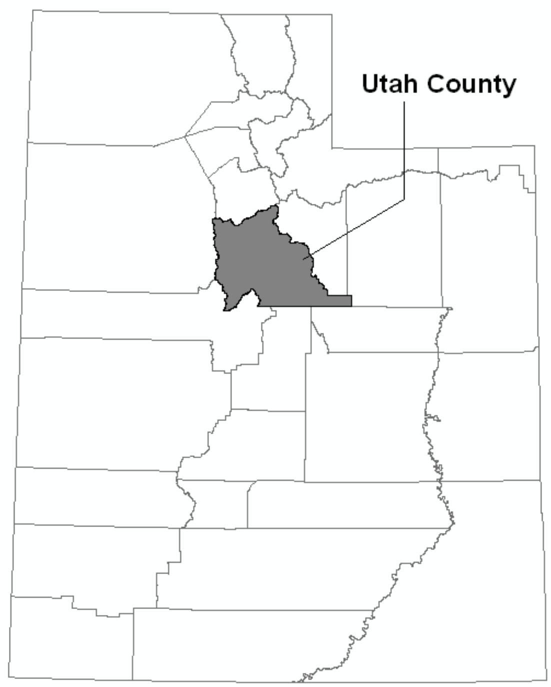
# FLOOD INSURANCE STUDY

# UTAH COUNTY, UTAH

## AND INCORPORATED AREAS

## VOLUME 1 OF 3




| COMMUNITY NAME | COMMUNITY NUMBER |
|---|---|
| ALPINE, CITY OF | 490228 |
| AMERICAN FORK, CITY OF | 490152 |
| BLUFFDALE, CITY OF | 490247 |
| *CEDAR FORT, TOWN OF | 490153 |
| CEDAR HILLS, CITY OF | 490204 |
| DRAPER, CITY OF | 490244 |
| *EAGLE MOUNTAIN, CITY OF | 490258 |
| *ELK RIDGE, CITY OF | 490259 |
| *FAIRFIELD, TOWN OF | 490260 |
| GENOLA, TOWN OF | 490154 |
| *GOSHEN, TOWN OF | 490155 |
| HIGHLAND, CITY OF | 490254 |
| LEHI, CITY OF | 490209 |
| LINDON, CITY OF | 490210 |
| MAPLETON, CITY OF | 490156 |
| OREM, CITY OF | 490216 |
| PAYSON, CITY OF | 490157 |
| *PLEASANT GROVE CITY, CITY OF | 490235 |
| PROVO, CITY OF | 490159 |
| SALEM, CITY OF | 490160 |
| *SANTAQUIN, CITY OF | 490227 |
| SARATOGA SPRINGS, CITY OF | 490250 |
| SPANISH FORK, CITY OF | 490241 |
| SPRINGVILLE, CITY OF | 490163 |
| UTAH COUNTY (UNINCORPORATED AREAS) | 495517 |
| VINEYARD, TOWN OF | 490261 |
| *WOODLAND HILLS, CITY OF | 490262 |

*No Special Flood Hazard Areas Identified

EFFECTIVE DATE
REVISED
PRELIMINARY
January 30, 2018

Federal Emergency Management Agency

**FLOOD INSURANCE STUDY NUMBER**
**49049CV001A**

**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) may not contain all data available within the repository. It is advisable to contact the community repository for any additional data.

Part or all of this FIS may be revised and republished at any time. In addition, part of this FIS may be revised by the 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 components.

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

| Old Zone | New Zone |
|---|---|
| A1 through A30 | AE |
| B | X |
| C | X |

Initial Countywide Effective Date: ___________________

**ATTENTION:** On FIRM panels 49049C0333F, 49049C0341F, 49049C0343F, 49049C0526F, 49049C0527F, 49049C0528F, 49049C0529F, 49049C0531F, 49049C0533F, the levees within Provo City have not been demonstrated by the community or levee owner(s) to meet the requirements of Section 65.10 of the NFIP regulations in 44 CFR as it relates to the levee's capacity to provide 1-percent-annual-chance flood protection. The subject areas are identified on FIRM panels (with notes and bounding lines) and in the FIS report as potential areas of flood hazard data changes based on further review.

FEMA has updated the levee analysis and mapping procedures for non-accredited levees. Until such time as FEMA is able to initiate a new flood risk project to apply the new procedures, the flood hazard information on the aforementioned FIRM panel(s) that are affected by the levees within Provo City are being added as a snapshot of the prior previously effective information presented on the FIRMs and FIS reports dated September 30, 1988 for the City of Provo. As indicated above, it is expected that affected flood hazard data within the subject area could be significantly revised. This may result in floodplain boundary changes, 1-percent-annual-chance flood elevation changes, and/or changes to flood hazard zone designations.

The effective FIRM panels (and the FIS report) will again be revised at a later date to update the flood hazard information associated with the levees within Provo City when FEMA is able to initiate and complete a new flood risk project to apply the updated levee analysis and mapping procedures.

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**FLOOD INSURANCE STUDY**
**UTAH COUNTY, UTAH AND INCORPORATED AREAS**

# 1.0 INTRODUCTION

## 1.1 Purpose of Study

This Flood Insurance Study (FIS) revises and updates information on the existence and severity of flood hazards in the geographic area of Utah County, Utah, and includes the cities of Alpine, American Fork, Bluffdale, Cedar Hills, Draper, Eagle Mountain, Elk Ridge, Highland, Lehi, Lindon, Mapleton, Orem, Payson, Pleasant Grove, Provo, Salem, Santaquin, Saratoga Springs, Spanish Fork, Springville, and Woodland Hills; and the towns of Cedar Fort, Fairfield, Genola, Goshen, and Vineyard; and the unincorporated areas of Utah County (hereinafter referred to collectively as Utah County).

Please note that, as of the effective date of this study, the cities of Eagle Mountain, Elk Ridge, Pleasant Grove, Santaquin, and Woodland Hills; and the towns Cedar Fort, Fairfield, and Goshen have no mapped Special Flood Hazard Areas (SFHAs) identified in Utah County. This does not preclude future determinations of SFHAs that could be necessitated by changed conditions affecting the community (e.g., the annexation of new lands), or the availability of new scientific or technical data about flood hazards.

Please note that the cities of Bluffdale and Draper are in both Salt Lake and Utah counties. See these separately published FIS and Flood Insurance Rate Maps (FIRMs) for the countywide map dates and flood hazard information outside of Utah County.

This study aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. Flood-risk data for various areas of Utah County will be used to establish flood insurance rates and to assist the community in its efforts to promote floodplain management. Minimum requirements for participation in the National Flood Insurance Program (NFIP) are set forth in the Code of Federal Regulations (CFR) at 44 CFR, 60.3.

In some states or communities, floodplain management criteria or regulations may exist that are more restrictive or comprehensive than the minimum Federal requirements. In such cases, the more restrictive criteria take precedence and the State (or other jurisdictional agency) will be able to explain them.

Please also note that FEMA has identified one or more levees in this jurisdiction that have not been demonstrated by the community or levee owner(s) to meet the requirements of 44 CFR Section 65.10 of the NFIP regulations (44CFR65.10) as it relates to the levee's capacity to provide 1-percent-annual-chance flood protection. As such, temporary actions are being taken until such time as FEMA is able to initiate a new flood risk project to apply new levee analysis and mapping procedures. Please refer to the Notice to Flood Insurance Study Users page at the front of this FIS report for more information.

## 1.2 Authority and Acknowledgments

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

This FIS was prepared to include all jurisdictions within Utah County in a countywide FIS. The authority and acknowledgments prior to this countywide FIS were compiled from FIS reports for the cities of Lehi, Payson, Provo, Salem, Saratoga Springs, and Springville, and for the unincorporated areas of Utah County (Federal Emergency Management Agency [FEMA], July 17, 2002; FEMA, May 1978; FEMA, September 30, 1988; FEMA, January 1979; FEMA, July 17, 2002; FEMA, September 1981; and FEMA, July 17, 2002, respectively). Reports and information for flood prone jurisdictions within Utah County are shown below.

| | |
|---|---|
| Lehi, City of: | Hydrologic and hydraulic analyses for this study were performed by the U.S. Bureau of Reclamation (USBR) for the Federal Insurance Administration (FIA), under Inter-Agency Agreement No. IAA-H-12-76, Project Order No. 2. This work, which was completed in April 1978, covered all significant flooding sources affecting the City of Lehi, Utah.<br><br>Hydraulic analyses for the July 17, 2002 revision to incorporate a restudy of the Jordan River were carried out by Montgomery Watson for FEMA under Contract Number EMD-96-CO-0037. |
| Payson, City of | Hydrologic analyses for this study were performed by the USBR, for the FIA under Inter-Agency Agreement No. IAA-H-1276, Project Order No. 2. This work, which was completed in October 1977, covered all significant flooding sources affecting the City of Payson. All previously completed hydraulic analyses are superseded by the 2017 study on Peteetneet and Dry Creeks. |
| Provo, City of: | Hydrologic and hydraulic analyses for this study were performed by the USBR for FEMA, under Inter-Agency Agreement no. IAA-H-12-76, Project Order No. 2. This work, which was completed in June 1977, covered all significant flooding sources affecting the City of Provo. Further analyses were |

performed by the USBR under Inter-Agency Agreement No. IAA-H-6-77, Project Order No. 4, for the Provo River within areas annexed into the city since the original study.

Hydrologic and hydraulic analyses for the annexed portion of this study were performed by Rollins, Brown and Gunnell, Inc., for FEMA, under Contract No. EMW-84-C-1628. This work was completed in May 1986.

Salem, City of: Hydrologic and hydraulic analyses for this study were performed by the USBR, for the FIA, under Inter-Agency Agreement No. IAA-H-12-76, Project Order No. 2. This work, which was completed in March 1978, covered all significant flooding sources affecting the City of Salem.

Saratoga Springs, City of: Hydrologic and hydraulic analyses for this study were performed by the USBR for FEMA under Interagency Agreement No. IAA-H-6-77, Project Order No. 4. This study was completed in July 1979.

Hydraulic analyses for the July 12, 2002 revision to incorporate a restudy of the Jordan River were carried out by Montgomery Watson for FEMA under Contract Number EMD-96-CO-0037.

Springville, City of: Hydrologic and hydraulic analyses for this study were performed by the USBR, for the FIA, under Inter-Agency Agreement No. IAA-H-12-76, Project Order No. 2. This work, which was completed in June 1977, covered all significant flooding sources affecting the City of Springville with the exception of Spring Creek and Little Rock Canyon. Approximate boundaries for these flooding sources were determined in January 1978 by Dames & Moore, under contract to the FIA.

Utah County, Unincorporated Areas: Hydrologic and hydraulic analyses for this study were performed by the USBR, for FEMA, under Inter-Agency Agreement No. IAA-H-6-77, Project Order No. 4. This work, which was completed in July 1979, covered all significant flooding sources affecting Utah County.

Hydraulic analyses for the December 15, 1994 revision involving a restudy of the Spanish Fork River, Soldier Creek, and Thistle Creek were performed by Love and Associates, Inc. for FEMA under contract number EMW-90-C-3132. Hydrologic analyses of the Spanish Fork River, Soldier Creek, and Thistle Creek were performed by the U.S. Army Corps of Engineers (USACE), Sacramento District, in August 1985.

Hydraulic analyses for the July 17, 2002 revision to incorporate a restudy of the Jordan River were carried out by Montgomery Watson for FEMA under Contract Number EMD-96-CO-0037. Revised hydrologic analyses were not conducted as part of this study.

The authority and acknowledgments for the cities of Alpine, American Fork, Cedar Hills, Eagle Mountain, Elk Ridge, Highland, Lindon, Mapleton, Orem, Pleasant Grove, Santaquin, Spanish Fork, and Woodland Hills; and the Towns of Cedar Fort, Fairfield, Genola, Goshen and Vineyard, are not listed because there were no FIS reports previously completed for these communities. These communities may not appear in the Community Map History table (Section 6.0).

The authority and acknowledgements for the City of Bluffdale and the City of Draper are covered in the FIS and countywide flood study completed for Salt Lake County, Utah in August 2012 (FEMA, August 2, 2012). Bluffdale and Draper are geographically located within both Utah and Salt Lake County with the vast majority of the population as well as the flood hazards affecting the City of Bluffdale and the City of Draper located in Salt Lake County.

URS Corporation, under contract with the State of Utah, compiled existing data to convert the previous Utah effective FIS documents into a countywide digital format. In addition, existing countywide effective flood insurance hardcopy or scanned maps were digitally captured, and new detailed studies were conducted for portions of the American Fork River (northern American Fork City boundary to Interstate Highway 15 [I-15]); Dry Creek (within Alpine corporate limits); Fort Creek (within Alpine corporate limits); and Hog Hollow (within Alpine corporate limits). This work was completed in August 2010 under Contract No. EMD-2006-GR-0686 and Contract No. EMD-2009-GR-0986. In 2014, URS Corporation conducted new detailed studies for portions of Hobble Creek (eastern Springville boundary to Utah Lake); Peteetneet Creek (Dry Creek [Payson] diversion to I-15); and Dry Creek (Payson) (Dry Creek [Payson] diversion to Spring Creek); performed a refinement of the 1%-annual-chance floodplain of Utah Lake on updated topography; and incorporated updated structure information for the American Fork River due to the I-15 road reconstruction project. This work was completed in October 2016 under Contract No. EMW-2014-CA-00249.

Base map information used for this project was derived from multiple sources. This information was compiled from the U.S. Geological Survey, 1989, Utah Automated Geographic Reference Center (AGRC), 1985, 2003, 2009, and 2016, National Geodetic Survey, 2005, and USDA Farm Service Agency Aerial Photography Field Office, 2011.

The projection used in the preparation of this Flood Insurance Rate Map (FIRM) is Universal Transverse Mercator (UTM) Zone 12N with a NAD83 horizontal datum, GRS80 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 across jurisdiction boundaries. These differences do not affect the accuracy of the FIRM.

## 1.3 Coordination

An initial Consultation Coordination Officer's (CCO) meeting is held with representatives from FEMA, the community, and the study contractor to explain the nature and purpose of a FIS, and to identify the streams to be studied by detailed methods. A final CCO meeting is held with representatives from FEMA, the community, and the study contractor to review the results of the study.

The dates of the initial and final CCO meetings held for Utah County and the incorporated communities within its boundaries are shown in Table 1, "Initial and Final CCO Meetings". For the City of Bluffdale and the City of Draper, please refer to the FIS for Salt Lake County to obtain this information.

Table 1 – Initial and Final CCO Meetings

| Community | FIS Dated | Initial CCO Date | Final CCO Date |
|---|---|---|---|
| Lehi, City of | March 1, 1983<br>July 17, 2002 | April 12, 1976<br>* | September 19,1978<br>August 2, 2001 |
| Payson, City of | May 1978 | April 12, 1976 | December 14,1977 |
| Provo, City of | September 30, 1988 | April 19, 1984 | June 12,1986 |
| Salem, City of | January 1979 | April 12,1976 | July 12,1978 |
| Saratoga Springs, City of | July 17, 2002 | * | August 2, 2001 |
| Springville, City of | September 1981 | April 12, 1976 | September 20,1977 |
| Utah County | October 15, 1982<br>December 15, 1994<br>July 17, 2002 | June 3, 1977<br>*<br>* | *<br>June 2, 1992<br>August 2, 2001 |

*Data not available

For this countywide FIS, an initial CCO meeting was held on January 26, 2006. This meeting was attended by representatives of the study contractor, the communities, the State of Utah, and FEMA. The final CCO meeting was held on _________, and was attended by representatives of the community, the study contractor, the State of Utah, and FEMA.

## 2.0 AREA STUDIED

### 2.1 Scope of Study

This FIS covers the geographic area of Utah County, Utah and has been revised and updated for all of the communities and unincorporated areas within Utah County.

All or portions of the flooding sources listed in Table 2, "Flooding Sources Studied by Detailed Method," were studied by detailed methods. Limits of each detailed study are indicated on the Flood Profiles (Exhibit 1) and on the FIRM (Exhibit 2).

Table 2 – Flooding Sources Studied by Detailed Method

| | |
|---|---|
| American Fork River | Jordan River |
| Dry Creek | Peteetneet Creek |
| Dry Creek (Payson) | Provo River |
| Dry Creek (Payson) 900 West Split | Salem Pond |
| Dry Creek (Payson) 1250 South Split | Slate Canyon Creek |
| Dry Creek (Payson) I-15 Split | Soldier Creek |
| East Fork Fort Creek | Spanish Fork River |
| Fort Creek | Thistle Creek |
| Hobble Creek | Utah Lake |
| Hobble Creek 400 West Split | Wastewater Ditch Diversion |
| Hog Hollow | West Fork Fort Creek |

Some detailed flooding information was developed for Buckley Draw, Little Rock Canyon, Maple Canyon/Snell Hollow, Rock Canyon Creek, and Slide Canyon, which has been compiled from the previous FISs, however, no profiles or modeling information exists for these streams.

No new approximate analyses were performed for this countywide FIS. Preexisting hardcopy FIRMs were used to digitally convert all flood prone areas, including those areas having a low development potential or minimal flood hazards. The scope and methods of study were proposed and agreed upon by FEMA, Utah County, and incorporated communities.

Table 3 lists the Letters of Map Revision (LOMR) that were incorporated in this countywide study.

Table 3 – Letters of Map Revision

| Case Number | Community | Flooding Source(s)/ Project Identifier | Date Issued | Type |
|---|---|---|---|---|
| 16-08-0706P | City of Alpine | Dry Creek, Fort Creek, Hog Hollow, East Fork Fort Creek, Middle Fork Fort Creek, West Fork Fort Creek | September 6, 2016 | LOMR |
| 16-08-0236P | City of Alpine | Dry Creek, Fort Creek, Hog Hollow, East Fork Fort Creek, Middle Fork Fort Creek, West Fork Fort Creek | September 2, 2016 | LOMR |
| 16-08-0597P | City of Saratoga Springs & Utah County (Unincorporated Areas) | Tickville Gulch | December 19, 2016 | LOMR |
| 15-08-0248P | City of Spanish Fork & Utah County (Unincorporated Areas) | Spanish Fork River | July 8, 2016 | LOMR |
| 13-08-0558P | City of Lehi, City of Saratoga Springs & Utah County (Unincorporated Areas) | Jordan River | March 20, 2014 | LOMR |
| 13-08-0544P | City of Lindon | Unnamed Zone A | October 25, 2013 | LOMR |
| 10-08-0282P | City of Spanish Fork & Utah County (Unincorporated Areas) | Spanish Fork River | February 14, 2011 | LOMR |
| 06-08-B571P | City of Orem | Clegg's Pond | December 11, 2006 | LOMR |
| 01-08-183P | City of Lindon | Sumac Hollow, Dry Canyon | January 28, 2002 | LOMR |
| 01-08-015P | City of Orem & City of Lindon | Dry Canyon | June 8, 2001 | LOMR |
| 99-08-433P | City of Provo & Utah County (Unincorporated Areas) | Provo River | June 22, 2000 | LOMR |

## 2.2 Community Description

Utah County is located south of the Great Salt Lake in north-central Utah along the Wasatch Mountains. It is bordered by Salt Lake County to the north, Wasatch and Duchesne Counties to the east, Carbon, Sanpete and Juab Counties to the south, and Tooele County to the west.

The total land area of Utah County is 2,003.45 square miles (U.S. Census Bureau, 2010). The total population of Utah County is 516,564 (U.S. Census Bureau, 2010). Urban and other developed areas are located along the wide valley between Utah Lake and the Wasatch Range. The major center of population in the county is the City of Provo, the county seat. In general, development in the county has spread steadily toward the Wasatch Range to the east and to the north and west of Utah Lake. The majority of the land surrounding Utah Lake is unincorporated; however, several communities border the lake on the north and east, with the Town of Genola residing at the very southern end. Development along floodplains of the streams studied by detailed analysis is mostly residential. There is some light industry in the floodplains, but most of this is confined to the incorporated towns and cities. A steady growth for the county is expected.

The northern, eastern, and southern extremities of Utah County are bounded by the Wasatch Mountain Range. All stream courses in the study area drain into Utah Lake except the Jordan River, which originates at the northern end of Utah Lake and flows northerly out of the county towards the Great Salt Lake. Dry Creek, American Fork River, and Hobble Creek originate in drainage basins in the Wasatch Range. The Provo River basin is a major drainage that originates in the Uintah Mountains in northeastern Utah and also has contributing drainage areas in the Wasatch Range. Elevations range from 4,500 feet at the valley floor to 11,000 feet in the mountains.

Average annual precipitation in Utah County ranges from approximately 12 inches in the valley floor to approximately 50 inches in the high headwater areas. The climate ranges from semi-arid in the lower elevations to dry sub-humid in the mountainous areas.

The soils in the area are characteristically alluvial deposits. Heavier gravels are deposited in the mouths of the canyons while finer sandy-clay loams are deposited farther into the valley. Vegetation in the area consists mainly of farm crops and orchards.

