	4,483.8	4,483.8	4,484.5	0.7
BL	105,732	150	1,023	5.4	4,487.5	4,487.5	4,488.5	1.0
BM	106,999	200	1,070	5.1	4,489.4	4,489.4	4,490.3	0.9
BN	109,692	456	2,748	2.0	4,490.8	4,490.8	4,491.7	0.9
BO	112,688	303	1,560	3.5	4,495.0	4,495.0	4,495.8	0.8
BP	113,969	176	1,157	4.8	4,496.5	4,496.5	4,497.4	0.9
BQ	115,584	270	2,119	2.6	4,497.6	4,497.6	4,498.6	1.0
BR	117,320	249	1,698	3.2	4,498.1	4,498.1	4,499.1	1.0
BS	119,064	278	1,966	2.8	4,498.9	4,498.9	4,499.9	1.0
BT	120,806	300	2,090	2.6	4,499.6	4,499.6	4,500.6	1.0

[1]Feet above the confluence with American Falls Reservoir

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

BANNOCK COUNTY, IDAHO AND INCORPORATED AREAS

FLOODWAY DATA

PORTNEUF 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)
Portneuf River (continued)								
BU	121,920	61	511	10.8	4,499.6	4,499.6	4,500.6	1.0
BV	123,130	125	1203	4.6	4,503.4	4,503.4	4,504.1	0.7
BW	125,347	599	3354	1.6	4,504.4	4,504.4	4,505.3	0.9
BX	127,560	219	1502	3.7	4,505.6	4,505.6	4,506.5	0.9
BY	129,677	421	2762	2.0	4,506.5	4,506.5	4,507.4	0.9
BZ	133,214	384	2126	2.6	4,507.1	4,507.1	4,508.1	1.0
CA	134,323	400	2315	2.4	4,507.6	4,507.6	4,508.6	1.0
CB	135,907	340	2346	2.3	4,508.2	4,508.2	4,509.2	1.0
CC	137,914	235	1555	3.5	4,509.0	4,509.0	4,510.0	1.0
CD	139,656	250	1346	4.1	4,510.4	4,510.4	4,511.4	1.0
CE	141,108	140	1164	4.7	4,512.1	4,512.1	4,513.0	0.9
CF	142,586	125	1180	4.7	4,513.6	4,513.6	4,514.4	0.8
CG	144,566	260	2004	2.7	4,515.0	4,515.0	4,515.7	0.7
CH	150,190	250	1360	4.0	4,517.1	4,517.1	4,517.9	0.8
CI	151,800	65	658	8.4	4,518.4	4,518.4	4,519.3	0.9
CJ	155,338	260	1564	3.5	4,522.0	4,522.0	4,522.8	0.8
CK	157,186	230	1132	4.9	4,523.9	4,523.9	4,524.6	0.7
CL	157,819	91	1286	4.3	4,524.6	4,524.6	4,525.4	0.8
CM	158,347	130	901	6.1	4,525.6	4,525.6	4,526.3	0.7
CN	158,747	80	605	9.1	4,525.7	4,525.7	4,526.6	0.9
CO	159,139	410	2747	2	4,529.3	4,529.3	4,530.0	0.7
CP	159,509	529	2901	1.9	4,529.3	4,529.3	4,530.1	0.8
CQ	160,565	633	3,633	1.5	4,529.8	4,529.8	4,530.5	0.7
CR	161,938	725	5,377	1.0	4,529.9	4,529.9	4,530.7	0.8

[1]Feet above the confluence with American Falls Reservoir

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

BANNOCK COUNTY, IDAHO
AND INCORPORATED AREAS

FLOODWAY DATA

PORTNEUF 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)
Portneuf River (continued)								
CS	166,320	547	3,006	1.8	4,530.2	4,530.2	4,531.0	0.8
CT	167,500	530	3,414	1.6	4,532.5	4,532.5	4,533.5	1.0
CU	168,500	160	1,083	4.9	4,533.4	4,533.4	4,534.3	0.9
CV	168,785	74	769	6.9	4,534.4	4,534.4	4,535.1	0.7
CW	168,850	64	701	7.6	4,534.9	4,534.9	4,535.3	0.4
CX	169,500	190	1,682	3.2	4,536.3	4,536.3	4,537.2	0.9
CY	169,860	155	1,388	3.8	4,536.7	4,536.7	4,537.5	0.8
CZ	170,110	161	688	7.7	4,536.7	4,536.7	4,537.6	0.9
DA	170,240	57	518	10.2	4,538.5	4,538.5	4,538.5	0.0
DB	170,410	119	1361	3.9	4,539.8	4,539.8	4,540.6	0.8
DC	170,800	109	676	7.8	4,540.2	4,540.2	4,540.9	0.7
DD	171,100	78	780	6.8	4,542.4	4,542.4	4,542.5	0.1
DE	171,430	140	987	5.4	4,543.3	4,543.3	4,543.7	0.4
DF	172,155	154	1069	4.9	4,545.0	4,545.0	4,546.0	1.0
DG	172,852	160	1232	4.3	4,546.8	4,546.8	4,547.8	1.0
DH	173,615	195	891	5.9	4,549.5	4,549.5	4,550.1	0.6
DI	174,350	280	1337	4.0	4,553.0	4,553.0	4,553.3	0.3
DJ	174,900	300	1032	5.1	4,554.6	4,554.6	4,554.7	0.1
DK	175,700	53/42[2]	428	12.4	4,559.8	4,559.8	4,560.1	0.3
DL	177,025	51	502	10.6	4,577.5	4,577.5	4,578.0	0.5
DM	178,895	350	2514	2.0	4,582.4	4,582.4	4,583.3	0.9
DN	180,980	150	1081	4.9	4,589.0	4,589.0	4,590.0	1.0
DO	181,430	90	717	7.4	4,590.2	4,590.2	4,591.1	0.9
DP	181,875	106	815	6.5	4,599.0	4,599.0	4,599.2	0.2

[1]Feet above the confluence with American Falls Reservoir [2]West Floodway Channel/East Floodway Channel

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

BANNOCK COUNTY, IDAHO AND INCORPORATED AREAS

FLOODWAY DATA

PORTNEUF 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)
Portneuf River (continued)								
DQ	185,174	235	1771	3	4,604.4	4,604.4	4,605.3	0.9
DR	188,850	183	1357	3.9	4,608.5	4,608.5	4,609.2	0.7
DS	190,420	250	1890	2.8	4,610.5	4,610.5	4,611.3	0.8
DT	190,900	141	1112	4.8	4,611.1	4,611.1	4,611.9	0.8
DU	191,370	116	1057	5.0	4,614.5	4,614.5	4,615.2	0.7
DV	195,000	90	728	7.3	4,629.5	4,629.5	4,630.0	0.5
DW	196,570	129	814	6.5	4,635.9	4,635.9	4,636.5	0.6
DX	199,040	167	1,254	4.2	4,642.7	4,642.7	4,643.3	0.6
DY	201,082	101	639	8.3	4,648.9	4,648.9	4,649.8	0.9
DZ	201,990	111	1,082	4.7	4,652.7	4,652.7	4,653.0	0.3
EA	203,795	50	543	9.4	4,655.7	4,655.7	4,656.7	1.0
EB	205,750	198	1,694	3.0	4,660.3	4,660.3	4,661.3	1.0
EC	208,070	156	967	5.3	4,663.1	4,663.1	4,663.7	0.6
ED	209,215	108	874	5.8	4,665.7	4,665.7	4,666.6	0.9
EE	210,765	136	1,038	4.9	4,669.3	4,669.3	4,670.2	0.9
EF	212,520	114	769	6.6	4,674.1	4,674.1	4,674.9	0.8
EG	214,055	61	584	8.7	4,680.9	4,680.9	4,681.8	0.9
EH	214,115	50	516	9.9	4,680.9	4,680.9	4,681.9	1.0
EI	214,280	61	670	7.6	4,683.1	4,683.1	4,683.6	0.5
EJ	214,825	110	962	5.3	4,685.1	4,685.1	4,685.5	0.4
EK	216,390	158	956	5.3	4,688.2	4,688.2	4,689.1	0.9
EL	218,405	64	563	9.1	4,698.6	4,698.6	4,699.4	0.8
EM	219,300	51	424	12.0	4,708.1	4,708.1	4,708.5	0.4
EN	220,155	65	621	8.2	4,715.2	4,715.2	4,715.8	0.6