Select communities are discussed in more detail below based on the presence of specific flooding sources in those communities.

Cities of Alpine, Highland, and Lehi

Dry Creek, which flows through the Cities of Alpine, Highland and Lehi, is a small perennial stream that originates in the Wasatch Front to the northeast and flows approximately 16 miles before emptying into Utah Lake, southwest of Lehi.

Hog Hollow and Fort Creek are small tributaries to Dry Creek within the City of Alpine. Alpine is located on the slopes of the Wasatch Range north of Highland and American Fork in northeastern Utah County. The City of Lehi is located in east-central Utah County, approximately 32 miles south of Salt Lake City.

Dry Creek Basin rises from 4,560 feet at the City of Lehi to an elevation of 11,300 feet in the headwater area. Commercial areas and older residential structures are located along Dry Creek in Lehi. The upper reaches of the creek exist in a confined floodplain, whereas the lower area of commercial and residential development is located on a relatively broad floodplain that slopes gently to the southwest to Utah Lake. Developing residential areas are located mostly in the northeast section of town. Portions of the residential developments are approximately 20 feet above the affected flood area, while some land is being developed within the floodplain.

Average annual precipitation in the basin ranges from approximately 12 inches in the valley floor to approximately 30 inches in the high headwater areas. The climate ranges from semi-arid in the lower elevations to dry sub-humid in the mountainous areas.

City of American Fork

The City of American Fork is located north of Utah Lake at the foot of Mount Timpanogos along the Wasatch Range. The American Fork River flows in a north-south direction through the city. Originating in the Wasatch Mountains, the American Fork River terminates at Utah Lake within the city boundaries.

Elevations within the American Fork drainage basin range from about 4,500 feet at Utah Lake to about 12,000 feet in the mountains. In the lower elevations, vegetation includes low-density stands of sagebrush, mountain brush, pinon pine, juniper, and associated grasses and weeds. Average annual precipitation ranges from about 14 inches in the valley areas to about 40 inches in the mountains. Convection-type thunderstorms that produce intense but short-duration rainfall frequently occur during the summer. The American Fork drainage basin drains a total of approximately 64 square miles of valley and mountain area.

City of Payson

The City of Payson is located approximately 57 miles south of Salt Lake City, in central Utah, adjacent to unincorporated Utah County land. Peteetneet Creek, which flows through the center of Payson as a diverted channel, is a small perennial stream that originates in the Wasatch Mountains to the east of Payson and flows approximately 10 miles before dissipation in the fields northwest of the city. The Peteetneet Creek basin rises from an elevation of 4,700 feet at the corporate limits of Payson to an elevation of 8,800 feet in the headwater area.

Commercial areas and older residential structures are located along Peteetneet Creek. The upper reaches of the creek exist in a confined floodplain, whereas the lower area of commercial and residential development is located on a relatively broad floodplain that slopes gently northwest to Utah Lake. Developing residential areas are principally located on bench areas to the east and southwest of Peteetneet Creek at elevations from 20 to 100 feet above the affected flood area and in the lower northwest corner of Payson.

Encroachment on the floodplain and numerous obstructions to the flow along Peteetneet Creek minimize the carrying capacity of the main channel. The flow capacity of the natural stream channel has been restricted to approximately 7 cubic feet per second (cfs) at the point of diversion from Dry Creek (Payson). From this point downstream to where the stream exits the city, the natural channel has been altered in many reaches to convey irrigation water throughout Payson.

Average annual precipitation in the Peteetneet Creek basin ranges from approximately 15 inches in the valley to approximately 30 inches in the high headwater areas. The climate ranges from semi-arid in the lower elevation to dry sub-humid in the mountainous areas.

City of Provo

The City of Provo is located approximately 46 miles south of Salt Lake City, in central Utah, and has a population of 112,488 (U.S. Census, 2010). Provo is now the commercial, industrial, governmental, and cultural center in Utah south of Salt Lake City.

The Provo River is a perennial stream that originates in the headwater areas of the Uinta Mountain Range in northern Utah and flows approximately 60 miles before emptying into Utah Lake at Provo. The largest single tributary to Utah Lake, the Provo River flows south from the mouth of Provo Canyon to the northern corporate limits, through the city, and then southwesterly to drain into Utah Lake. The Provo River basin rises from an elevation of about 4,480 feet at the mouth of the Provo River to an elevation of over 11,000 feet in the headwater areas.

Slate Canyon and Rock Canyon Creeks, which are small intermittent streams, and Little Rock Canyon, Slide Canyon, and Buckley Draw Creeks, small ephemeral streams, enter the Provo bench areas at the eastern corporate limits.

Utah Lake, a shallow water body with a surface area of approximately 150 square miles, lies along the western corporate limits of Provo. Provo Bay, a bay area of Utah Lake, borders the city on the south.

Commercial areas and older residential structures are located along the Provo River. The upper reaches of the river exist in a confined floodplain, whereas the lower area of commercial and residential development is located on a broad floodplain that slopes gently away from the main channel toward Provo Bay and Utah Lake. Developing residential areas which are located chiefly on the eastern bench areas of Provo are susceptible to flooding from mountain-front drainages.

Residential and commercial development is also occurring along the land adjacent to Utah Lake.

Average annual precipitation in the basin ranges from approximately 16 inches in the valley floor area to approximately 40 inches in the high headwater areas. The climate ranges from semi-arid in the lower elevation to dry sub-humid in the mountainous areas.

City of Salem

The City of Salem, which is located in central Utah County, is approximately 65 miles south of Salt Lake City. Unlike many cities in Utah County, Salem does not encroach along the floodplain of a major perennial stream. The only natural flooding threat to Salem is from small, frontal canyons along the mountains southeast of the city. Average annual precipitation in the Maple Canyon and Snell Hollow basins ranges from approximately 15 inches near Salem to approximately 30 inches in the high mountain areas. The climate ranges from semi-arid in the lower elevations to dry sub-humid in the mountainous areas.

The Maple Canyon and Snell Hollow basins range in altitude from 10,200 feet at the divide to 5,200 feet at the mouth of the canyons. They have a total drainage area of 7.4 square miles, with 5.6 square miles in Maple Canyon and 1.8 square miles in Snell Hollow. They are separated from Salem by approximately two miles of gently sloping farmland and two canal systems, the High Line Canal and Salem Canal.

City of Saratoga Springs

The City of Saratoga Springs is located in northwestern Utah County on the northern side of Utah Lake. It is surrounded by the Lake Mountains to the south and west, Utah Lake and the City of American Fork to the east, and the City of Lehi to the north. The Jordan River flows through the City of Saratoga Springs.

City of Spanish Fork

The City of Spanish Fork is located in southwestern Utah County on the southeastern side of Utah Lake at the Junction of I-15 and State Route 6. It is surrounded by the Wasatch Mountains to the east, Utah Lake to the west, the City of Springville to the north, and the City of Payson to the south. The Spanish Fork River flows through the City of Spanish Fork.

City of Springville

The City of Springville is located approximately 6 miles southeast of Provo in central Utah. Hobble Creek, which flows through the center of Springville, is a small stream that originates in the Wasatch Front to the east and flows approximately 17 miles before emptying into the Provo Bay of Utah Lake near Springville.

Commercial areas and older residential structures are located along Hobble Creek on a broad floodplain that slopes gently away from the main channel. Developing residential areas are located chiefly on bench areas to the east and northeast at elevations from 30 to 40 feet above the affected flood area. One area northwest of Springville has been developed as an industrial park and is located on a relatively flat, low-lying plain.

Springville's general topography is that of an alluvial fan, with a well-defined channel down the major axis of the fan. The soils within the Springville area are generally classified as alluvium materials, consisting of sands and gravels with shallow deposits of loam.

Average annual precipitation in the basin ranges from approximately 13 inches in the valley floor to approximately 27 inches in the adjacent mountains; the climate ranges from semi-arid in the lower elevations to dry sub-humid in the mountainous areas.

## 2.3 Principal Flood Problems

Utah County (Unincorporated Areas)

Flooding along the Jordan River is caused by high water levels in Utah Lake, which result mainly from spring runoff from snowmelt. A compromise maximum water-surface elevation has been established to avoid flooding. This compromise level of 4492.435 feet (NAVD 88) was arrived at by the landowners and water users as the level at which the lake would be kept in times of high runoff to ensure high-water storage capacity while minimizing damage to surrounding land by flooding. Whenever runoff forecasts indicate the level of Utah Lake will exceed this elevation, the outlet gates at the Jordan River are opened prior to the flood season to permit outflow discharges that will keep the lake at compromise level during the flood season. However, in years such as 1922 and 1952, the lake rose to slightly more than 3 feet above compromise level, and in 1983 and 1984, the lake rose to approximately 5 feet above compromise level, despite efforts that were made to not exceed this level. In addition, the various inflows to Utah Lake are regulated to keep the water below the compromise level.

Dry Creek and American Fork River have a history of flooding from both snowmelt and thunderstorms. For Dry Creek, the maximum established flood peak of 750 cfs, measured at the Dry Creek gage, occurred in 1951. This flood has a recurrence interval of approximately 30 years. Major and minor flooding is known to have occurred along Dry Creek in May 1950, August 1951, May 1952, June 1953, May 1964, and July 1967.

The maximum recorded flood from the American Fork River resulted from a thunderstorm in August 1951, with a peak flow of 645 cfs measured at a U.S. Geological Survey gage four miles above the mouth of American Fork Canyon. The discharge was estimated to be 1,000 cfs at the canyon mouth by the U.S. Soil

Conservation Service. This flood has a recurrence interval of approximately 20 years. The May 1952 snowmelt flood also threatened the City of American Fork. Additional flooding occurred in May 1958, July 1965, and June 1975. Accounts of early settlers, newspaper articles, and official records indicate that flooding occurred on the American Fork River in 1869, 1876, 1878, 1880, 1881, 1885, 1890, 1896, 1909, 1919, 1921, 1923, 1930, 1934, 1935, 1938, and 1946. However, little information is available concerning the size or the damage from these floods. The most recent recorded flood from the American Fork River was the flood of June 1975. It was a snowmelt flood with a peak discharge of 655 cfs at the mouth of American Fork Canyon with a recurrence interval of approximately 20 years.

Additionally, American Fork River, Provo River, and Hobble Creek are subject to unconfined shallow flooding with depths averaging less than one foot.

In 1983, a landslide completely blocked the Spanish Fork River approximately 0.5 mile downstream of the Town of Thistle, located in Spanish Fork Canyon in southwestern Utah County. The landslide debris formed a lake approximately 150 feet deep containing 40,000 acre-feet of storage, and inundated over 650 acres of land. The impoundment was drained and a debris basin was constructed just downstream.

Low-lying areas of the City of Lehi are subject to periodic flooding caused by overflow of Dry Creek. The most severe flooding occurs in the summer as a result of convective-type thunderstorms. These larger summer storms, while occurring infrequently, cause the major proportion of all downstream flood damages. Some of the larger floods occurred before stream flow or precipitation records were kept. Major and minor flooding is known to have occurred in Lehi in May 1950, August 1951, May 1952, June 1953, May 1964, and July 1967.

Low-lying areas of the City of Payson are subject to periodic flooding caused by overflow of Peteetneet Creek and also shallow flooding along the waterway. The most severe flooding has occurred because of dam failures. Twice since being settled in 1850, Payson has been deluged by floodwaters from dam failures, the first in May 1907 and the second in May 1973. The peak flow of the 1973 flood was estimated to be 2,000 cfs at the mouth of the canyon, a result of the dam failure and a subsequent increase in discharge. Other than the dam failure floods, the most severe flooding occurs in early spring as a result of snowmelt. Prior to the dam failure in the May 1973 flood, the estimated maximum flood peak flow on Peteetneet Creek was 650 cfs, having a recurrence interval of less than 50 years. Flood flows on Peteetneet Creek carry large amounts of sediment and debris that is deposited on the alluvial fan. Substantial damage has taken place in the canyon as a result of the high-velocity flow and high debris load of the floodwaters. Considerable expense is incurred in voluntary efforts to keep bridge structures free of debris, maintain channel capacity at key locations along the stream, and construct temporary diking systems. Furthermore, a diversion structure located at the mouth of the canyon now limits the flows down Peteetneet Creek to a mere 7 cfs to mitigate impacts from flooding.

Low-lying areas of the City of Provo are subject to periodic flooding caused by overflow from the Provo River. The most severe flooding occurs in early spring as a result of snowmelt. Flooding from cloudburst storms has occurred in Provo River Canyon, but flood flows largely dissipate before reaching the study area. Lands adjacent to Utah Lake are subject to frequent flooding from high lake elevations. The most severe floods in the City of Provo occur in the spring as a result of high snowmelt runoff in conjunction with high water levels in Utah Lake.

Shallow flooding caused by a combination of shallow overflow and alluvial fan flow occurs in portions of Provo below the mountain front canyons. Flooding occurs in late spring and summer as a result of intense convective-type storms and/or snowmelt runoffs. The five frontal canyon streams have a history of flooding. Rock Canyon and Slate Canyon Creeks have clearly defined channels which contain floods until they reach detention basins. These in turn dissipate peak floods, which then discharge into or near residential areas.

Little Rock Canyon empties small flood flows into a residential area. These flood flows are aggravated by debris and sediment which obstruct flow in front and inside of culverts and cause the stream to overflow its banks. Slide Canyon and Buckley Draw discharge similarly onto undeveloped alluvial fans.

Flood flow from both Maple Canyon and Snell Hollow accumulates in Salem Pond. Outflow patterns indicate that flows from Maple Canyon and Snell Hollow are likely sources of floodwater for areas within the Salem corporate limits.

Low-lying areas of Salem along the south side of U.S. Highway 91 and around Salem Pond are subject to flooding as the water surface of the pond rises during high inflows. The culvert under U.S. Highway 91 is almost completely submerged, and flow is restricted by water in the lower pond outlet. The culvert will not convey a large flood. As the water level rises, it will cause shallow flooding over the highway and in areas of Salem north of the highway.

A natural basin south of Salem, just north of the Salem Canal, collects flow from Maple Canyon. After filling, floodwaters overflow the road at 200 East and 300 South Streets and flow down a narrow swale to Salem Pond. Rather high-velocity shallow flooding occurs in this channel.

At least two floods are known to have occurred in or near Salem. A rapid spring thaw in 1962 caused snowmelt flows to overtop both canals above the city. The runoff was aided by frozen ground and ice-filled canals. Flooding occurred as water accumulated in a natural basin just south of the corporate limits and then flowed down a fairly restricted channel to Salem Pond. At least one house in the pathway to the pond sustained flood damage. Shallow flooding occurred along many of the streets in Salem.

The City of Saratoga Springs is affected by flooding from the Jordan River. Flood risks to Saratoga Springs include the overflow potential from Utah Lake and the Jordan River. All stream courses in the study area drain into Utah Lake except the Jordan River, which originates at the northern end of Utah Lake and flows northerly out of the county. A high water level in Utah Lake causes flooding along the Jordan River, which result mainly from spring runoff from snowmelt.

Areas of gently sloping terrain and areas of low relief in Springville are subject to periodic flooding caused by overflow of Hobble Creek. Shallow flooding caused by a combination of shallow overflow alluvial fan flow, and ponding occurs in a great portion of the city north of the main channel of Hobble Creek. In this area, the creek enters the city at the southeast boundary and flows to the west boundary, where it exits the city.

The flood discharges on the main channel of Hobble Creek overflow into a secondary drainage area upstream from the southeastern limits of the city. The most severe flooding occurs in early spring as a result of either snowmelt or a combination of rain and snowmelt. Springville is known to have a history of flooding from Hobble Creek. The maximum recorded flood peak of 1,250 cfs with a recurrence interval of approximately 50 years occurred on May 4, 1952. The maximum recorded flood was the result of low-altitude snowmelt runoff augmented by moderate rains. This flood caused considerable damage to the community.

Major and minor flooding is known to have occurred in 1862, 1920, 1931, and 1952. These floods were aggravated by trees, debris, and sediment, which pile up in front of, and inside of, culverts and bridges, causing Hobble Creek to back up and flood its banks. During the flood of 1952, most of the bridges were either washed out or damaged by the flood.

## 2.4 Flood Protection Measures

Flood control structures that affect the study area include Dry Creek Dam on Dry Creek, Tibble Fork Dam on the American Fork River, and Deer Creek and Jordanelle Dams on the Provo River. Dry Creek Dam and Tibble Fork Dam were built by the U.S. Soil Conservation Service to trap sediment and debris from snowmelt flooding and retard the more frequent low-volume thunderstorm floods.

Dry Creek Dam reduces the 1-percent-annual chance flood on Dry Creek by approximately 26 percent and reduces the 0.2-percent-annual chance flood by approximately 10 percent. Tibble Fork Dam on the American Fork River reduces the 1-percent-annual chance flood by approximately 18 percent and reduces the 0.2-percent-annual chance flood by approximately 11 percent.

Dry Creek Dam and its debris basin, located approximately two miles upstream from the Lehi corporate limits, significantly reduce the thunderstorm flood peaks. The dam and debris basin, completed by the U.S. Soil Conservation Service in 1962, have a capacity of 270 acre-feet. It was built to alleviate floodwater and sediment damages caused by rainstorms, and sediment damages from spring snowmelt flows. It was not designed to control snowmelt floodwater and does not provide a significant reduction in peak snowmelt flow. A wastewater ditch diversion has been constructed in Lehi which routes part of the excess flows to the west of the city and into the Jordan River. These two flood protection measures have been used to reduce the 1-percent-annual chance flood.

The Provo River is a perennial stream with 600 square miles of drainage area in the Uinta Mountains east of Provo. Flows are largely controlled by Jordanelle Dam. This facility provides increased flood protection from snowmelt runoff in the Provo area.

Deer Creek reservoir is a storage facility for municipal, industrial, and irrigation water. It has no specified role as flood control storage, but does provide some incidental flood protection to Provo by retaining high snowmelt runoff when the reservoir is not full.

In 1983 and 1984, Provo made major improvements in a previously discontinuous system of levees along the Provo River. A small levee also exists along Utah Lake within Provo City that was built to provide flood protection for a small residential area. While these levees, constructed from compacted earth fill and streambed materials, may provide some flood protection in the Provo area, it is important to note that these are non-accredited levees and subject to FEMA's seclusion process.

During the low-flow periods of late summer, portions of the main channel of the Provo River are routinely rehabilitated and cleaned of debris and vegetation to improve channel conditions and stream flow.

Both Jordanelle Dam and Deer Creek Dam, located in Wasatch County, were built as USBR projects to address the agricultural, industrial and municipal water needs of the growing Wasatch Front population. Jordanelle Dam was built and filled from 1986 to 1996 and divides the river into upper and middle reaches. Deer Creek Dam, constructed and filled between 1938 and 1941, divides the river into middle and lower reaches. Deer Creek Reservoir is a USBR water storage facility. It is used for storage of irrigation, municipal and industrial water on Provo River. It has no designated flood control space, but does provide incidental flood control by the attenuating effect of routing a flood through the reservoir and spillway. Jordanelle Dam and Reservoir is approximately 15 miles upstream from Deer Creek Reservoir. This facility provides increased flood protection from snowmelt runoff in the Provo area. Please note that the currently effective study for Provo pre-dates the construction of Jordanelle Dam.

After the impoundment was drained following the 1983 landslide near the Town of Thistle that completely blocked the Spanish Fork River, a debris basin was constructed just downstream. The debris basin was designed to prevent large-scale destruction downstream of the City of Spanish Fork (James M. Montgomery Consulting Engineers, Inc., 1985; Utah County, 1990). The approximate capacity of the debris basin is 125 acre-feet at an elevation of 5,051 feet, and is designed to keep the diversion tunnel free of debris during rare flood events.

Stream channels in Utah County are checked regularly for buildup of sediment and debris and are usually dredged out every spring where necessary.

Five high-mountain reservoirs in the headwater area of Peteetneet Creek provide a minimal amount of flood protection for the City of Payson. At the mouth of the canyon, the vast majority of the flow is diverted into Dry Creek (Payson) through a concrete water-control structure, thus reducing the flood flow through the city to a minimal 7 cfs. Historically, debris and sediment would clog either Dry Creek (Payson) or Peteetneet Creek at the control structure potentially directing the entire flow either through Payson via Peteetneet Creek or westward via Dry Creek (Payson). This happened during the flood of 1973, where the entire flow was directed through the City of Payson via Peteetneet Creek due to debris blocking Dry Creek (Payson). The new diversion structure at the mouth of the canyon prevents this scenario from occurring, as the mapped flood hazard information in this area depicts.

A recently completed flood management program on the Jordan River allows for a much increased discharge out of Utah Lake, thereby decreasing the peak lake elevation.

Flood damage from Slide Canyon and Buckley Draw is minimal because both have large undeveloped alluvial outwash fans and small flood flows. Flooding from Little Rock Canyon is also minimal because of small flows which can be mostly contained in the streets.