[1]Feet above the confluence with American Falls Reservoir

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

BANNOCK COUNTY, IDAHO AND INCORPORATED AREAS

FLOODWAY DATA

PORTNEUF 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)
Portneuf River (continued)								
EO	220,255	75	803	6.4	4,717.2	4,717.2	4,717.5	0.3
EP	220,720	48	420	12.1	4,718.8	4,718.8	4,719.4	0.6
EQ	220,915	57	647	7.9	4,721.9	4,721.9	4,722.3	0.4
ER	221,390	100	745	6.9	4,723.7	4,723.7	4,724.4	0.7
ES	222,150	82	521	9.8	4,728.1	4,728.1	4,728.4	0.3
ET	223,340	305	1549	3.3	4,749.0	4,749.0	4,749.9	0.9
EU	224,590	90	562	9.1	4,753.4	4,753.4	4,753.5	0.1
EV	225,960	300	1165	4.4	4,759.2	4,759.2	4,760.2	1.0
EW	228,500	93	773	6.6	4,765.4	4,765.4	4,766.2	0.8
EX	231,800	97	729	7	4,784.5	4,784.5	4,785.1	0.6
EY	232,050	170	914	5.6	4,785.4	4,785.4	4,786.4	1.0
EZ	232,150	33	348	14.6	4,786.4	4,786.4	4,787.4	1.0
FA	232,250	61	334	15.3	4,788.0	4,788.0	4,788.0	0.0
FB	233,840	128	929	5.5	4,800.1	4,800.1	4,801.0	0.9
FC	236,700	405	3,050	1.7	4,802.4	4,802.4	4,803.4	1.0
FD	292,900	68	522	9.6	4,955.7	4,955.7	4,956.7	1.0
FE	293,090	176	1,268	3.9	4,959.3	4,959.3	4,959.6	0.3
FF	293,540	172	1,240	4.0	4,959.7	4,959.7	4,960.1	0.4
FG	293,940	230	1,686	3.0	4,960.0	4,960.0	4,960.6	0.6
FH	294,190	132	989	5.1	4,960.1	4,960.1	4,960.7	0.6
FI	295,265	128	791	6.3	4,962.2	4,962.2	4,963.1	0.9
FJ	296,065	134	1,030	4.6	4,964.2	4,964.2	4,965.2	1.0
FK	297,315	89	641	7.4	4,967.2	4,967.2	4,968.1	0.9
FL	298,965	184	1,254	3.8	4,972.0	4,972.0	4,973.0	1.0

[1]Feet above the confluence with American Falls Reservoir

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

BANNOCK COUNTY, IDAHO AND INCORPORATED AREAS

FLOODWAY DATA

PORTNEUF 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)
Portneuf River (continued)								
FM	299,965	107	731	6.5	4,974.4	4,974.4	4,975.2	0.8
FN	300,940	111	885	5.4	4,978.3	4,978.3	4,979.3	1.0
FO	302,565	188	1,169	4.1	4,982.6	4,982.6	4,983.6	1.0
FP	303,015	134	1014	4.7	4,983.5	4,983.5	4,984.4	0.9
FQ	303,615	112	825	5.8	4,984.9	4,984.9	4,985.9	1.0
FR	304,215	120	789	6.0	4,986.9	4,986.9	4,987.7	0.8
FS	304,481	104	837	5.7	4,989.1	4,989.1	4,989.5	0.4
FT	304,731	120	976	4.9	4,989.8	4,989.8	4,990.3	0.5
FU	305,037	207	1,286	3.7	4,990.9	4,990.9	4,991.8	0.9
FV	305,537	72	475	10.0	4,992.4	4,992.4	4,992.8	0.4
FW	305,640	40	523	9.1	4,996.3	4,996.3	4,996.5	0.2
FX	305,680	99	967	4.9	4,997.5	4,997.5	4,997.7	0.2
FY	305,930	64	724	6.6	4,997.8	4,997.8	4,998.2	0.4
FZ	306,180	130	1181	4	4,998.6	4,998.6	4,999.1	0.5
GA	306,480	105	694	6.8	4,999.0	4,999.0	4,999.5	0.5
GB	306,705	47	365	13.0	5,001.7	5,001.7	5,001.7	0.0
GC	306,795	33	378	12.6	5,004.8	5,004.8	5,004.8	0.0
GD	306,920	69	619	7.7	5,006.3	5,006.3	5,007.3	1.0
GE	307,258	40	450	10.6	5,008.6	5,008.6	5,009.4	0.8
GF	307,723	103	605	7.8	5,016.7	5,016.7	5,016.7	0.0
GG	308,173	128	542	8.8	5,019.9	5,019.9	5,019.9	0.0
GH	308,648	130	609	7.8	5,025.4	5,025.4	5,025.5	0.1
GI	308,923	64	333	14.3	5,029.2	5,029.2	5,029.3	0.1
GJ	309,173	72	471	10.1	5,037.5	5,037.5	5,037.5	0.0

[1]Feet above the confluence with American Falls Reservoir

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

BANNOCK COUNTY, IDAHO AND INCORPORATED AREAS

FLOODWAY DATA

PORTNEUF 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)
Portneuf River (continued)								
GK	309,523	88	800	5.9	5,040.9	5,040.9	5,041.1	0.2
GL	309,717	101	727	6.5	5,044.1	5,044.1	5,044.1	0.0
GM	310,017	75	786	6.0	5,045.6	5,045.6	5,045.6	0.0
GN	310,677	98	444	10.7	5,072.9	5,072.9	5,073.2	0.3
GO	311,127	108	677	7.0	5,079.3	5,079.3	5,079.6	0.3
GP	311,627	112	468	9.9	5,083.9	5,083.9	5,084.7	0.8
GQ	311,902	81	939	4.9	5,095.6	5,095.6	5,095.6	0.0
GR	311,974	58	554	8.3	5,096.0	5,096.0	5,096.0	0.0

[1]Feet above the confluence with American Falls Reservoir

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

BANNOCK COUNTY, IDAHO AND INCORPORATED AREAS

FLOODWAY DATA

PORTNEUF 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)
Rapid Creek								
A	667	262	836	2.1	4,527.6	4,527.6	4,528.6	1.0
B	953	109	359	4.9	4,529.4	4,529.4	4,529.8	0.4
C	1,127	119	505	3.5	4,530.8	4,530.8	4,531.7	0.9
D	1,611	90	245	7.1	4,534.2	4,534.2	4,534.5	0.3
E	1,650	104	450	3.9	4,536.6	4,536.6	4,537.6	0.9
F	2,216	47	241	7.3	4,540.2	4,540.2	4,541.1	0.9
G	2,272	52	265	6.6	4,541.6	4,541.6	4,541.9	0.3
H	2,327	53	271	6.4	4,542.3	4,542.3	4,542.5	0.2
I	3,169	60	304	5.8	4,549.4	4,549.4	4,549.6	0.2
J	3,269	75	523	3.3	4,551.7	4,551.7	4,552.5	0.8
K	3,320	77	221	7.9	4,556.3	4,556.3	4,556.3	0.0
L	3,380	80	396	4.4	4,557.7	4,557.7	4,558.0	0.4
M	4,732	100	258	6.8	4,571.4	4,571.4	4,571.8	0.4
N	5,031	190	417	4.2	4,575.9	4,575.9	4,576.8	0.9
O	5,112	190	635	2.8	4,578.8	4,578.8	4,579.7	1.0
P	5,480	156	267	6.6	4,582.5	4,582.5	4,583.2	0.7
Q	5,508	189	464	3.8	4,583.0	4,583.0	4,583.9	0.9
R	6,249	40	154	11.3	4,596.2	4,596.2	4,596.2	0.0
S	6,882	85	371	4.7	4,607.2	4,607.2	4,607.4	0.1
T	6,948	88	435	4.0	4,608.3	4,608.3	4,608.8	0.6
U	7,745	200	295	5.9	4,616.7	4,616.7	4,616.7	0.0
V	8,000	90	261	6.7	4,620.8	4,620.8	4,621.1	0.3
W	8,094	120	905	1.9	4,627.3	4,627.3	4,628.2	0.9
X	9,370	54	172	10.2	4,642.1	4,642.1	4,642.1	0.0