Three debris basins constructed below the mouth of Slate Canyon and one basin below Rock Canyon provide some flood protection. The magnitude of flood flows from these canyons is significantly reduced by the debris basins.

The USFS has treated the land in the upper portions of the Rock Canyon, Little Rock Canyon, and Slate Canyon Creek drainage basins to stabilize slopes and improve surface storage capacities. The area has been treated with contour trenching, plugging of gully washes, and seeding of side slopes to increase vegetative cover.

Utah Lake, the Provo River, and the Wasatch Mountain Front drainage basins are included in the planning and design phases of the Central Utah Project Bonneville Unit, a massive water storage and conveyance system of the USBR Upper

Colorado Region that will provide flood control benefits and water supply for the Bonneville Basin of Utah.

There are no flood protection works in or above Salem. The Salem and Highline Canals, which lie between Salem and the mountains south of Salem, provide some incidental flood protection for small floods. They are not designed for flood control and large floods could cross over them.

There are no flood protection works on Hobble Creek. Since the major flood of 1952, the main channel has undergone numerous improvements and rehabilitation. A great portion of the channel has been lined with a concrete and/or stone wall, new bridges have been constructed with improved abutment alignment and a greater effective flow area, and the streambed in the lower reach of the creek has been excavated and deepened.

A levee exists along parts of the Spanish Fork River within the City of Spanish Fork as noted on the FIRM. A portion of that levee is accredited which will provide protection from the 1-percent-annual-chance flood.

Physical flood control structures that affect the Town of Vineyard include a levee that exists along the Utah Lake Shoreline. However, this levee will not contain the 1-percent-annual chance flood.

Levees exist along parts of the Utah Lake shoreline within the City of Provo. These levees will not contain the 1-percent-annual chance flood.

Some dikes have been constructed intermittently along the banks of the American Fork River, Provo River, and Hobble Creek, but these are adequate to contain only normal or moderately high spring runoff flows. They will not contain the 1-percent-annual chance flood.

Within this jurisdiction, there are one or more levees that have not been demonstrated by the communities or levee owner(s)to meet the requirements of 44 CFR Part 65.10 of the NFIP regulations as it relates to the levee's capacity to provide 1-percent- annual-chance flood protection. Please refer to the Notice to Flood Insurance Study Users page at the front of this FIS report for more information.

Check with your local community to obtain more information, such as the estimated level of protection provided (which may exceed the 1-percent annual chance level) and Emergency Action Plan on the levee systems shown as providing protection in Utah County. To mitigate flood risk in residual risk areas, property owners and residents are encouraged to consider flood insurance and flood-proofing or other protective measures. For more information on flood insurance, interested parties should visit the FEMA Website at http://www.fema.gov/businee/nfip/index.shtm.

## 3.0 ENGINEERING METHODS

For the flooding sources studied in detail, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this FIS. Flood events of a magnitude which 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 one year are considered. For example, the risk of having a flood, which equals or exceeds the 1-percent-annual chance flood (1-percent chance of annual exceedance) in any 50-year period is approximately 40 percent (4 in 10), and, for any 90-year period, the risk increases to approximately 60 percent (6 in 10). The analyses reported herein reflect flooding potentials based on conditions existing in the community at the time of completion of this FIS. Maps and flood elevations will be amended periodically to reflect future changes.

Note: Within this jurisdiction there are one or more levees that have not been demonstrated by the community or levee owner to meet the requirements of 44CFR 65.10 as it relates to the levee's capacity to provide 1-percent- annual -chance flood protection. Please refer to the Notice to Flood Insurance Study Users page at the front of this FIS report for more information.

### 3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency relationships for each flooding source studied in detail affecting the county. Peak discharge-drainage area relationships for streams studied in detail for all communities within Utah County are shown in Table 4, "Summary of Discharges".

**Pre-countywide Analyses**

The hydrologic analyses described in the previous FIS documents for Utah County that are not superseded by new hydrology analyses performed as part of this countywide update have been compiled here and are summarized below.

In each case a Log-Pearson Type III frequency analysis (U.S. Water Resources Council, 1976), was conducted using available stream flow records. These analyses involved snowmelt flood peaks. Thunderstorm flood peaks were also developed for each drainage using rain data from the National Oceanic and Atmospheric Administration Atlas (U.S. Department of Commerce, 1976). USBR computer models (U.S. Department of the Interior, 1976; U.S. Department of the Interior, 1977) were used to develop these flood hydrographs.

A composite frequency distribution was used for the portion of Dry Creek that was not restudied as part of the countywide update, with the 10-percent-annual-chance flood resulting from snowmelt analysis and the more rare floods from thunderstorm derivation. To determine the snowmelt flood peaks on Dry Creek in the City of Lehi and unincorporated Utah County a Log-Pearson Type III analysis was performed on spring runoff data at two upstream gages (Fort Creek at Alpine, USGS gage No. 1660; and Dry Creek near Alpine, USGS gage No. 1655), with 8 and 24 years of record respectively. In addition to the gage record data, the U.S. Soil Conservation Service estimated peak flows of two extreme flood events. In August 1951, the Dry Creek gage was washed out by flooding estimated at 750 cfs. A flow of 1,150 cfs was estimated for Fort Creek in July 1965. Both floods resulted from thunderstorm runoff (U.S. Soil Conservation Service, 1951; and U.S. Soil Conservation Service, 1965).

Dry Creek Dam, a flood control structure, is located on Dry Creek within the study area. Thunderstorm hydrographs were developed for the Dry Creek watershed and routed through Dry Creek Dam using the Modified Puls method (U.S. Department of the Interior, 1977) to determine flows below the dam. A precipitation frequency-duration analysis was performed on the available precipitation data to establish the one-hour rain depths for each required flood frequency. These depths were further adjusted to account for areal reduction factor and excess rainfall. Routing significantly reduced the thunderstorm flood peaks; however, thunderstorm runoff remains the critical source of flooding for the 2-, 1-, and 0.2-percent-annual-chance floods. The Dry Creek Dam is successful in retarding the 10-percent-annual-chance thunderstorm to the extent that snowmelt becomes dominant at that frequency.

Historical accounts of past flooding also indicate that thunderstorm runoff is the prominent source of flooding in Lehi. The 1-percent-annual-chance and 0.2-percent-annual-chance flood peaks derived are nearly the same as the USACE Intermediate and Standard Project floods in their 1969 Floodplain Information Report (USACE, 1969).

Dry Creek separates into two channels downstream of the Union Pacific Railroad in Lehi. One of these is the Wastewater Ditch Diversion. The total discharge under the railroad bridge was proportioned between the Wastewater Ditch Diversion and the main channel of Dry Creek, with a resulting maximum flow in the ditch of 175 cfs.

The American Fork River hydrology study also resulted in a composite frequency curve with the 10-percent-annual-chance flood resulting from snowmelt and the 2-, 1-, and 0.2-percent-annual-chance floods from thunderstorm runoff. Data for the snowmelt calculations were taken from USGS gage No. 10164500, American Fork River above the Upper Power Plant near American Fork, Utah (51-year record).

Tibble Fork Dam, a flood control structure, was built in American Fork Canyon to trap sediment and debris from snowmelt flooding and to retard low-volume rain peaks. Approximately one-half of the drainage area lies above the dam. The flood routing effects of Tibble Fork Dam were included in the flood peak determination.

A gaging station maintained by the County Commissioner's office near Lehi, Utah was the source of data for defining lake level-frequency relationships for Utah Lake. The gage data are recorded in the Utah Lake and Jordan River Commissioner's Report (County Commissioner's Office, published annually). Values of the 10-, 2-, 1-, and 0.2-percent-annual-chance lake levels were obtained from a Log-Pearson Type III distribution of annual peak lake-level data. Ninety-one years of record were used, from 1884 through 1974. It was found that a windset application would have a significant effect on lake water elevations. A wind fetch of 1.1 feet, assuming a northwest wind of 40 miles per hour, is added to the lake levels of desired frequency to determine the final flood elevations for Utah Lake.

The flood elevations of Utah Lake were used to determine the peak flood flows for the Jordan River, which is the outflow channel for Utah Lake. Elevations for floods of the selected recurrence intervals on Utah Lake are shown in Table 5, "Summary of Stillwater Elevations".

Flood discharges for Soldier Creek and Thistle Creek were determined by a proportional comparison of the total Spanish Fork River discharge/drainage area to the sub-basin drainage areas of Soldier and Thistle Creeks (James M. Montgomery Consulting Engineers, Inc., 1985).

The hydrologic analysis for the Provo River primarily concerned the lower reach of the Provo River below Deer Creek Dam (in Wasatch County), to identify the peak flows that could be generated downstream of Deer Creek Reservoir and subsequently pass through the urbanized area within Provo City limits. Uncontrolled flooding on the Provo River is caused by heavy snowmelt events in the lower watershed. Deer Creek Dam and Reservoir is operated to accommodate heavy spring runoff. Although Deer Creek Reservoir does not have designated flood control storage, operation of the dam has historically included evacuation of the reservoir in anticipation of high spring inflows.

As the Provo River reaches the Provo City limits, the tributary watershed area below Deer Creek Dam is approximately 107 square miles. Within the watershed there are numerous river gages that provide credible historical flow data. Flood magnitudes were determined by using stream flow records at various locations along the Provo River to generate a 64-year record (1912 through 1975) of annual peak snowmelt inflows at Deer Creek Dam and Reservoir.

The hydrology of the lower Provo River was analyzed using a Log-Pearson Type III analysis (USBR, 1976) to compute the peak flow for the 10-, 2-, 1- and 0.2-percent-annual-chance recurrence intervals. These floods were then routed through the reservoir by a Modified Puls computer program (USBR, 1977) to determine reservoir outflow peaks. The reservoir was assumed to be full and the transmountain diversions cut off at the beginning of the routing sequence. Routing below the dam included the addition of snowmelt flooding from the 107 square miles below the reservoir and reduction by capacity of the Murdock Diversion and Timpanogos Canals at the mouth of the Provo Canyon to arrive at the flooding that would enter at the corporate limits.

In the City of Provo, Rock Canyon is the only frontal canyon for which any stream flow data is available. The USFS installed a stream gage just below the forks in Rock Canyon in 1975. The gage was operated until it was washed out during the spring snowmelt flood of 1983, giving a total of eight years of record. During that time, peak annual discharges resulted from snowmelt, while no significant rainfall floods were recorded during the same period. A snowmelt flood-frequency curve was determined for this record using a Log-Pearson Type III distribution. It was weighted with flood frequency estimates from the USGS regional method for estimating flood frequencies (USGS, 1983). This curve was then combined with a rainfall flood frequency curve, developed from the SCS Curve Number and Dimensionless Unit Hydrograph method, to form a combined flood frequency curve from which the 10-, 2-, 1-, and 0.2-percent-annual-chance flood flows were determined.

The flows for Little Rock Canyon, Slate Canyon, Slide Canyon, and Buckley Draw were developed in much the same way, but without a stream flow record. The USGS regional method (USGS, 1983) was used in conjunction with the SCS Curve Number and Dimensionless Unit Hydrograph Method. Flows from Rock and Slate Canyons were routed through their respective debris basins using the Modified Puls method. This significantly reduced the flood flows.

There are no stream flow records available for Salem. Snowmelt flood flows were derived by correlation with available stream flow records of streams along the Wasatch Front in Utah County for recorded flood peaks. Stream flow measurements were taken from ten USGS gages within the area located respectively on Fort Creek, Dry Creek, Summit Creek, Payson Creek, South Fork Provo River, American Fork River, Hobble Creek, Provo River, and Spanish Fork River.

Thunderstorm flood peaks were computed by the rational formula and prevail as a source of the 0.2-percent-annual chance flood peaks whereas snowmelt runoff is the primary source for the 10-, 2-, and 1-percent-annual-chance peaks.

Elevations (based on capacity) and discharge relationships for Salem Pond and the basin south of Salem were determined using orthophoto maps at a scale of 1:2,400 with a contour interval of two feet (City of Salem, 1977). Snowmelt and thunderstorm flood hydrographs were routed through both basin areas using the Modified Puls method. Flows from Maple Canyon were routed through the basin south of Salem and flows from Maple Canyon and Snell Hollow combined were routed through Salem Pond. No elevations are presented for the ponding area south of Salem because it is outside the study area. Elevations for floods of the selected recurrence intervals on Salem Pond are shown in Table 5, "Summary of Stillwater Elevations".

Table 4 – Summary of Discharges

| FLOODING SOURCE AND LOCATION | DRAINAGE AREA (SQ. MILES) | PEAK DISCHARGES (CFS) | | | |
|---|---|---|---|---|---|
| | | 10-PERCENT ANNUAL CHANCE | 2-PERCENT ANNUAL CHANCE | 1-PERCENT ANNUAL CHANCE | 0.2-PERCENT ANNUAL CHANCE |
| American Fork River | | | | | |
| Northern American Fork Corporate Limit | 62 | 641 | 1,004 | 1,109 | 1,334 |
| At Mouth of American Fork Canyon | 60 | 590 | 1,750 | 2,440 | 3,660 |
| Buckley Draw | | | | | |
| At Mouth | 0.84 | 16 | 28 | 40 | 90 |
| Dry Creek | | | | | |
| At Dry Creek Dam Inflow | 37 | 480 | 1,870 | 2,700 | 4,050 |
| At Dry Creek Dam Outflow | 37 | 480 | 1,050 | 2,000 | 3,600 |
| Downstream of Alpine Corporate Limits | 32 | 480 | 1,680 | 2,420 | 3,620 |
| At Alpine Corporate Limits | 31.1 | 455 | 725 | 830 | 1,120 |
| At Fort Creek Confluence | 18.5 | 300 | 465 | 530 | 715 |
| Dry Creek (Payson) | | | | | |
| At Divergence from Peteetneet Creek | 27.6 | 450 | 800 | 1,000 | 1,240 |
| Downstream of 1400 South | --- | 450 | 800 | 959 | 1,097 |
| Downstream of 900 West | --- | 450 | 757 | 935 | 1,153 |
| Downstream of I-15* | --- | 300 | 315 | 320 | 410 |

* The significant decrease of flows downstream of I-15 is due to the limited capacity of the I-15 culvert. See Section 3.2 for more details.

Table 4 – Summary of Discharges

| FLOODING SOURCE AND LOCATION | DRAINAGE AREA (SQ. MILES) | PEAK DISCHARGES (CFS) 10-PERCENT ANNUAL CHANCE | 2-PERCENT ANNUAL CHANCE | 1-PERCENT ANNUAL CHANCE | 0.2-PERCENT ANNUAL CHANCE |
|---|---|---|---|---|---|
| Dry Creek (Payson) 1250 South Split | | | | | |
| At Divergence from Dry Creek (Payson) | --- | --- | 3 | 41 | 143 |
| Dry Creek (Payson) 900 West Split | | | | | |
| At Divergence from Dry Creek (Payson) | --- | --- | 37 | 65 | 87 |
| Dry Creek (Payson) I-15 Split | | | | | |
| At Divergence from Dry Creek (Payson) | --- | 150 | 485 | 680 | 830 |
| East Fork Fort Creek | | | | | |
| At Confluence with Fort Creek | 9.8 | 195 | 325 | 375 | 505 |
| Fort Creek | | | | | |
| At Dry Creek Confluence | 9.8 | 195 | 325 | 375 | 505 |
| Hobble Creek | | | | | |
| At Mouth of Hobble Creek Canyon | 115 | 650 | 970 | 1,390 | 1,940 |
| Hobble Creek 400 West Split | | | | | |
| Downstream of 400 West | --- | 14 | 52 | 112 | 150 |
| Hog Hollow | | | | | |
| At Dry Creek Confluence | 2.6 | 60 | 110 | 135 | 185 |
| Jordan River | | | | | |
| At Outlet from Utah Lake | 3,000 | 1,420 | 2,290 | 2,570 | 3,190 |
| Little Rock Canyon | | | | | |
| At Mouth | 0.70 | 16 | 27 | 32 | 50 |
| Maple Canyon | | | | | |
| South of Salem | 5.5 | 150 | 210 | 240 | 290 |
| Maple Canyon and Snell Hollow (combined) | | | | | |
| South of Salem | 7.5 | 170 | 240 | 270 | 330 |

Table 4 – Summary of Discharges

| FLOODING SOURCE AND LOCATION | DRAINAGE AREA (SQ. MILES) | PEAK DISCHARGES (CFS) | | | |
|---|---|---|---|---|---|
| | | 10-PERCENT ANNUAL CHANCE | 2-PERCENT ANNUAL CHANCE | 1-PERCENT ANNUAL CHANCE | 0.2-PERCENT ANNUAL CHANCE |
| Middle Fork Fort Creek | | | | | |
| At Confluence with Fort Creek | 9.8 | 195 | 325 | 375 | 505 |
| Peteetneet Creek | | | | | |
| At Payson Canyon Mouth | 27.6 | 7 | 7 | 7 | 160 |
| Provo River | | | | | |
| One mile below mouth of Provo Canyon | 680 | 1,800 | 2,600 | 3,200 | 3,800 |
| Rock Canyon Creek | | | | | |
| At Mouth of Rock Canyon | 9.92 | 115 | 280 | 450 | 890 |
| Below Debris Basin | 9.92 | 105 | 180 | 220 | 380 |
| Slate Canyon Creek | | | | | |
| At Mouth of Slate Canyon | 6.04 | 74 | 172 | 274 | 550 |
| Below Debris Basin | 6.04 | 64 | 113 | 150 | 475 |
| Slide Canyon | | | | | |
| At Canyon Mouth | 1.18 | 21 | 37 | 53 | 110 |
| Soldier Creek | | | | | |
| Just Upstream of Confluence with Thistle Creek | 236 | 690 | 1,330 | 1,750 | 3,080 |
| Spanish Fork River | | | | | |
| At I-15 | 660 | --- | --- | 3,750 | --- |
| Just Downstream of Confluence of Thistle and Soldier Creeks | 450 | 1,300 | 2,500 | 3,300 | 5,800 |
| Thistle Creek | | | | | |
| Just Upstream of Confluence with Soldier Creek | 214 | 610 | 1,180 | 1,550 | 2,730 |
| West Fork Fort Creek | | | | | |
| At Confluence with Fort Creek | 9.8 | 195 | 325 | 375 | 505 |

Table 5 – Summary of Stillwater Elevations

| FLOODING SOURCE AND LOCATION | ELEVATION (FEET NAVD 88) 10-PERCENT ANNUAL CHANCE | 2-PERCENT ANNUAL CHANCE | 1-PERCENT ANNUAL CHANCE | 0.2-PERCENT ANNUAL CHANCE |
|---|---|---|---|---|
| Salem Pond (at Salem) | 4,587.42 | 4,587,45 | 4,587.46 | 4,587.57 |
| Utah Lake | 4,495.89 | 4,497.39 | 4,497.89 | 4,498.69 |

**Countywide Analyses**

The hydrology for Alpine City was analyzed in 2007 and documented in two reports (Psomas, 2007; and Bowen, Collins & Associates, 2007) and approved by FEMA Region VIII in 2007. The flows for Dry Creek were adapted from a rainfall runoff model (Psomas, 2007). Fort Creek and Hog Hollow were analyzed using the National Flood Frequency equations and a multiplier of 1.4 to be consistent with the Dry Creek model (Bowen, Collins & Associates, 2007).

The hydrology for the American Fork River was determined using USGS Gage No. 10164500 (American Fork above Upper Power Plant near American Fork, UT). A Log-Pearson Type III analysis was performed on the available peak annual runoff data (69 years). Since the gage is on the same stream but located outside the study area, a method outlined by USGS in the Methods for Estimating Magnitude and Frequency of Peak Flows for Natural Streams in Utah Report, dated March 2008, was used to transpose the results from the gage location to the watershed outlet (USGS, 2008).

To determine the hydrology for Hobble Creek, a linear regression analysis was conducted using data from several gages within close proximity of Hobble Creek that are located on streams with similar characteristics to the Hobble Creek watershed. The Hobble Creek gage (No. 10152500) has 43 years of record ending in 1974. The gages that were used for this analysis also have 10-plus years in overlapping peak information and have additional years recorded beyond 1974. The following gages were used: Hobble Creek near Springville (No. 10152500); Provo River at Provo (No. 1016300); and Spanish Fork at Castilla (No. 10150500). Using the available peak and newly predicted annual runoff data (77 years), a Log-Pearson Type III analysis was performed to yield the flows for the 10-, 2-, 1- and 0.2-percent-annual-chance recurrence intervals. The previously effective FIS hydrology information for the 10-, and 2-percent-annual-chance recurrence interval only was retained, since there were no significant differences between the new analysis and the current effective flood values to justify change. One- and 0.2-percent-annual-chance recurrence interval data, however, were newly determined as part of the countywide update.