[1]Feet above mouth

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

BANNOCK COUNTY, IDAHO AND INCORPORATED AREAS

FLOODWAY DATA

RAPID 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)
Y	10,494	120	365	4.8	4,661.8	4,661.8	4,662.2	0.5
Z	11,338	157	271	6.5	4,675.4	4,675.4	4,676.2	0.8
AA	11,367	143	692	2.5	4,677.5	4,677.5	4,678.4	0.9
AB	12,237	87	210	8.3	4,689.1	4,689.1	4,689.2	0.1
AC	12,287	100	383	4.6	4,691.5	4,691.5	4,692.5	0.9
AD	13,832	66	192	9.1	4,716.5	4,716.5	4,716.8	0.3
AE	15,229	90	326	5.4	4,741.1	4,741.1	4,741.5	0.4
AF	16,095	140	254	6.9	4,756.4	4,756.4	4,756.7	0.3
AG	16,117	140	507	3.5	4,758.3	4,758.3	4,758.7	0.4
AH	16,303	78	193	9.1	4,765.6	4,765.6	4,766.2	0.6
AI	16,357	130	740	2.4	4,769.7	4,769.7	4,770.0	0.3
AJ	16,825	70	208	8.4	4,774.5	4,774.5	4,774.6	0.1
AK	17,379	83	408	4.3	4,785.1	4,785.1	4,785.8	0.7
AL	18,276	90	274	6.4	4,805.8	4,805.8	4,806.1	0.3
AM	19,830	92	415	4.2	4,835.9	4,835.9	4,836.6	0.7
AN	20,219	85	234	7.5	4,845.9	4,845.9	4,846.5	0.6
AO	20,356	117	486	3.6	4,848.5	4,848.5	4,849.4	0.8
AP	21,429	136	289	6.1	4,872.2	4,872.2	4,872.2	0.0
AQ	21,728	110	549	3.2	4,875.6	4,875.6	4,875.8	0.2
AR	21,773	110	1271	1.4	4,893.1	4,893.1	4,893.8	0.7
AS	22,941	60	187	9.4	4,905.0	4,905.0	4,905.3	0.3
AT	23,385	36	218	8.0	4,915.7	4,915.7	4,916.2	0.5
AU	23,429	70	630	2.8	4,922.1	4,922.1	4,923.1	1.0
AV	24,594	57	179	9.8	4,946.3	4,946.3	4,946.3	0.0
AW	26,220	68	336	5.2	4,976.9	4,976.9	4,977.6	0.7

[1]Feet above mouth

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

BANNOCK COUNTY, IDAHO AND INCORPORATED AREAS

FLOODWAY DATA

RAPID CREEK

FLOODING SOURCE		FLOODWAY			1 PERCENT ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[3]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET/SEC)	REGULATORY (FEET NAVD)	WITHOUT FLOODWAY (FEET NAVD)	WITH FLOODWAY (FEET NAVD)	INCREASE (FEET)
AX	27,663[1]	65	292	6.0	4,996.2	4,996.2	4,996.8	0.6
AY	28,985[1]	51	213	8.2	5,021.7	5,021.7	5,022.4	0.7
AZ	29,430[1]	110	426	4.1	5,027.5	5,027.5	5,028.4	0.9
BA	29,456[1]	110	434	4.0	5,027.5	5,027.5	5,028.5	1.0
BB	30,293[1]	124	339	5.2	5,035.3	5,035.3	5,035.9	0.6
BC	31,826[1]	17	334	5.2	5,048.9	5,048.9	5,049.8	0.9
BD	32,671[1]	110	251	7.0	5,059.1	5,059.1	5,059.2	0.0
BE	32,703[1]	130	558	3.1	5,060.9	5,060.9	5,061.8	1.0
North Fork Rapid Creek								
BF	38,386[4]	89	--[2]	--[2]	5,071.8	5,071.8	5,072.8	1.0
BG	40,086[4]	90	--[2]	--[2]	5,097.5	5,097.5	5,098.5	1.0
BH	41,886[4]	115	--[2]	--[2]	5,117.2	5,117.2	5,118.2	1.0
BI	43,506[4]	108	--[2]	--[2]	5,141.8	5,141.8	5,142.8	1.0
BJ	45,056[4]	139	--[2]	--[2]	5,166.9	5,166.9	5,167.9	1.0
BK	46,346[4]	173	--[2]	--[2]	5,181.0	5,181.0	5,182.0	1.0
BL	46,976[4]	87	--[2]	--[2]	5,195.4	5,195.4	5,196.4	1.0
BM	47,106[4]	49	--[2]	--[2]	5,196.5	5,196.5	5,197.5	1.0
BN	48,886[4]	100	--[2]	--[2]	5,221.9	5,221.9	5,222.9	1.0
BO	50,736[4]	122	--[2]	--[2]	5,252.9	5,252.9	5,253.9	1.0
BP	52,286[4]	60	--[2]	--[2]	5,289.2	5,289.2	5,290.2	1.0
BQ	53,966[4]	117	--[2]	--[2]	5,323.0	5,323.0	5,324.0	1.0
BR	55,407[4]	100	--[2]	--[2]	5,341.4	5,341.4	5,342.4	1.0
BS	56,294[4]	79	--[2]	--[2]	5,356.5	5,356.5	5,357.5	1.0

[1]Feet above mouth [2]Data not available [3]Subtract 5,073 feet from North Fork Rapid Creek stream distance to match Rapid Creek stream distance.

[4]Feet above mouth of Rapid Creek

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

BANNOCK COUNTY, IDAHO AND INCORPORATED AREAS

FLOODWAY DATA

RAPID CREEK NORTH FORK RAPID CREEK

FLOODING SOURCE		FLOODWAY			1 PERCENT ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1, 3]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET/SEC)	REGULATORY (FEET NAVD)	WITHOUT FLOODWAY (FEET NAVD)	WITH FLOODWAY (FEET NAVD)	INCREASE (FEET)
North Fork Rapid Creek (continued)								
BT	57,066	42	--[2]	--[2]	5,369.4	5,369.4	5,370.4	1.0
BU	57,886	63	--[2]	--[2]	5,381.2	5,381.2	5,382.2	1.0
BV	58,356	99	--[2]	--[2]	5,389.2	5,389.2	5,390.2	1.0
BW	59,456	79	--[2]	--[2]	5,417.6	5,417.6	5,418.6	1.0

[1]Feet above mouth of Rapid Creek [2]Data not available [3]Subtract 5,073 feet from North Fork Rapid Creek stream distance to match Rapid Creek stream distance.

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

BANNOCK COUNTY, IDAHO AND INCORPORATED AREAS

FLOODWAY DATA

NORTH FORK RAPID 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)
West Fork Rapid Creek								
A	1,000	110	--[2]	--[2]	5,084.0	5,084.0	5,085.0	1.0
B	2,175	107	--[2]	--[2]	5,102.8	5,102.8	5,103.8	1.0
C	2,604	190	--[2]	--[2]	5,110.5	5,110.5	5,111.5	1.0
D	3,364	84	--[2]	--[2]	5,122.3	5,122.3	5,123.3	1.0
E	5,014	67	--[2]	--[2]	5,175.8	5,175.8	5,176.8	1.0
F	6,649	90	--[2]	--[2]	5,196.2	5,196.2	5,197.2	1.0
G	8,449	47	--[2]	--[2]	5,228.2	5,228.2	5,229.2	1.0
H	10,199	47	--[2]	--[2]	5,264.6	5,264.6	5,265.6	1.0
I	11,267	115	--[2]	--[2]	5,281.7	5,281.7	5,282.7	1.0
J	11,787	48	--[2]	--[2]	5,293.9	5,293.9	5,294.9	1.0
K	13,787	70	--[2]	--[2]	5,337.8	5,337.8	5,338.8	1.0
L	15,387	118	--[2]	--[2]	5,358.2	5,358.2	5,359.2	1.0
M	17,187	74	--[2]	--[2]	5,382.4	5,382.4	5,383.4	1.0
N	17,772	66	--[2]	--[2]	5,390.1	5,390.1	5,391.1	1.0

[1]Feet above mouth [2]Data not available

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

BANNOCK COUNTY, IDAHO AND INCORPORATED AREAS

FLOODWAY DATA

WEST FORK RAPID 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)
Rowe Creek								
A	1,031	36	--[2]	--[2]	4,750.7	4,750.7	4,751.7	1.0
Unnamed Tributary to Marsh Creek								
A	1,155	39	--[2]	--[2]	4,639.1	4,639.1	4,640.1	1.0
B	1,862	91	--[2]	--[2]	4,679.2	4,679.2	4,680.2	1.0
C	2,258	41	--[2]	--[2]	4,690.3	4,690.3	4,691.3	1.0
D	3,292	36	--[2]	--[2]	4,730.3	4,730.3	4,731.3	1.0
Walker Creek								
A	1,671	284	--[2]	--[2]	4,618.5	4,618.5	4,619.5	1.0
B	2,098	73	--[2]	--[2]	4,636.9	4,636.9	4,637.9	1.0
C	2,833	58	--[2]	--[2]	4,670.3	4,670.3	4,671.3	1.0

[1]Feet above mouth [2]Data not available

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

BANNOCK COUNTY, IDAHO AND INCORPORATED AREAS

FLOODWAY DATA

ROWE CREEK UNNAMED TRIBUTARY TO MARSH CREEK WALKER 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 Flood Insurance Study by approximate methods. Because detailed hydraulic analyses are not performed for such areas, no base (100-year) 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 Flood Insurance Study by detailed methods. Whole-foot BFEs derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone AH

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

Zone X

Zone X is the flood insurance rate zone that corresponds to areas outside the 0.2-percent-annual-chance floodplain, areas within the 0.2-percent-annual-chance floodplain, areas of 1-percent-annual-chance flooding where average depths are less than 1 foot, areas of 1-percent-annual-chance flooding where the contributing drainage area is less than 1 square mile, and areas protected from the 1-percent-annual-chance flood by levees. No BFEs or depths are shown within this zone.

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- 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 Flood Insurance Rate Map presents flooding information for the entire geographic area of Bannock County. Previously, Flood Insurance Rate Maps were prepared for each incorporated community and the unincorporated areas of the County identified as flood-prone. This countywide Flood Insurance Rate Map also includes flood-hazard information that was presented separately on Flood Boundary and Floodway Maps, where applicable. Historical data relating to the maps prepared for each community are presented in Table 11.

COMMUNITY NAME	INITIAL IDENTIFICATION	FLOOD HA ARD BOUNDARY MAP REVISION DATE(S)	FLOOD INSURANCE RATE MAP EFFECTIVE DATE	FLOOD INSURANCE RATE MAP REVISION DATE(S)
Unincorporated Areas	January 17, 1975	May 31, 1977	September 5, 1979	--
Downey, City of	January 9, 1979	--	September 16, 1981	--
Inkom, City of	September 13, 1974	December 19, 1975	September 15, 1978	December 28, 1982
Lava Hot Springs, City of	January 16, 1974	February 27, 1976	August 1, 1979	--
McCammon, City of	April 23, 1976	--	September 15, 1978	--
Pocatello, City of	March 1, 1974	August 13, 1976	May 1, 1980	October 16, 1996
*, ** Arimo, City of	N/A	N/A	N/A	N/A
*, ** Chubbuck, City of	N/A	N/A	N/A	N/A

* No Special Flood Hazard Areas Identified
** This community does not have map history prior to the first countywide mapping

TABLE 11

FEDERAL EMERGENCY MANAGEMENT AGENCY

BANNOCK COUNTY, IDAHO
AND INCORPORATED AREAS

COMMUNITY MAP HISTORY

7.0 OTHER STUDIES

The US Army Corps of Engineers, Walla Walla District, completed an analysis of the 1-percent-annual-chance flood and the Standard Project Flood for the Portneuf River from Pocatello upstream to the confluence with Marsh Creek (References 1 and 3), and of the 10-, 2-, 1-, and 0.2-percent-annual-chance floods for the Portneuf River from the confluence with Marsh Creek, upstream to a point approximately 3,000 feet south of McCammon (Reference 2). They also completed an analysis of the 1-percent-annual-chance and Standard Project Floods for four tributaries of Portneuf River including: Johnny, Gibson Jack, Mink and Fort Hall Mine Creeks (Reference 3).

A review and update of the U.S. Army Corps of Engineers hydrologic analyses was made by the study contractor using the standard procedure of log-Pearson Type III curve fitting as described by the US Water Resources Council (Reference 49). Due to technical considerations, the newly developed 1-percent-annual-chance flows were 50 percent lower and 45 percent lower at the Pocatello and Topaz gages, respectively, than the 1-percent-annual-chance flows developed earlier by the US Army Corps of Engineers. However, to maintain regional consistency in the hydrology of the Portneuf River basin, the FEMA elected to adopt the U.S. Army Corps of Engineers' frequency curves.

The US Army Corps of Engineers' analysis for the Portneuf River from Pocatello upstream to the Portneuf area (Reference 3) was made using an old version of the HEC-2, computer program (References 26, 27, and 28). The computer analysis made for this Flood Insurance Study, using the current version of HEC-2, produced 1-percent-annual-chance flood water-surface elevations that vary up to 0.6 feet at each cross section from those shown in the U.S. Army Corps of Engineers' study.

Several changes were made from the U.S. Army Corps of Engineers' covering the Portneuf River reach from the Portneuf area to the confluence with Marsh Creek (Reference 1). First, at cross section T (shown as 4 in the Corps report), the computer input lacked information about a railroad fill on the floodplain; this information was added for this study, and produced no change in computed water-surface elevations. However, since the fill is higher than the 1-percent-annual-chance flood elevation, the 1-percent-annual-chance floodplain has been shown inside the tracks, and much narrower than in the U.S. Army Corps of Engineers' study in that area. Field verification indicates that no culverts or bridges exist in the area which would allow floodwaters to cross the railroad fill. A similar situation exists in the area from cross section X to AF (the US Army Corps of Engineers' cross sections 8 to 16), where the railroad tracks and an area north of them was shown flooded in the U.S. Army Corps of Engineers' study. In this case, the railroad fill information was included in their computer input, but flood flow was allowed to occur in low ground at cross sections AD and AE (US Army Corps of Engineers' cross sections 14 and 15), even though separated from the river by the fill. A field investigation conducted by the study contractor indicated that no flooding in this area is possible from the 100-year flow at cross sections AD, AE, AF and AG (U.S. Army Corps of Engineers' cross sections 14, 15, 16, 17) the elevations shown on the Flood Profiles are 0.3, 0.5, 0.8, and 0.2 feet higher respectively, than on the US Army Corps of Engineers Flood Profiles. Finally, the last flood profile sheet in the U.S. Army Corps of Engineers' study (plate 9) had the elevation scale misplotted. All elevations shown on that plate are 5 feet lower than they should be. That error was corrected..

The U.S. Army Corps of Engineers' study covering the reach of Portneuf River from the Marsh Creek confluence to upstream of McCammon (Reference 2) was found to be adequate, so its flood profiles, floodplain boundaries, and floodways were used without modification. However, the surveyed stream location of cross section BB (15 of the U.S. Army Corps of Engineers' study) was inconsistent with the location shown on the plan sheets. Following a discussion with the U.S. Army Corps of Engineers, it was agreed that the cross section should be shown 200 feet downstream from the location shown in the U.S. Army Corps of Engineers study. This change did not affect the floodplain boundaries, but it did change the computed water-surface elevations in the vicinity. For the 1-percent-annual-chance flood, the flood profile, when corrected, was 0.3 foot lower, 0.6 foot higher and 0.3 foot lower at cross sections BB(15), BC(16), and BD(17)m respectively, than reported in the U.S. Army Corps of Engineers study.

The four tributaries to Portneuf River, near Pocatello, studied earlier by the US Army Corps of Engineers: Johnny, Gibson Jack, Mink, and Fort Hall Mine Creeks, had the 1-percent-annual-chance flows determined using Snyder method synthetic unit hydrographs, and with rainfall totals determined using a now outmode publication entitled U.S. Weather Bureau Technical Paper 40 (Reference 50); backwater analysis was accomplished using a version of HEC-2 that is also currently outmoded. For this study, flood peaks were reevaluated using a current rainfall atlas (Reference 16). The same Snyder unit hydrograph coefficients and same loss rates used by the U.S. Army Corps of Engineers were used for this analysis; but with the change in rainfall totals, the flood peaks changed as well. For the 1-percent-annual-chance flood, the peaks were 25 percent higher, 9 percent lower, 10 percent lower, and 30 percent higher, respectively, for Johnny, Gibson Jack, Mink and Fort hall Mine Creeks than the peaks computed by the U.S. Army Corps of Engineers. With the change in peak flows and the newer version of HEC-2, computed water-surface elevations changed somewhat also. For Gibson Jack and Fort Hall Mine Creeks, the new flood profiles (used in this Flood Insurance Study) were 1.0 and 1.5 feet higher, respectively, than the U.S. Army Corps of Engineers flood profiles. For Mink Creek, the new profile was 1.0 foot lower than the U.S. Army Corps of Engineers flood profiles for the 1-percent-annual-chance flood.