Discharge-frequency relationships for selected recurrence intervals on Peteetneet Creek were established by hydrologic analysis of rainfall, snowmelt, and reservoir conditions in Payson Canyon. Snowmelt runoff was determined to be a critical source of future flooding.

A gaging station located on Peteetneet Creek (USGS Station No. 1475) above the diversion canals, near Payson, Utah, was used to define the stream discharge-frequency relationships. Fifteen years of record were available, from July 1947 through September 1962. In addition to the gage record, a historic flood peak of 650 cfs was used for the 1973 flood. This value was taken from a U.S. Forest Service report as a conservative estimate of the snowmelt peak sustained two days prior to the break of Box Lake Dam (USDA, 1973). A probability distribution was developed by computer analysis of the above data, with the historic 1973 flood peak weighted against the continuous record according to lapse of years in between.

Values for the 10-, 2-, 1-, and 0.2-percent-annual-chance peak discharges were obtained from a Log-Pearson Type III distribution of annual peak flows according to criteria established in U.S. Water Resources Council Bulletin 17 (U.S. Water Resources Council, 1976).

The reservoirs in Payson Canyon route less than five percent of the total drainage by natural stream inflows; therefore, the flood control they offer for a one-percent-annual-chance snowmelt event is considered negligible.

Due to the diversion structure only allowing flows of 7 cfs down Peteetneet Creek at the mouth of the canyon, all of the flow was routed down Dry Creek (Payson) as listed in Table 4, “Summary of Discharges”.

## 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 for 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 this FIS report. For construction and/or floodplain management purposes, users are encouraged to use the flood elevation data presented in this FIS in conjunction with the data shown on the FIRM.

Locations of selected cross sections used in the hydraulic analysis are shown on the Flood Profiles (Exhibit 1). Profiles were drawn showing the computed water surface elevations of the floods for the selected recurrence intervals.

The hydraulic analyses for these studies are based only on the effects of unobstructed flow. The flood elevations shown on the profiles are thus considered valid only if the hydraulic structures remain unobstructed, operate properly, and do not fail.

**Pre-countywide Analyses**

The hydraulic analyses described in the previous effective FIS documents for Utah County that are not superseded by new Countywide analyses have been compiled here and summarized below.

Water surface elevations of floods for the selected recurrence intervals, except for those on the Jordan River, were determined by using HEC-2 (USACE, 1976). For the Jordan River, the water surface elevations were determined by flood elevations on Utah Lake, which drains into the river, and by use of the Pseudo Water-Surface-Profile Computer Program (U.S. Department of the Interior, 1968). Computed profiles and depths of flooding are comparable to past flooding occurrences.

The hydraulic analysis for the Jordan River was performed using USACE's HEC-2 Model (USACE, 1976). HEC-2 modeling of the Jordan River extends from the Jordan Narrows Pumping Plant upstream approximately 9.7 miles to the outlet works at Utah Lake. Portions of the Jordan River located within the Camp Williams Military Reservation have been included in the 2002 restudy. Cross sections were obtained through field survey and Utah County data (Utah County, 1980; Utah County, 1989). Channel Manning's "n" values were established through calibration to surveyed water-surface elevations. Overbank Manning's "n" values were established using ground photos of the study reach. Refer to Table 6 for the Manning's "n" values used in this study.

Modeling of the Jordan River was carried out for two scenarios, both with and without the levee on portions of the eastern bank of the river. Stream profiles and 1-percent-annual-chance flood elevations for the Jordan River channel reflect the presence of the levee. In the eastern overbank, flood boundaries and elevations were determined assuming the levees completely fail. Flow breakouts from the main channel result in ponding in two overbank areas east of the river. The most upstream of these two locations is the reach between Saratoga Road and 9600 North Street. The second location is immediately downstream of 9600 North Street. Split flow computations were not carried out for areas of overbank ponding because of the very long duration of the peak discharge that flows out of Utah Lake. The long duration of peak flows is a result of the large drainage area (approximately 3,000 square miles) to Utah Lake.

Cross-section data and structural geometry for all bridges and culverts for the backwater analysis of the Jordan River, Dry Creek, and the American Fork River not restudied as part of the countywide update were obtained from field surveys of the main channels and overbank areas. The overbank data were supplemented where needed with USGS Quadrangle map topographic information.

Roughness coefficients (Manning's "n" values) used in the hydraulic computations were selected by field observations of the streams and floodplain areas using USGS Water-Supply Paper 1849 (USGS, 1967) as a guide. Manning's "n" values are listed in Table 6.

Through the use of the USACE HEC-2 Step-Backwater Computer Program (USACE, 1976), the capacity of the main channel for the American Fork River was determined. Knowing the channel capacity it was then determined where floodwaters would break out of the main channel and cause shallow flooding. In the shallow flooding analysis for the American Fork River, depths were determined by use of HEC-2. The low-relief overbank areas were assumed flat with cross sections taken at contour intervals from USGS topographic maps. Effective cross section lengths were reduced according to the density of structures in the floodplain.

Water surface elevations for the ponding area south of the City of Salem were determined by computing the inflow into the natural depression and then using the first road downstream as a weir structure.

The hydraulic analysis on the Spanish Fork River, Thistle Creek, and Soldier Creek was performed in the area of the unincorporated Town of Thistle after a landslide in 1983 completely blocked the Spanish Fork River approximately 0.5 mile downstream of the Town of Thistle. The detailed study to determine the 1-percent-annual-chance floodplain and floodway for the Spanish Fork River, Thistle Creek and Soldier Creek was performed using the USACE standard HEC-2 step-backwater program (USACE, 1990). Cross sections were developed for the study reaches on Thistle and Soldier Creeks from 1:600 maps, with a 1-foot contour interval, provided by James M. Montgomery Consulting Engineers, Inc., and the Utah Department of Transportation. Cross sections for the study reach on the Spanish Fork River were developed from 1:2,400 maps, with a 10-foot contour interval, provided by the Utah County Engineer's office (Utah County Engineer's Office, 1989; UDOT, 1991; and James M. Montgomery Consulting Engineers, 1983). The existing bridge and the new 18-foot diameter culvert along Soldier Creek were field surveyed by the Utah County Engineer's Office. Channel and Roughness Coefficients (Manning's "n") used in the hydraulic computations were determined by engineering judgment and field inspection and are listed in Table 6.

The rainfall floods used in the Dry Creek study below the Alpine City limits were routed from the downstream section of Dry Creek Dam to the Lehi corporate limits using the Tatum Method of stream flow routing (Chow, 1964). The rainfall floods used in the American Fork River study were routed from the mouth of American Fork Canyon using the NWS Dam-Break Flood Forecasting Model Computer Program (U.S. Department of Commerce, version unknown).

The reach of Dry Creek that presents flood hazards to Lehi extends from the northern corporate limits near I-15 approximately 2.0 miles downstream to the southwest corporate limits. Encroachments on the floodplain and numerous obstructions along the stream cause minimal flow capacity in the main channel. The stream flows in a confined floodplain from where it enters the city near I-15 downstream to 400 West. The carrying capacity of the channel is small and overbank flows are confined. At 400 West overbank flows fan out in a shallow sheet across gently sloping terrain. For the shallow overflow conditions that exist, only a minimum quantity of peak flow will reenter the main channel. The remaining overbank flow will dissipate over the outwash fan allowing for surface detention, retention, and ponding in areas of low relief.

Cross sections were located at regular intervals along the stream from 400 West to the upstream corporate limits. An onsite inspection indicates that the stream is capable of carrying only low flows from the elementary school downstream to the southern corporate limits. High flood flows are conveyed over bridge structures and in overbank areas. Channel cross section data was ignored for this reach of study area when analyzing the hydraulic effects of peak flows. Ground elevations for the cross sections were photogrammetrically obtained at a scale of 1:2,400 (U.S. Department of the Interior, 1977). Thalweg elevations for Dry Creek from the elementary school to the upstream corporate limits were obtained from existing profiles.

Hydraulic analyses for both Dry Creek and the Wastewater Ditch Diversion were performed using the HEC-2 step-backwater computer program (USACE, 1973). The backwater computations for Dry Creek were started using the slope-area method located at the first cross section. The starting elevation compares favorably with the shallow flooding conditions that existed during past flood events. Cross section data for the backwater analysis of Dry Creek were obtained from the 1:2,400 aerial photographs and from data used in the Floodplain Information Report for Dry Creek (USACE, 1969).

Roughness coefficients (Manning's "n") were evaluated from aerial photographs (U.S. Department of the Interior, 1977), 1:24,000 USGS topographic maps, and onsite field examinations. The "n" value was selected from tables published by the USGS (USGS, 1967), based on channel conditions and overbank vegetation of land use. Refer to Table 6 for Manning's "n" values for each flooding source studied using detailed methods in Utah County.

The I-15 culvert bridge and the adjacent Frontage Road embankment are major obstructions to flood flow of Dry Creek. A Modified Puls method of routing was employed for determining flow rates that affect Lehi downstream from the area. Flood flows are greatly reduced as a backwater effect, and resulting ponding conditions are caused by the roadway embankments. As ponded water overflows a drainage divide, a shallow flooding condition is created north of the freeway embankment.

Dry Creek separates into two channels downstream of the Union Pacific Railroad. One of these is the Wastewater Ditch Diversion. The quantity of water flowing in each drainage was determined using a divided flow approach. Water flows at the railroad embankment as a combination of pressure and weir flow. The water does not flow over the railroad embankment in the immediate area of the culvert, but over the railroad culvert approach. The computed pressure flow was used to determine the divided flow caused by the Wastewater Ditch Diversion structure. The Wastewater Ditch Diversion is a perched channel with a low left overbank. The total discharge under the railroad bridge was proportioned between the Wastewater Ditch Diversion and the main channel of Dry Creek, with a resulting maximum flow in the ditch of 175 cfs. The water surface elevation for the total flow was determined for Cross Section M and a water-surface profile was calculated for each assumed discharge through the two channels. A "total" discharge was obtained at the diversion by summing both main channel and Wastewater Ditch Diversion discharges for common water surface elevations.

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). Profiles are shown for the restricted area of Dry Creek from 300 North to the upstream corporate limits. The 10- and 2-percent-annual-chance flood profiles are similar, and water surface elevations are not significantly different. The same is true for the 1- and 0.2-percent-annual-chance floods.

Flood elevations in shallow flooding areas from Dry Creek were determined by appropriate methods including field reconnaissance, engineering judgment, reports of local citizens, local newspaper reports, and review with Lehi City officials.

Average floodwater depths were estimated to an accuracy of 1.0 foot in areas affected by shallow flooding. For purposes of applying study methods to shallow flooding, an average depth of 1.0 foot was given to inundated areas of shallow overflow designated as AO Zones.

Hydraulic analysis of the Provo River included a HEC-2 model to define the floodplain and base flood elevations along the Provo River for the 10-, 2-, 1-, and 0.2-percent-annual-chance flood events. Cross sections for the backwater analyses of the Provo River were obtained by field surveys and extensions of these cross sections were obtained from aerial photographs. Roughness coefficients (Manning's "n" values) for water-surface profile computations for the Provo River used in the HEC-2 model can be found in Table 6 for Manning's "n" values, which shows values for each flooding source studied using detailed methods in Utah County.

The Provo River is greatly influenced by the high water elevations of Utah Lake. Model scenarios were run with the effective Utah Lake elevations (see Table 5, "Summary of Stillwater Elevations") used as the downstream boundary condition.

Flood flows for the Provo River and Slate Canyon were routed through detention basins using the Modified Puls method (USBR, 1977). Flood boundaries below the detention basin and for Little Rock Canyon were determined using shallow flooding procedures.

Flood boundaries from Slide Canyon and Buckley Draw were determined using alluvial fan methods. Due to the minimal amount of flood hazard determined for the areas, flood boundaries and flood hazards were not delineated.

Roughness coefficients (Manning's "n") for water surface profile computations were determined by engineering experience and from field inspection of stream channels and overbank areas. Refer to Table 6 for Manning's "n" values for this study.

In Salem, analyses of the hydraulic characteristics of water bodies in the community were carried out to provide estimates of the elevations of floods for the selected recurrence intervals.

The floods were assumed to overtop the canals. Topography indicates that the floodwaters would eventually accumulate in the basin south of Salem and in Salem Pond, making them definite flood hazard areas. Average floodwater depth for the area of shallow flooding was estimated from the consideration of discharge, slope, and the topography of the area.

Table 6 – Manning's "n" Values

| Flooding Source | Channel | Overbank |
|---|---|---|
| American Fork River | 0.015 – 0.050 | 0.030 – 0.100 |
| Buckley Draw | 0.045 | 0.070 – 0.010 |
| Dry Creek | 0.030 – 0.045 | 0.055 – 0.100 |
| Dry Creek (Payson) | 0.020 – 0.035 | 0.030 – 0.100 |
| Fort Creek | 0.035 – 0.045 | 0.055 – 0.070 |
| Hobble Creek | 0.020 – 0.035 | 0.030 – 0.100 |
| Hog Hollow | 0.035 – 0.045 | 0.055 – 0.070 |
| Jordan River | 0.030 | 0.070 |
| Little Rock Canyon | 0.045 | 0.070 – 0.100 |
| Peteetneet Creek | 0.020 – 0.035 | 0.030 – 0.100 |
| Provo River | 0.045 | 0.100 |
| Rock Canyon Creek | 0.045 | 0.070 – 0.100 |
| Slate Canyon Creek | 0.045 | 0.070 – 0.100 |
| Slide Canyon | 0.045 | 0.070 – 0.100 |
| Soldier Creek | 0.035 – 0.040 | 0.035 – 0.050 |
| Spanish Fork River | 0.035 – 0.040 | 0.035 – 0.050 |
| Thistle Creek | 0.035 – 0.040 | 0.035 – 0.050 |
| Wastewater Ditch Diversion | 0.030 – 0.045 | 0.060 – 0.100 |

**Countywide Analyses**

Standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for the countywide detailed studies on Dry Creek/Fort Creek/Hog Hollow (within corporate limits of the City of Alpine), American Fork River (within corporate limits of the City of American Fork), Hobble Creek, Peteetneet Creek, and Dry Creek (Payson). The analyses reflect flooding potentials based on conditions existing in Utah County at the time of completion of this study.

Contraction and expansion coefficients of 0.1 and 0.3, respectively, were used for cross sections with no structures, while cross sections influenced by flow contraction and expansion caused by bridges or other conveyance structures were assigned a contraction coefficient of 0.3 and an expansion coefficient of 0.5.

Roughness coefficients (Manning's "n" values) for water-surface profile computations were based on field inspection of stream channels and overbank areas and adjusted based upon land use and ground cover determined from aerial photography. Table 6 lists the roughness coefficients used in this study. These values were coupled with the use of blocked obstructions in the cross sections to provide an accurate estimation of the conveyance through the overbank areas.

A hydraulic analysis using HEC-RAS (USACE, 2008) on Dry Creek, Hog Hollow, and Fort Creek was performed originally by the USACE in 2007 using two-foot contours and structures data provided by Alpine City. This model was used as the base model for this study and was checked against the available survey and topographic data. In addition, the model was converted to the NAVD 88 vertical datum. The Manning's "n" values used were those provided in the original USACE model and are listed in Table 6.

The Alpine model is a connected set of streams with boundary conditions that were dependent upon the water surface elevations at the model junctions. The furthest downstream boundary condition of the lower Dry Creek reach was set for a normal elevation based a slope of 0.007 ft/ft.

A floodway analysis was performed for the detailed study area with a one-foot target water surface increase used to define the limit of the encroachment. Equal conveyance reduction on each side of the channel was used.

The flooding sources of Alpine City are generally contained in the channel. Critical depth was computed at numerous locations along the Hog Hollow, Dry Creek and Fort Creek due to the HEC-RAS computations not finding a legitimate subcritical answer. The creek hydraulics in many locations likely results in supercritical flow regime due to the steep topography of the area. Critical depth is reported as the most conservative answer in these situations.

A detailed hydraulic study was performed on the American Fork River within the corporate limits of the City of American Fork using HEC-RAS (USACE, 2008) and HEC-GeoRAS (USACE, 2008).

The topographic surface used for this study was acquired through LiDAR methodology in 2003. This surface was supplemented with a field survey, performed during the fall of 2009, to collect bridge geometry and ground truth channel cross section data provided by the LiDAR flight. Structure information related to the I-15 Corridor Expansion (I-15 CORE) project, completed in 2012, was used for the I-15 bridge over the American Fork River and the upstream Frontage Road box culvert. All data used in these analyses were supplemented with site visits and investigation of aerial photography to identify flow paths, culvert and bridge locations and to estimate friction values to use with the modeling.

Hydraulic model results are reported for a subcritical flow regime. The downstream boundary condition for the American Fork River is controlled by Utah Lake, and was modeled as a known surface elevation (see Table 5, "Summary of Stillwater Elevations", for Utah Lake elevations).

The floodways calculated for the American Fork River reflect the minimum width allowed by encroachment of the 1-percent-annual chance floodplain on either overbank until a maximum floodplain elevation surcharge of one foot was created.

A split flow analysis was conducted at culvert AF-3 (golf course). The culvert output file at that location indicated that weir flow was overtopping the culvert, diverting 447 cfs from the main channel. Results from a site visit and the LiDAR terrain were used to determine the flow path of the overtopping culvert. The depth of the shallow flooding was found to be approximately 0.9 foot and was determined by a statistical analysis in GIS on the depth raster of the mapped shallow flooding zone. The approach to modeling the culvert overtopping was to contain the entire flow downstream in the main channel; therefore no additional floodway calculation was necessary. The split flow analysis had no effect on the delineated floodplain or the calculated floodway and was run in a separate HEC-RAS model.

The HEC-RAS results for culvert AF-13 (Main Street) showed that the 1-percent-annual-chance flow is leaving the channel and spilling onto the road, diverting 125 cfs from the main channel. This flow has been used to conduct an additional split flow down Main Street. The split flow analysis had no effect on the delineated floodplain, or the calculated floodway as the entire flow was routed into the main channel downstream. The depth of the shallow flooding was found to be approximately 0.1 foot and was determined by a statistical analysis in GIS on the depth raster of the mapped shallow flooding zone.

The channel upstream of the culvert under I-15 does not contain the 0.2-percent-annual-chance peak flow along the right overbank. A site visit and investigation of the low lying areas up-gradient of I-15 roadway embankment helped to determine the 0.2-percent-annual-chance inundation areas. The LiDAR terrain was used to support the field observations.

A detailed hydraulic study was performed on Peteetneet Creek and Dry Creek (Payson) in Payson using HEC-RAS (USACE, 2010) and HEC-GeoRAS (USACE, 2012).

The topographic surface used for this study was acquired through high-resolution LiDAR methodology in 2013-2014. This surface was supplemented with a field survey, performed during the fall of 2009 and summer of 2015, to collect bridge geometry and ground truth channel cross section data provided by the LiDAR flight. All data used in these analyses were supplemented with site visits and investigation of aerial photography to identify flow paths, culvert and bridge locations and to estimate friction values to use with the modeling.

Hydraulic model results are reported for a subcritical flow regime. The downstream boundary condition for both Peteetneet Creek, and Dry Creek (Payson), and all other split flows, are based on normal depth at the channel slope as determined by the last two modeled cross section inverts.

The floodway calculated for Dry Creek (Payson) reflects the minimum width allowed by encroachment of the 1-percent-annual-chance floodplain on either overbank until a maximum floodplain elevation surcharge of 1 foot is created.

A diversion structure (PET1) was constructed in 2014 to limit the flows down Peteetneet Creek to 7 cfs with the remaining flows continuing down Dry Creek (Payson). The Peteetneet Creek 1-percent-annual-chance flow is almost entirely contained in channel. The 0.2-percent-annual-chance discharge is too high to be contained within the local storm drain system at approximately 100 South, and a separate reach showing the overland flow path was modeled as a limited detail study.

Three locations along Dry Creek (Payson) do not have the capacity to contain the 1-percent-annual-chance flood. These split flows are modeled as limited detail studies, and only the 1-percent-annual-chance flood elevations are provided with no floodway determination.

The first split occurs at 1250 South due to overtopping before ultimately returning to Dry Creek (Payson) overbank flooding. The second split occurs at 900 West and ultimately joins up with the third split flow at I-15. Once flood flows escape the channel at the second and third splits they do not return to the channel due to the overland topography.

The significant decrease of flows downstream of I-15 as listed in Table 4, “Summary of Discharges”, is due to the limited capacity of the I-15 culvert.

A detailed hydraulic study was performed on Hobble Creek in Springville using HEC-RAS (USACE, 2010) and HEC-GeoRAS (USACE, 2012).

The topographic surface used for this study was acquired through high-resolution LiDAR methodology in 2013-2014. This surface was supplemented with a field survey, performed during the fall of 2009 and summer of 2015, to collect bridge geometry and ground truth channel cross section data provided by the LiDAR flight. The field survey included the box culvert under I-15 constructed as part of the I-15 CORE project, completed in 2012. All data used in these analyses were supplemented with site visits and investigation of aerial photography to identify flow paths, culvert and bridge locations and to estimate friction values to use with the modeling.

The floodways calculated for Hobble Creek reflect the minimum width allowed by encroachment of the 1-percent-annual-chance floodplain on either overbank until a maximum floodplain elevation surcharge of 1 foot is created.

The hydraulic analysis for this study is based on unobstructed flow and calculated flood elevations are only valid if hydraulic structures remain unobstructed, operate properly, and do not fail. Hydraulic model results are reported for a subcritical flow regime. The downstream boundary condition for Hobble Creek is controlled by Utah Lake, and modeled as a known surface elevation. See Table 5, “Summary of Stillwater Elevations” for a summary of these downstream boundary conditions.

At 400 West, Hobble Creek flow leaves the main channel and a split flow analysis was conducted. The split flow was modeled as a limited detail study, and only the 1-percent-annual-chance flood and base flood elevations are provided with no floodway determination.

A refinement of the Utah Lake 1-percent-annual-chance floodplain elevation of 4497.9 feet was performed on high-resolution LiDAR topography data collected in 2013-2014, as described in Section 4.1.

A First Order Approximation (FOA) Analysis was performed on the approximate Zone A floodplains located on select panels that were reissued as preliminary in 2017. The FOA was performed using a comparative, mostly automated approach to assess the validity of the floodplains that are not based on an existing or available engineering model, as outlined in the FOA procedures manual. All of the Zone A floodplains on the reissued panels were successfully validated through the FOA approach and were therefore left unchanged on the FIRMs, with the exception of one area of ponding in the City of American Fork which was removed to reflect current conditions.

## 3.3 Vertical Datum

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

All flood elevations shown in this FIS report and on the FIRM are referenced to NAVD 88. These flood elevations must be compared to structure and ground elevations referenced to the same vertical datum.

When a datum conversion is effected for an FIS report and FIRM, the Flood Profiles, and BFEs reflect the new datum values. To compare structure and ground elevations to 1-percent annual chance flood elevations shown in the FIS report and on the FIRM, the subject structure and ground elevations must be referenced to the new datum values.

The vertical datum conversion factor (NGVD 29 to NAVD 88) utilized in Utah County was calculated to be:

(+) 3.32 feet - Provo River

(+) 3.44 feet - Dry Creek

(+) 3.39 feet - All other streams and lakes in Utah County

For information regarding conversion between NGVD 29 and NAVD 88, visit the National Geodetic Survey website at www.ngs.noaa.gov, or contact the National Geodetic Survey at the following address:

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

## 4.0 FLOODPLAIN MANAGEMENT APPLICATIONS

The NFIP encourages state and local governments to adopt sound floodplain management programs. 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-percent and 0.2-percent annual chance floodplains; and 1-percent annual chance floodway. This information is presented on the FIRM and in many components of the FIS, including Flood Profiles, and Floodway Data 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 flood has been adopted by FEMA as the base flood for floodplain management purposes. The 0.2-percent annual chance flood is employed to indicate additional areas of flood risk in the county.

For streams studied by detailed methods the boundaries of the 1-percent and 0.2-percent-annual-chance floods are shown on the FIRM (Exhibit 2). On this map, the 1-percent-annual-chance floodplain boundary corresponds to the boundary of areas of special flood hazards (Zone A and AE); and the 0.2-percent-annual-chance floodplain boundary corresponds to the boundaries of moderate flood hazards. In cases where the 1-percent and 0.2-percent-annual-chance floodplains are close together, only the 1-percent annual chance floodplain boundary has been shown. As an example, small areas within the flood boundaries may lie above the flood elevations and, therefore, not be subject to flooding; owing to limitations of the map scale, such areas are not shown.

For streams studied by approximate methods, only the 1-percent annual chance floodplain is shown on the FIRM.

In areas not refined by LiDAR, flood boundaries for Utah Lake were delineated using USGS topographic quadrangle maps, historic accounts, and field inspection.

The 1-percent-annual chance floodplain limits near the Town of Thistle (Spanish Fork River, Soldier Creek, and Thistle Creek) were delineated on topographic maps obtained from the Utah County Engineer's Office (Utah County, 1989), the Utah Department of Transportation (UDOT, 1991), and James M. Montgomery Consulting Engineers, Inc. (James M. Montgomery Consulting Engineers, Inc., 1983).

Flood boundaries in shallow flooding areas from Dry Creek in Lehi were determined by appropriate methods including field reconnaissance, engineering judgment, reports of local citizens, local newspaper reports, and review with Lehi city officials.

The topographic surface used to study the American Fork River, Hobble Creek, Peteetneet Creek, and Dry Creek (Payson) was acquired through LiDAR methodology in 2003 (American Fork River), and 2013-2014 (all others). This surface was supplemented with a field survey, performed during the fall of 2009 and summer of 2015, to collect bridge geometry and ground truth channel cross section data provided by the LiDAR flight. All data used in these analyses were supplemented with site visits and investigation of aerial photography to identify flow paths, culvert and bridge locations and to estimate friction values to use with the modeling.

A refinement of the Utah Lake 1-percent-annual-chance floodplain elevation of 4497.9 feet was performed on high-resolution LiDAR topography data collected in 2013-2014. The results of the Utah Lake floodplain refinement depict a more accurate representation of the floodplain elevation on the surrounding topography as compared to the previous analysis.

The refinement was performed with a series of Esri ArcGIS tools. The 1-percent-annual-chance floodplain was calculated by mosaicking the 0.5-meter Bare Earth DEM surrounding the lake and performing a raster calculation on the DEM by selecting for a flood elevation of 4497.9 feet or less. The result of this selection delineates the shoreline of the 1-percent-annual-chance floodplain. In some areas, field verification and aerial photography were used to determine hydraulic connectivity to the lake.

The flood elevation of 4497.9 feet at the outlet structure located at the northern end of Utah Lake was analyzed in detail and determined to be the extent of lacustrine flooding. Flooding beyond the outlet structure was determined to be riverine driven and not within the scope of the Utah Lake refinement.

Due to the limits of the Bare Earth DEM, the southernmost extents of Utah Lake were not included in the analysis. The previous Utah Lake floodplain boundary was used in this area to tie into the newly delineated floodplain where the DEM cut off.

Within this jurisdiction there are one or more levees that have not been demonstrated by the community or levee owner(s) to meet the requirements of 44CFR Part 65.10 of the NFIP regulations as it relates to the levee's capacity to provide 1 percent annual chance flood protection. As such, the floodplain boundaries in this area were taken directly from the previously effective FIRM and are subject to change. Please refer to the Notice to Flood Insurance Study Users page at the front of this FIS report for more information on how this may affect the floodplain boundaries shown on the FIRM.

## 4.2 Floodways

Encroachment on floodplains, such as structures and fill, reduces the flood-carrying capacity of the channel, increases flood heights and velocities, and increases flood hazards in areas beyond the encroachment itself. One aspect of floodplain management involves balancing the economic gain from floodplain development against the resulting increase in flood hazard. For purposes of the NFIP, a floodway is used as a tool to assist local communities in this aspect of floodplain management. Under this concept, the area of the 1-percent-annual-chance floodplain is divided into a floodway and a floodway fringe. The floodway is the channel of a stream, plus any adjacent floodplain areas, that must be kept free of encroachment so that the 1-percent-annual-chance flood can be carried without substantial increases in flood heights. Minimum Federal standards limit such increases to 1.0 foot, provided that hazardous velocities are not produced. The floodways in this FIS are presented to local agencies as a minimum standard that can be adopted directly or that can be used as a basis for additional floodway studies.

Floodways were computed for all or portions of the streams studied by detailed methods (see Table 2) and are shown on the FIRM where applicable. Floodway Data Tables are shown in Table 7.

Along most of the Jordan River study reach, levees or the incised nature of the channel confine the 1-percent-annual-chance floodplain to the main river channel. Floodway encroachment computations carried out for the restudy did not permit encroachment inside existing levees or into the main channel. Because of these constraints and the very limited conveyance offered by overbank flow areas during flood events, floodplain encroachment to the delineated floodway would result in a maximum increase in 1-percent-annual-chance water-surface elevation in the study reach of 0.3 foot.

The concept of a floodway is not applicable for shallow flooding, so therefore a floodway is not shown in shallow flooding areas throughout Utah County.

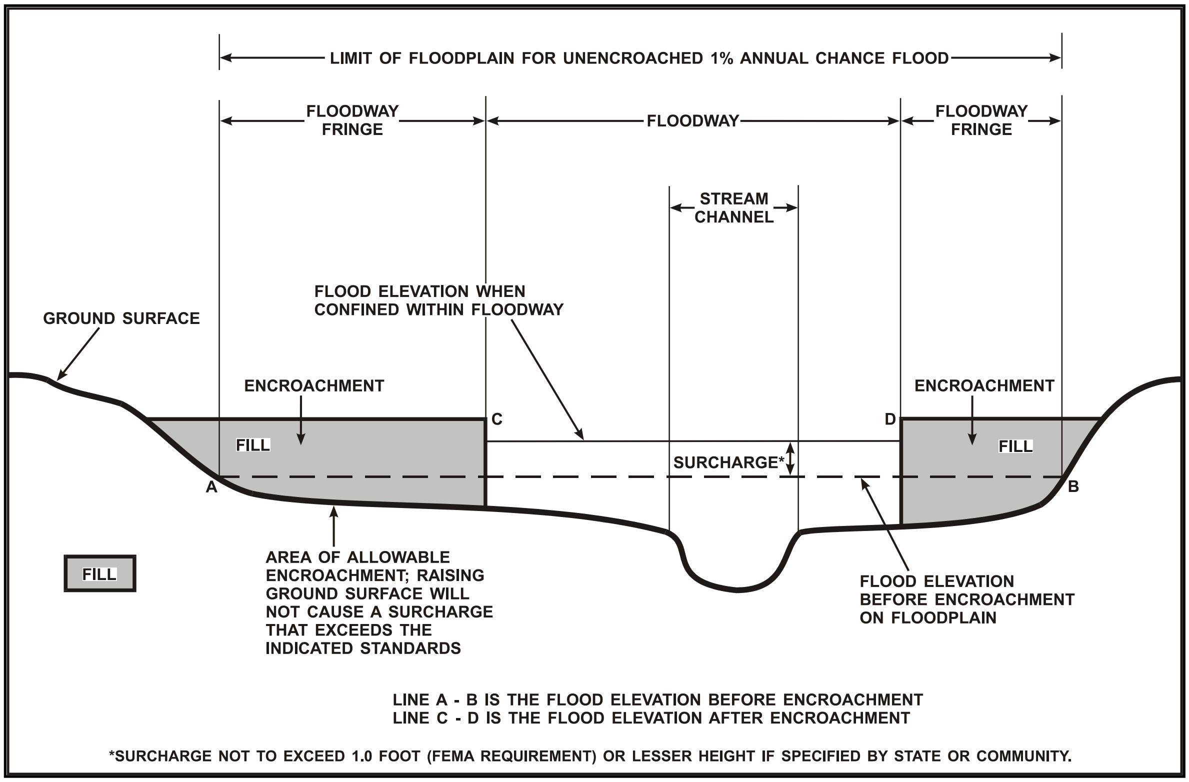
A floodway schematic is shown below explaining channel geometry in diagram form. The results of these computations are tabulated at selected cross sections for each stream segment for which a floodway is computed (Table 7).

Encroachment into areas subject to inundation by floodwaters having hazardous velocities aggravates the risk of flood damage and heightens potential flood hazards by further increasing velocities. To reduce the risk of property damage in areas where the stream velocities are high, the community may wish to restrict development in areas outside the floodway.

Along streams where floodways have not been computed, the community must ensure that the cumulative effect of development in the floodplains will not cause more than a 1.0-foot increase in the BFEs at any point within the county.

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 by more than 1.0 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to floodplain development are shown in Figure 1 – Floodway Schematic.

Figure 1 – Floodway Schematic



| FLOODING SOURCE | | FLOODWAY | | | 1-PERCENT-ANNUAL-CHANCE FLOOD WATER-SURFACE-ELEVATION (FEET NAVD) | | | |
|---|---|---|---|---|---|---|---|---|
| CROSS-SECTION | DISTANCE[1] | WIDTH (FEET) | SECTION AREA (SQUARE FEET) | MEAN VELOCITY (FEET PER SECOND) | REGULATORY | WITHOUT FLOODWAY | WITH FLOODWAY | INCREASE |
| American Fork | | | | | | | | |
| A | 396 | 513 | 619 | 3.5 | 4572.5 | 4572.5 | 4572.5 | 0.0 |
| B | 985 | 51 | 249 | 4.5 | 4576.3 | 4576.3 | 4577.1 | 0.8 |
| C | 1,681 | 28 | 103 | 10.9 | 4584.2 | 4584.2 | 4584.2 | 0.0 |
| D | 2,723 | 28 | 103 | 10.8 | 4593.3 | 4593.3 | 4593.3 | 0.0 |
| E | 3,223 | 21 | 91 | 12.3 | 4603.3 | 4603.3 | 4603.3 | 0.0 |
| F | 3,904 | 38 | 291 | 4.2 | 4613.0 | 4613.0 | 4613.9 | 0.9 |
| G | 4,439 | 21 | 124 | 9.0 | 4616.8 | 4616.8 | 4616.8 | 0.0 |
| H | 5,245 | 33 | 139 | 8.0 | 4622.0 | 4622.0 | 4622.1 | 0.1 |
| I | 5,926 | 21 | 126 | 8.8 | 4633.6 | 4633.6 | 4634.5 | 0.9 |
| J | 6,642 | 44 | 180 | 6.2 | 4642.2 | 4642.2 | 4642.9 | 0.7 |
| K | 7,590 | 44 | 157 | 7.1 | 4651.3 | 4651.3 | 4651.8 | 0.5 |
| L | 8,255 | 49 | 124 | 9.0 | 4659.7 | 4659.7 | 4659.7 | 0.0 |
| M | 9,082 | 46 | 146 | 7.6 | 4668.3 | 4668.3 | 4668.4 | 0.1 |
| N | 9,784 | 57 | 182 | 6.2 | 4681.0 | 4681.0 | 4681.0 | 0.0 |
| O | 10,743 | 50 | 134 | 8.3 | 4691.2 | 4691.2 | 4691.3 | 0.1 |
| P | 11,612 | 34 | 130 | 8.6 | 4701.1 | 4701.1 | 4701.2 | 0.1 |
| Q | 12,335 | 53 | 132 | 8.4 | 4722.0 | 4722.0 | 4722.0 | 0.0 |
| R | 13,169 | 33 | 108 | 10.4 | 4730.6 | 4730.6 | 4730.6 | 0.0 |
| S | 13,846 | 115 | 497 | 2.9 | 4746.5 | 4746.5 | 4747.4 | 0.9 |
| T | 15,017 | 35 | 154 | 7.2 | 4762.1 | 4762.1 | 4762.6 | 0.5 |
| U | 15,935 | 37 | 113 | 9.8 | 4775.3 | 4775.3 | 4775.3 | 0.0 |
| V | 16,860 | 103 | 160 | 7.4 | 4794.0 | 4794.0 | 4794.0 | 0.0 |
| W | 17,460 | 36 | 156 | 8.7 | 4804.2 | 4804.2 | 4804.2 | 0.0 |
| X | 17,602 | 148 | 320 | 4.5 | 4808.6 | 4808.6 | 4809.1 | 0.5 |

[1]Feet above I-15

TABLE 7

**FEDERAL EMERGENCY MANAGEMENT AGENCY**

**UTAH COUNTY, UT AND INCORPORATED AREAS**

**FLOODWAY DATA**

**AMERICAN FORK RIVER**

| FLOODING SOURCE | | FLOODWAY | | | 1-PERCENT-ANNUAL-CHANCE FLOOD WATER-SURFACE-ELEVATION (FEET NAVD) | | | |
|---|---|---|---|---|---|---|---|---|
| CROSS-SECTION | DISTANCE[1] | WIDTH (FEET) | SECTION AREA (SQUARE FEET) | MEAN VELOCITY (FEET PER SECOND) | REGULATORY | WITHOUT FLOODWAY | WITH FLOODWAY | INCREASE |
| American Fork | | | | | | | | |
| Y | 17,682 | 48 | 279 | 5.3 | 4809.1 | 4809.1 | 4810.1 | 1.0 |
| Z | 18,632 | 30 | 127 | 11.8 | 4824.2 | 4824.2 | 4824.5 | 0.3 |
| AA | 19,532 | 124 | 367 | 4.2 | 4834.8 | 4834.8 | 4835.4 | 0.6 |
| AB | 21,332 | 63 | 166 | 9.3 | 4866.8 | 4866.8 | 4866.8 | 0.0 |
| AC | 23,532 | 75 | 256 | 6.0 | 4897.8 | 4897.8 | 4898.1 | 0.3 |
| AD | 23,775 | 229 | 373 | 4.5 | 4906.2 | 4906.2 | 4906.8 | 0.6 |
| AE | 24,000 | 215 | 904 | 1.9 | 4907.0 | 4907.0 | 4908.0 | 1.0 |
| AF | 25,100 | 40 | 151 | 11.2 | 4922.9 | 4922.9 | 4922.9 | 0.0 |
| AG | 26,100 | 345 | 519 | 3.7 | 4938.7 | 4938.7 | 4939.1 | 0.4 |
| AH | 26,950 | 281 | 317 | 6.0 | 4955.6 | 4955.6 | 4955.6 | 0.0 |
| AI | 28,050 | 137 | 353 | 6.0 | 4975.1 | 4975.1 | 4975.5 | 0.4 |
| AJ | 29,400 | 77 | 232 | 9.9 | 5003.9 | 5003.9 | 5003.9 | 0.0 |
| AK | 30,200 | 59 | 220 | 11.0 | 5024.8 | 5024.8 | 5024.8 | 0.0 |

[1]Feet above I-15

TABLE 7

FEDERAL EMERGENCY MANAGEMENT AGENCY

**UTAH COUNTY, UT AND INCORPORATED AREAS**

**FLOODWAY DATA**

**AMERICAN FORK RIVER**

| FLOODING SOURCE | | FLOODWAY | | | 1-PERCENT-ANNUAL-CHANCE FLOOD WATER-SURFACE-ELEVATION (FEET NAVD) | | | |
|---|---|---|---|---|---|---|---|---|
| CROSS-SECTION | DISTANCE[1] | WIDTH (FEET) | SECTION AREA (SQUARE FEET) | MEAN VELOCITY (FEET PER SECOND) | REGULATORY | WITHOUT FLOODWAY | WITH FLOODWAY | INCREASE |
| Dry Creek | | | | | | | | |
| A | 0 | 162 | 321 | 3.7 | 4,560.4 | 4,560.4 | 4,561.4 | 1.0 |
| B | 420 | 129 | 319 | 3.4 | 4,563.2 | 4,563.2 | 4,564.2 | 1.0 |
| C | 850 | 139 | 296 | 4.8 | 4,566.2 | 4,566.2 | 4,567.2 | 1.0 |
| D | 1,050 | 218 | 490 | 2.7 | 4,567.0 | 4,567.0 | 4,567.2 | 0.2 |
| E | 1,275 | 195 | 332 | 4.1 | 4,568.3 | 4,568.3 | 4,569.1 | 0.8 |
| F | 1,440 | 134 | 292 | 4.7 | 4,569.6 | 4,569.6 | 4,570.6 | 1.0 |
| G | 1,885 | 216 | 372 | 2.9 | 4,571.6 | 4,571.6 | 4,572.5 | 0.9 |
| H | 2,050 | 167 | 316 | 3.5 | 4,572.8 | 4,572.8 | 4,573.7 | 0.9 |
| I | 2,425 | 170 | 339 | 3.7 | 4,575.7 | 4,575.7 | 4,576.6 | 0.9 |
| J | 2,625 | 102 | 209 | 6.2 | 4,578.0 | 4,578.0 | 4,578.9 | 0.9 |
| K | 2,845 | 183 | 371 | 3.5 | 4,580.3 | 4,580.3 | 4,581.3 | 1.0 |
| L | 3,040 | 210 | 555 | 1.7 | 4,581.3 | 4,581.3 | 4,582.1 | 0.8 |
| M | 3,090 | 232 | 660 | 2.4 | 4,581.3 | 4,581.3 | 4,582.2 | 0.9 |
| N | 3,250 | 52 | 168 | 7.7 | 4,582.4 | 4,582.4 | 4,583.4 | 1.0 |
| O | 5,300 | 124 | 421 | 3.6 | 4,598.4 | 4,598.4 | 4,599.0 | 0.6 |
| P | 6,400 | 81 | 285 | 5.3 | 4,605.2 | 4,605.2 | 4,605.8 | 0.6 |
| Q | 7,150 | 72 | 240 | 6.3 | 4,612.8 | 4,612.8 | 4,613.5 | 0.7 |
| R | 7,420 | 327 | 1,452 | 1.0 | 4,614.0 | 4,614.0 | 4,615.0 | 1.0 |
| S | 8,120 | 56 | 173 | 8.7 | 4,616.9 | 4,616.9 | 4,617.4 | 0.5 |
| T | 8,270 | 40 | 198 | 7.6 | 4,619.1 | 4,619.1 | 4,620.1 | 1.0 |
| U | 8,354 | 71 | 343 | 4.4 | 4,625.0 | 4,625.0 | 4,625.9 | 0.9 |
| V | 8,454 | 120 | 936 | 1.6 | 4,625.4 | 4,625.4 | 4,626.4 | 1.0 |
| W | 8,754 | 117 | 891 | 1.7 | 4,625.5 | 4,625.5 | 4,626.5 | 1.0 |
| X | 9,754 | 49 | 162 | 10.4 | 4,630.4 | 4,630.4 | 4,630.4 | 0.0 |