The U.S. Soil Conservation Service completed an analysis of the 4-, 2-, and 1-percent-annual-chance floods for Rapid Creek from the U.S. Interstate Highway 15 Business Loop Bridge in Inkom upstream to a point approximately 7 miles above the Inkom corporate limits (Reference 5). A portion of the West Fork Rapid Creek was also studied.

Agreement was reached between the study contractor and the Idaho State office of the U.S. Soil Conservation Service as to a reasonable placement of a 1-percent-annual-chance frequency curve on their frequency discharge-drainage area graph. Several attempts were also made by the study contractor to verify the U.S. Soil Conservation Service analysis using different methods of analysis. These include a statistical probability (risk) analysis, a regional frequency analysis, and a Snyder method synthetic unit hydrograph for a rainfall-runoff model of the Rapid Creek basis (Reference 15). Rainfall totals of the rainfall-runoff model were based on procedures and data published by the National Weather Service (Reference 16), and loss rates on the US Army Corps of Engineers analysis mentioned in Section 3.1. All three of the study contractors' analytic techniques were in agreement with the flow used by the U.S. Soil Conservation Service for the 10-percent-annual-chance discharge, but the 2-, 1-, and 0.2-percent-annual-chance flows developed by the study contractor were 24, 40, and 36 percent lower, respectively, than the U.S. Soil Conservation Service computed flows at the mouth of Rapid Creek. However, due to the inherent uncertainty in the hydrologic analysis of thunderstorm runoff, the Federal Insurance Administration elected to adopt the U.S. Soil Conservation Service frequency curve. In addition, the U.S. Soil Conservation Service study was carried out using the WSP-2 computer backwater program (Reference 29). The resulting water-surface profiles and floodplain boundaries for the 1-percent-annual-chance flood from the U.S. Soil Conservation Service study agreed in all respects with information prepared in this Flood Insurance Study, with the exception of the following discrepancies. The flood profiles shown in the U.S. Soil Conservation Service study are based on distances between cross sections measured along the floodplain; however, for this Flood Insurance Study, the distances are measured along the channel centerline. Since channel distances are always longer than floodplain distances, flood profile distances between cross sections shown in this Flood Insurance Study are longer than in the U.S. Soil Conservation Service study.

The 1-percent-annual-chance flood profile for Rapid Creek at cross sections W(RC-36) and AH(RC-22) and on the West Fork Rapid Creek at cross sections A(AW-18) and E(WF-13) were plotted approximately 1.0 foot low. For this Flood Insurance Study, the flood profile was corrected in these areas. The limits of the 1-percent-annual-chance flood shown in the U.S. Soil Conservation Service's study at cross section V(RC-37) was shown 100 feet narrower than what the computer output indicated. The floodplain was adjusted in that area for this Flood Insurance Study.

Between cross sections C and D on Rapid Creek, additional field survey information indicated that the 1-percent-annual-chance floodplain on the west side of the channel was shown too wide in the U.S. Soil Conservation Service study. The maps produced with this report show the corrected widths. The bridge on Rapid Creek at cross section E was constructed since the U.S. Soil Conservation Service report was published, and a bridge which was at cross section F has been removed since the U.S. Soil Conservation Service report was completed. These modified channel conditions were modeled using the HEC-2 computer step-backwater program (Reference 28). As a result, the profile at cross section F remained approximately the same as that shown in the U.S. Soil Conservation report, but at cross section G it dropped 2 feet with the 1-percent-annual-chance flood. Because of the lower profile, the floodway boundary of the 1-percent-annual-chance flood was shifted slightly toward the channel from the location it was shown at in the U.S. Soil Conservation Service report. The limits have been widened for this Flood Insurance Study.

The U.S. Soil Conservation Service also made an analysis of the 10-, 2-, 1-, and 0.2-percent-annual-chance floods on Marsh Creek and nine small tributaries (Reference 4). During the preparation of this Flood Insurance Study, the study contractor reviewed and updated the US Soil Conservation Service's hydrologic analysis for Marsh Creek using the log-Pearson Type III procedure. The newly developed 100-year flow was 33 percent lower than that developed by the US Soil Conservation Service; however, the Federal Insurance Administration accepted the US Soil Conservation Service's analysis as adequate, and adopted their frequency curve.

The downstream boundary condition assumed for Marsh Creek, at its confluence with the Portneuf River, was that a flood of equal recurrence interval would occur simultaneously on the Portneuf River. Therefore, the elevation computed at the confluence on the Portneuf River would be the starting elevation for Marsh Creek for each analyzed flood recurrence interval. A stage-frequency curve was interpolated by the U.S. Soil Conservation Service for cross section and on the Portneuf River, based on the water-surface profiles published by the U.S. Army Corps of Engineers of the 1-percent-annual-chance and standard project floods (Reference 1). All elevations published on that sheet are 5 feet too low; the stage-frequency curve prepared by the U.S. Soil Conservation Service, consequently, was also 5 feet too low. For this Flood Insurance Study, correct Portneuf elevations were used, but an average of values computed at cross sections AO and AP for the 10-, 2-, 1-, and 0.2-percent-annual-chance flood were used to determine the starting water-surface elevations for floods of equal recurrence interval on Marsh Creek. As a result, water-surface elevations for all flood intervals on Marsh Creek are higher than reported by the U.S. Soil Conservation Service near the confluence. For the 1-percent-annual-chance, this backwater effect extends from cross section A(AM-66) thorough L(MC-54), with a maximum difference of 7.3 feet higher than the flood profile shown by the U.S. Soil Conservation Service at cross section A.

Dry Canyon Creek, one of the tributaries of Marsh Creek studied by the U.S. Soil Conservation Service, shows an undefined hazard area in the alluvial fan below the canyon mouth. Following a field investigation, this area was shifted slightly. In general, all of the tributaries of Marsh Creek had similar undefined hazard areas shown in the U.S. Soil Conservation Service's study for the alluvial fan reaches. The approximate limits of these hazard areas shown by the U.S. Soil Conservation Service were used as the approximate 1-percent-annual-chance (Zone A) limits for this Flood Insurance Study.

The Federal Insurance Administration previously published Flood Hazard Boundary Maps covering the unincorporated areas of Bannock County (Reference 45). Some of the approximate 1-percent-annual-chance boundaries for the March 1979 Bannock County (Unincorporated Areas) Flood Insurance Study were taken from those maps.

This report either supersedes or is compatible with all previous studies published on streams studied in this report and should be considered authoritative for the purposes of the NFIP.

8.0 LOCATION OF DATA

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

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10.0 REVISION DESCRIPTIONS

This section has been added to provide information regarding significant revisions made since the original Flood Insurance Study was printed. Future revisions may be made that do not result in the republishing of the Flood Insurance Study report. To assure that any user is aware of all revisions, it is advisable to contact the community repository of flood-hazard data.

10.1 First Revision (Effective June 16, 2009)

This revision includes revised hydrologic and hydraulic analyses and floodplain mapping that was performed by WEST Consultants, Inc. for FEMA under IDIQ Contract No. EMS-2001-CO-0068, Task Order No. 16. It was completed in November 2007. A revised detailed studied was conducted for Rapid Creek from the U.S Highway 91 bridge upstream to the confluence with the North and West Forks of Rapid Creek The reach length of the study is approximately 6.3 miles.

The effective flows for Rapid Creek were originally developed and provided in the document "Rapid Creek Flood Hazard Analyses" for Bannock County, ID (Reference 5). The U.S. Soil Conservation Service (SCS) employed several analytical methods to arrive at estimates of flood frequency and magnitude. No stream data were available for Rapid Creek at the time of the analysis. The SCS used their in-house procedure called PO-2 as well as plots of all known peak flow estimates for small basins in southern Idaho on a drainage area versus discharge graph. Flood frequency curves were plotted on these data. The 1-percent-annual-chance frequency curve was plotted as an enveloping curve assuming that none of the recorded peak flows had exceeded a 1-percent-annual-chance flood. In addition, the estimated flows for Rapid Creek were 'bulked" to account for sediment and debris loading. However, the amount of "bulking" was not provided in the SCS document. Also, changes in future land use conditions were considered in the estimates of peak flows. Again, no detail on how land use was considered was provided in the SCS document.