[1]Feet above Cross Section 'A'

TABLE 7

**FEDERAL EMERGENCY MANAGEMENT AGENCY**

**UTAH COUNTY, UT**
**AND INCORPORATED AREAS**

**FLOODWAY DATA**

**DRY CREEK**

| FLOODING SOURCE | | FLOODWAY | | | 1-PERCENT-ANNUAL-CHANCE FLOOD WATER-SURFACE-ELEVATION (FEET NAVD) | | | |
|---|---|---|---|---|---|---|---|---|
| CROSS-SECTION | DISTANCE[1] | WIDTH (FEET) | SECTION AREA (SQUARE FEET) | MEAN VELOCITY (FEET PER SECOND) | REGULATORY | WITHOUT FLOODWAY | WITH FLOODWAY | INCREASE |
| Dry Creek (cont'd) | | | | | | | | |
| Y | 10,554 | 33 | 210 | 8.0 | 4,639.9 | 4,639.9 | 4,640.3 | 0.4 |
| Z | 11,504 | 38 | 173 | 9.7 | 4,648.9 | 4,648.9 | 4,649.1 | 0.2 |
| AA | 11,634 | 104 | 270 | 6.2 | 4,657.9 | 4,657.9 | 4,658.4 | 0.5 |
| AB | 11,856 | 220 | 620 | 2.7 | 4,664.3 | 4,664.3 | 4,664.7 | 0.4 |
| AC | 11,956 | 103 | 780 | 2.2 | 4,664.5 | 4,664.5 | 4,664.9 | 0.4 |
| AD | 12,550 | 36 | 157 | 11.7 | 4,667.8 | 4,667.8 | 4,667.8 | 0.0 |
| AE | 13,250 | 39 | 202 | 9.1 | 4,677.7 | 4,677.7 | 4,678.7 | 1.0 |
| AF | 14,100 | 63 | 271 | 6.8 | 4,686.3 | 4,686.3 | 4,686.6 | 0.3 |
| AG | 15,100 | 66 | 285 | 6.5 | 4,693.1 | 4,693.1 | 4,694.0 | 0.9 |
| AH | 15,550 | 54 | 387 | 5.0 | 4,702.0 | 4,702.0 | 4,702.0 | 0.0 |
| AI | 16,028 | 40 | 221 | 9.0 | 4,703.2 | 4,703.2 | 4,703.6 | 0.4 |
| AJ | 16,948 | 46 | 210 | 9.5 | 4,714.0 | 4,714.0 | 4,714.8 | 0.8 |
| AK | 18,048 | 61 | 272 | 7.4 | 4,725.8 | 4,725.8 | 4,726.1 | 0.3 |
| AL | 18,528 | 59 | 194 | 10.3 | 4,735.2 | 4,735.2 | 4,735.3 | 0.1 |
| AM-AN[2] | | | | | | | | |
| AO | 20,936 | 96 | 588 | 4.4 | 4,773.4 | 4,773.4 | 4,774.2 | 0.8 |
| AP | 21,186 | 280 | 3,326 | 0.8 | 4,773.9 | 4,773.9 | 4,774.8 | 0.9 |
| AQ | 22,566 | 49 | 217 | 11.9 | 4,778.6 | 4,778.6 | 4,778.9 | 0.3 |
| AR | 23,166 | 111 | 419 | 6.2 | 4,786.3 | 4,786.3 | 4,787.3 | 1.0 |
| AS | 23,816 | 79 | 386 | 6.5 | 4,791.1 | 4,791.1 | 4,791.3 | 0.2 |
| AT | 24,276 | 66 | 238 | 10.5 | 4,796.7 | 4,796.7 | 4,797.3 | 0.6 |
| AU | 25,856 | 70 | 328 | 7.6 | 4,814.5 | 4,814.5 | 4,815.4 | 0.9 |
| AV | 25,982 | 154 | 628 | 4.0 | 4,824.6 | 4,824.6 | 4,825.2 | 0.6 |
| AW | 26,092 | 270 | 2,292 | 1.1 | 4,825.0 | 4,825.0 | 4,825.6 | 0.6 |

[1]Feet above Cross Section 'A'  [2]Data Not Applicable Due to Manmade Impoundment

TABLE 7

FEDERAL EMERGENCY MANAGEMENT AGENCY

UTAH COUNTY, UT
AND INCORPORATED AREAS

FLOODWAY DATA

DRY CREEK

| FLOODING SOURCE | | FLOODWAY | | | 1-PERCENT-ANNUAL-CHANCE FLOOD WATER-SURFACE-ELEVATION (FEET NAVD) | | | |
|---|---|---|---|---|---|---|---|---|
| CROSS-SECTION | DISTANCE[1] | WIDTH (FEET) | SECTION AREA (SQUARE FEET) | MEAN VELOCITY (FEET PER SECOND) | REGULATORY | WITHOUT FLOODWAY | WITH FLOODWAY | INCREASE |
| Dry Creek (cont'd) | | | | | | | | |
| AX | 26,909 | 235 | 254 | 3.3 | 4,827.3 | 4,827.3 | 4,827.3 | 0.0 |
| AY | 28,085 | 91 | 154 | 5.4 | 4,837.3 | 4,837.3 | 4,837.3 | 0.0 |
| AZ | 28,957 | 79 | 161 | 5.2 | 4,845.6 | 4,845.6 | 4,845.7 | 0.1 |
| BA | 29,721 | 68 | 115 | 7.3 | 4,853.5 | 4,853.5 | 4,853.6 | 0.1 |
| BB | 30,810 | 93 | 153 | 5.5 | 4,867.4 | 4,867.4 | 4,868.0 | 0.6 |
| BC | 31,393 | 72 | 169 | 5.0 | 4,872.2 | 4,872.2 | 4,872.2 | 0.0 |
| BD | 32,405 | 39 | 109 | 4.9 | 4,879.9 | 4,879.9 | 4,880.0 | 0.1 |
| BE | 33,957 | 33 | 88 | 6.1 | 4,898.7 | 4,898.7 | 4,898.8 | 0.1 |
| BF | 34,972 | 24 | 60 | 8.9 | 4,914.0 | 4,914.0 | 4,914.0 | 0.0 |
| BG | 37,072 | 71 | 95 | 5.6 | 4,946.4 | 4,946.4 | 4,946.5 | 0.1 |
| BH | 38,926 | 25 | 61 | 8.7 | 4,972.0 | 4,972.0 | 4,972.0 | 0.0 |
| BI | 40,238 | 50 | 78 | 7.3 | 4,994.4 | 4,994.4 | 4,994.4 | 0.0 |
| BJ | 41,981 | 30 | 64 | 8.4 | 5,034.0 | 5,034.0 | 5,034.0 | 0.0 |
| BK | 43,499 | 79 | 89 | 6.0 | 5,080.6 | 5,080.6 | 5,080.7 | 0.1 |
| BL | 44,441 | 42 | 71 | 7.7 | 5,118.8 | 5,118.8 | 5,118.8 | 0.0 |
| BM | 45,371 | 25 | 61 | 8.7 | 5,155.2 | 5,155.2 | 5,155.2 | 0.0 |
| BN | 46,169 | 31 | 65 | 8.2 | 5,193.3 | 5,193.3 | 5,193.3 | 0.0 |
| BO | 47,329 | 48 | 76 | 7.0 | 5,252.4 | 5,252.4 | 5,252.4 | 0.0 |
| BP | 47,914 | 31 | 65 | 8.4 | 5,289.3 | 5,289.3 | 5,289.3 | 0.0 |
| BQ | 48,847 | 45 | 74 | 7.2 | 5,343.6 | 5,343.6 | 5,343.7 | 0.1 |
| BR | 49,547 | 43 | 73 | 7.3 | 5,392.7 | 5,392.7 | 5,392.7 | 0.0 |
| BS | 50,343 | 27 | 62 | 8.9 | 5,454.7 | 5,454.7 | 5,454.7 | 0.0 |
| BT | 51,070 | 20 | 57 | 9.3 | 5,509.3 | 5,509.3 | 5,509.3 | 0.0 |
| BU | 51,693 | 28 | 63 | 8.7 | 5,565.7 | 5,565.7 | 5,565.7 | 0.0 |

[1]Feet above Cross Section 'A'

TABLE 7

FEDERAL EMERGENCY MANAGEMENT AGENCY

**UTAH COUNTY, UT**
**AND INCORPORATED AREAS**

**FLOODWAY DATA**

**DRY CREEK**

| FLOODING SOURCE | | FLOODWAY | | | 1-PERCENT-ANNUAL-CHANCE FLOOD WATER-SURFACE-ELEVATION (FEET NAVD) | | | |
|---|---|---|---|---|---|---|---|---|
| CROSS-SECTION | DISTANCE[1] | WIDTH (FEET) | SECTION AREA (SQUARE FEET) | MEAN VELOCITY (FEET PER SECOND) | REGULATORY | WITHOUT FLOODWAY | WITH FLOODWAY | INCREASE |
| Dry Creek (cont'd) | | | | | | | | |
| BV | 52,369 | 34 | 67 | 7.9 | 5,638.3 | 5,638.3 | 5,638.3 | 0.0 |

[1]Feet above Cross Section 'A'

TABLE 7

FEDERAL EMERGENCY MANAGEMENT AGENCY

UTAH COUNTY, UT
AND INCORPORATED AREAS

FLOODWAY DATA

DRY CREEK

| FLOODING SOURCE | | FLOODWAY | | | BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD) | | | |
|---|---|---|---|---|---|---|---|---|
| CROSS-SECTION | DISTANCE[1] | WIDTH (FEET) | SECTION AREA (SQUARE FEET) | MEAN VELOCITY (FEET PER SECOND) | REGULATORY | WITHOUT FLOODWAY | WITH FLOODWAY | INCREASE |
| Dry Creek (Payson) | | | | | | | | |
| A | 2,047 | 134 | 170 | 1.9 | 4,628.0 | 4,628.0 | 4,628.9 | 0.9 |
| B | 3,070 | 85 | 181 | 1.8 | 4,634.4 | 4,634.4 | 4,634.7 | 0.3 |
| C | 4,115 | 148 | 291 | 3.2 | 4,639.3 | 4,639.3 | 4,639.7 | 0.4 |
| D | 5,350 | 170 | 185 | 5.1 | 4,646.0 | 4,646.0 | 4,646.9 | 0.9 |
| E | 6,320 | 113 | 165 | 5.7 | 4,656.9 | 4,656.9 | 4,657.7 | 0.8 |
| F | 7,586 | 23 | 95 | 10.1 | 4,671.7 | 4,671.7 | 4,672.0 | 0.3 |
| G | 8,514 | 29 | 109 | 9.2 | 4,681.0 | 4,681.0 | 4,681.0 | 0.0 |
| H | 9,721 | 41 | 125 | 8.0 | 4,696.2 | 4,696.2 | 4,696.2 | 0.0 |
| I | 10,920 | 30 | 98 | 10.2 | 4,730.1 | 4,730.1 | 4,730.1 | 0.0 |
| J | 11,923 | 36 | 133 | 7.5 | 4,743.0 | 4,743.0 | 4,743.8 | 0.8 |
| K | 12,818 | 126 | 138 | 7.2 | 4,755.8 | 4,755.8 | 4,756.7 | 0.9 |
| L | 14,037 | 42 | 164 | 6.1 | 4,776.9 | 4,776.9 | 4,777.4 | 0.5 |
| M | 15,137 | 25 | 91 | 10.9 | 4,793.5 | 4,793.5 | 4,793.5 | 0.0 |
| N | 16,145 | 27 | 95 | 10.6 | 4,818.4 | 4,818.4 | 4,818.8 | 0.4 |
| O | 17,105 | 26 | 92 | 10.9 | 4,833.2 | 4,833.2 | 4,833.2 | 0.0 |

[1]Feet above Railroad Bridge

TABLE 7

FEDERAL EMERGENCY MANAGEMENT AGENCY
**UTAH COUNTY, UT**
**AND INCORPORATED AREAS**

**FLOODWAY DATA**

**DRY CREEK (PAYSON)**

| FLOODING SOURCE | | FLOODWAY | | | 1-PERCENT-ANNUAL-CHANCE FLOOD WATER-SURFACE-ELEVATION (FEET NAVD) | | | |
|---|---|---|---|---|---|---|---|---|
| CROSS-SECTION | DISTANCE[1] | WIDTH (FEET) | SECTION AREA (SQUARE FEET) | MEAN VELOCITY (FEET PER SECOND) | REGULATORY | WITHOUT FLOODWAY | WITH FLOODWAY | INCREASE |
| East Fork Fort Creek | | | | | | | | |
| A | 43 | 27 | 49 | 7.6 | 5,350.1 | 5,350.1 | 5,350.1 | 0.0 |
| B | 644 | 26 | 47 | 7.7 | 5,398.1 | 5,398.1 | 5,398.1 | 0.0 |
| C | 1,470 | 18 | 43 | 9.0 | 5,449.8 | 5,449.8 | 5,449.8 | 0.0 |
| D | 2,172 | 16 | 41 | 9.1 | 5,502.2 | 5,502.2 | 5,502.2 | 0.0 |
| E | 2,771 | 17 | 42 | 8.9 | 5,545.5 | 5,545.5 | 5,545.5 | 0.0 |
| F | 3,466 | 24 | 47 | 8.0 | 5,604.3 | 5,604.3 | 5,604.3 | 0.0 |
| G | 4,143 | 30 | 51 | 7.3 | 5,659.0 | 5,659.0 | 5,659.0 | 0.0 |

[1]Feet above confluence with Fort Creek

TABLE 7

FEDERAL EMERGENCY MANAGEMENT AGENCY

UTAH COUNTY, UT
AND INCORPORATED AREAS

FLOODWAY DATA

EAST FORK FORT CREEK

| FLOODING SOURCE | | FLOODWAY | | | 1-PERCENT-ANNUAL-CHANCE FLOOD WATER-SURFACE-ELEVATION (FEET NAVD) | | | |
|---|---|---|---|---|---|---|---|---|
| CROSS-SECTION | DISTANCE[1] | WIDTH (FEET) | SECTION AREA (SQUARE FEET) | MEAN VELOCITY (FEET PER SECOND) | REGULATORY | WITHOUT FLOODWAY | WITH FLOODWAY | INCREASE |
| Fort Creek | | | | | | | | |
| A | 305 | 22 | 46 | 8.1 | 4,875.0 | 4,875.0 | 4,875.0 | 0.0 |
| B | 1,227 | 28 | 85 | 4.4 | 4,884.9 | 4,884.9 | 4,885.5 | 0.6 |
| C | 1,967 | 30 | 51 | 7.3 | 4,897.0 | 4,897.0 | 4,897.1 | 0.0 |
| D | 2,838 | 27 | 62 | 6.0 | 4,911.5 | 4,911.5 | 4,911.6 | 0.1 |
| E | 3,832 | 25 | 51 | 7.4 | 4,930.3 | 4,930.3 | 4,930.3 | 0.0 |
| F | 4,845 | 57 | 92 | 4.1 | 4,944.0 | 4,944.0 | 4,944.0 | 0.0 |
| G | 6,074 | 23 | 47 | 8.0 | 4,965.5 | 4,965.5 | 4,965.5 | 0.0 |
| H | 7,215 | 44 | 59 | 6.4 | 4,986.3 | 4,986.3 | 4,986.3 | 0.0 |
| I | 8,296 | 39 | 56 | 7.0 | 5,015.3 | 5,015.3 | 5,015.3 | 0.0 |
| J | 9,118 | 26 | 50 | 8.2 | 5,042.4 | 5,042.4 | 5,042.4 | 0.0 |
| K | 10,384 | 24 | 47 | 8.3 | 5,092.7 | 5,092.7 | 5,092.8 | 0.1 |
| L | 11,241 | 20 | 46 | 8.1 | 5,116.8 | 5,116.8 | 5,116.8 | 0.0 |
| M | 12,630 | 26 | 48 | 8.0 | 5,162.1 | 5,162.1 | 5,162.2 | 0.1 |
| N | 13,494 | 21 | 45 | 8.3 | 5,194.4 | 5,194.4 | 5,194.4 | 0.0 |
| O | 14,435 | 18 | 43 | 8.8 | 5,237.8 | 5,237.8 | 5,237.8 | 0.0 |
| P | 15,373 | 26 | 49 | 8.1 | 5,294.4 | 5,294.4 | 5,294.4 | 0.0 |
| Q | 16,165 | 28 | 49 | 7.6 | 5,339.6 | 5,339.6 | 5,339.6 | 0.0 |
| R | 16,720 | 22 | 46 | 8.4 | 5,374.3 | 5,374.3 | 5,374.3 | 0.0 |
| S | 17,289 | 19 | 44 | 8.5 | 5,408.6 | 5,408.6 | 5,408.6 | 0.0 |
| T | 17,972 | 34 | 53 | 7.4 | 5,449.7 | 5,449.7 | 5,449.7 | 0.0 |
| U[2] | 18,428 | 29 | 50 | 7.8 | 5,482.5 | 5,482.5 | 5,482.5 | 0.0 |
| V[2] | 18,819 | 29 | 51 | 7.8 | 5,503.8 | 5,503.8 | 5,503.8 | 0.0 |
| W[2] | 19,253 | 52 | 61 | 6.3 | 5,536.9 | 5,536.9 | 5,536.9 | 0.0 |
| X[2] | 19,750 | 28 | 49 | 7.8 | 5,600.3 | 5,600.3 | 5,600.3 | 0.0 |

[1]Feet above confluence with Dry Creek [2]Middle Fork Fort Creek

TABLE 7

FEDERAL EMERGENCY MANAGEMENT AGENCY

UTAH COUNTY, UT
AND INCORPORATED AREAS

FLOODWAY DATA

FORT CREEK

| FLOODING SOURCE | | FLOODWAY | | | BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD) | | | |
|---|---|---|---|---|---|---|---|---|
| CROSS-SECTION | DISTANCE[1] | WIDTH (FEET) | SECTION AREA (SQUARE FEET) | MEAN VELOCITY (FEET PER SECOND) | REGULATORY | WITHOUT FLOODWAY | WITH FLOODWAY | INCREASE |
| Hobble Creek | | | | | | | | |
| A | 2,822 | 1,320 | 1,846 | 0.7 | 4,499.8 | 4,499.8 | 4,500.8 | 1.0 |
| B | 3,939 | 1,330 | 830 | 1.9 | 4,500.8 | 4,500.8 | 4,501.1 | 0.3 |
| C | 4,983 | 706 | 628 | 2.0 | 4,502.9 | 4,502.9 | 4,503.5 | 0.6 |
| D | 6,002 | 520 | 293 | 4.4 | 4,507.0 | 4,507.0 | 4,507.5 | 0.5 |
| E | 7,181 | 755 | 538 | 2.4 | 4,510.8 | 4,510.8 | 4,511.2 | 0.4 |
| F | 8,024 | 269 | 270 | 4.7 | 4,517.0 | 4,517.0 | 4,517.6 | 0.6 |
| G | 9,171 | 430 | 334 | 3.8 | 4,524.8 | 4,524.8 | 4,525.8 | 1.0 |
| H | 10,028 | 450 | 216 | 5.9 | 4,531.4 | 4,531.4 | 4,531.5 | 0.1 |
| I | 11,138 | 314 | 231 | 5.5 | 4,541.6 | 4,541.6 | 4,542.1 | 0.5 |
| J | 12,031 | 33 | 119 | 10.8 | 4,550.6 | 4,550.6 | 4,550.6 | 0.0 |
| K | 13,098 | 57 | 178 | 7.8 | 4,559.3 | 4,559.3 | 4,559.3 | 0.0 |
| L | 14,000 | 52 | 247 | 5.6 | 4,568.2 | 4,568.2 | 4,568.5 | 0.3 |
| M | 15,015 | 40 | 135 | 10.3 | 4,575.3 | 4,575.3 | 4,575.3 | 0.0 |
| N | 16,118 | 41 | 212 | 6.6 | 4,588.4 | 4,588.4 | 4,588.7 | 0.3 |
| O | 17,093 | 39 | 194 | 7.2 | 4,596.0 | 4,596.0 | 4,596.0 | 0.0 |
| P | 18,087 | 37 | 152 | 9.2 | 4,606.4 | 4,606.4 | 4,606.4 | 0.0 |
| Q | 18,936 | 99 | 199 | 7.0 | 4,615.0 | 4,615.0 | 4,615.0 | 0.0 |
| R | 20,030 | 37 | 130 | 10.7 | 4,627.0 | 4,627.0 | 4,627.0 | 0.0 |
| S | 21,046 | 37 | 134 | 10.4 | 4,636.9 | 4,636.9 | 4,636.9 | 0.0 |
| T | 22,234 | 51 | 155 | 9.0 | 4,651.0 | 4,651.0 | 4,651.0 | 0.0 |
| U | 23,009 | 36 | 128 | 10.8 | 4,660.5 | 4,660.5 | 4,660.5 | 0.0 |
| V | 24,037 | 57 | 176 | 7.9 | 4,671.5 | 4,671.5 | 4,671.5 | 0.0 |
| W | 25,324 | 91 | 198 | 7.0 | 4,683.1 | 4,683.1 | 4,683.1 | 0.0 |
| X | 26,167 | 37 | 129 | 10.8 | 4,696.4 | 4,696.4 | 4,696.4 | 0.0 |
| Y | 27,241 | 59 | 372 | 3.7 | 4,710.3 | 4,710.3 | 4,710.3 | 0.0 |
| Z | 27,843 | 36 | 128 | 10.9 | 4,714.9 | 4,714.9 | 4,714.9 | 0.0 |