In addition to the analysis conducted by the Soil Conservation Service, the study contractor conducted an independent analysis of the hydrology using statistical probability, a regional frequency analysis, and a standard synthetic unit hydrograph for a rainfall-runoff model in order to verify the U.S. Soil Conservation Service estimates. The study contractor's estimate of the 1-percent-annual-chance peak discharge was 40 percent lower than the estimate made by the U.S. Soil Conservation Service. The Federal Emergency Management Agency (FEMA) elected to use the U.S. Soil Conservation Service estimate of 7,500 cfs for the 1-

percent-annual-chance peak discharge on Rapid Creek (Reference 20).

A memorandum dated March 10, 2002 from Michael Baker Jr. to Mr. Joseph Weber at FEMA Region X (Reference 21) addresses the Idaho State Floodplain Administrator's concern that the effective FIS estimate for the 1-percent-annual-chance peak discharge of 7,500 cfs for Rapid Creek is too large. The memo summarizes the analysis conducted by the Idaho State Floodplain Administrator to evaluate the reasonableness of the effective hydrology for Rapid Creek. The memo also details the additional analysis conducted by Michael Baker Jr. to further evaluate the peak discharge values.

Data for the additional analysis came from effective FIS base flood discharges for other streams in Bannock County, base flood discharges developed from regression equations provided in U.S. Geological Survey (USGS) Open File Report (OFR) 81-909 (Reference 22), and maximum recorded discharges and base flood discharges developed from statistical analysis of gaging stations in or near Bannock County. A gaging station installed on Rapid Creek collected data between 1980 and 1986 for a total of 6 years. Peak annual flows were also estimated for the 1955, 1963, and 1977 floods resulting in 9 years of combined peak flow data for the Rapid Creek gage.

The memo states that the Rapid Creek watershed has a mean annual precipitation (MAP) of 16 inches and a mean basin elevation (MBE) of approximately 6,300 feet. The criteria used to select gaging stations in basins with watershed characteristics similar to Rapid Creek were as follows: MAP of 10 to 24 inches, and MBE of 4,900 to 7,000 feet. With these criteria, eight gaging stations were selected using OFR 81-909 as the data source for MAP and MBE. A regression analysis was conducted using these data resulting in a base flood discharge of 1,900 cfs for Rapid Creek. The memo also states that the gaging station record, albeit only 9 years, indicates that the base flood discharge is about 1,860 cfs. The memo concludes that the State Floodplain Administrator has a valid argument that the effective discharge is too high and that "a more detailed hydrologic analysis of base flood discharges for Rapid Creek…appears warranted".

WEST Consultants used annual peak discharges from selected gaging stations in nearby basins with watershed characteristics similar to Rapid Creek to develop a set of proposed regression equations. The MBE criterion used in the 2002 memo was also used for the proposed hydrology analysis. However, the MAP was adjusted from a range of 10 to 24 inches to a range of 10 to 30 inches as the estimate for MAP in the Rapid Creek basin was revised to 19 inches. The revised value for MAP was determined by approximation from an isohyetal map for the state of Idaho for the period 1961-1990 (Reference 23). In addition to MBE and MAP, Forest cover was also included as a selection criterion. A forest cover estimate of approximately 19 percent was determined for the Rapid Creek watershed from recent aerial photos. The forest cover criterion for selecting gaging stations from watersheds similar to the Rapid Creek basin ranged from 8 to 29 percent.

Data for basin characteristics (MAP, MBE, and forest cover) came from the USGS Water-Resources Investigations Report (WRIR) 02-4170 (Reference 24), which was published shortly after the 2002 memo previously described. The potential number of gaging stations available for the analysis was limited to stations with 10 or more years of record within Regions 7b and 8 as delineated in WRIR 02-4170. Although spatially close in proximity, Region 0 was not considered in this analysis as it is an undefined area in WRIR 02-4170 with a significant amount of flow attributed to ground water.

Estimates of MAP at some gaging stations changed significantly from OFR 81-909 to WRIR 02-4170. MAP values listed in OFR 81-909 were developed from a grid-overlay method on a 1930-1957 NOAA mean annual precipitation map. MAP values listed in WRIR 02-4170 came from a more recent 1961-1990 mean annual precipitation map produced at the University of Idaho. MAP values for both reports for selected gaging stations are shown in Table 5.

Only MAP values from WRIR 02-4170 were used in the analysis. Also, some stations listed in OFR 81-909 were not included in WRIR 02-4170. The seven gaging stations selected for the analysis are listed in Table 6 along with corresponding criteria values.

The U.S. Army Corps of Engineers Flood Frequency Analysis (FFA) software (Reference 25) was used to determine flood frequency flows at each of the selected seven gaging stations using a standard Log-Pearson III analysis. A set of regression equations were then developed using the FFA estimates. Both drainage area and mean annual precipitation were used as independent variables in the initial analysis. However, after review of the initial results and discussion with Will Thomas at Michael Baker Jr., it was concluded that not including MAP as an independent variable in the analysis was warranted due to the small sample size. Therefore, only the drainage basin area variable was used for development of the regression equations.

The 1-percent-annual chance flood developed from a Log-Pearson Type III flood frequency analysis for Rapid Creek (using 9 years of record) is 1,600 cfs. This is approximately 9% less than the proposed regression estimate. However, the proposed regression estimate is considered to be a more reliable approximation because it is based on the observed annual peaks at both the Rapid Creek gage and 6 additional gaging stations that have between 16 and 36 years of record and watershed characteristics that are considered similar to those of Rapid Creek. Therefore, the following regression equations were used for computing the 10-, 2-, 1-, and 0.2-percent-annual-chance peak discharges for Rapid Creek.

The updated hydraulic analysis for Rapid Creek was conducting by converting the existing WSP-2 hydraulic model to HEC-RAS and using the above revised peak discharges. Geometry data for hydraulic structures in the WSP-2 model had been modified to provide only one-third of the original hydraulic opening to account for blockage by sediment and/or debris. The data in the model were not sufficient for input into the bridge geometry tables within HEC-RAS; therefore a field investigation was conducted to determine the effective hydraulic opening for each structure. Following the same logic as the original modeling, the effective hydraulic opening was reduced to one-third the measured opening within HEC-RAS. Floodways encroachment stations were determined for the 1-percent-annual-chance discharge using a maximum allowable rise of 1 foot. Floodway data are shown in Table 10.

The 1- and 0.2-percent-annual-chance floodplain boundaries were delineated using the flood elevations determined at each cross section. Between cross sections, the boundary of the 1- and 0.2-percent-annual-chance floods were interpolated using topographic maps at a scale of 1:24,000 with a contour interval of 40 feet (Reference 38).

This update combined the Flood Insurance Rate Maps and Flood Insurance Study reports for Bannock County and incorporated communities into the countywide format. Under the countywide format, Flood Insurance Rate Map 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 Flood Insurance Study report provides all Flood Insurance Study information and data for the entire County area.

Floodway widths for portions of Gibson-Jack Creek, Pocatello Creek, North Fork Pocatello Creek and the Portneuf River within the City of Pocatello were revised during the countywide update as a result of revisions to the floodplain and floodway boundaries based on new topographic mapping. Floodway widths shown in Table 10 were modified accordingly. The original floodway widths can be obtained from the backup data for this study as described in Section 8.0.

As part of this revision, the format of the map panels has changed. Previously, flood-hazard information was shown on both the Flood Insurance Rate Map and Flood Boundary and Floodway Map. In the new format, all base flood elevations, cross sections, zone designations, and floodplain and floodway boundary delineations are shown on the Flood Insurance Rate Map and the Flood Boundary and Floodway Map has been eliminated. 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 Flood Insurance Study report and all zone designations and reach determinations were removed from the profile panels.

10.2 Second Revision (July 22, 2020)

This revision incorporates the results of the analysis and mapping procedures for non-accredited levees systems for the Pocatello, Idaho Levee System along portions of the Portneuf River within the City of Pocatello. It incorporates the accreditation of portions of the levee system as certified by 44CFR65.10 compliance.