[1]Feet above a point 1,362 feet downstream of Frontage Road

TABLE 7

**FEDERAL EMERGENCY MANAGEMENT AGENCY**
**UTAH COUNTY, UT**
**AND INCORPORATED AREAS**

**FLOODWAY DATA**

**HOBBLE CREEK**

| FLOODING SOURCE | | FLOODWAY | | | BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD) | | | |
|---|---|---|---|---|---|---|---|---|
| CROSS-SECTION | DISTANCE[1] | WIDTH (FEET) | SECTION AREA (SQUARE FEET) | MEAN VELOCITY (FEET PER SECOND) | REGULATORY | WITHOUT FLOODWAY | WITH FLOODWAY | INCREASE |
| Hobble Creek cont'd | | | | | | | | |
| AA | 29,221 | 66 | 188 | 7.4 | 4,734.6 | 4,734.6 | 4,734.7 | 0.1 |
| AB | 30,112 | 51 | 156 | 8.9 | 4,744.5 | 4,744.5 | 4,744.5 | 0.0 |
| AC | 31,275 | 37 | 137 | 10.1 | 4,756.5 | 4,756.5 | 4,756.5 | 0.0 |
| AD | 32,080 | 31 | 121 | 11.5 | 4,768.0 | 4,768.0 | 4,768.0 | 0.0 |
| AE | 33,106 | 50 | 151 | 9.2 | 4,780.3 | 4,780.3 | 4,780.3 | 0.0 |
| AF | 34,323 | 39 | 132 | 10.5 | 4,794.1 | 4,794.1 | 4,794.1 | 0.0 |
| AG | 35,341 | 38 | 133 | 10.5 | 4,815.9 | 4,815.9 | 4,816.5 | 0.6 |
| AH | 36,212 | 33 | 126 | 11.0 | 4,829.6 | 4,829.6 | 4,830.0 | 0.4 |
| AI | 37,012 | 42 | 171 | 8.1 | 4,839.1 | 4,839.1 | 4,839.3 | 0.2 |
| AJ | 38,141 | 29 | 122 | 11.4 | 4,851.7 | 4,851.7 | 4,852.0 | 0.3 |

[1]Feet above a point 1,362 feet downstream of Frontage Road

TABLE 7

FEDERAL EMERGENCY MANAGEMENT AGENCY
UTAH COUNTY, UT
AND INCORPORATED AREAS

FLOODWAY DATA

HOBBLE CREEK

| FLOODING SOURCE | | FLOODWAY | | | 1-PERCENT-ANNUAL-CHANCE FLOOD WATER-SURFACE-ELEVATION (FEET NAVD) | | | |
|---|---|---|---|---|---|---|---|---|
| CROSS-SECTION | DISTANCE[1] | WIDTH (FEET) | SECTION AREA (SQUARE FEET) | MEAN VELOCITY (FEET PER SECOND) | REGULATORY | WITHOUT FLOODWAY | WITH FLOODWAY | INCREASE |
| Hog Hollow | | | | | | | | |
| A | 129 | 68 | 47 | 2.9 | 4,848.4 | 4,848.4 | 4,848.4 | 0.0 |
| B | 637 | 23 | 24 | 6.0 | 4,870.2 | 4,870.2 | 4,870.2 | 0.0 |
| C | 1,467 | 54 | 32 | 4.2 | 4,891.7 | 4,891.7 | 4,891.7 | 0.0 |
| D | 2,536 | 63 | 59 | 2.3 | 4,916.4 | 4,916.4 | 4,916.4 | 0.0 |
| E | 3,671 | 20 | 23 | 6.4 | 4,952.0 | 4,952.0 | 4,952.0 | 0.0 |
| F | 4,132 | 24 | 24 | 6.0 | 4,965.4 | 4,965.4 | 4,965.4 | 0.0 |
| G | 4,636 | 80 | 35 | 3.8 | 4,985.2 | 4,985.2 | 4,985.2 | 0.0 |
| H | 5,424 | 21 | 26 | 5.1 | 5,004.9 | 5,004.9 | 5,005.0 | 0.1 |
| I | 6,021 | 24 | 24 | 5.7 | 5,026.9 | 5,026.9 | 5,026.9 | 0.0 |
| J | 6,527 | 26 | 24 | 5.6 | 5,042.4 | 5,042.4 | 5,042.4 | 0.0 |
| K | 7,135 | 25 | 24 | 5.9 | 5,064.2 | 5,064.2 | 5,064.2 | 0.0 |
| L | 7,524 | 28 | 25 | 5.6 | 5,074.7 | 5,074.7 | 5,074.7 | 0.0 |
| M | 7,998 | 16 | 21 | 6.6 | 5,087.4 | 5,087.4 | 5,087.4 | 0.0 |
| N | 8,295 | 29 | 25 | 5.6 | 5,098.8 | 5,098.8 | 5,098.8 | 0.0 |
| O | 8,728 | 29 | 25 | 5.4 | 5,114.3 | 5,114.3 | 5,114.3 | 0.0 |
| P | 9,135 | 18 | 21 | 6.3 | 5,132.8 | 5,132.8 | 5,132.8 | 0.0 |

[1]Feet above confluence with Dry Creek

TABLE 7

FEDERAL EMERGENCY MANAGEMENT AGENCY

**UTAH COUNTY, UT**
**AND INCORPORATED AREAS**

**FLOODWAY DATA**

**HOG HOLLOW**

| FLOODING SOURCE | | FLOODWAY | | | 1-PERCENT-ANNUAL-CHANCE FLOOD WATER-SURFACE-ELEVATION (FEET NAVD) | | | |
|---|---|---|---|---|---|---|---|---|
| CROSS-SECTION | DISTANCE[1] | WIDTH (FEET) | SECTION AREA (SQUARE FEET) | MEAN VELOCITY (FEET PER SECOND) | REGULATORY | WITHOUT FLOODWAY | WITH FLOODWAY | INCREASE |
| Jordan River | | | | | | | | |
| A | 1,000 | 84 | 919 | 2.8 | 4,494.6 | 4,494.6 | 4,494.6 | 0.0 |
| B | 1,965 | 142 | 1,485 | 1.7 | 4,494.8 | 4,494.8 | 4,494.8 | 0.0 |
| C | 3,230 | 187 | 2,177 | 1.2 | 4,494.9 | 4,494.9 | 4,494.9 | 0.0 |
| D | 4,033 | 120 | 1,385 | 1.9 | 4,494.9 | 4,494.9 | 4,494.9 | 0.0 |
| E | 4,159 | 134 | 1,422 | 1.8 | 4,494.9 | 4,494.9 | 4,494.9 | 0.0 |
| F | 5,967 | 142 | 1,477 | 1.7 | 4,495.0 | 4,495.0 | 4,495.0 | 0.0 |
| G | 6,439 | 112 | 1,314 | 2.0 | 4,495.0 | 4,495.0 | 4,495.0 | 0.0 |
| H | 6,956 | 174 | 1,813 | 1.4 | 4,495.1 | 4,495.1 | 4,495.1 | 0.0 |
| I | 8,079 | 126 | 1,360 | 1.9 | 4,495.1 | 4,495.1 | 4,495.1 | 0.0 |
| J | 9,386 | 143 | 1,557 | 1.7 | 4,495.2 | 4,495.2 | 4,495.2 | 0.0 |
| K | 10,114 | 138 | 1,398 | 1.8 | 4,495.2 | 4,495.2 | 4,495.2 | 0.0 |
| L | 11,354 | 156 | 1,711 | 1.5 | 4,495.3 | 4,495.3 | 4,495.3 | 0.0 |
| M | 12,666 | 151 | 1,536 | 1.7 | 4,495.3 | 4,495.3 | 4,495.3 | 0.0 |
| N | 13,738 | 170 | 1,807 | 1.4 | 4,495.4 | 4,495.4 | 4,495.4 | 0.0 |
| O | 15,913 | 252 | 1,992 | 1.3 | 4,495.5 | 4,495.5 | 4,495.5 | 0.0 |
| P | 16,901 | 186 | 1,690 | 1.5 | 4,495.6 | 4,495.6 | 4,495.6 | 0.0 |
| Q | 17,509 | 207 | 1,833 | 1.4 | 4,495.6 | 4,495.6 | 4,495.6 | 0.0 |
| R | 19,568 | 150 | 1,549 | 1.7 | 4,495.7 | 4,495.7 | 4,495.7 | 0.0 |
| S | 20,711 | 230 | 2,096 | 1.2 | 4,495.7 | 4,495.7 | 4,495.7 | 0.0 |
| T | 22,386 | 151 | 1,690 | 1.5 | 4,495.8 | 4,495.8 | 4,495.9 | 0.1 |
| U | 23,320 | 135 | 1,492 | 1.7 | 4,495.8 | 4,495.8 | 4,495.9 | 0.1 |
| V | 25,422 | 104 | 1,392 | 1.8 | 4,495.9 | 4,495.9 | 4,496.0 | 0.1 |
| W | 27,379 | 241 | 2,020 | 1.3 | 4,496.0 | 4,496.0 | 4,496.1 | 0.1 |
| X | 28,669 | 145 | 1,908 | 1.3 | 4,496.0 | 4,496.0 | 4,496.2 | 0.2 |

[1]Feet above Jordan River Diversion Structure

TABLE 7

FEDERAL EMERGENCY MANAGEMENT AGENCY

**UTAH COUNTY, UT**
**AND INCORPORATED AREAS**

**FLOODWAY DATA**

**JORDAN RIVER**

| FLOODING SOURCE | | FLOODWAY | | | 1-PERCENT-ANNUAL-CHANCE FLOOD WATER-SURFACE-ELEVATION (FEET NAVD) | | | |
|---|---|---|---|---|---|---|---|---|
| CROSS-SECTION | DISTANCE[1] | WIDTH (FEET) | SECTION AREA (SQUARE FEET) | MEAN VELOCITY (FEET PER SECOND) | REGULATORY | WITHOUT FLOODWAY | WITH FLOODWAY | INCREASE |
| Jordan River (cont'd) | | | | | | | | |
| Y | 29,566 | 246 | 1,998 | 1.3 | 4,496.0 | 4,496.0 | 4,496.2 | 0.2 |
| Z | 31,254 | 166 | 1,850 | 1.4 | 4,496.1 | 4,496.1 | 4,496.3 | 0.2 |
| AA | 32,897 | 133 | 1,488 | 1.7 | 4,496.1 | 4,496.1 | 4,496.3 | 0.2 |
| AB | 35,245 | 193 | 1,678 | 1.5 | 4,496.3 | 4,496.3 | 4,496.8 | 0.5 |
| AC | 37,465 | 134 | 1,524 | 1.7 | 4,496.4 | 4,496.4 | 4,496.9 | 0.5 |
| AD | 39,298 | 98 | 1,164 | 2.2 | 4,496.5 | 4,496.5 | 4,497.0 | 0.5 |
| AE | 41,348 | 180 | 1,754 | 1.5 | 4,496.6 | 4,496.6 | 4,497.1 | 0.5 |
| AF | 42,840 | 155 | 1,592 | 1.6 | 4,496.7 | 4,496.7 | 4,497.2 | 0.5 |
| AG | 44,164 | 116 | 1,321 | 1.9 | 4,496.7 | 4,496.7 | 4,497.3 | 0.6 |
| AH | 45,220 | 190 | 2,331 | 1.1 | 4,496.8 | 4,496.8 | 4,497.4 | 0.6 |
| AI | 46,823 | 205 | 1,920 | 1.3 | 4,496.9 | 4,496.9 | 4,497.4 | 0.5 |
| AJ | 48,094 | 225 | 1,917 | 1.3 | 4,497.0 | 4,497.0 | 4,497.5 | 0.5 |
| AK | 49,227 | 382 | 2,735 | 0.9 | 4,497.0 | 4,497.0 | 4,497.6 | 0.6 |
| AL | 50,472 | 226 | 2,119 | 1.2 | 4,497.0 | 4,497.0 | 4,497.6 | 0.6 |
| AM | 51,623 | 231 | 1,659 | 1.6 | 4,497.3 | 4,497.3 | 4,497.8 | 0.5 |
| AN | 52,366 | 244 | 2,156 | 1.2 | 4,497.3 | 4,497.3 | 4,497.9 | 0.6 |
| Peteetneet Creek | | | | | | | | |
| A-H[3] | | | | | | | | |
| I | 18,636 [2] | 35 | 107 | 9.4 | 4,868.7 | 4,868.7 | 4,869.0 | 0.3 |

[1]Feet above Jordan River Diversion Structure

[2]Feet above 1450 West

[3]Floodway not studied

TABLE 7

FEDERAL EMERGENCY MANAGEMENT AGENCY

UTAH COUNTY, UT
AND INCORPORATED AREAS

FLOODWAY DATA

JORDAN RIVER - PETEETNEET CREEK

| FLOODING SOURCE | | FLOODWAY | | | 1-PERCENT-ANNUAL-CHANCE FLOOD WATER-SURFACE-ELEVATION (FEET NAVD) | | | |
|---|---|---|---|---|---|---|---|---|
| CROSS-SECTION | DISTANCE[1] | WIDTH (FEET) | SECTION AREA (SQUARE FEET) | MEAN VELOCITY (FEET PER SECOND) | REGULATORY | WITHOUT FLOODWAY | WITH FLOODWAY | INCREASE |
| Provo River | | | | | | | | |
| A[2] | 9,715 | 112 | 980 | 3.3 | 4,500.7 | 4,500.7 | 4,501.4 | 0.7 |
| B[2] | 14,964 | 92 | 538 | 6.0 | 4,514.1 | 4,514.1 | 4,514.1 | 0.0 |
| C[2] | 17,318 | 104 | 502 | 6.4 | 4,522.6 | 4,522.6 | 4,523.2 | 0.6 |
| D[2] | 17,519 | 87 | 420 | 7.6 | 4,524.2 | 4,524.2 | 4,524.2 | 0.0 |
| E[2] | 18,617 | 48 | 424 | 7.6 | 4,530.6 | 4,530.6 | 4,530.9 | 0.3 |
| F[2] | 19,013 | 101 | 584 | 5.5 | 4,532.4 | 4,532.4 | 4,532.6 | 0.2 |
| G[2] | 19,341 | 99 | 496 | 6.4 | 4,533.5 | 4,533.5 | 4,533.6 | 0.1 |
| H[2] | 19,541 | 90 | 482 | 6.6 | 4,534.4 | 4,534.4 | 4,534.5 | 0.1 |
| I[2] | 19,805 | 111 | 526 | 6.1 | 4,535.3 | 4,535.3 | 4,536.3 | 1.0 |
| J[2] | 21,833 | 60 | 372 | 8.6 | 4,548.7 | 4,548.7 | 4,549.5 | 0.8 |
| K[2] | 23,691 | 61 | 396 | 8.1 | 4,561.0 | 4,561.0 | 4,561.7 | 0.7 |
| L[2] | 23,966 | 62 | 365 | 8.8 | 4,564.3 | 4,564.3 | 4,564.3 | 0.0 |
| M[2] | 24,446 | 73 | 416 | 7.7 | 4,567.4 | 4,567.4 | 4,567.7 | 0.3 |
| N[2] | 24,547 | 71 | 468 | 6.8 | 4,568.1 | 4,568.1 | 4,568.3 | 0.2 |
| O[2] | 26,580 | 90 | 569 | 5.6 | 4,580.7 | 4,580.7 | 4,580.7 | 0.0 |
| P[2] | 26,685 | 85 | 300 | 10.7 | 4,583.5 | 4,583.5 | 4,583.5 | 0.0 |
| Q[2] | 27,118 | 87 | 492 | 6.5 | 4,590.3 | 4,590.3 | 4,590.3 | 0.0 |
| R[2] | 27,372 | 70 | 453 | 7.1 | 4,590.9 | 4,590.9 | 4,591.0 | 0.1 |
| S[2] | 29,167 | 68 | 386 | 8.3 | 4,603.2 | 4,603.2 | 4,603.2 | 0.0 |
| T[2] | 30,355 | 60 | 360 | 8.9 | 4,611.2 | 4,611.2 | 4,611.4 | 0.2 |
| U[2] | 30,650 | 67 | 312 | 10.3 | 4,612.9 | 4,612.9 | 4,612.9 | 0.0 |
| V[2] | 31,743 | 71 | 384 | 8.3 | 4,623.5 | 4,623.5 | 4,623.6 | 0.1 |
| W[2] | 31,939 | 65 | 305 | 10.5 | 4,625.2 | 4,625.2 | 4,625.2 | 0.0 |
| X[2] | 32,055 | 60 | 266 | 12.0 | 4,630.3 | 4,630.3 | 4,630.3 | 0.0 |

[1]Feet Above Mouth [2]This cross-section lies within an area that has not been updated on the FIRM at this time due to the presence of one or more levees that have not been demonstrated to meet the requirements of 44CFR Part Section 65.10 of the NFIP regulations. Please refer to the Notice to Flood Insurance Study Users page at the front of the FIS report for more information

TABLE 7

FEDERAL EMERGENCY MANAGEMENT AGENCY

UTAH COUNTY, UT
AND INCORPORATED AREAS

FLOODWAY DATA

PROVO RIVER

| FLOODING SOURCE | | FLOODWAY | | | 1-PERCENT-ANNUAL-CHANCE FLOOD WATER-SURFACE-ELEVATION (FEET NAVD) | | | |
|---|---|---|---|---|---|---|---|---|
| CROSS-SECTION | DISTANCE[1] | WIDTH (FEET) | SECTION AREA (SQUARE FEET) | MEAN VELOCITY (FEET PER SECOND) | REGULATORY | WITHOUT FLOODWAY | WITH FLOODWAY | INCREASE |
| Provo River (cont'd) | | | | | | | | |
| Y[3] | 33,755 | 150 | 537 | 6.0 | 4,645.2 | 4,645.2 | 4,646.1 | 0.9 |
| Z[3] | 34,008 | 140 | 476 | 6.7 | 4,647.2 | 4,647.2 | 4,647.6 | 0.4 |
| AA[3] | 34,209 | 70 | 381 | 8.4 | 4,648.7 | 4,648.7 | 4,648.9 | 0.2 |
| AB[3] | 35,387 | 70 | 368 | 8.7 | 4,658.5 | 4,658.5 | 4,658.6 | 0.1 |
| AC[3] | 39,252 | 69 | 357 | 9.0 | 4,692.5 | 4,692.5 | 4,692.9 | 0.4 |
| AD[3] | 39,405 | 58 | 276 | 11.6 | 4,693.9 | 4,693.9 | 4,694.0 | 0.1 |
| AE[3] | 43,439 | 120 | 500 | 6.4 | 4,732.3 | 4,732.3 | 4,732.3 | 0.0 |
| AF[3] | 45,508 | 72 | 340 | 9.4 | 4,747.7 | 4,747.7 | 4,747.7 | 0.0 |
| AG[3] | 45,709 | 69 | 279 | 11.5 | 4,751.1 | 4,751.1 | 4,751.1 | 0.0 |
| Soldier Creek | | | | | | | | |
| A | 1,619[2] | 78 | 256 | 6.8 | 5,057.6 | 5,057.6 | 5,057.6 | 0.0 |
| B | 1,806[2] | 114 | 368 | 4.8 | 5,058.2 | 5,058.2 | 5,058.7 | 0.5 |
| C | 1,850[2] | 108 | 350 | 5.0 | 5,058.4 | 5,058.4 | 5,058.8 | 0.4 |
| D | 1,986[2] | 18 | 119 | 14.7 | 5,060.4 | 5,060.4 | 5,060.4 | 0.0 |
| E | 2,587[2] | 18 | 227 | 7.7 | 5,069.4 | 5,069.4 | 5,069.4 | 0.0 |
| F | 2,735[2] | 26 | 300 | 5.8 | 5,070.6 | 5,070.6 | 5,070.6 | 0.0 |
| G | 3,200[2] | 90 | 611 | 2.9 | 5,070.6 | 5,070.6 | 5,071.1 | 0.5 |
| H | 3,600[2] | 84 | 288 | 6.1 | 5,070.6 | 5,070.6 | 5,071.1 | 0.5 |
| I | 4,000[2] | 88 | 235 | 7.4 | 5,072.0 | 5,072.0 | 5,072.9 | 0.9 |
| J | 4,413[2] | 61 | 217 | 8.1 | 5,075.4 | 5,075.4 | 5,075.8 | 0.4 |
| K | 4,954[2] | 42 | 179 | 9.8 | 5,079.9 | 5,079.9 | 5,079.9 | 0.0 |