The analysis and mapping process for the Pocatello, Idaho Levee System involved various community engagement meetings facilitated by FEMA and the Strategic Alliance for Risk Reduction (STARR). FEMA initiated the project with a kickoff meeting held on April 4, 2014 via webinar. The overarching objectives of the Stakeholder Coordination and Data Collection Meeting were to introduce stakeholders to each other and discuss areas of flood risk, available data and information, and the FEMA process for analyzing and mapping flood hazards landward of non-accredited levee systems. The meeting was attended by the representatives from FEMA, STARR, and the City of Pocatello.

Based on the discussion during this meeting, several stakeholders were identified as potential members of a Local Levee Partnership Team (LLPT). The primary function of the LLPT was to provide data and input to FEMA, including commenting on the creation of levee reaches and the procedures to be used for analyzing and mapping the reaches based on local levee conditions. A LLPT meeting was held at the City Hall of the City of Pocatello on September 22, 2014.

Based on the findings of the LLPT meeting, a final plan was produced on September 30, 2014. The plan outlined the methods in which a new FEMA RiskMAP project would be initiated to perform the modeling and mapping approach for the levee systems.

During the Stakeholder Coordination and Data Collection and LLPT processes, stakeholders identified time needed to assess the results of the new hydraulic analysis to identify what impacts the lower BFE has to the levee system's natural valley protected area. The analysis was submitted to the LLPT members as part of the plan submittal. This assessment allowed the City to decide where to pursue further certification efforts. The LLPT members agreed to a follow up conference call in January 2015 to discuss results of the City's assessment. Based on the results, the City opted to proceed with accreditation of Reach 2 of the levee system. Reach 1 of the levee system was previously accepted. The levee system reaches are described below.

The Portneuf River Flood Reduction Project, Systems 1, 2, 3, 4 and 5, which is operated and maintained by the City of Pocatello, was originally constructed on Sept. 19, 1967. Pocatello System 1 begins as an unrevetted left bank spur levee adjacent to the east side of Indian Hills Elementary School on the Portneuf River on the south side of Pocatello, Idaho. The spur levee is approximately 0.5 miles long. At Cheyenne Avenue, the system becomes a revetted left bank levee. The system continues northwest downstream through the City of Pocatello for an additional approximate 1.7 miles. The downstream end of the system is located upstream from Sue Road. The entire length of Pocatello System 1 is approximately 2.2 miles. An interior drainage flooding source from an alluvial fan area in the vicinity of Johnny Creek provides the source of ZONE AO flooding on the landward side of the accredited levee.

System 2 begins upstream of Cheyenne Avenue Bridge as a revetted channel. The system continues downstream of Cheyenne Avenue Bridge as a revetted right bank levee. The system proceeds northwest downstream through the City of Pocatello as a right bank levee where it ties into the concrete channel (Pocatello System 5) approximately 230 feet upstream of West Halliday Street. The entire length of the Pocatello System 2 is approximately 3.1 miles.

System 3 begins approximately 245 feet downstream of Sue Road as a revetted left bank levee. The system proceeds northwest downstream for approximately 0.9 miles as a revetted left bank levee through the City of Pocatello where it becomes an unrevetted spur levee that continues approximately 450 feet in a westerly direction to connect with Grant Avenue. The entire length of the Pocatello System 3 is approximately 1 mile.

System 4 begins near high ground upstream of the concrete channel as a revetted channel. The system continues downstream until reaching the concrete channel near City Creek. The system proceeds northwest downstream through the City of Pocatello as a left bank concrete channel where it transitions back to a left bank levee system. The left bank levee proceeds further downstream until it ties into high ground. The entire length of Pocatello System 4, including upstream levee segment, concrete channel and the spur levee, is approximately 2.3 miles.

System 5 begins approximately 230 feet upstream of West Halliday Street where it ties into Pocatello System 2. The system includes the right side of the concrete channel. The entire length of Pocatello System 5 is approximately 1.5 miles.

FEMA acknowledged that all certification requirements for Reach 1 were met, and accreditation of Reach 1 was accepted on April 6, 2012. All certification requirements for Reach 2 were met, and FEMA accepted accreditation for Reach 2 on November 29, 2017. This revision incorporates the accreditation of Reaches 1 and 2 and identifies the flood risks associated with natural valley analysis for the non-accredited portions of the levee system.

The Project Team analyzed the collected data, information, and documentation to prepare for the LLPT Meeting. Project team examined the hydrologic, hydraulic, topographic and structural data available for the Portneuf River and Pocatello Levee.

Hydrologic studies of Portneuf River near Pocatello were performed by the USACE in 1964, 1987, and 2011. For this revision, the 2011 study by USACE was utilized for the hydrologic analysis and subsequent floodplain delineations. These studies use the assumption that there are two primary and fundamentally different and independent types of causes driving peak discharges on the Portneuf River; winter rainfall on snow and spring snowmelt.The results of these analyses have a 1% annual chance discharge lowered by 40.9% from 5,500 cfs down to 3,250 cfs (Reference 51).

The modelling approach for this study used the Natural Valley reach analysis procedure and Accredited Levee simulations to determine water surface elevations and floodplains for each condition. The hydraulic model used for this flood study is the U.S. Army Corps of Engineers (USACE) Hydraulic Engineering Center River Analysis System (HEC-RAS), version 4.1.0. The William's Engineering HEC-RAS model was leveraged and used as a basis to develop the 10-, 4-, 2-, 1-, and 0.2-percent-annual-chance flood events.

The results of the hydraulic analysis lowered the base flood elevation to the range of 2.2 feet at the upstream end of the levee to 5 feet at the downstream end of the levee. For levee systems 3, 4, and 5. The new BFEs are now contained in the channel thus those levee systems did not get data certified. A final CCO meeting was held on February 4, 2019. The meeting was attended by the representatives from FEMA, STARR, and the City of Pocatello.

Each FIRM panel may contain specific notes to the user that provide additional information regarding the flood hazard data shown on that map. However, the FIRM panel does not contain enough space to show all the notes that may be relevant in helping to better understand the information on the panel. Figure 2 contains the full list of these notes.

Figure 2: FIRM Notes to Users

NOTES TO USERS

For information and questions about this map, available products associated with this FIRM including historic versions of this FIRM, how to order products, or the National Flood Insurance Program in general, please call the FEMA Map Information eXchange at 1-877-FEMA-MAP (1-877-336-2627) or visit the FEMA Flood Map Service Center website at https://msc.fema.gov. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. Many of these products can be ordered or obtained directly from the website. Users may determine the current map date for each FIRM panel by visiting the FEMA Flood Map Service Center website or by calling the FEMA Map Information eXchange.

Communities annexing land on adjacent FIRM panels must obtain a current copy of the adjacent panel as well as the current FIRM Index. These may be ordered directly from the Flood Map Service Center at the number listed above.

For community and countywide map dates, refer to Table 11 in this FIS Report.

To determine if flood insurance is available in the community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

PRELIMINARY FIS REPORT: FEMA maintains information about map features, such as street locations and names, in or near designated flood hazard areas. Requests to revise information in or near designated flood hazard areas may be provided to FEMA during the community review period, at the final Consultation Coordination Officer's meeting, or during the statutory 90-day appeal period. Approved requests for changes will be shown on the final printed FIRM.

The map is for use in administering the NFIP. It may not identify all areas subject to flooding, particularly from local drainage sources of small size. Consult the community map repository to find updated or additional flood hazard information.

BASE FLOOD ELEVATIONS: For more detailed information in areas where Base Flood Elevations (BFEs) and/or floodways have been determined, consult the Flood Profiles and Floodway Data and/or Summary of Non-Coastal Stillwater Elevations tables within this FIS Report. Use the flood elevation data within the FIS Report in conjunction with the FIRM for construction and/or floodplain management.

FLOODWAY INFORMATION: Boundaries of the floodways were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the FIS Report for this jurisdiction.

Figure 2. FIRM Notes to Users (continued)

FLOOD CONTROL STRUCTURE INFORMATION: Certain areas not in Special Flood Hazard Areas may be protected by flood control structures. Refer to Section 4.3 "Non-Levee Flood Protection Measures" of this FIS Report for information on flood control structures for this jurisdiction.

PROJECTION INFORMATION: The projection used in the preparation of the map was NAD 1983 Universal Transverse Mercator (UTM) Zone 12. The horizontal datum was the North American Datum of 1983 NAD83, GRS1980 spheroid. Differences in datum, spheroid, projection or State Plane zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of the FIRM.