[1]Feet Above Mouth [2]Feet above the Outlet Works of the Thistle Debris Basin [3]This cross-section lies within an area that has not been updated on the FIRM at this time due to the presence of one or more levees that have not been demonstrated to meet the requirements of 44CFR Part Section 65.10 of the NFIP regulations. Please refer to the Notice to Flood Insurance Study Users page at the front of the FIS report for more information

| FLOODING SOURCE | | FLOODWAY | | | 1-PERCENT-ANNUAL-CHANCE FLOOD WATER-SURFACE-ELEVATION (FEET NAVD) | | | |
|---|---|---|---|---|---|---|---|---|
| CROSS-SECTION | DISTANCE[1] | WIDTH (FEET) | SECTION AREA (SQUARE FEET) | MEAN VELOCITY (FEET PER SECOND) | REGULATORY | WITHOUT FLOODWAY | WITH FLOODWAY | INCREASE |
| Spanish Fork River | | | | | | | | |
| A | 199 | 250 | 8,249 | 3.5 | 4,561.3 | 4,561.3 | 4,561.3 | 0.0 |
| B | 1,649 | 174 | 1,076 | 3.5 | 4,566.3 | 4,566.3 | 4,567.2 | 0.9 |
| C | 4,305 | 92 | 565 | 6.6 | 4,574.4 | 4,574.4 | 4,574.5 | 0.1 |
| D | 5,644 | 176 | 853 | 4.4 | 4,578.0 | 4,578.0 | 4,578.4 | 0.4 |
| E | 7,582 | 217 | 1,042 | 4.7 | 4,583.6 | 4,583.6 | 4,583.6 | 0.0 |
| F | 8,865 | 85 | 581 | 6.5 | 4,589.3 | 4,589.3 | 4,589.4 | 0.1 |
| G | 10,101 | 150 | 658 | 5.7 | 4,593.2 | 4,593.2 | 4,593.3 | 0.1 |
| H | 12,041 | 76 | 480 | 7.8 | 4,599.6 | 4,599.6 | 4,599.6 | 0.0 |
| I | 14,470 | 481 | 1,273 | 3.0 | 4,608.1 | 4,608.1 | 4,609.0 | 0.9 |
| J | 17,343 | 419 | 1,010 | 3.7 | 4,617.3 | 4,617.3 | 4,618.2 | 0.9 |
| K | 21,391 | 494 | 1,010 | 3.7 | 4,633.9 | 4,633.9 | 4,634.8 | 0.9 |
| L | 23,380 | 126 | 699 | 5.4 | 4,642.6 | 4,642.6 | 4,643.2 | 0.6 |
| M | 26,471 | 97 | 643 | 5.8 | 4,657.4 | 4,657.4 | 4,657.6 | 0.2 |
| N | 29,313 | 133 | 773 | 5.8 | 4,670.4 | 4,670.4 | 4,670.7 | 0.3 |
| O | 31,223 | 510 | 1,335 | 3.7 | 4,678.7 | 4,678.7 | 4,679.1 | 0.4 |
| P | 34,015 | 380 | 991 | 3.8 | 4,693.7 | 4,693.7 | 4,694.6 | 0.9 |
| Q | 36,705 | 58 | 355 | 10.6 | 4,712.4 | 4,712.4 | 4,712.4 | 0.0 |
| R | 88,614 | 391 | 4,246 | 0.8 | 5,057.9 | 5,057.9 | 5,057.9 | 0.0 |
| S | 89,414 | 625 | 6,553 | 0.5 | 5,057.9 | 5,057.9 | 5,057.9 | 0.0 |
| T | 89,754 | 530 | 5,762 | 0.6 | 5,057.9 | 5,057.9 | 5,057.9 | 0.0 |

[1]Stream distance in feet above I-15

TABLE 7

FEDERAL EMERGENCY MANAGEMENT AGENCY

UTAH COUNTY, UT
AND INCORPORATED AREAS

**FLOODWAY DATA**

**SPANISH FORK RIVER**

| FLOODING SOURCE | | FLOODWAY | | | 1-PERCENT-ANNUAL-CHANCE FLOOD WATER-SURFACE-ELEVATION (FEET NAVD) | | | |
|---|---|---|---|---|---|---|---|---|
| CROSS-SECTION | DISTANCE[1] | WIDTH (FEET) | SECTION AREA (SQUARE FEET) | MEAN VELOCITY (FEET PER SECOND) | REGULATORY | WITHOUT FLOODWAY | WITH FLOODWAY | INCREASE |
| Thistle Creek | | | | | | | | |
| A | 1,700 | 180 | 528 | 2.9 | 5,057.8 | 5,057.8 | 5,057.8 | 0.0 |
| B | 2,160 | 67 | 181 | 8.6 | 5,061.3 | 5,061.3 | 5,062.2 | 0.9 |
| C | 2,644 | 108 | 361 | 4.3 | 5,065.4 | 5,065.4 | 5,066.1 | 0.7 |
| D | 3,039 | 61 | 166 | 9.3 | 5,067.9 | 5,067.9 | 5,067.9 | 0.0 |
| E | 3,435 | 102 | 337 | 4.6 | 5,070.6 | 5,070.6 | 5,071.5 | 0.9 |
| F | 3,871 | 94 | 269 | 5.8 | 5,072.6 | 5,072.6 | 5,073.5 | 0.9 |
| G | 4,158 | 108 | 262 | 5.9 | 5,075.5 | 5,075.5 | 5,075.5 | 0.0 |
| West Fork Fort Creek | | | | | | | | |
| A | 190[2] | 19 | 44 | 8.6 | 5,465.2 | 5,465.2 | 5,465.2 | 0.0 |
| B | 541[2] | 38 | 56 | 7.1 | 5,491.8 | 5,491.8 | 5,491.9 | 0.1 |
| C | 857[2] | 50 | 61 | 6.4 | 5,515.5 | 5,515.5 | 5,515.5 | 0.0 |
| D | 1,186[2] | 27 | 49 | 7.7 | 5,543.2 | 5,543.2 | 5,543.2 | 0.0 |

[1]Feet above the Outlet Works of the Thistle Debris Basin

[2]Feet above confluence with Fort Creek

TABLE 7

**FEDERAL EMERGENCY MANAGEMENT AGENCY**

**UTAH COUNTY, UT**
**AND INCORPORATED AREAS**

**FLOODWAY DATA**

**THISTLE CREEK - WEST FORK FORT CREEK**

## 5.0 INSURANCE APPLICATIONS

For flood insurance rating purposes, flood insurance zone designations are assigned to a community based on the results of the engineering analyses. The zones are as follows:

Zone A

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

Zone AE

Zone AE is the flood insurance rate zone that corresponds to the 1-percent-annual-chance floodplains that are determined in the FIS by detailed methods. In most instances, whole-foot base flood elevations 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 base flood elevations 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, and to 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 base flood elevations or depths are shown within this zone.

## 6.0 FLOOD INSURANCE RATE MAP

The FIRM is designed for flood insurance and floodplain management applications.

For flood insurance applications, the map designates flood insurance rate zones as described in Section 5.0 and shows selected whole-foot BFEs or average depths in the 1-percent annual chance floodplains that were studied by detailed methods. 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 uses tints, screens, and symbols to show the 1-percent and 0.2-percent annual chance floodplains. Floodways and the locations of selected cross sections used in the hydraulic analyses and floodway computations are shown where applicable.

The current FIRM presents flooding information for the entire geographic area of Utah County. Previously, separate FIRMs were prepared for each identified flood-prone incorporated community and for the unincorporated areas of the county. Historical data relating to the maps prepared for each community, up to and including this countywide FIS are presented in Table 8, "Community Map History".

Within this jurisdiction there are one or more levees that have not been demonstrated by the community or levee owner(s) to meet the requirements of 44CFR Part 65.10 of the NFIP regulations as it relates to the levee's capacity to provide 1-percent-annual-chance flood protection. Please refer to the Notice to Flood Insurance Study Users page at the front of this FIS report for more information on how this may affect the FIRM.

| COMMUNITY NAME | INITIAL IDENTIFICATION | FLOOD HAZARD BOUNDARY MAP REVISION DATE (S) | FLOOD INSURANCE RATE MAP EFFECTIVE DATE | FLOOD INSURANCE RATE MAP REVISION DATE (S) |
|---|---|---|---|---|
| Alpine, City of | April 4, 1983 | None | April 4, 1983 | |
| American Fork, City of | December 28, 1973 | February 6, 1976 | November 25, 1980 | |
| Bluffdale, City of[2] | September 30, 1987 | None | September 30, 1987 | June 19, 1989 |
| Cedar Fort, Town of[1] | February 7, 1975 | None | | |
| Cedar Hills, City of | January 10, 1975 (Utah County) | None | October 15, 1982 (Utah County) | July 17, 2002 (Utah County) |
| Draper, City of[2] | December 18, 1985 | None | December 18, 1985 | September 30, 1994 |
| Eagle Mountain, City of[1] | January 10, 1975 (Utah County) | None | October 15, 1982 (Utah County) | July 17, 2002 (Utah County) |
| Elk Ridge, City of[1] | January 10, 1975 (Utah County) | None | October 15, 1982 (Utah County) | July 17, 2002 (Utah County) |
| Fairfield, Town of[1] | January 10, 1975 (Utah County) | None | October 15, 1982 (Utah County) | July 17, 2002 (Utah County) |
| Genola, Town of | February 7, 1975 | None | | |
| Goshen, Town of[1] | February 7, 1975 | April 15, 1977 | | |
| Highland, City of | January 10, 1975 (Utah County) | None | October 15, 1982 (Utah County) | July 17, 2002 (Utah County) |
| Lehi, City of | February 7, 1975 | None | September 14, 1979 | March 1, 1983<br>July 17, 2002 |
| Lindon, City of | June 21, 1977 | October 28, 1980 | February 19, 1986 | |

[1] No Special Flood Hazard Areas Identified

[2] Dates for this community were taken from the Salt Lake County, Utah and Incorporated Areas FIS, August 2, 2012

TABLE 8

FEDERAL EMERGENCY MANAGEMENT AGENCY

UTAH COUNTY, UT
AND INCORPORATED AREAS

## COMMUNITY MAP HISTORY

| COMMUNITY NAME | INITIAL IDENTIFICATION | FLOOD HAZARD BOUNDARY MAP REVISION DATE (S) | FLOOD INSURANCE RATE MAP EFFECTIVE DATE | FLOOD INSURANCE RATE MAP REVISION DATE (S) |
|---|---|---|---|---|
| Mapleton, City of | June 28, 1974 | March 26, 1976 | December 16, 1980 | |
| Orem, City of | October 29, 1976 | None | September 24, 1984 | |
| Payson, City of | June 28, 1974 | December 5, 1975 | November 15, 1978 | January 6, 1981 |
| Pleasant Grove, City of[1] | | None | | |
| Provo, City of | February 15, 1974 | June 4, 1976 | February 1, 1979 | December 2, 1980<br>January 18, 1984<br>September 30, 1988 |
| Salem, City of | June 28, 1974 | None | July 16, 1979 | |
| Santaquin, City of[1] | | None | | |
| Saratoga Springs, City of | January 10, 1975<br>(Utah County) | None | October 15, 1982<br>(Utah County) | July 17, 2002<br>(Utah County) |
| Spanish Fork, City of | February 19, 1986 | None | February 19, 1986 | |
| Springville, City of | February 1, 1974 | May 21, 1976 | September 29, 1978 | September 22, 1981<br>February 15, 1985 |
| Utah County<br>(Unincorporated Areas) | January 10, 1975 | None | October 15, 1982 | December 15, 1994<br>July 17, 2002 |
| Vineyard, Town of | January 10, 1975<br>(Utah County) | None | October 15, 1982<br>(Utah County) | July 17, 2002<br>(Utah County) |
| Woodland Hills, City of[1] | January 10, 1975<br>(Utah County) | None | October 15, 1982<br>(Utah County) | July 17, 2002<br>(Utah County) |

[1] No Special Flood Hazard Areas Identified

TABLE 8

FEDERAL EMERGENCY MANAGEMENT AGENCY
**UTAH COUNTY, UT**
**AND INCORPORATED AREAS**

**COMMUNITY MAP HISTORY**

## 7.0 OTHER STUDIES

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

## 8.0 LOCATION OF DATA

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

## 9.0 BIBLIOGRAPHY AND REFERENCES


Bowen, Collins & Associates. (February 22, 2007). Alpine Peak Flow, pp. 4.

Chow, Ven Te. (1964). Handbook of Applied Hydrology, New York, McGraw-Hill Book Company, Inc.

City of Salem. (1977). Utah Topographic Map, Scale 1:2,400, Contour Interval 2 feet.

County Commissioners Office, Salt Lake City, Utah. Utah Lake and Jordan River Commissioners Report, published annually.

Federal Emergency Management Agency. (May 1978). Flood Insurance Study and Flood Insurance Rate Map, City of Payson, Utah.

Federal Emergency Management Agency. (January 1979). Flood Insurance Study and Flood Insurance Rate Map, City of Salem, Utah.

Federal Emergency Management Agency. (September 1981). Flood Insurance Study and Flood Insurance Rate Map, City of Springville, Utah.

Federal Emergency Management Agency. (September 30, 1988). Flood Insurance Study and Flood Insurance Rate Map, City of Provo, Utah.

Federal Emergency Management Agency. (July 17, 2002). Flood Insurance Study and Flood Insurance Rate Map, City of Lehi, Utah.

Federal Emergency Management Agency. (July 17, 2002). Flood Insurance Study and Flood Insurance Rate Map, City of Saratoga Springs, Utah.

Federal Emergency Management Agency. (July 17, 2002). Flood Insurance Study and Flood Insurance Rate Map, Utah County Unincorporated Areas, Utah.

Federal Emergency Management Agency. (September 29, 2009). Utah County Hydrology Report for a Detailed Study on Peteetneet Creek, Payson, Utah.

Federal Emergency Management Agency. (February 3, 2010). Utah County, Utah Hydraulics Report for Detailed Studies on the Lower Provo River and Flooding Sources in Alpine City.

Federal Emergency Management Agency. (April 5, 2010). Utah County Hydraulics Report for a Detailed Study on the American Fork River.

Federal Emergency Management Agency. (August 2, 2012). Flood Insurance Study and Flood Insurance Rate Map, Salt Lake County and Incorporated Areas, Utah.

Federal Emergency Management Agency. (November 2014). Guidance for Flood Risk Analysis and Mapping – First Order Approximation.

Federal Emergency Management Agency. (March 18, 2015). Topographic Data Development TSDN for Hobble and Peteetneet Creeks within Utah County, Utah.

Federal Emergency Management Agency. (July, 2016). Utah County Hydraulics Report for a Detailed Study on Hobble Creek Located in Springville City, Utah.

Federal Emergency Management Agency. (July, 2016). Utah County Hydraulics Report for a Detailed Study on Peteetneet Creek and Payson Dry Creek Located in Payson City, Utah.

Federal Emergency Management Agency. (August 5, 2016). Utah County First Order Approximation and Utah Lake Floodplain Refinement Report.

James M. Montgomery Consulting Engineers, Inc. (June 1983). Floodplain Mapping for Thistle and Soldier Creeks.

James M. Montgomery Consulting Engineers, Inc. (December 1985). Feasibility Study of Thistle Landslide Alternatives for the Resolution of Public Safety Hazards, Volumes I, II, III, and Executive Summary.

Psomas. (March 2007). Dry Creek Dam Hydrology Report.

U.S. Army Corps of Engineers, Hydrologic Engineering Center. (October, 1973). HEC-2 Water-Surface Profiles, Generalized Computer Program, Davis California.

U.S. Army Corps of Engineers, Hydrologic Engineering Center. (November, 1976). HEC-2 Water-Surface Profiles, Generalized Computer Program, Davis California.

U.S. Army Corps of Engineers, Hydrologic Engineering Center. (September 1990). HEC-2 Water-Surface Profiles, Generalized Computer Program, Davis California.

U.S. Army Corps of Engineers, Hydrologic Engineering Center. (March 2008). HEC-RAS, Version 4.0.0, Davis, California.

U.S. Army Corps of Engineers, Hydrologic Engineering Center. (July 2008). HEC-GeoRAS, Version 4.2.92, Davis, California.

U.S. Army Corps of Engineers, Hydrologic Engineering Center. (January 2010). HEC-RAS, Version 4.1.0, Davis, California.

U.S. Army Corps of Engineers, Hydrologic Engineering Center. (May 2012). HEC-GeoRAS, Version 10.1, Davis, California.

U.S. Army Corps of Engineers, Sacramento District. (November 1969). Floodplain Information, American Fork River and Dry Creek, American Fork and Lehi, Utah.

U.S. Army Corps of Engineers, Sacramento District. (June 1973). Floodplain Information, Springville, Utah.

U.S. Department of Agriculture, Forest Service. (June 1973). Hydrology of the Payson, Utah Flood, May 1973. Ogden, Utah.

U.S. Department of Agriculture, Soil Conservation Service. (August 9, 1951). Report on Floods in Dry Creek and Box Elder Canyons, Utah County, Utah.

U.S. Department of Agriculture, Soil Conservation Service. American Fork-Dry Creek Watershed Flood Report, Floods of July 18, 1965; and August 4, 1965.

U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Weather Service. (March 1976). Atlas 2, Precipitation-Frequency Atlas of the Western United States.

U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Weather Service. Hydrologic Research Lab W-23, NWS Dam-Break Flood Forecasting Model Computer Program, version unknown.

U.S. Department of Commerce, U.S. Census Bureau. (Accessed on July 20, 2010). State and County Quick Facts, Utah County, Utah, Internet Site: http://quickfacts.census.gov/qfd/states/49/49049.html.

U.S. Department of the Interior, Bureau of Reclamation, Hydrology Branch, Division of Project Investigations, Office of Chief Engineer. (December 1968). Pseudo Water-Surface Profile Computer Program, Denver, Colorado.

U.S. Department of the Interior, Bureau of Reclamation. (March 1976). Engineering and Research Center, Computation of Precipitation Frequency-Duration Values in the Western United States.

U.S. Department of the Interior, Bureau of Reclamation. (October 1976). Computer Program Applying a Log-Pearson Type III Frequency Analysis for Determining Annual Peak Flow Values.

U.S. Department of the Interior, Bureau of Reclamation. (February 1977). Engineering and Research Center, Flood Flow Frequency Analysis Program Users Manual.

U.S. Department of the Interior, Bureau of Reclamation. (May 1977). Engineering and Research Center, Reservoir Routing by the Modified Puls Program Users Manual.

U.S. Department of the Interior, Bureau of Reclamation. (November 1977). Aerial Photographs: City of Lehi, Scale 1:2,400, Contour Interval 2 feet: Provo, Utah.

U.S. Geological Survey. (1967). Water Supply Paper No. 1849, Roughness Characteristics of Natural Channels.

U.S. Geological Survey. (1983). Methods for Estimating Peak Discharge and Flood Boundaries of Streams in Utah, Water Resources Investigations Report No. 83-4129.

U.S. Geological Survey. (March 10, 2008). Methods for Estimating Magnitude and Frequency of Peak Flows for Natural Streams in Utah, Scientific Investigations Report 2007-5158, Version 4.0.

U.S. Water Resources Council. (March 1976). Guidelines for Determining Flood Flow Frequency, Bulletin 17.

Utah County Department of Public Works, Engineering Division. (November 4, 1990). Manual of Operation for the Thistle Debris Basin.

Utah County Engineer's Office. (June 15, 1989). Jordan River Flood Zone Revisions.

Utah County Engineer's Office. (August 1989). Thistle Debris Basin.

Utah County Engineer's Office. (April 6, 1980). Utah County Topographic Mapping, Scale 1:500, Contour Interval 5 feet.

Utah Department of Transportation, District Four, Price, Utah. (July 1991). Soldier Creek Bridge Replacement.