ELEVATION DATUM: Flood elevations on the FIRM are referenced to the North American Vertical Datum of 1988. These flood elevations must be compared to structure and ground elevations referenced to the same vertical datum. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at www.ngs.noaa.gov.

Local vertical monuments may have been used to create the map. To obtain current monument information, please contact the appropriate local community.

BASE MAP INFORMATION: Base map information shown on the FIRM was provided by the United States Geological Survey (USGS) dated 2009 at a 2-foot resolution. For information about base maps, refer to Section 6.2 “Base Map” in this FIS Report.

The map reflects more detailed and up-to-date stream channel configurations than those shown on the previous FIRM for this jurisdiction. The floodplains and floodways that were transferred from the previous FIRM may have been adjusted to conform to these new stream channel configurations. As a result, the Flood Profiles and Floodway Data tables may reflect stream channel distances that differ from what is shown on the map.

Corporate limits shown on the map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after the map was published, map users should contact appropriate community officials to verify current corporate limit locations.

NOTES FOR FIRM INDEX

REVISIONS TO INDEX: As new studies are performed and FIRM panels are updated within Bannock County, Idaho, corresponding revisions to the FIRM Index will be incorporated within the FIS Report to reflect the effective dates of those panels. Please refer to Table 11 of this FIS Report to determine the most recent FIRM revision date for each community. The most recent FIRM panel effective date will correspond to the most recent index date.

SPECIAL NOTES FOR SPECIFIC FIRM PANELS

This Notes to Users section was created specifically for Bannock County, Idaho, effective July 22, 2020.

FLOOD RISK REPORT: A Flood Risk Report (FRR) may be available for many of the flooding sources and communities referenced in this FIS Report. The FRR is provided to

Figure 2. FIRM Notes to Users (continued)

increase public awareness of flood risk by helping communities identify the areas within their jurisdictions that have the greatest risks. Although non-regulatory, the information provided within the FRR can assist communities in assessing and evaluating mitigation opportunities to reduce these risks. It can also be used by communities developing or updating flood risk mitigation plans. These plans allow communities to identify and evaluate opportunities to reduce potential loss of life and property. However, the FRR is not intended to be the final authoritative source of all flood risk data for a project area; rather, it should be used with other data sources to paint a comprehensive picture of flood risk.

Each FIRM panel contains an abbreviated legend for the features shown on the maps. However, the FIRM panel does not contain enough space to show the legend for all map features. Figure 3 shows the full legend of all map features. Note that not all of these features may appear on the FIRM panels in Bannock County.

Figure 3: Map Legend for FIRM

SPECIAL FLOOD HAZARD AREAS: The 1% annual chance flood, also known as the base flood or 100-year flood, has a 1% chance of happening or being exceeded each year. Special Flood Hazard Areas are subject to flooding by the 1% annual chance flood. The Base Flood Elevation is the water surface elevation of the 1% annual chance flood. The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights. See note for specific types. If the floodway is too narrow to be shown, a note is shown.

	Special Flood Hazard Areas subject to inundation by the 1% annual chance flood (Zones A, AE, AH, AO, AR, A99, V and VE)
Zone A	The flood insurance rate zone that corresponds to the 1% annual chance floodplains. No base (1% annual chance) flood elevations (BFEs) or depths are shown within this zone.
Zone AE	The flood insurance rate zone that corresponds to the 1% annual chance floodplains. Base flood elevations derived from the hydraulic analyses are shown within this zone.
Zone AH	The flood insurance rate zone that corresponds to the areas of 1% annual chance shallow flooding (usually areas of ponding) where average depths are between 1 and 3 feet. Whole-foot BFEs derived from the hydraulic analyses are shown at selected intervals within this zone.
Zone AO	The flood insurance rate zone that corresponds to the areas of 1% annual chance shallow flooding (usually sheet flow on sloping terrain) where average depths are between 1 and 3 feet. Average whole-foot depths derived from the hydraulic analyses are shown within this zone.
Zone AR	The flood insurance rate zone that corresponds to areas that were formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
Zone A99	The flood insurance rate zone that corresponds to areas of the 1% annual chance floodplain that will be protected by a Federal flood protection system where construction has reached specified statutory milestones. No base flood elevations or flood depths are shown within this zone.
Zone V	The flood insurance rate zone that corresponds to the 1% annual chance coastal floodplains that have additional hazards associated with storm waves. Base flood elevations are not shown within this zone.
Zone VE	Zone VE is the flood insurance rate zone that corresponds to the 1% annual chance coastal floodplains that have additional hazards associated with storm waves. Base flood elevations derived from the coastal analyses are shown within this zone as static whole-foot elevations that apply throughout the zone.

Figure 3: Map Legend for FIRM (continued)

	Regulatory Floodway determined in Zone AE.
OTHER AREAS OF FLOOD HAZARD	
	Shaded Zone X: Areas of 0.2% annual chance flood hazards and areas of 1% annual chance flood hazards with average depths of less than 1 foot or with drainage areas less than 1 square mile.
	Future Conditions 1% Annual Chance Flood Hazard – Zone X: The flood insurance rate zone that corresponds to the 1% annual chance floodplains that are determined based on future-conditions hydrology. No base flood elevations or flood depths are shown within this zone.
	Area with Reduced Flood Risk due to Levee: Areas where an accredited levee, dike, or other flood control structure has reduced the flood risk from the 1% annual chance flood.
	Area with Flood Risk due to Levee: Areas where a non-accredited levee, dike, or other flood control structure is shown as providing protection to less than the 1% annual chance flood.
OTHER AREAS	
	Zone D (Areas of Undetermined Flood Hazard): The flood insurance rate zone that corresponds to unstudied areas where flood hazards are undetermined, but possible.
NO SCREEN	Unshaded Zone X: Areas of minimal flood hazard.
FLOOD HAZARD AND OTHER BOUNDARY LINES	
(ortho) (vector)	Flood Zone Boundary (white line on ortho-photography-based mapping; gray line on vector-based mapping)
	Limit of Study
	Jurisdiction Boundary
	Limit of Moderate Wave Action (LiMWA): Indicates the inland limit of the area affected by waves greater than 1.5 feet
GENERAL STRUCTURES	
Aqueduct Channel Culvert Storm Sewer	Channel, Culvert, Aqueduct, or Storm Sewer
Dam Jetty Weir	Dam, Jetty, Weir
	Levee, Dike, or Floodwall

Figure 3: Map Legend for FIRM (continued)

Bridge	Bridge
REFERENCE MARKERS	
22.0	River mile Markers
CROSS SECTION & TRANSECT INFORMATION	
B 20.2	Lettered Cross Section with Regulatory Water Surface Elevation (BFE)
5280 21.1	Numbered Cross Section with Regulatory Water Surface Elevation (BFE)
17.5	Unlettered Cross Section with Regulatory Water Surface Elevation (BFE)
8	Coastal Transect
	Profile Baseline: Indicates the modeled flow path of a stream and is shown on FIRM panels for all valid studies with profiles or otherwise established base flood elevation.
	Coastal Transect Baseline: Used in the coastal flood hazard model to represent the 0.0-foot elevation contour and the starting point for the transect and the measuring point for the coastal mapping.
513	Base Flood Elevation Line
ZONE AE (EL 16)	Static Base Flood Elevation value (shown under zone label)
ZONE AO (DEPTH 2)	Zone designation with Depth
ZONE AO (DEPTH 2) (VEL 15 FPS)	Zone designation with Depth and Velocity
BASE MAP FEATURES	
Missouri Creek	River, Stream or Other Hydrographic Feature
234	Interstate Highway
234	U.S. Highway
234	State Highway
234	County Highway

Figure 3: Map Legend for FIRM (continued)

MAPLE LANE	Street, Road, Avenue Name, or Private Drive if shown on Flood Profile
RAILROAD	Railroad
______	Horizontal Reference Grid Line
—	Horizontal Reference Grid Ticks
+	Secondary Grid Crosshairs
Land Grant	Name of Land Grant
7	Section Number
R. 43 W. T. 22 N.	Range, Township Number
^{42}76^{000m}E	Horizontal Reference Grid Coordinates (UTM)
365000 FT	Horizontal Reference Grid Coordinates (State Plane)
80° 16’ 52.5”	Corner Coordinates (Latitude, Longitude)